March 15, 1927. F. SWAN 1,620,699

UNDERREAMER

Filed July 16, 1925 2 Sheets-Sheet 1

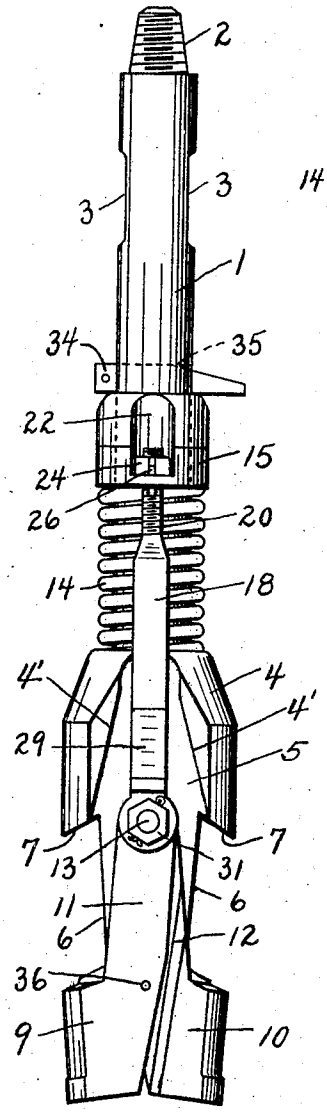


Fig. 1.

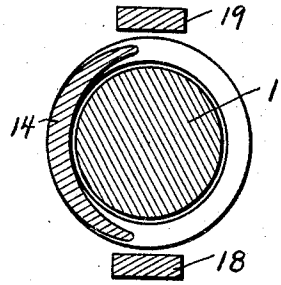


Fig. 3.

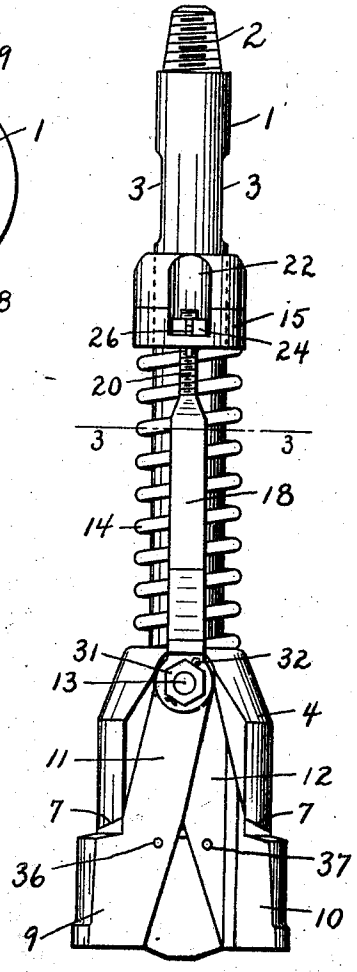


Fig. 2.

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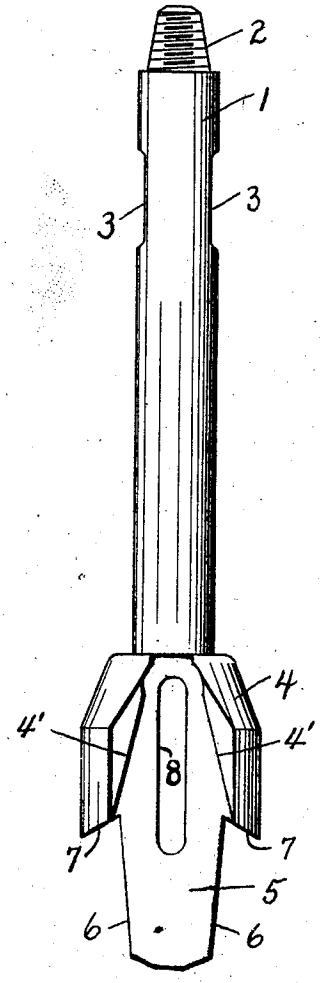


Fig. 4.

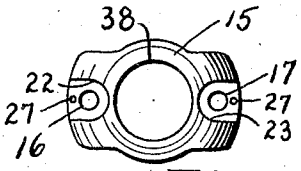


Fig. 5.

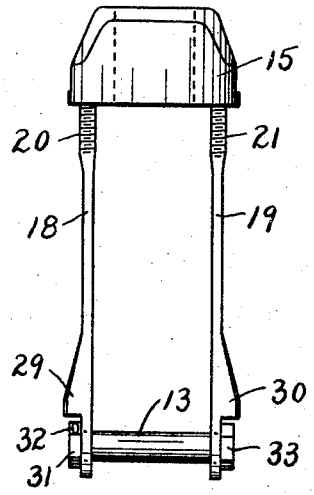


Fig. 6.

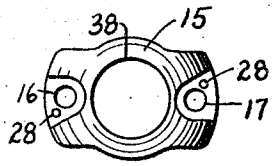


Fig. 7.

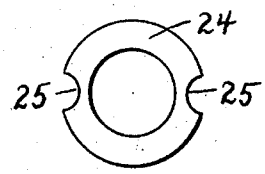


Fig. 8.

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Patented Mar. 15, 1927. 1,620,699

UNITED STATES PATENT OFFICE.

FRED SWAN, OF WICHITA, KANSAS.

UNDERREAMER.

Application filed July 16, 1925. Serial No. 43,995.

My invention relates to underreamers of the well known Swan type for use in oil or other drilled wells for enclosing a hole below casing, and relates particularly to underreamers of large diameter such as that shown in Letters Patent of the United States for solid wedge underreamer issued to me September 2, 1924, No. 1,507,444 to which reference is made for details of construction of the cutters and their general arrangement, though the invention is not to be understood as limited to the particular underreamer shown in said patent.

Among the objects of the present invention is to provide a construction by which a more powerful spring may be used for drawing the cutters from collapsed into expanded position than could be used if the spring is arranged within the tool body. A further object is by use of an outside spring to avoid the expense of boring out the tool body to receive the inside spring and to avoid the weakening of the tool body resulting from so boring it out. A further object is to provide a construction in which the pivot pin of the cutters may be made of larger size than is possible when an inside spring is used and may be supported at both ends.

With these objects and other objects hereinafter set forth in view, my invention consists in the construction and arrangement of elements hereinafter set forth and claimed.

Referring to the drawings:

Figure 1 is a front view of an underreamer embodying my invention with cutters drawn downward into collapsed or running in position.

Figure 2 is a view of the same with cutters drawn up into expanded position ready for underreaming.

Figure 3 is an enlarged sectional view on line 3—3 of Figure 2 and shows the solid construction of the tool body.

Figure 4 is a front view of the tool body which may be and preferably is made in one piece.

Figure 5 is a top view of the yoke which is slidably disposed on the tool body.

Figure 6 is a side elevation of the assembled elements which are slidably disposed on the tool body and serve to move the cutters.

Figure 7 is a top view of a modified yoke which may be substituted for that shown in Figure 5.

Figure 8 is an enlarged top plan view of one of the nuts used for retaining the upper ends of the spring rods in the yoke and shows the provision for a locking stud.

In the drawings, 1 indicates a tool body provided at its upper end with a screw threaded portion 2 for connection with a string of tools, 3 indicates flattened portions to be gripped by a wrench, 4 indicates the head of the tool body which is recessed on opposite sides so as to leave a central portion with parallel flat sides and having its edges inclined as shown at 6. At the upper ends of the wedge surfaces 6 are formed abutments 7. A slot 8 extending lengthwise of the tool body is formed through the portion 5. The portions of the head 4 are provided on their inner sides with inclined faces 4′, these faces converging upward.

Underreaming cutters 9 and 10 of any suitable shape and having upwardly extending side portions 11 and 12 are pivoted on a cross bar 13 which is slidably disposed in the slot 8 in the tool head. Cutters 9 and 10 have their upper faces adapted for contact with the wedge surfaces 6 and have their upper ends adapted for contact with the abutments 7 of the tool head 4 so that when drawn upward, said cutters are expanded and rest against the tool head 4.

The portion of the tool body 1 above the head 4 is preferably cylindrical in form and is adapted to carry a spring 14 and a sliding yoke 15. The yoke 15 is provided with an opening 38 of a size to fit the tool body 1 and is also provided with openings 16 and 17 adapted to receive therethrough the upper ends 20 and 21 of a pair of side rods 18 and 19. Above the holes 16 and 17, the yoke is provided with recesses 22 and 23, so formed that a nut 24 can be used on each of the rod ends 20 and 21; said recesses are also large enough so that a wrench can be used on nuts 24. Other forms of nut 24 may be used but the one shown in Figure 8 is desirable and is provided with opposite grooves 25 for engagement with a locking stud 26. Holes, which may be threaded, are provided for the locking studs 26 and may be placed at 27 as indicated in Figure 5 or at 28 as indicated in Figure 7. Somewhat greater space for the locking studs is provided in the modified collar shown in Figure 7 than in that shown in Figure 5.

The rods 18 and 19 are round and threaded at their upper ends 20 and 21 but are flattened and provided with outwardly extend-

ing bosses 29 and 30 near the lower ends, these bosses extending outward a sufficient distance to protect the nut 31 or head 33 of the bolt 13. The lower ends of rods 18 and 19 are perforated to receive therethrough the cross bar 13 on which the portions 11 of the cutters are pivoted. The cross bar 13 may be an ordinary bolt having a head 33 and nut 31 provided with a cotter pin lock 32. It is clearly indicated in Figure 6 how the bosses 29 and 30 extend outward so as to protect the nut and head of the cross bar while coming into contact with the well casing or while working under a hard shell in the reaming operation.

It will be noted by reference to Figure 4 that the slot 8 provided for the cross bar 13 may be made of ample size and I am not limited in the size of cross bar which can be used as is the case with an underreamer having an inside spring. The cross bar 13 is supported at both ends instead of at the center as in the construction using the inside spring as indicated in Figure 6. This permits the use of a round cross bar or bolt which is more economical to make than the oblong bar used in the inside spring underreamer.

The spring 14 shown in Figures 1 and 2 can obviously be of greater diameter and formed of heavier rod than can be used in forming the inside spring. The large diameter permitted greatly increases the limit of the pitch that can be used. The inside spring underreamer is very limited in the diameter, weight and pitch of spring that can be employed. By means of the nuts 24, adjustment can be made on the rods 18 and 19 to take up any weakening or set in the spring 14.

When it is desired to prepare the underreamer for running in the casing, the collar 15 is drawn downward to compress the spring 14. The collar 15 may be held in this position by the use of a drift 34 slipped in a transverse opening 35 in the tool body 1. The cutters 9 and 10 are then in the position shown in Figure 1. With the cutters in this contracted or collapsed position, a hole 36, 37 of a size suitable to receive a small piece of metal such as an eight penny nail is drilled through the overlapping portions 11 and 12. This hole is provided so that the cutters can be locked together and held in contracted position to prevent contact of the cutters with the interior of the casing while running in and thereby eliminate wear on the running in portion of the cutters, and also on the casing. When the underreamer has been lowered through the casing and the tools are allowed to swing out of plumb, the cutters will strike the reaming shoulder and cause the nail in hole 36, 37 to be sheared and thereby permit the cutters to move into reaming position.

It will be noted that the cutters 9 and 10 are connected together by the upwardly extending side portions or shanks 10 and 11 and the pivot bar or bolt 13 and that the spring 14 acts through the yoke 15 and the rods 18 and 19 to force the cutters upward by its expansion, acting in this respect the same as does the inside spring in the underreamer of my Patent No. 1,507,444 above referred to.

Having thus described my invention what I claim is:

1. In an underreamer a reamer body having its upper portion solid, having at its lower end oppositely arranged tapering surfaces and abutments at the upper ends of said tapering surfaces, a pair of cutters movable on said tapering surfaces having their upper ends adapted to fit against said abutments and provided with shanks extending upward and inward so that the upper ends of the shanks of opposite cutters are in line with the axial center of the reamer body, a pivot pin connecting the upper ends of said shanks, a yoke slidable upon the upper portion of the reamer body and provided on opposite sides with recesses which are adapted to receive nuts therein and an opening into each recess from below, side rods each secured at its lower end to one end of the pivot pin and having its upper end extending through one of said openings into a recess and provided therein with a nut, the walls of the recess being so formed as to protect the nut from contact with the walls of the well hole, and a spring carried by the upper portion of the reamer body and acting to force said yoke upward and to move the cutters against said abutments.

2. In an underreamer a reamer body having its upper portion solid, having at its lower end oppositely arranged tapering surfaces and abutments at the upper ends of said tapering surfaces, a pair of cutters movable on said tapering surfaces having their upper ends adapted to fit against said abutments and provided with shanks extending upward and inward so that the upper ends of the shanks of opposite cutters are in line with the axial center of the reamer body, a pivot pin connecting the upper ends of said shanks having a nut at one end, a yoke slidable upon the upper portion of the reamer body, side rods connecting said pivot pin and said yoke having at their lower ends bosses projecting outward beyond the line of the nut on the pivot pin, and a spring carried by the upper portion of the reamer body and acting to force said yoke upward and to move the cutters against said abutments.

3. In an underreamer, a reamer body having at its lower end a wedge having oppositely arranged tapering surfaces having abutments at their upper ends, a pair of

cutters movable on said tapering surfaces having their upper ends adapted to fit against said abutments and provided with shanks extending upward and inward the shanks of the two cutters overlapping and pivotally secured together at their upper ends, a spring for drawing the cutters upward on the tapering surfaces, the shanks of the cutters being of such length that when the cutters are drawn down into collapsed position they will be below the lower end of the wedge and each provided with a perforation so located that when the cutters are drawn down into collapsed position the perforations of the several shanks will be below the end of the wedge in line to receive a pin for holding the cutters in such collapsed position.

In testimony whereof, I hereunto affix my signature.

FRED SWAN.