June 16, 1931. E. F. RAYMOND 1,809,988

UNDERREAMER

Filed July 6, 1927

Fig. 1.

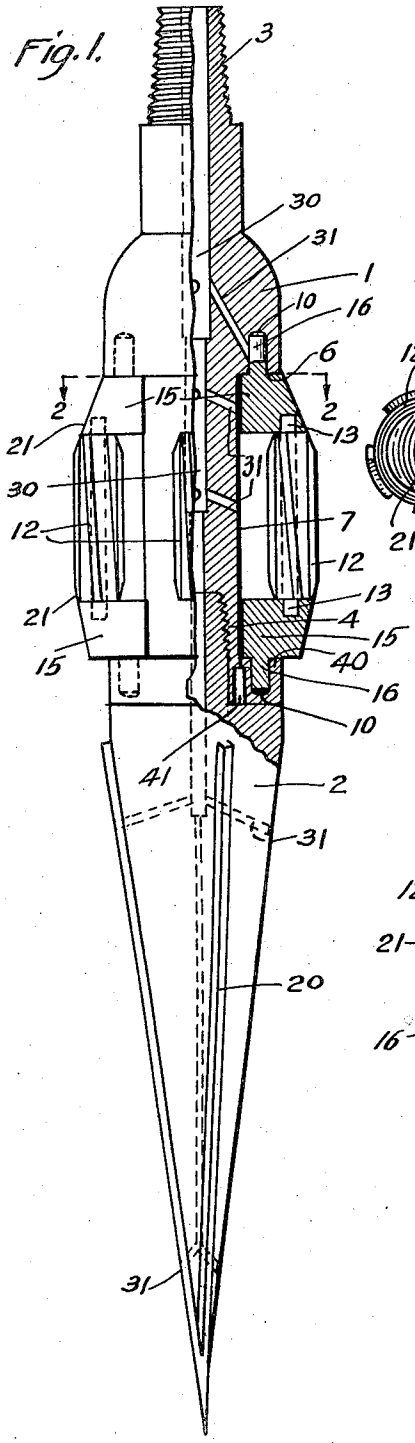


Fig. 2.

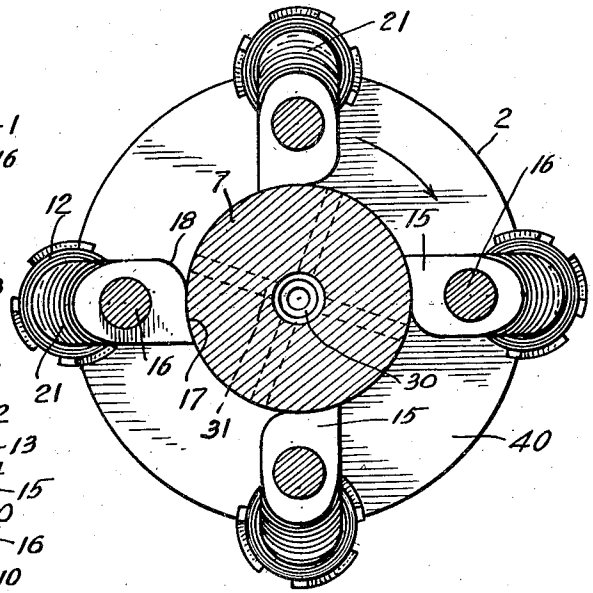
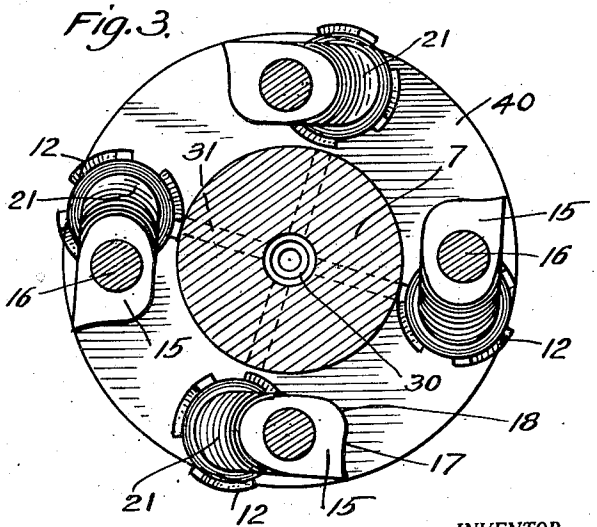


Fig. 3.



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UNITED STATES PATENT OFFICE

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UNDERREAMER

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This invention is an underreamer providing for the use of roller cutters as the underreaming medium and adapted for ready swinging of the cutter units to inoperative position within the body of the tool or expansion of said cutter units so that the roller cutters are in operative position projecting beyond the body of the tool.

It is an object of the invention to journal roller cutters in end bearing means which are in turn eccentrically pivoted to the body of the tool so that turning of the eccentric bearing means will expand or retract the rollers, and to so arrange the eccentric bearing means as to releasably retain them in position projecting the roller cutters by radial end abutment of the bearing means against the peripheral surface of the body of the tool, with the rollers radially spaced from the body of the tool when in such operative position so as to permit their free turning relative to their bearing means.

It is a further object of the invention to provide for fluid circulation through the tool and discharge of the fluid so as to tend to swing the cutter units to operative position and also act as a flushing medium for removing any mud or the like which might otherwise clog the action of the tool, the said flushing medium cooperating with the mountings for the cutter units, which mountings are without pockets or recesses so that the flushing action occurs at surfaces free of such recesses and thereby assures removal of all clogging media and is also adapted to clean the entire surfaces of the cutter rollers as the latter revolve.

Further objects of the invention will be readily understood from the following description of the accompanying drawings in which:

Fig. 1 is a side elevation of the tool partly in axial section and showing the cutter rollers in operative position.

Figs. 2 and 3 are transverse sections on the line 2—2 of Fig. 1, showing the cutter units in operative and inoperative position respectively.

The invention is preferably embodied in a tool having a body 1 and a depending pilot end 2 tapering to a point, the body 1 being adapted for connection at its upper end to a usual string of drill pipe, as for example by the tapering threaded pin 3, and the pilot end 2 being preferably detachably connected to body 1 by a usual threaded pin and socket connection 4.

The body of the tool has an elongated annular recess for reception of the cutter units forming the underreamer, with an undercut peripheral shoulder 6 of the body preferably forming the upper end of the recess; and the recess, in the present instance, preferably extends to the lower end of body 1 so that the body forms an axial mandrel 7 of reduced diameter at the base of the recess. A bearing annulus shown at 40 and which may be keyed to the mandrel as shown at 41, is preferably mounted on a shoulder at the upper end of the detachable pilot end 2 so as to form the lower end of the annular recess, and the shoulder 6 and annulus 40 have axially alined bearings 10 for the cutter units so that the latter are journaled in the annular recess.

The cutter units comprise roller cutters 12 having suitable mountings whereby the cutters are free for rotation and may be projected radially beyond the body 1 or may be retracted within the annular recess in the body, and for this purpose the cutter rollers may be journaled on concentric bearing pins 13 projecting beyond the ends of the rollers and journaled in bearing means which are eccentrically mounted so that turning of the bearing means will expand or retract the rollers.

The eccentrically mounted bearing means for pins 13 are shown at 15 and are preferably journaled in bearings 10 by means of pins 16 with the inner ends of the bearing means forming arcuate surfaces 17 adapted for radial abutment against mandrel 7 when the bearing means are turned so as to project rollers 12 as shown in Fig. 2; and the said arcuate abutment surfaces may be rounded-off at one end as shown at 18 to permit turning of the bearing means in one direction to retract the cutter rollers within the body of the tool as shown in Fig. 3.

When the tol is in use with the cutter rollers projected, it is rotated in the direction

indicated by the arrow in Fig. 2, and consequently the cutting engagement of the rollers tends to keep the bearing means 15 turned to operative position with their inner ends 17 abutting against mandrel 7, but when the tool is withdrawn so that the cutting engagement of the rollers is released, the bearing means 15 may freely turn in the opposite direction as a result of their rounded-off ends 18, in order to retract the rollers.

In order to guide the tool and permit it being readily lowered and withdrawn from a well bore, the tapering pilot end 2 may be provided with radially projecting longitudinally extending blades 20, and the ends of the blades of the cutter rollers together with the proximate outer ends of the bearing means 15 may be uniformly tapered as shown at 21, the taper at the upper end of the cutter units not only properly centering the tool during its withdrawal but providing abutment means tending to initiate retraction of the cutter units.

The tool is preferably provided with a usual axial bore 30 for circulating a fluid, the said bore having axially spaced radial passages 31 opening through the tool, preferably for discharge of the fluid in back of the cutter rollers and against the end portions of the bearing means 15 which swing outwardly as they turn to operative position, in order that said fluid pressure will tend to expand the cutter units; and the axial bore 30 is preferably of restricted diameter beyond each of the axially spaced radially branching passages 31 so as to equalize the pressure of the discharge from the different passages.

In operation the tool is lowered through a well casing with the cutter units turned to inoperative position and held against expansion by the surrounding wall of the casing; and when the tool has been guided by its pilot end past the lower end of the casing it is rotated in the direction of the arrow in Fig. 2 so that either centrifugal force or fluid discharge through passages 31 will turn the eccentrically mounted bearing means 15 and thereby expand the cutter rollers to operative position.

It will be noted that the eccentric mounting for the bearing means 15 permits the cutter rollers being journaled therein for free rotation with the rotatable rollers readily retracted or expanded by the eccentric turning of the bearing means; and that the construction eliminates the formation of pockets, recesses or the like which might clog with mud, etc., and thereby insures free turning of the rollers and positive retraction or expansion of the cutter units while securely retaining the same in operative position until the tool is to be withdrawn.

I claim:

1. A tool of the character described comprising a body, a cutter roller, and distinctly separate bearing means for the respective ends of the cutter roller, said bearing means being mounted on the body, at least one of said bearing means being eccentrically pivoted with relation to the body for retracting or expanding the cutter roller relative to the body, the eccentrically pivoted bearing means having an abutment adapted for engagement with the body at a substantial angle intersecting the line of radial thrust through the cutter roller when the latter is expanded.

2. A tool of the character described comprising a body, a cutter roller, and distinctly separate bearing means for the respective ends of the cutter roller, said bearing means being mounted on the body, at least one of said bearing means being eccentrically pivoted with relation to the body for retracting or expanding the cutter roller relative to the body, the body having a peripheral abutment surface which is without recesses at points circumferentially of said surface, and the eccentrically pivoted bearing means having an abutment adapted for engagement with the body at a substantial angle intersecting the line of radial thrust through the cutter roller when the latter is expanded.

3. A tool of the character described comprising a body having an axially elongated annular recess, a cutter roller in the recess, and distinctly separate bearing means for the respective ends of the cutter roller, said bearing means being mounted beyond the respective ends of the cutter roller with at least one of said bearing means eccentrically pivoted to the body at an end of the annular recess for retracting or expanding the cutter roller relative to the body, the eccentrically pivoted bearing means being adapted for abutment against the body when the cutter roller is expanded.

4. A tool of the character described comprising a body having an axially elongated annular recess, a cutter roller in the recess, and distinctly separate bearing means for the respective ends of the cutter roller, said bearing means being mounted beyond the respective ends of the cutter roller with at least one of said bearing means eccentrically pivoted to the body at an end of the annular recess for retracting or expanding the cutter roller relative to the body, the eccentrically pivoted bearing means being adapted for abutment against the body when the cutter roller is expanded, and the body having a bore adapted for discharge of fluid at the cutter roller.

5. A tool of the character described comprising a body having an axially elongated annular recess, a cutter roller in the recess, and distinctly separate bearing means for the respective ends of the cutter roller, said bearing means being mounted beyond the respective ends of the cutter roller with at least one of said bearing means eccentrically pivoted to the body at an end of the annular recess for retracting or expanding the cutter roller

relative to the body, the eccentrically pivoted bearing means being adapted for abutment against the body when the cutter roller is expanded, and the body having a bore adapted for discharge of fluid against the bearing means for expanding the cutter roller.

6. A tool of the character described comprising a body, a cutter roller, and distinctly separate bearing means for the respective ends of the cutter roller, said bearing means being mounted on the body, at least one of said bearing means being eccentrically pivoted with relation to the body for retracting or expanding the cutter roller relative to the body, the eccentrically pivoted bearing means having an abutment adapted for engagement with the body at a substantial angle intersecting the line of radial thrust through the cutter roller when the latter is expanded, and the body having a bore adapted for discharge of fluid against the eccentrically pivoted bearing means for expanding the cutter roller.

7. A tool of the character described comprising a body, a cutter roller, and distinctly separate bearing means for the respective ends of the cutter roller, said bearing means being mounted on the body, at least one of said bearing means being eccentrically pivoted with relation to the body for retracting or expanding the cutter roller relative to the body, the body having a peripheral abutment surface which is without recesses at points circumferentially of said surface, the eccentrically pivoted bearing means being adapted for abutment against the body when the cutter roller is expanded, and the body having a bore adapted for discharge of fluid against the eccentrically pivoted bearing means for expanding the cutter roller.

In testimony whereof he has affixed his signature to this specification.

EDWARD F. RAYMOND.