

March 31, 1936.

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2,035,888

WELL REAMER

Filed April 2, 1934

2 Sheets-Sheet 1

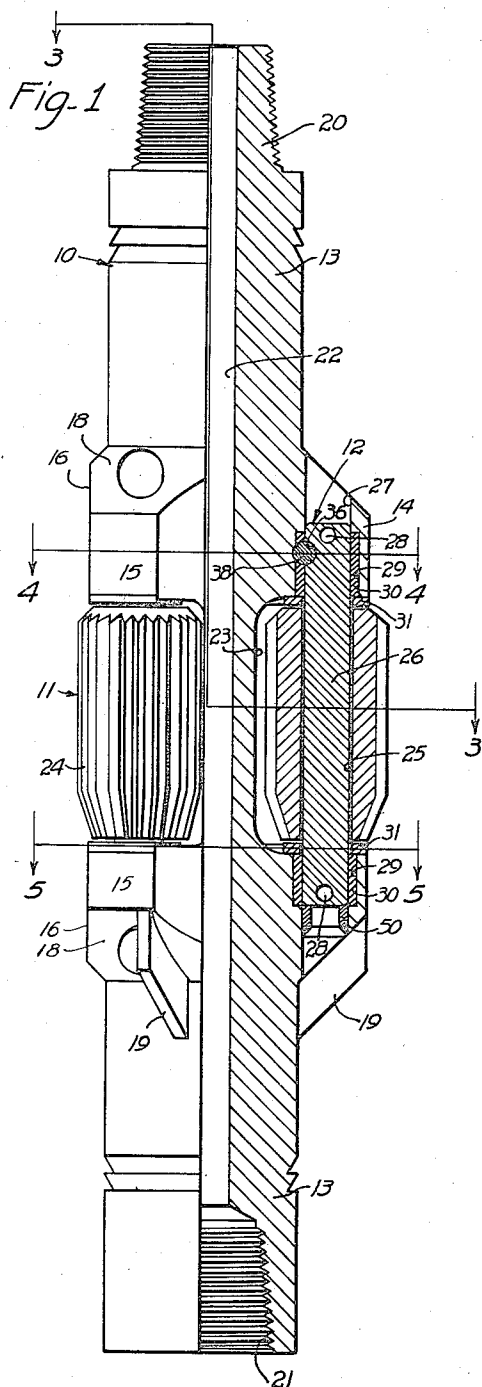
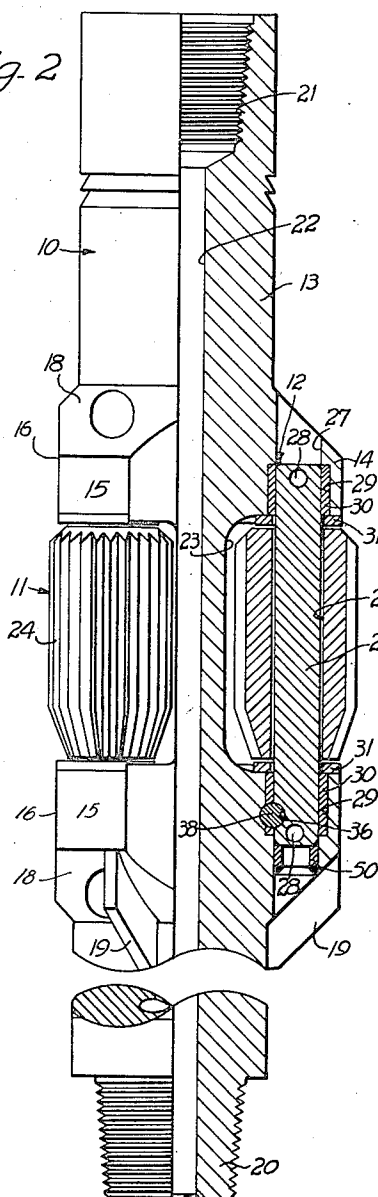


Fig. 2



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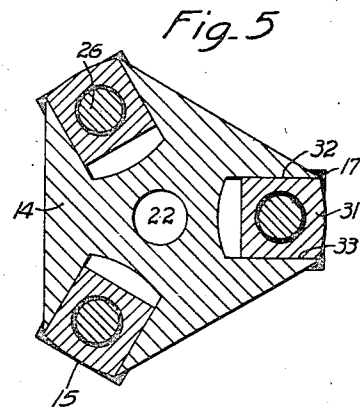
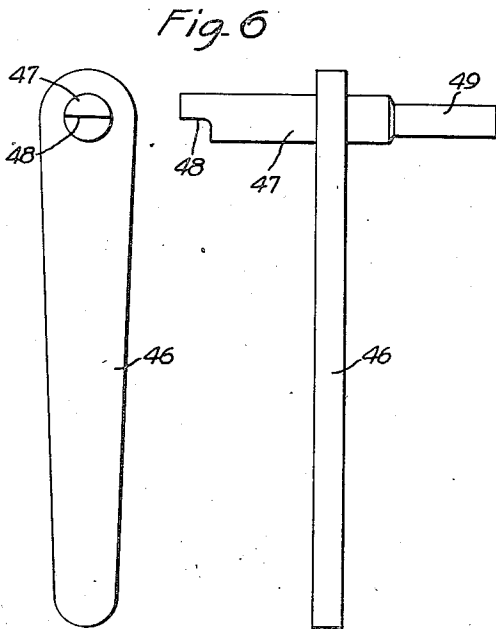
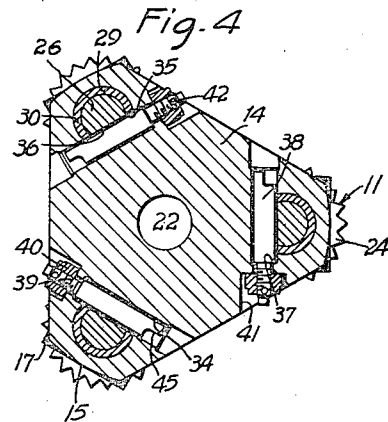
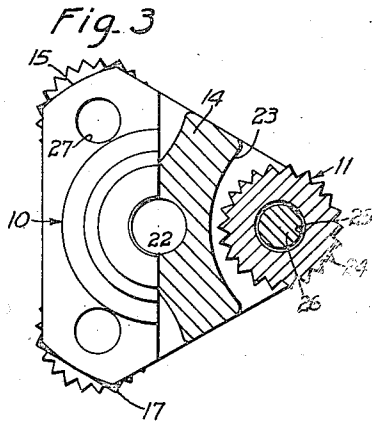
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UNITED STATES PATENT OFFICE

2,035,888

WELL REAMER

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Application April 2, 1934, Serial No. 718,592

6 Claims. (Cl. 255—73)

This invention relates to a well tool and relates more particularly to a well reamer. A general object of this invention is to provide a simple, practical and improved reamer for use in well drilling operations.

Another object of the invention is to provide a reamer for use in the rotary method of well drilling, including rotatable reaming cutters and simplified and improved means for mounting or supporting the cutters.

Another object of the invention is to provide a reamer involving an effective, dependable and inexpensive means for holding or locking the cutter carrying pins against movement and displacement.

Another object of the invention is to provide a reamer that may be inverted or turned end for end to be adapted for use either immediately above the drilling bit or at a higher point in the drilling string to operate as a guide.

Another object of the invention is to provide a well reamer in which the enlarged cutter carrying portion of the body has corners provided with beads of hard material and has hard faced blades for protecting the body against excessive wear.

Another object of the invention is to provide a well reamer of the character mentioned that is effective in operation and simple and inexpensive of manufacture.

A further object of the invention is to provide a single simple tool for holding the cutter carrying pins of the reamer against rotation to facilitate the threading of nuts on and off the pins and for driving the pins from their openings in the body.

Other objects and features of the invention will be best and fully understood from the following detailed description of a typical form and application of the invention, throughout which description reference is had to the accompanying drawings, in which:

Fig. 1 is a side elevation of the reamer provided by the present invention with one half in longitudinal cross section showing the reamer in position for use immediately above the well drilling tool. Fig. 2 is a view similar to Fig. 1 illustrating the reamer in a reversed or inverted position for insertion in the well drilling string at a point above the drill collar. Fig. 3 is a top view and partial transverse cross sectional view taken substantially as indicated by line 3—3 on Fig. 1. Figures 4 and 5 are transverse detailed sectional views taken as indicated by lines 4—4 and 5—5 respectively, on Fig. 1. Fig. 6 is an end elevation and side elevation of a tool useful for

holding the lock pins against turning and for driving the pins from their openings in the body.

The well reamer provided by this invention includes, generally, a body 10, roller cutters or reaming cutters 11 and means 12 for removably rotatably supporting the cutters 11 on the body.

The body 10 is an elongated structure or member provided to carry the cutter assemblies. In the simple form of the invention illustrated in the drawings the body 10 is integral and is designed to carry three roller cutters 11, it being understood that the body may be formed to carry fewer or more cutters if desired. The body 10 has elongated cylindrical end portions 13 and an intermediate enlarged portion 14 of substantially triangular cross section. The apices of the triangular portion 14 are truncated, having flat or slightly curved substantially tangential surfaces 15 and vertically extending edges or corners 16. Beads 17 of hard material are provided on the corners 16 to protect the body. The opposite ends 18 of the enlarged triangular portion 14 are preferably bevelled, as illustrated in Figures 1 and 2 of the drawings. Reaming wings 19 may project from the bevelled ends 18 and are preferably faced with hard cutting material. If desired the reamer as initially constructed may have blades 19 at both ends of the enlarged portion 14 whereby the tool is adapted for use as a reamer immediately above the well bit and as a reaming guide at a higher point in the drilling string. However, if desired or found practical spaced blades 19 may be initially provided on one end of the portion 14 and readily attachable blades 19 may be supplied with the reamer for use on the other end of the portion 14 in the event that the tool is to be inverted. In the two positions of the reamer shown in the drawings the blades 19 are provided on the lower end only of the portion 14.

A threaded pin 20 is provided on one end of the body 10 while a screw threaded socket 21 is provided in the other end of the reamer body. When used directly above the drilling bit the tool is positioned as illustrated in Fig. 1 so that the pin 20 may be threaded into the usual socket in the lower end of the drill collar and the socket 21 may receive the pin on the shank of the drilling tool. When the reamer is interposed in the drilling string it is preferable or necessary to arrange it in the position illustrated in Fig. 2 where the socket 21 is at its upper end for the reception of the pin of a tool joint section or the like, and the pin 20 is at its lower end to thread into a socket of a joint section. A central longitudinal passage 22 extends through the body

10 from one end to the other to conduct the circulation fluid through the tool. A pocket or recess 23 is provided in each apex portion or corner of the body portion 14 to receive a cutter 11. The recesses 23 are open at the surfaces 15 and at the side surfaces of the portion 14 and preferably have curved concaved inner walls, as illustrated in Fig. 3 of the drawings. The opposite end walls of the recesses 23 are preferably flat and normal to the longitudinal axis of the body.

The cutters 11 are rotatably supported in the recesses 23 to project from the body 10 and act on or ream the side walls of the well bore. The several cutters 11 may be alike in configuration, each having a cylindrical major portion and a frustro-conical portion at one end. Suitable cutting parts are provided on the cutters. In the typical case illustrated the cutting parts or teeth 24 extend longitudinally of the cutters from one end to the other, it being apparent that the teeth may be spiralled, interrupted or otherwise formed. The ends or corners of the teeth 24 at the plain ends of the cutters 11 may be bevelled off. The cutters 11 are proportioned to fit the recesses 23 of the body with suitable clearance and their opposite ends are preferably flat and normal to their axis. Central longitudinal openings 25 are provided in the cutters 11 and extend throughout their lengths.

The means 12 for rotatably supporting the cutters 11 is simple and dependable and is such that the cutters may be readily removed for replacement or inversion. The cutter supporting means 12 includes spindles or pins 26 extending through the openings 25 and rotatably carrying the cutters. The pins 26 project from the opposite ends of the cutters 11 and extend into longitudinal openings 27 in the body 10. In the form of the invention disclosed in the drawings the openings 27 extend between the bevelled ends 18 of the body portion 14 to intersect the recesses 23 and are vertical or parallel with the longitudinal axis of the body 10 so that the cutters 11 are rotatable about vertical axes. As the openings 27 are open at the opposite ends 18 of the portion 14 the pins 26 may be inserted in either end of the openings. The cutter supporting pins 26 terminate in the openings 27 and have their opposite end portions received in the openings. Transverse openings 28 may be provided in the pins 26 adjacent their ends for the reception of a bar, or the like, for lifting the pins.

The openings 27 are provided with portions 29 of increased diameter adjacent the opposite end walls of the recesses 23 to carry replaceable wear taking bushings 30. The bushings 30 may be inserted in the sockets or enlarged portions 39 of the openings 27 from the body recesses 23. The openings in the bushings 30 may be of the same diameter as the openings 25 and 27 and the cutter carrying pins 26 may be of uniform diameter throughout their lengths.

Thrust washers 31 surround the pins 26 between the ends of the cutters 11 and the end walls of the recesses 23. In accordance with the invention the thrust washers 31 have straight opposite edges 32 for engaging the parallel sides of recesses or slots 33 in the end walls of the recesses 23. This engagement of the straight sides 32 of the washers with the walls of the slots 33 positively prevents rotation of the washers 31. The washers 31 project inwardly beyond the slots 33 into the recesses 23 to space the ends of the cutters 11 from the end walls of the recesses 23. The outer ends of the slots 33 are

open so that the washers 31 may be easily slid into place prior to the insertion of the pins 26 in the openings 27. The outer ends of the thrust washers 31 may be flush with the flat or slightly curved surfaces 15 of the body.

The cutter mounting or supporting means 12 provides for the dependable locking of the pins 26 against rotation and displacement. Transverse openings 34 are provided in the triangular body portion 14 to intersect the enlarged portions of the openings 27. Openings 35 are provided in the walls of the bushings 30 and notches 36 are provided in the pins 26 to register with the openings 34. The openings 35 and notches 36 may each be substantially semi-circular in cross section to constitute even continuations of the openings 34. Each opening 34 has a reduced portion providing an annular shoulder 37. Lock pins 38 extend through the openings 34 and cooperate with the notches 36 to positively lock the cutter carrying pins 26 against rotation and longitudinal movement. Reduced portions 39 are provided on the pins 38 to extend through the reduced parts of the openings 34 and to provide shoulders for engaging the shoulders 37. This engagement of the pin shoulders with the shoulders 37 limits the inward movement of the pins in the openings 34.

Nuts 40 are threaded on the reduced end portions 39 of the pins 38 to removably lock the pins in position. In the preferred construction the nuts 40 are positioned in sockets 41 in the ends of the openings 34. The nuts 40 are preferably castellated, having openings or notches to receive cotter keys 42 passed through transverse openings in the lock pins 38. The cotter keys 42 prevent displacement of the nuts 40 from the lock pins 38 while the lock pins in cooperating with the notches 36 positively prevent rotation and longitudinal movement of the cutter carrying pins 26. The large ends of the lock pins 38 are cut away to have flat diametrical or tangential surfaces 45.

The invention provides a simple tool in the form of a combination wrench and punch for facilitating tightening of the lock pins 38 and to facilitate the removal of the lock pins from the openings 34. The wrench includes a handle 46 of suitable length and configuration. A transverse head 47 projects in opposite directions from one end portion of the handle 46. One end of the head 47 has a cut away portion or notch providing a flat diametrical or tangential surface 48. This notched end of the head 47 is adapted to be inserted in the large end of an opening 34 to have its flat face 48 cooperate with the face 45 of a lock pin 38 to hold the lock pin against turning while a nut 40 is threaded on or off the pin. The other end 49 of the head 47 is of reduced diameter and is in the nature of a punch for driving the lock pins 38 from their openings 34 after the removal of the nuts from the pins.

Means is provided to prevent loss or displacement of the cutter carrying pins 26 from the openings 27 in the event that the lock pins 38 fail or become displaced. Stops 50 are lightly welded in the openings 27 to engage the lower ends of the cutter carrying pins 26. The stops 50 may be tubular to pass a punch for removing the pins 26 from the openings 27. As the stops 50 prevent downward movement and displacement of the pins 26 they are provided in the lower ends of the openings 27 regardless of the use or disposition of the reamer. If the reamer is initially assembled for use in a given position and is later

inverted the stops 50 may be removed and replaced in what are the lower end portions of the openings 27 in the inverted reamer.

It is believed that the utility and practicability of the tool provided by the present invention will be readily apparent from the foregoing detailed description. During operation of the tool the cutters 11 project from the body 10 to engage or act on the side walls of the well bore to ream the bore and to center and stabilize the drilling string. It is usually preferable to position the cutters 11 so that their frusto-conical portions are at their lower ends to have a bore enlarging action. The cutters 11 are effectively supported for free rotation on the pins 26 and end thrusts from the cutters are taken by the non-rotatable washers 31. As described above, the cutter carrying pins 26 are dependably locked against displacement by the lock pins 38 and the stops 50. The hard beads 17 and the hard faced blades 19 prevent the cutter carrying portion of the body from becoming excessively worn. The lock pins 38 are dependably held against displacement by the keyed nuts 40 but may be easily removed to permit the removal of the cutter carrying pins 28. It is apparent that the pins 26 may be easily removed to permit the replacement or inversion of the cutters 11. The cutter carrying or supporting means of the invention is particularly simple and inexpensive of manufacture. As described above, the tool may be easily and quickly conditioned for inversion and is adapted for use immediately above the drilling tool and at a higher point in the drilling string.

Having described only a typical form and application of my invention, I do not wish to be limited or restricted to the specific forms and applications herein set forth, but wish to reserve to myself any modifications or variations that may appear to those skilled in the art or fall within the scope of the following claims.

Having described my invention, I claim:

1. A well reamer including a body having a cutter carrying portion of polygonal cross section, means at the opposite ends of the body for connecting it in a drilling string, and wear resisting material on the corners of said portion.

2. A well reamer including a body having a cutter carrying portion of polygonal cross section, means at the opposite ends of the body for connecting it in a drilling string, beads of hard wear resisting material on the corners of said portion, and blades on an end of said portion.

3. A well reamer including a body having a recess, a cutter in the recess, and means supporting the cutter for rotation including a pin rotatably carrying the cutter and having a portion received in an opening in the body, there being an opening intersecting the said opening, the pin having an external notch registering with the second mentioned opening, a removable lock pin extending through said second mentioned opening and cooperating with the notch to hold the pin against rotation and upward movement, and a stop removably welded in the first named opening to prevent downward displacement of the said pin from the opening.

4. A reamer including a body having a recess and an opening intersecting the recess, the opening having enlarged portions at the recess, a cutter in the recess, a pin rotatably supporting the cutter and having its end portions received in the opening, replaceable bushings in said enlarged portions carrying the pin, and removable means for locking the pin against rotation and longitudinal movement.

5. A well reamer including a body having a recess, and an opening intersecting the recess, there being straight-sided slots in the end walls of the recess, a cutter in the recess, a pin rotatably supporting the cutter and having its end portions extending into the opening, bushings in the opening carrying said end portions of the pin, flat-sided washers in the slots spacing the ends of the cutter from the end walls of the recess and held against rotation through cooperation with the walls of the slots, the body having a second opening intersecting the first mentioned opening and the pin having a notch registering with the second opening, a lock pin in the second opening cooperating with the notch to hold the cutter-carrying pin against movement, and means for locking the lock pin against displacement.

6. A reamer including a body having a recess and an opening intersecting the recess, the opening having an enlarged portion at the recess, a cutter in the recess, a pin rotatably supporting the cutter, a replaceable bushing in said enlarged portion carrying an end of the pin, there being a transverse opening in the body intersecting the first named opening and notches in the bushing and pin registering with the transverse opening, and a lock pin in the transverse opening cooperating with the notches to hold the pin and bushing against movement.

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