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2,199,693

WELL REAMER

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Fig. 1.

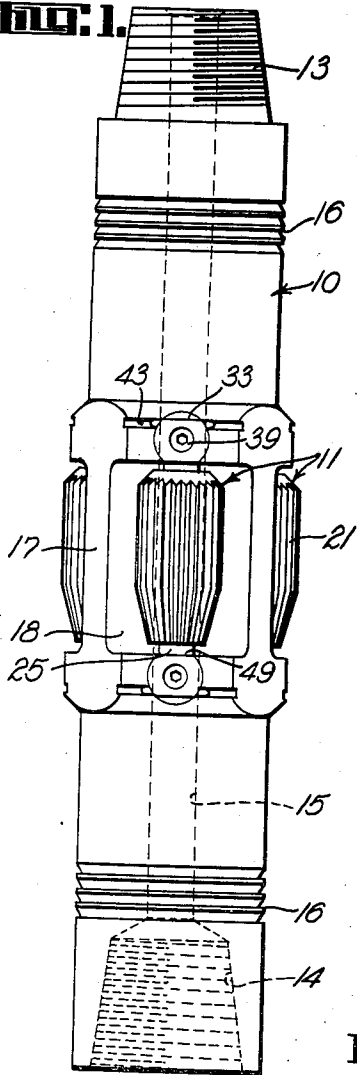


Fig. 2.

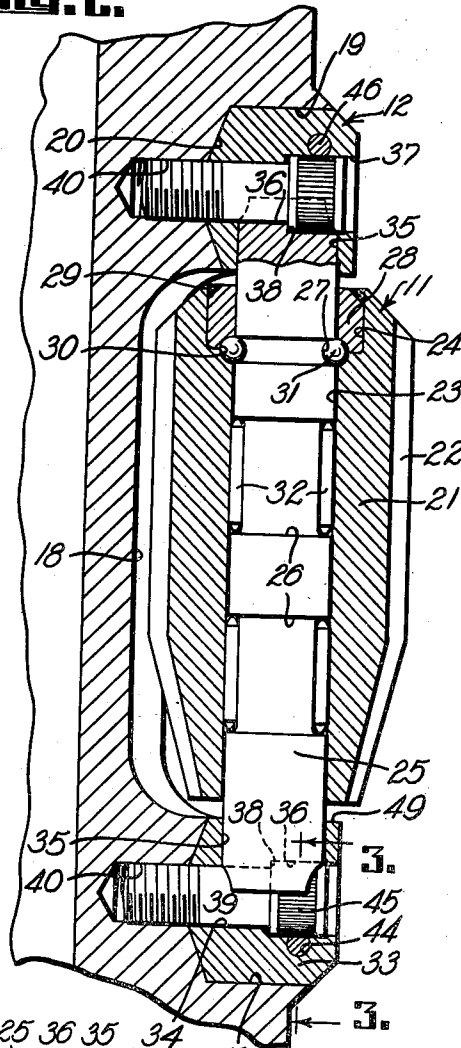


Fig. 3.

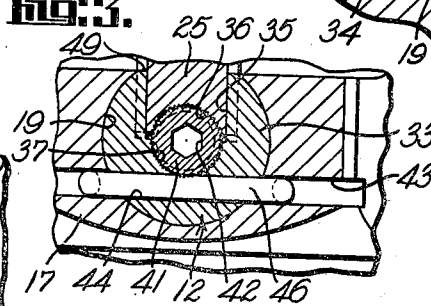


Fig. 5.

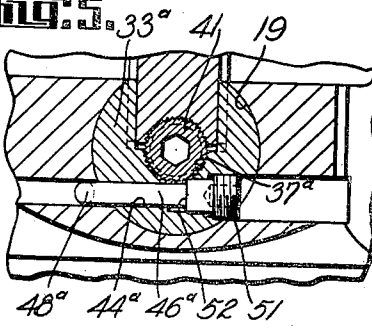
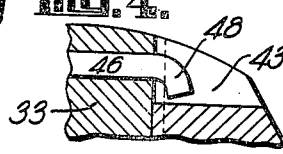


Fig. 4.



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UNITED STATES PATENT OFFICE

2,199,693

WELL REAMER

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9 Claims. (Cl. 255—73)

This invention relates to well drilling tools and relates more particularly to a reamer for use in the rotary method of well drilling. A general object of this invention is to provide a rotary well reamer embodying simplified and improved mounting means for the reaming cutters.

Another object of this invention is to provide a reamer of the character mentioned in which the reaming cutters and their mounting elements may be easily and quickly secured in place on the reamer body and removed for replacement by unskilled workmen and with simple, conventional tools.

Another object of this invention is to provide a well reamer of the character mentioned in which the blocks for carrying the cutter pins are dependably secured to the reamer body by simple, positive means that prevent the hammering and battering of the blocks against the reamer body.

A further object of this invention is to provide a well reamer of the character mentioned embodying novel means for securing and locking the supporting blocks to the reamer body.

The various objects and features of my invention will be fully understood from the following detailed description of typical preferred forms and applications of the invention, throughout which description reference is made to the accompanying drawing, in which:

Fig. 1 is a side elevation of the improved reamer of the present invention. Fig. 2 is an enlarged fragmentary longitudinal detailed sectional view illustrating one of the cutter units and its mounting means showing the pin and screws in elevation. Fig. 3 is a fragmentary longitudinal detailed sectional view taken as indicated by line 3—3 on Fig. 2. Fig. 4 is a fragmentary vertical sectional view illustrating the manner in which the lock pin is held in place, and Fig. 5 is a view similar to Fig. 3 illustrating another manner of locking the screw in place.

The rotary well reamer of the present invention may be said to comprise, generally, a shank or body 10, a plurality of reaming cutter units 11 and means 12 for securing the cutter units 11 to the body.

The reamer body 10 is an elongate member intended to be connected in a rotary well drilling string. The body 10 is provided at its opposite ends with suitable means for facilitating its connection in the drilling string. In the particular construction illustrated a tapered screw threaded pin 13 is provided on the upper end of the body 10 and a tapered threaded socket 14 is formed in the lower end of the body 10. A central longi-

tudinal fluid passage 15 extends through the body 10 from one end to the other to handle the circulation fluid. The body 10 may be provided with series of grooves defining annular wickers 16 adapted to be engaged by grappling tools.

The intermediate part 17 of the body 10 is generally triangular in cross section while the end portions of the body may be cylindrical. The vertical corners or apices of the triangular body part 17 are rounded off and a vertical or longitudinal recess 18 is provided in each of these corners. The recesses 18 are spaced between the upper and lower ends of the triangular part 17 and their upper and lower walls are preferably flat and substantially horizontal. The inner walls of the recesses 18 are concave and in practice may be cylindrically curved, as illustrated. Vertically aligned horizontal sockets 19 are provided in the triangular body part 17 at the upper and lower ends of the recesses 18. The sockets 19 are preferably in the nature of cylindrical bores extending radially into the triangular part 17 and having their longitudinal axes transverse of the longitudinal axes of the recesses 18. In accordance with the invention the bottoms or inner walls 20 of the sockets 19 are concave and conical. The sockets 19 join or communicate with the adjacent recesses 18. Thus the sockets 19 above the recesses 18 have their lower portions in communication with the recesses 18 and the sockets 19 below the recesses 18 have their upper portions joining the recesses. The sockets 19 are provided to receive parts of the means 12 as will be hereinafter described.

Each cutter unit 11 embodies a rotatable reaming cutter 21. Where the reamer body 10 has three recesses 18, as above described, there are three cutter units 11 and a cutter 21 is disposed in each recess. The cutters 21 are in the nature of elongate roller reaming cutters designed to rotate about their longitudinal axes. The reaming cutters 21 are generally cylindrical in shape and their lower portions are frusto-conical or tapered downwardly and inwardly. The upper corners of the cutters 21 may be bevelled off. Peripheral or external cutting teeth 22 are provided on the cutters 21. The cutting teeth 22 may be of any selected or preferred design. In the typical case illustrated the teeth 22 are in the nature of bevelled or sharpened ridges extending longitudinally of the cutters 21. The teeth 22 may be straight and axial and may extend between the opposite end portions of the cutters 21. It is to be understood that the cutting teeth 22 of the cutters 21 may be pitched or

inclined, if desired. A central longitudinal opening 23 extends through each cutter 21. The openings 23 are cylindrical and of uniform diameter except for enlargements or sockets 24 formed in the upper end portions of the cutters 21. The opposite ends of the cutters 21 may be flat and the cutters are proportioned so that their ends are spaced from the end walls of the recesses 18.

The cutter units 11 further include cutter carrying pins 25. The pins 25 extend longitudinally through the cutter openings 23 and are sufficiently long to project beyond the upper and lower ends of the cutters. The openings 23 receive the pins 25 with suitable clearance. Each pin 25 has spaced annular grooves 26. In the construction illustrated there are two spaced grooves 26 in each cutter pin 25. The grooves 26 are located to be within the cutter openings 23 and are preferably of substantial vertical extent or length. An annular ball race 27 is provided in each cutter supporting pin 25. The races 27 are spaced above the uppermost grooves 26 and are located to have their medial, horizontal or transverse planes coincident with the bottoms of the sockets 24 in the cutters 21. The races 27 are of substantial depth having a transverse or vertical curvature of substantially 180°.

Annular blocks or rings 28 are secured in the sockets 24. The rings 28 receive or pass the pins 25 with suitable clearance and bear inwardly or downwardly against the bottom walls of the sockets 24. In the preferred construction the rings 28 are integrally joined with the cutters 21. Welding 29 at the upper ends of the rings 28 integrally joins the rings with the cutters 21. Annular ball races 30 are provided to oppose the races 27. The races 30 are partly formed in the cutters 21 and partly formed in the rings 28. There are joining grooves provided in the bottoms of the sockets 24, where the sockets join the openings 23, and in the inner lower corners of the rings 28 which grooves constitute the races 30. The arc of transverse curvature of the races 30 is substantially 180°.

The cutter units 11 further include anti-friction bearing elements supporting the cutters 21 for free rotation on the pins 25. Rows of balls 31 occupy the registering or opposing races 27 and 30. The balls 31 of course assist in the transmission of radial loads and thrusts between the cutters 21 and their pins 25. The balls 31 cooperating with the deep races 27 and 30 are operable to transmit both upward and downward axial thrusts between the cutters 21 and the pins 25 and operate to effectively hold the cutters against endwise movement in both directions. Series of roller bearings 32 cooperate with the walls of the openings 23 and with the inner walls of the grooves 26 to transmit radial thrusts and loads between the cutters 21 and the pins 25. The balls 31 and the rollers 32 support the cutters 21 for free rotation on the pins 25.

The anti-friction bearing means described above forms the subject of my application Serial No. 260,973, filed March 10, 1939, as a division of this application.

The means 12 for securing the cutter units 11 to the body 10 are such that the units may be easily and quickly applied to the body and easily removed from the body for replacement. The means 12 include blocks 33 inserted in the sockets 19. The blocks 33 are cylindrical or circular and accurately fit the sockets 19. The inner ends of the blocks 33 are conical and evenly bear on

the conical concave bottom walls 20 of the sockets 19. The blocks 33 preferably have flat horizontal faces 49 at the upper and lower walls of the recesses 18. Central longitudinal openings 34 extend through the blocks 33. Each block 33 has a radial opening 35 receiving a projecting end portion of a cutter supporting pin 25. The pins 25 accurately or tightly fit the openings 35. The pin receiving openings 35 join the longitudinal openings 34 of the blocks 33. Notches 36 are provided in the opposite ends of the pins 25. The notches 36 have cylindrically curved walls which are flush with the walls of the longitudinal openings 34. The openings 34 are counterbored or provided at their outer ends with sockets 37. The notches 36 are correspondingly counterbored or enlarged to have portions flush with the walls of the sockets 37. The counterboring or enlarging of the notches 36 provides the notches with outwardly facing shoulders 38.

The means 12 further include screws 39 for securing the blocks 33 to the body 10. The screws 39 are passed inwardly through the openings 34 and their inner portions are threaded in radial sockets 40 in the body 10. The screws 39 are cap screws and have cylindrical heads 41 received in the sockets 37 and the enlarged portions of the notches 36. The heads 41 are entirely received in the sockets 37 and the registering portions of the notches 36. The parts may be related and proportioned so that the inner ends of the screw heads 41 bear inwardly against the shoulders 38. The screws 39 may be tightened down to securely hold the blocks 33 against movement. The engagement of the screws 39 and their heads 41 in the notches 36 dependably holds the pins 25 against longitudinal movement and turning. Wrench receiving sockets 42 are provided in the heads 41 of the screws 39.

Means are provided to lock the screws 39 against unthreading. Horizontal openings or grooves 43 are provided in the triangular body part 17 above and below the recesses 18. Openings 44 are provided in the blocks 33 to register with the grooves 43. The openings 44 are tangential with respect to the sockets 37. The heads 41 of the attaching screws 39 are provided with longitudinal knurling or teeth 45. Mild steel rods 46 are passed or driven through the openings 44 to cooperate with the screw heads 41. The rods 46 engage the teeth 45 and the teeth distort or roughen the rods 46. The engagement of the rods 46 with the teeth 45 dependably holds the screws 39 against unthreading and prevents loss or displacement of the rods. The opposite end portions of the rods 46 project into the grooves 43 and may be bent over as shown at 48, Fig. 4, to prevent loss or detachment of the rods.

In assembling a cutter unit 11 the rollers 32 are first inserted in their grooves 26 and are temporarily secured therein by stiff grease or the like. The pin 25 carrying the rollers 32 is then inserted through the opening 23 of the cutter 21. The balls 31 are entered through the socket 24 to their positions in the race 27 and the part of the race 30 in the cutter 21. Following the insertion of the balls 31 the ring 28 is set in the socket 24 and welded to the cutter 21. The welding 29 may then be ground off. The blocks 33 are arranged on the projecting end portions of the pin 25 and the unit 11 is ready for attachment to the body 10. The cutter unit 11 is moved radially inward with respect to the body 10 to enter the blocks 33 in the sockets 19. When the blocks have been seated in the sockets 19 the screws 39

are passed through the openings 34 and threaded in the sockets 40. The rods 46 are then driven into the openings 43 and 44 to lock the screws 39 against unthreading.

5 In the operation of the reamer the body 10 may be connected in a rotary well drilling string and the latter may be operated in the well in the usual manner. When the drilling string is rotated the reaming cutters 21 act on the side
10 wall of the well to ream the same. The cutter supporting pins 25 are dependably secured to the body 10 by the means 12. The cap screws 39 securely retain the blocks 33 in their sockets 19 and cooperate with the notches 36 to hold
15 the pins against axial movement and to prevent turning of the pins 25. The conical inner ends of the blocks 33 cooperating with the conical bottom walls 20 of the sockets 19 assist in preventing hammering and battering of the blocks
20 33 in the sockets. The conical ends of the blocks 33 and the conical socket walls 20 cooperate to convert the thrusts on the blocks to tensile strains on the screws 39. The screws 39 are of substantial diameter to resist these forces and
25 any elongation of the screws under the tensile strains is merely temporary and the screws return to their normal length when the strains are removed.

When it is desired to replace a cutter unit 11
30 the mild steel rods 46 are removed by driving them from the openings 44 and the screws 39 are unthreaded and removed. With the removal of the screws 39 the cutter unit 11 together with the blocks 33 is freed for disconnection from the
35 body 10. It is to be observed that the disconnection of the units from the body may be accomplished by the use of simple, conventional tools and does not require special care.

Fig. 5 of the drawing illustrates another
40 means for locking the screws 39 against unthreading. In the construction illustrated in Fig. 5 the openings 44^a in the blocks 33^a are enlarged or counterbored at one end. The counterbored portions of the openings 44^a join the
45 sockets 37^a in the blocks 33^a. Locking rods 46^a are inserted in the openings 44^a. Heads 51 are provided on the rods 46^a and are threaded in the counterbored portions of the openings 44^a. Sharp annular shoulders 52 are provided on
50 the rods 46^a and are adapted to cooperate with the teeth or knurling 45 of the screw heads 41. When the heads 51 of the rods 46^a are threaded in the openings 44^a the shoulders 52 engage the teeth or knurling 45 to turn or to tend to turn
55 the screws 39 in the direction to tighten the screws. The heads 51 are preferably provided with sockets for receiving a tool to facilitate the turning and threading of the rods 46^a. The plain or inner ends of the rods 46^a preferably
60 extend into a groove 43 and may be bent over at 48^a to lock the rods 46^a against unthreading. It will be apparent how the shoulders 52 of the rods 46^a cooperating with the teeth or knurling 45 dependably hold the screws 39 against
65 unthreading.

Having described only typical preferred forms and applications of my invention, I do not wish to be limited or restricted to the specific details herein set forth, but wish to reserve to myself
70 any variations or modifications 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 comprising a body having
75 spaced sockets, a reaming cutter, a pin carrying

the cutter and projecting from the opposite ends of the cutter, blocks arranged on the projecting end portions of the pin and received in the sockets, screws screwed into the body to secure the blocks to the body, and heads on the screws
5 engaging the pin to hold the pin against turning.

2. A well reamer comprising a body having spaced sockets, a reaming cutter, a pin carrying the cutter and projecting from the opposite ends of the cutter, blocks inserted in the sockets, the blocks having openings passing through them and lateral openings joining the first named openings and receiving the end portions of the pin, and screws passing through said first named openings and attaching the blocks to the body
10 15 and cooperating with the pin to hold the pin against rotation.

3. A well reamer comprising a body having a recess and lateral socket bores at the upper and lower ends of the recess, a cutter in the recess,
20 a pin carrying the cutter and projecting from the upper and lower ends of the cutter, blocks fitted in said bores and having longitudinal openings and having lateral openings joining the longitudinal openings and receiving the end portions of the pin, said pin having notches in its ends, and screws passing through the said longitudinal openings and threaded into the body to attach the blocks to the body and cooperating with said notches to prevent rotation and axial
25 30 movement of the pin.

4. A well reamer comprising a body having a recess and lateral socket bores at the upper and lower ends of the recess, a cutter in the recess, a pin carrying the cutter and projecting from the upper and lower ends of the cutter, blocks fitted in said bores and having longitudinal openings and having lateral openings joining the longitudinal openings and receiving the end portions of the pin, said pin having notches in its ends,
35 40 screws passing through said longitudinal openings and threaded into the body, said screws engaging the notches to hold the pin against rotation, heads on the screws bearing in the said longitudinal openings to secure the blocks to the
45 body, and removable means cooperating with the said heads to hold the screws against unthreading.

5. A well reamer including a body having spaced parallel lateral sockets, the inner walls of the sockets being conical, a cutter, a pin passing through the cutter to carry the same and projecting from the opposite ends of the cutter, blocks having openings receiving the end portions of the pin, the blocks being insertable in
50 55 the sockets to mount the cutter pin on the body, the inner ends of the blocks being conical to engage with the conical inner walls of the sockets, and screws attaching the blocks to the body and urging the blocks inwardly in the sockets.

6. In a well tool, a body, a cutter supporting pin, and means mounting the pin on the body including blocks on the end portions of the pin, the blocks having openings passing through them and second openings extending in transverse tangential relation to the first named openings and joining the said first named openings, screws passing through said first named openings and threaded into the body, heads on the screws engaging in said first named openings to attach
60 65 the blocks to the body, teeth on said heads, and rods in said second openings engaging with the teeth to prevent unthreading of the screws.

7. In a well tool, a body, a cutter supporting pin, and means mounting the pin on the body in-
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- cluding blocks on the end portions of the pin, the blocks having openings passing through them and second openings extending in transverse tangential relation to the first named openings and joining the said first named openings, screws passing through said first named openings and threaded into the body, heads on the screws engaging in said first named openings to attach the blocks to the body, teeth on said heads, the body having grooves registering with said second openings, and rods in said second openings engaging the said teeth to prevent unthreading of the screws, the rods having end portions bent over in the grooves to prevent displacement of the rods.
8. In a well tool, a body, a cutter supporting pin, and means mounting the pin on the body including blocks on the end portions of the pin, the blocks having openings passing through them and second openings extending in transverse tangential relation to the first named openings and joining the said first named openings, screws

passing through said first named openings and threaded into the body, heads on the screws engaging in said first named openings to attach the blocks to the body, teeth on said heads, and rods threaded in said second openings and cooperating with the said teeth to prevent unthreading of the screws.

9. In a well tool, a body, a cutter supporting pin, and means mounting the pin on the body including blocks on the end portions of the pin, the blocks having openings passing through them and second openings extending in transverse tangential relation to the first named openings and joining the said first named openings, screws passing through said first named openings and threaded into the body, heads on the screws engaging in said first named openings to attach the blocks to the body, teeth on said heads, rods threaded in said second openings, and shoulders on the rods cooperating with said teeth to hold the screws against unthreading.

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