

Sept. 21, 1937.

A. C. CATLAND

2,093,632

WELL REAMER

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Fig. 1

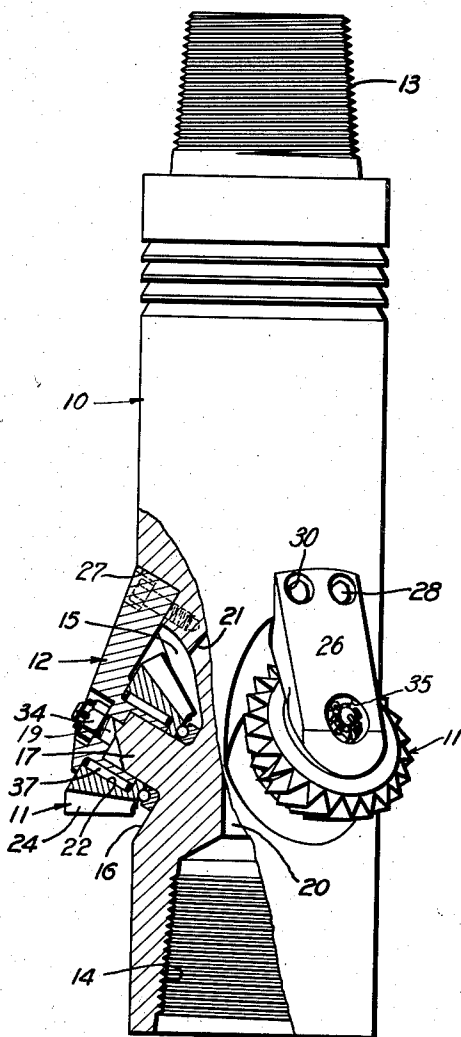


Fig. 2

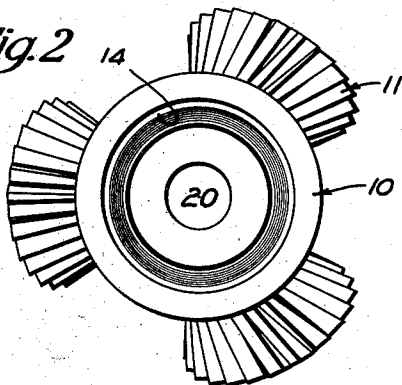


Fig. 3

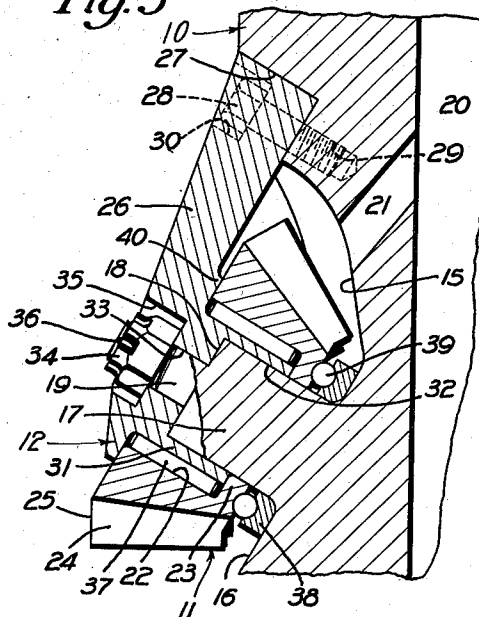
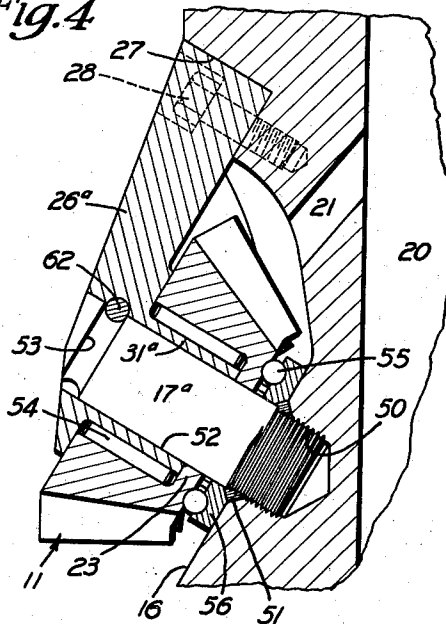


Fig. 4



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WELL REAMER

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14 Claims. (Cl. 255—73)

This invention relates to a well drilling tool and relates more particularly to a well reamer. A general object of this invention is to provide a practical, effective well reamer embodying improved means for rotatably mounting the reaming cutters.

Another object of this invention is to provide a well reamer embodying roller cutters positioned and mounted to be effective in acting on the shoulder of earth formation occurring between the rat hole or pilot bore and the larger main portion of the bore. The reamer of the present invention is operable to enlarge a well bore a considerable amount and its cutters are mounted so that they are particularly adapted for enlarging a well bore having a rat hole or pilot bore.

Another object of this invention is to provide simple, dependable means for removably or detachably mounting rotatable roller cutters on a well reamer.

Another object of this invention is to provide a practical inexpensive mounting for rotatably mounting a roller cutter of a well reamer that carries or supports the cutter so that its operation does not subject the shank or reamer body to wear.

Another object of this invention is to provide a well reamer of the character mentioned that is such that the cutters and the wear receiving parts of the cutter mountings may be easily and quickly removed for replacement and repair.

Another object of this invention is to provide a well reamer of the character mentioned in which the shank or body is a simple, inexpensive member and does not require expensive machining or the like.

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 reamer provided by this invention with a portion broken away to appear in vertical cross section. Fig. 2 is a bottom elevation of the reamer. Fig. 3 is an enlarged fragmentary vertical detailed sectional view of a portion of the reamer illustrating one of the cutters and its mounting and Fig. 4 is a view similar to Fig. 3 illustrating a modified or alternative form of cutter mounting means.

The improved well reamer of this invention includes, generally, a shank or body 10, a plurality of roller cutters 11 and means 12 for rotatably

supporting or mounting the cutters 11 on the body 10.

The shank or body 10 is an elongate member adapted to be interposed or connected in a well drilling string of drill pipe. The body 10 is preferably, though not necessarily, cylindrical in its general configuration and is provided at its opposite ends with means for facilitating its connection in the drilling string. In the form of the invention shown in the drawing a tapered screw threaded pin 13 is provided on the upper end of the body 10 and a threaded socket 14 is provided in the lower end of the body 10 to facilitate the connection of the body in the drilling or operating string. Wickers or ridges may be provided on the upper portion of the body 10 for engagement by a fishing tool or the like. In accordance with the invention the body 10 is provided with recesses 15 for partially receiving the cutters 11. The recesses 15 are spaced circumferentially around the periphery of the body 10 and are in a common horizontal plane or zone. The recesses 15 each have a flat wall 16 inclined upwardly and inwardly with respect to the longitudinal axis of the body. The upper walls of the recesses 15 may be suitably rounded upwardly and outwardly as illustrated in Figs. 1 and 3.

The invention provides bosses or pins 17 projecting from the flat inclined walls 16 of the recesses 15. The pins 17 project upwardly and outwardly, being substantially normal to the flat faces 16. In the form of the invention illustrated in Figs. 1, 2 and 3 of the drawing the pins 17 are integral with the body 10. Each pin 17 has an annular outwardly facing shoulder 18 and a reduced portion 19 projecting or continuing outwardly from its shoulder 18. In the typical embodiment of the invention illustrated in the drawing there are three equally spaced recesses 15 in the body 10 each having a projecting pin 17. A central longitudinal fluid passage 20 extends through the body 10 from one end to the other. Downwardly and outwardly inclined ports 21 extend from the passage 20 to the recesses 15 to discharge the rotary mud or circulation fluid against the cutters 11, as will be hereinafter described.

The cutters 11 are in the nature of roller cutters supported for independent rotation by the means 12. The cutters 11 each have a longitudinal opening 22 and flat normal ends. In the preferred construction each cutter 11 has an annular inwardly projecting flange 23 at its inner end forming a restriction in the inner end portion of its opening 22. The roller cutters 11 are

frusto-conical, having inclined or pitched peripheries. Axially extending cutting parts or teeth 24 are provided on the cutters 11. The teeth 24 of the three cutters 11 are formed and related so that they do not track in their engagement with the earth formation. One cutter 11 may have straight axial teeth 24, the second cutter 11 may have teeth 24 spiralled in a right hand direction and the third cutter 11 may have its teeth spiralled in the left hand direction. The outer corners of the cutting teeth 24 are bevelled or cut away at 25 so that they are substantially vertical when they come into active engagement with the formation to effectively trim the wall of the well bore.

The means 12 for rotatably supporting or rotatably mounting the cutters 11 on the body 10 is an important feature of the invention. The means 12 includes caps or legs 26. A leg 26 extends across the outer side of each recess 15 between its pin 17 and the portion of the body 10 immediately above the recess. Recesses or notches 27 are provided in the exterior of the body 10 at the upper ends of the recesses 15 to receive the upper end portions of the legs 26. The upper portions of the legs 26 fit the recesses 27 so that the walls of the recesses assist in holding the legs against lateral and upward movement and displacement. The legs 26 are inclined downwardly and outwardly relative to the longitudinal axis of the reamer being in planes substantially normal to the longitudinal axes of the pins 17. The upper end portions of the legs 26 are removably secured to the body 10 by screws 28 threaded into openings 29 in the body. The heads of the screws 28 are countersunk or inset in sockets 30 in the legs 26. The outer surfaces of the legs 26 are preferably inclined or tapered downwardly and outwardly to facilitate the withdrawal of the reamer from the well.

In accordance with the invention the caps or legs 26 have studs or bearing parts 31 rotatably supporting the cutters 11 which parts, in turn, are mounted on the pins 17. The bearing parts 31 are integral with the legs 26 projecting downwardly and inwardly from their inner sides. Openings or sockets 32 are provided in the bearing parts 31 to receive the outer major portions of the pins 17. The sockets 32 accurately or closely receive the pins 17 and the shoulders 18 cooperate with the end walls of the sockets so that the bearing parts 31 have effective bearing engagement with the pins. The outer bearing surfaces of the bearing parts 31 are cylindrical and concentric with the surfaces of the pins 17. The legs 26 are removably attached to the body pins 17. Openings 33 extend outwardly through the legs 26 from the sockets 32 to receive the reduced portions 19 of the pins. Nuts 34 are threaded on the reduced portions 19 of the pins 17 to rigidly connect the legs 26 with the pins 17. The nuts 34 are received in sockets 35 in the outer sides of the legs 26 and are held against unthreading by cotter keys 36.

The cutters 11 are arranged on or around the bearing parts 31 with their smaller ends facing inwardly and with their flanges 23 projecting inwardly at the inner ends of the bearing parts 31. Anti-friction bearing means are provided for rotatably supporting the cutters 11. Roller bearings 37 rotatably support the cutters 11 on the cylindrical bearing parts 31. Thrust bearings are provided at the inner ends of the cutters 11. The thrust bearings include washers 38 surrounding the pins 17 and seating inwardly against the in-

clined surfaces 16. Series of balls 39 operate in grooves or races in the washers 38 and the inner ends of the cutters 11. The series of balls 39 and the washers 38 form effective anti-friction bearings for transmitting inward thrusts from the cutters to the body 10. Bosses 40 may be provided on the inner surfaces of the legs 26 around the bearing parts 31 to space the outer ends of the cutters 11 from the inner sides of the legs. The cutters 11 mounted as just described project from the periphery of the body 10 and their active toothed peripheries face downwardly below the legs 26 to act on a shoulder of the earth formation in the well bore. Being frusto-conical and rotatable about axes inclined downwardly and inwardly the lower peripheral parts of the cutters 11 are substantially horizontal as they come into active contact with the earth formation.

It is believed that the utility and practicability of the form of the invention shown in Figs. 1, 2, and 3 will be readily apparent from the foregoing detailed description. The body 10 is adapted to be connected in a drilling string and as the string is rotated and fed downwardly in the usual manner the cutters 11 are adapted to act on the formation to enlarge the well bore. It will be noted that the cutters 11 project substantial distances from the periphery of the body 10 so that they are effective in enlarging the diameter of the well to a substantial degree. As the active portions or teeth 24 of the cutters 11 are substantially horizontal as they come into engagement with the earth formation they are well adapted for cutting away the formation at the annular shoulder present in a well having a rat hole or reduced pilot bore. The cutters carried by the bearings 37 and bearing inwardly against the series of balls 39 are supported for free independent rotation. The mounting means 12 is such that the cutters 11 are dependably retained in their active operative positions. The bearing parts 31 support the cutters 11 through the medium of the bearings 37 so that the body pins 17 are not subjected to wear. In a like manner the series of balls 39 and the thrust washers 38 transmit the inward thrusts from the cutters to the body and protect the body against wear from these thrusts. The circulation fluid passing downwardly through the passage 20 discharges from the ports 21 to effectively flush the cutters 11. The legs 26 may be easily detached from the body 10 by removing the screws 28 and the nuts 34 to permit the removal of the cutters 11 and the bearings. Thus the wearing parts of the mounting means may be readily replaced. The cutter mounting means 12 are simple and inexpensive and embody a minimum number of parts.

Fig. 4 of the drawing illustrates a modified or alternative form of cutter mounting means which may be employed to rotatably support the cutters 11 on the body 10. In this form of the invention the body pin 17^a is a separable part having an end portion threaded into a socket 50 in the body. The pin 17^a projects upwardly and outwardly being substantially normal with the body wall or surface 16. If desired the pin 17^a may be welded to the body 10 as at 51. The cutter mounting means includes a leg 26^a similar to the leg 26. The upper portion of the leg 26^a is received in the body recess 27 and is secured to the body by the screws 28. The leg 26^a is provided with an opening 52 receiving the pin 17^a and has a bearing portion 31^a surrounding the pin. The leg 26^a is connected with the pin 17^a by a lock member or lock pin 62 driven or arranged through an opening

in the leg and cooperating with an annular groove 53 in the outer portion of the pin 17^a. The bearing part 31^a rotatably supports the cutter 11 and the bearing part 31^a is, in turn, supported on the pin 17^a. In practice a roller bearing 54 may be provided in the opening of the cutter 11 to rotatably mount the cutter on the bearing part 31^a. The flange 23 of the cutter 11 projects inwardly at the inner end of the bearing part 31^a. A thrust washer 56 surrounds the pin 17^a and bears against the face 16. A series of balls 55 operates in grooves or races in the washer 56 and the inner end of the cutter 11. The cutter 11 rotatably mounted as just described operates in the same manner as the cutters 11 of the previously described form of the invention. The cutter mounting means shown in Fig. 4 of the drawing dependably and effectively mounts the cutter for free independent rotation. This form of mounting means is particularly simple and inexpensive as the pin 17^a may be a separable part and is easily applied or attached to the body 10.

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 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. In a well reamer, a shank having a projecting pin, a member removably secured to the shank at a point removed from the pin, a bearing part carried by the member and engaged on and surrounding the pin, and a cutter rotatable on the bearing part.

2. In a well reamer, a body having a recess, a pin projecting from a wall of the recess, a member removably attached to the body at a point removed from the pin and extending across the mouth of the recess, a tubular bearing part on the member extending inwardly over the pin, and a cutter rotatable on the bearing part.

3. In a well reamer, a body having a recess, a pin projecting from a wall of the recess, a member removably attached to the body at a point removed from the pin and extending across the mouth of the recess, means removably connecting the member with the pin, a bearing part rigid with the member and engaging around the pin, and a cutter rotatable on the bearing part.

4. In a well reamer, a body having a recess, a pin projecting from a wall of the recess, a member extending across the mouth of the recess, means removably securing the member to the body above the recess, a tubular bearing part on the member extending inwardly over the pin, and a frusto-conical roller cutter rotatable on the bearing part and facing downwardly to act on the earth formation.

5. In a well reamer, a body having an upwardly and outwardly projecting pin, a member removably attached to the body at a point removed from the pin and engaging the outer end of the pin, a bearing part carried by the member and engaging around the pin, and a cutter rotatable on the bearing part.

6. In a well reamer, a body, a pin fixed to the body and projecting upwardly and outwardly from the body, a member extending downwardly over the outer end of the pin, means removably attaching the member to the body, a roller bearing rotatable about the pin and retained thereon by the member, a reaming cutter carried by the bearing,

and an anti-friction bearing between the inner end of the cutter and the body.

7. In a well reamer, a body having an upwardly and outwardly projecting pin, a member removably attached to the body at a point removed from the pin and extending to the outer end of the pin, a tubular bearing part on the member extending inwardly over the pin, and a roller cutter rotatable on the bearing part.

8. In a well reamer, a body having an upwardly and outwardly projecting pin, a member removably attached to the body and extending downwardly to the outer end of the pin, a tubular bearing part projecting from the inner side of the member and surrounding the pin, a roller cutter rotatable on the bearing part, a flange on the inner end of the cutter projecting inwardly at the inner end of the bearing part, and an anti-friction bearing between the body and the inner end of the cutter.

9. A well reamer including a body, a pin projecting outwardly from the body, the pin having an outer portion of reduced diameter providing a shoulder, a member removably attached to the body and projecting downwardly to engage inwardly against said shoulder, the member having an opening receiving the said outer portion of the pin, a nut threaded on said outer portion of the pin to attach the member to the pin, and a cutter rotatable about the pin and retained thereon by the member.

10. A well reamer including a body, a pin projecting outwardly from the body, the pin having an outer portion of reduced diameter providing a shoulder, a member removably attached to the body and projecting downwardly to engage inwardly against said shoulder, the member having an opening receiving the said outer portion of the pin, a nut threaded on said outer portion of the pin to attach the member to the pin, a tubular boss on the inner side of the member surrounding the pin, and a cutter rotatable on the boss.

11. A well reamer including a body having a recess and a notch above the recess, a pin projecting outwardly from a wall of the recess, a member having its upper portion received in the notch and extending downwardly to the pin, a tubular boss on the member receiving the pin, a cutter partially received in the recess and rotatable on the boss, means detachably connecting the member with the pin, and means detachably securing the member to the body.

12. A well reamer including a body having a recess and a notch above the recess, a pin projecting outwardly from a wall of the recess and having a reduced outer portion providing an outwardly facing shoulder, a member having its upper portion received in the notch and extending downwardly to bear on the said shoulder, there being an opening in the member detachably connecting the member to the body, a tubular boss on the member surrounding the pin, and a cutter rotatable on the boss.

13. A well reamer including a body having a recess and a notch above the recess, a pin projecting outwardly from a wall of the recess and having a reduced outer portion providing an outwardly facing shoulder, a member having its upper portion received in the notch and extending downwardly to bear on the said shoulder, there being an opening in the member receiving the reduced portion of the pin, means detachably connecting the member to the body, a nut threaded on the reduced portion of the pin to

connect the member and pin, a tubular boss on the member surrounding the pin, a cutter rotatable on the boss, and a thrust bearing on the pin seated against said wall.

5 14. A well reamer including a body having a recess and a notch above the recess, a pin projecting outwardly from a wall of the recess, a member having its upper portion received in the notch and extending downwardly to the pin,

the member having an opening receiving the outer portion of the pin, and an opening intersecting the first mentioned opening, a lock part in the second mentioned opening cooperating with the pin to connect the member with the pin, a tubular boss on the inner side of the member surrounding the pin, and a roller cutter rotatable on the boss. 5

ALFRED C. CATLAND.

CERTIFICATE OF CORRECTION.

Patent No. 2,093,632.

September 21, 1937.

ALFRED C. CATLAND.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 3, first column, line 31, claim 1, for the word "saving" read having; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 7th day of December, A. D. 1937.

(Seal)

Henry Van Arsdale,
Acting Commissioner of Patents.