Oct. 6, 1936. J. C. WRIGHT 2,056,498

REAMER

Filed May 19, 1933

Fig. 1

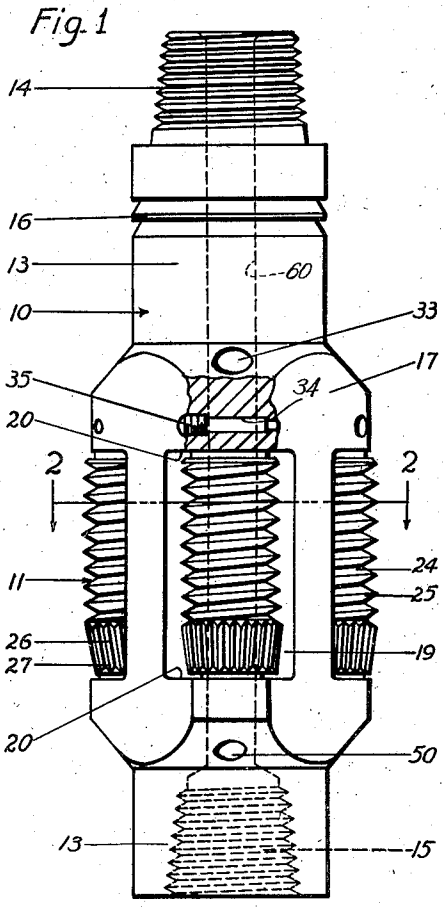


Fig. 3

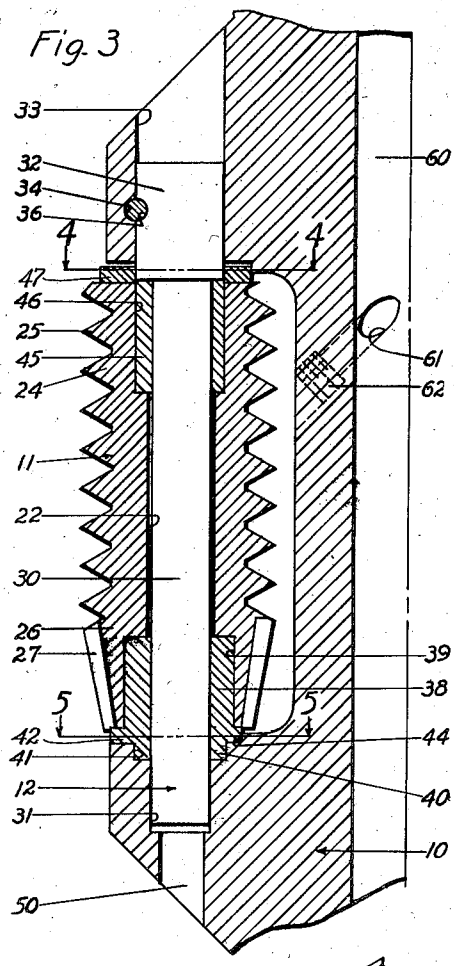


Fig. 2

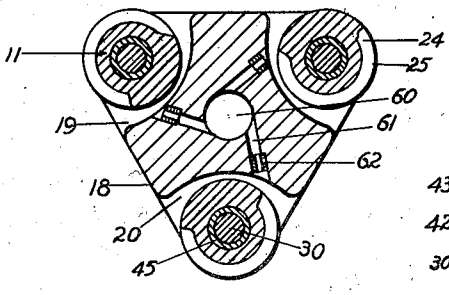


Fig. 4

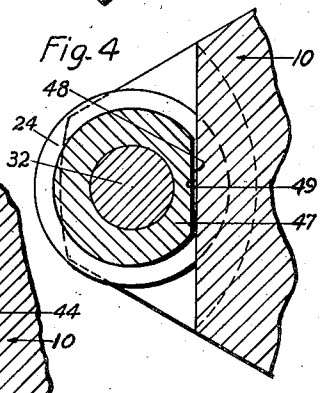
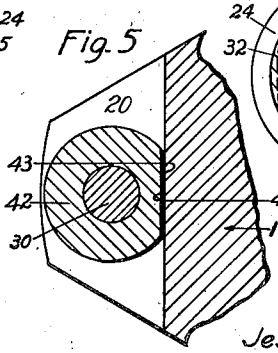


Fig. 5



Inventor
Jesse C. Wright
per
Attorney

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2,056,498

REAMER

Jesse C. Wright, Los Angeles, Calif., assignor to Globe Oil Tools Company, Los Nietos, Calif., a corporation of California

Application May 19, 1933, Serial No. 671,875

7 Claims. (Cl. 255—73)

This invention relates to a well drilling tool and relates more particularly to a well reamer. It is a general object of this invention to provide a simple, practical and effective well reamer having novel and efficient replaceable cutters.

Another object of the invention is to provide a reamer for use in the rotary method of well drilling including rotatable cutters having particularly effective cutting parts.

Another object of the invention is to provide a cutter for use on a well reamer having helical or spiralled cutting parts or teeth.

Another object of the invention is to provide a well reamer having cutters rotatably mounted in a manner so that they may have heavy or deep cutting parts.

Another object of the invention is to provide a simple and effective means for removably or replaceably mounting the rotatable cutters on a well reamer.

It is another object of the invention to provide a well reamer in which the pins carrying the rotatable cutters are not subjected to the wear caused by rotation of the cutters and therefore do not have to be replaced with the cutters.

Another object of the invention is to provide a reamer of the character mentioned in which readily replaceable bearings or bushings are provided on the cutter carrying pins to rotatably carry the opposite end portions of the cutters. In accordance with the present invention, the replaceable bushings on the pins within the end portions of the cutters and the replaceable thrust washers at the ends of the cutters receive all the wear caused by the rotation of the cutters so that the pins are prevented from becoming worn, and the bushing, in being provided in the end portions of the cutters, permit the provision of heavy or deep cutting teeth on the intermediate or major portions of the cutters.

A further object of the invention is to provide a well reamer of the character mentioned involving simple and effective means for removably locking the cutter carrying pins against rotation and longitudinal movement.

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 will be had to the accompanying drawing, in which:

Fig. 1 is a side elevation of the reamer provided by the present invention with a portion broken away to illustrate the manner of locking the cutter carrying pins against movement. Fig. 2 is a transverse detailed sectional view taken as indicated by line 2—2 on Fig. 1. Fig. 3 is an enlarged fragmentary detailed sectional view illustrating one of the cutters and its mounting means, and Figs. 4 and 5 are fragmentary transverse detailed sectional views taken as indicated by lines 4—4 and 5—5 respectively, on Fig. 3.

The well reamer provided by the present invention includes, generally, a body 10, rotatable cutters 11, and means 12 for detachably mounting the cutters 11 on the body.

The body 10 of the reamer is an elongate member adapted to be connected in a well drilling string. The opposite end portions 13 of the body 10 may be cylindrical or round in cross section. Means is provided at the opposite ends of the body 10 for facilitating its connection in the drilling string. In the particular embodiment of the invention illustrated in the drawing, a tapered pin 14 is provided on the upper end of the body 10 and is adapted to be threaded into the socket of a drill collar and a socket 15 is provided in the lower end of the body for receiving the threaded pin of the drilling bit. It is to be understood that if the reamer is to be arranged in the drilling string above the drill collar, a socket may be provided in the upper end of the body 10 to receive a pin on a part of the drilling string and a pin may be provided in the lower end of the body to thread into the socket in the upper end of the drill collar. Spaced grooves are provided in the upper portion 13 of the body 10 to form annular wickers or ribs for engagement by a fishing tool such as a slip socket, or the like.

The cutter carrying portion 17 of the body 10 is of enlarged cross section and is substantially triangular in cross section as illustrated in Fig. 2 of the drawing. The sides or faces 18 of the triangular cutter carrying portion 17 are preferably flat and vertical as illustrated. The opposite ends of the triangular portion 17 are bevelled to join the cylindrical end parts 13. The apices or corners of the cutter carrying portion 17 are preferably rounded. In accordance with the invention, vertical or longitudinal recesses 19 are provided in the corners of the triangular body portion 17. The recesses 19 are provided to carry or hold the cutters 11 and their inner walls are concaved as clearly illustrated in Fig. 2 of the drawing. The recesses 19 are spaced between the opposite ends of the triangular body portion 17 and their end walls 20 are normal to the longitudinal axis of the body.

The cutters 11 are rotatably mounted in the recesses 19 by the means 12 and their cutting

parts project from the open outer ends of the recesses to engage the formation at the wall of the well bore. The cutters 11 are elongate and of round cross section, and are slightly shorter than the recesses 19. The opposite ends of the cutters 11 are flat and normal to the longitudinal axes of the cutters. Each of the cutters 11 has a central longitudinal opening 22 extending completely through it from one end to the other. The cutters 11 rotate on vertical axes and their peripheral parts act on the formation at the wall of the well bore. It is a feature of the present invention that the cutters 11 are provided with particularly effective cutting parts 24.

The cutting parts 24 extend around the cutters 11 and are spiralled or helical. In the form of the invention illustrated in the drawing, there is a single continuous helical cutting part 24 on each cutter 11, it being apparent that there may be two or more such parts on each cutter, and that the cutting parts may be broken or interrupted if found desirable. The cutting parts 24 resemble coarse V-threads, being substantially V-shaped in cross section. In accordance with the invention, the teeth or cutting parts 24 are comparatively heavy or deep and have sharp cutting edges 25. The lower end portions 26 of the cutters 11 are frustro-conical and are provided with cutting parts or teeth 27. There is a circumferential series of spaced teeth 27 on each cutter 11. The cutting teeth 27 are comparatively thin or shallow, and in the particular embodiment of the invention illustrated in the drawing, extend longitudinally of the cutters 11. The spiralled or helical cutting parts 24 are preferably of considerable length and may extend from the tapered lower portions 27 of the cutters to the upper ends of the cutters.

During operation of the reamer the drilling string is rotated in the well and the cutting parts 24 engage the formation at the side wall of the well bore to cut threads in the formation. As the downward movement or feed of the drilling string is comparatively slow, the spiralled cutting parts 24 of the cutters 11 shear off the threads as they are formed in the formation and thus enlarge the bore. The threading engagement of the cutting parts 24 with the formation continuously urges the reamer, and parts connected therewith, downwardly and thus provides a downward feed for the drilling tool. The cutters 11, in engaging the formation at three circumferentially spaced points, stabilize the lower end portion of the drilling string and the bit connected therewith and the threading or feeding action of the spiralled cutting parts 24 acts to further stabilize or steady the reamer and drilling tool.

The means 12 for removably mounting the rotatable cutters 11 in the recesses 19 includes a removable pin 30 extending longitudinally through the opening 22 of each cutter 11. The pins 30 project or extend from the opposite ends of the cutters 11 and have their lower ends seated in sockets 31 in the triangular portion 17 of the body. The upper end parts 32 of the pins 30 are enlarged and are carried in longitudinal openings 33 extending downwardly from the upper end of the portion 17 to the recesses 19. In accordance with the invention, the pins 30 extend through the cutter openings 22 with suitable clearance. The invention provides simple and effective means for holding the cutter carrying pins 30 against rotation and longitudinal movement. Horizontal or transverse openings 34 are provided in the body to intersect the outer edge portions of the openings 33. Screws 35 extend through the transverse openings 34 and cooperate with notches 36 in the head portions 32 of the pins to positively hold the pins against rotation and longitudinal movement. The heads of the screws 35 are threaded into the leading or forward ends of the transverse openings 34 relative to the direction of rotation of the reamer. The screw heads are countersunk in the transverse openings 34 and cuttings and mud pack in the openings to dependably lock the screws 35 in place.

Renewable or replaceable wear-taking bushings are provided on the pins 30 for rotatably carrying the cutters 11. A bushing 38 is provided on each pin 30 to rotatably carry the lower end portion of a cutter 11. The comparatively shallow teeth 27 of the tapering lower end portions 26 of the cutters allow the provision of comparatively deep annular recesses or enlargements 39 in the lower portions of the cutter openings 22 to hold the bushings 38. Due to this relationship between the parts, the bushings 38 may be comparatively large in diameter to present substantial wear receiving surfaces. Reduced lower end portions 40 are provided on the bushings 39 and are received in sockets 41 at the lower walls of the recesses 19. Annular flanges 42 are provided on the bushings 38 and project outwardly between the lower ends of the cutters 11 and the lower walls 30 of the recesses 19. The flanges 42 receive the downward thrusts from the cutters 11 and effectively space the lower ends of the cutters from the lower walls of the recesses. Novel means are provided for holding the bushings 38 against rotation. A flat or straight face 43 is provided on the flange 42 of each bushing to cooperate with a correspondingly shaped face 44 on the body to hold the bushings against turning.

Removable or replaceable bushings 45 are provided on pins 30 for carrying the upper end portions of the cutters 11. The bushings 45 are pressed or otherwise fixed on the pins 30 at the lower ends of the pin enlargements 32. Enlargements 46 are provided in the upper portions of the cutter openings 22 to receive or hold the bushings 45. The bushings 45 are comparatively long and therefore present substantial wear receiving surfaces. Thrust washers 47 are provided between the upper ends of the cutters 11 and the upper walls 30 of the recesses 19. Straight or flat faces 48 are provided on the inner sides of the thrust washers 47 for engaging similar faces 49 on the body to hold the washers against turning. The thrust washers 47 surround the enlarged parts 32 of the pins 30 as clearly illustrated in Fig. 3 of the drawing.

In assembling a cutter on the body, the assembly of the cutter 11 and a bushing 38 is positioned in a recess 19 so that the opening 22 of the cutter is in longitudinal alignment with the openings 31 and 33. In practice, the end clearance of the cutter with the upper wall of the recess is sufficient to permit the proper arrangement of the end part 40 of the bushing in the socket 41. The thrust washer 47 may be easily arranged on the upper end of the cutter with its flat face against the shoulder 49. The pin 30 may then be passed downwardly through the opening 33 and through the cutter opening 22 and then locked in position by the screw 35. The bushing 45 is carried by the pin and is proportioned so that it readily passes through the opening 33. Openings 50 may be

provided in the body to extend from the lower end of the portion 17 to the sockets 31 to permit the pins 30 to be loosened and driven out of position after removal of the screws 35.

The reamer includes means for handling the circulation fluid and for washing or flushing the cutters 11. A central longitudinal fluid passage 60 extends through the body 10 from the upper end of the pin 14 to the socket 15. Downwardly and outwardly inclined outlet or discharge openings 61 extend from the central passage 60 to the inner walls of the recesses 19. The discharge openings 61 are preferably substantially tangential to the rear surfaces of the cutters 11 relative to the direction of rotation of the reamer. Flow beans or nozzles 62 are provided in the outer ends of the discharge openings 61. The nozzle 62 may be threaded into openings 61 or may be otherwise removably attached to the body. The openings in the nozzles 62 are considerably smaller in capacity than the openings 61 so that the velocity of the fluid discharging through them is increased to provide for the effective flushing of the cutting parts of the cutters 11. Further, the restricted openings in the nozzles 62 reduce the quantity of fluid discharged from the openings 61 and cause the nozzles to receive the wear or cutting action due to the discharge of the fluid.

In operation, the drilling string in which the reamer is connected is rotated and the cutting parts 24 and 27 of the cutters 11 act on the formation at the side walls of the well bore. The spiralled cutting parts 24 cut circumferential grooves or threads in the formation, and as the downward feed of the reamer is usually comparatively slow, they shear these threads way from the formation as the tool is rotated. The engagement of the spiralled cutting parts 24 with the formation acts to urge or feed the reamer and drilling tool downwardly and steadies the action of the tools. The cutters 11 are particularly effective in their cutting action and in being circumferentially spaced, provide for the smooth operation of the tools. All of the wear caused by rotation of the cutters 11 is received by the bushings 38 and 45 and the thrust washer 47. As these wear-taking parts are readily replaceable, the tool is economical to operate. The cutter carrying pins 30 are not subjected to any wear, and therefore do not have to be replaced together with the cutters or the bushings. The provision of the comparatively shallow cutting parts 27 on the tapered lower ends of the cutters permits comparatively heavy bushings 38 to be employed to support the lower ends of the cutters. As the bushings 38 and 45 rotatably support the end portions of the cutters, the cutters may be provided with heavy or deep cutting parts 24. The cutters and wear-taking bushings and washers may be easily and quickly replaced. To remove a cutter 11, the screw 35 is first removed and the pin 30 is then driven out through the opening 33. The upper bushing 45 is removable together with the pin. The cutter 11 and the lower bushing 38 may then be easily lifted out of the recesses 19. In mounting the replacement cutter, the same pin 30 may be employed. The cutter carrying pins 30 are dependably locked in position by the screws 35 which hold the pins against turning and longitudinal movement. The lock screws 35 are dependably set or retained in position by the accumulations of mud etc., in the forward ends of the openings 34 which cover the heads of the screws. The circulation fluid under pressure discharging from the nozzle 62 effectively flushes the cutting parts of the cutters. The reamer provided by the present invention is simple and inexpensive of manufacture and may be readily provided with replacement cutters and wear-taking bushings and washers.

Having described only a typical form and application, I do not wish to be restricted or limited to the specific form or application 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 recess, a cutter having a longitudinal opening, and means for rotatably mounting the cutter in the recess, said means including a removable pin extending through the recess and passing through said opening in the cutter, and replaceable bushings on the pin rotatably carrying the opposite end portions of the cutter, the bores of the bushings being of less diameter than said opening whereby the bushings space the wall of said opening out of frictional contact with the pin.

2. A well reamer including, a body having a recess, a cutter having a longitudinal opening, said opening having an enlarged portion at each of its ends, a removable pin carried by the body and extending through the cutter opening with clearance, and replaceable bushings on the pin received by said enlargements of the cutter opening and rotatably carrying the cutter, the bores of the bushings being of less diameter than the cutter opening whereby the bushings prevent frictional contact of the cutter with the pin.

3. A well reamer including, a body having a recess, a cutter having a longitudinal opening, said opening having an enlarged portion at its lower end, and means for rotatably mounting the cutter in the recess, said means including a removable pin carried by the body and freely passing through the opening in the cutter to be out of contact with the cutter, a replaceable bushing on the pin fitting said enlargement of the opening to rotatably carry the lower portion of the cutter, a replaceable bushing on the pin rotatably carrying the upper portion of the cutter, the bores of the bushings being of less diameter than the said opening whereby the bushings prevent frictional contact of the cutter with the pin, and a thrust washer between the upper end of the cutter and the upper wall of the recess.

4. A well reamer including, a body having a recess, a cutter having a longitudinal opening, said opening having an enlarged portion at its lower end, and means for rotatably mounting the cutter in the recess, said means including a removable pin carried by the body and freely passing through the opening in the cutter without cooperating with its wall, a replaceable bushing on the pin fitting said enlargement of the opening to rotatably carry the lower portion of the cutter, a replaceable bushing on the pin rotatably carrying the upper portion of the cutter, the bushings carrying the cutter so that the wall of the cutter opening is spaced from the pin, and a thrust washer between the upper end of the cutter and the upper wall of the recess, said washer having a flat peripheral face cooperating with a corresponding face on the body whereby it is held against rotation.

5. A well reamer including, a body having a recess, a cutter having a longitudinal opening, said opening having enlarged portions at the

upper and lower ends of the cutter, and means for rotatably mounting the cutter in the recess, said means including a removable pin carried by the body and passing through the opening in the cutter, replaceable bushings fitting said enlargements of the opening and cooperating with the pin to rotatably carry the upper and lower portions of the cutter, the pin passing bores of the bushings being of less diameter than the said opening whereby the bushings hold the wall of said opening out of frictional contact with the pin, and means for holding the bushings against rotation.

6. In a well reamer, a body having an external recess, a cutter having a frusto-conical lower portion, there being a longitudinal opening in the cutter having an enlargement in the lower portion of the cutter, a removable pin carried by the body and extending through the opening in the cutter with suitable clearance, a replaceable bushing on the pin received in the enlargement of the cutter opening, the bore of the bushing being of less diameter than said opening whereby the bushing prevents frictional contact of the wall of said opening with the pin, and cutting parts on the frusto-conical portion of the cutter, the cutting parts being comparatively shallow whereby said enlargement and bushing may be of large diameter.

7. A well reamer including a body having an external recess and sockets in the opposite end walls of the recess, a cutter having a longitudinal opening and a socket at the upper end of the opening, a pin passing through said opening without contacting its wall and having its lower end carried in one of the first mentioned sockets, replaceable means on the pin rotatably supporting the lower end of the cutter, an enlargement on the pin carried in the other of the first mentioned sockets and presenting a downwardly facing shoulder, and a replaceable bushing carried in said socket of the cutter engaging the pin to rotatably support the upper end of the cutter and bearing upwardly against said shoulder.

JESSE C. WRIGHT.