

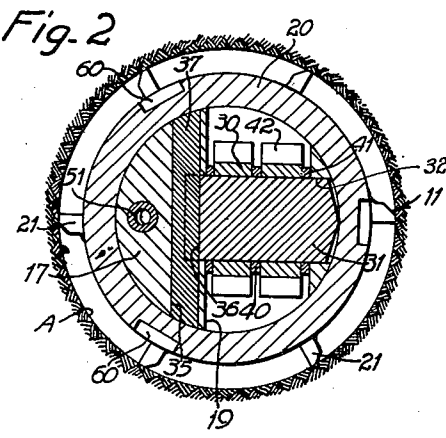
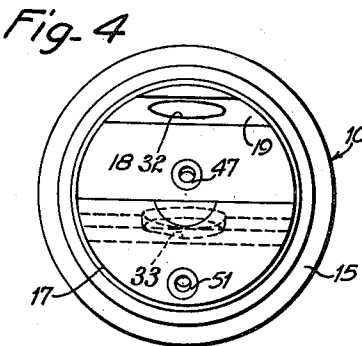
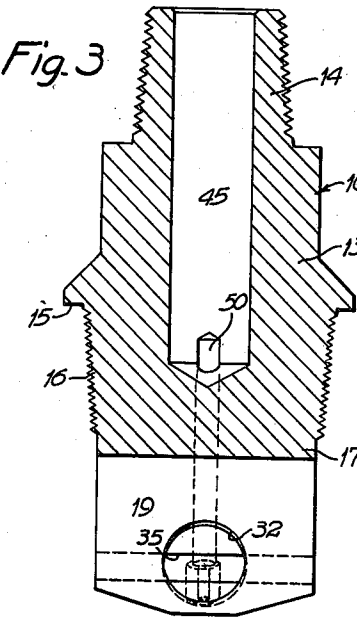
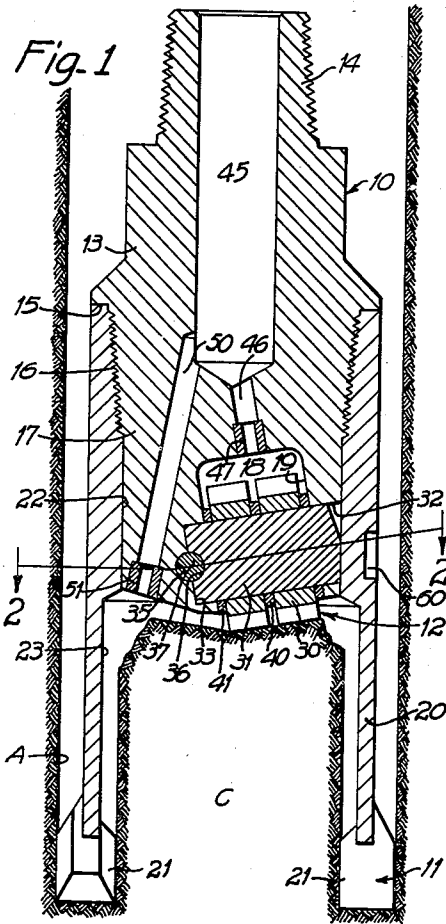
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WELL BIT

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WELL BIT

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This invention relates to a well tool and has particular reference to a well drilling bit for use in the rotary method of well drilling. A general object of the invention is to provide a simple, practical well bit that is rapid and effective in operation.

Another object of the invention is to provide a well bit including cutting means for making an annular cut in the earth formation to leave a core, a cutting means to destroy or cut away the core thus formed and means for handling the circulation fluid so that it thoroughly flushes the cutting means and is effective in eroding and softening the core to materially aid the second mentioned cutting means in destroying the core.

Another object of the invention is to provide a well bit comprising a sleeve or body part having scraper type cutting means on its lower end which make an annular cut leaving a core which is received in the tubular body part, and roller cutters in the upper end of the tubular body part for acting on the upper end of the core to destroy or cut away the core.

Another object of the invention is to provide a well bit comprising a tubular body part having cutting blades or teeth on its lower end for making an annular cut and to leave a core which is received in the tubular body part, cutters for engaging the upper end of the core to cut it away and means discharging circulation fluid downwardly onto the core to wash some of the core away and to soften the remainder of the core, the tubular body part operating to confine the core so that the fluid is made to flow downwardly around it and discharge from the lower end of the body to effectively flush the blades or teeth on the end of the tubular body part.

A further object of the invention is to provide an improved bit construction involving a simple and dependable means for mounting roller cutters.

Other objects and features of the invention may become apparent from the following detailed description of a typical preferred form and application of the invention throughout which description reference may be had to the accompanying drawing, in which:

Fig. 1 is a longitudinal detailed sectional view of the bit provided by the invention illustrating it in operation in a well. Fig. 2 is a transverse detailed sectional view taken substantially as indicated by line 2—2 on Fig. 1. Fig. 3 is a longitudinal detailed sectional view of the body or shank, being a view taken in a plane at right angles to

the plane of sectioning of Fig. 1 and Fig. 4 is a bottom view of the shank or body.

The well drilling bit of the present invention includes generally a shank or body 10, lower or outer cutting means 11 on the lower end of the body 10 for making an annular cut A in the formation which leaves a core C, and inner cutting means 12 for destroying or removing the core C.

The body 10 includes a shank portion 13 provided at its upper end with suitable means for connecting with the lower end of a drilling string. In the particular form of the invention illustrated in the drawing a tapered screw threaded pin 14 is provided on the upper end of the shank portion 13 to facilitate connection with a drill collar, or the like, on the lower end of a drilling string of drill pipe. An outwardly projecting annular flange is provided on the body at the lower end of its shank portion 13. The lower or underside of the flange forms a downwardly facing annular shoulder 15. A thread 16 is provided on the exterior of the body 10 and extends downwardly from the shoulder 15. The body 10 includes a lower portion 17 of cylindrical cross section which extends downwardly from the lower end of the thread 16. A socket or recess 18 extends upwardly into the lower end of the body portion 17 to receive or carry the inner cutting means 12, as will be subsequently described. The recess 18 preferably extends transversely through the body portion 17 from one side to the other. The inner and outer walls 19 of the recess 18 are inclined downwardly and outwardly relative to the central longitudinal axis of the body and are preferably substantially parallel. The recess 18 is eccentric or offset from the central longitudinal axis of the body having the lower end of its outer wall 19 adjacent the periphery of the portion 17 and having the lower end of its inner wall 19 adjacent the central vertical axis of the body. In the preferred construction the recess 18 is sufficiently large or wide to intersect the longitudinal axis of the body. The lower end of the body or body portion 17 may be frusto-conical, tapering downwardly and inwardly toward its center.

The outer cutting means 11 includes a sleeve or tubular part 20 attached to the body 10 to form a downwardly extending continuation thereof and cutting blades or teeth 21 on the lower end of the tubular part 20. The tubular part 20 is a carrier or mounting for the cutting teeth 21 and surrounds or encloses the core C to insure an effective downward circulation of fluid around the core. In accordance with the invention the

tubular part 20 telescopes over the lower portion 17 of the body having a cylindrically curved internal wall 22 contacting with the periphery of the portion 17. The upper portion of the part 5 20 is screw threaded onto the body 10 having an internal thread cooperating with the body thread 16. The upper end of the tubular part 20 bears upwardly against the shoulder 15. The opening 23 in the portion of the tubular part 21 which 10 projects downwardly from the body may be of increased diameter.

The cutting parts 21 of the means 11 are in the nature of scraping blades or teeth which operate to make the annular cut A in the earth 15 formation when the drill is rotated and fed downwardly in accordance with the usual practice in rotary drilling. In the particular bit structure illustrated in the drawing, the teeth 21 are formed on the tubular part 20, it being apparent 20 that they may be provided on a detachable ring or shoe, on the lower end of the part 20. There is a plurality of circumferentially spaced cutting teeth 21 projecting downwardly from the lower end of the tubular part 20. The teeth 21 project 25 inwardly and outwardly from the tubular part 20 to cut an annular channel of sufficient width to pass or receive the tubular part 20 with the desired clearance. The particular cutting teeth 21 illustrated in the drawing are disposed substantially radially relative to the central vertical 30 axis of the tool and are provided with normal or substantially horizontal lower cutting edges. During the drilling operation when the drill is rotated on the lower end of a drilling string the annular series of cutting teeth 21 penetrates or 35 cuts downwardly in the earth formation, making the cut A and providing the upstanding central core C which extends upwardly into the tubular part 20.

The inner cutting means 12 acts on or engages 40 the upper end of the core C to remove or cut away the core as it is formed by the outer cutting means 11. The cutting means 12 includes one or more roller cutters 30 rotatably supported on 45 a bearing or pin 31. The pin 31 extends across the recess 18 to rotatably support the cutters 30 in positions where they project downwardly into the upper end of the opening 23 to engage the core. The invention provides novel means for 50 removably holding the pin 31 in its proper cutter supporting position. A lateral opening 32 extends inwardly from the periphery of the lower body portion 17 to communicate with the recess 18 at its outer wall 19. A cylindrical socket 33 is 55 provided in the inner wall 19 of the recess 18 in axial alignment with the opening 32. The axes of the opening 32 and socket 33 are inclined upwardly and outwardly with respect to the central longitudinal axis of the body 10 and lie 60 in a plane substantially radial of the central longitudinal axis of the body. The cutter carrying pin 31 has its inner end portion supported in the socket 33 and its outer end portion carried in the opening 32. The pin 31 supported as just 65 described is inclined upwardly and outwardly. The outer end of the pin 31 is conical to be engaged by the interior of the tubular part 20 which effectively holds the pin against longitudinal movement. Means is provided for holding 70 the pin 31 against rotation. A transverse opening 35 is provided in the body 10 to intersect the socket 33 at its inner wall. A diametrical groove 36 of substantially semi-circular transverse cross section is provided in the inner end of 75 the pin 31 to register with the groove portion

of the opening 35 extending diametrically across the inner wall of the socket 33. A pin or key 37 is arranged in the opening 35 for cooperating with the groove 36 to dependably hold the cutter 5 carrying pin 31 against rotation. The ends of the key 37 are preferably finished to be substantially flush with the periphery of the lower body portion 17. The tubular part 20 surrounding the body portion 17 holds the key 37 against longitudinal displacement. 10

One or more independently rotatable roller cutters 30 are supported on the pin 31. The embodiment of the invention illustrated in the drawing includes two like roller cutters 30. I 15 have shown the roller cutters 30 directly rotatably supported on the pin 31, it being apparent that the cutters 30 may be rotatably mounted on the pin through suitable bearings if desired or found practical. A spacing washer 40 is provided on the pin 31 between the two cutters 30 and thrust 20 washers 41 are provided between the walls 19 of the recess and the outer ends of the cutters. The cutters 30 are cylindrical in their general configuration and are provided with peripheral cutting parts or teeth 42. The cutters 30 mounted 25 as just described are independently rotatable on axes inclined upwardly and outwardly with respect to the central longitudinal axis of the tool. The cutters 30, therefore, rotate in planes inclined downwardly and outwardly. The cutters 30 are 30 positioned so that their paths of activity or engagement with the upper end of the core cover substantially the entire end of the core. The path of movement of the innermost cutter 30 extends outwardly from a point immediately adjacent the central longitudinal axis of the bit. 35 The roller cutters 30 in rotating in planes inclined downwardly and outwardly provide the core C with a dish or concave upper end.

The invention includes means for handling or 40 discharging the circulation fluid in a manner to thoroughly flush the roller cutters 30, erode and soften the core C, and flush the cutting teeth 21. A central longitudinal duct 45 extends downwardly into the body 10 from its upper end. A branch 45 port 46 communicates with the lower end of the duct 45 and discharges fluid downwardly into the upper end of the recess 18. A bean 47 is provided in the lower end of the port 46 and has a reduced fluid opening which provides for an increase 50 in the velocity of the discharging fluid. It will be apparent that the fluid under pressure discharging from the bean 47 thoroughly flushes the roller cutters 30. After flushing the cutters 30 the fluid flows downwardly through the opening 55 23 around the core C to erode and soften the core and then pass upwardly around the lower end of the tubular part 20 to clean and flush the teeth 21. A branch passage 50 extends downwardly and outwardly from the lower end part 60 of the duct 45 to discharge into the opening 23 at a point adjacent the peripheral edge of the lower end of the body. A bean 51 having a reduced fluid opening is provided in the lower end of the passage 50 to discharge the fluid at an 65 increased velocity. The circulation fluid under pressure discharged from the bean 51 strikes the upper corner portion of the core C to erode or wash away that part of the core. After striking 70 the upper portion of the core the fluid flows downwardly around the core to discharge from the lower end of the tubular part 20 in a manner to provide effective circulation and turbulence in the bottom of the bore and to flush the teeth 21. As the tubular part 20 completely surrounds and 75

confines the major portion of the core C the circulation fluid discharged from the beans 47 and 51 is made to flow or pass downwardly through the comparatively narrow annular passage between the core C and the interior of the tubular part 20. This fluid passing downwardly through the tubular part 20 has an effective erosive action on the earth formation of the core and softens the portion of the core that is not eroded or washed away.

In assembling the bit the roller cutters 30 and the washers 40 and 41 are held in their proper respective positions in the recess 18 while the pin 31 is passed inwardly through the opening 32 and cutters to seat in the socket 33. The pin 31 is then positioned so that its groove 36 is in alignment with the opening 35 and the key 37 is passed into the opening 35 to key the pin 31 against turning. With the cutter carrying pin 31 and the key 37 in position the tubular part 20 may be threaded onto the body 10 to dependably lock the pin and key against movement. The exterior of the tubular part 20 may be provided with spaced sockets or notches 60 to facilitate engagement of the tubular part by a turning or holding tool.

It is believed that the operation of the well drilling bit provided by the present invention will be readily understood from the foregoing detailed description. The bit may be attached to the lower end of a drilling string which is rotated in the usual manner to operate the bit. The plurality of spaced teeth 21 cut the comparatively narrow annular channel A in the earth formation and leave the core C which is received in the tubular part 20. The roller cutters 31 have cutting engagement with the upper end of the core to remove or destroy the core. Circulation fluid is continuously pumping downwardly through the drilling string to discharge from the beans 47 and 51. The roller cutters 30 are fully flushed by the fluid discharged from the bean 47. Fluid discharged from the bean 51 washes away the upper corner part of the core C materially reducing the size of the core. The fluid discharged from the beans 47 and 51 is confined by the tubular part 20 to pass downwardly through the comparatively narrow annular space surrounding the core C and is accordingly made to erode the core. In addition to eroding or washing away the core the circulation fluid softens the core so that it is easily cut away by the roller cutters 30. It is well recognized in the art of well drilling that an unconfined or free portion of earth formation such as the core C is more readily and quickly cut away than a continuous uncut part of the formation. Further, it is recognized that cutters or cutting means making a narrow annular cut in the earth formation are very rapid and efficient in operation. The bit of the present invention provides the lower or outer cutting means 11 which makes a comparatively narrow annular cut in the earth formation and the inner cutting means 12 acts on the upstanding core C and is, therefore, particularly efficient. Further, the series of circumferentially spaced cutting teeth 21 on the lower end of the tubular part 20 cut through the earth formation without being deflected so that the bit operates to make a straight vertical bore.

Having described only a typical form or embodiment of the invention, I do not wish to limit myself to the specific details set forth, but wish to reserve to myself any changes or variations that may appear to those skilled in the art or that fall within the scope of the following claims:

Having described my invention, I claim:

1. A well bit including a shank body having means at its upper end for connecting with a drilling string, a tubular part threaded to the body to surround its lower portion and projecting downwardly from the lower end of the body, cutting means on the lower end of the tubular part for making an annular cut which leaves a core to be received in the tubular part, there being an opening in said portion of the body whose outer end is closed by the tubular part, a pin carried in said opening where it is held against displacement by the tubular part, and a cutter rotatable on the pin to engage the upper end of the core and cut away the core.

2. A well bit including a shank body having a recess in its lower end and an opening communicating with the recess, means at the upper end of the body for connecting with a drilling string, a pin supported in the opening and extending across the recess, a tubular part threaded to the body to surround the lower portion of the body and close the end of said opening and thus prevent displacement of the pin, the tubular part projecting downwardly from the lower end of the body, cutting means on the lower end of the tubular part to make an annular cut and leave a core for reception in the tubular part, and a cutter on the pin for cutting away the core.

3. A well bit including a shank body having a recess in its lower end and an opening communicating with the recess, means at the upper end of the body for connecting with a drilling string, a pin supported in the opening and extending across the recess, a tubular part threaded to the body to surround the lower portion of the body and close the end of said opening and thus prevent displacement of the pin, the tubular part projecting downwardly from the lower end of the body, cutting means on the lower end of the tubular part to make an annular cut and leave a core for reception in the tubular part, and a roller cutter carried by the pin to rotate about an inclined axis and project into the tubular part to engage the upper end of the core to cut away the core.

4. A well bit including a shank, a tubular imperforate part threaded on the shank to project downwardly beyond the lower end of the shank, cutting means on the lower end of the tubular part for making an annular cut which leaves a core to be received in the tubular part, and cutting means projecting from the lower end of the shank to extend into the tubular part and cut away the core, there being a passage in the shank discharging fluid into the tubular part from a point spaced from the last mentioned cutting means to erode the core and then flow downwardly through the tubular part around the core.

5. A well bit including a body having a recess in its lower end and an opening communicating with the recess, a pin supported in the opening and extending across the recess, there being a second opening in the body, a key in the second opening engaging the pin to hold it against rotation, a tubular member surrounding the lower portion to close the outer ends of both of said openings and projecting from the lower end of the body, cutting means on the lower end of the tubular part making an annular cut to leave a core to be received in the projecting portion of the tubular part, and a cutter carried by the pin to engage the upper end of the core.

6. A well bit including a shank body having means at its upper end for connecting with an operating string, an inner cutting means comprising a pin removably carried in an opening in the body, and a cutter on the pin, outer cutting means comprising a series of cutting teeth related to make an annular cut and leave a core to be cut away by said cutter, and a carrier for said teeth supported on the body where it closes the end of the opening and holds the pin against displacement.

7. A well bit including a body, an inner cutting means comprising a pin removably carried by the body, and a cutter on the pin, outer cutting means comprising a series of cutting teeth related to make an annular cut and leave a core to be cut away by said cutter, and a tubular carrier threaded on the body to hold the pin against displacement and to project from the lower end of the body to support the teeth below the body and surround the core.

8. A well bit including, a body having a recess in its lower end and an opening extending inwardly from its periphery to join the recess at its outer wall, the inner wall of the recess having a socket, a pin extending across the recess and having its end portions supported in the opening and socket, roller cutters rotatable on the

pin, means holding the pin against rotation, a tubular part threaded on the body to cover the outer end of said opening and projecting downwardly from the lower end of the body, and cutting teeth on the lower end of the tubular part for making an annular cut to leave a core to extend into the tubular part and be engaged by the roller cutters.

9. A well bit including, a body having a recess in its lower end and an opening extending inwardly from its periphery to join the recess at its outer wall, the inner wall of the recess having a socket, a pin extending across the recess and having its end portions supported in the opening and socket, roller cutters rotatable on the pin, means holding the pin against rotation, the cutters being cylindrical in their general configuration and rotatable about axes inclined outwardly and upwardly with respect to the vertical axis of the bit, a tubular part threaded on the body to cover the outer end of said opening and projecting downwardly from the lower end of the body, and cutting teeth on the lower end of the tubular part for making an annular cut to leave a core to extend into the tubular part and be engaged by the roller cutters.

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