Jan. 21, 1936. J. C. WRIGHT 2,028,579

WELL DRILLING TOOL

Filed April 3, 1933

Fig 1

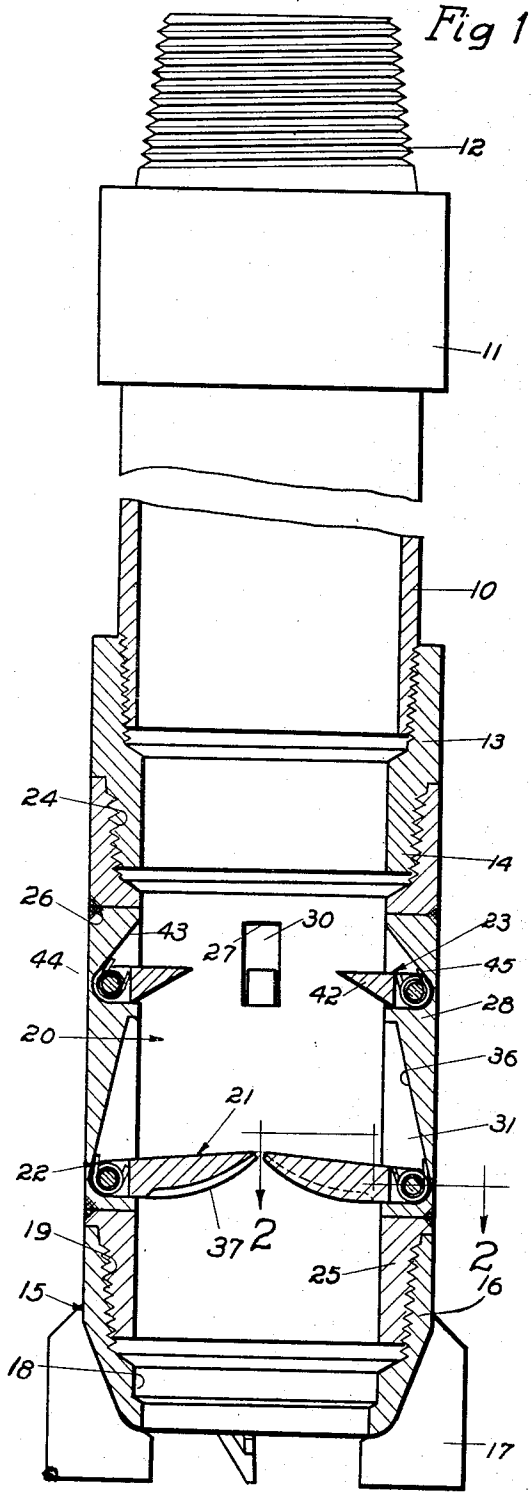


Fig 2

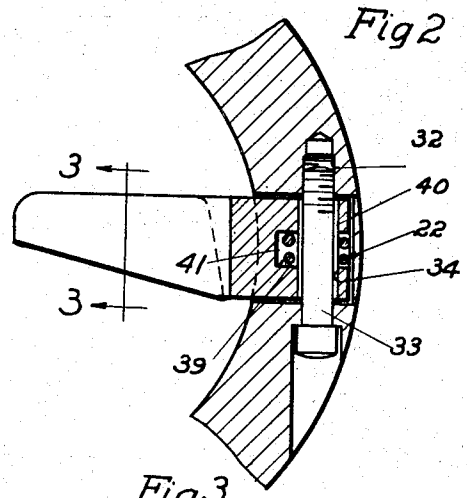


Fig 3

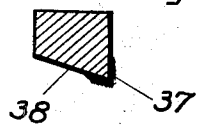
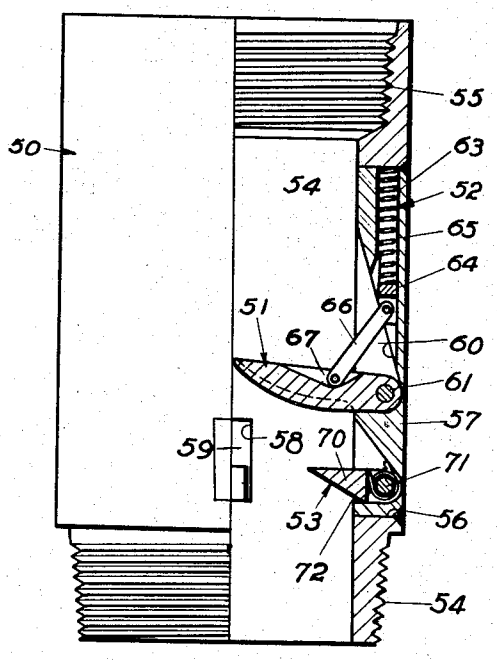


Fig 4



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WELL DRILLING TOOL

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3 Claims. (Cl. 255—72)

This invention relates to a well drilling tool, and relates more particularly to a device or means to be used in connection with a core receiving type of well drill that is operable to break up or cut away the core received by the drill. A general object of this invention is to provide a practical and effective means for destroying or cutting away the core in a core receiving type of well drill.

It has been found that rotary well drills that operate to make an annular cut in the earth formation and then remove or break up the remaining central core, are more rapid and efficient in operation than drills that make a hole or bore of round cross section. Several forms of devices for removing or breaking up the core received in the first mentioned type of drill have been introduced, but have not proved entirely satisfactory. One type of core destroying or removing device that has been introduced involves a cutter rigidly attached to the drill and operable to break up the core by making an annular cut in its exterior. When hard earth formations are encountered, the cutter in the type of device just mentioned, is not effective in breaking up the core so that sections of the core are broken loose from the formation at the bottom of the well bore, become jammed in the drill, and rotate with the drill and prevent the proper engagement of the cutting parts of the drill with the formation, thus impairing the efficiency of the drill.

An object of the present invention is to provide a means or device for use in connection with a core receiving type of rotary well drill that is effective in breaking up or cutting away the relatively soft, and the medium hard portions of the core, and that will allow the very hard portions of the core to enter the drill without being broken away from the formation at the bottom of the bore, so that hard sections of the core do not interfere with the proper operation of the drill.

Another object of the invention is to provide a core breaking or cutting means of the character mentioned that includes one or more knives or cutters for acting on the core that are retractable so as to allow the core to enter the drill intact when very hard earth formations are encountered.

Another object of the invention is to provide a core cutting or removing means of the character mentioned that includes a cutter or cutters pivotally mounted on the interior of the drill in a manner so that they may pivot upwardly and outwardly to retracted positions to permit the hard portions of the core to pass upwardly into the body of the drill, and springs normally yieldingly urging the cutters down into effective cutting engagement with the upper end of the core.

Another object of the invention is to provide a tool of the character mentioned that includes core catching means for retaining the hard portions of the core in the drill so that they may be withdrawn from the well with the drill.

A further object of the invention is to provide a core removing or core cutting device of the character mentioned that is simple and inexpensive of manufacture and that is such that it may be readily embodied in drills of various characters.

A further object of the invention is to provide a simple and efficient well drill having cutting parts for making an annular cut in the earth formation and that includes cutters for breaking up or cutting away the portions of the core that are not eroded or washed away by the circulation fluid, said retractable cutters being adapted to allow the very hard parts of the core to pass upwardly in the drill to be withdrawn from the well with the drill.

Other objects and features of the invention will be fully understood from the following detailed description of typical forms and applications of the invention, throughout which description reference is had to the accompanying drawing, in which:

Fig. 1 is a central longitudinal detailed sectional view of a well drill embodying one form of the present invention showing the core destroying cutters in their fully operative positions. Fig. 2 is an enlarged fragmentary horizontal sectional view taken substantially as indicated by line 2—2 on Fig. 1. Fig. 3 is a vertical detailed sectional view taken as indicated by line 3—3 on Fig. 2, and Fig. 4 is a side elevation of another embodiment of the invention with one quarter in longitudinal cross section.

The tool or device provided by the present invention may be used in well drills varying considerably in character, and in drills having various types of cutters or cutting parts. Throughout the following detailed description, I will describe two embodiments of the invention in connection with a more or less typical core receiving well drill, it being understood that the invention is not to be construed as limited or restricted to the specific forms or applications about to be described, but is to be taken

as including any features or modifications that may fall within the scope of the claims.

The drill illustrated in the drawing includes a body 10 to be attached to the lower end of an operating string of drill pipe, or the like, and adapted to receive a core or portions of a core. A sub 11 is provided on the upper end of the barrel 10 and has a tapered screw threaded pin 12 for facilitating connection of the drill with the operating string. A connecting member or sub 13 is threaded on to the lower end of the barrel 10 and has a downwardly projecting threaded pin 14. The drill has a bit head 15 on its lower end for making an annular cut in the earth formation. The bit head 15 is connected to the lower end of the barrel 10 through the body of the core destroying means of the present invention, which is interposed between the sub 13 and the bit head. The bit head 15 includes an annular or tubular shoe 16 provided with downwardly and outwardly projecting cutting parts or blades 17. The opening 18 in the shoe 16 is restricted at its lower end so that the softer portions of the core are eroded or washed away. The particular bit head shoe 16 illustrated in the drawing is provided at its upper end with a threaded socket 19.

The embodiment of the present invention illustrated in Figs. 1, 2 and 3 inclusive of the drawing, includes generally, a tubular body 20; adapted to be assembled in the drill between the sub 13 and the bit head 15, one or more retractable cutters 21 mounted in the body 20 and operable to break up or cut away the core, means 22 for yieldingly urging the cutters 21 downwardly into cutting engagement with the upper end of the core, and core catching means 23 in the body 20 for retaining the harder portions or sections of core within the barrel 10.

The body 20 is in the nature of a tubular connecting member or sub having comparatively heavy walls. A socket 24 is provided in the upper end of the body 20 to receive the screw threaded pin 14, and a pin 25 on the lower end of the body 20 is threaded into the socket 19 in the bit head. One or more longitudinal openings or slots 26 are provided in the walls of the body 20. In the particular embodiment of the invention illustrated in the drawing, there are two comparatively long diametrically opposite slots 26, and shorter slots 27 spaced substantially 90° from the slots 26. Blocks 28 are welded or otherwise secured in the slots 26 to carry the cutters 21 and units of the core catching means 23. Blocks 30 are provided in the slots 27 for carrying the other units of the core catching means 23.

The cutters 21 are provided to break up or cut away the core as it passes upwardly into the drill and are pivotally mounted so that they may retract in the event that the drill encounters very hard earth formations, and a hard portion of core passes into it. One or more like cutters may be embodied in the device. In the embodiment of the invention being described there are two cutters 21, one being carried by each of the blocks 28. The cutters 21 are in the nature of cutting blades or knives for acting on or cutting away the upper end of the core when the drill is rotated. The outer ends of the cutters 21 are pivotally mounted in diametrically opposite recesses 31 in the blocks 21. Tangential openings 32 are provided in the wall of the body 20 and intersect the slots 26. Pins or screws 33 extend through the openings 32 and pass through transverse openings 34 in the outer end portions of the cutters 21. The inner ends of the screws 33 may be threaded into openings 32, while the outer ends of the screws may be provided with socketed heads counter-sunk in the outer end parts of the openings. In the preferred embodiment of the invention, the outer ends of the cutters 21 are rounded or cylindrically curved about the pivotal axes of the cutters, and correspondingly shaped seats are provided in the walls of the recesses 31, so that the cutters may bear directly against the walls of the recesses. The lower walls of the recesses 31 are flat and horizontal and are adapted to be engaged by the lower sides of the cutters 21 when the cutters are in their fully operative or horizontal positions. In accordance with the invention, the recesses 31 are proportioned and formed to receive the cutters when they are in the retracted positions. The recesses 31 extend upwardly considerable distances from the pivotal axes of the cutters, and have parallel vertical side walls against which the sides of the cutters may slidably bear. In the particular construction illustrated in the drawing, the inner walls 36 of the recesses 31 are flat and are inclined upwardly and inwardly relative to the vertical axis of the drill. The outer or upper sides of the cutters 21 are adapted to seat against the walls 36 when the cutters are in the fully retracted positions. If found practical or desirable, the cutters 21 and the recesses 31 may be proportioned and related so that the active portions of the cutters project into the core passing opening of the body 28 when the cutters are in their fully retracted positions against the walls 36.

The cutters 21 are formed so that they shear or cut away the upper end of a core when in their operative or partially operative positions during the drilling operation, that is, during rotation of the drill when the cutting parts 17 are acting on the formation at the bottom of the well bore. The forward lower edges 37 of the cutters relative to the direction of rotation of the drill, constitute the cutting edges, and are curved upwardly and outwardly to the inner ends of the cutters. The lower sides 38 of the cutters may be inclined downwardly to the cutting edge 37, and the edges 37 may be substantially radial relative to the central vertical axis of the drill. The portions of the cutters 21 at and adjacent the cutting edges 37 may be faced with stellite or other hard cutting material, and/or may be provided with hard cutting inserts of tungsten carbide, or the like. The cutters 21 are preferably sufficiently long to extend inwardly to points at or immediately adjacent the central longitudinal axis of the drill, and the cutting edges 37 extend from points adjacent the walls of the body to the inner ends of the cutters so that the entire upper end of the core may be acted upon by the cutting edges of both cutters 21.

The means 22 for normally yieldingly urging the cutters 21 downwardly into active cutting engagement with the upper end of the core are in the nature of spring means. In the embodiment of the invention illustrated in detail in Figs. 1 and 2 of the drawing, the spring means 22 are located at the pivotal mountings of the cutters 21. Longitudinal or radial slots 39 are provided in the outer ends of the cutters 21 and intersect the openings 34. Sleeves or tubes 40 are arranged in the openings 34 and rotatably

pass or receive the screws 33. Helically wound springs 41 are arranged in the slots 39 around the tubes 40. The springs 41 are under torsional strain, and each has an end reacting against the wall 36 and the inner wall of a slot 39. The springs 41 are operable to normally urge the cutters 21 to their open or fully operative position and to yieldingly hold the cutters in active cutting engagement with the upper end of the core. In practice, the springs 41 are sufficiently heavy or strong to hold the cutters 21 in engagement with the upper end of the core with enough pressure to insure the efficient cutting action of the cutters. The tubes 40 carry the springs 41 so that the assemblies of the cutters 21, tubes 40 and springs 41 may be readily arranged in the recesses 31 and mounted on the screws 33 as units.

The core catching means 23 is operable to retain in the barrel 10, any hard sections of the core that pass the cutters 21 so that they may be removed with the drill. A plurality of core gripping and supporting members 42 is provided on the body 20. In the form of the invention being described, core gripping and supporting members 42 are pivotally mounted in recesses 43 in the blocks 28 and 30 at points spaced above the cutters 21. Pins 44 extend horizontally through the recesses 43 to pivotally support the members 42. Springs 45 similar in arrangement and operation to the springs 41 are provided to yieldingly pivot the core supporting members 42 to their down or active positions. The recesses 43 extend upwardly from the pivotal axes of the members 42 so that the members 42 may be shifted to retracted positions by hard sections of core passing upwardly through the body. The lower sides of the members 42 are inclined upwardly and inwardly to the inner edges of the members to provide the members with sharp core gripping edges and to provide bevelled surfaces to be slidably engaged by the hard sections of core.

During the operation of the embodiment of the invention illustrated in Figs. 1, 2 and 3 of the drawing, the drill is rotated with its cutting parts 17 in engagement with the formation at the bottom of the well bore, and while circulation fluid under pressure is being discharged downwardly through it. The cutting parts 17 make an annular cut in the formation to provide a core that may pass upwardly through the restricted portion of the opening 18 with but slight clearance. The circulation fluid discharging from the restricted lower end of the opening 18 around the core erodes or washes away the softer portions of the core. The restriction at the lower end of the opening 18 increases the velocity of the discharging circulation fluid and thus provides for the effective erosive action of the fluid. The hard or medium hard portions of the core that are not washed away by the circulation fluid pass upwardly into the body 20 and are acted upon by the cutters 21. The springs 41 yieldingly urge the cutters 21 downwardly so that the cutters have effective cutting engagement with the upper end of the core. The two cutters 21, in both being adapted to engage the entire upper end of the core may cut away the core as rapidly as the hole or bore is drilled by the cutting parts 17. In the event that hard earth formations are encountered and the cutters 21 are not capable of cutting away the core as rapidly as it is received in the drill, the cutters are forced upwardly and outwardly to their retracted positions. The hard section or sections of core that pass upwardly between the cutters 21 are received in the barrel 10 of the drill and when the drill has passed through the hard stratum, the cutters 21 are again pivoted downwardly to their active positions by the springs 41. In this manner, the circulation fluid washes away the softer portions of the core, while the cutters 21 are operable to cut away any remaining soft parts and medium hard portions of the core, but are retractable to permit the very hard parts to pass upwardly into the barrel 10. The core gripping and supporting members 42 are forced to the retracted positions by the hard portions of the core passing upwardly into the barrel 10. When the drill is withdrawn from the well, the core gripping and supporting members 42 obtain firm holds on the hard adjacent portion or section of core to retain the hard pieces of core in the drill so that they are withdrawn from the well with the drill. The cutters 21 in being retractable, permit passage of the core upwardly into the barrel 10 when hard earth formations are encountered so that they do not interfere with the rapid operation of the tool. The cutting parts 17 only make an annular cut in the formation and are therefore rapid in their penetration of the formation. The action of the circulation fluid together with the cutting action of the cutters 21 normally destroy the core so that the drill is operable to penetrate the earth formation for a great distance before a quantity of core is received in the barrel 10.

The form of the invention illustrated in Fig. 4 of the drawing includes generally, a tubular body 50 adapted to be interposed in a core receiving drill, retractable cutters 51 for cutting the core passing through the body 50, means 52 normally yieldingly urging the cutters 51 downwardly into cutting engagement with the upper end of the core and core engaging or core retaining means 53.

The body 50 is substantially identical with the body 20, that is, there is a tubular member having a central longitudinal opening 54 and is provided at its upper end with a threaded socket 55, and at its lower end with a threaded pin 54. The body 50 may act to interpose parts of a drill in the same manner as the body 20. Circumferentially spaced longitudinal slots 56 are provided in the walls of the body 50 and carry blocks 57. In practice, there may be two diametrically opposite slots 56 and blocks 57. Shorter slots 58 carrying blocks 59 are spaced substantially 90° from the blocks 57. The cutters 51 are of substantially the same formation and are of the same proportion as the cutters 21. The outer end portions of the cutters 51 are pivotally mounted in recesses 60 in the blocks 57 by pins or screws 61. The recesses 60 extend upwardly substantial distances from the pivotal axes of the cutters 51 so that they are adapted to receive the major portions of the cutters when in the retracted positions. The outer walls of the recesses 60 are inclined upwardly and inwardly as clearly illustrated in the drawing.

The means 52 for urging the cutters 51 to their operative positions and for yieldingly holding the cutters in cooperation with the upper end of the core are spaced from the pivotal axes of the cutters. Longitudinal openings 63 are provided in the blocks 57 in vertical alignment with the pivotally mounted outer ends of the cutters 51. The lower ends of the openings 63 open at the

inclined walls of the recesses 60 while the upper ends of the openings 63 are closed by the upper walls of the slots 56. The blocks or plungers 64 are slidable in the lower end portions of the openings 63. Springs 65 are provided in the openings 63 and are held under compression between the plungers 64 and the upper walls of the slots 56. Links 66 are pivotally connected to the plungers 64 and the cutters 51. Recesses 67 are provided in the upper sides of the cutters 51 to receive the lower end portions of the links 66. It will be apparent how the springs 65 acting through the links 66 normally tend to pivot the cutters 51 to their down or operative positions.

The core catching means 53 includes a plurality of pivotally mounted core gripping and retaining members 70. The core gripping and supporting members 70 are pivotally mounted in recesses in the blocks 57 and 59, being carried by screws or pivot pins 71. In the embodiment of the invention disclosed in Fig. 4 of the drawing, the core gripping members 70 are spaced below the cutters 51. Springs 72 are provided to urge the members 70 to their down or core gripping positions.

The operation of the embodiment of the invention illustrated in Fig. 4 of the drawing is substantially the same as that of the form illustrated in Figs. 1 and 2. The cutters 51 are adapted to act upon the upper end of the core to cut away the core as it enters the drill. The springs 65 hold the cutters 51 in effective cutting engagement with the core. In the event that a hard core is encountered, the cutters 51 may pivot upwardly to their outer retracted positions. After the hard portion of the core has passed upwardly into the barrel of the drill, the springs 65 again urge the cutters downward to their operative positions where they again cut away the upper end of the core entering the drill. The core gripping and supporting members 70 are forced to their retracted positions during the drilling operation, but are adapted to bite into the core when the drill is raised.

Having described only typical forms and applications of my invention, I do not wish to limit or restrict myself to the specific forms or applications above 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. A rotary well drill including, a tubular body adapted to receive a core, there being a recess in the inner wall of the body, a cutter for cutting away the core, means pivotally mounting the cutter in the recess so that it is shiftable between a substantially horizontal position where it is adapted to engage the upper end of the core to cut away the core as the drilling progresses and a substantially vertical retracted position in the recess, the cutter having a cutting edge curved upwardly and inwardly toward the longitudinal axis of the body, and means yieldingly urging the cutter to the substantially horizontal position.

2. A well drill including, a tubular body adapted to receive a core, there being a recess in the inner wall of the body, a tubular cutting head on the lower end of the body for making an annular cut as the drill is rotated, a cutter for cutting away the core, means pivotally mounting the cutter in the recess so that it is shiftable between a substantially horizontal position where it is adapted to engage the upper end of the core to cut away the core as the drilling progresses and a substantially vertical retracted position in the recess, and means yieldingly urging the cutter to the substantially horizontal position, the last mentioned means including a spring in a longitudinal opening in the wall of the body, and means operatively connecting the spring and cutter.

3. A well drill including, a tubular body adapted to receive a core, there being a recess in the inner wall of the body, a tubular cutting head on the lower end of the body for making an annular cut as the drill is rotated, a cutter for cutting away the core, means pivotally mounting the cutter in the recess so that it is shiftable between a substantially horizontal position where it is adapted to engage the upper end of the core to cut away the core as the drilling progresses and a substantially vertical retracted position in the recess, and means yieldingly urging the cutter to the substantially horizontal position, the last mentioned means including, a spring in a longitudinal opening in the body, a plunger slidable in the longitudinal opening and acted upon by the cutter, and a link pivotally connected to the cutter and plunger.

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