ROTARY DRILL APPARATUS

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This invention relates generally to improvements in a drill unit, and more particularly to improvements in a rotary drill apparatus suspended on a cable.

Briefly, the present drill unit comprises a rotary drill and means such as an electric motor, all suspended from a cable, the upper end of the cable being connected to a suitable derrick or hoist at the surface so that it can be payed out as drilling progresses. It is an important object of the present invention to provide improved means for precluding rotation of specific parts of the well drill unit in response to torque exerted on the apparatus by the rotating parts.

Another important objective is achieved by the provision of an improved anti-rotation device on the drill unit which is adapted to engage effectively the wall of the well to hold the parts associated therewith against rotation, the anti-rotation device being operable responsive to the reaction torque exerted on the well-engaging claws by the rotating parts of the drilling apparatus.

Other important objects and advantages are realized by the structural arrangement and mounting of well-engaging claws of the anti-rotation device relative to a central body constituting an element of the slide feed assembly, which assures a positive engagement of the claws upon initial torque reaction.

Still another important object is realized by the provision of an auxiliary well-engaging mechanism in the anti-rotation device operable automatically as the device is moved to its retracted position relative to the drill casing, such mechanism being connected to the mounting means of the claws, and adapted to assure engagement of the claws by the central body upon initial torque reaction, in addition to augmenting the initial wall-gripping action of the device to preclude rotation.

Still another object is achieved in an improved slide-feed assembly which transmits the reaction torque of the motor to the anti-rotation device and enables that portion of the drill unit carrying the motor and rotating elements to be moved downwardly relative to the fixed position of the anti-rotation device in the well wall as the drilling progresses.

Yet another important object is realized in the novel structural arrangement and mounting of a filter screen relative to the slide-feed assembly and to the drill casing to provide a container for collecting debris and to provide a passage for drilling liquid to a pump for subsequent circulation to the drill bit. Other advantages are realized in utilizing parts of the slide-feed assembly in combination with the filter screen to provide the structure and functional results mentioned above.

The foregoing and numerous other objects and advantages of the invention will more clearly appear from the following detailed description of a preferred embodiment, particularly when considered in connection with the accompanying drawings in which:

Fig. 1 is a side elevational view of the upper end of the drill unit, with portions of the slide-feed filter assembly cut away;

Fig. 1A is a cross sectional view of that portion of the drill unit connected to and forming an extension of the portion shown in Fig. 1;

Fig. 1B is a side elevational view, partly in cross section, of the lower end of the drill unit forming an extension of that portion disclosed in Fig. 1A;

Fig. 2 is an enlarged view, partly in cross section, as seen along line 2—2 of Fig. 1;

Fig. 3 is an enlarged view, partly in cross section, as seen along line 3—3 of Fig. 1;

Fig. 4 is an enlarged view, partly in cross section, as seen along line 4—4 of Fig. 1A;

Fig. 5 is a fragmentary side elevational view of the lower end of the anti-rotation device as seen at 90 degrees to Fig. 1;

Fig. 6 is a fragmentary view, partly in cross section, of the connection of the cable as seen at right angles to the disclosure of Fig. 1A, and

Fig. 7 is a view, partly in cross section, as seen along line 7—7 of Fig. 6.

Referring now by characters of reference to the drawings, and first to a detailed description of the anti-rotation device more clearly shown in Figs. 1 and 2, it will be seen that the anti-rotation device includes an elongate central body 10 of circular cross section located at the top of the drill unit. Carried on central body 10 are a plurality of longitudinally spaced plate members 11 arranged in horizontal relation. A pair of pivot pins 12 are arranged in diametrically opposed relation to the central body 10, and extend through and bridge the plate members 11. Pivoted mounted on each of pivot pins 12 are a plurality of claws 13 arranged in vertically spaced relation between plate members 11. Spacer elements 14 are disposed between adjacent claws 13 and between certain of the claws and adjacent plate members 11.

Each claw 13 includes a pointed forward end 15 having a downwardly and outwardly sloping cam portion 16, and includes a rear portion with a flat face 17. The rear portion of each claw 13 is provided with an intermediate slot 20 in which a spring element 21 is located. From Fig. 2, it is seen that one arm 22 of spring 21 engages a retaining pin 23 attached to plate members 11, while the opposite end 24 of spring 21 engages the rear portion of claw 13, the spring being wound about the pivot pin 12. It is seen from this spring arrangement that the spring 21 tends to urge the claw 13 inwardly to a retracted position, as shown in full lines in Fig. 2, in which the claw 13 does not engage the well wall.

The claws 13 are pivotally mounted on pins 12 near their rear end portions so that the greater mass of the claw is in the length from the pivot pin to the forward end portion 15. This particular mounting of the claws enables the forward claw end 15 to move outwardly because of centrifugal action upon a slight rotational movement of plate members 11 and pins 12 in response to the torque reaction created by the rotating parts of the drilling apparatus, all of which will be fully understood after detailed description of the remaining parts of the drilling unit.

The central body 10 is provided with opposed longitudinal keys arranged in 180 degree relation, the keys constituting laterally projecting shoulders 25. The plate members 11 are provided with oppositely arranged recesses 26 adapted to receive the lateral shoulders 25.

The recesses 26 are of much greater width than shoulders 25 for reasons which will later appear.

In the retracted position of claws 13, each claw overlaps one end portion of recess 26 in a position forwardly of a lateral shoulder 25, and includes a shoulder 27 which is adapted to be engaged by a lateral shoulder 25 upon rotation of central body 10, whereby the shoulders 25 urge the claws 13 outwardly to cause effective engagement
of the outer end 15 with the well wall. After initial expansion of claws 13 by lateral shoulders 25, such shoulders 25 will engage abutments 28 defining outer boundary of recesses 26, and hence tend to cause rotation of plate elements 11 and the pivot pins 12 carried thereby. Since the outer ends 15 of claws 13 now engage the well wall, the rotative action of pivot pins 12 about central body 10 will cause further expansion of claws 13 to its fully expanded position as determined by the abutment of stop elements 30 with the flat face 37 of the rear portion of each claw.

An auxiliary well-gripping mechanism is carried by the lowermost plate member 11, and includes a collar portion 31 seating on a shoulder 32 fixed to central body 10, the collar 31 including a pair of spaced flanges 33 at each side. Pivotally connected toggle arms 34 and 35 connect a mass 36 of considerable weight to flanges 33, the toggle arms 35 being pivotally connected to the mass 36, and toggle arms 34 being pivotally connected to flanges 33. The mass 36 is slidably movable along central body 10 within limits as determined by the expansion and retraction of toggle arms 34—35. From Fig. 1, it is seen that the outermost end 37 of each toggle arm 34 is adapted to engage the well wall when the mass 36 is slidably moved upward to the upper limit of its range of movement, thus providing a resisting force to plate members 11 that tend to prevent rotation of such members in response to torque reaction.

The combined slide-feed and filter assembly of the drill unit will now be described. This assembly includes an elongate drill casing 40, the upper end of which is attached to a top collar 41 providing a top opening or inlet port 42 leading internally to casing 40. Secured immediately below collar 41 to casing 40 is a top plate member 43 that is provided with a central aperture (not shown) to permit the passage of central body 10 therethrough, and is provided with flattened side portions 44 to permit the passage of liquid in a manner to be described. A spring element 45 is located about central body 10 and seats on top plate member 43, the spring element 45 constituting a cushion for mass 36 when the anti-rotation device is lowered with respect to the drill casing 40. It will be noted that the outer diameter of mass 36 is slightly less than the diameter of opening 42 in collar 41.

Located a considerable distance below top plate member 43 is a bottom plate member 46 that extends horizontally across drill casing 40 and is secured thereto. The opening provided with a central aperture of circular cross section constituting an outlet port 47, and includes an upstanding collar 50 about port 47.

Disposed between top plate member 43 and bottom plate member 46 are a plurality of spaced intermediate plate members 51 secured to drill casing 40 by screws 52 as is clearly shown in Fig. 3. These plate members 51 are also provided with flattened sides 53 to provide a passage. Each plate member 51 is provided with a central aperture 54 of circular section defined by a collar formation 55. It will be noted that apertures 54 of intermediate plate members 51 and outlet port 47 of bottom plate member 46 are axially aligned.

An elongate tubular member 56 of square cross section extends centrally along the longitudinal axis of drill casing 40, the tubular member 56 having its upper end 57 arranged in abutting relation to and secured to the under side of upper plate member 43, and having its lower portion 60 extending through outlet port 47 and located substantially below the bottom plate member 46. It will be seen perhaps more clearly from Figs. 3 and 4 that the diagonal dimension of tubular member 56 closely approximates the diameter of plate apertures 54 and 47, and that the tubular member 56 is secured to the plate members in the region where the corners of the tubular member 56 engage the periphery of the plate apertures.

Filter screen section 61 of circular section are located about the length of tubular member 56 located above bottom plate member 46. Each screen section 61 is retained by the collar formations 55 and 58, the screen sections 61 being located about the central apertures 47 and outlet port 47 to provide a passage 58 between the screen sections 61 and tubular member 56.

As will become apparent later, the chamber 59 between the screen sections 61 and drill casing 40 will constitute a passage for the flow of liquid including debris as it enters from the top of casing 40 through inlet port 42. The liquid passes through the screen sections 61 and is consequently filtered, the clarified liquid passing into the passage 58 between screen sections 61 and tubular member 56, and hence passing through plate members 51 and outlet port 47 provided in bottom plate member 46. The debris separated from the liquid is collected at the bottom of chamber 59 provided by bottom plate member 46 as shown in Fig. 1A.

The central body 10 is slightly mounted in tubular member 56, the lower end of body 10 carrying a plurality of vertically arranged rollers 62 at each side. The rollers 62 are pivotally mounted on pins 63 pressed-fit into central body 10 as shown in Fig. 4, the rollers engaging opposite internal walls of tubular member 56 to prevent relative rotation of body 10 and tubular member 56, and the rollers facilitate movement of body 10 along tubular member 56.

The tubular member 56 is filled with a lubricant such as oil which flows up around body 10, the lubricant providing a cushioning effect upon the central body 10 when moved downwardly into tubular member 56, and lubricates the opposite internal walls of member 56 which constitute track sections for rollers 62.

The container 59 for debris located above bottom plate 46 and between filter screen 61 and drill casing 40 is provided with a pair of oppositely arranged clean-out ports 64 Fig. 1A, and with a valve mechanism for opening and closing such ports. The valve mechanism consists of a cylindrical member 65 that is slidably mounted in contiguous relation with the internal wall of casing 40. A pair of guide pins 66 are carried by cylindrical member 65, one at each side, each pin including a reduced portion that is slidably received in an elongate vertical slot 67. The cylindrical member 65 extends upwardly to a point above slot 67 when the member 65 is in its lowest closed position, as indicated in Fig. 1A. When it is desired to remove debris from the collecting chamber 59 located below bottom plate 46, the cylindrical member 65 is moved to a raised position as determined by the movement of pins 66 in guide slots 65 so as to open the lateral cleanout ports 64. Then, the debris may be removed. When the debris collecting chamber 59 is cleaned, the cylindrical member 65 may then be dropped to its lowest position to close ports 64.

The lower end 60 of tubular member 56 is provided with upwardly tapered side flanges 70 which are secured by screws 71 to drill casing 40 as is shown clearly in Fig. 6. The lower end of tubular member 56 is closed by a horizontal plate member 72 that is provided with a pair of slots 73 at each end. Located below bottom plate 72 is a pair of semi-circular heads 74, each being adapted to receive the looped lower end of a lifting cable 75.

There are two lifting cables 75, one being located at each side of the drill unit and each being of a double strand type. The upper end of each cable 75 is connected to a suitable derrick or hoist at the surface so that it can be payed out as drilling progresses. Each cable 75 is located and slidably received in lateral recesses 76 formed in plate members 11 of the anti-rotation device; the cable 75 then extends downwardly into the interior of drill casing 40 along the flattened sides of the top and intermediate plate portions 43 and 51 as shown in Fig. 3, and then extends through side recesses 77 formed in bottom plate member 46.
lower looped end of each cable 75 extends over one of the lateral flanges 70 of tubular member 56 and extends through a pair of slots 73 and over one of the semi-circular head portions 74.

The pump and motor assembly is located within the drill casing 40 below the lower end of tubular member 56. This assembly includes a circular plate coupling 80 (Fig. 1A) that bridges the casing 40 and holds a sealing ring 81. Attached to the upper side of circular plate coupling 80 is a pump inlet 82. Attached to the under side of circular plate coupling 80 is a pump structure 85 which includes a plurality of outlet ports 84. Drivingly connected to the pump 83 is an electrical motor 85. The housing of motor 85 is rigidly connected by a drive shaft sleeve 86 to the casing of a speed gear reduction unit 87 as shown in Fig. 1B, the gear reduction unit being rigidly attached to the drill casing 40. It will be particularly noted that the pump, electrical motor, and speed gear reduction unit are spaced from the drill casing 40 to provide a path 96 for the circulation of drilling liquid.

The electrical cable 90 for motor 85 extends downwardly along the side of the anti-rotation device as shown in Fig. 2 and downwardly into the interior of drill casing 40 and through the openings provided by one of the flattened sides of the top and intermediate plate members 43 and 51, extends downwardly through debris container 59, and extends through a recess 91 provided in bottom plate member 46 as is shown in Fig. 4. Then, the electric cable 90 extends downwardly through the circular sealing plate 80 and into operative connection with motor 85. Sealing plates 92 are fastened to the under side of bottom plate member 46 to close off cable recesses 77 and electrical cable recess 91 to prevent debris from falling through such recesses.

The core barrel 93 is drivingly connected to the output shaft 94 of the gear-reduction unit 87. The core barrel 93 is of a double wall construction providing a liquid circulating passage 95 that communicates with the passage 96 located about the motor and gear reduction unit. A drill bit 97 is attached to the lower end of core barrel 93 and includes a plurality of ports 100 which place the liquid circulating passage 95 in communication with the drill teeth.

In the preferred structure, the upper end of core barrel 93 is provided with elongate vertical slots 101 which communicate with its interior. A helical flight or conveyer 102 is carried by the core barrel 93 and serves to convey cuttings from the drill bit upwardly to the slots 101, the cuttings being deposited through the slots 101 and into the core barrel on top of the core contained therein.

The operation of the drilling unit will now be described. Assuming an initial starting position in which the claws 13 of the anti-rotation device are fully retracted, the drill bit 97 rests at the bottom of the hole, the anti-rotation device and central body 10 are located in their lowest position relative to the tubular member 56 and drill casing 40, and the mass 36 has engaged the spring 45 and is moved to an uppermost position on central body 10 so that the ends 37 of toggle arms 34 are extended outwardly to engage the wall well.

It is seen that the anti-rotation device and the mass 36 are carried by central body 10. When central body 10 moves downwardly into tubular member 56, the mass 36 moves downwardly therewith. Normally the weight of mass 36 holds the toggle arms 34 in a retracted position. However, as the mass 36 moves upwardly with respect to the drill casing, the mass 36 engages the spring 45 and moves upwardly on the body 10 to extend the toggle arms 34.

Then, the motor is energized to rotate the core barrel and drill bit 97. Immediately, the torque reaction of the drill bit 97 is carried and attached, and through tubular member 56 tends to rotate the central body 10. Upon rotation of central body 10, the lateral shoulders 25 engage the abutments 27 of the claws 13 and hence urge the claws 13 outwardly to grip the well wall. The toggle arms 37 in gripping the well wall tend to hold the plate members 11 relatively stationary. Upon further rotation of body 10, the lateral shoulders 25 engage the abutments 27, and hence tend to cause a rotation of plate members 11. The claws 13 can be rotated about pivot pins 12 upon rotation of plate members 11 to their fully expanded position shown in dotted lines in Fig. 2. These claws 13 halt the rotation of central body 10 and permit efficient rotation of the core barrel 93 and drill bit 97.

As the drilling progresses, the cables 75 are payed out to lower the drill casing 40 downwardly from the mass 36, such mass under its own weight will move downwardly on the central body 10 to retract the toggles 35 and disengage the toggles from the well wall. When the casing 40 and core barrel 93 are lowered to their lowermost limit relative to the anti-rotation device, the motor is deenergized and hence the torque reaction is eliminated. Whereupon, the claws 13 under the action of springs 21 are moved inwardly out of wall-engaging relation and into their retracted position, as shown in full lines in Fig. 2.

The anti-rotation device may be lifted slightly to effect complete disengagement of the claws 13 from the well wall. When cable 75 is lifted, the spring sleeve 78 is brought upwardly against the lowermost plate member 11 to exert a lift to the anti-rotation device. A spring 79 is disposed between the sleeve 78 and the lug 88 fixed to the cables 75. The sleeve 78 raises the anti-rotation device and the mass 36 before the drill casing is lifted to allow the mass 36 to move downwardly on body 10 to retract the toggles 35. The spring 79 acts as a cushion. Upon this slight upward movement, the camming portions 16 of claws 13 engage the well wall and move the claws inwardly to the retracted position.

Then, the anti-rotation device, central body 10 and mass 36 are lowered with respect to the drill casing 40 until the mass 36 strikes the spring 45. At which time, the mass 36 moves upwardly on central body 10 and causes expansion of the toggle arms 34 into the well wall-gripping relation previously described. Then, the motor is again energized and the sequence of steps is repeated.

During operation of the drill unit, the core will extend upwardly into the core barrel 93 and the cuttings from the drill bit 97 will move upwardly along the outside of core barrel 93 and be carried in an upward direction by the helical flights 102. The cuttings will be directed into the apertures 101 by the helical flights 102, and will be deposited on top of the core.

When the drilling apparatus is utilized, the drill casing 40 is completely submerged in the drilling liquid at all times. This drilling liquid is introduced through ports 100 at the top of the drill bit 97 and then moves upwardly along the outside of the core barrel 93 and upwardly along the outside of drill casing 40. Then, the drilling liquid enters the interior of drill casing 40 through the top inlet port 42, and hence into the chamber 59 provided between filter screens 61 and the casing 40. The debris and other foreign matter collecting in the filter screen sections 61 and the drilling liquid flow downwardly through the passage 58 provided between the filter screen sections 61 and tubular member 56, through the apertures 54 provided in intermediate plate members 51, and through the outlet port 47 provided in bottom plate member 46. This clarified drilling liquid then enters the inlet pump section 82 and is discharged forcibly through the outlet ports 84 of pump 83. Then, the drilling liquid
flows downwardly between the drill casing 40 and housing of motor 85 and housing of gear reduction unit 80 along the passage 96, thence along a passageway provided between drill casing 40 and core barrel 93, and then into communication with the passage 95 provided by the double wall structure of core barrel 93. The drilling liquid is then introduced through the ports 100 of drill bit 97 as previously described.

Although the invention has been described by making reference to a preferred embodiment, such details are to be understood in an instructive, rather than in any restrictive sense, many variants being possible within the scope of the claims hereunto appended.

I claim as my invention:

1. An anti-rotation device for well drilling comprising a central body having lateral shoulders, a plurality of plate members carried by said body in longitudinally spaced relation, said plate members being provided with recesses adapted to receive said shoulders, the width of said recesses being greater than said shoulders, a plurality of pins attached to and extending between said plate members, a plurality of claws pivotally mounted on each pin, said claws in retracted position being disposed in the path of movement of said shoulders, said shoulders engaging said claws to urge the claws outwardly to engage the well wall upon initial rotation of said body.

2. The anti-rotation device for well drilling comprising a central body having lateral shoulders, a plurality of plate members carried by said body in longitudinal spaced relation, said plate members being provided with recesses adapted to receive said shoulders, the width of said recesses being greater than said shoulders, said recesses having shoulder-engaging abutments to provide a drive connection between the body and plate members, a plurality of pivot pins attached to and extending between said plate members, a plurality of claws pivotally mounted on each pin, said claws in a retracted position extending over said recesses ahead of said shoulder-engaging abutments, a plurality of spring elements wrapped around each pivot pin, each of said spring elements having a plurality of claws pivotally mounted on each pin, said claws in a retracted position extending over said recesses ahead of said abutments, a plurality of pivot pins attached to and extending between said plate members, a plurality of claws pivotally mounted on each pin, said claws in a retracted position extending over said recesses ahead of said abutments, a plurality of spring elements wrapped around each pivot pin, each of said spring elements having a plurality of claws pivotally mounted on each pin, said claws in a retracted position extending over said recesses ahead of said shoulder-engaging abutments, said abutments engaging said claws to urge the claws inwardly to retracted position.

3. An anti-rotation device for well drilling comprising a central body having lateral shoulders, a plurality of plate members carried by said body in longitudinal spaced relation, said plate members being provided with recesses adapted to receive said shoulders, the width of said recesses being greater than said shoulders, a plurality of shoulder-engaging abutments to provide a drive connection between the body and plate members, a plurality of pivot pins attached to and extending between said plate members, a plurality of claws pivotally mounted on each pin, said claws in a retracted position extending over said recesses ahead of said shoulder-engaging abutments, said abutments engaging said claws to urge the claws inwardly to retracted position.

4. The combination and arrangement of elements as recited above in claim 2, but further characterized in that the claws are pivotally mounted near one end to the respective pins so that the other end of said claw swings outwardly to engage the well wall upon rotation of said body and plate members, and by the provision of means on said plate members engaging said claws to determine the extended position of said claws.

5. The combination and arrangement of elements as recited above in claim 2, but further characterized in that the claws have wall-engaging ends provided with downwardly and outwardly sloping cam portions adapted to engage the well wall upon upward movement of the device to swing the claws inwardly to a retracted position.

6. The combination and arrangement of elements as set forth above in claim 2, but further characterized by the provision of spring-engaging abutments on said plate members, and a plurality of spring elements wrapped around each pivot pin, each spring element having one end engaging an abutment on said plate member and having another end engaging one of said claws, the spring elements tending to urge the claws outwardly toward retracted position.

7. An anti-rotation device adapted for use with a drill unit in which a motor is carried, comprising a central body adapted to rotate responsive to the reaction torque of the motor, said central body having lateral shoulders, a plurality of plate members carried by said body in longitudinal spaced relation, said plate members being provided with recesses adapted to receive said shoulders, the width of said recesses being greater than said shoulders, said recesses having shoulder-engaging abutments to provide a drive connection between the body and plate members, a plurality of pivot pins attached to and extending between said plate members, a plurality of torque claws pivotally mounted on each pin, said claws in a retracted position extending over said recesses ahead of said shoulder-engaging abutments, said shoulders engaging said claws on initial rotation of said body to urge said claws outwardly into engagement with the well wall, the shoulders subsequently engaging said abutments to swing the claws to an extended position, the claws being pivotally mounted near one end to the respective pins so that the other end of said claws swings outwardly to engage the well wall upon rotation of said body and plate members, means on said plate members engaging said claws to determine the extended position of said claws, said claws having wall-engaging ends provided with downwardly and outwardly sloping cam portions adapted to engage the wall upon upward movement of the device to swing the claws inwardly to retracted position.

8. The combination and arrangement of elements as recited above in claim 10, but further characterized in that the means connecting the motor consists of toggle arms, said toggle arms including wall-engaging means movable outwardly under the action of said toggle arms upon upward movement of said motor on said central body, said well-engaging means tending to hold said plate members relatively stationary upon initial rotation of said central body, said means being slidable downwardly under gravity as the body and drill casing are moved to the other limit of relative movement so that the mass moves the toggle arms inwardly and causes operative disengagement of the wall-engaging means.

9. In a well drill of the type having a bit driven by a motor carried in the drill casing, the improvement comprising an elongate vertical vessel fixedly attached to the motor housing and lowered into the bore hole therewith, a tubular element located and fixed centrally of said vessel, said tubular element having internal track portions, a slide feed rod slidably mounted in said tubular element, an anti-rotation device carried by said rod, and roller means carried by said rod engaging said track portions to prevent relative rotation of said rod and tubular element.

10. In a well drill of the type having a bit driven by a motor carried in the drill casing, the improvement comprising an elongate vertical vessel fixedly attached to the motor housing and lowered into the bore hole therewith, a tubular element located and fixed centrally of said vessel, said tubular element having opposed internal track portions and being closed at its bottom, a slide feed rod slidably mounted in said tubular element, said rod being...
9 substantially circular, rollers carried at one side of said rod and engaging one of said track portions, and rollers carried at the other side of the rod engaging the other said track portion to prevent relative rotation of said rod and tubular element, an anti-rotation device carried by said rod, and lubricant in said tubular element and between the rod to lubricate the track portions for the rollers.

11. In a well drill of the type having a bit driven by a motor carried in the drill casing, the improvement comprising an elongate vessel connected to the motor housing and lowered into the bore hole therewith, an elongate tubular element located and fixed centrally of said vessel, a rod slidably mounted in said tubular element, an anti-rotation device carried by said rod, a plate member between said vessel wall and said tubular element, the plate member being provided with an outlet port surrounding the tubular element, and a filter screen located about the outlet port and extending upwardly around said tubular element to provide a liquid passage between the screen and tubular element in communication with said outlet port and to provide a debris chamber between the screen and said vessel wall, the vessel having an inlet port to said debris container.

12. In a well drill of the type having a bit driven by a motor carried in the drill casing, the improvement comprising an elongate vessel connected to the motor housing and lowered into the bore hole therewith, a plate member in said vessel providing a bottom wall for a debris chamber, and plate member being provided with an outlet port, a filter screen located around said port and extending upwardly in said vessel, said vessel having an inlet port that communicates with the chamber externally of said screen, an elongate tubular element fixed in said vessel and located internally of said screen to provide a passage therebetween that communicates with the outlet port, a rod slidably mounted in said tubular element, and an anti-rotation device carried by said rod to provide a slide feed between the vessel and rod.

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