March 7, 1933. T. G. TAYLOR 1,900,029

WELL DRILLING APPARATUS

Filed Nov. 24, 1931

Fig. 2.

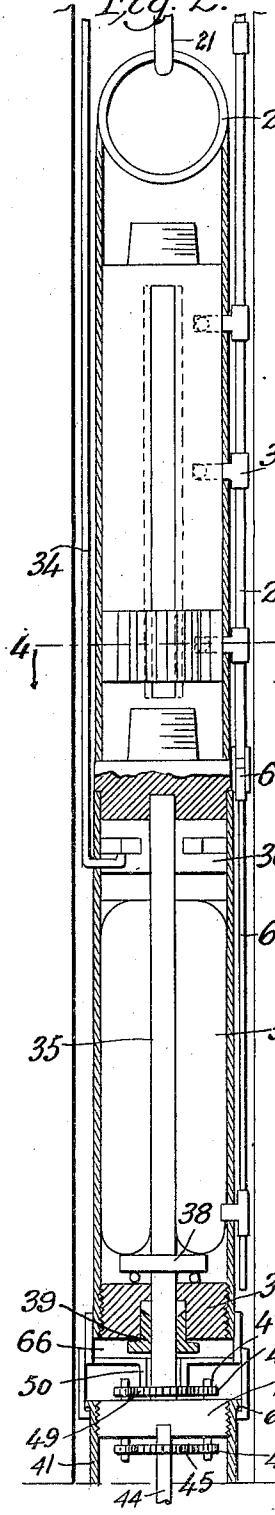


Fig. 3.

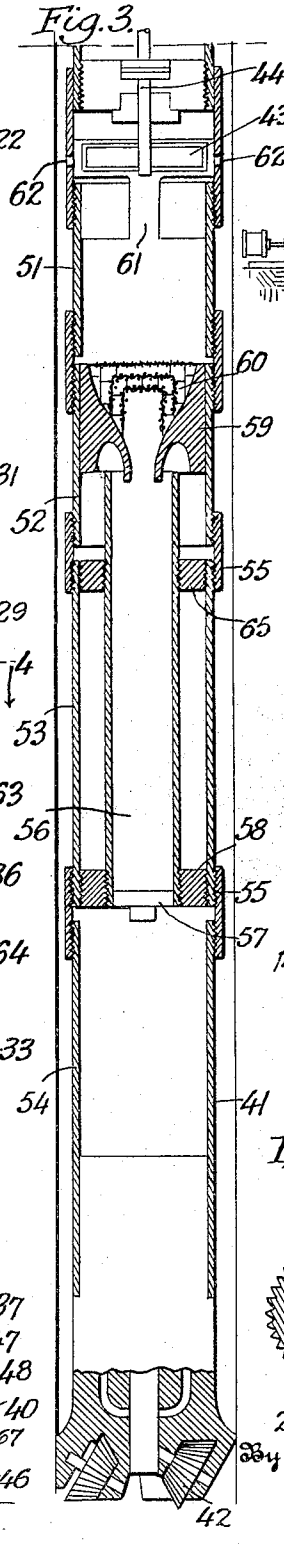


Fig. 1.

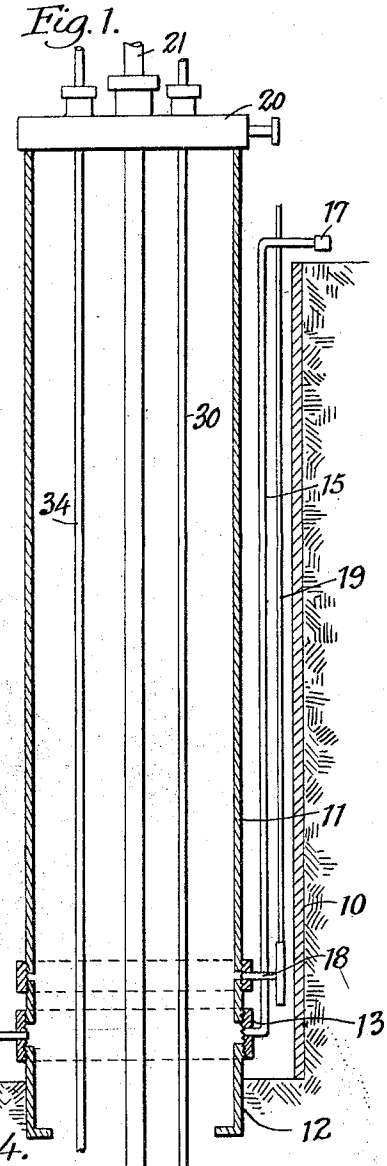
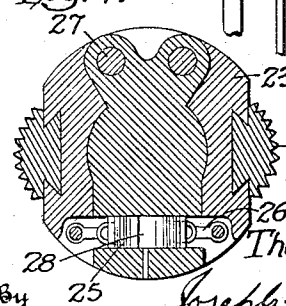


Fig. 4.



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UNITED STATES PATENT OFFICE

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WELL DRILLING APPARATUS

Application filed November 24, 1931. Serial No. 577,075.

This invention relates to improvements in deep well drilling apparatus and particularly to means for keeping the drilling bit cool and to means for holding certain holding and supporting elements from rotating during the rotation of the drilling bit.

A further object is to provide means for maintaining suitable pressure within the well at all times to prevent caving of the walls of the well.

A still further object is to provide means for supplying drilling fluid to the well during drilling and to use this fluid in carrying off some of the heat of the bit caused by the drilling.

And another object is to provide mechanism which will require less power in its operation, will insure drilling a straighter hole and which will be less expensive in operation than with well drilling machines as heretofore built.

Further general objects and advantages will become apparent from the description which proceeds.

The invention is designed as an improvement over the machines shown in my co-pending applications Serial No. 378,595, filed July 16, 1929, for self cooling and drilling bit, and Serial No. 500,588, filed December 6, 1930, for apparatus for holding rotary drilling power units in a well against rotation.

Referring to the accompanying drawing which is made a part hereof and on which similar reference characters indicate similar parts,

Figure 1 is a view in elevation of the upper casing elements of a well showing some of my apparatus positioned therein.

Figure 2, a view of the upper drilling apparatus showing the motor for rotating the drilling bit and the elements for holding other elements from rotating.

Figure 3, a view in elevation of the lower portion of the drilling elements showing the drilling bit and associated elements, and

Figure 4, a section on line 4—4 of Figure 2, showing some features of the holding elements.

In the drawing numeral 10 indicates in outline a large outer casing element which is positioned in a well hole which is dug to a considerable depth, in some cases to approximately 150 feet. The hole in which this casing is set may be drilled with the usual equipment for drilling a relatively large hole to this depth. A hole of reduced size is then drilled somewhat deeper and a smaller casing 12 is seated within this reduced hole and rests on a shoulder formed around the wall of the well. Threaded on the casing 12 is a coupling 13 to which is attached a casing 11 which extends to the top of the well. The coupling 13 is bored to receive pipes 14 and 15. The pipe 14 is attached to the discharge side of a slush pump 16 and the pipe 15 discharges into a slush pit, not shown. In the pipe 15, preferably adjacent its outlet is a back pressure valve 17, the purpose of which is to maintain a desired high pressure within the well. Within the lower end of the casing 11 is placed a gate valve 18 which may be operated from the surface of the ground in any suitable way as by a rod, cable or other means 19. When the drilling assembly is in the well and operating the gate valve 18 will of course be open. It is closed after the tools are raised out of the casing 12 and before a high pressure stuffing box 20 closing the upper end of the casing 11 is opened. The purpose of the gate valve is to maintain the high pressure in the well when the stuffing box 20 is opened, for it is necessary to keep the high pressure in the well at all times, both while drilling and when the tools are withdrawn, one purpose of the pressure being to prevent caving of the well.

The drilling tools are suspended from a flexible cable 21, which is attached to an eye 22 in the upper part of the holding means for the tools. This holding means has hinged wings 23 having serrated edged gripping elements 24 connected thereto by a dovetailed connection, this connection permitting the drilling bit to descend into the well hole as the well is deepened. The wings are moved against the sides of the well by pistons 25 attached by connecting rods 26 to the wings, the wings being hinged at 27. The pistons are moved radially outwardly by pressure fluid delivered against their in-

ner ends in chamber 28. Pressure fluid is delivered to this chamber from pipe 29 and flexible hose 30 to which it is supplied by a pump at the surface of the well, not shown. The pipe 29 is secured by T-connections 31 through which pressure fluid is delivered to the chamber 28. The motor 33 is suspended by the holding elements just described. Current is supplied to the motor from electric cables 34 connected to suitable source of current at the surface of the well. A rotor shaft 35 of the motor is journaled in suitable bearings 36 and 37 secured in the motor casing, a thrust bearing 38 being provided near the lower end of the shaft. A suitable bushing 39 is provided around the shaft 35 to prevent leakage of foreign matter into the motor casing. The shaft 35 is connected by means of collar 40 with the stock 41 of the drilling bit which carries drilling cones 42. The stock 41 which supports the drilling instrumentalities is rotatably supported on a swivel connection 67.

A mud circulating pump 43 is operated by the shaft 35 as will now be explained. The pump here shown is a centrifugal pump secured on the shaft 44. The upper end of this shaft carries a gear 45 which meshes with gears 46 carried on shafts 47 mounted in the collar 40. The upper ends of the shafts 47 carry gears 48 which mesh with gears 49 mounted on or made integral with a stationary nipple 50. Rotation of the shaft 35 will rotate the drilling bit and at the same time will rotate the centrifugal pump 43 in the opposite direction at a speed dependent on the relative sizes of the gears 45, 46, 48 and 49.

The drilling unit consists of a number of sections 51, 52, 53, and 54 held together by joints 55. Within one of the sections is provided a cuttings chamber 56. This chamber is closed at its lower end by a removable plug 57 by the removal of which the well cuttings may be taken out from time to time. The cuttings chamber is held by guides 58 and 65 through which there are axial passages to permit circulation of the fluid in the well. Above the cuttings chamber is a classifier 59 having a depending edge for directing cuttings down into the chamber 56. The upper side of the classifier is cone shaped and has a number of inverted screens 60 positioned therein. These screens are made of different sizes, the largest being inside so as to screen out the coarsest cuttings first. These screens screen out all remaining cuttings and cause them to fall into the cuttings chamber. From the cuttings classifier the drilling fluid passes through an opening 61 into the suction of the centrifugal pump by which it is expelled out through openings 62 into the well hole.

In the pipe 29 is placed a back pressure valve 63 the purpose of which is to prevent excessive pressure in pipe 29 and yet make it possible to maintain a desired pressure in the holding elements. The pressure in the pipes 29 and 30 is independent of the pressure in the well itself. The holding elements may therefore be operative when other elements are released. Secured at the lower end of the pipe 29, below the back pressure valve 63 is a pipe 64. This extends down into the well so as to carry the cooling fluid adjacent the drilling parts to cool them and thus avoid the necessity of an auxiliary cooling system.

In operation pressure fluid is supplied through flexible hose 30 and pipe 29 to the chamber 28. This holds the wings in engagement with the walls of the well and holds the supporting parts of the motor so that it can rotate the drill. During operation drilling fluid is supplied by the slush pump 16 through line 14 and thru the coupling 13 into the casing 12. This insures ample drilling fluid in the well at all times as well as maintaining the necessary pressure in the well. Pressure is also supplied to the well from the pipes 29 and 64. Drilling fluid is circulated in the well by the pump 43 and rises to the top of the well. This results in carrying off heat generated by the drilling. When the hole has been dug a small depth, usually about ten feet, the tools are removed, the cuttings are taken from the chamber 56 and the core removed. In removing the tools, the stuffing box 20 remains closed until the tools have been raised above the gate 18. This gate is then closed to hold the pressure in the well while the stuffing box 20 is removed to permit withdrawal of the tools. When the tools are returned to the well the stuffing box 20 is first closed and then the gate 18 is opened.

It should be apparent that by the mechanism described well drilling is much more easily accomplished than when a long and heavy string of tools is used.

In order to insure proper operation the motor casing may be filled with suitable oil and the chamber at 66 may be packed with grease. This grease will also serve the purpose of keeping objectionable foreign matter out of bearings.

It will be obvious to those skilled in the art that various changes may be made in my device without departing from the spirit of the invention and therefore I do not limit myself to what is shown in the drawing and described in the specification, but only as indicated by the appended claims.

Having thus fully described my said invention, what I claim as new and desire to secure by Letters Patent, is:

1. In a well drilling apparatus having a rotary drilling bit and a motor for rotating it, means for holding the motor support from rotating to permit rotation of the bit, means

for supplying and maintaining pressure in the well, said means serving also to operate said motor holding means.

2. In a well drilling apparatus having a rotary drilling bit and a motor for rotating it, means for holding the motor support from rotation during rotation of the said bit, means for supplying pressure fluid to the said well, said pressure fluid being delivered adjacent to said bit to assist in cooling it, a part of said pressure fluid being applied to the said holding means to operate it.

3. In well drilling apparatus having a rotary drilling bit and a motor for rotating it, a support for said motor, means for holding said support from rotating with said bit, said means comprising wings movable to engage the walls of the well, pressure fluid means for operating said wings, said pressure fluid being also delivered into the well to maintain a desired high pressure therein and to assist in cooling the drilling bit.

4. In a well drilling apparatus of the kind described, a drilling bit, a motor for rotating it, a support for said motor, a motor shaft, a drilling fluid circulating pump, said drilling bit and said pump being both operated by said shaft, means for maintaining a supply of drilling fluid in said well and means for supplying additional fluid under pressure to said well to compensate for losses due to leakage, the said additional pressure means serving also to operate the motor supporting means to prevent rotation of the said motor.

In testimony whereof, I affix my signature.

THOMAS G. TAYLOR.