

Oct. 6, 1936.

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2,056,471

WELL DRILLING UNIT

Filed May 2, 1933

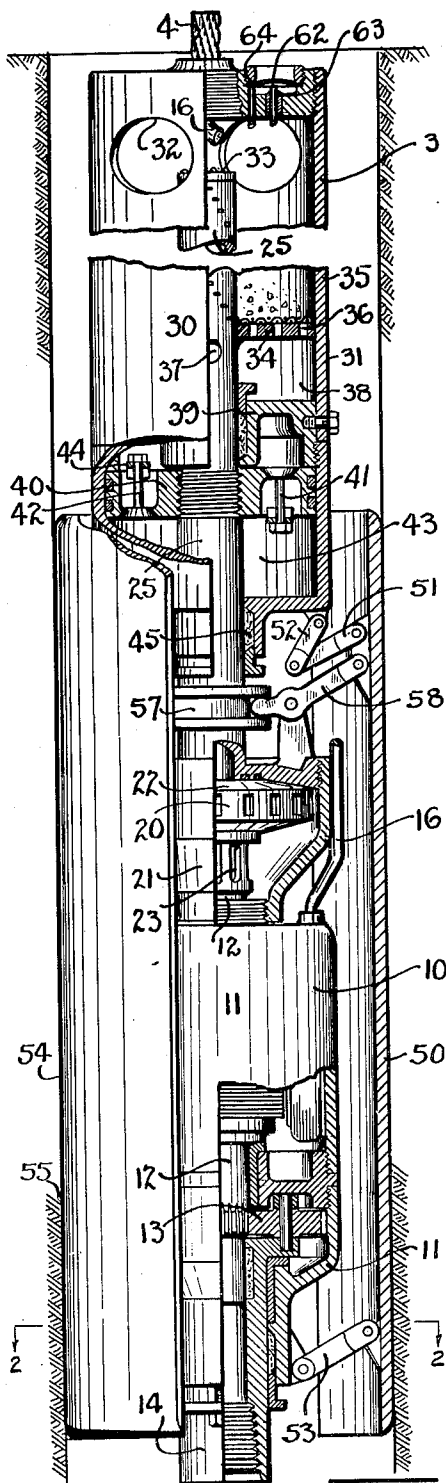


FIG. 1

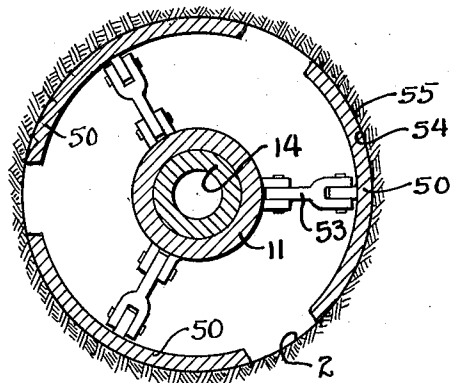


FIG. 2

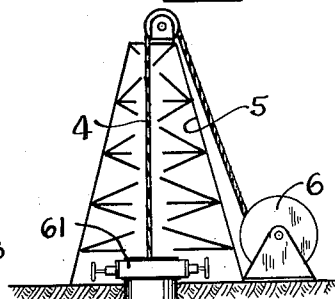


FIG. 3

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2,056,471

WELL DRILLING UNIT

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Application May 2, 1933, Serial No. 668,906

1 Claim. (Cl. 255—4)

The invention relates to an improvement in a well drilling unit and the method of drilling a well with such unit, and comprises a unitary mechanism which may be lowered into the well bore as the drilling proceeds and which is made up of a motor, the drill bit to be driven thereby, a pump to circulate the flushing liquid and a carrier for the silt or cuttings from the bit.

It is one of the objects of the present invention to provide a single unit which may be lowered into the well bore on a cable or suitable equipment to perform the drilling operation and in which the motive power is furnished at a point adjacent the surface being drilled.

Another object of the invention is to provide a composite drilling unit which can be submerged in a column of liquid at least of a height equal to the length of the unit so that flushing liquid can be drawn in at the top of the unit and discharged at the bottom to remove the cuttings from the drill bit.

It is another object of the invention to provide in combination with a complete drilling unit a silt box to trap the cuttings from the bit so that the drilling unit need only be removed from the well when the silt-box has accumulated a full charge of cuttings from the bit.

Another object of my invention is to provide a drilling unit wherein the drill bit and the pump for circulating liquid to the bit are both operated by the same power unit.

Still another object of the invention is to provide a drilling unit to be lowered into the well bore so that a circulation of flushing liquid may be maintained against the force of the bit by a pump which is made up as a part of the drilling unit.

It is one of the objects of the invention to perform the drilling operation by the rotary method of drilling without filling the well bore full of flushing fluid in order to maintain the circulation thereof, but to only provide a sufficient column of flushing liquid in the well to submerge the drilling unit or to provide the desired hydrostatic pressure upon the formation being drilled.

Other and further objects of the invention will be readily apparent when the following description is considered in connection with the accompanying drawing wherein:

Fig. 1 is a central, vertical, sectional view of the drilling unit disposed in the well bore in drilling position and showing certain of the parts in section.

Fig. 2 is a section taken on the line 2—2 of Fig. 1, and showing the relation of the anchor plates to their supporting housing.

Fig. 3 is a diagrammatic view illustrating the manner of using the invention.

In the drilling of wells by the rotary method it is the usual practice to accomplish the rotation of the drill bit in the bottom of the well bore by

means of the drill stem and the rotary table driven from the surface. This, of course, entails an enormous expenditure for equipment and the inconvenience and hazard of constantly rotating the drill stem in order to drill the well. With my invention, I contemplate a composite drilling unit which can be lowered into the well on a cable or otherwise and which will so anchor itself in position that all of the functions necessary to perform the drilling operation will be completed at the bottom of the well. In other words, the complete drill stem and the slush pumps now used on the surface as well as the rotary equipment can be dispensed with. In addition to these enormous simplifications in the equipment, it is also possible to drill the well with but a small head or column of flushing liquid in the well. This is also of material advantage because in many instances the pressure of the column of heavy mud filling the well bore causes such an enormous pressure upon the formation being drilled that productive sands are often mudded off and passed by during the drilling operation. It will also be seen that the guiding action of the shoes restrains the bit to the limit, thus making a straight hole possible.

Fig. 3 illustrates generally the apparatus used in practicing the present invention. The well bore is indicated at 2. Disposed in the well bore is the composite drilling unit indicated at 3. This unit is adapted to be raised and lowered from the well by means of the cable or other suitable support 4 which is shown as passing over the derrick 5 and controlled as to movement by the draw works or reel 6.

The drilling unit 3 is shown as carrying the drill 7 which rotates on the surface 8 which is being cut.

The drilling unit 3 embodies a motor 10 which is disposed within the housing 11. The motor 10 imparts rotation to the shaft 12 which drives the reduction gears 13 mounted in the housing 11. These reduction gears tend to rotate what will be known as the drill shaft 14 in order to rotate the drill 7. It is to be understood that the motor 10 may be of any suitable design, and has connected thereto the conduit or cable 16 which may extend to the surface as a separate unit or be incorporated within the cable 4 as seen at the top of Fig. 1.

It seems obvious that upon rotation of the motor 10, the drill 7 will be caused to rotate. It is, of course, necessary to wash the cuttings and silt away from the surface 8 in order to facilitate the drilling operation. To accomplish this, the circulating pump 20 has been incorporated as a part of the unit and this pump is disposed in the housing 21 which is shown as connected to the housing 11 of the motor. The pump includes the impeller 22 which is of the centrifugal type and discharges the liquid into the housing 21 where

it enters the openings 23 in the shaft 12, which is of hollow construction. It is to be understood that the shaft 12 of the motor extends above the housing 11 in order to have the impeller 22 connected therewith.

The supply of liquid for the pump 20 is received through the perforated inlet pipe 25 which extends upwardly from the housing 21. This pipe extends into the silt box or cutting accumulator 30 and it is from this silt box 30 that the liquid is drawn by the pump 20.

The silt box includes the tubular housing 31 which may be of considerable length as seen in Fig. 3, in order to receive a goodly supply of cuttings from the drill bit. It seems obvious that if the liquid is discharged at the bit 7 that it will be forced to pass upwardly around the housing 11 and up around the silt box 3 until it reaches the openings 32. The suction in the upper end of the pipe 25, as at 33, will, of course, aid in the circulation of the liquid.

Disposed within the cylinder 21 is a diaphragm 34 which serves as a support and a receiver for the silt. This diaphragm may be provided with a suitable screen 35 and has openings 36 therein so that there will be a drainage of the liquid from the accumulating silt. To facilitate this drainage small openings 37 are provided in the stem 25 below the diaphragm so that there will be a suction created within the chamber 38 which is formed by the base plate 39 and the diaphragm.

A piston 40 is shown as fixed on the stem 25 and is provided with an upwardly opening valve 41 and a downwardly opening valve 42. These valves control the flow of a suitable pressure-liquid within the chamber 43 formed in the base of the cylinder 31. These valves are normally held closed by a spring such as 44, and are only caused to open when a predetermined pressure is exerted. It will be noted that the connection of the cylinder 31 with the stem 25 is a sliding connection which is sealed by the stuffing box 45. The springs 44 may be so adjusted that when the drilling unit is suspended by the cable 4 the drill bit, the motor, and the stem 25 will only slightly be permitted to move downward as the drilling proceeds without movement of the silt box 31. In this manner the weight to be disposed upon the drill 7 can be accurately measured by suitable gauges on the ground surface. When it is desired to raise the unit an upward pull on the cable 4 will, of course, cause the piston to move to the base of the cylinder and the weight of the drilling unit can then be lifted. On the other hand, if weight in addition to that of the pump anchor plates and silt barrel is needed, additional weight can be added to top of the silt barrel.

In order that the drilling unit may resist the tendency to rotate when power is applied to the drill, the anchor plates 50 have been provided. These may be grooved to facilitate gripping action. These plates may be arranged in any desired number, three having been shown in the present illustration. These plates are shown as connected to the drilling unit by means of the links such as 51 and 52 adjacent the top and by the links 53 adjacent the base. These links may be attached either to the silt box or to the motor housing and are so arranged that the housing and silt box may be in limit independent in movement with respect to the traction plates or the traction plates may move relative to the motor. It is intended that these traction plates may be of any desired length in order to present a sufficient surface 54 which will engage with the wall

55 of the well bore and create a frictional or gripping resistance to prevent rotation of the drilling unit. It is contemplated that the gravitational force of these anchor plates against the formation wall will be sufficient to prevent rotation of the drilling unit.

In order that all of the plates 50 will be retained at the same elevation a guide ring 57 is slidably mounted on the stem 25 and the guide arms 58 ride in this ring and one such arm is pivoted to each of the anchor plates 50. It seems obvious that these arms all being engaged in the ring 57 will retain the plates at the same elevation.

In operation the drilling unit keeps the well bore straight by the guiding action of the plates while the drilling unit is gradually fed into the bore as the drilling proceeds. The force of gravity will pull the plates 50 downwardly so that they will pivot outwardly and engage the wall of the well. As the motor rotates, the drill will be caused to rotate and flushing liquid will be discharged from the drill. The flushing liquid carrying the cuttings and silt will flow upwardly around the silt box 31 and be drawn into the openings 32 so that there is a complete circulation through the drilling unit. It seems obvious if desired only a sufficient column of liquid need be maintained in the well to submerge the drilling unit. In other words only a slight hydraulic pressure will be caused on the formation being drilled by the column of liquid. The line 60 of Fig. 3 indicates the elevation to which the column of liquid may be maintained. It is contemplated, of course, that the well bore may be completely filled with liquid if desired. Such a practice is sometimes necessary when heavy pressures are encountered during the operation. It is, of course, possible, however, to use only a short column of liquid and close the head of the well by a suitable casing head or blowout preventer, such as 61.

In order to determine whether or not there is a sufficient column of liquid in the well, a contact disc 62 has been provided in the top of the silt box 31. This disc may be pliable, and when a sufficient pressure of liquid is exerted on this disc it will move downwardly to make the contact with the point 63 which is grounded to the disc as indicated at 64. This contact may be indicated to the driller on the surface by any suitable signal.

When there is an insufficient head of drilling fluid, the diaphragm 62 may raise away from the contact 63 and indicate this fact to the driller.

While one form of the invention has been shown, it is understood that it may be varied to suit the conditions encountered. The principal novel feature is the provision of a complete drilling unit to be lowered into the well bore to perform the drilling operation while utilizing only a short column of liquid in the well bore. It is to be understood, of course, that a casing may be inserted into the well bore as it is drilled to prevent caving when the formation so requires.

What is claimed is:

In a well drilling unit a motor, a shaft rotatable thereby, a circulating pump on said shaft, openings through said shaft for the discharge from said pump, a drill bit adapted to receive said discharge as a flushing fluid, and anchor plates pivoted to settle by gravity against the wall of the well bore to resist rotation of said unit.