

Feb. 19, 1924.

E. J. GOULD

1,484,065

AUTOMATIC DEPTH DRILLING MACHINE

Filed March 23, 1921

3 Sheets-Sheet 1

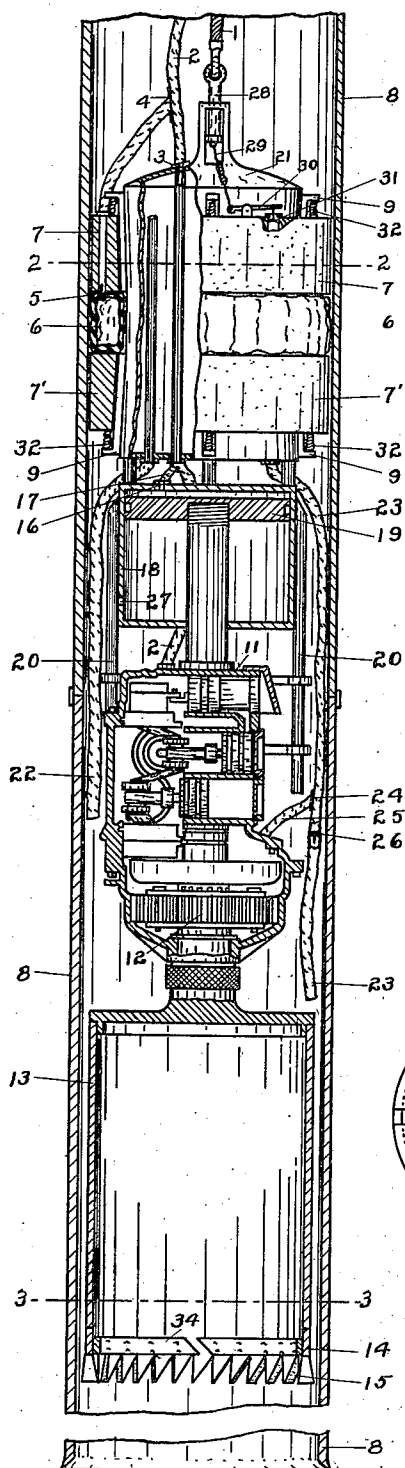


Fig. 1

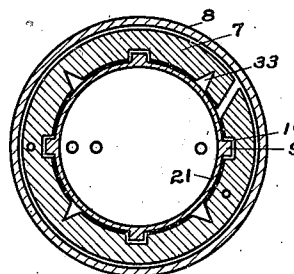


Fig. 2

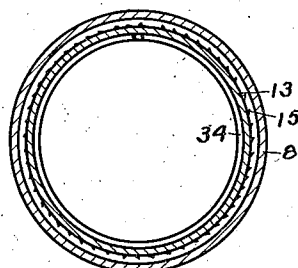


Fig. 3

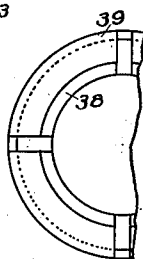


Fig. 5

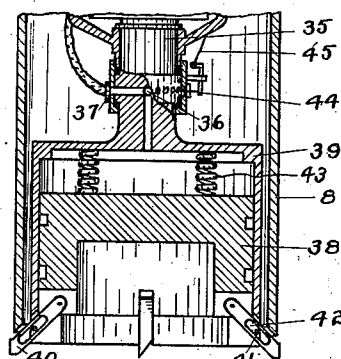


Fig. 4

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3 Sheets-Sheet 2

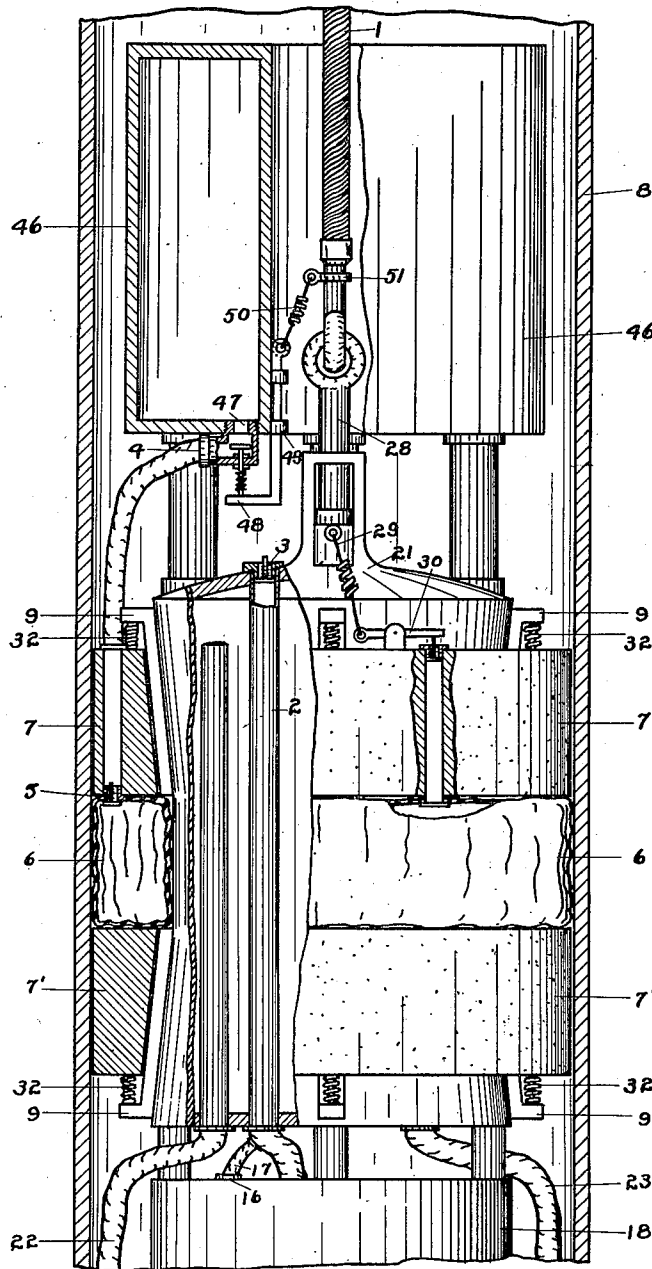


FIG. 6

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3 Sheets-Sheet 3

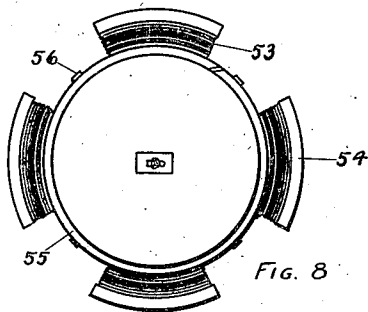


Fig. 8

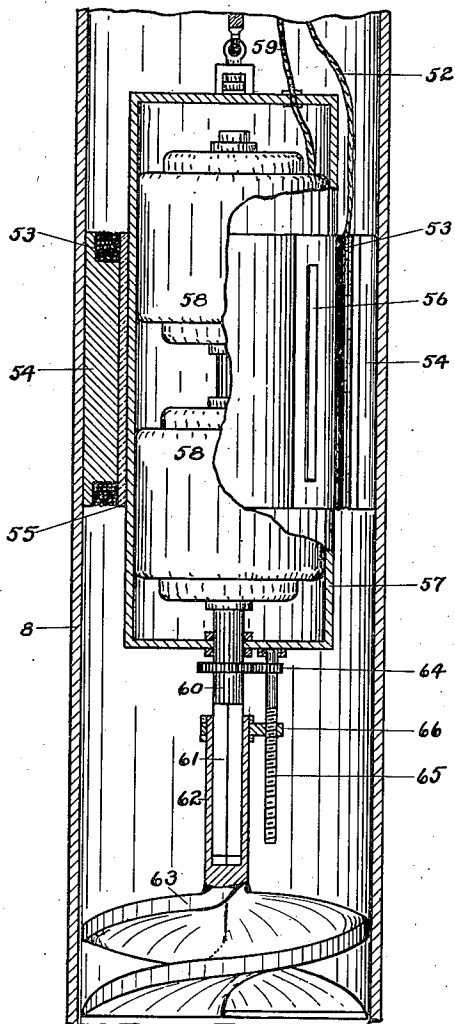


Fig. 7

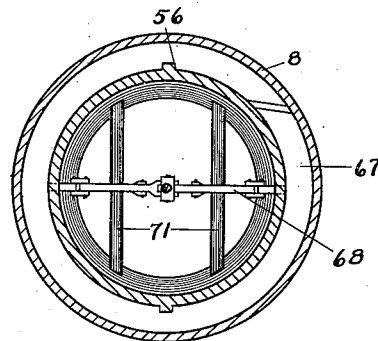


Fig. 10

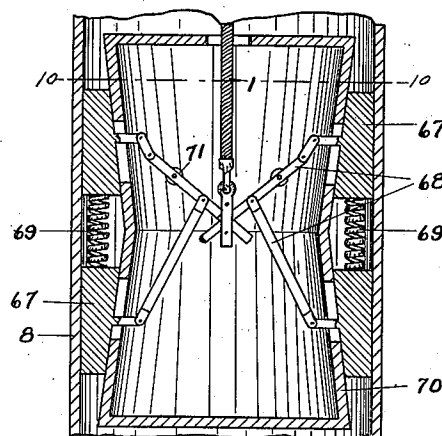


Fig. 9

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Patented Feb. 19, 1924.

1,484,065

UNITED STATES PATENT OFFICE.

EDWIN J. GOULD, OF OAKLAND, CALIFORNIA, ASSIGNOR OF ONE-HALF TO CHARLES T. HENRY, J. BROOKS MILLARD, AND JOSEPH T. HENRY, ALL OF YORK, PENNSYLVANIA.

AUTOMATIC DEPTH-DRILLING MACHINE.

Application filed March 23, 1921. Serial No. 454,806.

To all whom it may concern:

Be it known that I, EDWIN J. GOULD, a citizen of the United States, residing at Oakland, county of Alameda, State of California, have invented certain new and useful Improvements in Automatic Depth-Drilling Machines, whereof the following is a specification.

The objects I have in view are to provide a drill that can operate at a greater depth than any now in use, by eliminating all strain or weight on the cable when the drill is in operation, to combine the driving motor and the drill itself into a compact and complete working unit that can be lowered to any depth, and to provide a simple and effective means of automatically securing the machine at the bottom of the well. Other objects and advantages will be further brought out in the description of the operations.

I attain these objects by the mechanism illustrated in the accompanying drawings, in which Fig. 1 is a view partly in section of an elevation of the entire mechanism shown attached inside of a well casing; Fig. 2 is a plan view in section at the line 2—2; Fig. 3 is a plan section at the line 3—3; Fig. 4 is an elevation in section of the expanding reamer shown inside a well casing; Fig. 5 is a bottom view of the reamer with the reamer cutters removed showing slots in which expanding cutters fit; Fig. 6 is a view in elevation of the water tank, the clutch, and a supplementary air tank for setting the clutch when the mechanism is used without the main air hose; Fig. 7 is a view in elevation showing a modification of the device where an electromagnetic clutch, an electric motor, are used and a rotary auger drill; Fig. 8 is a plan view of the electric clutch; Fig. 9 is a view in elevation of a modification of the clutch actuated by the cable 1 attached to a series of levers; and Fig. 10 is a plan view in section at the line 10—10. Similar numerals refer to similar parts throughout the several views. In operation the entire device having been lowered into the well casing by the cable 1, air is turned on from a compressor through the main air hose 2, the pressure valve 3 by resistance causing the air to go through the by-pass 4 and the check valve 5, inflating the elastic reservoir tube 6, which in ex-

panding presses the clutch rings 7—7' in opposite directions, causing them to tighten against the casing 8, because the tank ribs 9 are set at a slight angle to the casing, being furthest from the casing near the elastic tube 6, and nearer the casing at their outside ends, the tank ribs 9 fit slots 10 in the clutch rings 7—7' and as soon as sufficient air pressure has been exerted to cause the clutch rings to expand and clutch the inside of the casing with the scarified surfaces of the clutch members where they hold the device from turning in the casing when the drill is in operation. The pressure valve 3 is forced open by the added air pressure, after its limit of resistance is reached, and it allows the air to go through the main air hose 2, to the compressed air motor 11; the compressed air motor through a train of reduction gears 12 rotates the core barrel 13, the lower edge of the core barrel 13 has screwed to it a cutting bit or drill 14, which cutting bit or drill 14, may be a diamond drill or chilled shot bit, but the bit is here shown as having hardened steel teeth.

While the drill is being rotated by the compressed air motor 11, the check valve 16 admits air under pressure, coming through the by-pass 17 of the main air hose 2 to the cylinder 18, and the air by exerting pressure on the piston head 19, keeps a steady pressure of the cutting teeth against the bottom of the well sufficient to make them cut, and is sliding the motor and core barrel downwards on the slide rods 20 as the teeth cut their way in. The expanding air reservoir 6, the clutch rings 7—7' and tank ribs 9, surround and are attached to a concave water tank 21 containing water, and having a pipe 22 extending up through the bottom of the tank the upper end of the said pipe is near the surface of the water in the tank, and its lower, or discharge end, just above the core barrel. This allows the water discharged through the pipe 22 to run between the casing and the core barrel, and causes the sediment ground out by the drill teeth, to mix into a soft sludge.

The second pipe 23 returns fluid to the water tank, because by-pass 24 is let into the pipe 23 from the motor exhaust pipe 25; a portion of the exhaust impulses carries fluid upward through the check valve 26 into the tank 21. It will be understood in

this connection that a small amount of water can be poured into the well before the drill is let down, sufficient in amount to cover the lower end of the pipe 23, which pipe as soon as the air motor is started, raises the water level in the tank 21 by the exhaust impulses through by-pass 24 until the water level in the tank 21 is raised above the upper end of the pipe 22. The water then runs through the pipe 22 and keeps up a continuous circulation.

The solid matter then tends to settle to the bottom of the tank 21 and the water flows again through outlet pipe 22, keeping up a constant circulation to carry away and raise the sludge, from the cutting teeth of the drill. When the drill and motor have cut themselves down the full length of the slide rods 20, the piston head 19, then comes below a hole 27, in the cylinder wall 18, automatically releasing the air pressure on the piston 19. The cable 1 is then slowly tightened, the slip swivel 28 pulls up the length of its slip link, before the cable begins to raise the entire device, and the spring wire 29, attached to the lever 30, opens the valve 31, which releases the air pressure in the elastic clutch reservoir 6, after which the clutches release their grip on the casing. Then the tank 21, the slide rods 20, and the piston head 19 slide down and resume the position assumed at starting, the teeth of the drill resting on the bottom of the well ready to begin operations again and drill to the length of the slide rods. This operation is repeated until a solid core fills the entire length of the core barrel. When the air is released by pulling up the cable to the length of the slip joint in the slide swivel 28, the springs 32 automatically move the clutch rings 7-7' toward the center of the tank 21, releasing the clutch grip on the casing 8, the slits 33 in the clutch rings allowing the rings to contract easily. The air having been shut off, the whole device is hoisted from the well by the cable 1. The self expanding (core holding ring) 34, holding the core in the core barrel. The core barrel is then detached and emptied, the tank also is emptied of the sludge and refilled with water, the expanding reamer bit Fig. 4 is then attached to the motor in place of the drill and core barrel. The hollow stem 35 of the reamer having a line of holes 36 drilled through its shell, the air being turned on through the main hose 2 passes under pressure through an extension of the by-pass 17, the end of the by-pass hose 17 being attached to a ball bearing packed collar 37 which does not rotate. The air passing through the line of holes 36 into the cylinder 39 brings air pressure to bear on the reamer 38, when the reamer cutters 40 reach the bottom of the casing 8, the air

pressure on the reamer head 38 causes the reamer cutters 40 to slide on the pins 41 working in slots 42 in the reamer cutters. The upper ends of the reamer cutters being attached to the reamer head 38, causes the ends of the cutters 40 to extend beyond the circumference of the casing 8, and when the reamer is rotated the cutters, ream out a hole of greater diameter than the casing, and the casing is lowered with the reamer and cuts out the sides of the well until the casing and reamer reach the bottom together, the bottom edge of the casing being beveled off as shown in the detached cut at the bottom of Fig. 1. As soon as the air pressure is released through the valve 44 by a pull on the spring wire 45, the springs 43 lift up the reamer head 38, and cause the reamer cutters to close in as the reamer and motor are hoisted from the well by the cable 2. The well is then bailed out in the manner well known and used in standard drilling, and known as bailing or "running the sand pump." The drill and core barrel are again attached to the motor and the foregoing procedure repeated.

When the mechanism is operated without the air hose 2 the high pressure air tank 46 is attached to the top of the water tank 21, the valve 47 being held shut by the arm 48, the shank of the arm 48 sliding in clips 49, and being attached to the cable 2 by a spring wire 50, fastened to the cable 2 by a clip 51. As soon as the drill rests on the bottom of the well the valve is released and air under pressure operates the expanding clutches 7-7' as previously described. When the cable 2 is tightened the air is released from the expanding air reservoir, by the valve 30, and when the whole mechanism is lowered, the clutches are again pressed against the casing 8 by air pressure from the air tank 46. The compressed air to run the drill, after the clutch is set, enters the air motor through the pipe 2, by the valve 3, the same as though the main air hose 2 was used, in this instance the well casing 8 acting as the air hose. Fig. 7 shows a modification of the device in which an electric motor, and an electric clutch, are used in place of the air motor, and air clutch shown in Fig. 1. It will be seen that when the electric current is turned on through the conducting wire 52 the current passes through the coil 53, and causes the electro-magnetic clutch 54, to adhere to the casing 8, causing the split ring 55 to expand slightly. The expansion ring 55 has slots fitting over lugs 56 projecting from the motor casing 57, holding the motors 58-58 from turning in the well when the drill is in operation, the motor casing 57 being perfectly water tight to protect and insulate the motor by keeping the motor from contact with any water in the well. As soon as the clutch is set the

current is turned on through the conducting wire 59 the motors rotate the stem 60 said stem having a squared extension 61 having a sliding fit in the sleeve 62 of the rotary auger drill 63. Attached to the motor stem 60 are reduction gears 64, turning a threaded shaft 65 which engages a threaded collar 66 attached to the drill sleeve 62 causing a steady pressure to be exerted on the drill forcing it downward as the drill rotates. When the drill has cut down to the limit of the sleeve and threaded shaft, the clutch is released, and the whole mechanism hoisted from the well, which is then bailed out and the operation repeated. Fig. 10 shows an automatic lever clutch which operates as follows:

When this clutch is attached to the device the weight of the device keeps the clutch 67 from pressing against the well casing by action of the series of levers 68 to which the hoisting cable 1 is attached. As soon as the drill reaches the bottom of the well the cable being relieved of the weight, by compression springs 69 force the clutches 67 apart sliding them outward against the surface of the concave shell 70, causing the clutches to grip the well casing 8. When the device is hoisted from the well the pull of the cable 1 compresses the springs 69 by the action of the series of levers 68 releasing the clutch 67. Fig. 10 shows the expanding clutch ring 67 the lugs 56, holding the concave shell 70 from rotating in the clutch rings one set of the levers 68, and the rods 71, that hold the levers, and act as a fulcrum.

It will be seen by the description of operation that this device is especially adapted for deep drilling, for it is obvious that once in position and firmly set in the casing by the clutch, that it will operate as effectively at great depth as it will near the surface, because the driving motor travels downward as a unit with the drill, and it is also plain that the hoisting and lowering of this machine can be accomplished in a rapid manner by reeling up the cable and air hose, and allowing them to unreel, thus giving a much greater average in speed when any considerable depth is reached than the methods now employed. With the usual methods progress is very rapid near the surface, but the decrease in speed is in geometrical ratio to the depth attained; first, because the transmission of power from the power plant on the surface is increasingly imperfect as the medium of transmission lengthens; and second, because of the time consumed in hoisting and lowering the drill, and this is especially true where pipe driven rotary drills are used, and no great depth can be reached because the time consumed in hoisting and lowering the drill is much more than the actual drilling time.

The limit of the standard drilling outfit is reached when the stretch in the rope or cable near the surface, which holds the combined weight of the tools and cable, is so great, due to the necessary weight of the string of tools and cable, that the cable will no longer work the tools effectively, and this type also has many troubles from crooked holes, as a crevice, or soft spot at one side of the hole, will deflect and cause the drill to sometimes run one way and then the other, and the cable then saws in running on the turns or corners of the crooked hole, and makes further drilling impossible, unless the hole is straightened, which consumes much time. This very serious drawback is entirely eliminated by my device as while drilling it is held precisely and accurately in line with the casing. I have especially pointed out the difficulties in the ordinary methods of deep drilling and the novelty of construction I have used in my device to overcome them, and while the drilling machine has been thus far described as working inside of the casing, it can be used in the manner shown without any casing whatever, whenever the formation is solid enough to hold up the walls of a drilled well, and to afford a grip for the expanding clutch, and these conditions are most apt to be found in the deeper drilling, as the increased natural pressure tends to cause the harder formations. It is apparent that after certain extreme drilling depths are reached, the casing would not support its own weight by its tensile strength and would then part near the upper end where the accumulated strain would be on it, it being supported at the top, and its own weight being always considerable due to the fact that the casing must be heavy enough to stand side pressure. As my device needs to have no undue weight, the only increase in weight is from the increase in cable and air hose lengths, and as the cable holds the machine's weight only it can be of a moderate size at the drilling machine, and when unsafe stresses come upon it from the accumulation of cable weight, a heavier cable can be spliced on to it at the upper end of the first cable, which process can be repeated to the limit of the size of the drilled hole. This method could not well be used with the air hose and as the air hose has only to support its own weight at any time it can be fastened to the cable at intervals of its length, in case of sufficient depth being reached to endanger its being able to support its own weight. The air motor exhausts into lower part of casing 8.

It being desirable to run the drill at comparatively high speed in some formations, and high speed requiring more power, it will always be possible to add more electric motor units or increase the number of cylinders used in the air motor, by increasing the

length of the device. I do not intend to restrict myself to any particular construction of parts, as herein disclosed, but reserve the right to make such changes, variations, and modifications, as come properly within the scope of the protection prayed.

Having thus described my invention, what I claim as new is:—

1. In an apparatus of the character described, means for rotating a boring member, a pneumatic clutch member slidably and nonrotatably attached to the said means operating the said drilling member, and means for feeding said boring member.

2. In an apparatus of the character described, pneumatic driving means, a boring member removably attached to said driving means, a pneumatic clutch adapted to engage the well casing, and pneumatic means for feeding the said boring member a predetermined distance.

3. In an apparatus of the character described, a compressed air motor slidably and nonrotatably attached to a pneumatic clutch, a boring member removably attached to said motor, a cylinder attached to said clutch and a piston therein attached to the said motor for the purpose of producing a predetermined axial movement of the motor and boring means in relation to the said cylinder and clutch.

4. In an apparatus of the character described, a compressed air motor, a removable boring member, a clutch slidably and nonrotatably attached to said motor, inflatable means in said clutch to cause axial movement of the clutch members for engagement with the well casing, a fluid container arranged within the said clutch, means for keeping the contents of said container in circulation between said boring means and said container, and pneumatic means for feeding the boring member a predetermined axial distance from the said clutch.

5. The combination in an automatic depth drilling machine of a rotating motor, an automatic expanding clutch holding said motor, a rotating cutting bit operated by said motor, a means for automatically feeding said bit downward from said motor, and a means for automatically releasing said expanding clutch, all adapted to be operated inside of a drilled well at depth substantially as claimed, and set forth.

In testimony that I claim the foregoing, I have hereunto set my hand in the presence of two witnesses, this 17th day of March, 1921.

EDWIN J. GOULD.

Witnesses:

E. A. WINSTON,
EDMUND BOW.