Dec. 23, 1930. C. C. SCHARPENBERG 1,786,173

DRILLING APPARATUS

Filed April 17, 1926 4 Sheets-Sheet 1

Fig. 1

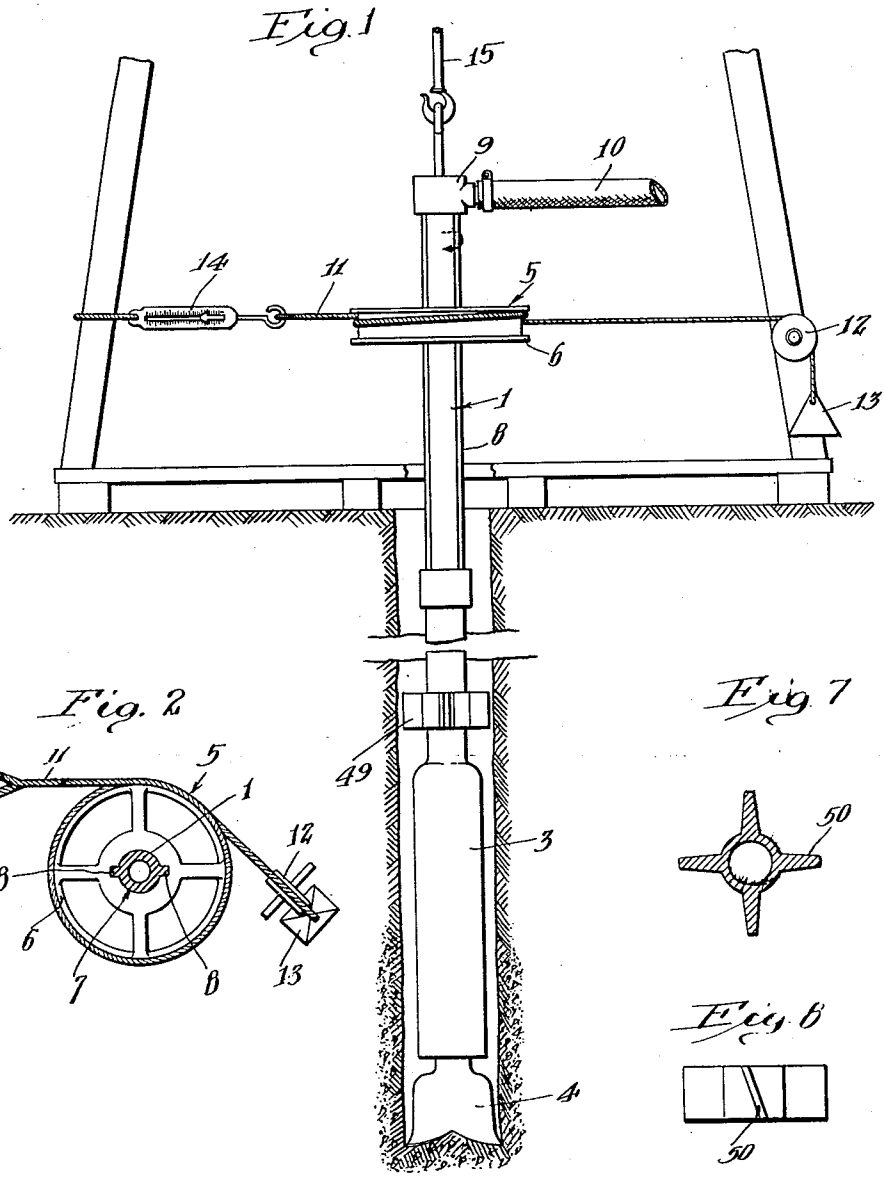


Fig. 2

Fig. 7

Fig. 6

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DRILLING APPARATUS

Filed April 17, 1926 4 Sheets-Sheet 2

Fig. 3

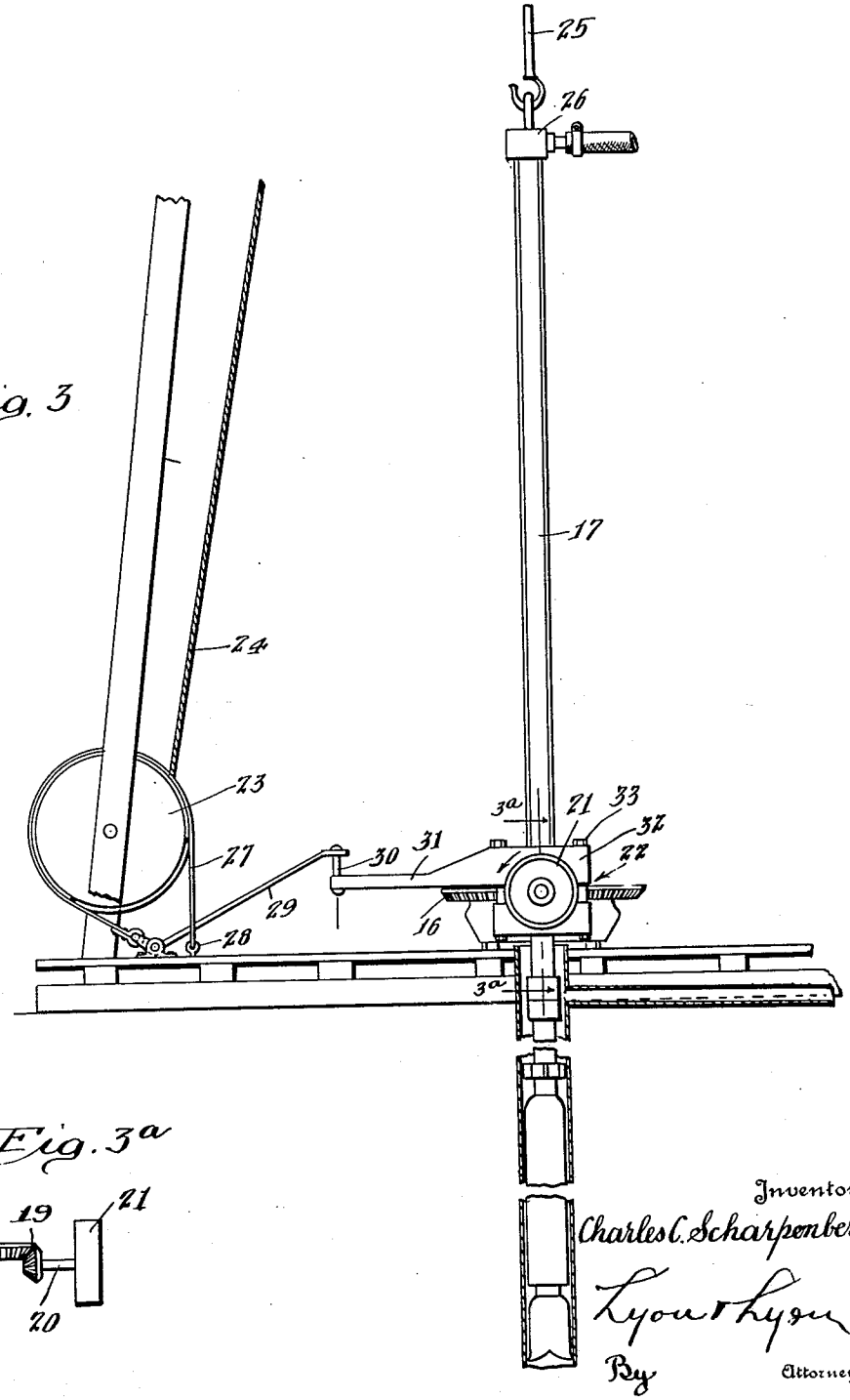


Fig. 3a

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DRILLING APPARATUS

Filed April 17, 1926 4 Sheets-Sheet 3

Fig. 4

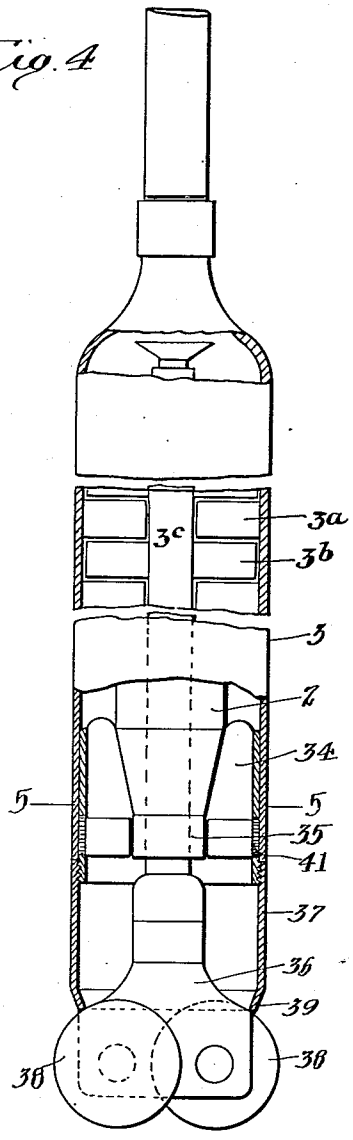


Fig. 9

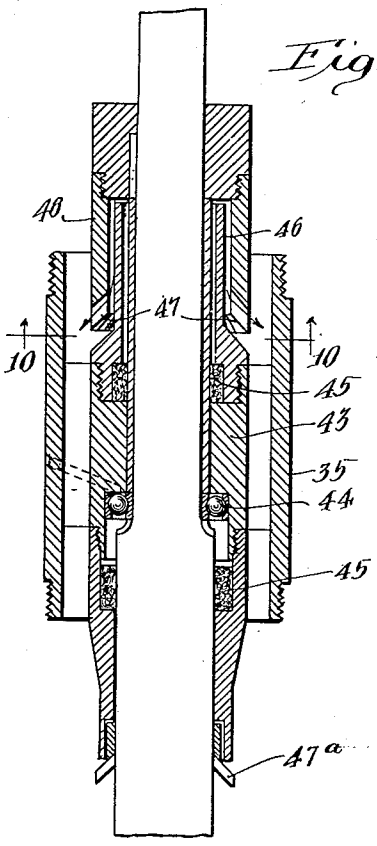


Fig. 10

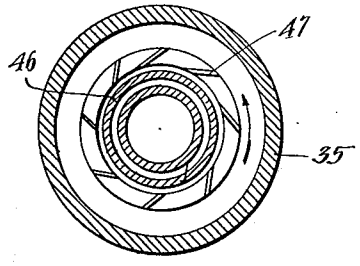


Fig. 5

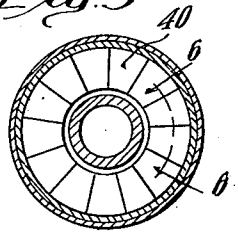
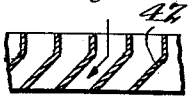


Fig. 6



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DRILLING APPARATUS

Filed April 17, 1926 4 Sheets-Sheet 4

Fig. 11

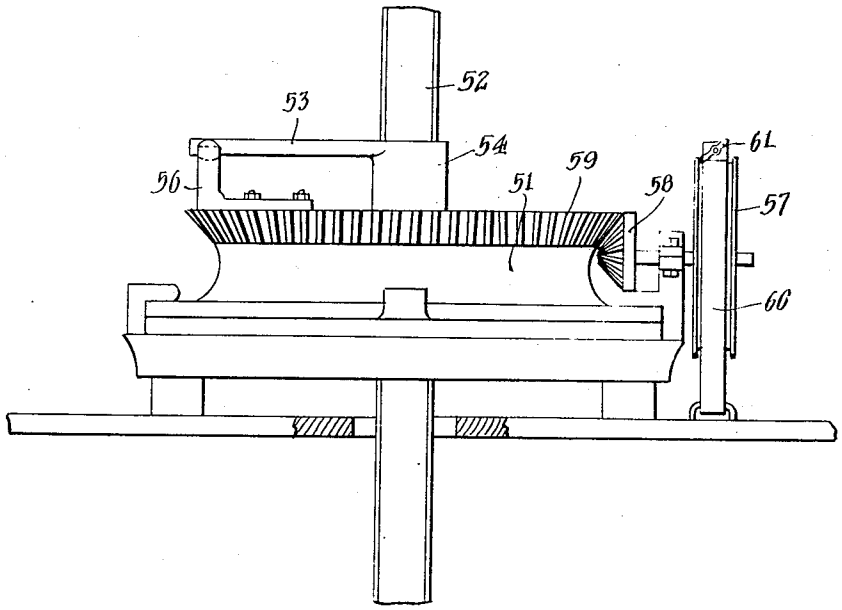
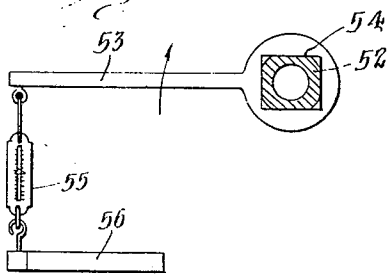


Fig. 12



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UNITED STATES PATENT OFFICE

CHARLES C. SCHARPENBERG, OF BAKERSFIELD, CALIFORNIA, ASSIGNOR, BY MESNE ASSIGNMENTS, TO STANDARD OIL COMPANY OF CALIFORNIA, OF SAN FRANCISCO, CALIFORNIA, A CORPORATION OF DELAWARE

DRILLING APPARATUS

Application filed April 17, 1926. Serial No. 102,623.

This invention relates to drilling apparatus of that type in which the drill is driven by a motor, the reaction of which tends to rotate the drill stem, and while the invention is applicable where any motive force is used, it is particularly applicable to the type of apparatus disclosed in my Patent No. 1,482,702, granted February 5, 1924. This type of drilling apparatus includes a motor at the lower end of the drill stem for driving the drill bit. In the patent referred to, I disclosed means for indicating the reactive torque of the motor at the mouth of the well and suggested the use of this indicated torque as a guide to the driller in feeding the drill bit downwardly.

The general object of the present invention is to provide drilling apparatus in which the drill stem may be held against rotation or permitted to rotate at any desired speed while the bit is operating, thereby controlling the action of the drill-bit, also to provide means for indicating the reactive torque of the motor which can be used as a guide to the driller in feeding the bit while drilling. In the preferred embodiment of the invention, I provide a variable feeding mechanism and control the same automatically through the reactive torque of the rotating drill stem. In drilling operations with this type of apparatus, it should be understood that as the motor is driven, it drives the bit in a forward direction, tending to rotate the drill stem slowly in a reverse direction, and the higher the resistance to the rotation of the bit, the slower the bit will move and the greater the tendency will be for the drill stem to revolve. For this reason, the rotation of the drill stem becomes an indicator of the resistance being offered to the advance of the bit. According to my invention, I provide automatic means for slowing up the feeding when the bit rotates slower and accelerating the feeding when the bit is rotating at a relatively high speed.

Further objects of the invention will appear hereinafter.

The invention consists in the novel parts and combinations of parts to be described hereinafter, all of which contribute to produce an efficient drilling apparatus.

A preferred embodiment of the invention is described in the following specification, while the broad scope of the invention is pointed out in the appended claims.

In the drawings:

Figure 1 is a diagrammatic view showing the derrick floor and the well as viewed in section, a portion of the drill stem being broken away. This view shows a simple embodiment of the apparatus in which the reactive torque is indicated but in which the feed of the bit is controlled by the driller.

Figure 2 is a diagrammatic plan view indicating the use of the torque indicating apparatus.

Figure 3 is a view somewhat similar to Figure 1 but showing the preferred embodiment of the apparatus in which the feeding mechanism or apparatus is automatically controlled by the reactive torque of the motor.

Figure 3*a* is a section taken on line 3*a*—3*a* of Figure 3 and further illustrating details of this apparatus.

Figure 4 is a side elevation in partial section showing the lower end of the drill stem and drill bit, certain parts being broken away, and particularly illustrating the means which I employ for using the discharge water from the motor to keep the drill bit clear of débris.

Figure 5 is a horizontal section taken about on the line 5—5 of Figure 4.

Figure 6 is a vertical section taken about on the line 6—6 of Figure 5, further illustrating details of this apparatus.

Figure 7 is a cross section through a type of rotary device which I may employ for clearing the hole in withdrawing the bit.

Figure 8 is a side elevation of the device shown in Figure 7.

Figure 9 is a vertical section taken through a bearing of the motor.

Figure 10 is a cross section taken just above the bearing and about on line 10—10 of Fig. 9.

Figure 11 is a side elevation in partial section showing another embodiment of the invention in which the torque-indicating device is separated from the brake device.

Figure 12 is a plan further illustrating the

torque-indicating device and its attachment to the rotary table.

In practicing my invention, I provide a drill stem which supports a drill bit and I also provide a motor which drives the bit in a forward direction; through the reaction of the motor, the drill stem tends to rotate in a reverse direction. At the mouth of the well, I provide means for yieldingly resisting the rotation of the drill stem and use this reaction as a means of gauging or controlling the speed of feeding the drill to the bottom of the hole.

In the simple type of the apparatus disclosed in Fig. 1, 1 represents the drill stem which carries a motor having a rotor 2 at its lower end (see Figure 4), the same being carried in a motor casing 3. The motor casing has blades 3^a which project radially inward between blades 3^b carried on a shank 3^c that extends up from the drill. In other words, the construction is a simple turbine. As the water flows down between the blades 3^a and 3^b it rotates the motor casing 3 in one direction and the drill shank 3^c and the drill in the other direction. The motor drives a drill bit 4 at the bottom of the hole and the reaction of the motor drives the drill stem 1 in a reverse direction. In order to measure the reactive torque of the motor, I provide means at the mouth of the hole for yieldingly resisting the rotation, and at the same time, I provide means for measuring the force developed by the rotation of the drill stem.

This is preferably accomplished by using a brake apparatus 5 which may include a brake wheel 6 having an opening 7 through which the drill stem 1 may slide freely; in other words, the wheel permits the stem to slide freely downwardly but is non-rotatable with respect to the stem. For this purpose, I prefer to employ a tubular stem and provide the same with two diametrically opposite longitudinal fins or flanges 8 (see Figure 2). The upper end of the stem is provided with a swiveled circulating head 9 to which a hose 10 is attached from the hydraulic line.

On the brake wheel 6, I provide a brake with means for indicating the pull or torque of the wheel on the brake. In the present instance, the brake is in the form of a band which is a rope 11 disposed in a coil around the wheel, one end of the rope passing over a guide pulley 12 and supporting a cage 13 to which weights may be applied as may be desired to control the tension of the rope or band around the wheel. The other end of the rope 11 may be attached to an ordinary weighing scale 14. In this connection, it should be understood that the direction of rotation is that indicated by the arrow in Figure 1, the result of which is that the cable or rope exerts a pull on the scale 14. In this way, the scale operates to indicate the reactive torque of the motor and indicates relatively the speed at which the motor is rotating; this torque, of course, is the inverse of the speed of the bit and when the scale indicates the greatest torque in the drill stem, the bit will be performing its slowest speed of rotation.

The drill stem and the circulating head 9 are supported by a hook 15 from a suspending cable which is within the control of the driller. In feeding the drill stem down, he would be guided by the indications of the scale 14, and when the wheel 6 is showing its highest torque, he should reduce the speed of feeding the drill stem downwardly.

In Figure 3, I illustrate an embodiment of the invention in which the reactive torque of the motor can be used to control directly the operation of the feeding mechanism. In this embodiment of the invention, instead of employing a brake wheel 6, I provide a gear wheel 16 which has a sliding connection at its center with the drill stem 17, so that as the stem rotates, the wheel will rotate. This gear wheel has beveled teeth 18 which enables it to rotate a pinion 19, the shaft 20 of which carries a brake wheel 21. On this brake wheel, there is mounted a Prony brake 22.

Any suitable feeding mechanism may be provided which is controlled by the Prony brake. In the present instance, I have illustrated a feed drum 23 carrying a coil of cable 24 which extends up to the crown of the derrick and passes over a crown pulley (not illustrated), the fall 25 of the cable operating to support a circulating head 26 attached to the upper end of the drill stem. The drum 23 is provided with a brake or a brake band 27 and the application of this brake to the drum is controlled by the Prony brake. For this purpose, the dead end of the brake band 27 is anchored at 28, and the live end is attached to the short arm of a lever 29 which is connected by a link or loose pin 30 with an arm 31 which extends out from one of the brake blocks 32 of the Prony brake. By means of bolts 33, the pressure of these blocks on the wheel 21 may be regulated as desired.

With this feed mechanism, it is evident that if the resistance to the rotation of the bit decreases, the drill stem 17 will rotate slower; this will ease up the pressure of the brake-band 27 and will pay out the feed line 24 faster, thereby increasing the speed of feeding the drill stem down by the descent of the hook at 25. If desired, the bolts 33 can be tightened sufficiently to prevent rotation of the drill stem altogether, or they may be set to hold the drill stem unless a relatively high torque is developed.

The discharge water from the motor comes down the annular space 34 and passes the bearing housing 35. At any suitable point, I provide the casing 3 of the motor with means for producing a swirling movement in the discharge water so as to give it a good scour-

ing effect while throwing it into contact with the drill bit 36. This feature of the invention is particularly useful where the drill bit is of the disk cutter type illustrated. The casing 3 of the motor is preferably provided with a cylindrical hood or extension 37 which extends down very close to the upper edges of the disks 38 of the bit, and the lower edge of the hood may have an inturned flange 39 to assist in directing the water down and across the face of the disks. The lower edge of this flange 39 may have a contour which enables it to fit fairly closely to the outline of the drill shank and cutters. The space around the bearing housing 35 may be utilized to receive the means which produces a swirl in this discharge water. For this purpose, I may provide a plurality of substantially radial inclined blades 40 which project in from a ring 41 carried by the inner side of the casing 3 (see Figs. 4 and 5). The blades 40 or at least their lower portions 42 should be inclined so as to give the discharge water a swirling motion, (as indicated by the arrow in Fig. 6), in the direction the bit turns.

In Figure 10, I illustrate one of the bearings for the motor. This bearing includes a housing such as the housing 35 already referred to, within which the box or bearing proper 43 is provided. If desired, a ball bearing 44 may be employed. At each end of the bearing and in the present instance on each side of the ball bearing, I provide a stuffing box with packing 45. According to my invention, I provide a centrifugal ejecting device associated with the bearing which operates to exclude the water and sand. In order to accomplish this, I prefer to provide a circuitous duct, such as the duct 46, through which the water and sand would have to pass before it reaches the packing and at the mouth of this duct I provide a centrifugal device which may involve the use of a plurality of centrifugal blades 47 (see Figure 10). These blades may be carried on the lower edge of a sleeve 48 and as the sleeve revolves, the blades tend to produce an outward flow of water in the duct, as indicated by the arrows in Figure 9. A similar centrifugal device 47^a is provided at the lower end of the bearing.

In order to facilitate the withdrawal of the stem in case of a cave-in of the material above the motor, I provide a device such as a cutter or rotary sweep 49, which is located just above the motor casing 3 and this device has a suitable construction to enable it to clear the hole when it is rotated. In the present instance it has a plurality of substantially radial blades 50, which may be inclined as indicated in Figure 8. This sweep should have sufficient diameter to clear the hole for the passing of the motor casing.

One of the advantages arising from rotating the drill stem is that it tends to keep the hole straight as the drilling progresses.

If desired, my apparatus can be constructed in such a way that the torque-indicating device is separated from the brake. I illustrate such apparatus in Figs. 11 and 12. In these figures 51 represents a turn-table through which the drill stem 52 passes loosely. This drill stem, in rotating, rotates an arm 53 which has an angular opening 54 receiving the stem with a loose fit to permit the stem passing up or down; the outer end of this arm 53 is connected through a tension gauge 55 with a bracket 56 attached to the upper face of the rotary table. A brake is then applied to the rotary table. If desired, this brake may press directly upon the table but I prefer to apply the brake to a brake drum 57 mounted at one side of the table and driven by a bevel pinion 58 which meshes with a bevel gear 59 carried by the table. The brake drum is provided with a suitable brake band 60, the ends of which may be pulled together by means of an adjusting screw 61. With this construction it will be evident that, if desired, the adjusting screw 61 can be adjusted so that the rotary table 51 can be prevented from rotation or, if desired, the adjusting screw can be so adjusted that the table will commence to rotate at a predetermined tension exerted through the gauge device.

It is understood that the embodiment of the invention described herein is only one of the many embodiments this invention may take, and I do not wish to be limited in the practice of the invention, nor in the claims, to the particular embodiment set forth.

What I claim is:

1. In hydraulic drilling apparatus, the combination of a drill stem carrying a drill bit, a motor operating to rotate said bit in one direction and rotate the drill stem in the other direction, and variable means for yieldingly resisting the rotation of the drill stem to regulate the rotation of the drill bit.

2. In hydraulic drilling apparatus, the combination of a drill stem supporting a drill bit at its lower end and having a brake device at its upper end, a motor associated with the drill stem operating to drive the bit in a forward direction and the drill stem in a reverse direction, said brake device including variable means for yieldingly resisting the rotation of the drill stem to regulate the rotation of the drill bit.

3. In hydraulic drilling apparatus, the combination of a drill stem, a wheel carried by the drill stem, a motor supported by the drill stem, a drill bit driven by the motor, said motor operating to rotate the drill in one direction, and drill stem in the other direction, a brake on the brake wheel, and an adjustable tension device connected with the

brake for regulating the resistance exerted by the brake on the wheel.

4. In hydraulic drilling apparatus, the combination of a drill stem carrying a drill bit, a motor for driving the bit in a forward direction and operating to rotate the drill stem by the reactive force of the motor, a movable member for yieldingly resisting the rotation of the drill stem, and feeding mechanism for the drill controlled by the last named member.

5. In hydraulic drilling apparatus, the combination of a drill stem carrying a bit, a motor for driving the bit in a forward direction and operating to rotate the drill stem by the reactive force of the motor, a brake wheel driven by the drill stem, a brake on the brake wheel, and feeding mechanism for the drill stem controlled by the movements of the brake.

6. In hydraulic drilling apparatus, the combination of a drill stem, a brake drum and cable for supporting the same, a brake band on the drum, a drill bit carried by the drill stem, a motor for driving the same and operating to rotate the drill stem by the reactive force of the motor, and means for yieldingly resisting the rotation of the drill stem connected with the brake band to control the same and permit the drill stem to be fed automatically as the resistance to the rotation of the bit in the hole decreases.

7. In hydraulic drilling apparatus, the combination of a drill stem, a brake drum and cable for supporting the same, a brake band on the drum, a drill bit carried by the drill stem, a motor for driving the same and operating to rotate the drill stem by the reactive force of the motor, and means for yieldingly resisting the rotation of the drill stem connected with the brake band, operating to control the same and tighten the brake band as the resistance to the rotation of the bit in the hole increases.

8. In drilling apparatus, the combination of a drill stem of tubular form with longitudinal flanges, a wheel loose on the stem and rotatable by the stem, a drill bit, a motor for rotating the bit in a forward direction and operating to rotate the drill stem in a reverse direction, and means for normally yieldingly resisting without arresting the rotation of the drill stem.

9. In drilling apparatus, the combination of a drill-stem, a drill-bit, a motor carried by the drill-stem for driving the bit so that the reaction of the motor rotates the drill-stem in a reverse direction, and means connected with the drill stem normally functioning in the normal operation of the apparatus to prevent and to permit continuous rotation of the drill stem.

10. In hydraulic drilling apparatus, the combination of a drill bit, a motor having a casing for driving the bit in a forward direction and operating to rotate said casing in a reverse direction, and variable means for yieldingly resisting the rotation of the motor casing to regulate the rotation of the drill bit.

Signed at Bakersfield, Calif., this 26th day of March, 1926.

CHARLES C. SCHARPENBERG.