

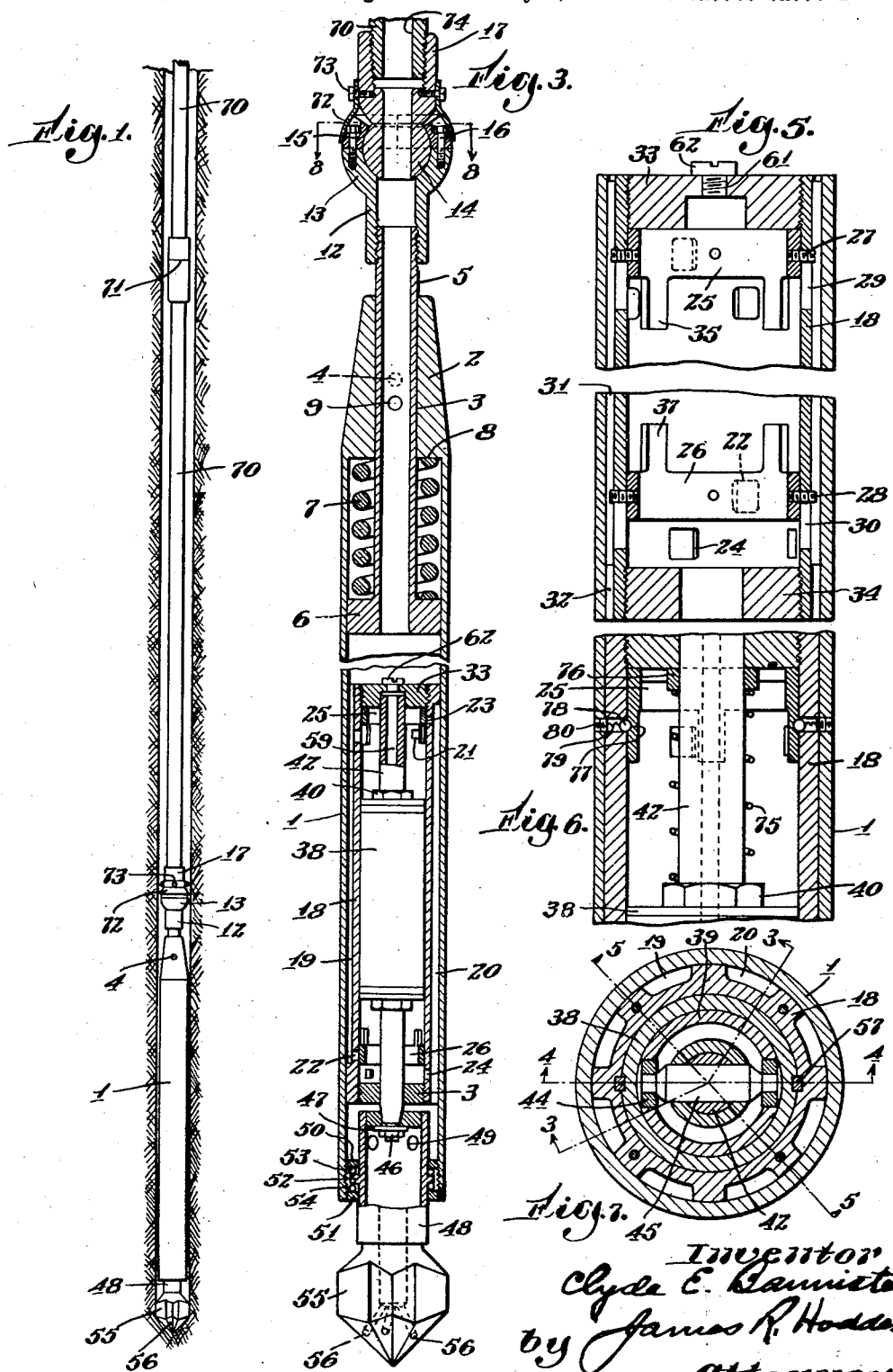
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C. E. BANNISTER

2,002,385

DRILLING APPARATUS

Original Filed May 1, 1931 2 Sheets-Sheet 1



Inventor
Clyde E. Bannister
by James R. Hodder
Attorney

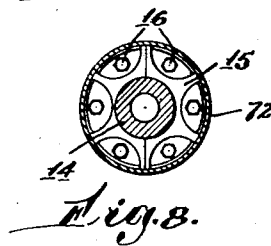
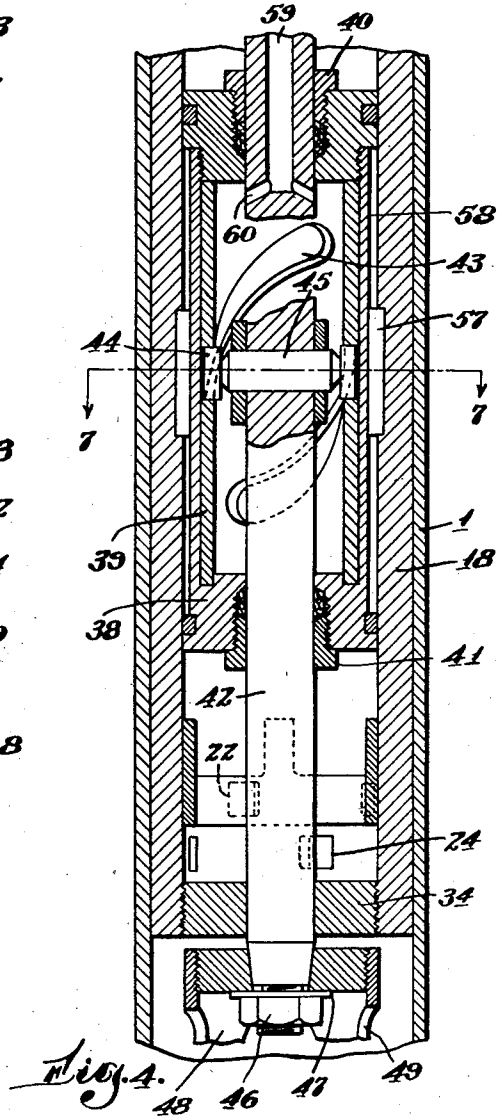
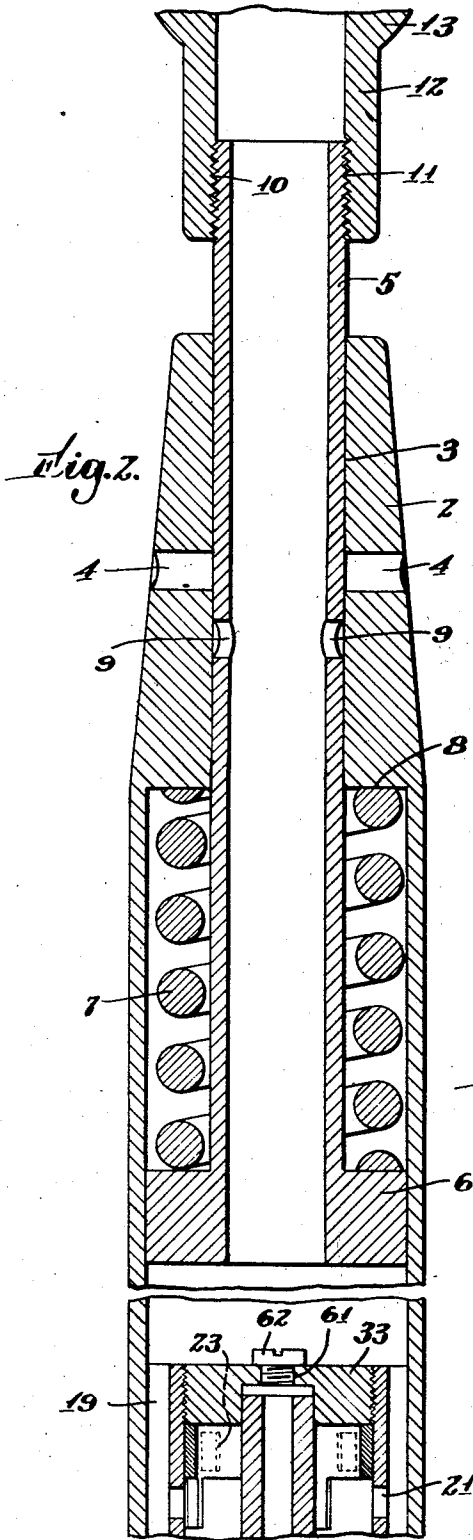
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DRILLING APPARATUS

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Clyde E. Bannister
by James H. Hodder
Attorney

UNITED STATES PATENT OFFICE

2,002,385

DRILLING APPARATUS

Clyde E. Bannister, Akron, Ohio

Application May 1, 1931, Serial No. 534,322

Renewed November 9, 1933

9 Claims. (Cl. 255-4)

My present invention relates to drilling apparatus, and more particularly to a novel and improved apparatus primarily designed for the drilling of vertical wells or bores such as oil wells.

An important object of the present invention resides in the combining, with a rigid non-rotating drill stem, of a boring tool, means for operating said boring tool, and a support for said operating means.

A further object of my invention resides in so constructing said combined apparatus that the support, the tool, and the means for operating said tool will all be tiltable relatively to the rigid non-rotating drill stem, the said support being flexibly suspended from said rigid drill stem, in order to accomplish this desirable result.

It is a well known fact, in the oil well drilling industry, that the ideal bore or well is the one which most nearly approaches verticality. In prior methods of drilling, as the cutting tools or bits have worked downwardly through the bore which was being formed thereby, there has been a tendency for said tools to "crawl", or in other words, to deviate from a perpendicular descent and form inclined or crooked holes or bores. This has resulted in many cases in serious property damage, destruction of bores, and abandonment of one or more bores, should one bore cross another during its descent. This has resulted in considerable expense coupled with many other disadvantages. Furthermore, in prior drilling apparatus, should an obstruction such as a boulder be encountered during the descent of the cutting tools, and should the said cutting tools be deflected by the said obstruction, the tendency is for the tool or device to increase said deflection or crawl, rather than to attempt to return to its normal position.

A further and important object of my present invention, therefore, is the provision of drilling apparatus which will automatically insure a substantially vertical descent of the cutting tools, by reducing the tendency to crawl, as well as having an inherent tendency, after a possible deflection, to return to normal vertical cutting position. The many advantages incident to the straight drilling produced by my novel apparatus will be instantly apparent to and appreciated by those skilled in this art.

In the drawings of the present application I have illustrated a rigid, non-rotating drill stem, so arranged that the support for the tool operating means will hang freely from and be tiltable relatively to said drill stem. This desirable result is accomplished by utilizing the novel ball and socket

joint structure illustrated. Furthermore, I preferably interpose between the ball and socket joint and the cutting tool a heavy inertia barrel of considerable weight. The flexible suspension of said inertia barrel or support will thus result in the said support having an inherent tendency to hang straight, because of its weight, or in other words, to function in a manner similar to a plumb bob, at the same time conveying this important characteristic or tendency to the cutting tool or boring bit itself.

In the present application I have illustrated a fluid pressure motor within the flexibly suspended support, as the means for operating the cutting tool, but it will be appreciated that this is for illustrative purposes only, and that I am not limited thereto, it being within the range and scope of my present invention to utilize any tool operating means which can properly be adapted for use in combination with a rigid non-rotating drill stem or support.

Other features and objects of my invention reside in the particular details of construction of various portions of my apparatus.

The above and other objects of the invention, details of construction, combinations of parts, and advantages, will be hereinafter more fully pointed out, described and claimed.

Referring to the drawings, illustrating a preferred embodiment of the present invention, Fig. 1 is a side elevation of my novel apparatus positioned in a bore which is being formed thereby;

Fig. 2 is a vertical sectional view of the upper portion of the support and machine utilized;

Fig. 3 is a vertical sectional view on the line 3-3 of Fig. 7;

Fig. 4 is a vertical sectional view on the line 4-4 of Fig. 7;

Fig. 5 is a vertical sectional view on the line 5-5 of Fig. 7;

Fig. 6 is a vertical sectional view illustrating the valve sleeve holding and actuating means;

Fig. 7 is a cross sectional view on the line 7-7 of Fig. 4; and

Fig. 8 is a cross sectional view on the line 8-8 of Fig. 3.

Referring now to the drawings for a particular description of the invention, its construction and operation, 1 designates a tubular shell or casing, and 2 designates a reduced and tapered upper end portion formed with a bearing 3 and ports 4-4.

Extending and fitting through the bearing 3 is a long tubular nipple or slip-sleeve 5 having an

these vertical reciprocations will be converted into oscillations of the shaft 42 through the medium of rollers 44 in the spiral bearing grooves 43, and the bit or drilling tool will thus also be oscillated, and will gradually break away the formation against which it operates at the bottom of the bore. The rollers 44 are carried on the ends of a pin 45 extending transversely of the shaft 42 and fixed therein.

The distance of each oscillation of the bit 55 will, of course, be determined by the extent of the spiral grooves 43, and the stroke of the piston, and the speed of oscillation of the bit will be fixed and determined by the speed of operation of the piston 38. It will be readily understood that the inertia of the machine will restrain the machine itself from any material turning sufficient to eventually allow the abrading tool or bit to remain stationary. If the bit or abrading tool utilized were subjected to a continuous rotating action, the machine would, of course, gradually develop a rotating action in a direction opposite to the direction of rotation of the bit and this would necessarily result in the stoppage of the bit.

By utilizing a rigid non-rotating stem, great weights may be carried thereby at considerable depths, without the likelihood of breakage which would be present if a rotating drill stem were utilized. Also, by utilizing a non-rotating rigid stem, considerable expense is saved in the surface equipment, by eliminating the necessary machinery and apparatus heretofore required to rotate a rigid drill stem. The advantages of this feature will be instantly apparent to those skilled in this art. Furthermore, a non-rotating drill stem will enable the boring of a much deeper well than is possible with a rotating drill stem, as the non-rotating drill stem, not being required to bear torsional strains, may be made much lighter in weight per foot.

The apparatus may be withdrawn from the bore by means of the stem sections 70 and in withdrawing the apparatus the spring 7 will carry the load and be compressed, thus bringing the ports 9 into register with the ports 4. Should the apparatus become stuck in the bore, by a cave-in or otherwise, the water may be pumped down through the sections 70 and nipple 5 and out through the ports 9 and 4 to flush out and wash away the surrounding material and thus free the apparatus so that it may be freely withdrawn from the bore.

If desired, the spring 7 may be of sufficient strength to remain inoperative unless and until an obstruction is encountered in withdrawing an apparatus from the bore, whereupon on meeting with resistance, the spring will function to allow the ports 9 and 4 to be put in register and permit the flushing operation above described.

In order to accelerate the action of the valves 25 and 26 I may surround the shaft 42, at each end of the piston 38, with a coiled spring 75 resting at one end on the stuffing box 40 and at the other end against a ring or collar 76 formed in the valve 25 and also surrounding the shaft 42. This spring structure will be the same at each side or end of the piston and therefore one only need be described. I also provide recesses 77 in each valve to receive balls 78 held in position by springs 79 and set screws or plugs 80. The arrangement of recesses, balls, plugs and springs is similar in each of the valves 25 and 26.

Thus the piston, in its travel, compresses the spring 75, which, however, when fully compressed,

preferably has not quite enough energy to move the valve, which is held in place by the balls 78 and springs 79. The piston, continuing along its stroke, finally strikes the valve extensions and dislodges the balls. Unless the balls are dislodged, the spring 75 will snap the valve across the ports which are to be closed, giving a quick and positive action.

In the meantime the valve rods 31 are pulling the valve on the opposite end into the position where the balls will fall into place in the recesses in the valve. On the return stroke of the piston the pent-up energy of the spring will assist in starting the piston in the opposite direction, this action being the same regardless of the direction of movement of the piston.

Should an obstruction be encountered by the bit 55 in its descent, and deflect it from its normal vertical path, the ball and socket joint will permit the weighted machine to again seek a vertical descent, the device thus having a constant inherent tendency to descend vertically.

I believe that the apparatus disclosed and described in this application is novel, and I have therefore claimed the same broadly herein.

While I have necessarily described my present invention somewhat in detail, it will be appreciated that I may vary the size, shape, and arrangement of parts within reasonably wide limits without departing from the spirit of the invention. It will also be appreciated that while I have illustrated and described the fluid motor which is the subject matter of my co-pending application Ser. No. 347,039, I may utilize any tool operating mechanism, motor, or the like, which is capable of use in the combination herein described.

My invention is further defined and described in the form of claims as follows:

1. Well drilling apparatus comprising a rigid non-rotating drill stem, a fluid pressure motor suspended therefrom for universal movement relative thereto, a boring tool operable by said fluid pressure motor, and a barrel enclosing said motor, the mass of said barrel with respect to said motor and said boring tool being such that said fluid pressure motor will effect operation of said boring tool independently of movement of said barrel.

2. Well drilling apparatus comprising a rigid non-rotating drill stem, a fluid pressure motor suspended therefrom for universal movement relative thereto, a boring tool operable by said fluid pressure motor, and a barrel enclosing said motor, the mass of said barrel with respect to said motor and said boring tool being such that said fluid pressure motor will effect operation of said boring tool independently of movement of said drill stem or said barrel.

3. Well drilling apparatus comprising a rigid non-rotating stem, boring tool operating means, a support for said operating means, a ball member carried by the lower end of said stem, a socket member carried by the upper end of said support and adapted to receive said ball, whereby said support will be suspended from said stem with capacity for universal movement, and a substantially semi-spherical protecting cap fixed to said ball member and overlapping a portion of said socket member.

4. Drilling apparatus comprising substantially rigid suspension means adapted to be lowered in a well, an elongated weight structure having universal-joint connection to said suspension means, a rotative bit having connection to said suspension means and directionally controlled by the

said weight structure acting in the manner of a plumb-bob, and power means interposed operatively between the weight structure and the bit for driving the latter.

- 5 5. Drilling apparatus comprising substantially rigid suspension means adapted to be lowered in a well, an elongated weight structure having universal-joint connection to said suspension means, a rotative bit having connection to said suspension means and directionally controlled by the
10 said weight structure acting in the manner of a plumb-bob, a pressure fluid motor interposed operatively between the weight structure and the bit for driving the latter, means for supplying
15 pressure fluid to said motor from the top of the well, and means for causing the fluid on occasion to flow into the lower portion of the well without passing through the motor.
- 20 6. Drilling apparatus comprising substantially rigid suspension means adapted to be lowered in a well, an elongated weight structure having universal-joint connection to said suspension means, a rotative bit having connection to said suspension means and directionally controlled by the
25 said weight structure acting in the manner of a plumb-bob, a pressure fluid motor interposed operatively between the weight structure and the bit for driving the latter, means for supplying pressure fluid to said motor from the top of the
30 well, and means automatically actuated by any pull upon the suspension means greater than the weight of the assembly suspended therefrom for causing the fluid to flow into the lower portion of the well without passing through the motor.

7. Drilling apparatus comprising suspension means adapted to be lowered in a well, a hy-

draulic bit of the rotary-drilling type mounted on the lower end of the suspension means, means for supplying fluid to the bit at drilling pressure from the top of the well, and means controllable at will and adapted to be brought into operation by simple vertical pull from the top of the well for causing the fluid on occasion to be discharged at full drilling pressure into the lower portion of the well but above the bit.

8. Drilling apparatus comprising an inertia member and a bit, a fluid-actuated motor interposed operatively between the two for oscillating the bit, the inertia member being without anchoring connection to the wall or to the top of the well and of such mass as to sustain solely by its inertia and with smaller amplitude of oscillation than that of the bit substantially all of the reaction force of the motor, and means controllable from the top of the well for supplying the motive fluid operatively to the motor and alternatively discharging it at full drilling pressure into the lower part of the well but above the motor.

9. Drilling apparatus comprising substantially rigid suspension means adapted to be lowered in a well, an inertia member and a full-gauge bit mounted at the lower end thereof, and power means interposed operatively between the inertia member and the bit for oscillating the bit, the inertia member being without anchoring connection to the wall or to the top of the well and of such mass as to sustain solely by its inertia and with smaller amplitude of oscillation than that of the bit substantially all of the reaction force of the said power means.

CLYDE E. BANNISTER.