

June 2, 1931.

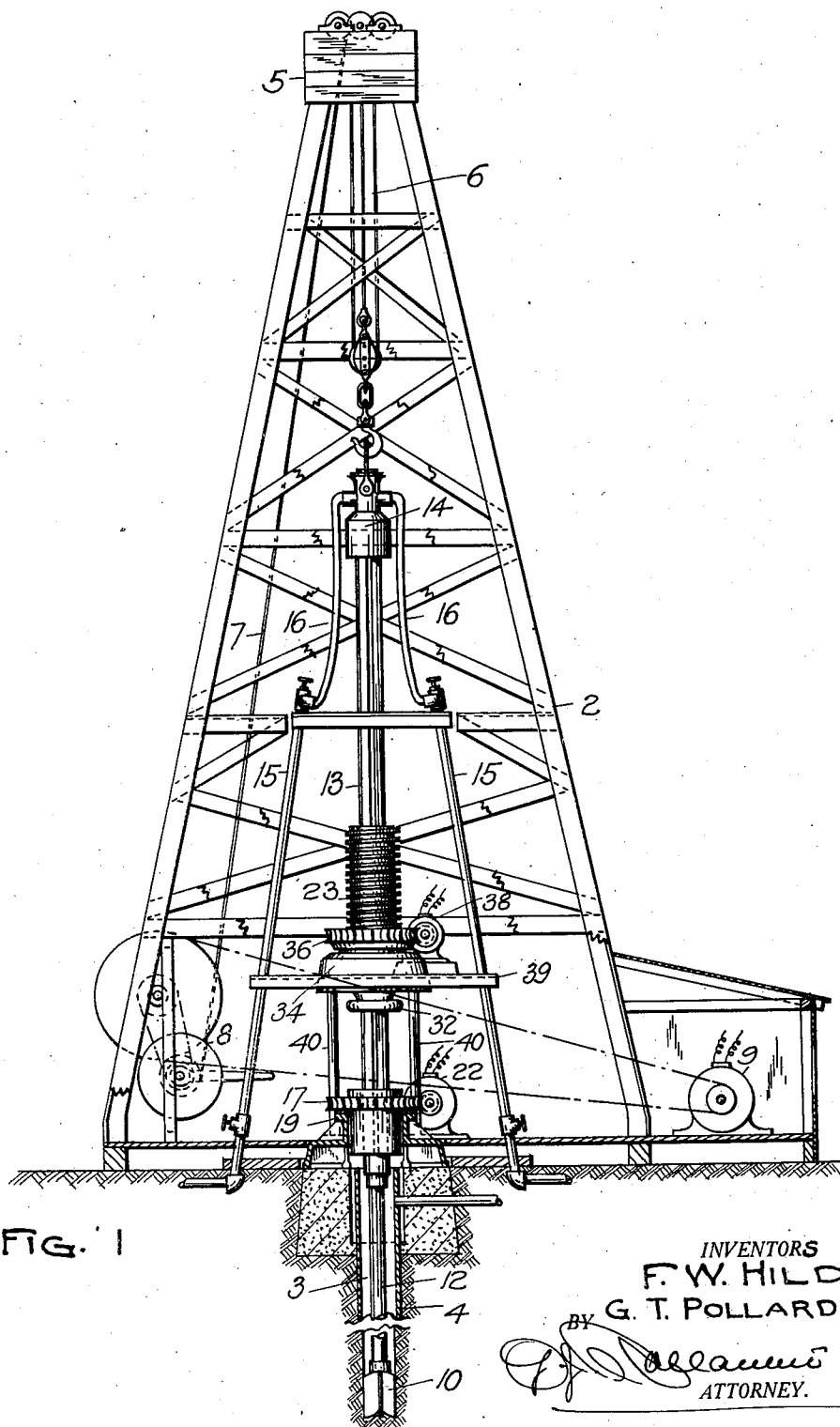
F. W. HILD ET AL

1,808,221

DRILLING MACHINE

Filed Dec. 15, 1920

4 Sheets-Sheet 1



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DRILLING MACHINE

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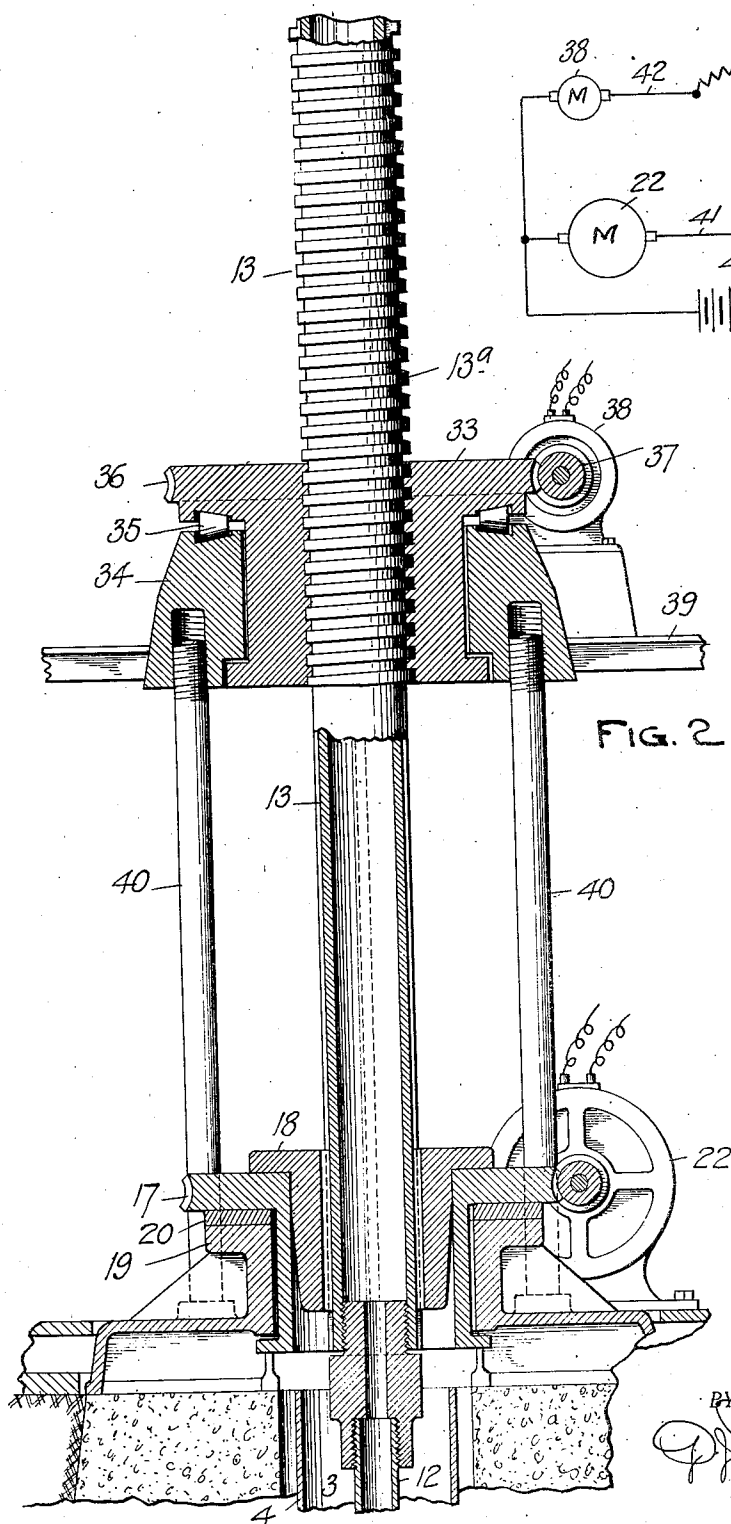


FIG. 2

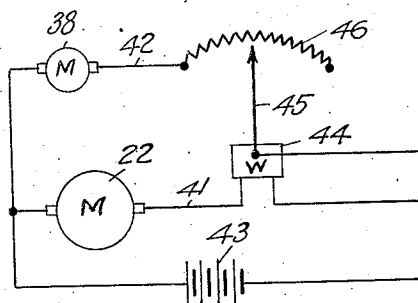


FIG. 8.

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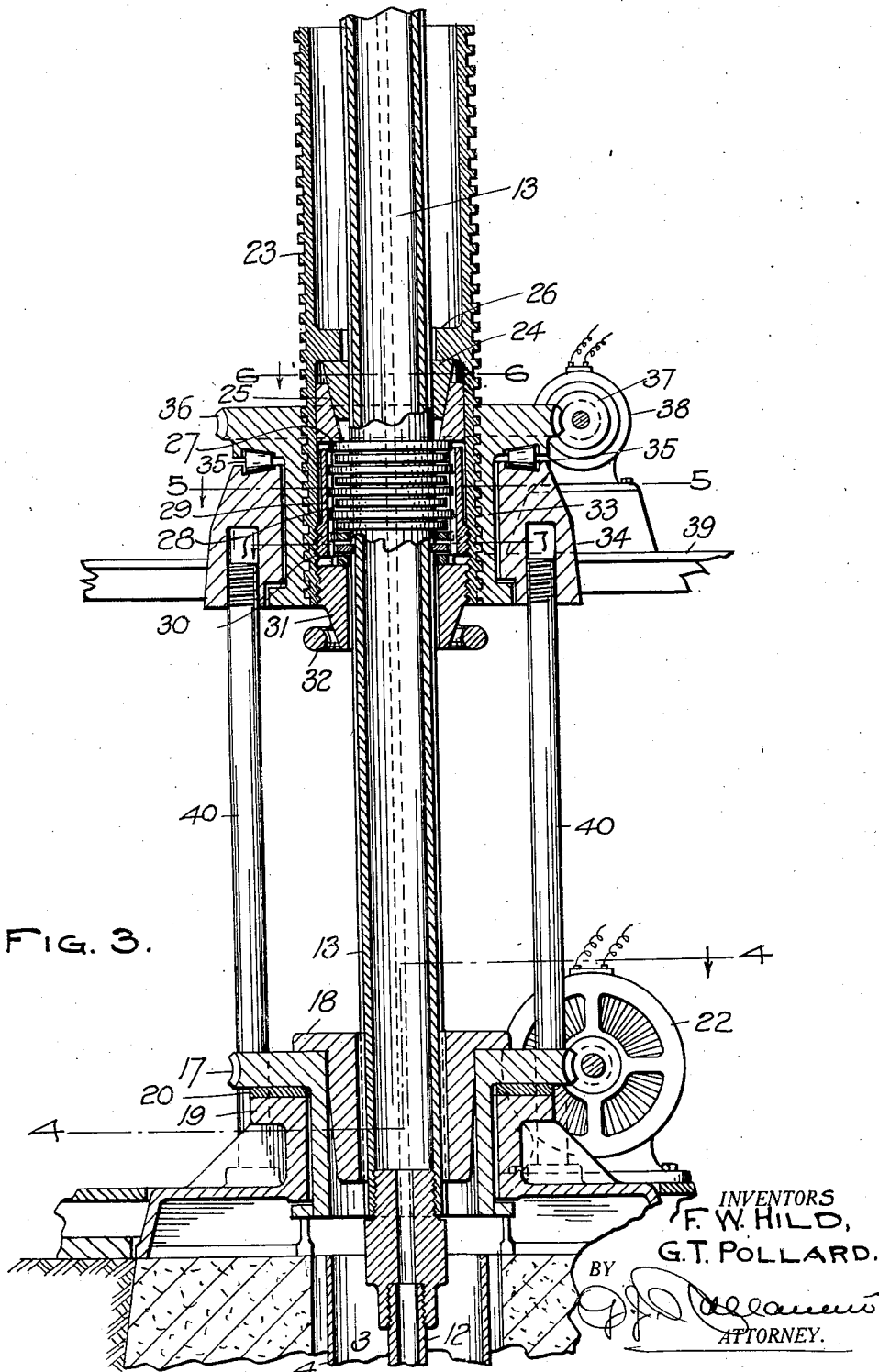
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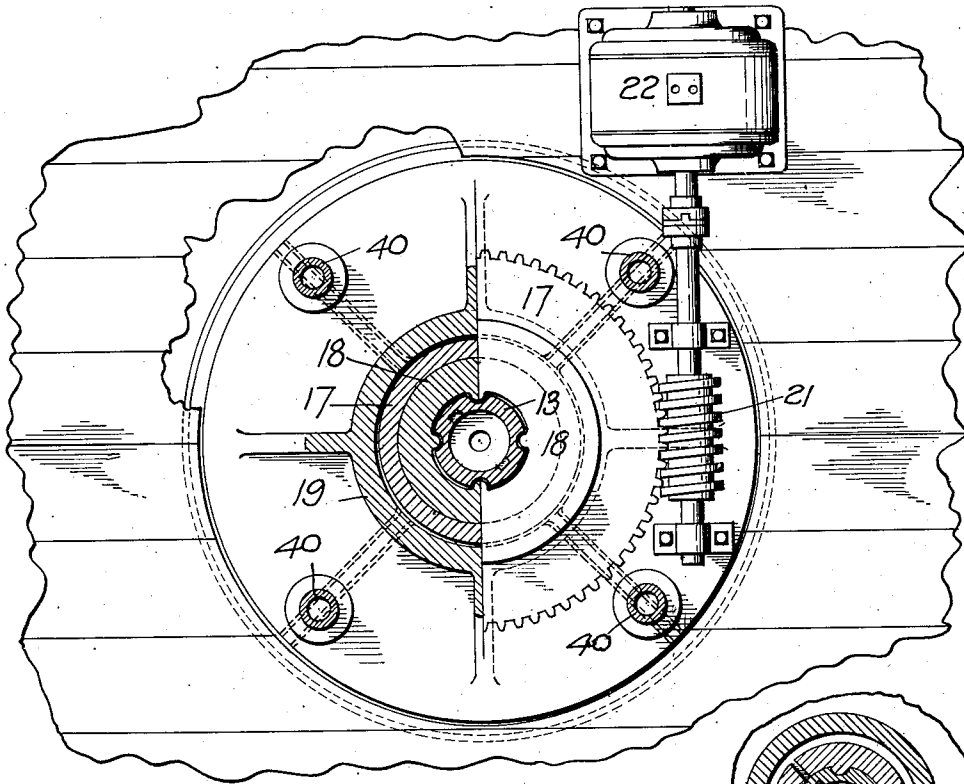


FIG. 4.

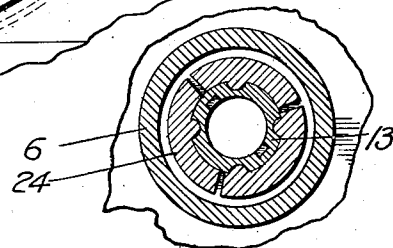


FIG. 6.

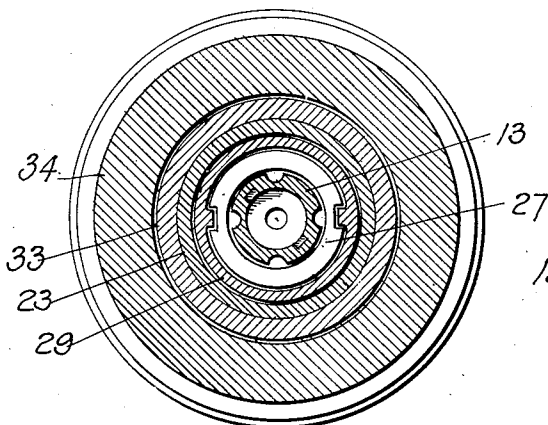


FIG. 5.

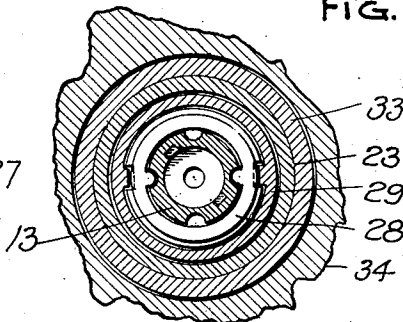


FIG. 7.

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DRILLING MACHINE

Application filed December 15, 1920. Serial No. 430,940.

This invention relates to drilling machines and more particularly to machines of the type used in sinking oil wells by the rotary movement of a longitudinally advancing cutting tool.

It is a matter of common knowledge to those versed in the art that in boring oil wells, the heterogeneous character of the earth formations through which the drilling tool is driven and the great depth to which the hole must often be sunk to reach the desired oil stratum, are obstacles which render it difficult to produce a continuously straight bore and frequently cause the breakage of tools and other machine elements with consequent delays for repairs and the recovery of broken parts.

The drilling machines at present most commonly used require, for these reasons, the employment of highly skilled operatives who, owing to their long and varied experience, are able to avoid to some extent the detrimental incidents in the operation of boring oil wells above referred to.

It is obvious that, irrespective of its causes, most of the accidents occurring in the work of drilling oil wells are the direct result of an excess stress on the drill tool, and it is the primary object of our invention to constantly limit said stress to a predetermined maximum by the provision of a system of cooperative devices which automatically regulate the feed of the cutting tool in ratio to the resistance it encounters.

With this object in view, our invention in its preferred form, comprises an element for the rotation of a longitudinally movable drill tool and a feed element which advances the same to the work by a relatively differential movement.

It is obvious that variations in the resistance encountered by the drill tool will correspondingly vary the load on the element which effects its rotary motion and our invention includes in combination with the elements already referred to, a means by which these load variations are employed to correspondingly vary the relative velocities of the two elements and thereby maintain the stress upon the tool within predetermined limits.

Having thus briefly described the nature and objects of our invention, we will now proceed to describe the same in detail with reference to the accompanying drawings which illustrate an embodiment of the invention in its most convenient and practical form at present known to us.

In the drawings in the various views of which like parts are similarly designated,

Figure 1 represents an elevation of a machine for drilling oil wells, to which our invention is applied;

Figure 2, an enlarged vertical section through the feed element and the drill-rotating element of the construction, together with the drill tool and other adjacent parts of the machine;

Figure 3, a sectional elevation similar to that of Figure 2, showing a modification in the construction of the feed element of the invention;

Figure 4, a horizontal section on the line 4—4, Figure 3;

Figure 5, a similar section taken along the line 5—5, Figure 3;

Figure 6, a section on the line 6—6, Figure 3;

Figure 7, a section on the line 7—7, Figure 3, and

Figure 8, a diagrammatic representation of the electrical system included in the invention.

Referring more specifically to the drawings, the reference numeral 2 designates the derrick of an oil-well erected over the bore 3 which as usual is protected against caving of its wall by an inserted tubing 4.

The derrick has a crown block 5 for the support of a multiple tackle 6 from which the drill tool is suspended, the pull rope 7 of the tackle being as usual connected with the winding drum of a hoist 8 installed at the foot of the derrick in operative connection with a motor 9.

The drill tool of the construction shown in the drawings consists of a cutting bit 10 at the end of a pipe 12 which is coupled to and in axial alinement with a hollow grief stem 13.

Superimposed upon the grief stem is a

swiveled head 14 provided with a clevis for its connection with the before-mentioned tackle and connected to a conveniently located source of water supply by means of valve-controlled pipes 15 and flexible hose connections 16.

The element of the machine by which a rotary movement is imparted to the drill tool, comprises a worm-wheel 17 which is connected to the grief stem through the medium of a flanged collar 18.

The worm-wheel is rotatably supported upon a stationary bearing 19 through the medium of an anti-friction ring 20 and it meshes with a worm 21 on the shaft of an electric motor 22 the electrical connections of which will hereinafter be described.

The grief stem is free to move longitudinally through the collar of the worm wheel, but is connected for conjunctive rotation therewith, the connection being established in the illustration by means of ribs on the collar which are loosely fitted in longitudinal grooves of the grief stem.

In the preferred form of the invention shown in the drawings, the grief stem has an external screw thread 13a for its cooperation with a nut 33 which is rotatably mounted on a relatively stationary support 34 through the medium of a roller bearing 35.

A worm-wheel 36 on the nut meshes with a worm 37 on the shaft of a second motor 38 mounted on a platform 39 which together with the support 34 is erected in an elevated position on standards 40.

The motors 22 and 38 are independently connected in separate circuits 41 and 42 which derive their current from a common source of electricity 43 as shown in Figure 8 of the drawings.

A watt meter 44 or other similar instrument which operates by current variations, is connected in the circuit of the motor 22 and has an operative action upon the contact member 45 of a rheostat 46 connected in the circuit of the motor 38.

The above described electric system constitutes the automatic element of our invention which in the operation thereof, functions to vary the relative velocities of the drill tool and its feed-element proportionate to variations in a resistance to the movement of the tool.

In the operation of our invention the drill tool rotated by the motor 22, is advanced longitudinally at a predetermined rate by a relatively differential movement of the nut 33 which is actuated by the motor 38.

When the drill bit at the end of the longitudinally moving tool encounters a substance harder than that through which it was previously driven, the increased resistance to its advance correspondingly increases the load on the motor 22.

The consequent current-variation in the

circuit of the motor operates the watt meter which in turn actuates the contact member of the rheostat to diminish the resistance in the circuit of the motor 38.

The nut 33 of the feed element is, as a result of this condition, rotated at an increased velocity which is directly proportionate to the increased resistance to the movement of the drill tool and the downward movement of the drill tool is correspondingly reduced and if the resistance continues, may be eventually discontinued.

The above described operation is reversed when the resistance to the movement of the drill bit is lessened by its entering a softer substance than that with which it was previously engaged, and it will thus be seen that by the use of our invention the stress on the drill tool is automatically maintained within predetermined limits and that the many accidents and detrimental conditions directly due to changes in said stress, are effectively avoided.

Although the employment of means to automatically vary the velocity of the feed element by and proportionate to load variations on the motor which effects the rotation of the drill tool, is preferable as a dependable medium for attaining the object of the invention, a similar result may be produced by rotating the feed element at a constant velocity differential to a normal rate of motion of the drill tool, through the instrumentality of a second motor separate from the other.

Variations in the resistance to the operative movement of the tool will under such conditions correspondingly change the rate of motion of the motor by which it is rotated, while the feed element maintains its constant velocity and thereby regulates the longitudinal movement of the tool to correspond with the changes in the resistance it encounters.

In the modified construction of our invention illustrated in Figures 3, 5, 6 and 7 of the drawings, the feed element comprises two cooperating members one of which is adjustably connected to the grief stem of the drill tool.

The hereinbefore described nut 33 operatively engaged by a motor 37 through the medium of a worm movement of which the gear 36 of the nut is the driven part, constitutes the driving member of the feed element, and a hollow exteriorly threaded cylinder 23 which by means of a friction clamp of suitable construction is rigidly connected around and in concentric relation to the grief stem forms the driven member of the same.

It is the function of the friction clamp to readjust the driven member of the feed element on the grief stem after it has reached the limit of its downward movement with relation to the driving member of the same and it consists to this end of a sectional annular

wedge 24 the members of which have feathers for their non-rotative connection with the grief stem, and a solid annular wedge 25, which cooperates with the other and is slidably fitted in the hollow cylinder.

The sectional wedge abuts against an internal shoulder 26 of the cylinder and the other wedge is engaged by the upper one of a number of rings 27 and 28 contained in a cylindrical cage 29 which has a screw thread connection with the cylinder as at 30.

The rings are alternately connected with the grief stem and the cage by integrally formed inwardly projecting keys so that part of them may rotate with the cage and the other part with the grief stem when they are free from pressure.

The lower ring of the series rests upon a nut 31 which cooperates with an interior screw thread at the lower end of the cylinder and which has a hand wheel 32 to facilitate its rotary adjustment.

In the normal condition of the feed element, the driven member 23 is rigidly connected with the grief stem by turning the nut against the rings until they are firmly clamped together and driven against the wedge 25 which thereby is moved into frictional contact with the correlative wedge 24.

By loosening the nut the clamping parts are instantly released and the cylinder is free for longitudinal adjustment on the grief stem by a rotary movement relative to the correspondingly threaded driving member of the feed element with which it is cooperatively connected.

The operation of the modified form of our invention is similar to that of the first above described preferred construction of the same, it being understood that the same or similar electrical connections may be used in the circuits of the two motors to vary the velocity of one proportionate to variations in the resistance to the movement of the other.

When in the operation of the machine the drill tool has been fed a distance limited by the length of the threaded cylinder of the feed element, the friction clamp is loosened and the member thus being free to rotate in the nut, is moved upwardly along the grief stem until it occupies its original position with relation to the nut as shown in Figure 3.

The adjustment of the driven member of the feed element is repeated until the hole is bored to the desired depth, it being understood that as in all drilling machines of this character, it is necessary to lengthen the drill pipe from time to time by additional sections, and it will thus be seen that the use of the second above described construction of the feed element involves the operation of the machine in a series of intermittent forward movements interrupted by periods of inactivity during which the above described adjustment is effected.

Having thus described our improved drilling machine in its preferred form, we desire it understood that variations in the construction and arrangement of the parts thereof, may be resorted to within the principle of our invention as outlined hereinabove and defined in the hereunto appended claims, and it should be further understood that while our invention is particularly adapted for use on machines for drilling oil wells and the like, it may be advantageously employed in connection with drilling and impact machines of different character.

What we claim and desire to secure by Letters Patent is:

1. In a drilling machine, the combination of a drill tool, an element for its rotation including a motor, a rotary nut having a screw connection with the drill tool, a second motor for rotation of the nut, and means for varying the relative velocities of said motors by and proportionate to variations in a resistance to the movement of the tool.

2. In a drilling machine, the combination of a drill tool, an element for its rotation, a feed element including a driven member, a friction clamp connecting said member to the tool, and a driving member in operative relation to the driven member, and means for continuously varying the relative velocities of said members by and proportionate to variations in a resistance to the movement of the tool.

3. Earth-boring apparatus comprising a drill stem, means for suspending a portion of the weight of said drill stem, driven means for effecting rotation of said drill stem, and a plurality of motor devices having an interposed differential mechanism for operating said means, whereby variations in the relative speeds of said motor devices affect the degree of suspension of said drill stem.

4. Earth-boring apparatus comprising a drill, means including a motor device for rotating said drill, means for suspending all or a portion of the weight of said drill and for imparting feeding pressure thereto irrespective of said weight and means for regulating the feeding pressure in accordance with the load on said motor.

5. The combination with a cutting tool, of means for rotating and for feeding said tool, said means including two electric motors electrically connected to each other only at their common point of energy supply, and means responsive to the resistance encountered by said tool for varying the feed and for reversing it.

6. In a drilling system, in combination, a drill biased to advance to its work, a motor for operating the drill, mechanism for exerting force in opposition to the biasing force, a second motor connected to said mechanism for normally increasing the opposing force, and means for connecting the drilling motor

to said mechanism in such manner as to reduce the opposing force when the speed of the drilling motor exceeds a predetermined limit.

- 5 7. Earth-drilling apparatus including a gravity-fed drill, a differential mechanism, a motor connected to apply a torque of suspension in one direction to one element thereof to oppose the torque reaction provided by
10 gravity acting on said drill, a second motor connected to rotate said drill and also to apply a torque of rotation in the opposite direction to another element of said mechanism, whereby an unbalance in the torques of sus-
15 pension and rotation effects an upward or a downward movement of said drill.

In testimony whereof we have affixed our signatures.

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