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W. A. LOOMIS

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DUMMY DRILLER

Filed Dec. 14, 1927

2 Sheets-Sheet 1

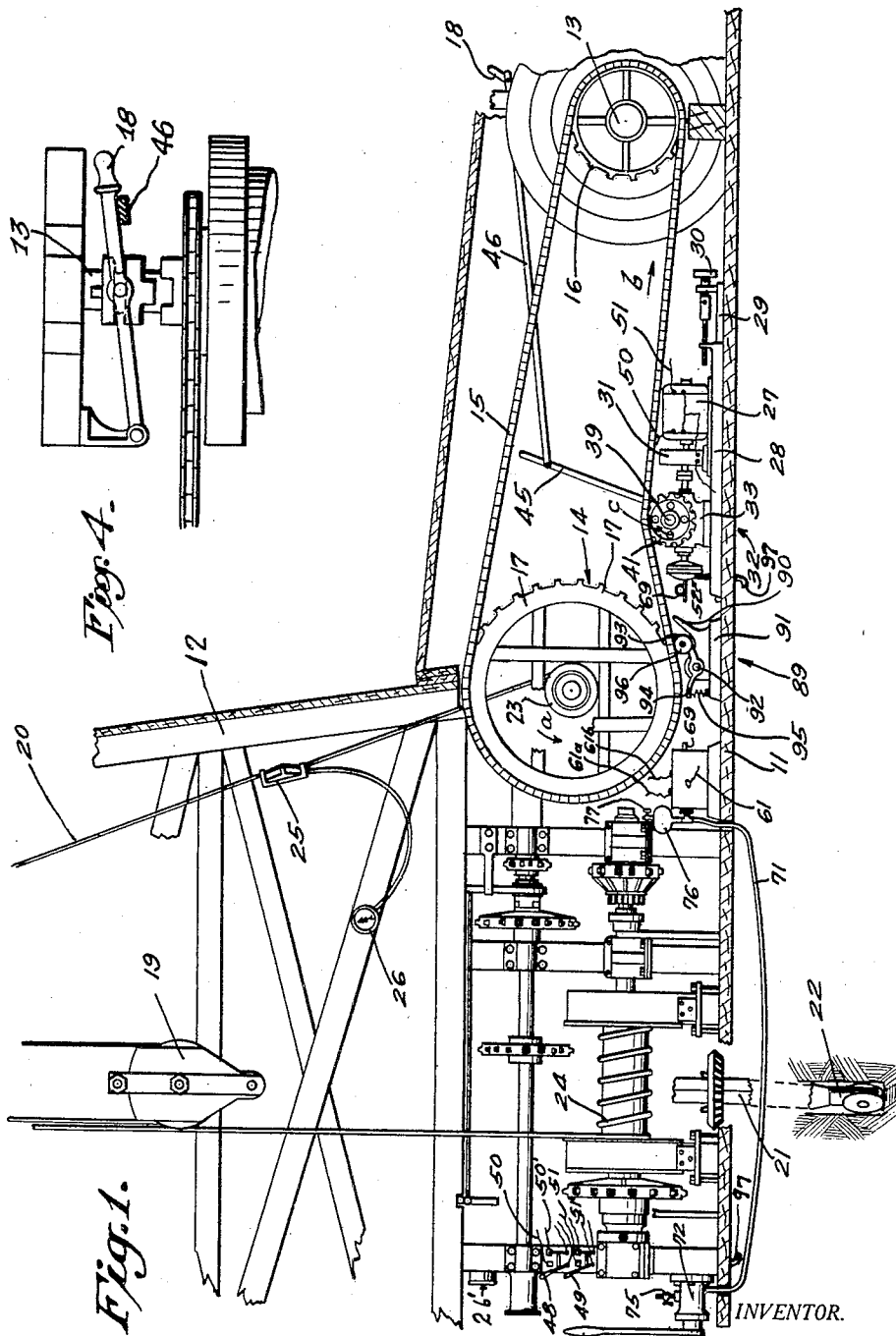


Fig. 1.

Fig. 4.

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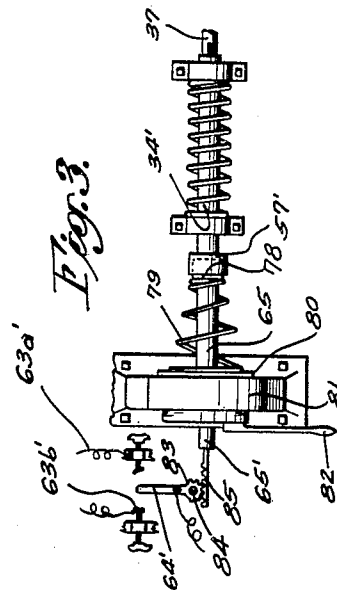
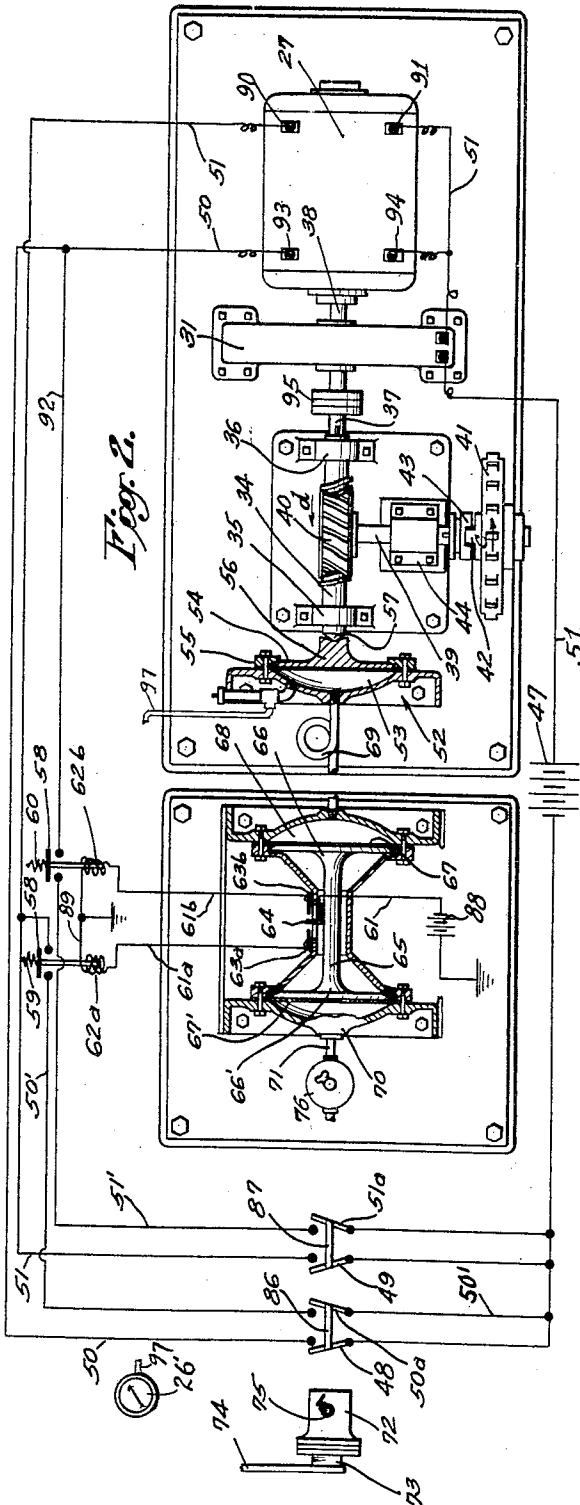
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2 Sheets-Sheet 2



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DUMMY DRILLER

Application filed December 14, 1927. Serial No. 239,920.

My present invention is referred to as a "dummy driller" for the reason that although various parts thereof are capable of independent or alternative uses, it is a primary object of this invention to provide means for maintaining, within reasonable limits, a predetermined pressure upon a rotary drill supported, in part, by a cable.

Broadly, my invention, is applied to a combination rotary and cable-tool drilling outfit, or the like, and involves the use of novel and independent means, comprising a reversible motor for slowly rotating a so-called "calf wheel" in either direction, to pay out or to pick up a cable by which a rotary drill string is partially supported; and said invention may include means rendering the action of said motor dependent upon either the pull exerted by the string and tending to rotate said calf wheel (an excessive pull being effective to cause the motor to pay out the cable until the strain upon the cable is diminished) or upon a manual manipulation of switches.

Extensive use may be made of a device which utilizes hydraulically actuated apparatus to indicate and/or record strains upon cables by which drill strings, or the like, may be directly or indirectly and partially or completely supported. It is an object of my present invention, in some embodiments thereof, to utilize hydraulically actuated apparatus also in effecting an automatic control of drilling operations. In preferred embodiments of this invention, I may employ gearing including a worm drive to move a sprocket chain which extends over a wheel or rim secured to a calf wheel, the variable reaction of a longitudinally shiftable worm being utilized to produce such variations in pressure of an incompressible fluid to open and close electrical circuits controlling the electric motor in the event such a motor is used.

It is a further object of this invention to provide means whereby a calf wheel, or the like, provided with a usual sprocket drive from an engine-driven band wheel, may be alternatively operated either by the means heretofore customary or by an electric motor provided with a gear train which includes a special sprocket wheel engaging the usual sprocket chain and adapted to serve either as an idler (incidentally capable of taking up slack in said chain) or as a means, available upon a shifting of clutches, for advancing said sprocket chain in a delicately controllable manner.

It is a further object of my present invention, to provide a structure in which an automatic brake may advantageously be associated with the mentioned motor to prevent coasting of the same, and in rotary drilling, to provide automatically controlled means which are dependent upon the downward pull exerted by a drill string rather than upon the torque or resistance of a drill or drill string to rotation to permit a drill string to be freely raised and lowered during continued rotation thereof, as for the purpose of removing a "ball" from the drill.

Other objects of my invention may be best appreciated from the following description, taken in connection with the appended claims and accompanying drawings, in which:

Fig. 1 is a general elevational view of a so-called "combination" drilling outfit in which an embodiment of my invention is incorporated,—parts being broken away.

Fig. 2 is a diagrammatic plan view with parts broken away, showing certain indicating, driving and control parts,—this view serving also as a wiring diagram.

Fig. 3 is a partial plan view, corresponding to a central portion of Fig. 2, but suggesting the use of a spiral spring, under an adjusted tension, in predetermining the pressures at which electrical contacts are made, for the control of a mentioned reversible motor.

Fig. 4 is a fragmentary view in plan showing the operating clutch for the main cable drive shaft.

Referring to the details of that specific embodiment of my present invention shown in Figs. 1 and 2, 11 indicates a platform beneath a derrick 12. I show a band wheel shaft 13 driven by positive driving means, such as the motor 13' as adapted to drive a calf wheel 14 by means of a sprocket chain 15 extending over sprocket wheels 16 and 17. The connection between shaft 13 and sprocket wheel 16

are subject to control by means such as a clutch lever 18 which operates a jaw clutch and initiates or interrupts the driving of the shaft 13. A pulley block 19 is suspended beneath a so-called "crown block" (not shown) by several laps of a cable 20; and the block 19 will be understood to be adapted to raise and lower by means such as a usual swivel hook, not shown. A rotary drill string 21, is suspended from the block 19 and its lower end terminates with any suitable drill 22.

One end of the cable 20 is shown as secured to and wound upon a calf wheel drum 23,—the other end thereof being shown as similarly secured to and wound upon a separate drum 24. The drum 24 is adapted to be rotated, in a known manner, at desired different speeds from that of the calf wheel drum 23.

Numerous additional parts, as customarily included in rotary or combination drill rigs, are shown in a conventional manner without reference characters. A Martin-Loomis weight indicator is also diagrammatically shown at 25 and is so applied as to produce a predetermined deflection in a length of the cable 20, so that the resultant pressure will be indicated by a gage or recorder 26 which is conveniently disposed for inspection by the driller. A reversible electric motor 27 is mounted upon a base 28 which may be longitudinally adjustable, for a take-up effect, upon rails 29, by means of a screw 30. The base is also adapted to carry an electro-magnetically controlled brake 31, or its equivalent, and a special transmission organization 32, which I will next describe.

A subsidiary bearing block 33 is mounted upon the platform 11 or preferably upon the longitudinally slidable base 28. I may not only support a hollow worm shaft 34 thereby, but also a driven shaft 39, shown as disposed at right angles to the mentioned shaft and carrying a worm gear 40 and a sprocket 41 at its opposite ends. A hollow worm shaft 34 is longitudinally slidable in bearings 35 and 36, and is here shown as splined to an intermediate shaft 37, which is driven by the shaft 38 of the motor 27.

The sprocket wheel 41 is shown as provided with one element 42 of a jaw clutch. A complementary clutch element 43 is splined upon the shaft 39 which shaft is here shown as provided with a bearing support at 44. It will be seen that manipulation of the slidable clutch element 43 by means such as a clutch-operating lever 45 shown in Fig. 1, as connected, by a link or rod 46, to the mentioned clutch lever 18 will actuate the clutch for shaft 13 as well as for shaft 39. It will be understood that, one of the mentioned clutches is ordinarily "out" when the other is "in", and thus the sprocket chain 15 may be driven alternatively from the shaft 13 or from the shaft 39; and, although I may optionally energize the motor 27 directly from any suitable source of energy

47, as, by the manual manipulation of switches 48 and 49 respectively, thus closing circuits 50 and 51 effects a reversal of the motor 27. I consider it advantageous to provide automatic means, dependent upon a longitudinal pressure applied through and by the worm shaft 34, to effect an automatic opening and closing of alternative branch circuits 50' and 51', in shunt relationship with the mentioned circuits 50 and 51. These circuits are shown as provided with relay switches 58, 59' which are normally held open by gravity or by such means as springs 59 and 60. This action is brought about due to the fact that a worm and worm wheel are irreversible in relation to each other. Thus rotation of the worm wheel 40 will not produce rotation of the worm 34' which is in mesh therewith, but will impart an end thrust to the shaft 34 which thrust is utilized in a manner to be hereinafter pointed out.

I show at 52 an hydraulic unit comprising a chamber 53 adapted to contain suitable incompressible liquid, this being confined by means comprising a flexible diaphragm element 54, shown as retained by a ring 55 and as movable by a so-called "finger" 56,—any suitable thrust bearing being provided between said finger and a pressure-applying end 57 of the worm shaft 34.

In order to utilize any diminution in the capacity of the chamber 53, in opening and closing the branch or shunt circuits 50', 51', I have shown a subsidiary circuit comprising branches 61^a and 61^b which respectively include coils 62^a and 62^b and fixed contacts 63^a and 63^b. Between the last mentioned contacts I show a movable contact 64 carried by a longitudinally movable rod 65. The ends of this rod are provided with disks 66, 66' respectively secured to diaphragms 67, comparable with the mentioned diaphragm 54. A chamber 68 one wall of which is formed by diaphragm 66 is connected with the mentioned chamber 53 by a pipe 69, or its equivalent, and a chamber 70 one wall of which is formed by the oppositely disposed diaphragm 66' is subject to pressure of an inelastic fluid delivered thereto through an additional pipe 71. I may employ any preferred near or remote means for maintaining a predetermined counter-pressure within the chamber 70,—thereby establishing the amount of tension required to be exerted by the cable 20, or its equivalent, by reaction through the longitudinally slidable worm shaft 34, to close the circuit 61 and thereby energize the motor 27 to effect a desired manipulation of said cable to automatically adjust it to varying operating conditions.

In order to suggest an easy method of adjustment and readjustment of the counter-pressure within the chamber 70 from a remote point, such as that at which a driller may ordinarily stand, I show the pipe 71 as

extending (see Fig. 1) beneath the platform 11 and as carried to and connected with a cylinder 72,—which may contain means such as a screw plunger 73, manipulable by a lever 74, and may also be provided with a filling cock 75, or its equivalent. To provide a controllable element of elasticity tending to maintain a pressure restorative of the worm shaft 34 to an inner position, I may interpose in the pipe 71, or its equivalent, a small air pocket such as suggested at 76,—this being shown as provided with a cock 77 for the introduction or withdrawal of air or another fluid.

By way of illustrating the scope of this invention, and its possible independence of hydraulic means, I suggest in Fig. 3 an alternative construction of the control unit. In this structure a worm shaft 34' is longitudinally slidable upon an intermediate shaft 37' in the general manner described, and is provided with a terminal thrust bearing at 57'. Pressure is imparted thereto by a slidable element 65', shown as provided with a thrust-collar 78 engaged by a compression spring 79, confined between said collar and threaded stop element 80. These collars may be adjustable within a similarly threaded bearing support 81 and manipulable by means such as a wrench or lever 82. The slidable element 65' may be provided with a directly movable contact element 64' or said contact element may be in the form of or carried by a toothed sector 83, mounted upon a pivot 84, and engageable by a rack 85, carried by the slidable element 65'. The contact element 64' is adapted to engage either of two fixed or adjustable contacts 63^a and 63^b to close the circuits as have already been described.

It will be obvious that, upon closing the respective switches 48, 49, a reversal of the motor 27 may be produced and that similar result may be automatically obtained by the pressure-responsive mechanisms above described. In order however to render the manual switches 48, 49 dominant, when closed, I show the respective shunt circuits 50 and 51^a as provided respectively with switches 50^a and 51^a respectively, which switches may be mechanically or otherwise connected with the switches 48 and 49 respectively by means such as rods 86 and 87. In this manner switches 48 and 49 and the switches 50^a and 51^a may be alternately closed.

As to additional or optional features,—an initial filling of chamber 53 and pipe 69 may be effected for example through, an opening adapted normally to contain an adjusting screw; and, in preference to relying upon the usual instrument 26, I may connect with said opening, by means such as a pipe 97, any suitable pressure-revealing instrument 26'; but I consider it ordinarily inexpedient to employ, in any one installation, such a

substantial duplication of pressure-indicating or recording devices as might lead to confusion. The clutch levers 18 and 45 (if interconnected) are preferably so related that both of the clutches referred to may be simultaneously set at "Off", although either extreme position throws one of the mentioned clutches into engagement. It will be obvious that throw-magnifying and contact-spacing means, of the general character referred to in connection with contacts 63^a and 63^b (adapted to remain open so long as opposing pressures are about equal) may be employed in connection with either hydraulic or other pressure-responsive control means.

In case the motor 27, is electrical in character, it is intended to be promptly stopped and held, by means such as the spring-applied and magnetically-released brake 31, whenever and so long as the motor circuits 50, 51 are both broken; but an irreversible transmission relationship between worm 34 and worm gear 40, although it renders the longitudinal position of the worm 34 (so mounted as to permit translatory axial movement) dependent upon the pull exerted by or through cable 20, or its equivalent, may ordinarily serve to keep the main load entirely off from brake 31; and this brake (in which there need be no patentable novelty) is assumed to be electro-magnetically withdrawn whenever either circuit 50 or circuit 51 is energized.

In operation of the present invention the structure is assembled as indicated generally in Fig. 1 of the drawings, and the clutch on the shaft 13 is released to pay out the cable 20 so that the drill string 21 may be lowered to a position where the drill tool 22 is disposed in a drilling position. When the drill tool has been lowered to a desired position adjustment can be made to dispose a desired weight and pressure upon the drill tool, and this condition may be accurately determined and established by reference to the Martin-Loomis indicator 25, which will actuate the indicating member 26 to show the tension upon the cable 20, and thus make it possible to ascertain the load bearing against the drill tool 22. After the initial adjustment of the cable and drill string has been made by rotation of the calf wheel drum 23, the clutch of shaft 13 is temporarily disconnected by the clutch lever 18, and the movement of the clutch lever 18 will act through link 46 to operate clutch lever 45, by which the jaw clutch elements 42 and 43 are placed in interlocking relation with each other. This will act to positively connect the sprocket wheel 41 with the shaft 39 and will thus place the sprocket chain 15 and the sprocket wheel 41 in driving relation with the worm wheel 40, and the worm 34'.

Whenever, due to progress in drilling, the thrust of the drill string creates an excess-

sive tension upon the cable 20, this tension will act to rotate the calf wheel drum 23 in the direction of the arrow "a", and this in turn will cause the lower run of the sprocket chain 15 to move in the direction of the arrow "b", as indicated in Fig. 1. Due to the fact that the lower run of the sprocket chain 15 is in driving relation to the sprocket wheel 41, this wheel will tend to rotate in the direction of the arrow "c" as indicated in Figs. 1 and 2, and since rotation of the sprocket wheel 41 and the worm wheel 40 will not produce rotation of the worm 34', the worm and its shaft 34 will be moved in the direction of the arrow "d" as indicated in Fig. 2. This longitudinal movement of the shaft 34 through the sliding bearings 35 and 36 permits the shaft to create an end thrust pressure against the finger 56 of the diaphragm 54 and will thus cause the incompressible fluid within the chamber 53 to be forced through the tube 69 and into the compression chamber 68 of the switch actuating organism shown in Fig. 2 of the drawings.

It will be understood that under normal conditions a contact finger 64 will be out of electric contact with either of the contact members 63^a or 63^b. When, however, the equilibrium of the switch actuating unit is effected the contact member 64 will move into engagement with one or the other of the contacts 63^a or 63^b. During the present operation, when the end thrust is imparted against the diaphragm 54, the contact 64 will move into engagement with contact 63^a and this will act to complete an electric circuit from a source of supply indicated at 88 in Fig. 2, along a conductor 61 to the contact 64 and thence through contact finger 63^a and to conductor 61^a, after which the circuit will pass through the coil of a relay switch 62^a, and will be completed through a ground wire 89.

It is to be understood that during the time of automatic operation of the present invention the switches 50^a and 51^a are closed. The switch member of the relay 62^a will close the circuit from a source of electrical supply 47 along a conductor 50' and thence along a wire 51 to pole 90 of the motor 27. The circuit then includes the windings of the motor whereby the motor is rotated in a direction to drive the sprocket wheel 41 in a manner to advance the lower run of the sprocket chain in the direction of arrow "b" and to result in lowering the drill tool. The circuit then is completed from the motor through pole 91 to conductor 51 and thence through the energizing magnets of the magnet clutch 31 to the opposite side of the source of supply 47.

The motor shaft 38 is driven to rotate worm shaft 34 and thus drive the worm wheel 40 through the worm 34'. This will

result in rotation of the sprocket wheel 41 in the direction of the arrow "c" and will act to amplify the movement of the lower run of the chain 15 in the direction of the arrow "b" until the calf wheel 23 has paid out enough cable to lower the drill tool to a position where it will have established its predetermined thrust, at which time the end thrust upon the worm shaft 34 will be relieved. This will decrease the fluid pressure within the chamber 53 and will permit the pressure of the fluid acting against the diaphragm 67' to restore the contact 64 to its intermediate and non-contacting position.

It will, of course, be understood that the thrust of the drill tool required to relieve the end thrust on the worm shaft 34 will be determined and maintained by adjustment of the plunger within the cylinder 72, and the pressure established within the chamber 70 which is in communication with the cylinder 72, through a pipe 71. This will act to determine the equilibrium pressures required in the various parts of the structure to restore the apparatus to an optimum drilling pressure for the particular geological formation through which the drill is passing. When the driller determines that he has an excessive amount of weight acting upon the drill bit for the existing drilling conditions he may readjust the apparatus to raise the fluid pressure in the chamber 70. This will cause outward distention of the diaphragm 54 to relieve the pressure of the incompressible fluid within the chamber 53, as well as within the chamber 68, so that the contact member 64 will be moved by the pressure of the fluid acting against diaphragm 67' and will thus act directly to move the contact finger 64 into electrical contact with the contact 63^b. This will initiate a reverse driving action of the motor 27 by establishing the following circuit: The finger 64 in contact with the contact member 63^b will thus establish a circuit from a source of electrical energy 88 along the wire 61, through contacts 64 and 63^b, thence along a wire 61^b to and through the coil 62^b of a relay switch 58', the circuit being completed through a ground wire 89. When the relay switch 58' is closed it will establish a circuit from the source of electrical energy 47 through switch 51^a and thence along conductor 51' through the relay switch 58' and thence along the conductor 92 to wire 50, connected with pole 93 of the motor 27. The circuit then contacts through the reverse windings of the motor to a pole 94 and thence along conductor 51 through the coil of the magnetic brake 31 to the source of energy.

In this operation, the motor 27 will be driven in a reverse direction and will thus drive the gear 41 in a counter-direction to that indicated by the arrow "c" in Fig. 2, to

drive the lower run of the chain 15 in a counterdirection to that indicated by the arrow "b" of Fig. 1. This will act to rotate the calf wheel and wind the cable 20 onto the drum thereof. This winding action will continue until such time as tension on the calf wheel chain 15 creates an end thrust on the worm shaft 34 sufficient to cause the fluid within the chamber 53 to exert pressure upon the diaphragm 67 to move the contact finger 64 out of engagement with the contact 63^b, at which time the operation of the motor will be discontinued.

It is, of course, understood that the magnetic brake 31 embodies an actuating mechanism normally operative to set the brake and that the flow of current along conductor 51 through a magnetic coil therein, acts to release the brake during the time that a motor circuit is completed. The instant, however, that the motor circuit is interrupted, the brake will automatically set and will thus act through the worm 34 and the worm gear 41 to instantly interrupt movement of the chain 15, and to thus prevent coasting of the cable driving mechanism. The brake will thus hold the shaft 37 and the worm shaft 34 from rotation until a sufficient end thrust has been created on the worm shaft 34 to automatically start the motor in one of its directions of rotation.

A flexible coupling 95 is interposed between the shaft 38 and the shaft 37 to permit longitudinal movement of the shafts with relation to each other without binding.

Whenever the driller elects to assume manual control, this only requires manipulation of the conveniently placed switches 48 and 49. The resultant control is, in either case, much more delicate than has heretofore been obtainable; it is independent of torque (which may result mainly from wall-friction) and it is not unimportant that this invention may be quickly and rather inexpensively applied to existing rigs to adapt them either to be operated in the customary manner or by means of the new mechanism herein described.

Although I have herein described a single complete embodiment of my invention, suggesting various alternatives and optional features, it should be understood not only that certain details of the invention may be independently used, but also that numerous modifications might easily be devised by workers in the sets to which this case relates,—without involving the slightest departure from the spirit and scope of this invention as the same is indicated above and in the following claims.

Claims:

1. In an organization suitable for predetermining the weight upon a rotary drill supported in part by a cable: means, comprising

alternative actuating means, for moving said cable in either of two directions; and pressure-responsive means, manipulable by reaction movements of an element of said gearing in response to variations in the weight carried by said cable, for operating said actuating means.

2. In an organization suitable for predetermining the weight upon a rotary drill supported in part by a cable: a motor in an energization circuit: means, comprising gearing which includes a worm driven by said motor for moving said cable in either of two directions; and means, operable by reaction movements of said worm in response to variations in the pull of said cable, for energizing and deenergizing said circuit.

3. In an organization suitable for predetermining the weight upon a rotary drill supported in part by a cable: means, comprising gearing and a reversible motor with alternative energization circuits, for moving said cable in either of two directions; and pressure-responsive means, manipulable by reaction movements of an element of said gearing, in response to variations in the weight carried by said cable, for opening and closing said circuits,—said motor being provided with means to prevent the same from coasting when said circuits are open.

4. An organization of the general character described, comprising: rotatable means for paying out and taking up a cable which is subject to a variable tension; and means, responsive to variations in said tension, for positively so rotating said rotatable means in either of two directions as to maintain said tension within predetermined limits.

5. In an organization of the general character described: a drum provided with a sprocket wheel for rotating the same; a main drive wheel also provided with a sprocket wheel; an intermediate sprocket wheel; a chain running over all of said sprocket wheels; clutch means adapting either the second mentioned or the last mentioned sprocket wheel to run as an idler; and means for positively driving either of said last mentioned sprocket wheels while the other runs as an idler.

6. In an organization of the general character described: a drum provided with a sprocket wheel for rotating the same; a main drive wheel also provided with a sprocket wheel; an intermediate sprocket wheel; a chain running over all of said sprocket wheels; clutch means adapting either the second mentioned or the last mentioned sprocket wheel to run as an idler; and means for positively driving either of said last mentioned sprocket wheels while the other runs as an idler,—the driving means for said intermediate sprocket wheel comprising a reversible prime mover and a transmission train; and

means for independently controlling the reversible prime mover.

7. In an organization of the general character described: a drum provided with a sprocket wheel for rotating the same; a main drive wheel also provided with a sprocket wheel; an intermediate sprocket wheel; a chain running over all of said sprocket wheels; clutch means adapting either the second mentioned or the last mentioned sprocket wheel to run as an idler; and means for positively driving either of said last mentioned sprocket wheels while the other runs as an idler,—the driving means for said intermediate sprocket wheel comprising a reversible motor and a transmission train which includes a worm driving a worm gear in an irreversible transmission relationship.

8. In an organization of the general character described: a drum provided with a sprocket wheel for rotating the same; a main drive wheel also provided with a sprocket wheel; an intermediate sprocket wheel, a chain running over all of said sprocket wheels; clutch means adapting either the second mentioned or the last mentioned sprocket wheel to run as an idler; and means for positively driving either of said last-mentioned sprocket wheels while the other runs as an idler,—one of said drive means comprising a transmission element which is mounted for translatory reaction movement and is operatively positioned in relation to a circuit control organization predetermining the energization of said motor.

9. In a well drilling organization having a drill string at the lower end thereof, a cable supporting the string, said cable being under a tension determined by the weight of the string and the character of earth formation upon which the drill tool is acting, and means whereby variation in the tension of said drill string supporting cable, as produced by variation in the load sustaining qualities of the earth formation against which the drill tool will act, to automatically adjust the cable and the drill string to maintain a substantially uniform pressure of the drill tool against the earth formation upon which it is resting.

10. In a well drilling organization a drill tool adapted to rest against an earth formation with a substantially uniform pressure for maximum cutting efficiency, a drill string connected therewith and having its weight partially superimposed thereon, a drill cable adjustably supporting said string to maintain the substantially constant pressure of said drill tool, a calf wheel drum around which said cable is wound, a motor driving means operatively connecting said motor and drum, and means whereby variation in tension of said driving means as produced by variation in the weight sustaining qualities of the earth formation within which the drill is working

will act to rotate said calf wheel drum to wind the cable in a manner to restore the drill to a predetermined pressure upon the earth formation through which it is working.

11. In a well drilling organization, a drill string provided with a boring tool, a cable providing a predetermined partial support for the string, winding means for said cable, driving means for operating said winding means to take in or give out cable, and means responsive to the tension in said cable for controlling said driving means to operate said winding means so as to maintain a predetermined constant tension in said cable corresponding to said predetermined partial support for the drilling string and thereby maintain a substantially constant pressure of the boring tool upon the earth formation.

12. In a well drilling organization a drill string, a cable providing a determined partial support for the string, winding means on to which said cable is wound, means holding said winding means inoperative when the cable is supporting the determined proportion of weight of the drill string, and acting automatically and positively to operate when the proportion of weight supported by the cable varies from the determined proportion to re-establish said proportion whereby a substantially constant pressure of the boring tool of the drill string upon the earth formation will be maintained.

13. In a well drilling organization a drill string, a cable providing a determined partial support for the string, winding means on to which said cable is wound, means holding said winding means inoperative when the cable is supporting the determined proportion of weight of the drill string, and acting to automatically release and operate when the proportion of weight supported by the cable varies from the determined proportion to re-establish said proportion whereby a substantially constant pressure of the boring tool of the drill string upon the earth formation will be maintained.

14. In a well drilling organization a drill string, a cable providing a determined partial support for the string, winding means on to which said cable is wound, means holding said winding means inoperative when the cable is supporting the determined proportion of weight of the drill string, and acting automatically and positively to operate said winding means when the proportion of weight supported by the cable varies from the determined proportion to re-establish said determined proportion whereby a substantially constant pressure of the boring tool of the drill string upon earth formation will be maintained.

15. In a well drilling organization a drill string, a cable providing a determined partial support for the string, winding means on to which said cable is wound, means holding

said winding means inoperative when the cable is supporting the determined proportion of weight of the drill string, and acting automatically and positively to operate the winding means in either direction when the proportion of weight supported by the cable varies from the determined proportion to re-establish said proportion whereby a substantially constant pressure of the boring tool of the drill string upon the earth formation will be maintained.

16. In a well drilling organization, a drill string provided with a boring tool, a cable providing a predetermined partial support for the string, winding means for said cable, means for securing said winding means, positive operating means for releasing said securing means, and means responsive to the tension in said cable for controlling said operating means whereby said operating means is caused to release said winding means so as to maintain a predetermined constant tension in said cable corresponding to said predetermined partial support for the drill string and thereby maintain a substantially constant pressure of the boring tool upon the earth formation.

In witness whereof, I have hereunto affixed my signature.

WALTER A. LOOMIS.