May 31, 1949. J. F. MOORE, JR 2,471,644

LENGTH METERING APPARATUS FOR DRILL PIPES AND THE LIKE

Filed June 4, 1948 2 Sheets-Sheet 1

FIG. 1.

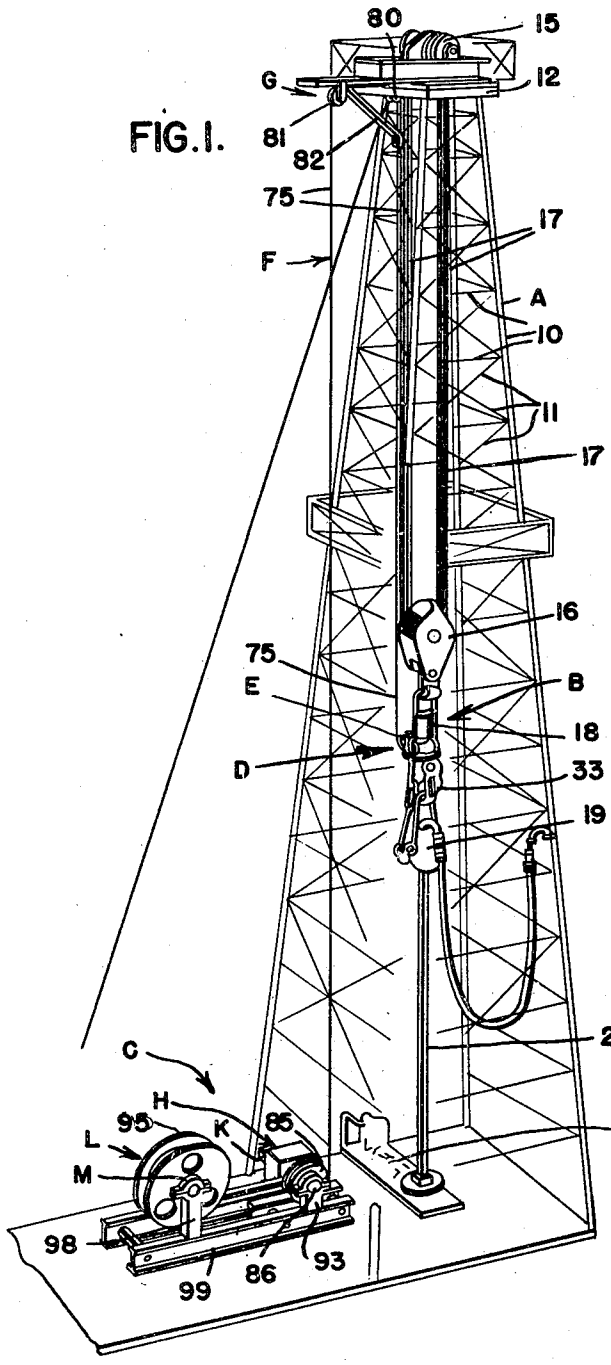


FIG. 2.

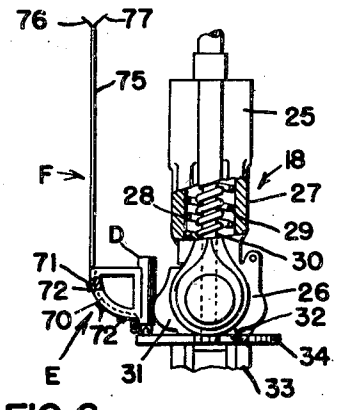
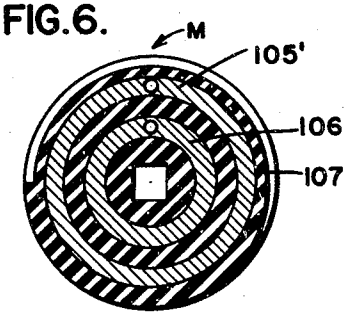


FIG. 6.



INVENTOR.
Joseph F. Moore, Jr.

BY Lancaster, Allwine & Rommel
ATTORNEYS.

May 31, 1949. J. F. MOORE, JR 2,471,644

LENGTH METERING APPARATUS FOR DRILL PIPES AND THE LIKE

Filed June 4, 1948 2 Sheets-Sheet 2

FIG. 3.

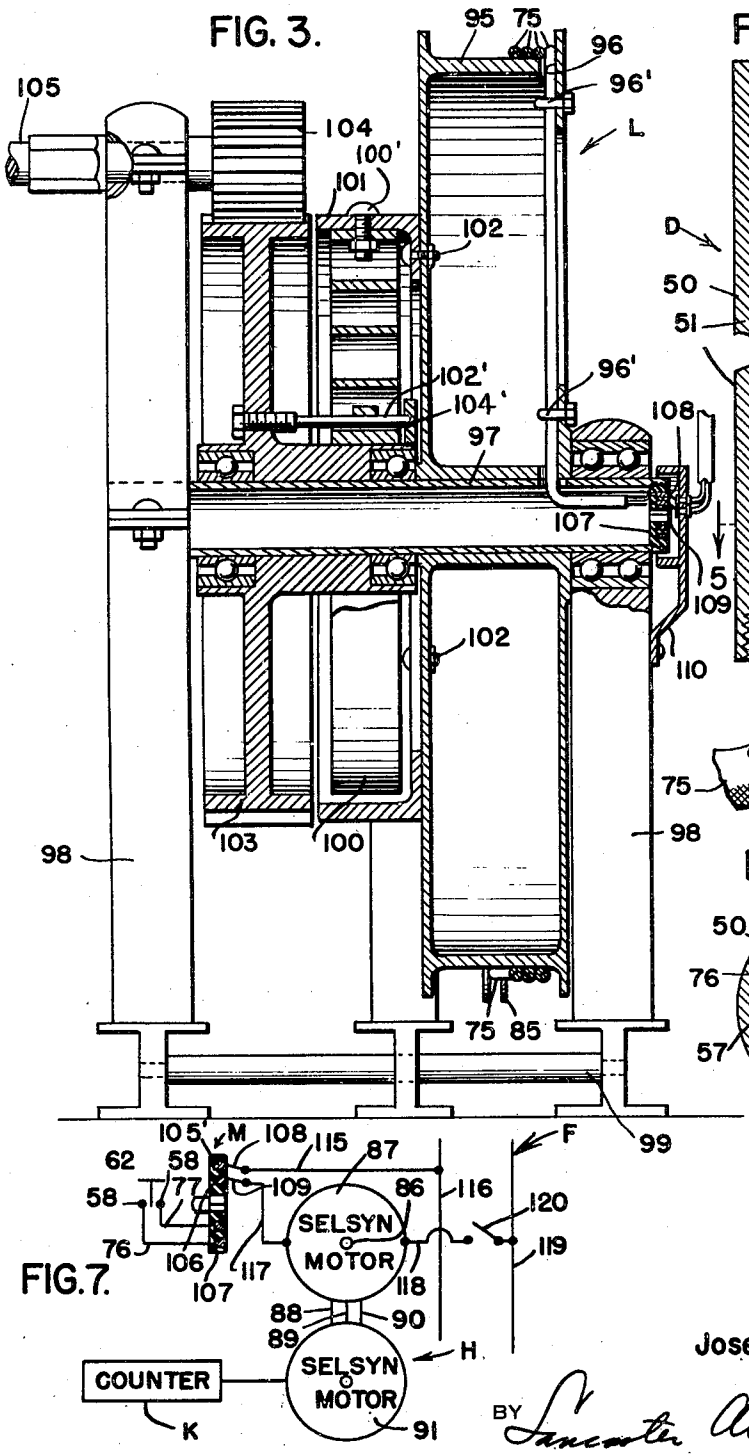


FIG. 4.

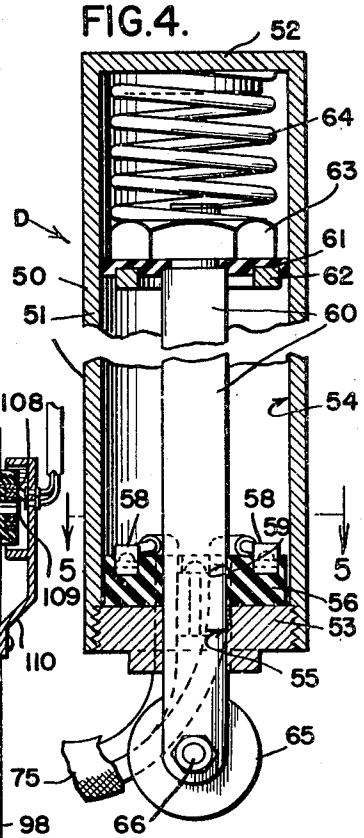


FIG. 5.

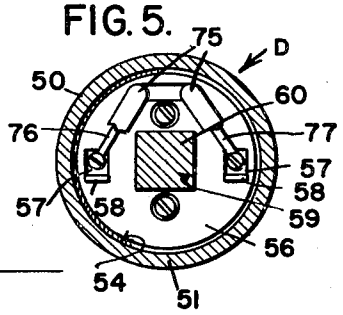


FIG. 7.

INVENTOR.
Joseph F. Moore, Jr.

BY Lancaster Allwine & Rommel
ATTORNEYS.

Patented May 31, 1949 2,471,644

UNITED STATES PATENT OFFICE

2,471,644

LENGTH METERING APPARATUS FOR DRILL PIPE AND THE LIKE

Joseph F. Moore, Jr., Berryville, Va.

Application June 4, 1948, Serial No. 31,186

14 Claims. (Cl. 33—134)

1

This invention relates to length-measuring devices and more specifically to devices for metering, one by one, lengths of material which may be joined end to end. An example of such lengths of material is lengths of drill pipe employed in well drilling operations.

An important object of the invention is to provide means, dependent upon the successive elongations of a hook (such as the hook of the hoisting gear of well drilling equipment) when loaded with successive lengths of material (such as drill pipe), to register (in feet, for example) the total lengths of such material.

Another important object is to provide means, as just described, which will also compensate for bodily movements of the loaded hook, such as when the hook is raised or lowered, whereby there will be no errors in the totals revealed by the register.

Still another important object is to provide an electro-mechanically-operated device for the purpose named, which is positive in operation, of generally rugged construction and requires no fine adjustments or calculations in order to operate it.

Yet another important object is to make provision for a device of this kind which requires no alterations of consequence in conventional well drilling equipment, the device being an attachment or addition to standard equipment.

Other objects and advantages of the invention will be apparent during the course of the following detailed description of the invention, taken in connection with the accompanying drawings, and in which drawings:

Fig. 1 is a perspective view of a well derrick and rotary drilling rig with the novel metering device attached thereto.

Fig. 2 is a view mostly in elevation of a conventional hook of a rotary drilling rig, with an electric switch, forming a part of the new metering device, associated with the hook.

Fig. 3 is a view, mostly in vertical section of an electrical conductor winding drum and a collector ring assembly associated therewith, both forming a portion of the new device.

Fig. 4 is a vertical section, greatly enlarged, of the novel electric switch of Fig. 2.

Fig. 5 is a horizontal section, substantially on the line 5—5 of Fig. 4.

Fig. 6 is a vertical section of the collector ring of Fig. 3.

Fig. 7 is an electrical wiring diagram of the novel device.

In the drawings, wherein for the purpose of

2

illustration is shown a preferred embodiment of the invention and wherein similar reference characters designate corresponding parts thruout the several views, the letter A designates a support, B designates drilling equipment, and C designates the novel device.

The support A is shown as a conventional oil well derrick, including girts 10 and braces 11, and having a crown platform 12 at its summit.

The drilling equipment B is shown, by way of example, as a mechanically-controlled drilling equipment assembly, including a crown block 15, traveling block 16, cables 17 connecting the blocks 15 and 16 and draw works (not shown), hook 18, swivel 19, grief stem or kelly 20 and drilling unit, with engine 21.

Since the hook 18 is especially associated with the novel metering device C, some of its parts, altho conventional, will need to be described briefly. Referring mainly to Fig. 2, the hook 18 comprises two main portions 25 and 26, with the portion 25 being the upper, crown block-attached portion, and including housing walls 27 defining a chamber 28 containing a retraction spiral spring assembly 29, with the lower end of the assembly 29 borne by the lower portion of the walls 27, and the upper end of the spring assembly 29 supporting the lower, rotatable, swivel-attached portion 26, which portion 26 includes a headed stem 30 extending upwardly into the chamber 28 with its head disposed upon the upper end of the spring assembly 29. Below the stem 30 the portion 26 has an enlargement 31 with a substantially horizontal ledge or flange 32, and this enlargement terminates in a hook section 33. Disposed upon this ledge 32 may be a perforated disc 34. If such a disc does not form a part of the hook 18, it should be provided. The periphery of the disc 34 is outwardly of the vertical plane of the enlargement 31.

The novel metering device C comprises electric switch means D, first guide and support means E for an electric wiring means F, second guide and support means G for the electric conductor, metering operator assembly H, metering or counter means K, reeling means L, collector ring assembly M.

The electric switch means D, shown best in Figs. 2, 4 and 5, includes a preferably tubular housing 50 comprising arcuate side wall 51 an upper end wall 52 and a lower end wall 53, defining a chamber 54. Preferably one end wall is removable, such as the wall 53. This may be accomplished by providing an interior screw thread at the lower end of the wall 51 and ex-

terior screw thread at the inner periphery of the end wall 53, to cooperate therewith. The end wall 53 is provided with an axially-disposed, polygonal opening, such as a square opening 55. Disposed upon the inner face of the end wall 53 is an insulating member 56 of dielectric material containing two spaced-apart binding posts 57. These have upstanding lugs, providing a pair of terminal contacts 58. These comprise the fixed contacts of the switch D. The member 56 has an axially-disposed, polygonal opening, such as the square opening 59, concentric with the opening 55. Slidably extending thru the openings 55 and 59 is a vertically-reciprocating member 60 of polygonal transverse cross section, as may be seen in Fig. 5. This extends into the chamber 54 and outwardly of the housing 50. Its upper end portion within the housing, may be provided with a disc 61 of dielectric material supporting, on its under side, a ring-shaped electric contact 62, which constitutes the movable contact of the switch D and, as the member 60, disc 61 and contact 62 move downwardly, the fixed contacts 58 are disposed within the path of travel of the ring-shaped contact 62, so that it may abut the fixed contacts and complete a circuit across them. The upper end of the member 60 may be screw threaded to receive a nut 63 to retain the disc 61 in place and provide an abutment for the lower end of an expansion spiral spring 64, the other end of which bears against the inner face of the end wall 52. The outer or lower end portion of the member 60 rotatably carries a roller 65 on axle 66, constructed and arranged to roll over the upper face of the disc 34. Since the member 60 and the openings 55 and 59 are polygonal, the member 60 will not rotate. The axis of the shaft 66 is set to intersect the longitudinal axis of the member 60. The housing 50 is attached to the enlargement 31 of the hook 18, in a substantially vertical position, as by welding. The spiral spring 64 of course urges the roller 65 in rolling contact with the disc 34, as the hook portion 26 rotates with respect to the hook portion 25 or the hook portion 26 moves downwardly under a load.

Associated with the switch D is the first guide and support means E which includes a wing or bracket 70 suitably secured to the housing 50 in any approved way, to extend outwardly therefrom, substantially as in Fig. 2. The wing or bracket 70 has an arcuate groove 71 in its outermost face to receive a portion of a two-wire electric conductor 75 which may be secured in the groove 71 by clips 72 of any approved style.

The two-wire electric conductor 75 forms part of the wiring F and includes lead 76 and 77, one electrically connected with one fixed terminal 58 and the other electrically connected with the other fixed terminal 58, since the conductor 75 may extend thru suitable openings in the end wall 53 and disc 56. The other ends of these leads are electrically connected with a pair of collector rings 105 and 106 to be subsequently described in connection with the collector ring assembly M. The conductor 75 is, preferably, one of rugged construction and subject to substantially no stretch.

The conductor 75 extends upwardly from the wing or bracket 70 to, preferably, the summit of the derrick A where it may be trained over a pair of suitable grooved rollers 80 and 81 rotatably supported on substantially parallel horizontal axes by a bracket 82 extending outwardly of the derrick, as from the crown platform 12 and

braced against the adjacent girts and braces, thus providing the second conductor guide and support means G.

From the roller 81, the conductor 75 extends downwardly to the metering operator assembly H, which includes a grooved rotor 85 about which the conductor 75 is wrapped for one and one-quarter turns. Preferably the circumference of the base of the groove of the rotor 85 is such that exactly ten feet of conductor 75 is run off or wrapped around the rotor 85 upon one revolution of the latter. The shaft 86 of the rotor 85 is operatively connected with the rotor of a conventional Selsyn electric motor 87 (Industrial Instruments for Measurement and Control by Thomas J. Rhodes, First Edition, McGraw-Hill Book Co., New York, 1941, page 368), which is electrically connected, as is well known in the art by the three-wires 88, 89 and 90, with a second Selsyn electric motor 91. The shaft of the latter is operatively connected with the metering or counter means K which may be a conventional forward-and-back mechanical counter. Preferably this counter is of the type which will register multiples of ten feet, both as additions and as substractions. The shaft of the rotor 85 is supported in bearings 93.

From the rotor 85, the conductor 75 extends to the reel or drum 95 of the reeling means L, passes thru the periphery of the reel as at 96, to which reel it is suitably secured, as by clips 96' and thru the shaft 97 upon which the reel 95 is mounted. The shaft 97 may be supported by any approved bearing means 98, extending upwardly from a suitable support structure 99 (which may also support the bearings 93).

So that the conductor 75 will be kept taut at all times, since the correct operation of the metering or counter means K depends upon a taut conductor, the take-up and play-out of the drum 95 may be governed by a governor for the reel. This may include a conventional heavy-duty coil spring 100 with one end (outer end) operatively connected as by the bolt 100' with a spring housing 101 which is, in turn, secured to the drum 95 as by bolts 102 and, of course, turns with the drum. The other (inner end) of the coil spring 100 extends about the shank of a connecting member 102' which is connected to the web of a master gear wheel 103, in mesh with a small gear wheel 104 The latter may be rotated by means of a conventional hand crank 105 which may be thereupon latched in a fixed position by any conventional latching means. The gear wheel 104 has a shaft extending thru one of the bearings 98 and the gear wheel 103 is mounted upon the shaft 97. The hub of this wheel 103 carries a socketed member 104' to receive the end of the connecting member 102' after the latter has passed thru the inner end of the spring 100.

The collector ring assembly M, includes a pair of collector rings 105' and 106 carried by a dielectric material disc 107, mounted upon the shaft 97. To the ring 105' is electrically connected the end of the lead 76 of conductor 75 within the shaft 97, and to the ring 106 is electrically connected the end of the lead 77 within the shaft 97. A suitable brush 108 contacts the ring 105' and brush 109 contacts the ring 106, and these may be supported to brush the rings by a suitable bracket 110.

The brush 108 is electrically connected with a lead 115 extending to the alternating current power conductor 116 and the brush 109 is electrically connected with a lead 117 extending to

and electrically connected with the wiring of the Selsyn motor 87 and this wiring is also electrically connected with a lead 118 extending to and electrically connected with the alternating current power conductor 119. If desired, a suitable manually-operated electric switch 120 may be interposed as in the lead 118.

No altering of consequence is necessary in order to attach the novel metering device C to a derrick and drilling equipment. The electric switch means D may be secured by welding the housing 50 to the upper main portion 25 of the hook 18 with the roller 65 in contact with the upper face of the flange 32. The bracket 82 of the second guide and support means G may be secured to the derrick A by the use of bolts or the like. The support structure 98 of the reeling means L, metering or counter means K, its operator assembly H and collector ring assembly M may be disposed at the foot of the derrick.

In use, since the weight of the swivel 19, grief stem 20 and up to one stand (substantially 92 feet) of conventional drill pipe will not elongate the spring assembly 29 of the hook 18, it will be necessary to take the unit (total length or number of sections) of the stand of drill pipe into consideration and manually set the counter accordingly.

The addition of the next section of drill pipe will result in the following: Raising the stand of drill pipe will not elongate the hook 18, consequently the switch means D will not operate, nor will it operate when the weight of only the next section of pipe is borne by the hook, but, after this next section is attached to the slips-held first stand of drill pipe and the conventional slips are removed, the weight of the added section of pipe will elongate the hook 18 and this will cause the reciprocating member 60 and its disc 61 and ring-shaped electric contact 62 to move downwardly, closing the electric circuit and energize the Selsyn motor 87. While the lowering of the drill pipe is now going on, for the purpose of positioning the drill bit, the conductor cable 75 will play out from the drum 95 and rotate the rotor 85 of the metering operator assembly H in one direction. As is obvious this will effect operation of the counter to register such play out (as in feet). Operation of the counter is effected by the extent of travel of the conductor 75. If the conductor travels in one direction, the counter mechanism is actuated to cause the counter to add the distance traveled but if the conductor travels in the opposite direction, the counter mechanism is actuated to cause the counter to subtract the distance traveled in the latter direction. Consequently every time the switch-connected end of the conductor 75 is raised (as ten feet), there will be a corresponding reduction in the number of units (as 10 feet) registered and every time this end of the conductor 75 is lowered, there will be a corresponding addition to the number of units registered. Therefore, at any desirable time, the units of measurement may be noted upon the counter.

It is important that the conductor 75 be kept taut at all times, and this is effected by the construction disclosed. The spring 100 is not strong enough to raise the freed hook 18, but is sufficiently strong to retain the conductor taut and in good frictional contact with the rotor 85, which is of considerable importance for the correct registering of the units.

Various changes may be made to the form of the invention herein shown and described without departing from the spirit of the invention or scope of the claims.

I claim:

1. In combination with a bodily vertically-reciprocable, elongative member, a length metering apparatus for metering successive lengths of material suspended from and elongating said member during bodily reciprocation of said member, said apparatus including electric switch means, having two fixed contacts, carried by and operable by said member upon elongation and retraction thereof; an elongate electric conductor including a sheath and leads enclosed thereby, with an end of each lead electrically connected with said fixed contacts; means movably supporting an intermediate portion of said conductor above said member and switch means; a length metering mechanism; electro-mechanical means to cause operation of said metering mechanism, including a rotor, about which portions of said conductor are trained, a Selsyn motor, means operatively connected between said rotor and motor to cause rotation of said motor upon rotation of said rotor, a second Selsyn motor electrically connected with the first Selsyn motor and shaft means operatively connected said second Selsyn motor and said metering mechanism; means to retain said conductor taut; and means placing said first Selsyn motor in circuit with said leads.

2. In combination with a bodily vertically-reciprocable, elongative member comprising an upper portion, and a lower, vertically-movable portion provided with an abutment, a length metering apparatus for metering successive lengths of material suspended from and elongating said member during bodily reciprocation of said member, said apparatus including electric switch means operable by said member upon elongation and retraction thereof, said means having two fixed electric contacts, a vertically-disposed housing secured to said upper portion, a plunger slidable vertically thru said housing with its lower end in engagement with said abutment and its upper end supporting a movable electric contact, with said fixed contacts disposed within the path of travel of said movable contact; an elongate electric conductor including a sheath and leads enclosed thereby, with an end of each lead electrically connected with said fixed contacts; means movably supporting an intermediate portion of said conductor above said member and switch means; a length metering mechanism, electro-mechanical means to cause operation of said metering mechanism, including a rotor, about which portions of said conductor are trained, a Selsyn motor, means operatively connected between said rotor and motor to cause rotation of said motor upon rotation of said rotor, a second Selsyn motor electrically connected with the first Selsyn motor and shaft means operatively connecting said second Selsyn motor and said metering mechanism; means to retain said conductor taut; and means placing said first Selsyn motor in circuit with said leads.

3. In combination with a bodily vertically-reciprocable, elongative member, a length metering apparatus for metering successive lengths of material suspended from and elongating said member during bodily reciprocation of said member, said apparatus including electric switch means having two fixed contacts, carried by and operable by said member upon elongation and retraction thereof; an elongate electric conductor including a sheath and leads enclosed thereby, with

an end of each lead electrically connected with said fixed contacts; means movably supporting an intermediate portion of said conductor above said member and switch means, including a roller over which the intermediate portion of said conductor is trained and from which said conductor hangs; a length metering mechanism; electro-mechanical means to cause operation of said metering mechanism, including a rotor, about which portions of said conductor are trained, a Selsyn motor, means operatively connected between said rotor and motor to cause rotation of said motor upon rotation of said rotor, a second Selsyn motor electrically connected with the first Selsyn motor and shaft means operatively connecting said second Selsyn motor and said metering mechanism; means to retain said conductor taut; and means placing said first Selsyn motor in circuit with said leads.

4. In combination with a bodily vertically-reciprocable, elongative member comprising an upper portion, and a lower vertically-movable portion provided with an abutment, a length metering apparatus for metering successive lengths of material suspended from and elongating said member during bodily reciprocation of said member, said apparatus including electric switch means, carried by and operable by said member upon elongation and retraction thereof, said means having a vertically-disposed housing secured to said upper portion, a pair of spaced-apart fixed electric contacts within said housing, a plunger slidable vertically thru said housing with its lower end in engagement with said abutment and its upper end supporting a movable electric contact, with said fixed contacts disposed within the path of travel of said movable contact; an elongate electric conductor including a sheath and leads enclosed thereby, with an end of each lead electrically connected with said fixed contacts; means attaching the conductor at the contacts-attached end portion of said leads to said housing, including a bracket having a conductor-receiving groove, with said end portion disposed within said groove, and retaining clips for said portion carried by said bracket means movably supporting an intermediate portion of said conductor above said member and switch means; a length metering mechanism; electro-mechanical means to cause operation of said metering mechanism, including a rotor, about which portions of said conductor are trained, a Selsyn motor, means operatively connected between said rotor and motor to cause rotation of said motor upon rotation of said rotor, a second Selsyn motor electrically connected with the first Selsyn motor and shaft means operatively connecting said second Selsyn motor and said metering mechanism; means to retain said conductor taut; and means placing said first Selsyn motor in circuit with said leads.

5. In combination with a bodily vertically-reciprocable, elongative member, a length metering apparatus for metering successive lengths of material suspended from and elongating said member during bodily reciprocation of said member, said apparatus including electric switch means, having two fixed contacts, carried by and operable by said member upon elongation and retraction thereof; an elongate electric conductor including a sheath and leads enclosed thereby, with an end of each lead electrically connected with said fixed contacts; means movably supporting an intermediate portion of said conductor above said member and switch means; a length

metering mechanism, electro-mechanical means to cause operation of said metering mechanism including a rotor, about which portions of said conductor are trained, a Selsyn motor, means operatively connected between said rotor and motor to cause rotation of said motor upon rotation of said rotor, a second Selsyn motor electrically connected with the first Selsyn motor and shaft means operatively connecting said second Selsyn motor and said metering mechanism; means to retain said conductor taut including a drum, with a portion of said conductor adjacent the other end of each lead wrapped around said drum and retained thereby, a shaft for said drum, and spring means to rotate said drum to take up slack in said conductor; and means placing said first Selsyn motor in circuit with said leads.

6. In combination with a bodily vertically-reciprocable, elongative member, a length metering apparatus for metering successive lengths of material suspended from and elongating said member during bodily reciprocation of said member, said apparatus including electric switch means, having two fixed contacts, carried by and operable by said member upon elongation and retraction thereof; an elongate electric conductor including a sheath and leads enclosed thereby, with an end of each lead electrically connected with said fixed contacts; means movably supporting an intermediate portion of said conductor above said member and switch means; a length metering mechanism, electro-mechanical means to cause operation of said metering mechanism including a rotor, about which portions of said conductor are trained, a Selsyn motor, means operatively connected between said rotor and motor to cause rotation of said motor upon rotation of said rotor, a second Selsyn motor electrically connected with the first Selsyn motor and shaft means operatively connecting said second Selsyn motor and said metering mechanism; means to retain said conductor taut including a drum, with a portion of said conductor adjacent the other end of each lead wrapped around said drum and retained thereby, a shaft for said drum, and spring means to take up slack in said conductor; and means placing said first Selsyn motor in circuit with said leads including a pair of spaced-apart collector rings carried by said shaft, with one lead electrically connected with one ring and the other lead electrically connected with the other ring, and a pair of spaced-apart brushes bearing upon said rings.

7. In a successive lengths-metering apparatus, for association with drilling equipment including a bodily-reciprocable, elongative hook, for metering successive lengths of drill pipe suspended from said hook during bodily reciprocation of said hook, said apparatus including electric switch means operable upon elongation and retraction of said hook; a lengths-metering mechanism; and electro-mechanical means operating said lengths-metering mechanism upon closing of said switch means and bodily reciprocation of said hook.

8. In a successive lengths-metering apparatus, for association with drilling equipment including a bodily-reciprocable, elongative hook, for metering successive lengths of drill pipe suspended from said hook during bodily reciprocation of said hook, said apparatus including electric switch means operable upon elongation and retraction of said hook; a lengths-metering mechanism; and electro-mechanical means operating said lengths-metering mechanism upon closing of said

switch and bodily reciprocation of said hook, an electric conductor electrically connected with said switch and with said electro-mechanical means, a rotor over which intermediate portions of said conductor are trained, and means operatively connecting said rotor and lengths-metering mechanism, to actuate said lengths-metering mechanism.

9. In a successive lengths-metering apparatus, for association with drilling equipment including a bodily-reciprocable, elongative hook, for metering successive lengths of drill pipe suspended from said hook during bodily reciprocation of said hook, said apparatus including electric switch means operable upon elongation and retraction of said hook; an additive-subtractive lengths-metering mechanism; electro-mechanical means operating said lengths-metering mechanism upon closing of said switch and bodily reciprocation of said hook, and an electrical connection between said switch means and electro-mechanical means.

10. In a successive lengths-metering apparatus, for association with drilling equipment including a bodily-reciprocable, elongative hook, for metering successive lengths of drill pipe suspended from said hook during bodily reciprocation of said hook, said apparatus including electric switch means operable upon elongation and retraction of said hooks; an additive-subtractive lengths-metering mechanism; and electro-mechanical means operating said lengths-metering mechanism upon closing of said switch and bodily reciprocation of said hook, an electric conductor electrically connected with said switch and electro-mechanical means, a rotor over which intermediate portions of said conductor are trained, and means operatively connecting said rotor and lengths-metering mechanism to actuate said lengths-metering mechanism.

11. In a successive lengths-metering apparatus, for association with drilling equipment including a bodily-reciprocable, elongative hook, for metering successive lengths of drill pipe suspended from said hook during bodily reciprocation of said hook, said apparatus including electric switch means operable upon elongation and retraction of said hook; an additive-subtractive lengths-metering mechanism; and electro-mechanical means operating said lengths-metering mechanism upon closing of said switch and bodily reciprocation of said hook, an elongate electric conductor electrically connected with said switch and electro-mechanical means, a rotor over which intermediate portions of said conductor are trained, a shaft for said rotor, a Selsyn-motor type telemetering system, with said shaft operatively connected therewith, and said system operatively connected with said lengths-metering mechanism.

12. In a successive lengths-metering apparatus, for association with drilling equipment including a bodily-reciprocable, elongative hook, for metering successive lengths of drill pipe suspended from said hook during bodily reciprocation of said hook, said apparatus including electric switch means operable upon elongation and retraction of said hook; a lengths-metering mechanism; electro-mechanical means operating said lengths-metering mechanism upon closing of said switch and bodily reciprocation of said hook, an electric conductor electrically connected with said switch and electro-mechanical means, a rotor over which intermediate portions of said conductor are trained, and means operatively connecting said rotor and lengths-metering mechanism, to actuate said lengths-metering mechanism; and means to take up slack in said conductor at said intermediate portions thereof and between said switch and rotor.

13. In a successive lengths-metering apparatus, for association with drilling equipment including a bodily-reciprocable, elongative hook, for metering successive lengths of drill pipe suspended from said hook during bodily reciprocation of said hook, said apparatus including electric switch means operable upon elongation and retraction of said hook; a lengths-metering mechanism; electro-mechanical means operating said lengths-metering mechanism upon closing of said switch and bodily reciprocation of said hook, an electric conductor electrically connected with said switch and electro-mechanical means, a rotor over which intermediate portions of said conductor are trained, and means operatively connecting said rotor and lengths-metering mechanism, to actuate said lengths-metering mechanism; and means to take up slack in said conductor at said intermediate portions thereof and between said switch and rotor, including a drum to which is attached the end portion opposite the switch-attached end portion of said conductor and over which the drum-attached end portion of said conductor is wound, and means yieldably resisting rotation of said drum upon unwinding of said drum-attached end portion of said conductor from said drum.

14. In a successive lengths-metering apparatus, for association with drilling equipment including a bodily-reciprocable, elongative hook, for metering successive lengths of drill pipe suspended from said hook during bodily reciprocation of said hook, said apparatus including electric switch means operable upon elongation and retraction of said hook; a lengths-metering mechanism; electro-mechanical means operating said lengths-metering mechanism upon closing of said switch and bodily reciprocation of said hook, an electric conductor electrically connected with said switch and electro-mechanical means, a rotor over which intermediate portions of said conductor are trained, and means operatively connecting said rotor and lengths-metering mechanism, to actuate said lengths-metering mechanism; and means to take up slack in said conductor at said intermediate portions thereof and between said switch and rotor, including a drum to which is attached the end portion opposite the switch-attached end portion of said conductor and over which the drum-attached end portion of said conductor is wound, and spring means for normally rotating said drum to wind said drum-attached end portion thereon and yieldably resisting unwinding of said conductor from said drum.

JOSEPH F. MOORE, JR.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,982,182	Williams et al.	Nov. 27, 1934
2,060,233	Mathy et al.	Nov. 10, 1936
2,131,868	Bolton et al.	Oct. 4, 1938
2,208,604	Scaramucci	July 23, 1940
2,326,219	Hayward	Aug. 10, 1943
2,327,506	Conrad et al.	Aug. 24, 1943