

Jan. 14, 1941.

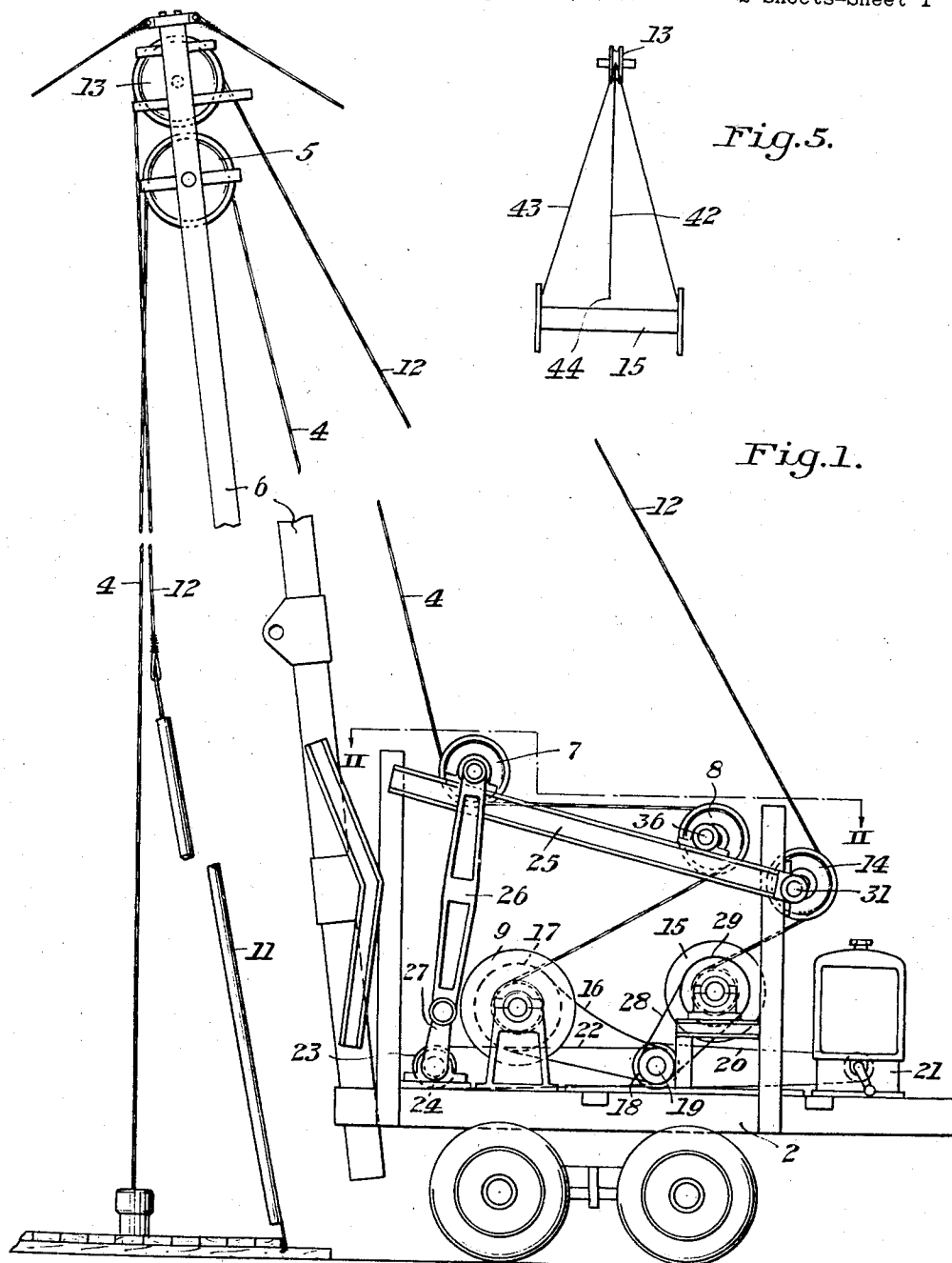
R. R. DOWNIE

2,228,346

CABLE WINDING MACHINE

Filed April 24, 1937

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

Fig. 2.

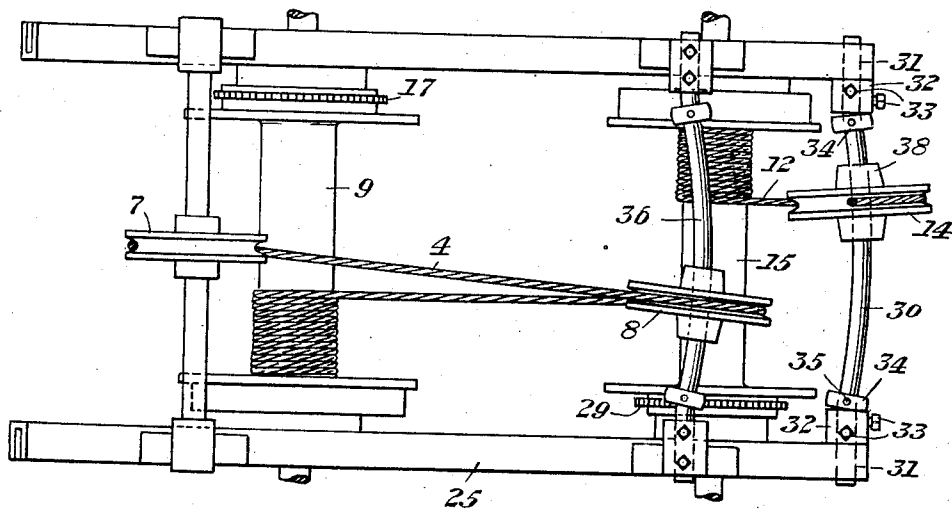


Fig. 3.

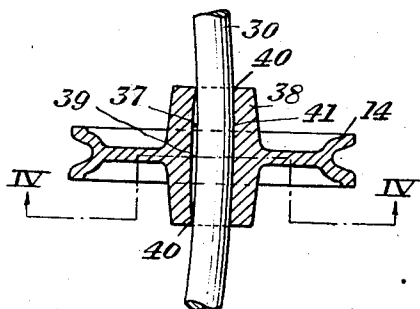
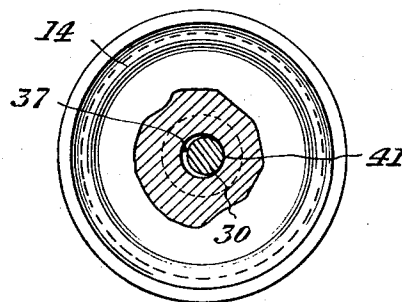


Fig. 4.



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UNITED STATES PATENT OFFICE

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CABLE WINDING MACHINE

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4 Claims. (Cl. 254—190)

This invention relates to means for smooth and even winding of a cable on a winding drum, and in the particular embodiment illustrated in the drawings to the winding up and unwinding of operating cables of a well drilling machine. However, the invention may be applied to the winding and unwinding of other cables regardless of the general direction of the pull of the cable. Examples of other such cables are the calf or casing line of well drills, car haulage lines, and elevator ropes.

My invention provides means for so leading the cable to the drum that as the latter revolves in the inwinding direction, the cable is fed to the winding point of the drum without substantial lateral draft either toward the side of the preceding wraps or in the advance direction.

Objects of the invention are to cause the cable to wrap and lie in smooth and compact courses without voids, to reverse or turn back readily without piling up at the ends of the course, and without "leading away" or cutting across the drum in the first few wraps of the course.

Further objects are to avoid the lateral abrasion and bruising of the cable which result from excessively tight packing; to avoid the kinking and pinching which occur in a given course if the preceding or underlying course contains voids or humps; to secure the maximum possible spooling capacity on a drum of given barrel and flange diameters and given length; to secure well balanced or concentric loading of the drum so that at high speeds in paying out, the vibration and jumping tendency of the drum and the machine carrying it are kept to a minimum, thus in effect permitting substantially higher payout speeds than are feasible with the eccentric loading which invariably occurs with bad spooling; and what is very important, to prevent the sharp momentary checking of the payout which results from a cable so spooled as to be bound or seized at some point in its length.

In the accompanying drawings which illustrate a preferred embodiment of the invention:

Figure 1 is a side elevation of a well drilling machine having two cable leads in accordance with the present invention, parts being broken away;

Figure 2 is a horizontal section taken substantially on the broken line II—II of Figure 1;

Figure 3 is a horizontal section through the axis of a floating sheave mounted on a curved axle;

Figure 4 is a vertical section taken on the line IV—IV of Figure 3; and

Figure 5 illustrates in a diagrammatic manner a method of determining the curvature of a shaft on which a floating sheave is to be mounted.

Referring more particularly to the accompanying drawings which illustrate my invention as applied to a well drilling machine, the machine is mounted on a truck 2 for easy transportation. A drilling tool is secured to the end of a drilling line or cable 4 which passes over a crown sheave 5 supported by a mast or derrick 6 which is secured at its lower end to the truck. The drilling cable then passes under a front spudding sheave 7 and around a floating or laterally shiftable rear sheave 8 and is connected at its end to a winding drum 9 for the drilling line.

A bailer 11 is secured to one end of a bailer or sand line 12 which passes over a sheave 13 also mounted on the mast 6. The cable 12 then passes around a floating sheave 14 and is connected at its lower end to a winding drum 15 for the sand line.

The winding drum 9 is driven by means of a chain 16 passing around a sprocket 17 on the winding drum 9 and around a sprocket 18 on a countershaft 19. The winding drum 15 is also driven from the countershaft 19, which in turn is connected by a chain 20 to an engine 21. A chain 22 connected to the countershaft 19 and to a sprocket 23 on a shaft 24 moves a walking beam 25 through connecting rods 26 and crank arms 27. The sheaves 7, 8 and 14 are supported on the walking beam. The winding drum 15 is driven from the countershaft 19 by a chain 28 passing around a sprocket wheel 29 on the drum and a sprocket wheel on the countershaft.

The drilling line 4 and the sand line 12 are normally of approximately the same length and range from 200 or 300 to 4000 or 5000 feet in length, depending upon the depth to which the machine is designed to drill. The crown sheave 5 rotates in a vertical plane, is fixed against lateral movement relative to the machine and to earth, and the well is drilled plumb beneath the front vertical tangent of the crown sheave. Practical considerations of variation of torque required for winding up and brake torque for holding and lowering tend to limit the outside or full diameters of the winding drums 9 and 15 to the extent that, particularly on machines for drilling to greater depths, the drums must have such substantial width to accommodate the line that the line has a heavy side draft when approaching and returning from the sides of the drum. This results from the well known prin-

ciple that a reach of cable passing over two wheels having parallel axes tends to pull the wheels into alinement; that is, into a common plane perpendicular to both axes, or if resisted, to run off one or both wheels. The axes of the crown pulley and the drum are parallel and neither wheel can be permitted lateral movement along its axis. In practice, there is even grave objection especially at shallow depths and in hard material to so mounting the front spudding sheave 7 as to permit it to float into the line or plane of pull of the cable in its extent from the crown pulley to the drum. Such lateral freedom of the spudding sheave, desirable for spooling when hoisting tools, permits sharp axial movements (side slap) during the spudding or drilling operation. Under conditions requiring the fixing of position of the front spudding sheave 7 on its axle, the length of line in recurrent misalignment with the drum is decreased, and hence the angle of misalignment increased and the difficulty of spooling aggravated. In the embodiment shown in the drawings, the front spudding sheave 7 is fixed, that is, it is not free to float on its axle, whereas the sheaves 8 and 14 are free to float on their axles. However, under certain conditions, the spudding sheave 7 may also be arranged to float or shift laterally on its axis.

Also, it will be understood that with the trend toward shorter and generally more compact machines for transportation by truck without dismantling the machines, the effective length of lead is further shortened.

The present invention obviates the difficulties in winding and unwinding cable previously referred to by maintaining a substantially constant length of cable between the tangent points of the winding drum and the crown sheave. In the specific embodiment shown for purposes of illustration, this is done by curving the axles of one or more intervening sheaves which float or shift transversely on their axles and contact the cable at a point or points intermediate the winding drum and the fixed sheave. The curvature of the axle and the plane in which the curved axle is located bear such reference to the angle formed by the reaches of the cable as it passes around the floating sheave that as the sheave reaches the midpoint of its path of travel laterally of the drum, the length of line between the fixed sheave and the drum is sufficiently increased to offset the shortening of the reaches which would otherwise occur on straight axles due to the approach to alinement. Of course, the axle may be considered as having its true spacing at the midwidth of the machine, the ends of the axle being curved in such direction as to tend to relieve or shorten the reaches of the cable as the sheave travels outwardly from the midwidth of the axle, thus compensating for the tendency of the misalignment to lengthen them.

In the embodiment shown, the sand line sheave 14 is mounted on an axle 30 so as to have lateral shifting or floating movement under tension of the cable 12 as the cable winds across the face of the drum 15. The axle 30 is curved, except for its ends 31 which are straight. The axle is non-rotatable, being mounted at its ends in brackets 32 and prevented from rotation by means of set screws 33. A collar 34 secured to the axle by a pin 35 is located at each end of the curved portion of the axle so as to limit the path of travel of the floating sheave.

The axle 36 on which the floating sheave 8 rotates and moves transversely of the axis is also

non-rotatable and is curved and mounted in a manner similar to the axle 30.

The appropriate curvature of the axles is quite perceptible and for sheaves having long hubs, it is preferable to slightly increase the diameter of bore at the center, retaining the normal running fit at the ends of the bore. Thus, in Figure 3 the bore 37 of the hub 38 of sheave 14 is of greater diameter at its midpoint 39 than at its ends 40. The axle 30 makes a running fit with the hub at its ends, but intermediate its ends there is a space between the axle and bore. Since the working load on the sheave is always directed substantially against the back 41 of the curve, full length contact of the sheave hub is secured, and the normal fit at the ends prevents lateral rocking or chatter. Chatter, of course, is of greater importance at the higher speeds of running-in than in hoisting.

The curve of the axle 30 is preferably in the plane which bisects the angle formed by the reaches of the sand line 12 at median position as it passes around the sheave 14. The curvature of the axle is such that the ends of its curved portion are nearer the fixed sheave 13 than the central portion of the curved axle.

A satisfactory method for determining the curvature required in the axle 30 is as follows. First, determine the total taut line length from the laterally fixed sheave 13 representing the one end of the lead, to the midwidth of the drum 15 at mean winding diameter, the intervening sheave axle 30 being assumed to be straight. This length is represented in Figure 5 by the reference numeral 42. Second, determine the total taut line length from the laterally fixed sheave 13 to the edge of the drum 15, the final reach of the line being perpendicular to the axis of the drum and parallel to the plane of the drum flange. This is represented in Figure 5 by the reference numeral 43. The difference between the lengths of the lines 43 and 42 represents the amount of increase of line length required at the median or normal point 44 of the lead. Third, determine the radius of curvature required in an axle to produce a chord height sufficient to take up the line length released from the lead as the line is wound upon the drum from the end of it to the plane of the fixed sheave. It will be understood that the takeup in the line may be distributed over two or more axles instead of over only a single axle if desired, also, as shown in the drawings, that the curved portion of the axle must be extended at each end, beyond the length of chord used in determining the radius of curve, a sufficient distance to permit the lower tangent point of the pilot sheave to travel nearly to the center plane of the wrap of line adjacent the drum flange.

Although I prefer to maintain the length of cable between the fixed sheave and the winding drum constant as the cable is wound about the drum, by mounting the floating sheave on a curved shaft, other suitable means may be employed. My invention is intended to cover any means whereby the point of intersection of the axis and plane of rotation of the sheave which leads to the winding drum traverses a curved path so as to compensate, with sufficient precision to permit smooth spooling, for the differences in lengths of the cable between the fixed sheave and the winding drum as the cable winds across the drum face.

Although I have illustrated and described a preferred embodiment of the invention, it is to

be understood that the invention may be otherwise embodied or practiced within the scope of the following claims.

I claim:

- 5 1. In combination, a curved shaft, a sheave rotatable on and movable along the curved shaft, the sheave having a hub provided with a bore, the diameter of the bore adjacent its mid portion being greater than adjacent its ends.
- 10 2. In combination, a curved shaft, a sheave rotatable on and movable along the curved shaft, the sheave having a hub provided with a bore, the diameter of the bore adjacent its mid portion being greater than adjacent its ends, the diameter of the bore adjacent its ends being such that
- 15 the hub adjacent its ends makes a running fit with the curved shaft.
3. In combination, a curved shaft, a sheave rotatable on and movable along the curved shaft,
- 20 the sheave having a hub provided with a bore, the diameter of the bore adjacent its mid portion being greater than adjacent its ends, the diameter of the bore adjacent its ends being such that

the hub adjacent its ends makes a running fit with the curved shaft, the curvature of the wall of the bore being substantially the same as the curvature of the curved shaft.

4. In a cable-winding machine the combination of a motor, a winding drum driven by the motor, a sheave of which the axis and plane of rotation are substantially stationary with reference to the drum, a cable secured to the drum and engaging the sheave, another sheave so located as to engage the cable at a point intermediate the drum and stationary sheave, said other sheave being mounted to travel laterally along a curved bar under tension of the cable as the latter winds across the drum face, the curvature of said bar being such that the total length of cable between the drum and stationary sheave remains substantially constant as the cable winds across the drum face, said other sheave having a hub provided with a bore, the diameter of the bore adjacent its mid-portion being greater than adjacent its ends.

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