March 2, 1926. 1,575,142

E. C. WILSON ET AL

HOISTING APPARATUS

Filed Dec. 28, 1923 2 Sheets-Sheet 1

Fig. 1.

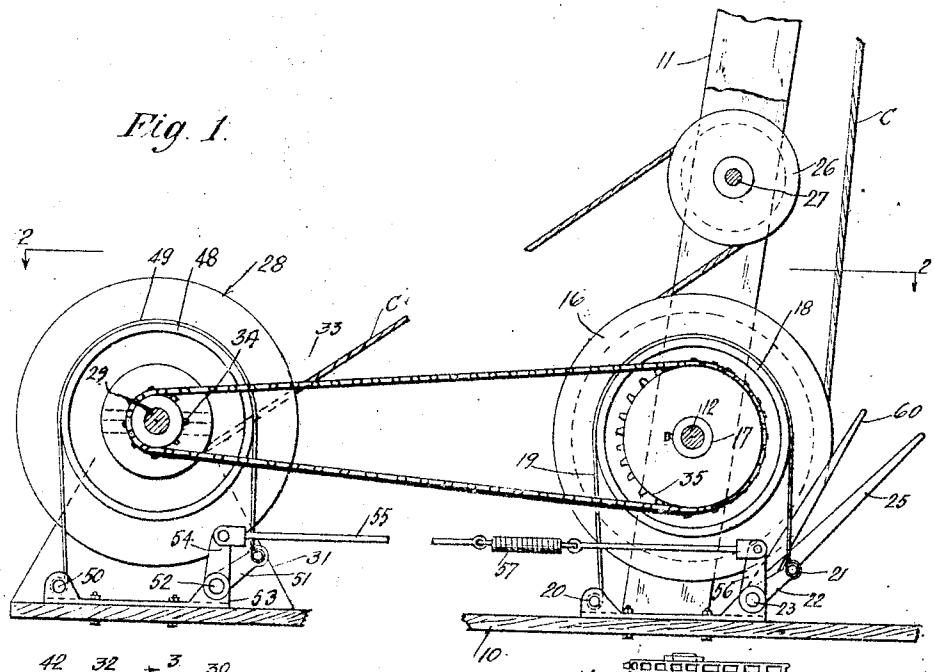
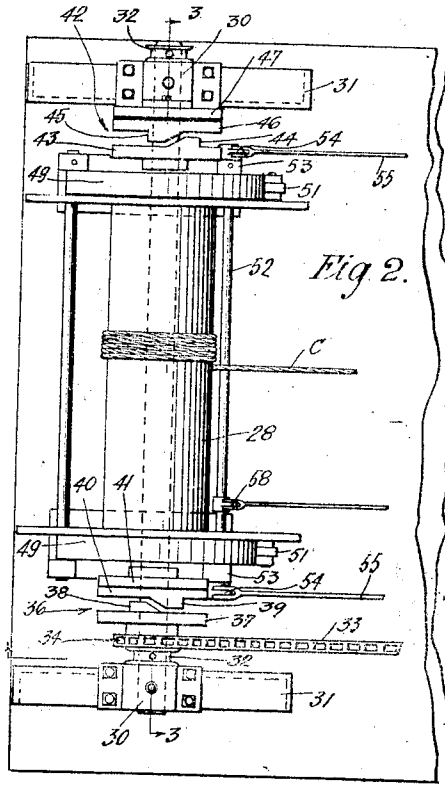
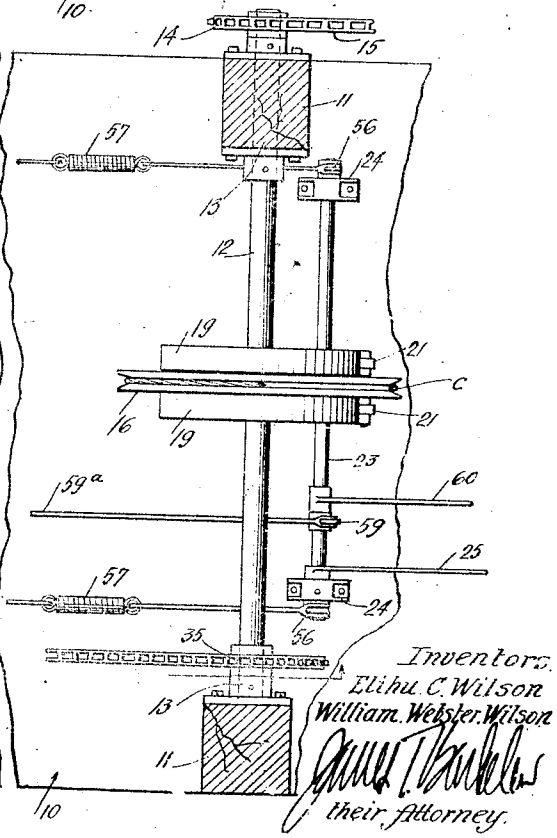


Fig. 2.





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Fig. 3.

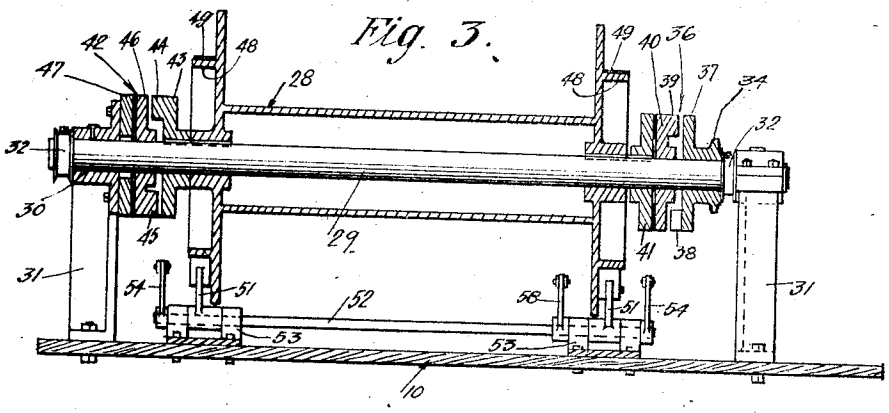
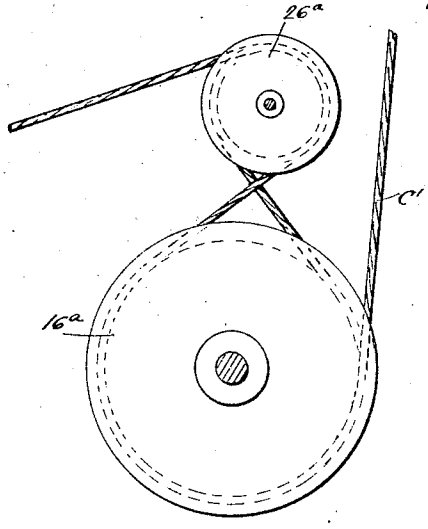


Fig. 4.



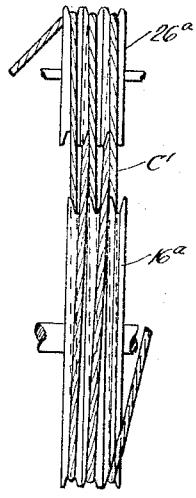


Fig. 5.

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Patented Mar. 2, 1926. 1,575,142

UNITED STATES PATENT OFFICE.

ELIHU C. WILSON AND WILLIAM WEBSTER WILSON, OF LOS ANGELES, CALIFORNIA.

HOISTING APPARATUS.

Application filed December 28, 1923. Serial No. 683,190.

To all whom it may concern:

Be it known that we, ELIHU C. WILSON and WILLIAM WEBSTER WILSON, citizens of the United States, and residents of the city of Los Angeles, in the county of Los Angeles and State of California, have invented a new and useful Improvement in Hoisting Apparatus, of which the following is a specification.

This invention relates generally to hoisting apparatus, and while the invention may be embodied in many different forms and used in various situations, it is particularly applicable to hoisting apparatus used in connection with the drilling of oil or artesian wells. Therefore we have illustrated and will describe the invention as applied to this particular use, but this is not to be construed as limiting the invention or restricting the broader claims appended hereto.

The invention may be applied with equal advantage either to "standard" or "rotary" drilling rigs, but, for the sake of brevity, we will confine this description to a "draw works" installation wherein a winch or hoisting drum is utilized for transmitting power from an engine to a rotary table, cat heads, and cables for raising and lowering drill or well pipe, etc. We will still further narrow down the description to the performance of the hoisting apparatus in accomplishing a single task, namely, that of lowering drill pipe or casing into a drill hole. From this description of its use in a particular situation, it will be immediately apparent to those skilled in the art that the invention is equally efficacious in many other situations.

To better point out the utility and merit of our device, it will be well to discuss the usual type of hoisting apparatus and its failings; for it is among the purposes of our invention to provide a hoist which shall have none of these failings.

At the top of each derrick is a set of crown blocks, the hoisting cable being rove first through these blocks and then through a traveling block from which the casing elevator depends. The free end of the cable is led from the crown block to the hoisting drum of the draw-works; and when the cable is intially wound on the drum it is necessarily wound loosely, there being no practicable means of winding the cable initially under a strain as great as subsequently applied to it in use. And even if the cable could be wound tightly when first put on the drum, its subsequent use under varying loads tends to wind it comparatively loosely and then draw it up tight, as will be explained.

Now assume that a joint or stand of casing has just been added to the string within the hole, that the string has been lowered and is suspended from the rotary table by "slips" and the elevator released from the top of the string. The hoisting drum is then rotated to wind up the cable and thereby lift the elevator to or near the crown block in order that the next stand of casing may be picked up. The elevator, while of considerable weight, is relatively light with respect to the string which it has just lowered and also with respect to a single stand of pipe, and consequently the cable is wound upon the hoisting drum in series of relatively loose coils, and, since the cable is rove through crown and traveling blocks a number of times, there will be several hundred feet of relatively loosely wound cable on the hoisting drum by the time the traveling block is at the top of the derrick. The elevator is then applied beneath the uppermost collar of a new pipe stand, and the drum rotated to elevate this stand sufficiently to allow its lowermost end to be swung into axial alinement with and threadably joined to the slip-suspended pipe string.

In picking up the weight of this new stand, the drum first revolves sufficiently to take up the slack of the loosely wound coils. Then, after the new stand is screwed to the string, the entire string must be lifted to enable the slips to be withdrawn from the table bushing for the subsequent lowering of the string with the newly added stand. When the weight of the entire string is first imposed on the cable, naturally, the coils on the drum are still further tightened.

Now this initial loose winding and subsequent tightening of the coils is most harmful, for the coils in the outer windings are drawn tightly and wedged between the coils of inner windings, and there is relatively longitudinal movement between adjacent coils and adjacent windings due to the progressive tightening of the coils. These conditions soon result in the cables becoming chafed and worn to such an extent that their useful life, especially in deep well drilling, is not much over a month in length, and when it is considered that such cables are especially fabricated for the purpose and hence most

expensive, it is evident that the ultimate cost of drilling a well is greatly increased due to this single factor of excessive cable wear. Further, it constitutes a hazard, as a worn cable may lead to disastrous accidents.

We eliminate the above objectionable features by the provision of one drum or traction sheave for applying the hoisting power to the cable and for controlling the lowering movement of the cable, and a second drum for storing up and paying out the cable as it is fed from the power drum. A drive connection from the first to the second drum maintains the cable taut as it is wound on the storage drum or reel so there is no likelihood of loose winding, and all strains of hoist and lowering-away are taken by the power drum. The effective diameter of the storage reel varies accordingly to the number of windings upon it, and in order that the storage reel may revolve at just the proper speed to reel up the cable as it is fed from the power drum, the drive from drum to drum is accomplished through a slip clutch mechanism, as will be presently described.

We also provide novel means for braking the two drums with relatively varying degrees of force during paying-out periods, and also provide means, active only during said periods, for offsetting the tendency of the reel to unwind cable faster than it is passed over the power drum. In other words the cable from drum to reel is maintained in a taut condition at all times; yet the strain is concentrated on the power drum, and no slack is allowed to accumulate in the cable on the reel. How this is accomplished in connection with the illustrated embodiment of the invention will be understood from the following detailed description, reference being had to the accompanying drawings, in which—

Figure 1 is a contracted side elevation of the hoisting apparatus, the shafts upon which the revolvable elements are mounted, being shown in section.

Fig. 2 is a top plan section on line 2—2 of Figure 1.

Fig. 3 is a vertical section on line 3—3 of Figure 2.

Fig. 4 illustrates a modified form of power drum or sheave, and idler; and

Fig. 5 is a side elevation of Figure 4.

As mentioned above, we will limit the description of the invention as embodied in the draw works of a "rotary" well drilling rig but, as this is done merely to more definitely point out a typical physical embodiment of the invention, following references to specific structures are not to be considered as limitations on the invention.

In the drawings, numeral 10 designates derrick flooring from which tower timbers 11 rise. A horizontal shaft 12 has bearing at 13 in timbers 11, and driving power from a suitable source, for instance, a steam engine (not shown), is delivered to sprocket 14 on shaft 12 by chain 15.

A grooved traction sheave 16 is keyed to shaft 12 and held from longitudinal movement therealong by collars 17; and secured to and disposed on opposed sides of sheave 16 are brake drums 18. Brake bands 19 are anchored at 20 to the derrick flooring, thence pass over drums 18, and are secured at 21 to cranks 22 on shaft 23, which shaft is journaled in floor bearings 24. A brake lever 25 on shaft 23, is adapted to be swung in a clockwise direction, as viewed in Figure 1, to rock shaft 23 and thereby contract bands 19 about drums 18 for effecting the application of braking force to the sheave.

The hoisting cable C leads downwardly from the crown blocks (not shown) at the top of the derrick, and thence about sheave 16, as clearly shown in Figure 1. The cable is then trained over idler 26 on shaft 27, this shaft being supported between timbers 11 at a point above sheave 16. The principal function of idler 26 is to insure sufficient extent of traction contact between cable C and sheave 16.

Cable C leads from idler 26 to a storage reel or drum 28 which is keyed to shaft 29, this shaft being journaled at 30 in floor standards 31 and held from longitudinal movement by the engagement of collars 32 with said standards.

Now the function of reel 28 is to store up and pay out cable as it comes from, or is taken out by sheave 16, and we will now describe the means employed for maintaining the course of cable from sheave to reel in a taut condition, whether being taken up or payed out, so the cable coils are always evenly and snugly wound about the reel. This reel may be aptly termed a "pay out and take up reel" while that portion of the cable which extends from sheave to reel may be termed the "intermediate course" of the cable.

First, let us consider the means for taking up cable on reel 28. A chain 33 is adapted to drive sprocket 34 on shaft 29 from sprocket 35 keyed to shaft 12. Sprocket 34 is smaller in diameter than sprocket 35 and is loose on shaft 29, there being a ratchet friction clutch 36 for intermittently establishing a drive between sprocket 34 and its shaft. The ratio of sprockets 34 and 35 is such that when the effective diameter of the reel is less than the diameter of sheave 16, the reel is driven with sufficient angular velocity to take up the cable fed to it by sheave 16, thereby maintaining the intermediate course of cable in a taut condition. However, when the effective diameter of the reel is greater than that of the sheave (which condition exists when the amount of cable on the reel is considerable) the friction

clutch slips so the intermediate course is not under excessive tension and will not cause the coils to be drawn onto the reel with undue tightness.

The ratchet friction clutch 36 may be of any suitable design, that shown in the drawings being more or less conventional but serving to illustrate the working principle. Clutch plate 37, loose on shaft 29, is integral with sprocket 34 and carries a cam lug 38 adapted to coact with complementary cam lug 39 on friction disk 40, also loose on shaft 29. Disk 40 is adapted to facially contact with friction disk 41 which is keyed to shaft 29. Now when sheave 16 is rotated in a clockwise direction, as viewed in Figure 1, to take in cable C, clutch plate 37 is rotated in the same direction through the sprocket and chain drive previously described. This rotation of plate 37 causes a wedging coaction between cams 38 and 39, and plate 40 is thereby pressed or biased into contact with plate 41 to frictionally drive shaft 29 and hence reel 28 in a clockwise direction.

As the effective diameter of reel 28 increases (due to the accumulation of cable windings thereon) the intermediate cable course is, of course, still controlled in its movement from idler 27 by sheave 16, and acts to retard the forward rotation of the reel, slippage occurring between plates 40 and 41.

Now when allowing cable C to lower away under the weight of the traveling block or well pipe connected thereto, sheave 16 rotates in a counter clockwise direction, as viewed in Figure 1, and it is necessary that the drive connection between sheave and reel be inoperative during such rotation; otherwise, slack would accumulate in the intermediate course due to the sprocket ratio in the drive connection.

This desirable inoperative clutch condition is brought about automatically, for, when rotated in a counter clockwise direction, clutch plate 37 merely causes idle rotation of plate 40, without cam action and therefore without the application of side pressure to frictionally engage plate 40 and 41.

In order to hold back the counter clockwise rotation of reel 28 so it will not unwind cable faster than it is payed out by sheave 16, we provide a "drag" for the drum, said drag being in the form of ratchet friction brake 42. This brake comprises a plate 43 keyed to shaft 29 and having a cam lug 44 adapted to coact with cam lug 45 on friction disk 46 which is rotatively loose and longitudinally slidable on the shaft. Now when shaft 29 is rotated in a clockwise direction, as viewed in Figure 1, the square shoulder of cam lug 44 merely engages the square shoulder of cam lug 45, so plate 46 is rotated with the shaft without effecting operative cam engagement. When shaft 29 revolves in a counter clockwise direction, due to the pull of the cable when being lowered, the inclined face of cam lug 44 engages the inclined face of lug 45 with the result that friction disk 46 is pressed or biased into facial engagement with brake plate 47 which is secured to standard 31, thereby frictionally braking or imposing a drag on the reel.

While well casing is being lowered through the drilled hole, its movement is controlled by the application of braking force to sheave 16 through bands 19 and drums 18, as previously described, and it is important, when sheave 16 is thus checked in its rotation, that the rotation of reel 28 be simultaneously checked; otherwise the momentum or inertia of the reel would tend to carry it over with a resulting accumulation of slack in the intermediate course. However, it is evident that the braking force exerted on the reel need not be as great as that exerted on the sheave, for, by our arrangement, the reel is relieved from the stresses and strains of load. Furthermore, this ratio of braking forces should exist by reason of the fact that, with the sheave rotating at a constant angular velocity, the reel rotates at variable angular velocity (due to the decrease in its effective diameter as the cable is unwound therefrom) and there will be periods when the reel is necessarily rotating faster than the sheave. In such a situation the application of equal braking force to both reel and drum would tend to put the intermediate course under excessive tension and tend to draw the coils more closely about reel 28, which tendency is, of course, undesirable.

We accomplish the simultaneous braking of the sheave and reel by providing the reel with brake drums 48; brake bands 49 being about the drums and secured at one end to floor staples 50 and at the other end to cranks 51 on rock shaft 52 which is journaled in floor bearings 53. On shaft 52 are cranks 54 which are connected by tie rods or links 55 to cranks 56 on shaft 23. However, the connections between cranks 54 and 56 are somewhat flexible, for each link 55 is made up of two rods joined by springs 57. Thus, when lever 25 is swung in a manner to brake sheave 16, shaft 52 is rocked so as to contract bands 49 about drums 48, but due to the presence of springs 57, the braking force exerted on reel drums 48 is necessarily less than that exerted on sheave drums 18.

Of course, the yieldable element between the two sets of brake bands may be other than shown without departing from the spirit and scope of our broader claims appended hereto. For instance, levers 54 and 56 may be yieldable with respect to their associated rock shafts. It is also possible to secure an unequal braking effect on the reel

and sheave brake drums by varying their relative diameter or their relative areas of braking contact and thereby varying the braking torque, but the method illustrated is preferable from a manufacturing standpoint as springs of varying strength may be utilized to secure adjustment of the reel and sheave brakes with respect to each other.

We have also provided means for independently and positively braking reel 28 in the event drag brake 42 or yieldable brakes 48, 49, should fail to retard the rotation of the reel sufficiently to prevent it from overrunning or gaining speed to such an extent that slack develops in the intermediate cable course. Such means consists of crank arm 58 on shaft 52, this arm being connected by rigid tie rod 59ª to crank 59 which is loosely journaled on shaft 23 and provided with an actuating lever 60. By this connection, shaft 52 may be rocked to apply the brakes or reel 28 without effecting the sheave brakes, this being possible by reason of the flexible character of tie rod 55.

In Figures 4 and 5 are illustrated modifications of sheave 16 and idler 26. In the modifications, sheave 16ª and idler 26ª each have a plurality of grooves, the cable C′ being rove therethrough in a "criss-cross" fashion, as clearly illustrated in these figures. By this arrangement the surface of contact between power sheave and cable is greatly increased over that existing in the arrangement illustrated in Figure 1.

We wish to make the reservation that the drawings and descriptions are to be considered as merely illustrative of and not restrictive on the broader claims appended hereto, and we reserve to ourselves all such changes in structure and design as lie within the scope of said claims.

Having described a preferred form of our invention, we claim:

1. In a device of the character described, a driven sheave, a reel for storing cable fed thereto by rotation of the sheave in one direction and adapted to pay out said cable as the sheave rotates in the opposite direction, the reel being rotated by the withdrawal of cable therefrom, means for checking rotation of the sheave, and means for checking rotation of the reel, one of said checking means being adapted to be put into operation by virtue of the putting of the other into operation.

2. In a device of the character described, a driven sheave, a reel for storing cable fed thereto by rotation of the sheave in one direction and adapted to pay out said cable as the sheave rotates in the opposite direction, the reel being rotated by the withdrawal of cable therefrom, a brake for the sheave, a brake for the reel, and unitary means for controlling application of said brakes.

3. In a device of the character described, a driven sheave, a reel for storing cable fed thereto by rotation of the sheave in one direction and adapted to pay out said cable as the sheave rotates in the opposite direction, the reel being rotated by the withdrawal of cable therefrom, a brake for the sheave, a brake for the reel, and means for simultaneously applying said brakes, said means being of a nature whereby the braking force exerted on the reel is less than that exerted on the sheave.

4. In a device of the character described, a driven sheave, a real for storing cable fed thereto by rotation of the sheave in one direction and adapted to pay out said cable as the sheave rotates in the opposite direction, the reel being rotated by the withdrawal of cable therefrom, a brake for the sheave, a brake for the reel, means for manually applying the sheave brake, and connecting means between said applying means and the reel brake, whereby application of the sheave brake is accompanied by simultaneous application of the reel brake.

5. In a device of the character described, a driven sheave, a reel for storing cable fed thereto by rotation of the sheave in one direction and adapted to pay out said cable as the sheave rotates in the opposite direction, the reel being rotated by the withdrawal of cable therefrom, a brake for the sheave, a brake for the reel, means for manually applying the sheave brake, and a flexible connection between said applying means and the reel brake, whereby said brakes are simultaneously applied, but with the exertion of less braking force on the reel than on the sheave.

6. In a device of the character described, a sheave rotatable oppositely for taking in and paying out cable, a storage reel to which the cable extends from the sheave, a friction drive for the reel and operable when the sheave is rotated in a direction to take in and feed cable to the reel, means for checking rotation of the sheave, and means for checking rotation of the reel, both of said checking means being operable when the sheave is rotated in a direction to pay out cable; one of the checking means being adapted to be put into operation by virtue of the putting of the other into operation.

7. In a device of the character described, a sheave rotatable oppositely for taking in and paying out cable, a storage reel to which the cable extends from the sheave, a friction drive for the reel and operable when the sheave is rotated in a direction to take in and feed cable to the reel, means for checking rotation of the sheave, and means for checking rotation of the reel, both of said checking means being operable when the sheave is rotated in a direction to pay

out cable; one of the checking means being adapted to be put into operation by virtue of the putting of the other into operation, and one of said checking means being adapted to exert greater checking force than does the other.

8. In a device of the character described, a sheave rotatable oppositely for taking in and paying out cable, a storage reel to which the cable extends from the sheave, a friction drive for the reel and operable when the sheave is rotated in a direction to take in and feed cable to the reel, means for checking rotation of the sheave, means for checking rotation of the reel, both of said checking means being operable when the sheave is rotated in a direction to pay out cable; one of the checking means being adapted to be put in operation by virtue of the putting of the other into operation; and a separate frictional retard automatically operable to retard rotation of the reel when the sheave is paying out cable, said retard being operable independently of said reel checking means.

9. In a device of the character described, a sheave rotatable oppositely for taking in and paying out cable, a storage reel to which the cable extends from the sheave, a friction drive for the reel and operable when the sheave is rotated in a direction to take in and feed cable to the reel, means for checking rotation of the sheave, means for checking rotation of the reel, both of said checking means being operable when the sheave is rotated in a direction to pay out cable: one of the checking means being adapted to be put into operation by virtue of the putting of the other into operation: a separate frictional retard operable to retard rotation of the reel when the sheave is paying out cable, and means adapted to act automatically upon successive reversals in the common direction of sheave and reel rotation for rendering said frictional drive and said separate retarding means reversely and alternately operative and inoperative.

In witness that we claim the foregoing we have hereunto subscribed our names this 3rd day of December 1923.

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WILLIAM WEBSTER WILSON.