April 17, 1956 C. H. ARNOLD 2,742,261

HOISTING DEVICE

Filed April 27, 1954

FIG. 1

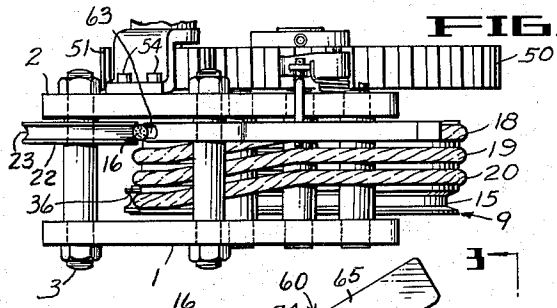


FIG. 2

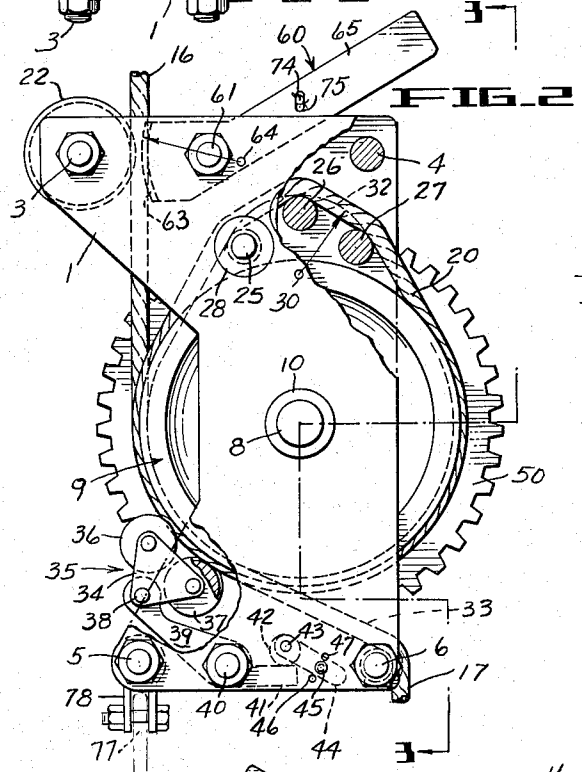


FIG. 3

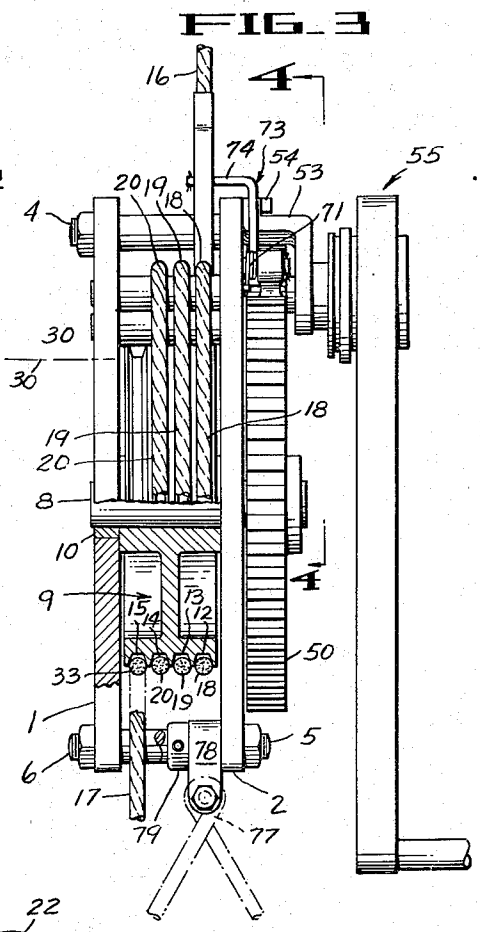
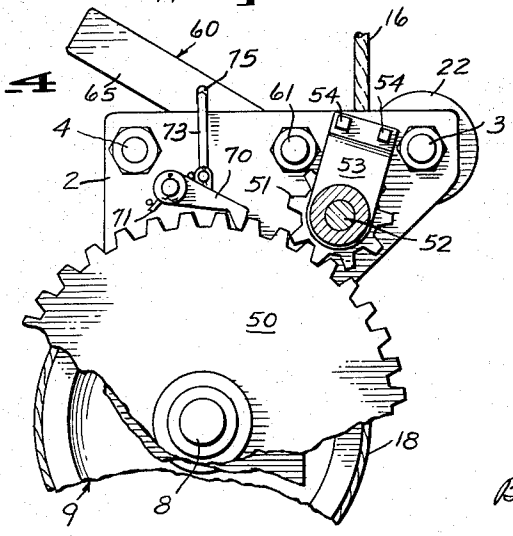


FIG. 4



INVENTOR.
CARTER H. ARNOLD
BY
Boyken, Molden & Wood.
ATTORNEYS

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HOISTING DEVICE

Carter H. Arnold, Redwood City, Calif.

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7 Claims. (Cl. 254—150)

This invention relates to hoisting devices of the type generally employed to support scaffolds and similar in general operation to that shown in my copending United States patent application Serial No. 374,697, filed August 17, 1953, now abandoned.

Heretofore various hoisting devices have been proposed to avoid the piling up of rope on the drum carried by the scaffold which is to be raised or lowered. Such devices include one or more drums around which the rope is reeved in such a way that the friction between the rope and drum (or drums) is intended to be sufficient to prevent slippage. In this manner, the hoisting device and its associated load in effect travel along the length of the rope and no piling up of the latter results at any point.

Although such prior art devices are theoretically correct in operation, as a practical matter, none has been adopted in practice because of various disadvantages such as unnecessary weight, lack of inherent safety in operation, impracticability in operation, complexity, and expensiveness.

It is therefore the main object of the present invention to provide a hoisting device for scaffolds and the like which overcomes the disadvantages of prior art mechanisms of like nature.

Another object of the invention is the provision of a hoisting device which is foolproof in operation and which positively prevents fouling of the suspended rope.

Still another object of the invention is the provision of a hoisting device for scaffolds which includes means for preventing the formation of slack in the suspended rope at any point along the length of the latter so that the rope is under control at all times.

Yet another object of the invention is the provision of a hoisting device adapted to be run along the length of a rope and which is more compact than those heretofore available.

Another object of the invention is a hoist incorporating novel safety features which render the same foolproof in operation.

Other objects and advantages will be seen in the accompanying drawings and in the specification wherein:

Fig. 1 is a top plan view of the invention with the handle portion broken away.

Fig. 2 is a side elevation of the invention with portions broken away and in section to show internal structure.

Fig. 3 is an end elevation partly broken away and in section and with portions omitted for clarity.

Fig. 4 is a fragmentary side elevation from the side opposite Fig. 2.

In detail, the invention comprises a housing which is provided with a pair of similar, spaced opposed parallel side plates 1, 2 which are secured together adjacent their upper edges by means of studs 3, 4 and adjacent their lower edges by studs 5, 6. Said studs may be reduced in diameter at their threaded ends so that side plates 1, 2 may be positively spaced apart a predetermined distance.

Although the invention will be described assuming that

the side plates 1, 2 are disposed vertically, it should be understood that the invention contemplates various different applications and in many instances the hoist may be used horizontally.

Extending between side plates 1, 2 about centrally of the latter is a shaft 8 to which is fixedly secured a drum, generally designated 9. Shaft 8 is rotatably mounted in bearings 10 (Fig. 3) which are preferably press fitted in side plates 1, 2.

Drum 9 is preferably provided with four peripherally extending axially spaced grooves although a greater or lesser number may be employed. As best seen in Fig. 3 said grooves are numbered 12, 13, 14, 15 respectively and are preferably undercut U grooves or V grooves having sidewalls disposed at an angle between 20 and 30 degrees.

Grooves 12—15 are adapted to receive therein the windings or turns of a rope, preferably wire rope, with the opposite ends of said rope extending away from the drum in opposite directions. Thus, referring to Fig. 2, run 16 of the rope extends upwardly from drum 9 and run 17 extends downwardly therefrom. Between said runs the rope is formed with three turns, that is, one less than the number of grooves, and designated 18, 19, 20 respectively in the drawings.

Rotatably mounted on stud 3 and adjacent sideplate 2 is a fairlead sheave 22 provided with a peripheral groove 23 (Fig. 1) so that said sheave is in rolling engagement with run 16 for guiding said run into the groove 12 that is adjacent sideplate 2.

Spaced upwardly from drum 9 but relatively closely adjacent thereto are three rollers 25, 26, 27 which extend between sideplates 1, 2 and are rotatably mounted at their ends therein as by pressed bearings 28 (Fig. 2). Rollers 25, 26, 27 are preferably equally spaced from an axis 30 which in parallel to shaft 8 and which preferably passes through the drum 9 closely adjacent the periphery of the latter.

It is pertinent to note that the locus of the points of engagement between the rollers 25, 26, 27 and the rope is preferably the arc 32 of a circle having a center substantially coincident with the periphery of the drum 9 but slight inwardly therefrom.

The effect of the above described structure is that the rope is never subjected to a sharp change in direction and at the same time an extremely compact means is provided for leading the rope from one groove to the adjacent groove.

As best seen in Figs. 1, 3, the turn 18 of rope engages more than 180 degrees of the groove 12, then joins with turn 19 in groove 13 and then turn 20 in groove 14. From groove 14 the rope runs over the rollers 25, 26, 27 and enters the groove 15 of drum 9 from which a diagonal portion 33 extends over bolt 6 of the housing and joins with the downwardly extending run 17.

It will be noted, as best seen in Fig. 3, that the rope is of such a diameter that it is wedged within the grooves 12—15 so that it never engages the bottoms of said grooves and at all times projects beyond the periphery of drum 9. In this manner the rope turns are held under positive restraint at all times and there is no possibility of the rope turns fouling each other.

To provide an additional restraint for the rope turns and to keep them at all times in engagement with the drum grooves, it is preferable to provide a tensioning device generally designated 35 (Fig. 2) for preventing slack in the rope turns. Heretofore analogous devices have been employed but have generally comprised rollers which simultaneously engage all the turns on the drum. Such an arrangement has been found to promote rather than obviate the formation of slack. By the present

invention only the terminal turn is engaged. Furthermore, the use of one roller, giving only a unitary point of engagement has, in the past, proved ineffectual for holding the rope in the grooves.

The tensioning device of the present invention comprises a pair of peripherally grooved spaced rollers 36, 37 rotatably mounted between a pair of side plates 34, only one of which shows in Fig. 2. Plates 34 are generally triangular with the rollers 36, 37 mounted adjacent two of the corners thereof and with the third corners swingably supported by means of a pin 38 to one end of an arm 39 which, in turn, is swingably mounted intermediate its ends on a bolt 40 extending between side plates 1, 2 of the housing. The opposite end 41 of arm 39 is engaged by an eccentric cam portion 42 of a shaft 43 to which is secured an operating handle 44.

Handle 44 is adjacent side plate 1 and is apertured to receive a pin 45 which is passed through a corresponding aperture in side plate 1 to securely hold the handle 44 in place. Additional holes 46, 47 may be provided in side plate 1 to afford adjustability so as to vary the pressure exerted by rollers 36, 37 against the rope that is in groove 15.

The tensioning device 35 exerts a radially inwardly directed pressure along a substantial length of the rope because of the presence of the two rollers 36, 37. In addition, because both rollers are pivoted as a unit about pin 38, each roller exerts the same amount of force and there are no forces exerted along the length of the wire such as would cause the formation of slack.

The fact that the rollers 36, 37 engage only the last turn of the rope is extremely important in preventing the formation of slack, and results in the rope being under some tension at all points along the turns that engage the grooves 12—15.

In the drawings run 16 of the rope is assumed to be the loaded run and run 17 the unloaded run. When the hoist is employed to support a scaffold from a vertically extending rope fixed at its upper end to the top of a building, the run 16 supports the load and the run 17 supports only its own weight. It will be apparent, therefore, that the tension in the rope will decrease from run 16 through turns 18, 19, 20 and will be relatively small at the points engaged by the tensioning device 35. The latter should, of course, be on the side of the drum opposite that from which the run 16 exetnds. It is due to the fact that the tension on the rope is light adjacent run 17 that the tensioning device must exert a radially inwardly directed force without drag as described above.

In the drawings the rope turns are shown as they appear when the drum 9 is being rotated (in a manner to be described) so that the upper run 16 is being wound on the drum. In such a case the portions of the turns 18, 19, 20 that are on the side of the drum 9 opposite the run 16 extend vertically from the drum 9 to the upper roller 26. The turns then become slantingly disposed to enter the adjacent grooves. When the drum 9 is being turned so as to wind the lower run 17 onto the drum then the slanted portions become vertical and the vertical portions become slanted.

This natural shifting of the turns caused by changes in the tension of the rope is not impeded in any way by the rollers 25, 26, 27. However, it should be noted that the use of a grooved drum instead of the plain rollers shown, as has been attempted in the past, would result in chafing and wearing of the rope which is not present in the instant device.

Rigid with the drum shaft 8 is a relatively large spur gear 50 which is in mesh with a pinion 51 mounted on a stub shaft 52 rotatably supported at its inner end in side plate 2 and at its outer end in a bracket 53 which is secured to side plate 2 by bolts 54. The stub shaft 52 is driven by a conventional hand crank unit generally designated 55 (Fig. 3) of a conventional type incorporating the usual safety features such as a clutch requiring the application of torque regardless of the direction in which the pinion 51 is being turned. One such hand crank unit is known by the trade name "Budget." However, it will be understood that any suitable type of crank arrangement may be employed to rotate pinion 51 and drum 9 through gear 50.

As a valuable safety feature the present invention includes an elongated clamping arm generally designated 60 which cooperates with the fairlead sheave 22 in a manner now to be described.

Arm 60 may be formed from a heavy plate and is swingably supported intermediate its ends on a stud 61 extending between and secured to side plates 1, 2.

The arm 60 is coplanar with sheave 22 and is formed with an arcuate grooved end 63 to receive the side of upper rope run 16 that is opposite the side engaged by the sheave 22.

The end 63 of arm 60 is formed to the arc of a circle having a center 64 positioned as shown in Fig. 2 so that clockwise swinging of arm 60 urges the gooved end 63 into clamping relation with the sheave 22 so as to clamp the rope run 16 therebetween. The end 65 of arm 60 that is opposite the clamping end is relatively long and of sufficient mass to urge the arm into clamping engagement with the rope at all times due to gravity.

Thus, if it is assumed that run 16 is hanging stationary and vertical and a load is applied to the housing so as to rotate the drum 9 clockwise (Fig. 2), the housing will tend to move downwardly relative to run 16 and securely clamp the rope against sheave 22 thereby positively preventing such downward movement. However, if it is assumed that drum 9 is positively rotated counetrclockwise so as to wind run 16 thereon, the housing moves up relative to the stationary run 16 and swings arm 60 counterclockwise away from clamping position. It will be understood that arm 60 is always in engagement with run 16 but has no effect thereon except when the housing tends to fall relative thereto.

When it is desired to move the housing downward relative to the run 16 it is merely necessary for the operator to lift the end 65 of arm 60 out of clamping engagement with the run 16. This may be facilitated by first running the device upwardly slightly.

Inasmuch as relative slippage between the rope and drum 9 is always impossible because of the wedging action of the rope within the drum grooves, it is merely necessary to prevent accidental rotation of the drum 9 if an additional safety device is desired. To this end a pawl 70 may be swingably mounted on side plate 2 (Fig. 4) and urged into engagement with the teeth of gear 50 by means of a helical torsion spring 71 (Figs. 3, 4). Pawl 70 is shaped so as to prevent counterclockwise rotation of gear 50 (Fig. 4) which is equivalent to downward falling of the housing (Fig. 2).

A safe means is employed to allow downward movement of the hoist by connecting the pawl 70 by means of a link 73 with the clamping arm 60. Link 73 is provided at its upper end with a horizontally extending portion 74 (Fig. 4) which is received in an elongated slot 75 in arm 60. By this structure a slight amount of movement of arm 60 is permitted to allow it to perform its clamping function without disengaging the pawl 70. However, when it is desired to lower the device the operator may simultaneously unclamp the rope and release pawl 70 by swinging handle portion 65 of arm 60 upwardly.

Although the present invention has many applications its greatest use lies in supporting a scaffold having pair of stirrups at opposite ends in which case a hoisting device is employed with each stirrup. Ordinarily, such stirrups are formed from steel rod bent to provide an eye portion 77 (Fig. 3) from which the scaffold is suspended. In such a case the side plates 1, 2 are preferably provided with an offset portion so that stud 5 is in vertical alignment with the upper run 16 of the rope.

In order to position the eye portion 77 in vertical

alignment with the run **16**, a shackle **78** may be carried by stud **5** as best seen in Fig. 3. A positioning collar **79** on stud **5** serves to hold the vertical alignment between run **16** and the eye **77** of the stirrup. By the above described structure the line of action is always vertical and the housing is held vertical at all times.

When used with a 650 pound working load it has been found that the side plates **1**, **2** need not be longer than 12 inches, thus making an extremely compact, light weight unit which is easily handled by one man without help.

In use, the rope is easily reeved around the drum **9** and rollers **25**, **26**, **27** to set up the hoist because the tensioning device may be swung outwardly by means of the adjustable handle **44**.

The provision of the rollers **25**, **26**, **27** and their positioning as above described is an extremely important feature of the invention as they provide a compact means for switching the turns from one groove to the adjacent one without undue wear on the rope. The present invention also contemplates other means for performing the function of rollers **25—27**. A fixed plate curved to provide a shape similar to the locus of the points of engagement of the rope with the rollers may be provided. However, in such a case friction would be excessive.

Another alternative contemplated by the invention is the provision of a separate small roller slidably supported on a shaft for engaging each turn of wire so that axial movement is permitted as described above.

In any case it is important that the center of the locus of all points of engagement of the rope should be as close to the periphery of the drum as possible and preferably inwardly thereof.

It is pertinent to note that the novel combination of the clamping arm **60** and fair lead sheave **22** also functions to guide the run **16** into the groove **12** at all times and there is no chance of the rope separating from sheave **22**.

The safety features above described, exclusive of whatever features are incorporated within the conventional cranking device **55**, make the hoist acceptable even under the most stringent state laws. There is no opportunity for sudden jerks in the scaffold taking place as is the case when the rope is found unevenly on a drum as in conventional hoisting units.

The lower run **17**, of course, resists only its own weight and such weight contributes to the tightness of the rope turns on the drum. However, even when the length of run **17** is only a few inches, there is no chance for slippage.

The arc of contact between the rope and drum **9** is about 240 degrees; and, as is apparent, the efficiency of the device is directly proportional to the arc of contact, which in the present case is much greater than the usual 180 degrees.

With respect to the fair lead **22** it should be noted that its function may be approximately duplicated by substituting a stationary plate formed with a groove for guiding the rope. In such an event a better clamping action is obtained when such fair lead cooperates with the arm **60**. However, in normal operation such a stationary fair lead increases friction slightly although not to an objectionable extent.

An extremely important feature of the invention is that the load bearing shackle and the load run of the wire rope are in perfect vertical alignment as seen in Figs. 2 and 3. This constitutes an extremely beneficial safety feature inasmuch as there is no tendency for the hoisting device to tilt from an upright position when the load is applied or removed.

With respect to the arm **60** a spring may obviously be employed to urge the same in a clockwise direction into clamping engagement with the rope run **16**. The arm **60** illustrated has sufficient unbalanced weight in the portion **65** to effect proper automatic working of the safety when used with a vertically extending rope. However, additional yieldable urging on the arm **60** may be desirable in many instances especially when the device is employed with a rope inclined to the vertical or if horizontal.

Link **73** in cooperation with spring **71** prevents arm **60** from swinging completely out of operating engagement with rope run **16**.

The above very specific description of the preferred form of the invention is not to be taken as restrictive thereof as it is obvious that various changes in design may be resorted to without departing from the spirit of the invention as defined in the following claims.

I claim:

1. A hoisting device adapted to be employed with a length of rope comprising: a housing, a rotatable grooved drum carried by said housing, a loop formed in said rope and partially wrapped around said drum, means carried by said housing for guiding a portion of such loop in a path spaced from said drum whereby said loop is wrapped around both said drum and said means, said means being positioned whereby said portion is spaced from the periphery of said drum a distance less than the radius of the latter.

2. A hoisting device adapted to be employed with a length of rope comprising: a housing, a rotatable grooved drum carried by said housing, a loop formed in said rope and partially wrapped around said drum, means carried by said housing for guiding a portion of such loop in a path spaced from said drum whereby said loop is wrapped around both said drum and said means, said means being positioned whereby said portion is spaced from the periphery of said drum a distance less than the radius of the latter and the remainder of said loop engages said drum for at least 200 degrees.

3. A hoisting device adapted to be employed with a length of rope comprising: a housing, a rotatable grooved drum carried by said housing, a loop formed in said rope and partially wrapped around said drum, means carried by said housing for guiding a portion of such loop in a path spaced from said drum whereby said loop is wrapped around both said drum and said means, said means being positioned whereby said portion is spaced from the periphery of said drum a distance less than the radius of the latter, said means including a plurality of rope engaging surfaces substantially equidistant from a point located radially inwardly of the periphery of said drum.

4. A hoisting device adapted to be employed with a length of rope comprising: a housing, a rotatable grooved drum carried by said housing, a loop formed in said rope and partially wrapped around said drum, means carried by said housing for guiding a portion of such loop in a path spaced from said drum whereby said loop is wrapped around both said drum and said means, said means being positioned whereby said portion is spaced from the periphery of said drum a distance less than the radius of the latter, said means comprising a plurality of members rotatable relative to said housing.

5. A hoisting device adapted to be employed with a length of rope comprising: a housing, a rotatable grooved drum carried by said housing, a loop formed in said rope and partially wrapped around said drum, means carried by said housing for guiding a portion of such loop in a path spaced from said drum whereby said loop is wrapped around both said drum and said means, said means being positioned whereby said portion is spaced from the periphery of said drum a distance less than the radius of the latter, said means comprising a plurality of members rotatable relative to said housing and equally spaced from an axis parallel to the axis of rotation of said drum, said first mentioned axis being radially inwardly of the periphery of said drum.

6. A hoisting device comprising: a housing, a rotatable drum supported on said housing, a rope formed intermediate its ends with a plurality of windings partially wrapped around said drum with the opposite end runs of said rope extending away from said drum in opposite

directions, said drum being provided with a plurality of axially spaced peripherally extending grooves thereon in planes normal to the axis of said drum for receiving portions of said windings therein, a plurality of rollers rotatably mounted in said housing closely adjacent the periphery of said drum with their axes substantially parallel to and radially spaced from the axis of said drum, said windings being formed to extend over said rollers whereby said windings are wrapped around both said drum and said rollers, means for rotating said drum for winding one of said runs thereon whereby the windings on said drum are unwound therefrom into the other of said runs.

7. A hoisting device for handling a rope having a loaded end and a slack end comprising: a housing, a drum rotatably supported on said housing, a plurality of rollers substantially smaller in diameter than the diameter of said drum and rotatably supported on said housing with their axes radially spaced from but closely adjacent the periphery of said drum, said rope being wound around said drum and said rollers in a plurality

of windings formed intermediate the ends of said rope with a portion of each winding wrapped around said drum and with said rollers in rolling engagement with the remainder of each winding, said drum being provided with a plurality of axially spaced peripheral grooves in planes at right angles to the axis of said drum for receiving said windings therein, means for rotating said drum for winding one of said ends thereon whereby the windings on said drum are unwound therefrom into the other end.

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