July 1, 1941. P. WHITCOMB ET AL 2,247,795

ELECTRIC HOIST

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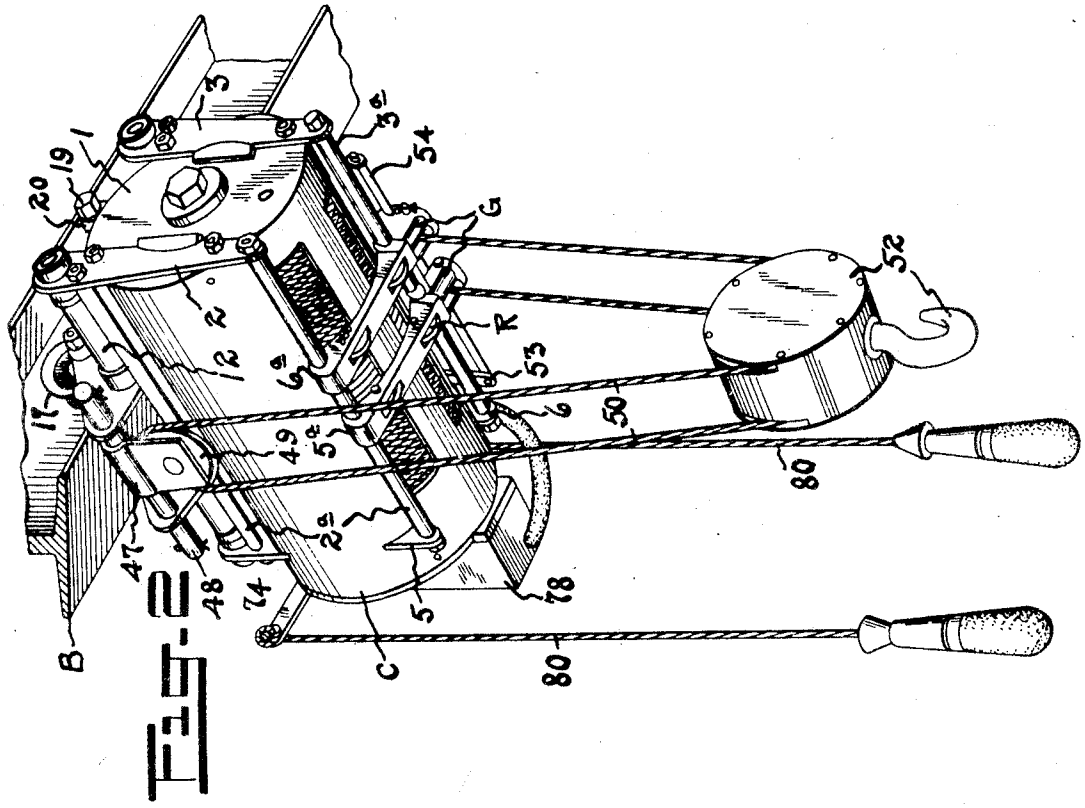


FIG-2

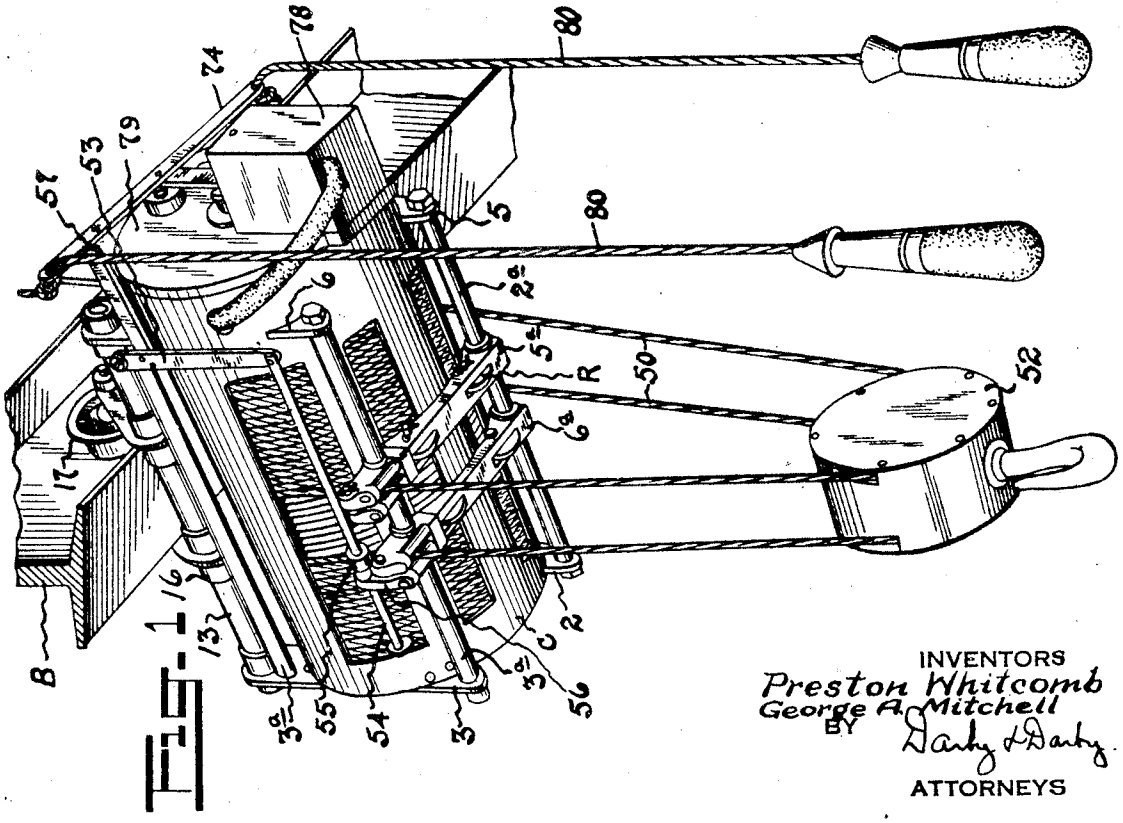


FIG-1

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Fig. 4

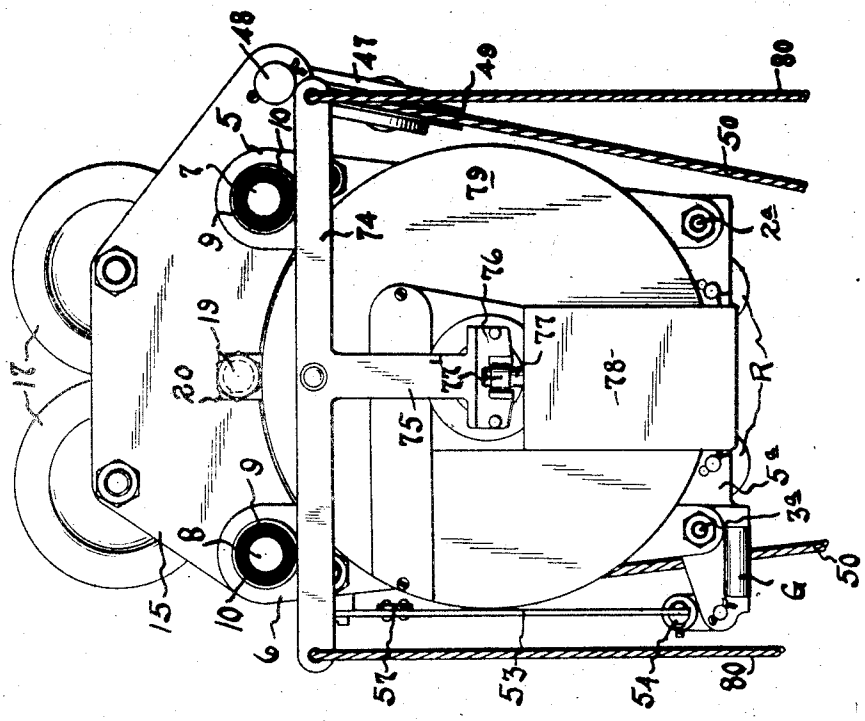
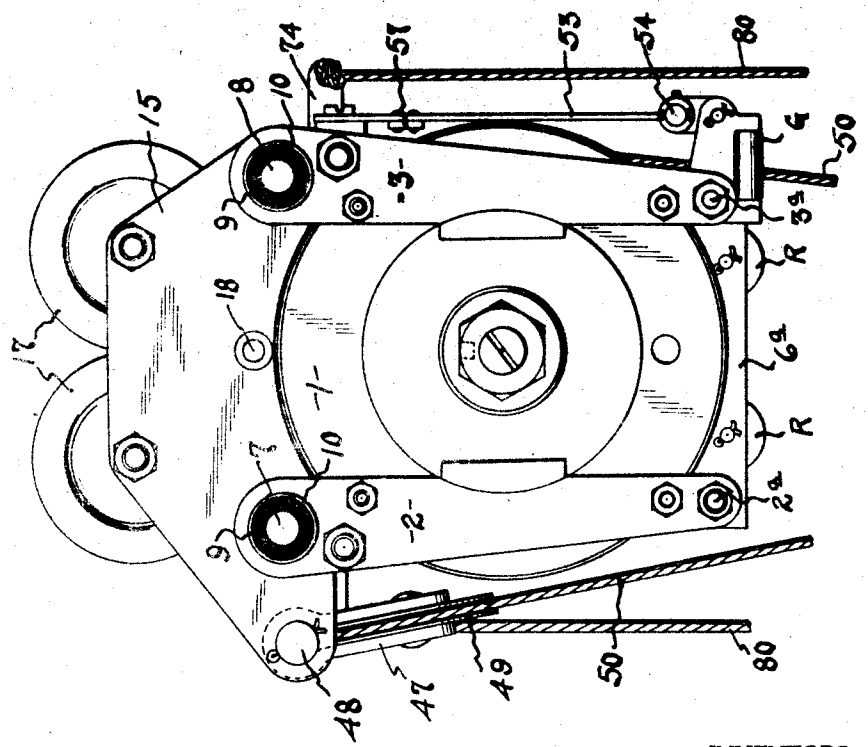


Fig. 5



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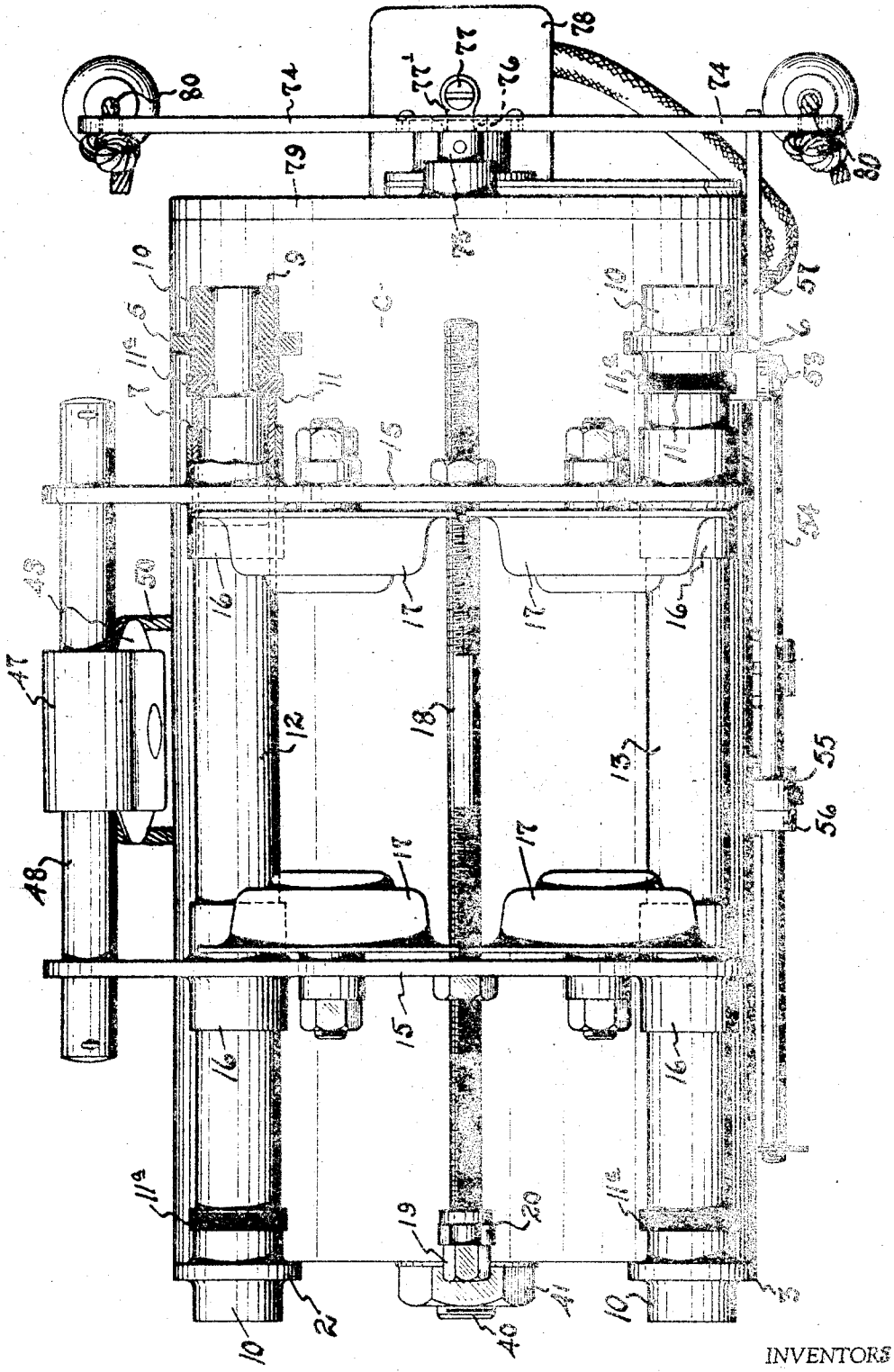
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ELECTRIC HOIST

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FIG. 5



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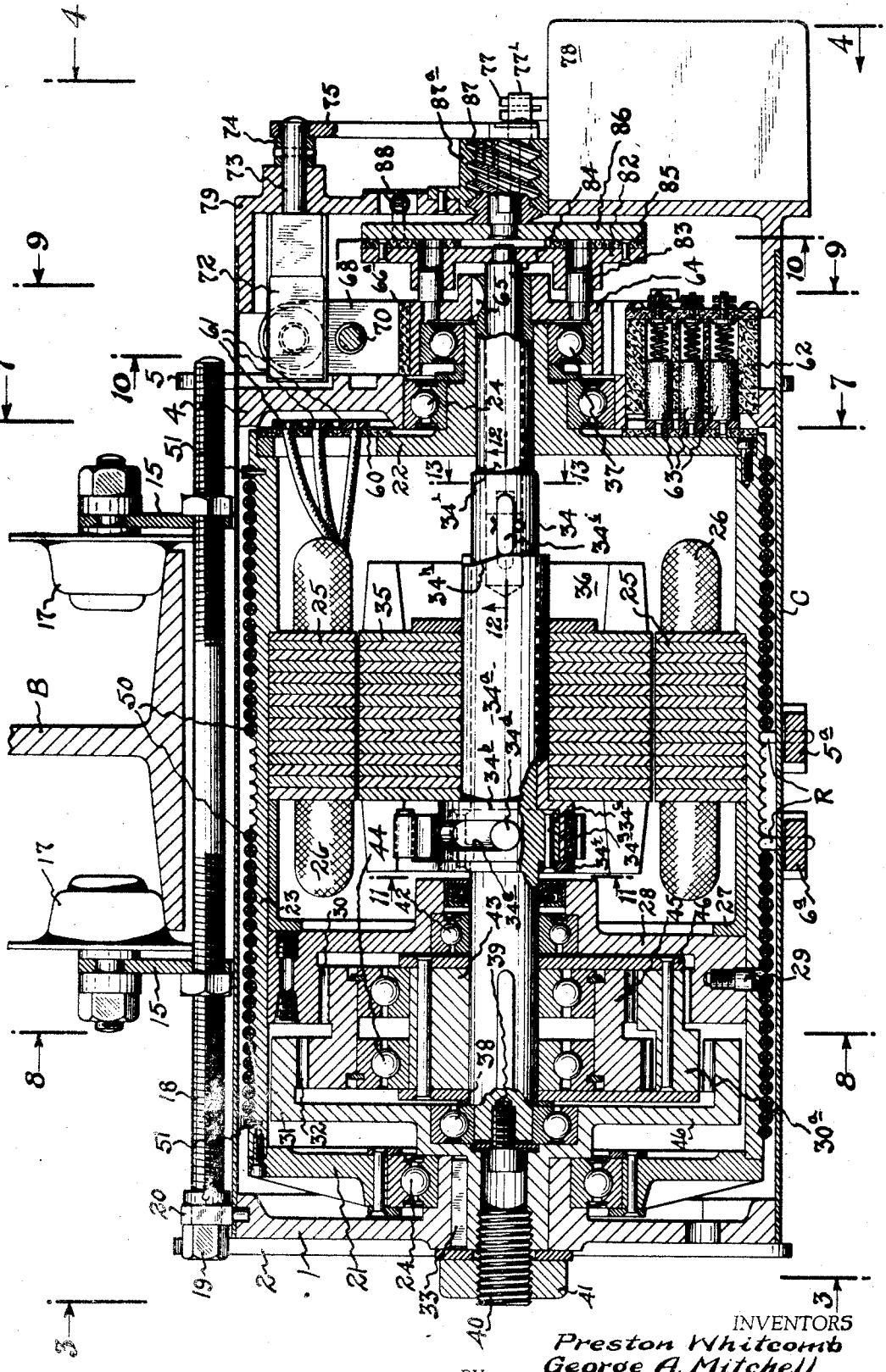
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FIG. 6



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Fig. 8

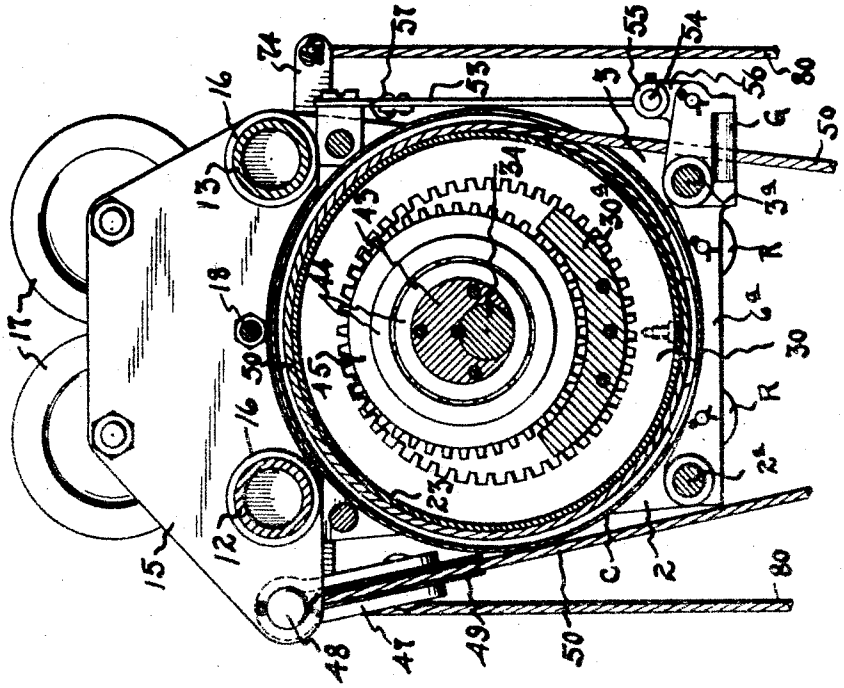
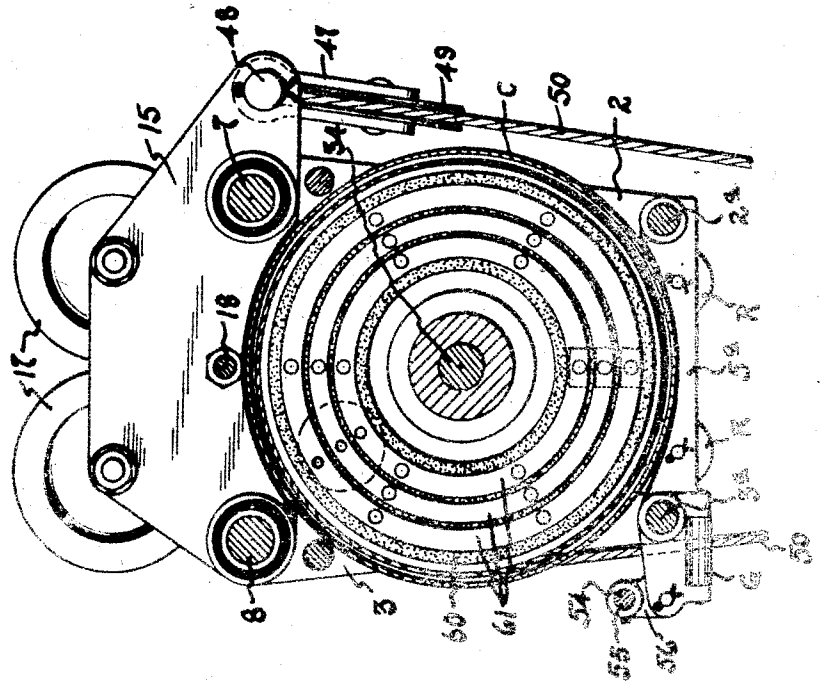


Fig. 7



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Fig-9

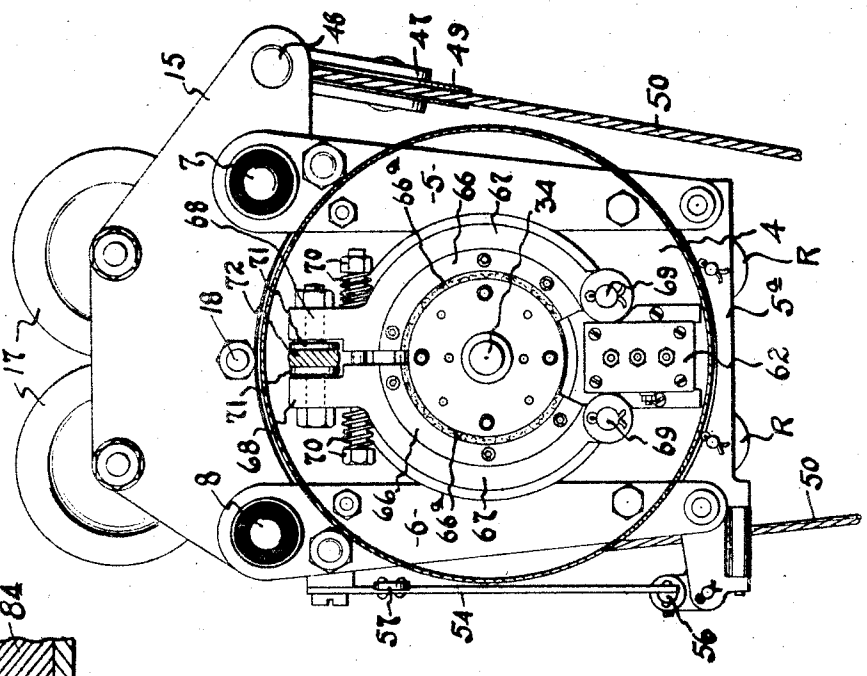


Fig-12

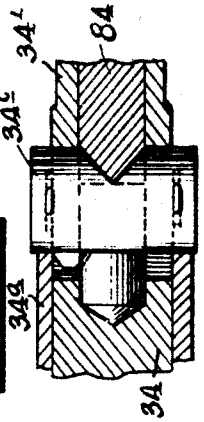


Fig-10

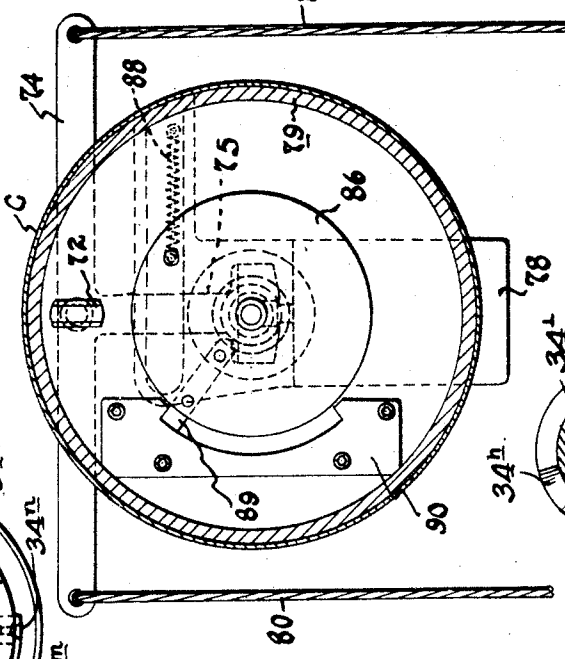


Fig-13

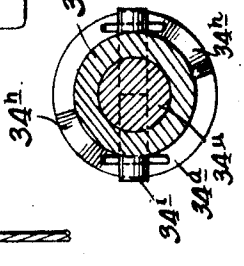
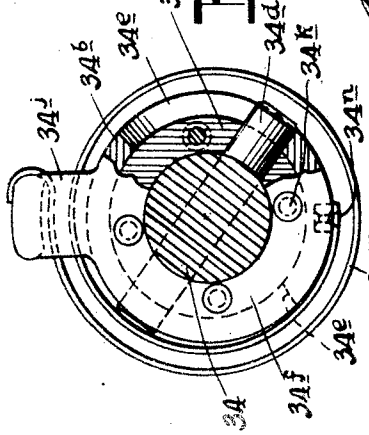


Fig-11



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Patented July 1, 1941 2,247,795

UNITED STATES PATENT OFFICE

2,247,795

ELECTRIC HOIST

Preston Whitcomb, Kenmore, N. Y., and George A. Mitchell, Muskegon, Mich., assignors to Manning, Maxwell & Moore, Inc., New York, N. Y., a corporation of New Jersey

Application February 1, 1938, Serial No. 188,044

7 Claims. (Cl. 254—168)

This invention relates to improvements in electric hoist units.

An important object of the invention is to provide a completely self-contained electric motor driven hoist including a supporting carriage by means of which it may be movably mounted upon an overhead support such as an I-beam.

A very important object of this invention is the provision of a hoist mounting associated with the hoist proper so that the entire load of the hoist, together with one-half of the loads lifted thereby, is carried on end members incorporated in the hoist and not on the remainder thereof.

A further object of this invention is to include in such a combination a compensating sheave attached to the hoist mounting thereby removing one-half of the loads lifted by the hoist from the hoist proper.

Another object of the invention is to provide a hoist having a hoist drum within which the driving motor is mounted and connected thereto by means of a compact gear train.

Another object of the invention is to provide a supporting mounting having an adjustable roller assembly by means of which the entire structure may be supported from overhead by I-beams and transported therealong.

Another object of the invention is to provide cable guiding means for ensuring the proper movement of the cable onto and off of the cable drum.

A still further object of the invention is to provide a brake for the hoist which acts at all times to hold the hoist against downward movement of the hook under load and which is automatically actuated when the motor is de-energized thereby ensuring at all times against undesired descent of the load.

A further object of the invention is to provide automatically acting means to de-energize the motor at the limit of movement in the upward direction.

These and many other objects as will appear from the following detailed disclosure of one embodiment of the invention are successfully secured.

This invention resides substantially in the combination, construction, arrangement and relative location of parts, all as will be described in greater detail in the following specification.

In the accompanying drawings,

Figure 1 is a front perspective view of an electric hoist constructed in accordance with this invention;

Figure 2 is a similar view from the rear;

Figure 3 is a right hand end elevational view thereof, see line 3—3, Figure 6;

Figure 4 is a left hand end elevational view thereof, see line 4—4, Figure 6;

Figure 5 is a top plan view thereof;

Figure 6 is a vertical, central, longitudinal, cross-sectional view showing the internal mechanism;

Figure 7 is a cross-sectional view taken on the line 7—7 of Figure 6;

Figure 8 is a cross-sectional view taken on the line 8—8 of Figure 6;

Figure 9 is a cross-sectional view taken on the line 9—9 of Figure 6;

Figure 10 is a cross-sectional view taken on the line 10—10 of Figure 6;

Figure 11 is a cross-sectional view taken on the line 11—11 of Fig. 6;

Figure 12 is a cross-sectional view taken on the line 12—12 of Figure 6; and

Figure 13 is a cross-sectional view taken on the line 13—13 of Figure 6.

The supporting mounting includes an end plate 1 of circular form having bolted or otherwise secured to the outer face thereof a pair of bars 2 and 3. Spaced therefrom, as is clear, for example, from Figure 6, is a second end plate or disc 4 having bolted to the outer face thereof a pair of bars 5 and 6. Encircling these discs and forming therewith a closed housing is a cylindrical casing C which with the disc forms, as is clear from Figure 6, a suitable housing for the cable drum within which is enclosed the driving motor and the gear train. The casing C projects beyond the disc 4 and is closed at its outer end by a cover plate 19 forming a housing for the brush and brake assemblies.

As is clear from Figures 1 and 2, the bars 5 and 6 extend through slits in the casing C. A series of cross-bracing bars 2^a and 3^a interconnect the bars 2, 3, 5 and 6. Also extending between the bars 2, 3, 5 and 6 are a pair of tubes 12 and 13 which have mounted therein cylindrical plugs of which two are shown at 7 and 8, see Figures 5 and 7. These plugs are secured in the ends of the tubes in any suitable manner and are provided with ends of reduced diameter, on each of which is mounted a metal washer 11, a resilient washer 11^a, and a cylindrical resilient sleeve 9. The sleeves 9 are mounted in metallic sleeves 10 which in turn are mounted and secured by welding in the ends of the bars 2, 3, 5 and 6. Thus the tubes 12 and 13 are interconnected with the supporting mounting through vibration absorbing

bushing structures, one of which is fully illustrated in cross-section in Figure 5.

A pair of metal plates 15, the configuration of which may be seen from Figures 3 and 4, are provided with aligned openings in which are welded short metal sleeves 16 of an internal diameter to ensure a smooth sliding fit on the tubes 12 and 13. Rotatably mounted on these plates in aligned pairs are rollers 17 which are preferably so formed as to ride smoothly on the flanges of an I-beam, as indicated at B in Figures 1 and 2. Extending through and between these plates is a rod 18 reversely threaded at opposite ends and engaging threaded nuts secured to the plates as shown in Figure 5. The left hand end of this rod is provided with a headed end 19 and a spaced collar so as to engage therebetween the notched end of a lug 20 fixed to the end plate 1. When a suitable tool is applied to the nut 19 the rod 18 may be rotated while held against longitudinal movement, thereby causing movement of the plates 15 towards and away from each other. By this arrangement it is possible to effect the proper spacing between the rollers 17 to permit of mounting of the hoist on an overhead support such as an I-beam and the adjustment of the rollers for smooth movement therealong. Within the casing formed by the discs 1 and 4 and the casing C is the cable drum which includes the end discs 21 and 22 and the cylindrical casing 23 suitably grooved on its surface to receive the cable. The discs 21 and 22 and the cylinder 23 are united together into a rigid structure and are journaled on the bearings 24 which are supported on the discs 1 and 4. As is clear from Figure 6, the drum 23 is counterbored to form a shoulder against which the motor field laminations 25 rest. These laminations are secured against the shoulder by means of a sleeve 27 which is forced into the drum 23 and up against the laminations. At 26 are diagrammatically illustrated the field windings.

Secured within the drum and against the flanged edge of the sleeve 27 is a cup-shaped disc 28 which is secured within the drum by means of screws 29. The cup rim has formed thereon the internal gear 30, see Figure 6. A somewhat similarly shaped cup member 31 is provided on the inner periphery of its rim with an internal gear 32 and on its outer opposite face with a hub which sets in the disc 1 and is secured therein and held against rotation by means of a key 33. This hub is also engaged by means of a short threaded plug 40 to which is applied a nut 41, by means of which it may be securely locked against longitudinal movement. At 34 is the armature shaft of the motor. A sleeve 34a on the shaft is provided with a squirrel-cage armature 35 having cooling fan blades 36. The shaft 34 revolves in the bearing 38 in member 31 and is supported on bearing 37 through member 64 secured on its end. The shaft is free to turn in disc 4 since the cable drum also revolves on shaft 34 at its reduced portion 34'. Since the member 28 rotates with the drum a bearing 42 therefor is provided on the shaft 34. Secured to the shaft 34 is an eccentric sleeve 43 upon which are mounted a pair of bearings 44 providing a rotatable support for the double-toothed pinion 45. One set of teeth thereof meshes with the internal gear 30 and the other set with the internal gear 32. As is clear from Figure 8, this makes the pinion eccentric with respect to the gears 30 and 32 and for this reason, as is common in this structure, a filler piece 30a is provided. A bearing 38 is interposed between the shaft 34 and the member 31 and a screw and washer 39 are provided to hold the inner race of the bearing 38 on the end thereof. A pair of plates 46 are clamped to the sides of the eccentric sleeve 43 and the filler piece 30a, as is clear from Figure 6, to form a single unit rotatable with shaft 34.

Extending between the plates 15 is a rod 48 which is slidably mounted therein and is provided with a clamp 47 in which the compensating sheave 49 is rotatably mounted. The cable 50 passes around this sheave through the hook pulley block 52, through the pairs of guide rollers G and through an opening in the casing C to and around the cable drum 23. The two ends of the cable are attached to the drum in any suitable manner, as by means of the pins 51 as shown in Figure 6. The groove in the cable drum is, of course, of reverse pitch so that as the drum revolves the cable winds thereonto from the outer ends towards the center and then unwinds in a reverse direction. The guide rollers G are mounted in a pair of bars 5a and 6a which are slidably mounted on the cross-bracing rods 2a and 3a. These bars are provided with pairs of rollers R which lie in the cable grooves of the cable drum so that as the drum revolves these bars move towards and away from each other, guiding the cable 50 through the guide rollers G properly to and from the drum.

Pivotally mounted on the bar 3 is a lever 53 which is pivotally connected at its lower end to a rod 54 which has an enlarged end and a collar 55 mounted thereon and spaced from the enlarged end. The rod 54 passes through an extending lug 56 formed integral with the front end of the bar 6a. Secured to the lever 53 so as to project therefrom at right angles is a lever 57, the function of which will be described later.

Secured to the outer face of disc 22, see Figure 6, is a ring 60 of insulating material, to the outer face of which, in turn, are secured the three slip rings 61 to which the field windings connect. In a suitable insulating housing 62 are mounted the three spring-pressed slip ring brushes 63 which engage the slip rings 61, respectively. The housing as shown is provided with connection terminals by means of which the circuit wires may be connected to the motor.

The cup-shaped member 64 fits over the end of the shaft 34 and is connected to it by means of a key 65. The outer configuration of this member is cylindrical and forms a brake drum engaged by the brake bands 66a which are mounted in the brake shoes 67. These brake shoes are pivotally mounted on pivot pins 69 and have a bolt and spring structure 70 at their upper ends to cause them to resiliently urge the brake bands against the brake drum. The brake bands are secured to members 66, which in turn are secured to the brake shoes 67. The springs 70, of course, always act to urge the brakes into applied position. A cam 72 lies between a pair of adjustable contact members 71 mounted on ears 68 integral with the brake shoes. The cam 72 is mounted on a shaft 73, see Figure 6, which extends through the cover plate 79 and has secured to its projecting end a horizontal lever 74 and a vertical lever 75. The lower end of lever 75 is provided with a pair of contact fingers 76, see Figure 4, positioned to engage a cam arm 77' mounted on the shaft 77 of a switch 78. This switch is interconnected with the motor circuit and brushes for controlling the motor. Secured to the ends of lever 74, which extends in both directions from the shaft 73, are

the cords 80 which terminate in operating handles, as shown in Figure 2.

A second brake mechanism consists of a disc 82 which is held concentric with the shaft 34 and the member 64 by means of pins 83 which are secured to the member 64, as shown. The pins 83 which project into holes in the plate 82 permit slight movement of the plate in an axial direction. The plate 82 is secured to a plunger 84 axially slidable in a bore in the end of end 34' of shaft 34. Secured to the outer face of the plate 82, as by means of rivets, is a friction ring 85 of any suitable material, such as leather. A disc 86 is positioned to be engaged by the friction ring 85 and is secured to a short threaded stud 87 having left hand threads of high pitch and cooperating with threads on the supporting member 87a secured to the outer face of the cover plate 79.

The brake 82—86 is operated in accordance with this invention by the energization and de-energization of the operating motor. In order to accomplish this the shaft 34 is provided with a cam sleeve 34^a rotatably mounted thereon for movement with respect thereto through a limited angle of the order, for example, in a practical construction, of about 72°. The sleeve 34^a has an enlarged cylindrical end 34^b which encloses a collar 34^c integral with the shaft 34. Secured in the shaft at the collar, as for example by a brass fitting, as is clear from Fig. 11, is a pin 34^d which extends through a pair of diametrically opposite slots 34^e in the enlarged collar 34^b. The length of these slots in a circumferential direction is such as to permit of the relative angular movement between the shaft and sleeve of 72° mentioned above. Fitting over the shaft 34 and secured to the collar 34^c by means of rivets 34^g is a disc 34^f which has a radial lug or extensions 34^j as is clear from Figs. 6 and 11. A spiral spring 34^m has one end secured in any suitable manner to the extension 34^j and its other end secured by rivets to a block 34^n which is set and secured in a recess in the enlarged collar 34^b in any suitable manner.

The opposite end of the sleeve 34^a is provided with a pair of camming surfaces 34^h disposed on the end edge thereof, in diametrically opposed relation as is clear from Figs. 6 and 13. The throw of these cams is small. A diametrical slot is formed in the shaft 34 adjacent the right hand end of the sleeve 34^a and intersects the axial bore in which the plunger 84 is mounted. The cam follower 34^i is engaged to the right hand end of sleeve 34^a and to have axial movement under the action of the cams 34^h, the slots in the shaft 34 being of sufficient axial length to permit of this movement. The end of the plunger 84 is formed as shown in Fig. 12 so as to have a pointed end engaging in a notch in the adjacent side of the cam follower 34^i. This end and notch are proportioned as shown in Fig. 12 so as to permit of a slight rocking movement between the parts to accommodate the cam follower 34^i through any slight differences between the cams 34^h normally supposed to be exactly the same.

The spring 34^m connected in the manner shown is constructed to be strong enough to hold the parts in the position shown in Fig. 6 when the motor is de-energized. At this time, as is shown, the pin 34^d is at the lower end of the slot 34^e. At this time the cam follower 34^i is at its right hand position, being at the high points of the cams 34^h. From this it follows that the plunger 84 is at its right hand position, as shown, and hence plate 82 is at its extreme right hand position. Thus if the load tends to move downwardly the brake comprising the plate 82 and disc 86 is in engagement under its maximum pressure holding the load in conjunction with the drum brake.

It is to be remembered, of course, that the plate 82 will tend to move in a counterclockwise direction when viewed from the right hand end of Fig. 6, and will because of its engagement with disc 86 cause it to rotate with it in the same direction so that the threads 87 will move the disc 86 towards the plate 82 the full amount of the movement permitted as limited by the lug 89 (Fig. 10) secured to it. This lug cooperates with the ends of a notch in a fixed plate 90 attached to the cover plate 79. The shoulders of this notch limit the amount of rotation which the disc 86 may undergo in either direction. The spring 88 is provided to always hold the disc 86 in light engagement with the friction ring 85 on the plate 82 even when plate 82 is fully withdrawn in an axial direction toward the left of Figure 6. In other words, the light spring 88 always ensures sufficient engagement between the disc 86 and the plate 82 so that counterclockwise movement of the disc 82 under load, with the motor de-energized, will cause the disc 86 to move into maximum engagement with it.

As soon as the motor is energized to raise the load, the rotor 35 starts to move in a clockwise direction (when viewed from the brake end) and being mounted on the sleeve 34^a carries that sleeve with it and the shaft 34 because of the pin 34^d. Should the loaded hook tend to descend it will, of course, cause counterclockwise movement of plate 82 to move the disc 86 to the left (Fig. 6 as explained above) to fully apply the brake. This brake acts in conjunction with brake 66 which, of course, is applied when the power is turned off. However, the brake 82—86 is provided to ensure that the load may not descend in the event that the brake 66 does not hold. As soon as any creeping occurs because of the failure of brake 66 to hold, brake 82—86 comes into full play and by the nature of its construction and manner of operation holds with a certainty.

In order to lower the load the motor is energized in the reverse direction which energization is immediately followed by a movement of the armature 35 and sleeve 34^a on the shaft 34 until pin 34^d strikes the upper end of slot 34^e (Fig. 6) when the shaft 34 then moves with the armature. This relative movement between sleeve 34^a and shaft 34 moves the cam follower 34^i to a position where it may drop down to the bottom of the cam surfaces 34^h, that is, move to the left (Figs. 6 and 12) permitting plunger 84 to move to the left as well as plate 82 connected thereto. This plate, as explained above, slides on the pins 83. This relieves the pressure between the brake, plate 82 and disc 86 so that the motor may lower the load with no drag due to the brake 82—86 other than the negligible amount caused by the action of spring 88 which has moved the disc 86 to the left (Fig. 6) with the plate 82 so as to always maintain the light contact therebetween, as explained above. At the end of the lowering operation and immediately upon de-energization of the motor, spring 34^m causes a return relative movement between the sleeve 34^a and shaft 34 so that they move back to the position shown in Fig. 6, moving cam follower 34^i to the right as well as plunger 84 and plate 82. Immediately any creeping occurs from this position the brake

elements **82** and **86** engage under their maximum pressure to securely hold the load.

It will be noted from Figures 1 and 5, for example, that the arm **57** on the lever **53** extends under the arm **74**.

From the above description of the structural details the operation of the hoist will be apparent to those skilled in the art. For the sake of completeness, however, a brief further description of the manner of operation of the device will be given. Assuming the hook loaded and the desire to lift the load, the left hand handle on cord **80**, see Figure 1, is pulled downward. This causes rotation of shaft **73** and cam **72** to release the brake shoes **66***a* from the brake drum **64**. At the same time lever **75**, acting on cam lever **76**, operates switch **78** to complete the circuit to the motor and cause energization thereof in a direction to rotate it and the drum in a clockwise direction when viewed from the right hand end, Fig. 1. Thus the drum revolves to wind the cable **50** upon it, the pulleys travelling thereto being guided into the proper grooves on the drum by the guiding structure in an obvious manner.

The drum is caused to revolve in the following manner. The armature rotates in a clockwise direction causing the gear on **45** meshing with gear **32** to roll around on it. Gear member **45** therefore rotates on bearings **44** having more teeth than gear **32**. The result is that gear **30** revolves at a slow speed by reason of its engagement with the other set of teeth on member **45**. Thus the cable drum revolves at a greatly reduced speed in a clockwise direction, gear **30** having more teeth than the gear on **45** meshing with it. A differential motion, of course, results from the magnetic forces of action and reaction between the motor field and armature. As a practical example, gear **32** has 54 teeth on a pitch diameter of six and three-quarter inches, the gear on **45** meshing with it 46 teeth on a pitch diameter of five and three-quarter inches, gear **30** has 61 teeth on a pitch diameter of six and one-tenth inches and the gear on **45** meshing with it has 51 teeth and a pitch diameter of five and one-tenth inches. This gives a speed reduction of sixty-four to one.

When the load has been lifted to the desired amount the operator releases the handle which returns to neutral position, at which time switch **78** is turned off and cam **72** is turned back so that the springs **70** may apply the brake shoes **66**[a] to the brake drum, thereby holding the load at that position. To cause the load to descend, the right hand handle on cord **80** is operated to move the lever **74** to the opposite position so that switch **78** connects the motor in circuit in a reverse direction effecting a reverse movement of all the parts. It is not necessary to repeat here the action of the brake **82—86** in the event that the load tends to creep downwardly when the motor is de-energized or to explain how the brake **82—86** is released when the load is lowered but is automatically brought back into play when the motor is de-energized.

If the apparatus is operating to lift a load and the operator forgets to turn off the switch **78**, it will be turned off automatically in the following manner. When the load is at a safe upper limit of movement, the lug **56** engages the collar **55** on rod **54**, moving the rod to the right, Figure 1, and causing lever **57** to move the lever **74** back to horizontal position, shutting off the motor.

The adjustment of the carriage arrangement to permit of mounting the hoist on an overhead I-beam and adjusting it for various sized beams has already been described. It will be seen that by reason of the supporting mounting employed but one-half of the load lifted, together with the entire weight of the hoist, is carried on the end members through the tubes **13** and bars **2**, **3**, **5** and **6**, leaving only half of the weight of the load lifted to be supported by the drum and associated parts. This makes it possible to use lighter structural members in many places in the hoist and makes for longer life and greater safety.

From the above description it will be apparent to those skilled in the art that the principles of this invention and the physical structures employed to accomplish them may readily be varied by those who are familiar with the art without departure from the novel scope of the subject matter hereof. We do not, therefore, desire to be strictly limited to the disclosure as given for purposes of illustration, but rather to the scope of the appended claims.

What we seek to secure by Letters Patent is:

1. A hoist mechanism of the type described including a cable drum, a motor mounted within said drum including a field secured to the drum, a shaft journaled for rotation, an armature mounted on said shaft for rotation therewith and arranged to have limited relative rotational movement with respect thereto, a gear train for connecting said shaft with said drum whereby when the motor is energized the drum rotates, and a brake mechanism including a relatively fixed member and a member mounted on said shaft for rotation therewith and axial movement with respect thereto, and means operated by the relative limited rotational movement of the armature on the shaft for moving said second member axially towards or away from said relatively fixed member.

2. In a hoist mechanism the combination including a cable drum, a reversible electric motor having a rotor and shaft operatively connected to said drum to rotate it, said rotor being capable of limited rotational movement on the shaft, a brake mechanism including a member, supported for limited rotative and axial movement, and a rotatable member, connected to the motor shaft for rotation therewith, and having limited axial movement with respect to said first member, means on the motor shaft and operated by the rotor upon its movement on said shaft for causing movement of said members towards each other upon de-energization of the motor and initial reverse movement of the drum after energization for operation of the drum in one direction, and means acting to always hold said members in contact.

3. In a mechanism of the type described, the combination including a cable drum, a reversible electric motor having an armature and shaft, said shaft being operatively connected to said drum to rotate it in either direction, a sleeve interposed between the armature and the shaft and secured to the armature, said sleeve being capable of limited rotational movement on the shaft, a brake having a relatively fixed contact member and a contact member rotatable with said shaft, and means actuated by the sleeve upon relative movement of the sleeve on the shaft to engage the contact members of the brake mechanism upon deenergization of the motor and initial operation thereof in a reverse direction and to disengage the contact members upon energization of the motor.

4. In a hoist mechanism, the combination including a cable drum, a reversible electric motor having an armature and shaft operatively connected to said drum to rotate it, the armature being movable on the shaft to a limited extent, a brake mechanism including a member supported for limited rotative and axial movement, and a rotatable member slidably connected to said shaft for rotation therewith and limited axial movement with respect to said first member, and means actuated by the armature when it moves on the shaft for causing axial movement with respect to the armature of both said members so that they move toward each other upon deenergization of the motor and initial reverse movement of the drum, after energization for operation of the drum in one direction.

5. In a hoist mechanism, the combination including a cable drum, a reversible electric motor having a rotor and shaft operatively connected to said drum to rotate it, a brake mechanism including a member supported for limited rotative and axial movement, and a rotatable member connected to the motor shaft for rotation therewith and having limited axial movement with respect to said first member, and means actuated by the rotor for causing axial movement of both of said members toward each other upon deenergization of the motor and initial reverse movement of the drum, after energization for operation of the drum in one direction, and for moving both of said members away from each other in an axial direction upon energization of the motor in said reverse direction.

6. In a device of the type described, the combination including a motor having a shaft and an armature, the armature being mounted on the shaft for movement on the shaft, means for limiting the movement of the armature on the shaft, means for normally holding the armature at one of its limits of movement, and a brake mechanism operated by the armature when it moves on the shaft, said brake mechanism including a pair of contacting members, one of such members being mounted on said shaft for rotation with it, and axial movement with respect to it, and the other of said members being mounted on a support fixed with respect to said shaft so as to be capable of limited axial and rotational movement with respect to the first of said members.

7. In a device of the type described, the combination including a cable drum, a motor having an armature and a shaft mounted for relative rotation with respect to each other, means for limiting the relative rotation of the armature on the shaft, means for normally holding the armature and shaft at one of their limits of relative rotation, means for connecting the motor to the drum to rotate it, a brake mechanism comprising a pair of contacting members and a rod slidably mounted in said shaft and engaged by said armature, one of said members being mounted on said rod and the other of said members being mounted on a support fixed with respect to said shaft so as to have limited rotational and axial movement with respect to the shaft, relative movement of the armature with respect to the shaft causing axial movement of said rod and the member mounted on it.

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