Oct. 3, 1939. R. E. SMITH 2,175,037

ELECTRIC HOIST

Filed Sept. 6, 1938 2 Sheets-Sheet 1

Fig. 1

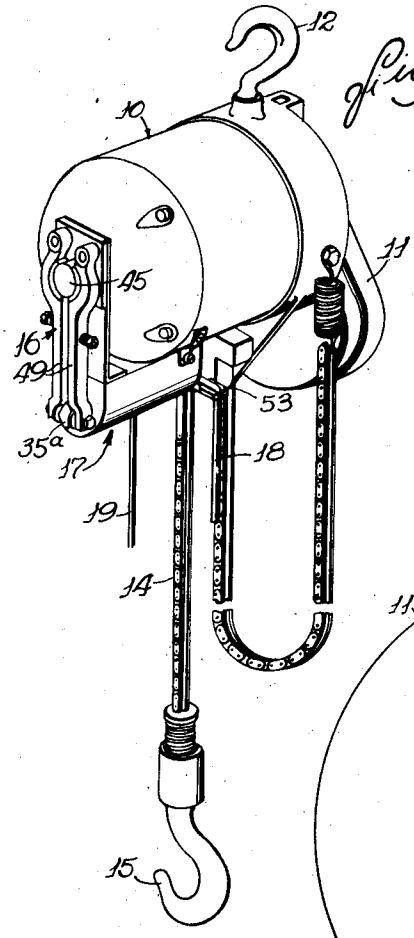
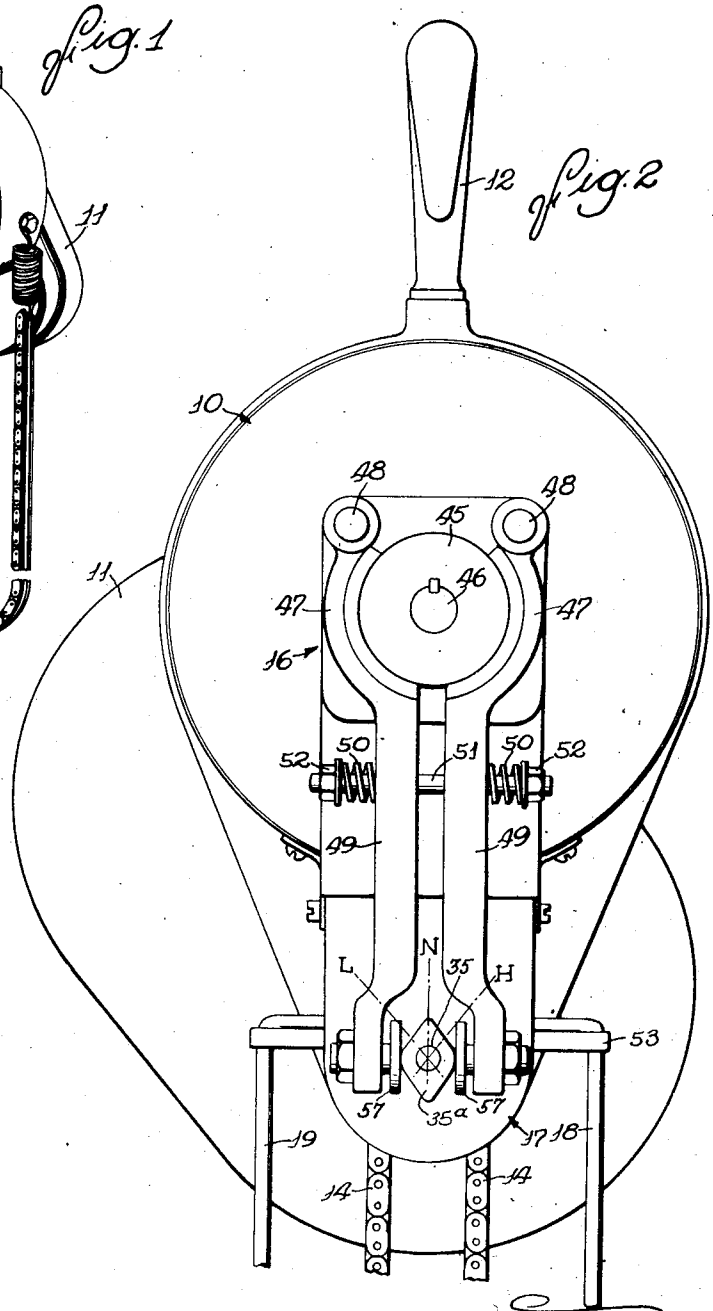


Fig. 2



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ELECTRIC HOIST

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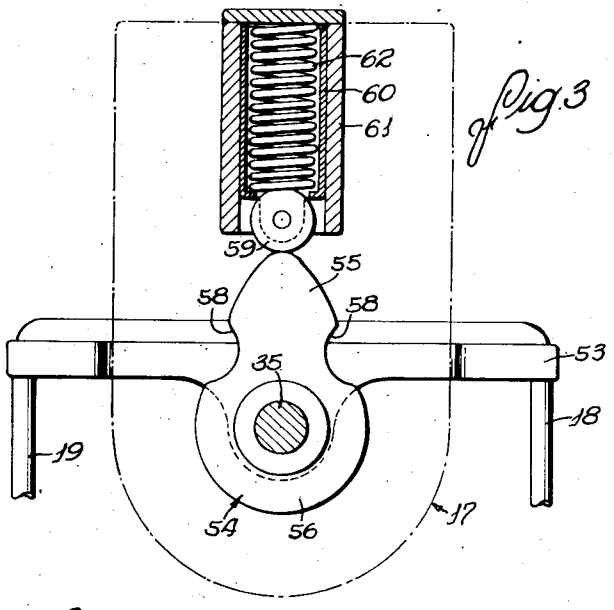


Fig. 3

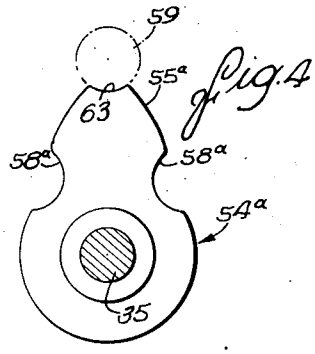


Fig. 4

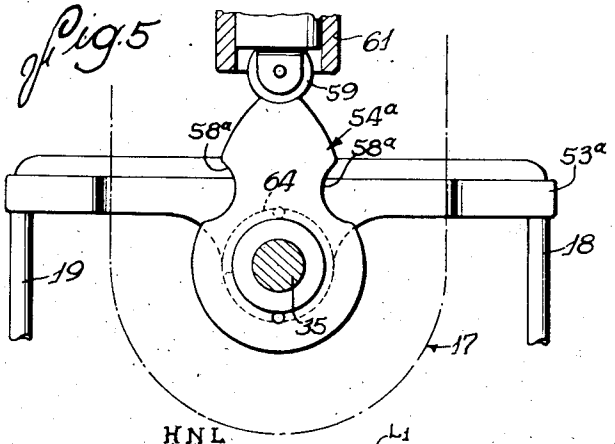


Fig. 5

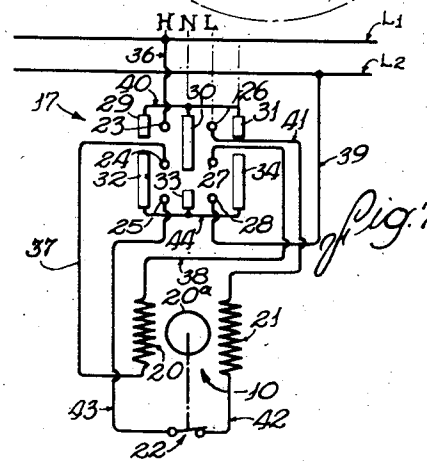


Fig. 7

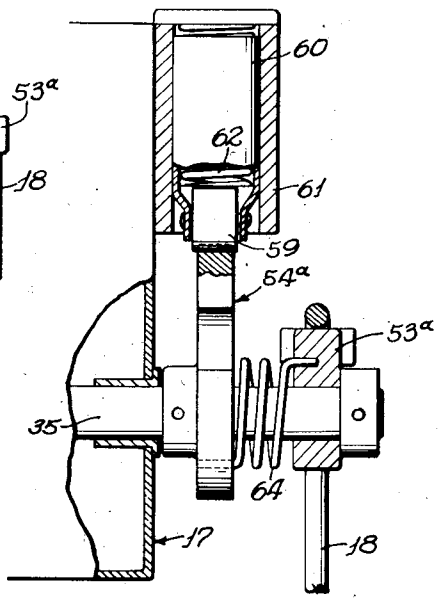


Fig. 6

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Patented Oct. 3, 1939 2,175,037

UNITED STATES PATENT OFFICE

2,175,037

ELECTRIC HOIST

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Application September 6, 1938, Serial No. 228,510

7 Claims. (Cl. 192—2)

The invention relates to electric hoists and more particularly to such hoists of the type embodying an electric driving motor together with a brake for holding the associated motor driven hoist member against rotation when the driving motor is stopped.

In hoists of the type noted above, it has heretofore been proposed to utilize a single manually operated actuator for both the motor reversing-controller and the brake mechanism. In general, the actuator has a central or neutral position and may be shifted in opposite directions from this neutral position for hoisting and lowering respectively. When the actuator is in its neutral position the brake is set but is subsequently released whenever the actuator is moved from neutral to either hoisting or lowering positions. One serious danger likely to arise with such a system is that there will be a substantial time interval, upon moving from neutral position, between the release of the brake and the closure of the controller contacts to energize the motor. It will be understood that this cannot be readily overcome by arranging the motor contacts to be closed substantially before the release of the brake since in that case the motor would be overloaded by being started with the brake applied. On the other hand, it is difficult to synchronize exactly the release of the brake and closure of the controller contacts, and even if they are exactly synchronized during the initial adjustment of the hoist, subsequent wear of the brake parts and the like is likely to throw them out of synchronization.

Another factor to be considered is the prevalent tendency of hoist operators to move the manual control cords or levers of the hoist with a very slow movement when it is desired to "inch" the hoist along very slowly. If the brake is released before the controller contacts are closed, then such slow operation by the operator will of course greatly increase the actual time interval between the release of the brake and closure of the contacts. During such an interval, if the hoist is loaded, the load is free to descend by gravity and thereby very quickly accelerates the deenergized driving motor with consequent danger of injury to the motor and associated hoist parts. This danger is particularly aggravated in the event that the driving motor is of the single phase alternating current type with a speed responsive switch-controlled starting winding such as is disclosed in the copending application of Preston W. Whitcomb and Ralph E. Smith, Serial No. 228,509, filed September 6, 1938. If a motor of the type noted is accelerated by a freely falling load attached to the hoist, the speed responsive switch on the starting winding is opened and may in many cases be actually torn apart by the centrifugal force resulting from the undue acceleration of the motor. Even if the speed responsive switch is only opened, rather than broken, the motor is rendered incapable of hoisting the load until it has first been stopped since it is a characteristic of such motors that they will continue to rotate, in the direction in which they have previously been started, upon application of a voltage to them unless the starting winding is in circuit. These considerations make it amply apparent that a motor driven hoist, and particularly one embodying a motor of the type described, is likely to be rendered altogether inoperative if there is any appreciable time interval between the release of the brake mechanism and the energization of the driving motor.

The general object of the present invention is to provide an electric hoist in which the difficulties described above are overcome by the provision of a snap-acting mechanism for positively insuring a rapid and complete throw of the brake and motor control devices from their respective neutral positions to their full hoisting or lowering positions despite any misguided or inadvertent attempt on the part of the operator to move them slowly. By virtue of this improved arrangement, the motor and brake controller devices snap into position so quickly that even if they are not exactly synchronized, the time interval between the release of the brake and energization of the motor will be so short that any load attached to the hoist cannot descend an appreciable distance due to gravity.

The invention also resides in certain structural improvements and combinations of parts embodied in the control mechanism for the hoist.

Further objects and advantages of the invention will become apparent as the following description proceeds taken in connection with the following drawings, in which:

Figure 1 is a general perspective view of an electric hoist embodying the invention.

Fig. 2 is an enlarged end elevation of the brake end of the hoist shown in Fig. 1.

Fig. 3 is a detail end elevation partly in section of the snap-action control device included in the hoist.

Fig. 4 is an enlarged detail end elevation of a modified form of cam adapted to be embodied in the mechanism of Fig. 3.

Figs. 5 and 6 are respectively enlarged detail end and side elevations of a further modified form of snap-action control mechanism adapted to be used with the hoist of Fig. 1.

Fig. 7 is a wiring diagram of the motor control circuits for the hoist.

For purposes of illustration of its various novel features, the invention has been shown herein (Fig. 1) as embodied in a small hoist of what may be designated as the portable type. It will be understood, however, that the invention is, in many of its aspects, also applicable to other types of hoists. The particular hoist selected for illustration of the invention embodies in general an electric driving motor 10 mounted on one end face of a gear case 11 and supported as a unitary structure therewith by a suitable hook 12. The motor 10 drives a revolvable hoisting member such as a chain pinion (not shown) located below the motor 10, through the medium of a speed reduction gearing enclosed by the gear casing 11. The chain pinion is disposed below the motor 10 in general vertical alinement with the supporting hook 12, and a suitable hoist line such as a roller chain 14 is reeved over the pinion with one end of the chain made fast to the gear case 11 and with the other end hanging free for hoisting a load hook 15 being attached to its lower end. A brake mechanism, designated generally by the numeral 16, for holding the motor 10 and driven chain pinion against rotation when the motor is stopped, is mounted on the outboard end of the motor (Fig. 2). Also a reversing controller 17, operated for example through the medium of a pair of control cords 18 and 19, is secured to the lower side of the motor. It will be understood that the particular location or arrangement of the parts of the hoist as described above forms no part of the present invention and may be varied as necessity or expediency require.

Turning now to a more detailed consideration of the parts of the hoist illustrated, the driving motor 10 may be of the single phase alternating current type and embody a main field winding 20 as well as a starting winding 21 (Fig. 7) cooperating with a rotor 20^a. A control arrangement adapting such a motor for use in an electric hoist is disclosed in the Whitcomb et al. application referred to above. Although the present invention is applicable to hoists embodying other types of motors it does find particular utility with the type of motor noted and accordingly such type of motor has been illustrated and described herein. The motor starting winding 21 is, in order to reduce the cost of the motor, made of such small current carrying capacity that it must be cut out of circuit after the motor has started. For this purpose a speed responsive switch 22, which may be of the conventional centrifugal type and built into the motor itself in the usual manner, is utilized to open circuit the starting winding 21 whenever the motor 10 is operating at a speed in excess of a predetermined value.

The reversing controller 17 for the motor has been shown in developed or schematic form in Fig. 7. As illustrated it embodies two rows of fixed contacts 23, 24 and 25 and 26, 27, and 28 as well as cooperating movable contacts 29, 30, 31, 32, 33 and 34. These movable contacts are carried by an oscillatable rotor, actuated by rock shaft 35 (Fig. 2). Current is supplied to the motor 10 from suitable alternating current supply lines L_1—L_2. When the controller 17 is in its central or neutral position, with the movable contacts disposed with their center line at N (Fig. 7) the motor 10 is open circuited and hence deenergized. Upon shifting the controller contacts to the left to hoisting position H, the hoisting movement of the motor is initiated with the main winding 20 energized (through a circuit L_1—36—23—30—24—37—20—38—27——34—28—39—L_2) and the starting winding 21 is also energized (through a circuit L_1—36—23—30—40—31—26—41—21—42—22—43—25—33—44—34—28—39—L_2). It will be noted that the speed responsive switch 22 is included in the starting winding circuit and as soon as the motor attains a predetermined speed for which the switch is set, the switch 22 opens thereby deenergizing the starting winding. Upon a subsequent deenergization of the motor, the switch 22 again falls closed as the motor decelerates although usually at a somewhat lower speed than that at which it opens, due to the inherent sluggishness of such switches. In a similar manner, when the movable contacts of the controller 17 are shifted so that their center line occupies the position located at L, a reverse or lowering motion of the motor is initiated, the main winding 20 being energized with the voltage reversed as compared to that for hoisting (through a circuit L_1—36—29—40—30—27—38—20—37—24—32—44—33—28—39—L_2) and the starting winding 21 is energized in the same voltage sense as before (through a circuit L_1—36—23—29—40—30—26—41—21—42—22—43—25—32—44—33—28—39—L_2). As before, the speed responsive switch 22 is included in the starting winding circuit and is automatically opened after the motor comes up to speed.

The brake mechanism 16 is utilized for holding the motor 10 and the connected hoist pinion 13 against rotation when the motor is deenergized. The brake mechanism has been shown to be of the friction shoe type although other types or forms of brake mechanisms may be used if desired. In the particular construction shown (Fig. 2), the brake mechanism embodies a brake drum 45 keyed to the outboard end of shaft 46 of motor 10 and a cooperating pair of brake shoes 47. The brake shoes are pivotally mounted on the end of the motor casing as indicated at 48, and each brake shoe includes an integral laterally extending actuator arm 49. The brake shoes 47 are yieldably urged into engagement with the drum 45 by a pair of compression springs 50 encircling a pin 51 and interposed between the outer faces of the arms 49 and nuts 52 threaded on the pin 51. The lower ends of the brake arms 49 embrace a generally diamond shaped cam 35^a fixed on the outer end of the controller rock shaft 35. Abutments 57, adjustably mounted on the opposed ends of the brake arms are disposed to contact the cam and cause the brake arms to be pushed apart and release the brake whenever the controller is shifted from its central-neutral position to either hoisting or lowering positions. When the controller is in its neutral position (indicated by the dot dash line N in Fig. 2) the brake arms are pressed toward each other by the springs 50 so that the brake is set to hold the motor 10 against rotation.

One difficulty with the arrangement so far described is that the brake 16 is likely to be released before, rather than substantially in synchronism with, the closure of the contacts of controller 17 for hoisting or lowering. It will be apparent that even though the parts are nicely adjusted at the

factory when the hoist is assembled, that after continued use the friction brake or other parts may become worn or misadjusted. In the event that the brake is released even slightly before the closure of the controller contacts, there is danger that the operator will move the actuating mechanism so slowly that an appreciable time interval will elapse during which the brake is released and the motor deenergized. In this interval any load attached to the hoist falls freely by gravity and very quickly accelerates the driving motor 10. There seems to be an almost inirradicable impression on the part of most hoist operators that the speed of operation of the hoist bears a direct ratio to the speed with which the control mechanism is moved. In other words, there is, for obvious psychological reasons, a strong tendency to pull gingerly or slowly on the control cords 18—19 when it is desired to inch the hoist line along slowly. Of course, the speed of motor operation actually bears no relation whatever to the speed of operation of the controller, and as a matter of fact, a very dangerous operating condition is likely to result from such attempted slow operation. With a split phase alternating current motor of the type described, the danger is particularly aggravated. For example, if a load is suspended by the hoist in stopped position and the operator moves the controller rock shaft 35 slowly toward hoisting position, the brake may be released before the controller contacts close to energize the motor. In such case, the motor is rapidly accelerated by the load which falls under the influence of gravity, and the speed responsive switch 22 is opened. After this switch has once opened, then even if the operator subsequently closes the controller contacts in the manner which would normally energize the motor for hoisting, the motor will not, in fact, be energized for such movement, but will, on the other hand, continue to rotate in the lowering direction. This latter result is due to the inherent characteristic of motors of the type noted that when once rotation has been initiated, any reversing of the voltage on the main winding alone will not serve to reverse the direction of rotation, but on the other hand, such reversal of rotation can only be obtained when the starting winding is in circuit. Even though some other type of driving motor be used, the sudden acceleration due to release of the load is likely to strain or break the motor parts due to the extreme centrifugal forces encountered.

In accordance with the present invention a mechanism of the snap-acting type has been provided for positively insuring a quick throw of the brake and motor controller mechanisms from their neutral positions to either their hoisting or lowering position, no matter how slowly the operator applies force to the control cords 18—19, or other manual actuating device. In the particular construction illustrated in Figs. 1, 2 and 3, the controller rock shaft 35 is provided with a cross bar 53 fixed thereon and carrying the control cords 18—19 at its outer ends. The cord 18 may be used, for example, to shift the controller to hoisting position and the cord 19 to shift it to lowering position. A peripheral cam 54 is fixed on the inner end of the rock shaft 35. This cam 54 includes (Fig. 3) a high point or nose 55 and a rounded butt end portion 56. In order to accommodate the cam 54 for snap-acting motion, notches 58 are fashioned in the opposite side edges of the cam and are positioned to receive a cam follower roller or stop member 59 carried by a plunger 60 which is mounted for axial sliding movement in a bracket 61. The cam follower roller 59 is yieldably urged into engagement with the cam by a helical compression spring 62.

When the controller rock shaft 35 is in its neutral position, the cam follower roller 59 is pressed against the nose 55 of the cam. Then as soon as the operator shifts the rock shaft 35 slightly to the right or left for hoisting or lowering, the spring 62 pushes the cam around so that the roller 59 finally moves into the corresponding one of the notches 58 with a rapid or snap action. The controller shaft 35 is thus moved with such rapidity into its full hoisting or lowering position that the brake is released and the controller contacts closed substantially instantaneously. Consequently, there is no appreciable time interval for the load on the hoist to gain momentum by falling even though the brake and controller mechanisms are not exactly synchronized. In this manner, the operator, no matter how misguided, is powerless to move the controller rock shaft slowly with the conscquent danger of faulty operation described above.

Too rapid shifting of the controller from hoisting to lowering position or vice versa is prevented by the engagement of the cam nose 55 with the spring pressed roller 59 as it passes neutral position. This engagement of the cam by the roller arrests the cam motion for a substantial time interval and during this time the brake 16 is applied. As a result, the motor 10 is slowed down sufficiently that the speed responsive switch closes, thereby conditioning the motor for proper subsequent starting with its starting winding 21 in circuit.

A modified form of control cam 54ª has been illustrated in Fig. 4. This cam is substantially identical with the cam 54 except that a notch 63 is formed in the nose 55ª to receive the cam follower roller 59 when the cam is in its central or neutral position. Otherwise, the cam 54ª is shaped like the cam 54 previously described and includes peripheral edge notches 58ª for receiving the cam follower when the cam is in its hoisting or lowering positions, respectively. The additional notch 63 serves two purposes. First, it acts to center and positively hold the cam in its neutral position. Second, it cooperates with the cam follower roller 59 to resist movement of the cam from its neutral position and as a result a comparatively large force must be exerted on the rock shaft 35 before the cam 54ª can be moved from its neutral position. This strong initial force on the rock shaft helps to carry it through its complete movement to hoisting or lowering position with the required rapidity.

To further insure snap action of the controller rock shaft 35 a spring or similar energy storing means may be interposed between the manual operating device and the rock shaft. For example, as shown in Figs. 5 and 6, a manual operating cross arm 53ª may be loosely journaled on the rock shaft 35 as distinguished from being fixed thereto, as in the case of the arm 53 in Fig. 2. A cam 54ª is fixed to the rock shaft 35 and is identical in construction with the cam 54ª of Fig. 4, being provided with a cam follower mechanism also identical with that previously described. A helical torsion spring 64 is interposed between the cross arm 53ª and the cam 54ª. This spring may surround the rock shaft and have two opposite ends fixed to the cam and to the cross arm. With such an arrangement, when the operator pulls down on either of the control cords 18—19 the cross arm 53ª is osci-

lated about the rock shaft and tension built up in the torsion spring 64. Subsequently, when the force stored up in the spring reaches a predetermined amount, the cam 54a is pulled sharply by the spring to either its full hoisting or lowering position, as the case may be. By this means a full snap-acting type of operation for the motor and brake controls is achieved and there is no possibility of a time lag between release of the brake and energization of the driving motor.

Although certain particular embodiments of the invention have been described in some detail for purposes of explanation of the invention, there is no intention to limit the invention thereby to such embodiments but, on the other hand, the appended claims are intended to cover all modifications and alternative constructions within the spirit and scope of the invention.

I claim as my invention:

1. An electric hoist comprising, in combination, a revolvable hoist member, an electric motor connected in driven relation with said hoist member and having an energizing circuit, a reversing controller for controlling the energization of said motor including a control member oscillatable from a central neutral position in which said motor is deenergized to either a hoisting or lowering position displaced on respective opposite sides of said neutral position and in which said motor energizing circuit is completed with correspondingly reversed voltage for hoisting or lowering, means including a brake for releasably holding said motor and hoisting member against rotation, means including a cam carried by said control member and a brake actuating member yieldably urged into engagement with said cam for setting said brake when said control member is in neutral position and for releasing said brake in response to movement of said control member to either hoisting or lowering position, manually operable means for oscillating said control member, and means including a second cam carried by said control member for moving said control member from neutral position to either hoisting or lowering position with a rapid snap action irrespective of the speed with which force is applied to said manual means.

2. An electric hoist comprising, in combination, a revolvable hoist member, an electric motor connected in driven relation with said hoist member and having an energizing circuit, a reversing controller for controlling the energization of said motor including a control member oscillatable from a central neutral position in which said motor is deenergized to either a hoisting or lowering position diplaced on said opposite sides of said neutral position and in which said motor energizing circuit is completed with correspondingly reversed voltage for hoisting or lowering, means including a brake for releasably holding said motor and hoisting member against rotation, means responsive to movement of said control member for setting said brake when said control member is in neutral position and for releasing said brake in response to movement of said control member to either hoisting or lowering position, manually operable means for oscillating said control member, and means for moving said control member from neutral position to either hoisting or lowering position with rapid snap action.

3. An electric hoist comprising, in combination, a revolvable hoist member, an electric motor connected in driven relation with said hoist member and having an energizing circuit, a reversing controller for controlling the energization of said motor including a control member oscillatable from a central neutral position in which said motor is deenergized to either a hoisting or lowering position displaced on respective opposite sides of said neutral position and in which said motor energizing circuit is completed with correspondingly reversed voltage for hoistng or lowering, means including a brake for releasably holding said motor and hoisting member against rotation, brake actuating means for setting said brake when said control member is in neutral position and for releasing said brake in response to movement of said control member to either hoisting or lowering position, manually operable means for oscillating said control member, and a peripheral cam carried by said control member, said cam having peripheral notches on opposite sides of a projecting nose portion, and means including a resilient cam follower engaging the periphery of said cam for moving said control member from neutral position to either hoisting or lowering position with a rapid snap action irrespective of the speed with which force is applied to said manual means.

4. In an electric hoist, the combination with a reversible driving motor, a hoisting member driven by said motor, and a reversing controller for said motor including a control member oscillatable from a central neutral position in opposite directions to respective hoisting and lowering positions, of means for shifting said control member from said neutral position to either hoisting or lowering position with a rapid snap action.

5. In an electric hoist, the combination with a reversible driving motor, a hoisting member driven by said member, and a reversing controller for said motor including a control member oscillatable from a central neutral position in opposite directions to respective hoisting and lowering positions, of means for shifting said control member from said neutral position to either hoisting or lowering position with a rapid snap action, said last named means including a peripheral cam carried by said oscillatable member and having a projecting nose portion thereon and notches in the periphery thereof on the opposite sides of said nose and a cam follower yieldably urged into peripheral engagement with said cam and positioned to engage said nose when said control member is in neutral position and to ride off of said nose portion into engagement with said notches when said control member is shifted correspondingly toward hoisting and lowering positions.

6. An electric hoist comprising, in combination, a revolvable hoisting member, a single phase alternating current electric motor connected in driving relation with said hoisting member and embodying a main winding and an auxiliary starting winding, means including a speed responsive switch for deenergizing said starting winding when said motor is rotating at a speed in excess of a predetermined value, a reversing controller for said motor including a control member oscillatable from a central neutral position in opposite directions to respective hoisting and lowering positions, a releasable brake for holding said motor against rotation, means responsive to movement of said control member for setting said brake when said control member is in its neutral position and for releasing said brake when said control member is in either hoisting or lowering position, said last named means in-

cluding a peripheral cam connected to said control member and having an elongated nose portion thereon with a notch in the end thereof, and means including a cam follower yieldably urged into engagement with said cam and engageable with the notch therein when said control member is in neutral position for slowing up the movement of said control member in passing from hoisting to lowering position and vice versa to thereby increase the period during which said brake is set in the course of such reversing operation, whereby said motor is slowed down to effect actuation of said speed responsive switch during the reversing operation.

7. An electric hoist comprising, in combination, an electric hoisting motor, a controller for reversing and deenergizing said motor, said controller including a shaft rockable from a central neutral position in one direction or the other respectively to hoisting and lowering positions, a peripheral cam shaft on said shaft, said cam having peripheral notches therein corresponding to the neutral position as well as the hoisting and lowering positions of said shaft, stop means yieldably pressed into engagement with the notched portion of said cam for releasably holding the same in any one of its several corresponding positions, an actuator member loosely journaled on said shaft, manual means for moving said actuator, and means including a helical torsion spring anchored at its opposite ends to said cam and to said actuator member for operatively connecting the same to store up force upon oscillation of said actuator and thereby move said cam from one position to another with a rapid snap action.

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