April 28, 1953 J. W. HUNT 2,636,953

SAFETY SWITCH

Filed Feb. 25, 1950 2 SHEETS—SHEET 1

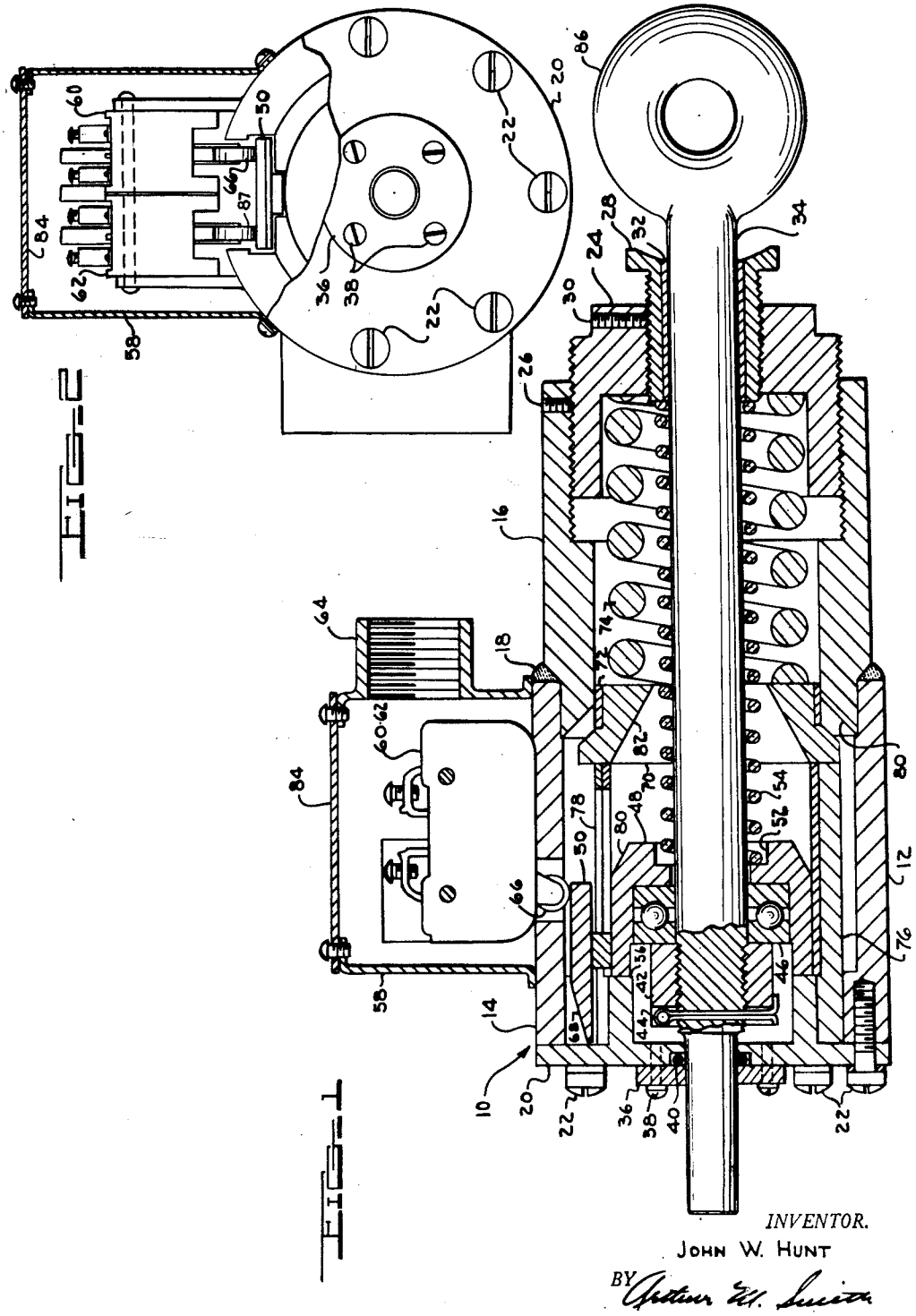


FIG. 2

FIG. 1

INVENTOR.
JOHN W. HUNT
BY Arthur W. Lucas
ATTORNEY

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SAFETY SWITCH

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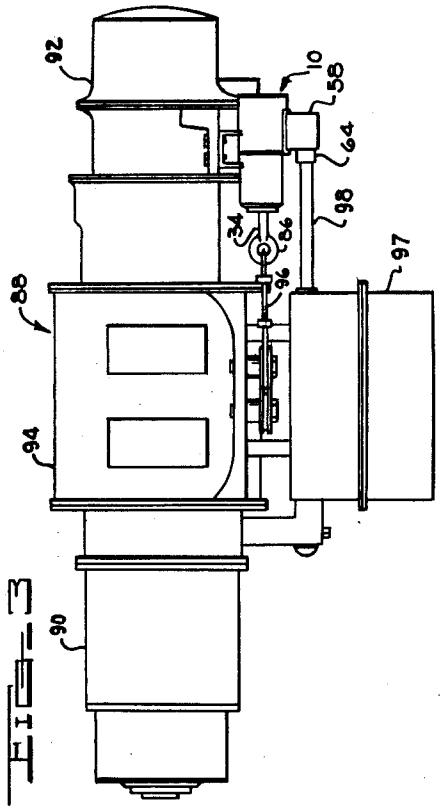


FIG. 3

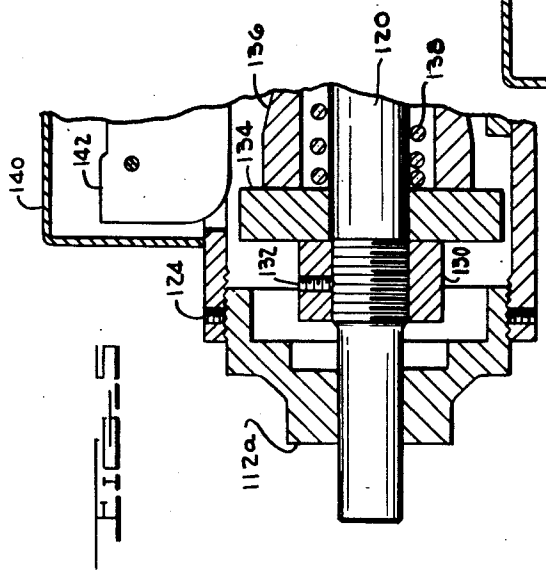


FIG. 5

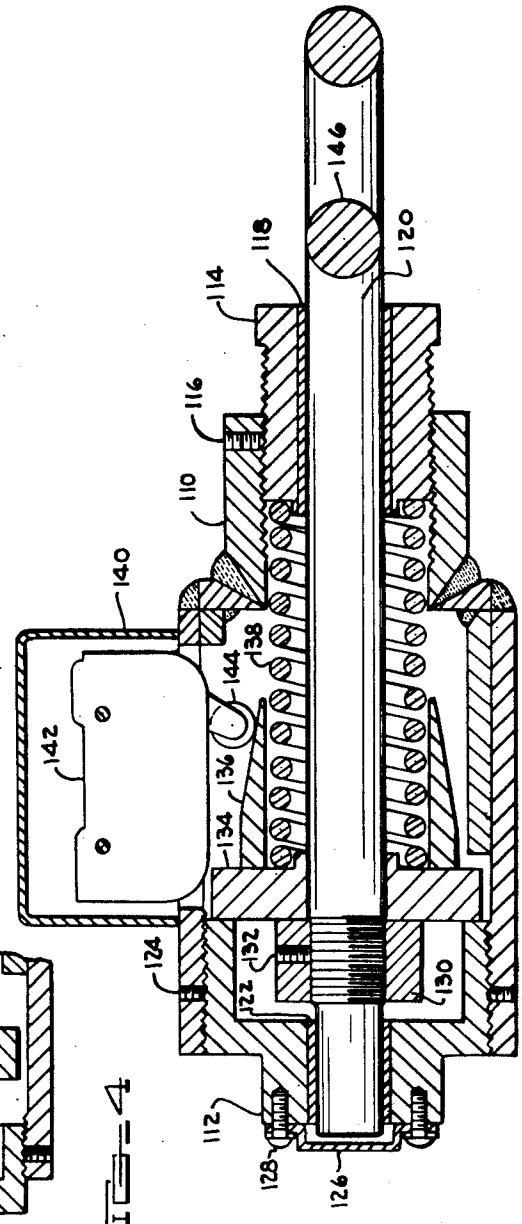


FIG. 4

INVENTOR.
JOHN W. HUNT
BY
Arthur M. Smith
ATTORNEY

Patented Apr. 28, 1953

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UNITED STATES PATENT OFFICE

2,636,953

SAFETY SWITCH

John W. Hunt, Pontiac, Mich., assignor of one-half to Walter P. Barrett, Pontiac, Mich.

Application February 25, 1950, Serial No. 146,310

10 Claims. (Cl. 200—85)

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The present invention relates to electric switch units and constitutes an improvement over switches of the type disclosed in my co-pending application No. 34,462, filed June 22, 1948. My co-pending application relates to load-carrying safety switches adapted for supporting the fixed end of a hoist cable and for automatically stopping the downward movement of the hoist block when the tension in the cable falls below a predetermined minimum.

It is desirable for switches of the type shown in my co-pending application as well as other types of such switches to include a safety feature to protect the switch units and hoist equipment from injury resulting from lifting loads in excess of the designed maximum load-carrying capacity of the hoisting equipment. Overloading in this manner may cause injury to personnel and also may cause serious damage to the equipment resulting in excessive maintenance costs and further resulting in prolonged periods of idleness while repairs are being made.

Accordingly, it is an object of the present invention to provide an improved electric switch unit suitable for use with hoisting equipment and which is adapted to stop operation of the hoist motor when a load above a predetermined amount is placed on the hoist cable, thereby to prevent damaging the hoisting equipment, and further, which is adapted to stop downward unwinding movement of the cable-winding drum whenever the tension in the cable falls below a predetermined minimum, thereby to stop unwinding of the cable so as to prevent slack forming therein.

It is a further object of the present invention to provide an improved electric switch unit suitable for use with hoisting equipment, conveyer drive units, winches, and the like, to prevent overloading thereof, which includes means for making small adjustments of the overload limit and which is adapted to permit relatively greater adjustment of the overload limit by interchanging of spring biasing means therein.

It is still a further object of the present invention to provide a combined overload and downward control switch unit which is characterized by its simplicity, sturdiness, and adaptability for use with hoisting equipment, and which is constructed and arranged to permit repairing thereof when necessary in a most efficient and economical manner.

Other objects of this invention will appear in the following description and appended claims, reference being had to the accompanying drawings forming a part of this specification wherein

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like reference characters designate corresponding parts in the several views.

In the drawings:

Fig. 1 is a longitudinal sectional view of one form of overload and downward control switch of the present invention.

Fig. 2 is an end view of the overload and downward control switch shown in Fig. 1 with a section broken away.

Fig. 3 is a plan view of an electric hoist showing a combination overload and downward control switch installed in its operating position.

Fig. 4 is a longitudinal sectional view of another form of overload switch of the present invention.

Fig. 5 is a fragmentary sectional view of still another form of the control switch.

Before explaining the present invention in detail it is to be understood that the invention is not limited in its application to the details of construction and arrangement of parts illustrated in the accompanying drawings, since the invention is capable of other embodiments and of being practiced or carried out in various ways. Also it is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation.

Referring to Figures 1 and 2 of the drawing, a combination overload and downward control switch 10 can be seen which includes a housing 12 having a left housing section 14 and a right housing section 16. The housing sections 14 and 16 are suitably secured together as by welding at 18. The housing 12 is generally cylindrical in shape and has its one end closed by a cap member 20 which is secured thereto by a plurality of bolts 22. The other end of the housing 12 is closed by an adjustable overload nut 24 which is threadedly connected to the housing 12 and held in a fixed position therein by a set screw 26.

Threadedly connected within the overload nut 24 is a downward control adjustment nut 28 held in a fixed position therein by the set screw 30. A bushing 32 extends axially through the downward control adjustment nut 28 within which is journaled a load shaft 34. The shaft 34 is journaled at its other end in the cap member 20. An oil seal is provided in the cap member 20 which includes a plate 36 secured to the cap member 20 by a plurality of screws 38 and an oil seal gasket 40.

The load shaft 34 has a load nut 42 threadedly secured thereto and locked against movement by a cotter pin 44. Mounted on the load shaft 34

on one side of the load nut 42 is a thrust bearing 46. On the other side of thrust bearing 46 is a load plate 48. The load plate 48 has rigidly secured to its one side a cam 50 which is adapted to actuate either an overload switch or a downward control switch in the control circuit of a hoist motor as will be more fully described hereinafter.

The load plate 48 has a recessed portion 52 formed therein adjacent the load shaft 34 and within which is seated a downward control spring 54. The downward control spring 54 has its other end seated against the downward control adjustment nut 28. Thus, it can be seen that the downward control spring 54 acts to bias the load plate 48 to the left, as seen in Fig. 1, to the unloaded position thereof. When in this position, the load plate 48 will be abutted against the annular stop 56 of the cap member 20. It is believed understood from the above description that when a load is placed on the load shaft 34, moving it to the right, the load nut 42, thrust bearing 46, load plate 48, and cam 50 will all be moved a corresponding amount to the right with the load shaft 34. In a similar manner, when the load is removed from the load shaft 34 the downward control spring 54 will bias the load plate 48, cam 50, thrust bearing 46 and load nut 42 to the left to the unloaded position of the load shaft 34.

Mounted on the outside of the housing 12 is a switch housing 58 adapted to house any form of conventional switch. In the present modification of the invention, two conventional micro-switches 60 and 62 are shown. A fitting 64 is shown on one side of the housing 58 through which electric leads (not shown) may be extended to said switches from the electric controls for a hoist motor.

The electric switch 60 is in a circuit adapted for controlling the downward hoisting of the hoist motor. The switch 60 can be actuated by means of a cam follower 66, which is adapted to follow on the cam 50. When the cam 50 is in its unloaded position, as seen in Figure 1, the cam follower 66 will actuate the switch 60 to prevent unwinding action of the hoist motor, and thereby prevent lowering of the hoist cable. When a load is placed on the hoist cable, which will be transmitted to the load shaft 34 causing movement thereof, the cam 50 will be moved to the right, and after the cam follower 66 has moved a predetermined distance down the inclined surface 68 of the cam 50, the switch 60 will be actuated closing or opening the said circuit, as necessary, to permit the hoist motor to hoist downwardly. The load necessary to move the cam sufficiently far to this predetermined position will depend upon the strength of the downward control spring 54 and the adjusted position of the downward control adjustment nut 28. If desired, this load may be equivalent to the weight of the hoist block and hook of the hoist cable. In this manner, the hoist will be ready for use whether or not a load is placed on the cable hook. However, if during the lowering operation the load on the cable should be reduced below this predetermined minimum, the downward control spring 54 will bias the cam 50 to the left causing the switch 60 to be actuated to stop the downward action of the hoist motor. Thus, it can be seen that a downward control switch for a hoist motor is provided which will prevent slack from forming in the hoist cable when any obstruction is met by the load on the cable preventing the downward movement thereof.

If it is desired to vary the amount of the predetermined minimum load necessary to actuate the switch 60, this can be accomplished by substituting for the downward control spring 54 another spring having different load characteristics or by adjustment of the downward control adjustment nut 28. When only slight adjustments of the minimum predetermined load are desired, this can be accomplished by loosening the set screw 30 and by increasing or decreasing the tension in the downward control spring 54 by screwing the downward control adjustment nut 28 in or out, respectively. However, if greater changes in the predetermined minimum load are required than can be made by adjustment of the downward control adjustment nut 28, a new spring can be substituted for the downward control spring 54 merely by removing the cap member 20, load nut 42, thrust bearing 46 and load plate 48.

The present form of the invention also includes an overload control mechanism for preventing upward hoisting action by the hoist motor when a load above a predetermined maximum has been placed on the hoist cable. This mechanism includes an overload plate 70, mounted on a bushing 72 for axial movement in the housing 12. An overload spring 74 is seated at its one end against said overload plate 70 and at its other end against the overload nut 24. The overload spring 74 acts to bias the load plate 70 against a bearing assembly 76. When in the normal position, shown in Figure 1, the overload plate 70 has an inclined shoulder 78 which is spaced from a corresponding inclined surface 80 on the inner wall of the housing 12. The overload spring 74 is designed to have sufficient strength to maintain the overload plate 70 and the housing 12 in this spaced relation whenever loads below the predetermined maximum are carried by the hoist cable. When an overload is placed on the hoist cable, the overload spring 74 will be collapsed by the load exerted thereon through the load plate 70. The overload is transferred to the overload plate 70 in the following manner:

When a load is placed on the load shaft 34, the cam 50 will be moved to the right in the slot 78 of the bearing assembly 76. Also, the load plate 48 will be moved a corresponding distance therewith as was previously described. If an excessive load is placed on the load shaft 34, the inclined surface 80 of the load plate 48 will come into engagement with the inclined surface 82 of the overload plate 70. Thus, if an overload is placed on the shaft 34, this overload will be transferred from the load plate 48 to the overload plate 70 causing the spring 74 to be collapsed, resulting in the movement to the right of the load plate 48, the cam 50 and the overload plate 70. The overload switch 62 is adapted to be actuated by a cam follower 87 which follows on the cam 50. The overload switch 62 is designed to be actuated when the cam follower 87 has progressed down the inclined surface 68 of the cam 50 beyond a predetermined position. Thus, it can be seen that a safety mechanism has been provided for the electric hoist whereby upward hoisting action of the electric motor will be stopped if an excessive load has been placed on the hoist cable.

If it is desired to change the overload limit of this switch unit, this can be accomplished either by adjusting the overload nut 24 or by substituting for the overload spring 74 a spring having different load characteristics. Adjustment of the spring 74 can be made simply by loosening the set screw 26 and screwing the overload nut

in or out depending upon whether it is desired to tighten or loosen the overload spring 74. If a new overload spring is to be substituted for the overload spring 74, this can be accomplished by removal of the cap member 20 and the various elements necessary to slide the overload spring 74 off the load shaft 34. Thus, it can be seen that suitable means are provided whereby the switch mechanism may be set to operate at any desired overload limit.

As previously stated, any form of conventional switch may be used with the present combination overload and downward control switch unit. There is very little danger of any damage being done to these switches during the operation of the combination overload and downward control switch unit. As can be seen, none of the load placed on the shaft 34 will be carried by the switches 60 and 62. If the switches do become defective for any reason, new switches can be substituted therefor without any appreciable delay merely by removal of the cover plate 84 of the housing 58.

The present form of the invention is adapted to be used either as a pull-type combination overload and downward control switch or as a push-type combination overload and downward control switch. At the one end of the load shaft 34 is an eye 86 to which a cable or the like may be attached for applying a load to the load shaft 34. The other end 88 of the load shaft 34 extends outwardly through the cap member 20 to permit the shaft 34 to be actuated by a pushing action against the end 88. This latter feature was developed to eliminate the necessity of fastening the load shaft directly to the hoist cable so that this combination switch unit will be adapted for use with any form of hoist cable reeving. It is believed to be apparent that a pull-type switch cannot be used, for example, with a hoist cable reeving having one rope, one part single, since in this reeving one end of the cable will be secured to the drum on which the cable is wound and said cable will extend directly from said drum to its other end which will have the block and hook attached thereto. Thus, there will be no place on the cable to which the eye of the load shaft 34 could be operatively connected. However, the pusher-type switch can be used with any hoist cable reeving since the load shaft 34 can be actuated by a worm gear or the like suitably driven from the cable drum.

When the present invention is used as a pull-type switch, suitable means are provided permitting the load shaft 34 to be rotated within the housing 12. If a turning moment is applied to the eye 86, the load shaft 34 and the load nut 42 will turn on the thrust ball bearing 46. The remainder of the elements within the housing 12 will be held against rotation by the cam 50 which is movable only in an axial direction in the slot 78 of the bearing assembly 76. The latter is securely mounted against rotation within the housing 12.

Referring now to Figure 3 of the drawings, a pull-type combination overload and downward control switch 10 can be seen mounted on an electric hoist unit 93. The electric hoist unit 93 has an electric motor 90 at its one end and a braking unit 92 at its other end.

Disposed between the electric motor 90 and the brake unit 92 is a drum 94, suitably housed, on which is wound a cable 96 which is connected to the eye 86 of the load shaft 34 by a suitable reeving. Mounted on the housing of the electric hoist unit is an electric control box 97, which is connected to the pull-type control switch 10 by a conduit 98.

In Figure 4 of the drawings, a modified form of the present invention can be seen. This form of the invention is a simplification of the form of the invention shown in Figures 1 and 2 and includes only the overload switch thereof. A housing 110 is provided which is closed at its one end by a transfer member 112 and at its other end by an overload adjustment nut 114. The latter is threadedly connected to the housing 110 and is locked in place therein by the set screw 116. A bushing 118 extends axially through the overload adjustment nut 114 and within which is journaled a load shaft 120. The load shaft 120 is journaled at its other end in a bushing 122 extending through the transfer member 112. The latter is threadedly connected to the housing 110 to permit axial adjustment therein for a purpose to be hereinafter described and is locked in place by a set screw 124. A closure plate 126, held to the transfer member 112 by a plurality of screws 128, encloses the end of the load shaft 120.

Threadedly connected to the load shaft 120 is a load nut 130 which is locked to the said shaft 120 by a set screw 132. Forward of the load nut 130 is a stop member 134 adapted to engage the end of the travel member 112. On the forward face of the stop member 134 is an annular cam 136 which is secured thereto by any suitable means such as welding, for example. An overload spring 138 is seated at its one end against said stop member 134 and at its other end against said overload nut 114. The overload spring 138 acts to bias the stop member 134 and the cam 136 to the inoperative position shown in Figure 4.

Mounted on the housing 110 is a switch housing 140 suitably constructed to house any form of conventional switch for causing an electric hoist motor to be de-energized when an overload is placed on the hoist cable. In the housing 140, a conventional micro-switch 142 is shown which is adapted to be actuated by a cam follower 144 in response to movement of the cam 136.

As indicated above, any form of conventional switch can be used in the present form of the overload switch unit. When the switch 142 has been installed in the unit, proper adjustment can be made so that the unit can be effective to prevent hoisting action of the electric motor at any desired overload limit. This can be done by selecting an overload spring 138 of suitable strength and by properly adjusting the overload adjustment nut 114, as was explained above with respect to the corresponding parts of the form of the invention shown in Figures 1 and 2. In the form of the invention shown in Figure 4, an additional adjustment feature is provided by the transverse member 112. As can be readily seen from the drawings, when the transfer member 112 is moved axially in or out, a new stop position will be provided for the stop member 134 and the cam 136. Thus, the overload switch 110 can be easily used with any switch 142, and if it becomes necessary to replace the electric switch 142, this can be done and overload switch 110 can be adjusted to conform to the new switch 142 so that the same operating characteristics of the overload switch unit will be provided.

The modification shown in Figure 4 is a pull-type overload control switch and has an eye 146 on the load shaft 120 for attaching the hoist cable. Provision is made in this unit to allow

the load shaft 120 to rotate, if rotation movement is imparted to it by the cable. When the load shaft 120 is rotated, the load nut 130, stop member 134 and cam 136 will all be rotated therewith. Since the cam is annular in shape, the cam follower 134 will be actuated in the same manner whether the cam is being rotated or stationary.

Another modification of the present invention is shown in Figure 5 of the drawings. This form of the invention is very similar to that shown in Figure 4 and like reference numbers are used to indicate like parts. This form of the invention shows a push-type control switch in contrast to the pull-type shown in Figure 4. In this form of the invention, the load shaft 120 extends axially through the travel member 112A and is adapted for actuating the overload switch unit in response to a pushing action on the outer end of the load shaft 120. This form of the invention has the advantage that it can be used with any type of reeving as was explained above in the description of the modification of the invention shown in Figures 1 and 2.

It should be understood that the modified forms of the invention shown in Figures 4 and 5 can be adapted for use either as a downward control switch or as an overload switch. When it is desired to use this type of control switch for downward control purposes, a suitable spring 138 must be used and the switch 142 must be in the downward control circuit and must be one which will cut off power to the hoist motor during downward hoisting in response to movement of the cam follower 144 a predetermined distance down the inclined surface of the cam 136. Whereas, when this type of control switch is used as an overload control switch, a stronger spring 138 must be used and the switch must be in the control circuit for controlling the upward hoisting of the motor and must be responsive to movement of the cam follower 144 a predetermined distance up the inclined surface of the cam 136.

Having thus described my invention, I claim:

1. A hoist control switch adapted for stopping the upward hoisting action of a hoist motor when load on the cable of the hoist exceeds a predetermined amount, said switch comprising a housing, a load shaft operably supported in said housing for limited axial movement, cam means operably connected to said shaft for axial movement therewith, a switch mounted adjacent said cam means and adapted for stopping hoisting action of said motor when said load shaft is moved in one direction to a predetermined position, a cam follower operably disposed between said switch and said cam means for actuating said switch when said shaft is in said predetermined position, and spring biasing means operably disposed between said cam means and said housing for biasing said shaft in the other direction axially away from said predetermined position, said housing including an axially adjustable travel member for varying the length of the effective stroke of said cam means.

2. A hoist control switch as claimed in claim 1 wherein said housing includes an axially adjustable seat member for varying the tension in said spring biasing means, whereby the load on the load shaft necessary to stop hoisting action can be varied.

3. A hoist control switch adapted for stopping the upward hoisting action of a hoist motor when load on the cable of the hoist exceeds a predetermined amount, said switch comprising a housing, a load shaft journaled in an adjustable seat member at one end of said housing and in an adjustable travel member in the other end of said housing permitting axial movement therein, cam means operably connected to said shaft for axial movement therewith, a switch mounted adjacent said cam means and adapted for stopping hoisting action of said motor when said load shaft is moved in one direction to a predetermined position, a cam follower operably disposed between said switch and said cam means for actuating said switch when said shaft is in said predetermined position, and a coil spring seated at its one end against said cam means and at its other end against said adjustable seat member for biasing said shaft in the other direction axially away from said predetermined position.

4. A hoist control switch as claimed in claim 3 wherein said load shaft extends axially outwardly from said housing in said other direction, whereby said switch will be actuated in response to a pushing action on said load shaft.

5. A hoist control switch as claimed in claim 3 wherein said load shaft extends axially outwardly from said housing in said one direction and has a cable attachment thereon, whereby said switch will be actuated in response to a pulling action on said cable attachment.

6. A combined hoist control switch adapted for controlling the downward hoisting action of a hoist motor and for preventing overloading the hoist on upward hoisting action of the hoist motor, said control switch comprising a housing, a load shaft journaled in said housing for axial movement, a load plate mounted on said load shaft for axial movement therewith, a cam carried by said load plate, a first electric switch adapted to control downward hoisting action of said motor, a first cam follower operatively disposed between said first electric switch and said cam for actuating said first electric switch when said cam is moved to a predetermined position, first spring biasing means for biasing said cam to said predetermined position, a second electric switch adapted to control upward hoisting action of said motor, a second cam follower operatively disposed between said second electric switch and said cam for actuating said second electric switch when said cam is moved to a selected position, a second load plate mounted in said housing in axial alignment with said first load plate and positioned to be engaged by the latter when the load shaft has moved a predetermined distance against the biasing action of the first spring biasing means, a second spring biasing means operatively disposed against said second load plate for opposing movement of said cam toward said selected position, and a stop for limiting movement of said second load plate after said cam has reached said selected position.

7. The combination hoist control switch as claimed in claim 6 wherein said housing includes an axially adjustable seat member for varying the tension in said second spring biasing means, whereby the switch may be made selectively responsive to a greater or lesser load on the load shaft for stopping hoisting action.

8. The combination hoist control switch as claimed in claim 6 wherein said housing includes an axially adjustable seat member for varying the tension in said second spring biasing means, whereby the switch may be made selectively responsive to a greater or lesser load on the load shaft for stopping hoisting action, and an axially adjustable travel member for varying the axial

length of the effective stroke of said cam means.

9. The combination hoist control switch as claimed in claim 6 wherein said load shaft extends axially outwardly from said housing in said other direction, whereby said switch will be actuated in response to a pushing action on said load shaft.

10. The combination hoist control switch as claimed in claim 6 wherein said load shaft extends axially outwardly from said housing in said one direction and has a cable attachment thereon, whereby said switch will be actuated in response to a pulling action on said cable attachment.

JOHN W. HUNT.

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