Jan. 6, 1931. W. A. HUMMEL 1,788,302

UPPER AND LOWER LIMIT SWITCH MECHANISM FOR ELECTRICAL HOISTS

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Fig. 4.

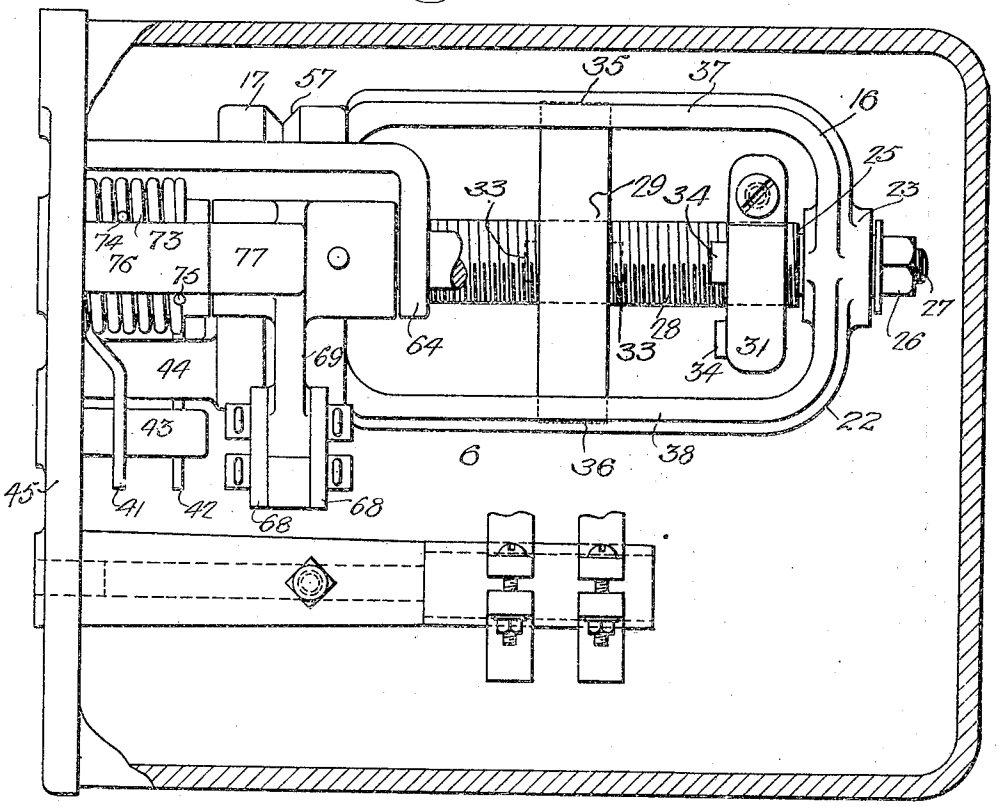
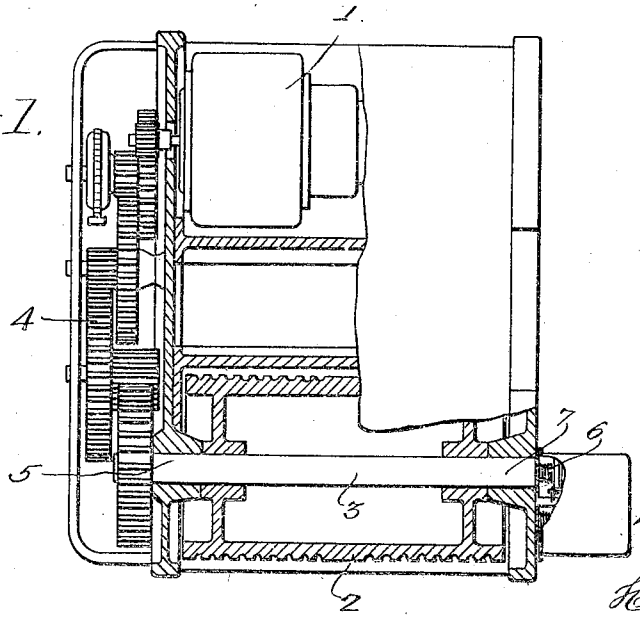


Fig. 1.



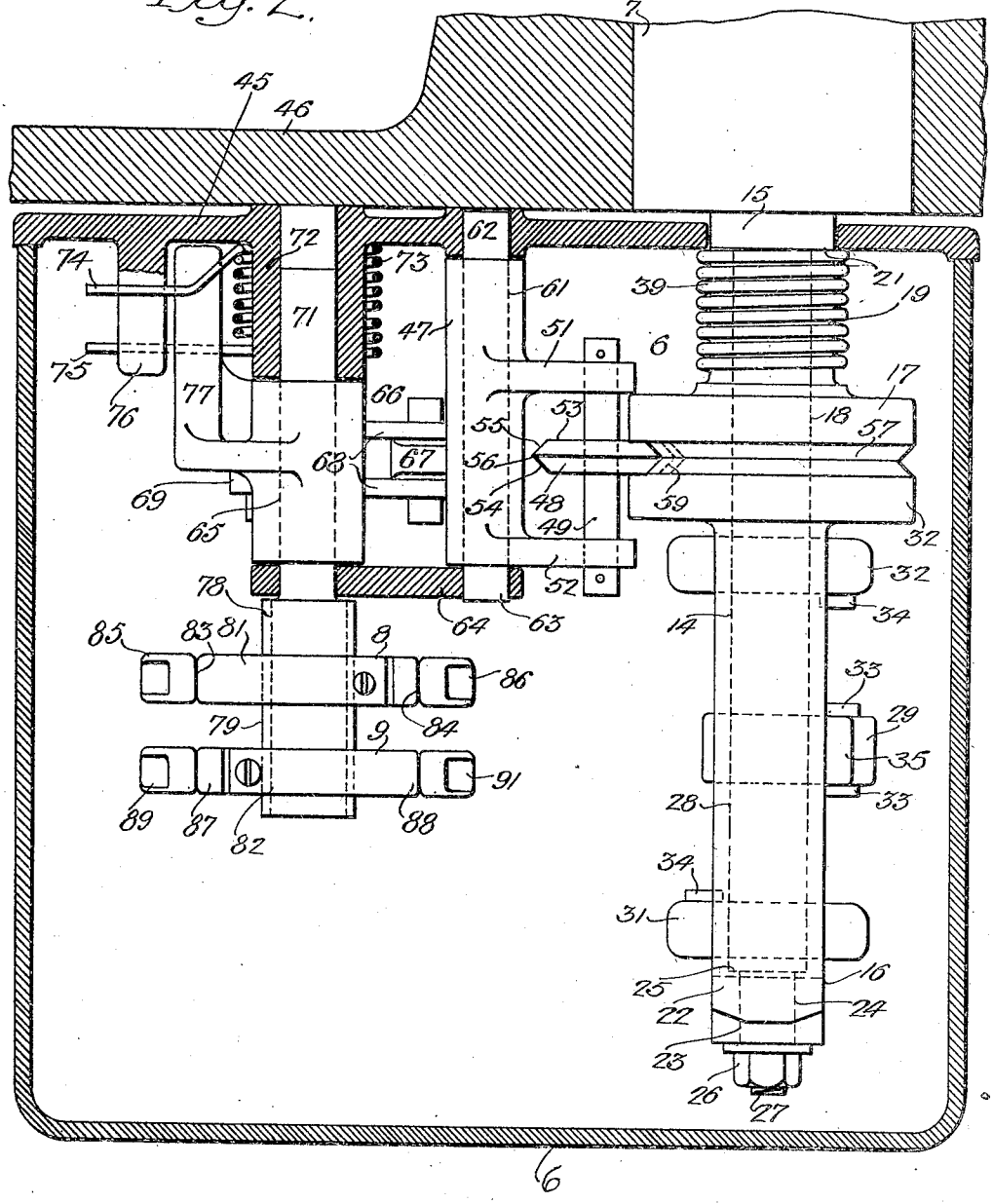
Inventor:-
Willard A. Hummel,
by his Attorneys.
Howson & Howson

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Fig. 2.



Inventor,
Willard A. Hummel
by his Attorneys,
Howson & Howson

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Fig. 3.

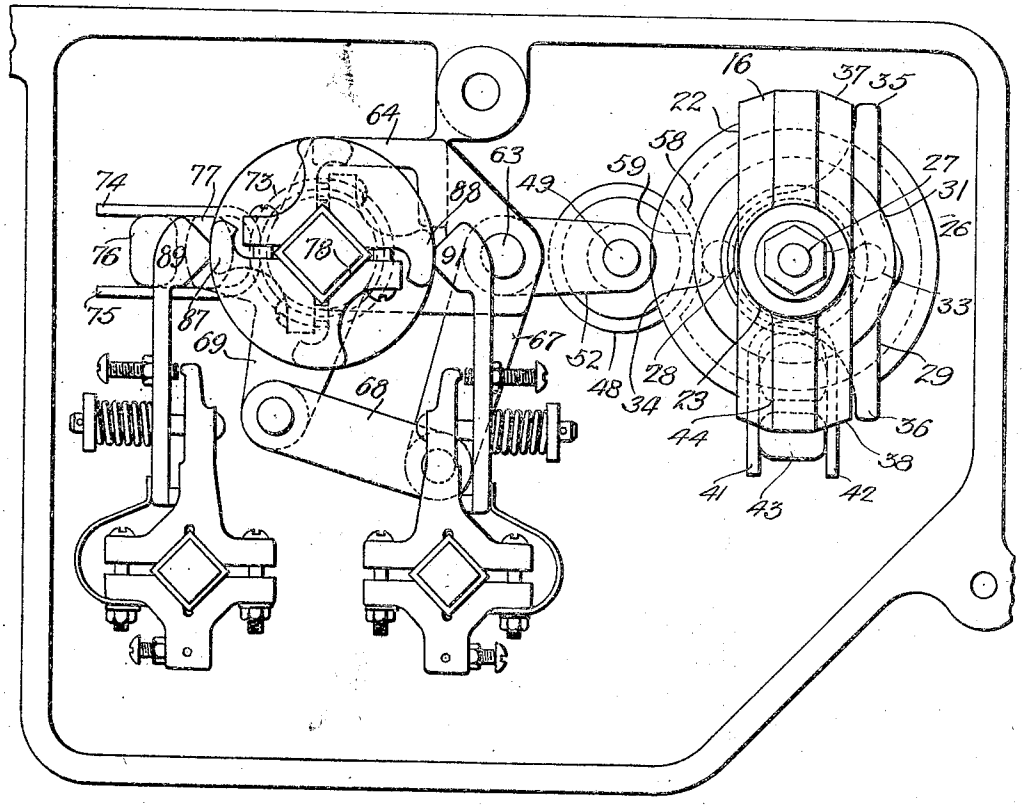
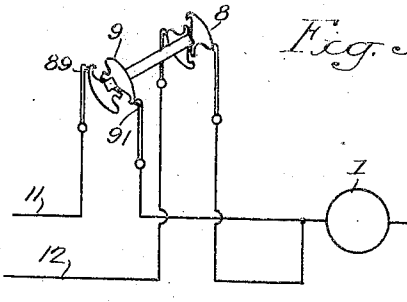


Fig. 5.



Inventor:
Willard A. Hummel,
by his Attorneys,
Howson & Howson

Patented Jan. 6, 1931

1,788,302

UNITED STATES PATENT OFFICE

WILLARD A. HUMMEL, OF PHILADELPHIA, PENNSYLVANIA, ASSIGNOR TO AMERICAN ENGINEERING COMPANY, OF PHILADELPHIA, PENNSYLVANIA, A CORPORATION OF PENNSYLVANIA

UPPER AND LOWER LIMIT SWITCH MECHANISM FOR ELECTRICAL HOISTS

Application filed October 31, 1927. Serial No. 230,111.

My invention relates to systems of control for hoisting apparatus and the like.

It has heretofore been the practice to install limit-switch mechanism in the pilot circuit of hoist control-equipment. The pilot circuit functions as an auxiliary circuit to the main motor-energizing circuit, and it includes in addition to the limit-switch mechanism, the push-button station which is controlled by the operator and also the energizing windings of the contactors in the main motor circuit. Such arrangement, however, has not proved entirely satisfactory in practice. For example, the contact points of the main contactor equipment very frequently fuse together, thereby permitting the continued energization of the driving motor, even though the pilot circuit has been opened by the limit-switch mechanism.

An object of my invention, therefore, is to provide a system of control which overcomes the disadvantages characteristic of the pilot-circuit equipment,—my invention contemplating the insertion of the limit-switches directly in the main motor circuit.

Another object of my invention is to provide mechanism of the character described, wherein the positive actuation of the limit-switches is assured by power derived from the hoisting drum; and wherein damage to the switch mechanism is averted upon a predetermined over-travel of the drum.

A further object of my invention is to provide a stop mechanism comprising a driving member, a driven member having a lost-motion connection therewith, a third member adapted to be connected to the limit-switches, a fourth member, a wheel carried by the fourth member in such operative relation to the driven member as to be actuated bodily upon the initial movement of the driven member, and multiplying linkage extending between the fourth member and the third member, whereby the rapid operation of the switches may be assured upon said bodily movement of the wheel.

Other objects and applications of my invention, as well as details of construction and operation, whereby my invention may be practiced, will be apparent more fully hereinafter, when taken in connection with the accompanying drawings, wherein,

Fig. 1 is a top plan view, partially in horizontal section, of one form of embodiment of my invention;

Fig. 2 is an enlarged detail horizontal sectional view of the stop mechanism shown in Fig. 1, the sectional plane being taken on the line 2—2 of Fig. 3;

Figs. 3 and 4 are end and side elevational views, respectively, of the structure shown in Fig. 2, the several parts being shown in their neutral position, and

Fig. 5 is a diagrammatic view of circuits and apparatus embodying my invention.

Referring to Fig. 1, the mono-rail hoist therein shown comprises a driving electric motor 1; a drum 2, which is mounted on a shaft 3; gearing 4 which extends between the motor 1 and one end 5 of a drum shaft 3; a stop mechanism 6 which is operatively associated with an opposite end 7 of the drum shaft 3; and a pair of limit-switches 8 and 9. As shown in Fig. 5, these switches are respectively connected in conductors 11 and 12, which constitute a divided circuit portion of a main motor-energizing circuit 13. The conductors 11 and 12 are connected to a pair of reversing contactors which serve to control the direction of operation of the motor 1, and may be controlled from a remote point by the usual push-button station. The latter, as well as the reversing contactors, have not been shown in order to simplify the description of my invention, it being deemed sufficient to specify merely that when currents are supplied to the branch conductor portion 11 of the main energizing circuit 13, the motor 1 operates, say, in a direction to lift the hoisting hook, and that when currents are supplied to the branch conductor portion 12, the motor 1 is so energized as to operate in the opposite direction, that is, in a direction tending to lower the hoisting hook. The limit-switch 9, therefore, must be closed in order for the motor to raise the hoisting hook, and the switch 8 must be closed for the motor to lower the hook; and this is the normal position of these switches, all as will appear more fully hereinafter.

Considering in greater detail the stop mechanism 6, a shaft section 14 is provided with an enlarged head portion 15 which is adapted to be detachably secured to the end portion 7 of the drum shaft 3 in any convenient manner; rocker frame or flier 16 is provided at one end with an enlarged portion 17, which is journaled on an adjacent portion 18 of the shaft section 14, and a sleeve portion 19 which extends from the portion 17 into abutting relation to a shoulder 21 formed by the shaft head portion 15. An opposite end 22 of the rocker frame 16 is provided with a journal portion 23 which is mounted on an adjacent shaft portion 24 of reduced diameter. A shoulder 25, which is positioned at one end of the shaft portion 18, affords an abutment tending to prevent a movement of the frame 16 toward the drum shaft 3. The movement of the frame 16 in the opposite direction may be prevented by a nut 26 which is mounted on a threaded end portion 27 of the shaft portion 24.

A portion 28 of the shaft section 14 between the bearing portions 18 and 24 thereof, is threaded for the reception of a traveling nut or cross-head 29 and a pair of adjustably spaced clutch collars 31 and 32. The spacing between the collars 31 and 32 is such that the drum 2 may be moved through its maximum distance before a shoulder 33 on the traveling nut 29 engages a shoulder 34 on one of the collars 31, 32. Since the traveling nut 29 is connected at the upper and lower edges thereof by shoulder portions 35 and 36 to spaced parallel side portions 37 and 38 of the rocker frame 16, the continued turning of the drum shaft 3 and consequently the shaft section 14 causes a corresponding movement of the rocker frame 16. Thus, the rocker frame 16 is actuated only when the travel of the drum 2 exceeds a certain value which has been predetermined by the spacing of the collars 31 and 32.

The rotatable frame 16 may be returned to its initial position shown in Fig. 2 of the drawing, when the traveling nut 29 disengages either of the co-acting clutch collars 31 and 32 due to the reversal of the drum 2, by means of a spring 39 which encircles the rocker frame portion 16. As shown in Fig. 4, opposite ends 41 and 42 of the centering spring 39 are positioned on opposite sides of lugs or shoulders 43 and 44. The lug 43 extends from a vertical base plate 45 which is secured to an adjacent portion 46 of the hoist housing in any convenient manner. The lug 44 is secured to the rocker frame 16, and it is disposed between the portions of the spring ends 41 and 42 which are positioned intermediate the shoulder 43 and the rocker frame portion 16. Hence, the rocker frame or flier 16 constitutes a floating, spring-center member with a lost-motion connection to the drum shaft 3.

In accordance with my invention, movement of the floating rocker frame 16 from its neutral central position shown in the drawing, due to over-travel of the drum 2, may be imparted to a rocker sleeve 47 by means of an anti-friction roller or wheel 48 which is mounted on a shaft 49, opposite ends of which are journaled in arms 51 and 52 extending from the sleeve 47. The wheel 48 is preferably provided with a beveled portion 53 having angled sides 54 and 55 terminating in a central peripheral edge 56. The enlarged portion 17 of the floating rocker frame 16 is provided with a complementary circular recess or groove 57, which is adapted to receive the beveled portion 53 of the wheel 48 and which constitutes a circular track in frictional engagement therewith.

As shown in Fig. 2, the circular groove 57 is provided with an enlarged recess portion 58 which is adapted to receive an adjacent portion 59 of the wheel 48, affording a seat therefor. The position of the recess portion 58 is such that the wheel 48 is seated thereon only when the rocker frame 16 is in the central position shown in the drawing. Should the rocker frame 16 turn in either direction, then the wheel 48 is actuated out of the recess portion 58 during the initial movement of the rocker frame 16 and thereafter it traverses the remaining track portion of the groove 57 without causing a further bodily movement of the wheel 48. There is thus a lost-motion connection between the rocker sleeve parts 47, 48 and the floating frame 16.

The rocker sleeve 47 may be mounted on a shaft 61, opposite ends 62 and 63 of which are journaled in the base plate 45 and a plate portion 64 thereof. The movement of the rocker sleeve 47 may be transmitted to a switch operating member 65 through multiplying linkage 66 which is so designed that a relatively small movement of the rocker sleeve 47 causes a relatively large movement of the switch operating member 65. As illustrated in Fig. 3, the linkage 66 comprises an arm 67 extending downwardly from the sleeve 47, a pair of links 68, and an arm 69 which is relatively short compared with the arm 67 and which also extends downwardly from the switch operating member 65. The member 65 may be mounted on a shaft 71, opposite ends of which are journaled in a hub portion 72 of the base plate 45 and the frame portion 64.

Since it is desirable, for reasons as will presently appear, to return automatically the switch operating member 65, the wheel 48 and the intermediate parts to the neutral position shown in the drawing, immediately upon the return of the rocker frame 16 to its neutral position, a centering spring 73 is mounted on the hub portion 72 of the base plate 45. Opposite ends 74 and 75 of the spring 73 are positioned on opposite sides of a pair of

lugs 76 and 77 which are respectively secured to the base plate 45 and the switch operating member 65, the movable lug 77 being positioned between the stationary lug 76 and the hub portion 72.

An outer end 78 of the shaft 71 is extended beyond the supporting plate section 64, and it is provided with an insulating sleeve 79 upon which is mounted a pair of drum segments 81 and 82. The drum segment 81 is provided with a pair of contact portions 83 and 84 which co-act with a pair of spaced contact members 85 and 86. The contact portions 83 and 84 are so designed that the contact members 85 and 86 are connected together for the maximum movement of the member 65, say, in a counter clock-wise direction, but are immediately disconnected upon a counter clock-wise movement of the member 65 from its mid or neutral position.

The drum segment 82 comprises contact portions 87 and 88 which co-act with contact members 89 and 91, the contact portions 87 and 88 being so designed that the contact members 89 and 91 are normally interconnected when the member 65 is in the mid or neutral position shown in the drawing, but are immediately disconnected upon a counter clock-wise movement of the member 65. The contact members 89 and 91 remain connected together for a clock-wise movement of the spring-centered member 65.

Assuming the contactor (not shown), which controls the conductor 11, to have been energized from the push-button station (not shown), then the motor 1 operates in a direction, say, to raise the hoisting hook. Should said contactor be not de-energized when the drum 2 has moved through its maximum safe travel and the hoisting hook is in its maximum elevated position then the teeth 33 and 34 of the traveling nut 29 and the clutch collar 31 engage, causing the turning of the floating rocker frame 16 against the force of the centering spring 39. Upon the initial movement of the frame 16, the wheel 48 is actuated out of engagement with the recessed track portion 58, the resulting bodily movement being transmitted by means of the multiplying linkage 66 to the switch-operating member 65. The member 65 now turns against the force of the centering spring 73 in a clock-wise direction, disengaging the contact portion 83 and 84 from their co-acting members 85 and 86, and hence opening the switch 8. An advantage of the double break thus afforded in the conductor 11 is that arcing is reduced to a minimum.

The opening of the limit-switch 8 interrupts the supply of energy through the conductor 12 to the motor 1, and thereby prevents the further turning of the drum 2 by the motor 1. It is noted that while the flier or rocker frame 16 may continue to move through a short distance immediately following the operation of the limit-switch 8, the bodily movement of the wheel 48 and hence that of the connected switches 8 and 11 is limited to that occuring upon the initial movement of the rocker frame 16. During the continued movement of the flier 16 just mentioned, the roller 48 traverses a portion of the circular track 51.

When it is desired to lower the hoisting hook, the contactor (not shown) connected to the conductor 12 is energized from the push-button station (not shown), causing the motor 1 to turn in the reverse direction. When this occurs, the traveling nut 29 is actuated out of engagement with the collar 31 permitting the rocker frame 16 to be actuated into its central or mid position by the spring 39. The centering spring 73 similarly causes the parts connected therewith to be returned to their mid position, the wheel 48, for example, being caused to seat in the track recess portion 58 and the drum segments 81 and 82 being returned to their original mid position. During this movement, the switch 8 is again closed and the switch 9 remains closed.

If the drum 2 is permitted to unwind beyond the predetermined value, then the traveling nut 29 engages the clutch collar 32, causing the frame 16 to turn in a clock-wise direction. During the initial movement of the rocker frame 16, the wheel 48 is actuated bodily in a counter clock-wise direction about the rocker sleeve 47, so that the switch-operating member 65 is so turned as to cause the contact portions 87 and 88 to be disengaged from their co-operating members 89 and 91. The switch 9 is thus opened, but the switch 8 remains closed, permitting the hook to be raised again when currents are supplied to the conductor 11.

While I have shown only one form of embodiment of my invention, it is apparent that various changes and modifications may be made therein without departing from the spirit of my invention and I desire, therefore, that only such limitations shall be imposed thereon as are indicated in the appended claims or as are demanded by the prior art.

I claim:

1. In a combination, a driving member, a driven member having a lost-motion connection therewith, said driven member being provided with a circular track, at least one portion of which is recessed, mechanism to be controlled, and means for operatively associating said mechanism and said driven member, said means including a rotatable member, the periphery of which is beveled, said rotatable member being positioned in frictional engagement with said track.

2. In a stop mechanism for hoisting apparatus, the combination with a driving member and a driven member provided with a

track, of mechanism to be controlled, and means for operatively associating said mechanism and said driven member comprising a rotatable element, the periphery of which is beveled, said track having a complementary portion in frictional engagement with said element.

3. Stop mechanism for hoisting apparatus comprising driving means, a floating spring-centered driven member having a lost-motion connection therewith, a second member adapted to actuate switch mechanism, and means extending between said members comprising a rotatable element having a lost-motion connection with said driven member and linkage adapted to cause a rapid movement of said second member upon the occurrence of a relative movement between said element and said driven member.

4. Control apparatus for a hoist comprising driving means, a floating spring-centered driven member having a lost-motion connection therewith, a second spring-centered floating member adapted to actuate limit-switch mechanism, and means whereby said second member may have a predetermined movement only upon the initial actuation of said driven member, said means comprising multiplying linkage, a third rotatable member connected to said linkage and an element positioned in frictional engagement with said driven member and carried by said third member.

5. Apparatus comprising driving means, a spring-centered driven member having a lost-motion connection therewith, a second spring-centered member, a rocking member, means carried by said rocking member for causing a movement thereof upon a relative movement between said rocking member and said driven member, and movement-multiplying linkage extending between said rocking member and said second spring-centered member.

6. A driving member, a driven member having a lost-motion connection therewith, a member also rotatable adapted to be connected to switch mechanism, a fourth rotatable member, a wheel carried by said fourth member and positioned in such operative relation to said driven member as to cause the turning of said fourth member upon an initial movement of said driven member, and linkage extending between said fourth member and said third-mentioned member for multiplying the movement of said fourth member.

7. The combination with a driving member having a threaded portion carrying a traveling nut, of a driven member adapted to be actuated upon a predetermined movement of said nut, a third member adapted to be connected to switch mechanism, a fourth member having a rotatable mounting, an element carried by said fourth member and positioned in frictional engagement with said driven member, and linkage extending between said fourth member and said third member.

8. Stop mechanism for a hoist comprising a driving member provided with a threaded portion having a pair of spaced stops and a traveling nut, a rotatably mounted member so associated with said nut as to be actuated upon engagement of said nut with one of said stops, a spring-centered member adapted to be connected to switch mechanism, a fourth member also rotatable and having such lost-motion connection to said driven member as to be actuated thereby upon an initial movement of said driven member, multiplying means for operatively associating said fourth member and said third member, so that a quick movement of the switch mechanism may occur upon said initial movement.

9. In a stop mechanism for hoists, the combination with a driving member having a threaded portion provided with spaced stops and a traveling nut, of a spring-centered floating member so connected to said nut as to be actuated upon engagement of either of said stops with said nut, said driven member having a circular track, a second spring-centered floating member adapted to be operatively associated with switch mechanism, a fourth member having a rocking support, an element carried by said fourth member and positioned in such operative relation to the track of said driven member as to be actuated bodily upon the occurrence of a predetermined movement of said driven member, and linkage extending between said fourth member and said second spring-centered member, whereby said bodily movement of the element may be imparted to said switch mechanism.

10. Apparatus of a character described comprising a driving motor, a main energizing circuit for said motor having a divided portion respectively including limit-switches, a drum actuated by said motor, and operating mechanism for said switches effective upon a predetermined over-travel of said drum.

11. Apparatus of the character described comprising a driving motor having a main energizing circuit with a divided portion adapted to permit reversal in the direction of operation of said motor, limit-switches for said divided circuit portion, respectively, a drum connected to said motor, and means for causing the operation of one or the other of said limit-switches depending upon the direction of over-travel of said motor.

12. In combination, a driving motor, a main energizing circuit having a divided portion adapted to permit reversal in the direction of operation of said motor, normally closed limit-switches for said divided circuit portion, respectively, a drum connected to be actuated by said motor, and means responsive to over-travel of said drum in either direction

for causing the opening of at least one of said limit switches.

13. In a system of control for a hoist, the combination with a driving motor of a main energizing circuit for said motor having a divided portion adapted to permit a reversal in the direction of operation of said motor, normally closed limit-switches for said divided circuit portion, respectively, a drum actuated by said motor, and means responsive only to the initial over-travel of said drum for causing the operation of one of said limit-switches.

14. In apparatus of the character described, the combination with a driving motor and a main energizing circuit therefor provided with a pair of limit-switches adapted to cause an interruption in the operation of the motor in either direction, of a drum actuated by said motor, and means for causing the operation of at least one of said switches upon the over-travel of said drum, said means comprising a threaded shaft provided with spaced stops and traveling nut, a floating spring-centered member having such connection with said nut as to be actuated thereby upon the engagement of said nut with either of said spaced stops, a second spring-centered floating member adapted to be connected to said limit-switches and means for operatively associating said first-mentioned spring-centered member and said second-mentioned spring-centered member so that at least one of said switches may be actuated upon the occurrence of a predetermined movement of said first-mentioned spring centered member.

WILLARD A. HUMMEL.