Aug. 31, 1965 J. L. ANDERSON 3,203,671

HOIST CONTROL MECHANISM

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FIG. 1

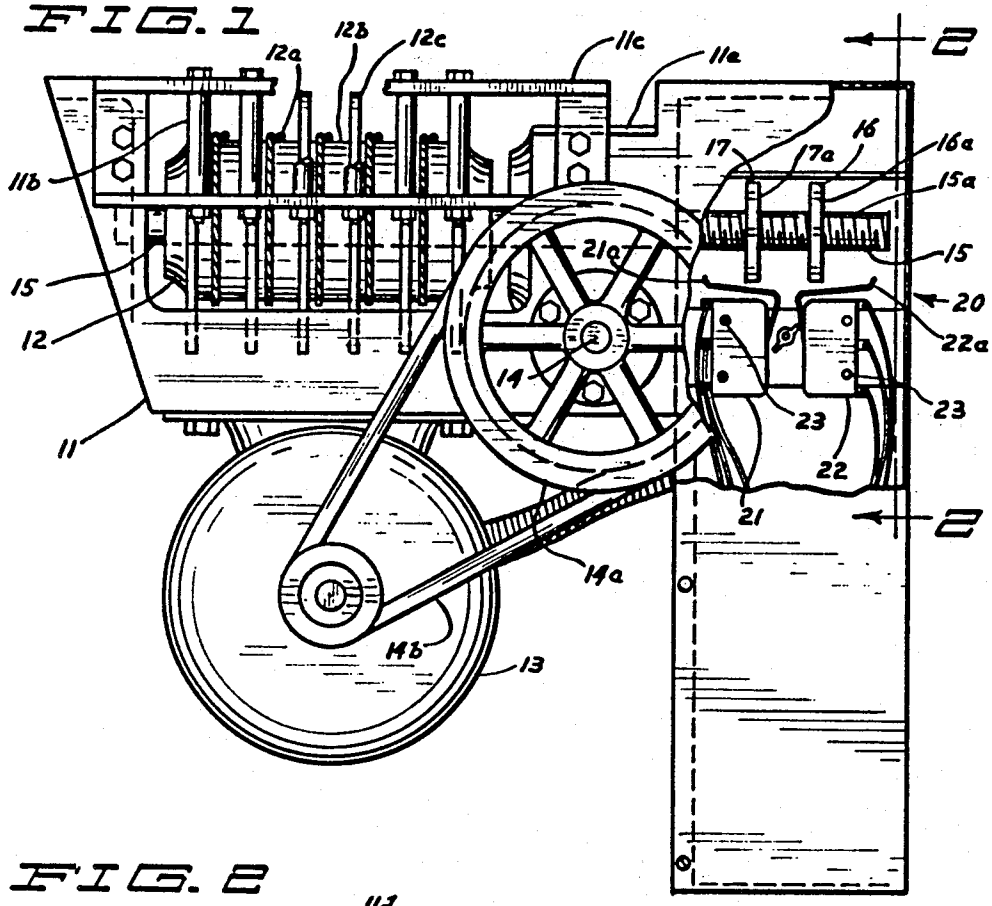
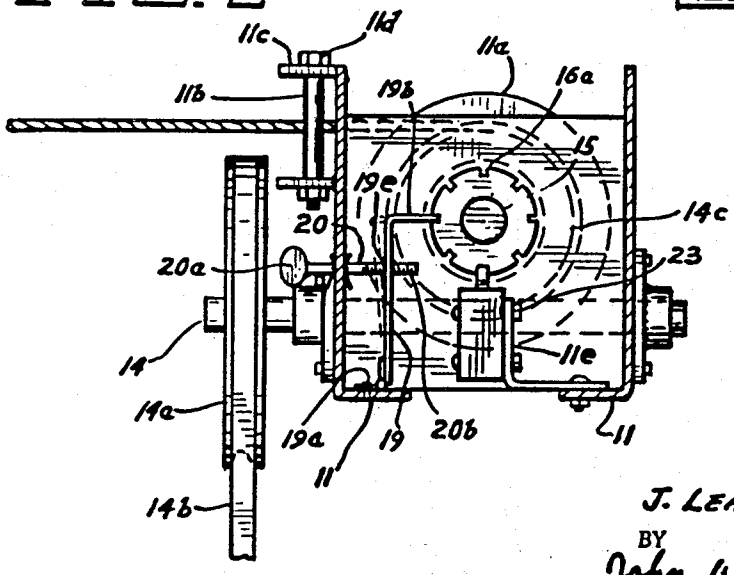


FIG. 2



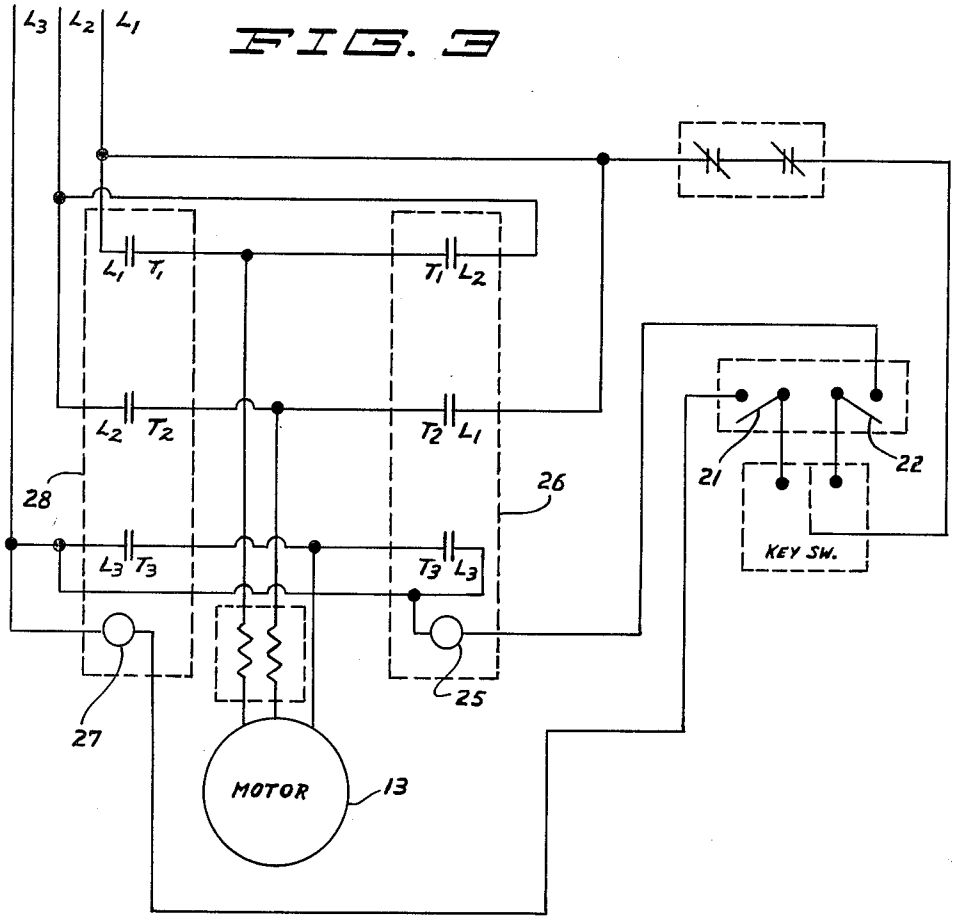
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FIG. 3



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HOIST CONTROL MECHANISM

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This invention relates generally to control mechanisms, and more particularly to control mechanisms for controlling a stage hoist or the like used to elevate equipment such as curtains, props or the like.

In the use of stage equipment, such as curtains, stage props and lights, it has long been a problem to provide a mechanism which will either raise or lower the equipment to a predetermined level and further to pre-set this height such that the article may be returned to its desired position after being moved therefrom. When using stage props or curtains, it is often necessary to maintain these articles at certain heights to give the proper effect to the stage setting. When using the normal system of counterweights, this is often accomplished by marking the counterweight cables and returning this mark to coincide with a fixed reference point. This, of course, is a manual operation and therefore not precise. Similarly, this same problem has confronted users of hoist mechanisms which are electrically operated. In this case it remains necessary to provide a reference point to which the operator can refer such that he may control the electric power to the hoist when the stage equipment reaches the proper level. This, however, remains not only very inaccurate but also requires the constant supervision of an operator who is familiar with the setting of the stage. Applicant, however, has provided a method of controlling the height to which a prop may be lifted or lowered by providing a pair of stop elements to work in combination with a hoist such that when the hoist has drawn in or played out a specific amount of cable, the predetermined setting will be reached and electric power supplied to the hoist will be cut off to maintain the stage equipment at the proper level.

It is a specific object of this invention to provide a height control mechanism for an electric hoist which cooperates with the amount of cable travel from or to the cable reel such that upon reaching a predetermined prop or curtain level, the appropriate control mechanism will be encountered which will turn off the electric power to the hoist and maintain the prop at this level.

It is a specific object to provide a stage lift control mechanism which includes a pair of limit switches to control the upper and lower limits of a stage prop's travel and which work in coordination with a pair of adjustable actuating means such that when either of the indicating means trips the appropriate limit switch, the hoist will stop and position the prop a this point.

It is a further specific object of this invention to provide a pair of adjustable actuating means which are longitudinally adjustable along the main drive shaft of a cable reel such that they may be spaced therealong to cover the entire travel of the cable from the reel and will further move longitudinally along the shafts as the shaft is rotated such that upon playing out or taking in a predetermined amount of cable the actuating means will contact a switch mechanism to cut off electric power to the cable reel motor and thus locate the cable load at a specific predetermined level.

It is a further specific object of this invention to provide an actuating retaining means such that upper and lower actuating members may be spaced relative to each other therealong and this relative spacing may be maintained as the actuating means travel therealong such that once a predetermined spacing of the actuating means is determined, no further adjustments will be necessary.

It is a further specific object to provide a control circuit having a selector switch thereon which selector may be used to initially start the movement of the stage lift hoist, but which switch is so wired into the circuit that it will not overrule limit switches included therein such that the limit switches will control the stopping point of the stage lift and the selector switch will only initiate the hoist motor.

These and other objects and advantages of this invention will more fully appear from the following description made in connection with the accompanying drawings, wherein like reference characters refer to the same or similar parts throughout the several views, and in which:

FIG. 1 is a partial elevation with a portion removed to show the control mechanism;

FIG. 2 is a vertical section taken substantially along line 2—2 of FIG. 1; and

FIG. 3 is a schematic diagram showing the electrical control mechanism for a hoist embodying the principles of this invention.

As shown in the accompanying drawings, a hoist mechanism to be controlled generally consists of a support frame member **11** having a cable reel **12** rotatably mounted thereon and provided with an electric drive motor **13** connected to a main drive shaft **14** through a pulley wheel **14***a* and belt arrangement **14***b*.

In the form shown, the main shaft **15** of the cable reel **12** is rotatably contained in suitable bearings arranged on the support frame **11** and extends completely through the cable reel member **12** such that one end **15***a* thereof will form an outboard shaft arrangement upon which the control mechanism may be mounted. The drive shaft **14** of the pulley **14***a* is in driving relation to the main cable reel shaft **15** by providing a worm gear drive arrangement **14***c* within a support frame housing **11***a*. In this manner rotary power is delivered to the pulley **14***a* and transferred therefrom at greatly reduced speed to the cable reel mechanism **12**.

When using the hoist mechanism as a stage hoist a plurality of cables **12***a* are arranged in a plurality of grooves **12***b* circumferentially around the cable reel **12** and the grooves are separated by a plurality of flange members **12***c* therebetween such that each cable **12***a* is contained within its own take-up area. By providing a multiplicity of cables it is possible to distribute the load, such as a stage prop being lifted, and to provide proper lifting thereof in case the prop is substantially long or particularly heavy. A plurality of cable guiding members **11***b* are rotatably mounted upon the support frame **11** and, in the form shown, the cable guide support mechanism comprises a channel beam **11***c* from which a portion of the web has been removed to allow cable **12***a* to pass therethrough. The cable guides **11***b* are arranged to rotate upon fastening means, such as bolts whose head portions are designated **11***d* passing through the flanges of the channel beam.

As previously stated, an outboard end **15***a* of the cable reel drive shaft **15** is provided to extend from one end of the reel **12** such that a control arrangement, as best illustrated in FIG. 1, may be arranged thereon. Although the shaft **15** is shown as an extension of the cable reel, it should be obvious that this may be a separate shaft connected for rotation with the reel. The extending end **15***a* of the shaft **15** is provided with a screw thread such that a pair of arcuate nut members **16** and **17** may be arranged thereon and adjusted therealong. A plurality of radially spaced grooves **16***a*–**17***a* are longitudinally arranged on the periphery of the adjusting nuts **16**–**17** and are provided as stop receiving openings such that when a stop is engaged therein, the nuts **16**–**17** will not be allowed to rotate with the shaft **15** but rather will be

advanced longitudinally thereon as the shaft **15** turns. It is obvious that this arrangement may either be an extension of the cable shaft **15** as shown or may be an integrally geared individual member which will rotate with respect to the cable reel shaft.

In the form shown, a stop member **19** is provided to be received into the grooved portions **16***a*–**17***a* of the nuts **16**–**17** and, as shown in FIG. 2, has one end or flange **19***a* thereof hingedly attached to the support frame **11** such that the other end or flange **19***b* may be swung into registering relation with the stop openings **16***a*–**17***a* or may, in its retracted position as shown by the dotted portion of FIG. 2, allow the nuts **16**–**17** to rotate with the shaft **15**. A stop adjustment member, such as the wing nut **20**, is arranged to pass through an opening of the support frame **11** and is contained therein by a pair of confining washer members against longitudinal movement through the support structure **11**. One end of the wing nut is, of course, provided with an enlarged turning head **20***a* and the other end is provided with threads **20***b* which are received in a threaded passage **19***e* in the stop member **19**. It is obvious that by rotating the wing nut **20**, the stop member **19** will either be forced into engagement with the slot openings **16***a*–**17***a* of the nuts **16**–**17** or may be retracted therefrom to allow clearance therebetween. The stop plate **19** in this manner actually acts as a follow control member to prevent rotation of the nuts **16**–**17** and move them longitudinally along the drive shaft **15** or to allow the same to rotate with the shaft **15** and therefore not be advanced longitudinally therealong.

A pair of limit switches **21**–**22** are attached to a section **11***e* of the support frame **11** as by fastening means such as screws and nuts **23**. The limit switches **21**–**22** are naturally provided with actuating fingers **21***a*–**22***a* respectively which, as shown in FIG. 1, are in opposed relation longitudinally with respect to the shaft **15**. The limit switches **21**–**22** are normally closed such that depression of the actuating fingers **21***a*–**22***a* will open the circuit in which they are connected. As shown in FIG. 1, the limit switches **21**–**22** are arranged such that their actuating fingers **21***a*–**22***a* will be in interfering relation with the outer periphery of the adjusting nuts **16**–**17** as the nuts are moved longitudinally along the shaft **15** such that as the nuts move therealong in either direction, the outer circumference of one of the nuts will come in contact with the actuating finger of one of the limiting switches and therefore open the circuit in which they are connected. By providing the limit switch and nut arrangement to travel in conjunction with the shaft **15**, it is obvious that the amount of cable **12***a* being played out or taken up upon the cable reel **12** may be controlled by properly spacing the adjusting nuts **16**–**17** along the shaft **15** such that as the cable reel **12** is rotated, the appropriate nut will contact a limit switch and open the circuit so as to stop the cable take-up. This, of course, is true wherther the cable reel **12** is taking up or playing out cable **12***a*. Thus when a prop or curtain to be used on a stage is fastened to the free ends of the cable **12***a*, the height to which the prop is raised may be controlled and the height to which the prop is lowered may also be controlled.

As shown in the circuit diagram of FIG. 3, the limit switches **21**–**22** are so wired into the circuit such that a starting key switch will control the start of the hoist operation in either the upward or downward direction and the opening of the appropriate limit switch will control the stopping thereof such that when the adjusting nuts **16**–**17** are in proper predetermined position, the operator will only have to hold the key switch until the motor **13** automatically stops. This, of course, relieves the operator of the job of constantly surveying the location of the prop as it is being raised or lowered as he has no control over the motor stopping point.

To properly explain the operation of the circuit in conjunction with the hoist, we will select the limit switch **21** to represent the upper control limit and the limit switch **22** to represent the lower control limit and respectively the adjusting nuts **16**–**17** act as the proper actuating units for the same. In the form shown, the key switch is a spring loaded three-position switch and always returns to the center open position to serve as a safety device such that the circuit may not be energized accidentally without the key.

As shown in the circuit, a reversing system is provided for the motor by providing the reversing of lines **1** and **2** when the proper control coils are energized by the key switch. The reversing of the lines, of course, will reverse the operation of the motor **13**. The limit switches **21**–**22**, as previously stated, are normally closed and the position of the key switch is closed to contact either the up circuit or the down circuit, at which time the appropriate actuating coil will be energized and the proper circuit closed.

In explaining the operation of the control mechanism the adjusting nuts **16**–**17** must be pre-set which is done in the following manner. The prop is attached to the free ends of the cables **12***a* and the motor **13** is run to take up the necessary cable **12***a* to place the prop at the desired height and then stopped. At this time the adjusting nut **17** is rotated so as to move longitudinally along the shaft **15** until it is in such a position that it will contact and actuate the actuating finger **21***a* of the limit switch **21** such that in later operation it will always actuate the finger **21***a* at this point along the shaft **15**. The upper limit adjusting nut **17** is now held against rotation and the motor **13** is run in the reverse direction to lower the prop to the desired level. At this point the adjusting nut **16** will be rotated along the shaft **15** such that it will be in position to actuate the actuating finger **22***a* of limit switch **22** to open the same. The follower plate **19** is then engaged with slot openings **16***a*–**17***a* of each of the nuts **16**–**17** and locked therein by rotating the wing nut **20**. Although an arrangement of eight such slots are shown on the adjusting nuts, it is obvious that this number may be varied to provide for more precise limiting control. The upper and lower limits of the prop travel have now been determined and this setting will not change throughout the operation of the control arrangement. When it is desirable to move the prop to its proper position, such as when being used in a play, a situation in which a prop has been stored above a stage and it is now desirable to lower the same to effect a scenery change will be described. The key switch is turned to contact the limit switch **22** contactor point thus closing the circuit to the energizing coil **25** of the down contactor control arrangement **26** such that the three feed lines of the motor **13** will be closed and electric power will be delivered to the motor **13** in the proper rotary sense to allow cable **12***a* to be fed from the cable reel **12**. The rotation of the cable reel **12**, of course, causes the now restrained adjusting nuts **16**–**17** to move to the right longitudinally along the shaft **15** being held against rotation therearound by the follower plate **19**. As the stop nut **16** moves to the right, it will contact the actuating finger **22***a* of limit switch **22** and force the same downward at exactly the pre-set position. Such actuation will open limit switch **22**, thus de-energizing the coil **25** and opening the line contacts within the down contactor control **26**. This circuit opening will take place even though the operator maintains the key switch in contact with the limit switch contact point as the limit switches **21**–**22** control the circuit. When it is desirable to remove the prop from the stage by lifting the same upwardly, the key switch is rotated to contact the up limit switch contactor and thus close the circuit to energizing coil **27** which controls the line contacts within the up contactor control **28**, controlling electrical power supplied to the motor **13**. In this up contactor the lines **1** and **2** are reversed as compared with the wiring arrangement in contactor **26** such that upon energization

of coil **27** and closing of these contacts, the motor **13** will rotate in an opposite sense thus taking up cable **12***a* on the cable reel **12** and lifting the prop. This opposite rotation causes the adjusting nuts **16–17** to move to the left longitudinally along shaft **15** until the adjusting nut **17** contacts and depresses the actuating finger **21***a* of the up limit switch **21**. Such actuation opens the coil **27** circuit and the associated line contacts within the up contactor control and the motor **13** stops. The circuit may also make provision for overload heaters and overload contacts as shown. By providing the circuit in this manner a safety factor is introduced by use of the spring loaded key selector switch which may be changed at the user's option.

By arranging the lower and upper adjusting nuts **16–17** and the coordinating follow plate **19** in the manner described in the disclosure, it is obvious that once the spacing prop travel limits have been determined, they will remain in this relative position until a further change is desirable, thus eliminating the guess work ordinarily associated with lowering and raising props.

The adjusting nuts **16–17** are adjustable over a sufficient length of the cable shaft **15** such that adjustment may be made the entire length of cable **12***a* contained on the reel **12**.

It is obvious that applicant has developed a unique and simple control mechanism for controlling the operation of a hoist such as may be used in lifting and lowering stage props, curtains and the like which is not only simple in construction but provides a positive limiting arrangement which will be particularly useful for users of the equipment.

It will, of course, be understood that various changes may be made in the form, details, arrangement and proportion of the parts without departing from the scope of my invention, which generally stated consists in the matter set forth in the appended claims.

What I claim is:

1. Control for a line take-up mechanism of the type having a rotary drum and means for driving the drum, said control comprising:

(a) a shaft member adapted for connection to and rotation by said take-up mechanism having external threads thereon;

(b) at least one internally threaded projectable nut member threadably mounted on said screw shaft and having a plurality of recesses in the outer peripheral surface thereof;

(c) holding means having a recess receiving flange for interfitting with a selected recess of such nut to permit rectilinear movement of said nut while preventing rotation thereof, said holding means being shiftably mounted to permit movement from a selected recess whereby the position of the nut may be initially adjusted;

(d) locking means positively connected to said holding means for positively holding said recess receiving flange in engagement with a selected recess; and

(e) means mounted in cooperative relation to said projectable nut member and responsive thereto for stopping the driving means.

2. In combination with a line take-up mechanism of the type having a rotary drum and means for driving the drum, a control comprising:

(a) an externally threaded shaft adaptable for connection to and rotation by said drum;

(b) a pair of internally threaded projectable nut members having threaded connection with said shaft and provided with a plurality of recesses in the outer surface thereof;

(c) holding means provided with a recess receiving flange for interfitting with a selected recess of said nuts to prevent rotation thereof and produce rectilinear movement of said nuts along said shaft, said holding means being shiftably mounted to permit retraction thereof whereby the position of the nuts may be adjusted along the shaft;

(d) locking means positively connected to said holding means for positively holding said recess receiving flange in engagement in a selected recess of said nuts; and

(e) a pair of limit switches in cooperative relation to said nut members for actuation thereby for stopping the drum driving means.

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