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ELEVATOR CONTROL SYSTEM

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Fig. 1.

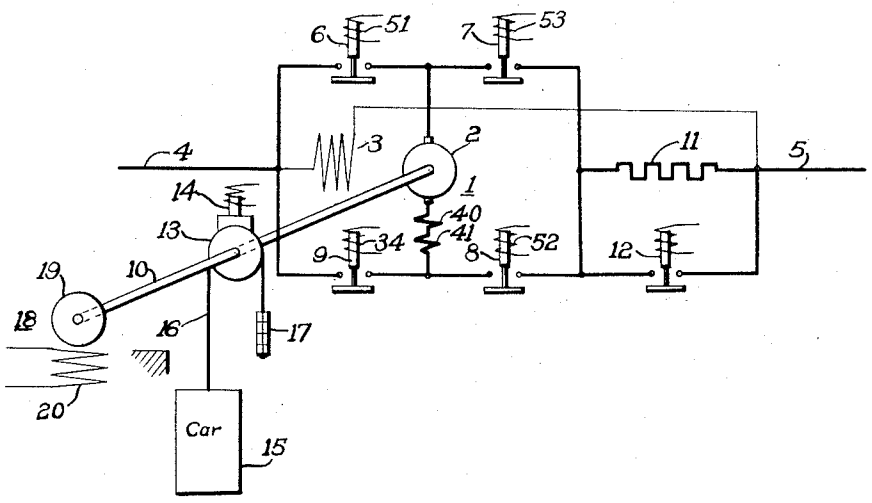
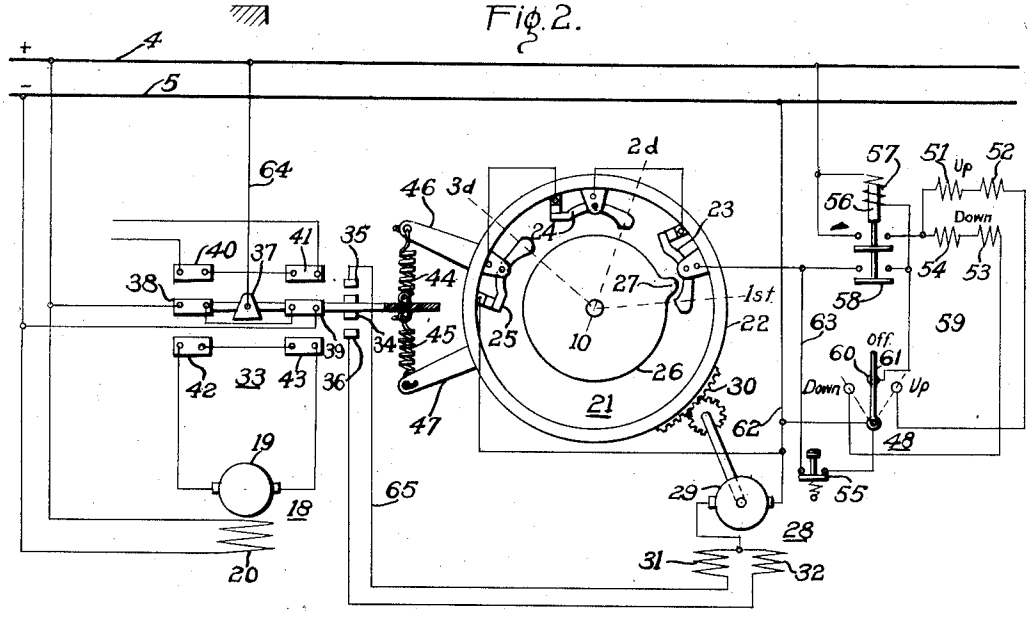


Fig. 2.



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ELEVATOR-CONTROL SYSTEM.

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My invention relates to motor-control systems and it has particular relation to such systems as are employed in connection with elevators, hoists and similar machines.

The object of my invention is to provide a system for effecting accurate stops of an elevator car independently of the skill of the car operator.

According to my invention, a selector device, having a stop switch corresponding to each elevator stop or landing and a cam device for operating these switches, is provided, together with electroresponsive means that is controlled in accordance with varying load conditions and is arranged for effecting adjustments and shifting the relative positions of said stop switches so as to insure that the elevator will be brought to any desired level.

My invention will be best understood by reference to the accompanying drawing in which,

Figure 1 is a diagrammatic view of main circuits and apparatus embodying my invention, and

Fig. 2 is a similar view of the auxiliary or control circuits and devices employed in my invention.

Referring to Fig. 1, a hoisting motor 1, having an armature 2 and a shunt field-magnet winding 3, is operatively connected to line conductors 4 and 5 through reversing switches 6, 7, 8 and 9 and a starting resistor 11. An accelerating switch 12 is provided for controlling the armature 2 in a well-known manner, as desired. A hoisting drum 13 is directly coupled to armature 2, as by a shaft 10, and is provided with an electromagnetic brake 14 of familiar design, whereby the armature 2 is maintained at rest in its inoperative condition. A car 15 is suspended by one or more cables 16 from hoisting drum 13 and is preferably provided with a counter-balance 17 that is somewhat heavier than the car 15. A small generator 18, having an armature 19 and a separately excited field-magnet winding 20, is directly coupled to the motor 1 so that its speed will correspond to the motor speed.

With reference to Fig. 2, a stop-selector device 21 is provided with an annular supporting member 22 upon which are mounted a plurality of switches 23, 24 and 25. This device is preferably located adjacent to winding drum 13, to which a cam member 26 is operatively connected, being mounted on shaft 10, for example. However, the cam member 26 may be geared or otherwise connected for operation with drum 13, as will be understood, so that the projection 27 will successively actuate switches 23, 24 and 25 when car 15 passes the three assumed stopping positions or landings. It is evident that switches 23, 24 and 25 may be suitably spaced within member 22 so as to correspond in position with the respective landings. By way of example, I have illustrated a three-landing device. As will be understood by those familiar with the construction and operation of automatic push-button elevators, a stop-selector device for any required number of landings may be readily devised. However, according to my invention, the device 21 has additional features not heretofore employed in automatic elevator control.

A pilot or "shifting" motor 28, having an armature 29, is adapted, through gear members 30, for shifting the position of annular member 22 relative to the position of cam 26. For reversing the pilot motor 28, field-magnet windings 31 and 32 are alternatively employed in a familiar manner.

A device 33, constructed on the principle of a Kelvin balance, comprises a movable switch member 34 and co-operating stationary contact members 35 and 36 for controlling field windings 31 and 32, respectively. Switch 34 is pivotally mounted in a bearing 37 and carries a pair of coils 38 and 39, one on either side of the pivotal point 37, which are energized from line conductors 4 and 5. A pair of coils 40 and 41, which are connected in circuit with armature 2, are arranged above and adjacent to coils 38 and 39 for cooperation therewith, as hereinafter described. Another pair of coils 42 and 43 are similarly situated below and adjacent to coils 38 and 39 and are energized in accordance with the voltage supplied by armature 19 of the auxiliary generator 18.

Switch member 34 is normally biased by means of a pair of springs 44 and 45 to an intermediate position between stationary contact members 35 and 36, these springs being attached to a pair of lugs 46 and 47

projecting from the annular member 22 of the stop device 21.

A car switch 48 is located within the car 15 for controlling the reversing switches 6 and 8, and 7 and 9, respectively, by means of operating coils 51, 52, 53 and 54. A stop-button 55 is also located within the car 15 for controlling a relay 56 that is provided with an operating coil 57. An interlock 58 is mechanically attached to and operated by relay 56. This relay controls the above-mentioned reversing switches 6 to 9.

Assuming the apparatus in its illustrated and inoperative positions, when power is applied to conductors 4 and 5, a circuit is established for the operating coil 57 of relay 56 extending from line conductor 4, through coil 57, conductor 59, stationary contact member 60 and movable contact member 61 of car switch 48, and conductor 62 to line conductor 5. Relay 56 now closes and a holding circuit extends from conductor 4 through coil 57, interlock 58, conductor 63, push-button 55 and conductor 62 to conductor 5. When car switch member 61 is actuated to the right, a circuit is established for coils 51 and 52 of reversing switches 6 and 8, whereby the motor 1 is connected for operating the car 15 in the "up" direction. When car 15 is carrying a "balanced load," that is, when the total or gross car-load is equal to the weight of the counter-balance 17, the armature current traversing coils 40 and 41 is insufficient to effect an unbalancing of the switch member 34 of the Kelvin balance 33. Therefore, during normal operation with what is commonly termed a "balanced load," the annular member 22 occupies its illustrated position.

When it is desired to stop the elevator, the operator depresses push-button 55 interrupting the above-traced holding circuit for coil 57, while car switch 48 is maintained in its running position. Another holding circuit for coil 57, however, controlled by stop-device 21, extends from conductor 4 through coil 57, interlock 58, switches 23, 24 and 25 and conductor 62 to line conductor 5. Therefore, after the operation of stop-button 55, which is maintained in its open position until the elevator comes to a stop, the elevator will automatically be stopped at the next landing upon the opening of one of the switches 23, 24 or 25. I have illustrated by the legends 1st, 2d, and 3d, the corresponding positions of the cam 26 when the elevator is at the 1st, 2d or 3d landings. Car switch 48 must be returned to its "off" position to reset relay 57 prior to further operation of the elevator.

I wish to discuss four different operating conditions requiring adjustments to compensate for varying loads, wherein the utility of my invention is apparent.

(1) When a heavy load is imposed upon the car 15, whereby the total load is greater than the counter-balance 17, a current in proportion thereto, traversing the armature 2 and coils 40 and 41, is sufficient to actuate switch member 34 to engage contact member 35; that is, the normal relation between coils 38, 39, 40 and 41 no longer exists on account of the increased field strength that is produced by the increased current in coils 40 and 41.

Assume now that car 15 is traveling from the first to the second landing with a heavy load. Push-button 55 is actuated as above described and in order to prevent the car from stopping short of the second landing, it is necessary to maintain power connections for an instant longer than with "balanced load." The operation of stop device 21 accomplishes the desired result in the following manner. A circuit is established from line conductor 4 through conductor 64, switch members 34 and 35, conductor 65, field winding 31, armature 29 of pilot motor 28 and conductor 62 to line conductor 5. The pilot motor 28 thereupon operates to shift the ring 22 in a counter-clockwise direction, against the bias of spring 45, until the tension in spring 45 is sufficient to overcome the bias of switch member 34 that is occasioned by the current traversing coils 40 and 41, whereupon switch 34 disengages contact member 35 and pilot motor 28 is stopped. Since switch 24 has been moved slightly to the left of its illustrated position it is opened by cam 26 an instant later than is normal in the upward travel of the car 15. The opening of switch 24 interrupts a previously traced circuit for reversing switch coils 51 and 52 and, on account of the heavy load which motor 1 is lifting, the car 15 tends to stop more abruptly than with balanced load.

(2) Assuming the car 15 again at the first floor and a very light load in the car, so that the counter-balance 17 is greater than the total weight carried by car 15, we have what is known as an "overhauling load." that is, the motor 1 is driven as a generator in the "up" direction and returns current to the line through armature 1 and, in a reverse direction, through coils 41 and 40. Consequently, the reversal of current through the last named coils effects a movement of switch 34 to engage stationary contact member 36, whereupon a circuit is established for field winding 32 and armature 29, of pilot motor 28 whereby the pilot motor actuates annular member 22 in a clockwise direction. Push button 55 is operated after the car has left the first floor. Switch 24 is now shifted slightly to the right, so that it is opened by cam 26 an instant earlier than is normal in the upward motion of the car 15. It will be understood that this new position is necessary on ac-

count of the tendency of the elevator to overtravel with an "overhauling load", there being an overbalance tending to maintain movement in an upward direction against the retarding influence of the brake 14. When the switch 34 engages contact member 36, in this instance, it is actuated in opposition to the action of spring 44, and the operation of "shifting" motor 28 to actuate member 22 in a clockwise direction is, of course, such as to eventually overcome the spring 44 and break contact between members 34 and 36.

(3) In a third instance, if the car 15 is at the second landing, for example, and is to be operated with a heavy load to the first landing, we again have a condition of "overhauling load" but the condition is reversed in that the loaded car, instead of the counterweight 17, drives the motor 1 as a generator. When the car switch 48 is actuated to the left, reversing switches 7 and 9 are closed and the motor operates in a "downward" direction. Push-button 55 is operated after the car has left the second landing. The direction of current through coils 40 and 41, since the connections of armature 2 have been reversed, is the same as was described in discussion (1), whereby switch 34 is actuated to engage contact member 35. Pilot motor 28 is consequently operated as previously described, to shift the annular member 22 in a counter-clockwise direction, so that cam 26 actuates switch 23 an instant earlier than is normal in the downward movement of the elevator. This condition operates to offset the tendency of the car to overtravel when lowering a heavy load.

(4) In a fourth instance, again assuming the elevator to be operated toward the first landing, with a light load in car 15, the motor 1 must draw current from line conductors 4 and 5 to drive the net load, which is the difference between the counter-balance 17 and the total load of the car 15. Reversing switches 7 and 9 being closed for downward travel, current is now taken from the line and traverses coils 40 and 41 in a direction opposite to that described in the third instance (3). Push-button 55 is actuated as before to effect a landing. Switch 34 is actuated to engage contact member 36 and effect energization of field winding 32 of pilot motor 28, whereupon annular member 22 is rotated in a clockwise direction to shift switch 23 slightly to the right of its normal position. Consequently, the latter is opened an instant later than is normal in the downward movement of the car and, since the downward movement of the car is opposed by the counter-balance 17, the motor 1 is stopped more abruptly than with a normal or balanced load.

In connection with the foregoing description it will be understood of course, that necessary adjustments are to be made to obtain suitable tension in springs 44 and 45, so that the above-mentioned circuits through switch member 34 are interrupted when the pilot motor 28 has been operated exactly to the required degree in either direction from its normal or illustrated position.

In the foregoing description no mention has been made of the effect of coils 42 and 43. The effect of these coils in nowise changes the operations set fourth above, except that the coils in question co-operate with coils 40 and 41 to compensate for variations in speed of the elevator in accordance with the voltage delivered by the generator 18, which, of course, is proportional to variations in the speed of the hoisting motor 1. Under ordinary circumstances the compensating coils 42 and 43, together with generator 18, may be dispensed with as an unnecessary refinement. It is apparent, however, that the fields produced by these coils may be utilized to vary the effective fields produced by the windings 38 and 39 to release switch 34 earlier or later from its closed positions and to thereby compensate for variations in speed of the hoisting motor 1. Modifications in the structural details and arrangement of parts herein set forth may readily be made without departing from the essential ideas, as expressed in the appended claims.

I claim as my invention:

1. The combination with a hoisting mechanism and a motor therefor, a stop-selector device, load-responsive means for controlling the effect of said device to insure accurate stopping of said mechanism independently of change in load, and speed-responsive means for controlling the last-named means.

2. The combination with a hoisting mechanism and a motor therefor, a stop-selector device, means for shifting the position of said device with respect to the hoisting mechanism, load-responsive means for controlling the shifting means and speed-responsive means for controlling the load responsive means.

3. The combination with a hoisting mechanism and a motor therefor, a stop-selector device, means for shifting the position of said device with respect to the hoisting mechanism, load-responsive means for controlling the shifting means to insure accurate stopping independently of change in load and speed-responsive means for controlling said load responsive means.

4. The combination with a hoisting mechanism and a motor therefor, of reversing means, a stop-selector device for controlling the reversing means, and a Kelvin balance for controlling said device and means dependent upon the motor speed for controlling said balance.

5. The combination with a hoisting mechanism and a motor therefor, of reversing means, a stop-selector device for controlling the reversing means, a Kelvin balance for controlling said device, manually operable means for controlling the effect of said selector device and electro-responsive means for restoring said device when said reversing means is inoperative.

6. The combination with a hoisting mechanism and a motor therefor, of reversing means, a stop-selector device for controlling the reversing means, a Kelvin balance for controlling said device, a manually operable switch for rendering said selector-device effective and means for restoring said device to its normal condition.

7. The combination with an elevator and a hoisting motor therefor, of reversing means for the motor, a stop-selector device having a plurality of switches corresponding to a plurality of stop positions for the elevator, for controlling said reversing means, a Kelvin balance device operative in accordance with the value of current traversing said motor to control the time of operating said switches, manually operable means for rendering said switches effective and electro-responsive means for restoring said device.

8. The combination with an elevator and a hoisting motor therefor, of reversing means for the motor, a stop-selector device having a plurality of switches corresponding to a plurality of stop positions for the elevator, for controlling said reversing means, a motor for shifting the positions of said switches relative to the stop positions of the elevator, and a Kelvin balance device operative in accordance with the load and speed of the elevator for controlling the second-named motor, whereby accurate stops of said elevator are effected.

9. The combination with an elevator and a hoisting motor therefor, of reversing means for the motor, a stop-selector device having a plurality of switches corresponding to a plurality of stop positions for the elevator, for controlling said reversing means, a motor for shifting the positions of said switches relative to the stop positions of the elevator, and a Kelvin balance device comprising a coil responsive to armature current of the hoisting motor, a constant-potential coil and a reversing switch controlled by said coils, for controlling the shifting motor, whereby accurate stops of said elevator may be effected.

10. The combination with an elevator and a hoisting motor therefor, of reversing means for the motor, a stop-selector device having a plurality of switches corresponding to a plurality of stop positions for the elevator, for controlling said reversing means, a motor for shifting the positions of said switches relative to the stop positions of the elevator, a generator driven in accordance with the speed of said elevator, and a Kelvin balance device having a coil responsive to the value of current traversing said hoisting motor, a constant-potential coil co-operating therewith, a coil responsive to the voltage of said generator for modifying the effect of said other coils and a switch operated by said balance device, for controlling said shifting motor.

In testimony whereof, I have hereunto subscribed my name this 7th day of March 1923.

ROY J. WENSLEY.