

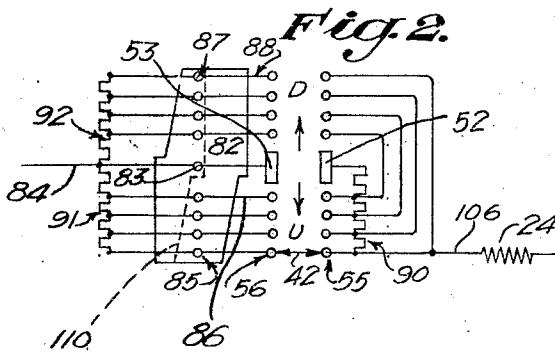
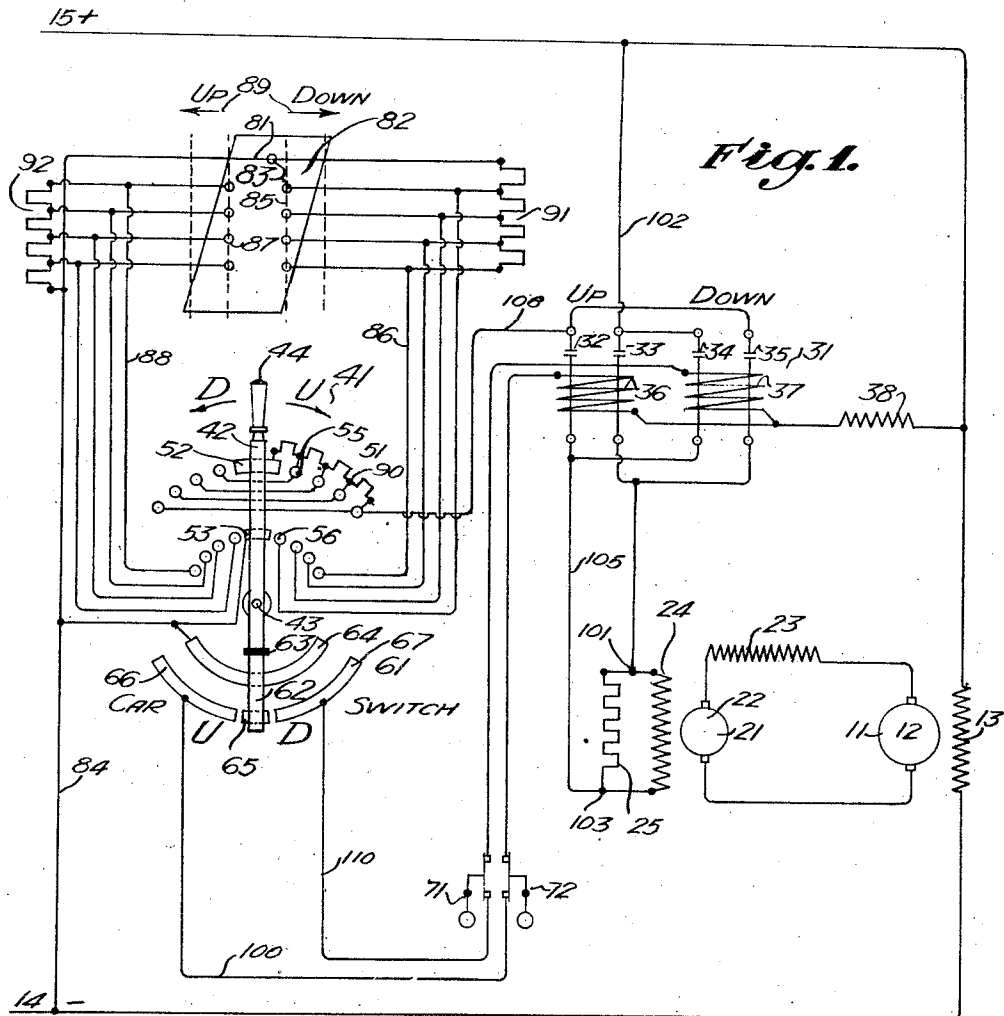
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APPARATUS FOR CONTROLLING RESISTANCE IN AN ELECTRIC CIRCUIT

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APPARATUS FOR CONTROLLING RESISTANCE IN AN ELECTRIC CIRCUIT.

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My invention relates to electrically operated elevators and hoists and the principal object of the invention is to provide novel means for controlling such an elevator or hoist. In the standard form of elevators used in buildings, the elevator car is operated between top and bottom limits and it is necessary to provide automatic means for preventing the car from running past these limits.

In the form of my invention illustrated, I utilize what is known as the Ward-Leonard system for controlling and operating the elevator motor. In this system a direct current generator is utilized, this generator being driven from any convenient source of power such, for example, as an alternating current motor. The direct current generator drives a direct current motor, this direct current motor furnishing the power to raise and lower the elevator car. In the use of the Ward-Leonard system, the voltage and direction of polarity of the generator are controlled by variations in the generator field. By decreasing the current in the field, the voltage delivered by the generator may be reduced, and by reversing the direction of this current the polarity of the generator may be reversed. Since the normal speed of the motor under any given set of conditions is directly proportional to the voltage impressed upon it and since the direction of rotation is dependent upon the polarity of the voltage impressed upon the armature of the motor, (the direction of polarity of the field of the motor being maintained constant), it is evident that the speed and direction of rotation of the motor may be regulated by this manipulation of the generator field. Since the current in the generator field is small, it is possible to control a comparatively large generator with very small controlling apparatus and with small electrical losses, thus cutting down the first cost of the apparatus, the cost of maintenance of the apparatus, and the energy used.

In the operation of an elevator controlled by the Ward-Leonard system, the speed of the elevator as it approaches either limit may be reduced by inserting resistance in series with the generator field. There are in general two methods of connection which will accomplish this. In other words, the elevator motor can be slowed down as it approaches the limits of car travel (a) by

having a switch, actuated by the movement of the car, insert resistance in the field circuit of the generator or (b) by having separate rheostats for the up and down directions in series with which the slow down resistance is inserted. The disadvantage of the first system, noted above as (a), is that it is not possible to leave either terminal of travel at a speed greater than the speed at which the terminal was approached, due to the presence of slow down resistance in the field circuit of the generator. The second system, noted above as (b), overcomes this objectionable feature but possesses another undesirable feature, which is, that when the car is stopped near the terminal landings and some of the slow down resistance is in circuit with the generator field, it is impossible to move the car forward on the first few points of the rheostat, making it necessary for the operator to handle the rheostat in a different manner. Under these conditions the number of points the controller has to be moved, to move the car, depends upon the amount of slow down resistance in the generator field circuit, which in turn depends on the position of the car. For instance if the car is stopped a few inches away from a terminal landing, it is necessary for the operator to throw the controller over to the last point before the car will move up to the landing.

It is an object of my invention to overcome these disadvantages and to provide a slow down resistance which will stop the car at either limit of elevator travel regardless of the position of the car switch, the control device used being so constructed that the operation of the car switch is exactly the same at the top and bottom floors as it is at intermediate floors.

A further object of my invention is to provide means to automatically slow down the motor at either limit of the car travel, the control of this motor being accomplished by varying the direction and strength of the field current in the generator.

A still further object of my invention is to permit the car to be accelerated away from either limit of travel at the same rate it is accelerated at intermediate points by means of the car switch.

A still further object of my invention is to make it possible to move the car at a slow speed and through small distances in

either direction at either end of its travel by a manipulation of the controller in exactly the same manner that it would be manipulated to provide a similar movement at intermediate floors.

Further objects and advantages will be made evident hereinafter.

Referring to the drawings which are for illustrative purposes only,

Fig. 1 is a diagram of a complete elevator control system utilizing my invention.

Fig. 2 is a simplified diagram showing the method by which the resistors are connected and disconnected from the circuit to accomplish the above designated objects.

In the form of the invention shown, 11 is the motor driving the elevator, this motor having an armature 12 and a field 13, the field being connected between wires 14 and 15 which are connected to any source of direct current supply and which may be designated as + and - for convenience. The field of the motor is, therefore, always of one polarity and of constant strength, the voltage between the wires 14 and 15 being constant. The armature 12 of the motor is supplied from a direct current generator 21 having an armature 22, a series field 23, and a shunt field 24. The shunt field 24 is provided with a field discharge resistor 25 to prevent excessive voltages building up on the field when it is disconnected from the remainder of the circuit. The direction of polarity of the field 24 is controlled by an electrically operated reverser switch 31 having contacts 32, 33, 34 and 35 and having an up-coil 36 and a down-coil 37. A brake magnet coil 38 is also provided.

The movement of the car is controlled by a car switch 41 having a sliding arm 42 pivoted at 43 and operated by means of a handle 44. The car switch may be conveniently divided into rheostat 51 and a reversing switch 61. The rheostat 51 is provided with central contacts 52 and 53, and with outer contacts 55 and inner contacts 56. The contacts 55 are hereinafter designated as primary contacts, the contacts 56 being designated as intermediate contacts. The contacts 55 are arranged in two series extending to the right and left of the contact 52. The arm 42 connects the contact 52 to the contact 53 or when moved to the right or left, it connects each of the contacts 55 with the corresponding contact 56. An arm 62 separated by insulation 63 from the arm 42 is provided in the reversing switch 61, this arm 62 making contact at all times with a sector 64 and in its central position making contact with a dead sector 65. As the handle 44 is moved to the right or left, the arm 62 makes contact with members 66 or 67 forming parts of the reversing switch 61.

Limit switches 71 and 72 are provided at the extreme top and bottom of the car travel,

these switches opening the circuit when the car reaches its limit in either direction. For the purpose of slowing down the car before it reaches this position I provide a slow down switch 81 consisting of a drum having a moving contact 82 which is connected at all times to the wire 14 through a contact 83 and a wire 84. Two series of secondary contacts 85 and 87 are provided, the series of secondary contacts 85 being connected to the contacts 56 to the right of the central position by means of wires 86 and the other set of secondary contacts 87 being connected by means of wires 88 with the contacts 56 at the left of the central position. The contact 82 is moved to the right or left in the direction of the arrows 89 opening the circuit to the sectors 85 and 87 as the car approaches its limit of travel. A primary resistor 90 is provided, this primary resistor being connected by means of taps placed at suitable intervals with the primary contacts 55. Two secondary resistors 91 and 92 are provided, the resistor 91 being connected by suitable taps with the contacts 85 and the resistor 92 being connected by suitable taps with the contacts 87. The switch 61 is utilized to operate the switches 36 and 37 and thus control the direction of motion of the car by controlling the polarity of the field 24. This can readily be understood from the following description of its operation.

As the handle 44 is moved to the right in the direction of the arrow U, contact is established between sectors 64 and 66. The sector 64 is connected at all times with the wire 14 and the sector 66 is connected through a wire 100 and the limit switch 72 with the coil 36 on the switch 31, the other terminal of this coil being connected through the brake magnet 38 with the wire 15. By energizing the coil 36 the contacts 32 and 33 are connected together, one terminal 101 of the field 24 being connected to the wire 15 through a wire 102, and the other terminal 103 of the field 24 being connected through a wire 105 and a wire 106 with one terminal of the resistance 90, the other terminal of this resistance being connected through the lever 42 with the wire 14 when the lever is near its center position. This connects the field 24 in one direction.

If the lever 44 is moved to the left in the direction of the arrow D, the contact 67 is energized from the wire 14 and the coil 37 is energized through a wire 110 and the brake magnet 38. By energizing the coil 37, the contacts 34 and 35 are closed and the field 24 is connected in the opposite direction to that previously described. It will thus be seen that the initial movement of the lever 44 in either direction energizes the coils 36 or 37 and thus determines the polarity of the field 24. The manipulation of the resistors 90, 91 and 92 can be best under-

stood from the diagram Fig. 2 which shows in extremely diagrammatic form the method of cutting out these resistors.

It will be noted that there are shown three sets of contacts, namely, the secondary contacts 85 of the slow down switch, the intermediate contacts 56 and the primary contacts 55 of the car switch. It will also be noted that the secondary resistance 91 is connected by means of taps with the contacts 85 and that the resistance 90 is connected by means of taps with the contacts 55. It will also be noted that the contacts 56 and 85 are connected together in pairs as shown. As long as the car is a sufficient distance away from the limits of travel, the member 82 of the slow down switch connects all of the contacts 85 together, these contacts being in turn connected to the wire 14 through a wire 84.

In the diagram, Fig. 2, the arm 42 is shown at its lowest position. This is the position assumed when the car is running at full speed with all resistance cut out of the circuit. It will be noted that there is a circuit from the wire 84 through the segment 82 to the lowest contact 85 and to the lowest contact 56, this lowest contact 56 being connected to the lowest contact 55 by means of the arm 42. In this position neither the resistor 90 nor the resistor 91 is in circuit.

For the purpose of explaining the operation of the slow down device, let it be assumed that the car is stopped at an intermediate position. When the car is in this position, the segment 82 will be in contact with all of the contacts 85 and 87. In order to move the car upward, the operator advances the slider, or controller lever, 42 in a right hand direction as indicated by the arrow U in Fig. 1. In Fig. 2 the advance of the slider would be downward from the segments 52 and 53, making successive contact between the pairs of contacts 55 and 56. With the initial movement of the slider, the entire resistance 90 is in circuit, thus giving a low strength current in the generator field 24 and providing for a slow starting of the motor. As the slider is advanced and the successive pairs of contacts 55 and 56 are connected, the current flows through the segment 82, through the successive conductors 86 and the slider 42, and thus cuts out increasing amounts of the resistance 90 as the slider advances. Upon the slider 42 reaching the lowest pair of contacts 55 and 56, the resistance 90 is entirely removed from the generator field circuit and at such time the car will be moving upward at full speed. It is evident that so long as the member 82 is in the position shown in the two figures, the arm 42 may be moved back and forth, cutting in or out resistance in the resistor 90, and regulating the generator field to give any speed desired by the operator, quite independent of the slow down switch.

As the car approaches the limit of its travel, the member 82 moves to the left from the position shown in Figs. 1 and 2, and breaks contact successively with the contacts 85, beginning with the bottom contact. With the slider 42 in the lowest position, as shown, and the car travelling at full speed, it is evident that this movement of the member 82, by successively breaking contact with the contacts 85, will gradually cut the resistor 91 into the circuit between the wires 84 and 86, thus inserting the resistor 91 in series with the generator field 24, thereupon reducing the field strength and slowing down the motor. The resistors 90, 91, and 92 are substantially similar to each other in their characteristics, so that when the member 82 has moved to the position indicated by the dotted lines 110 in Fig. 2, and the contacts 85 are entirely disconnected therefrom, the current must then travel through the resistor 91, with the result that a resistance is placed in circuit with the generator field 24 substantially equal to the resistance 90.

With reference to Fig. 2, it will be perceived that with the segment 82 in the position indicated by the dotted lines 110, the movement of the slider 42 upwardly from the position shown will not cause any change in the resistance in the generator field circuit owing to the fact that as the slider moves up each successive pair of contacts 55 and 56, and a resistance element is removed from the resistor 91, an equivalent resistance element is added in the resistor 90, thus maintaining a designated resistance in the generator field circuit. Let it be assumed that the car is stopped several inches from the upper terminal landing. The segment 82 would then be in the position indicated by the dotted lines 110. It is possible by the device shown to move the car up to the landing at slow speed by advancing the slider 42 over to the first notch. It will be evident that a further advance of the slider 42 beyond the first notch cannot have the effect of increasing the speed of the car in upper direction, because of the cutting in of the resistor 91 to the same degree that the resistor 90 is cut out by the advance of the slider. The car can, however, be caused to leave the upper landing with the same acceleration of speed as when operating the car in an intermediate position, owing to the fact that with the segment 82 in the position indicated by the dotted line 110, the down contacts 87 are all in contact therewith, and the current may travel through the segment 82 and the successive conductors 88, as the slider is advanced in an upward or left hand direction from the central contacts 52 and 53.

I claim as my invention:

1. An apparatus for inserting resistance in an electric circuit independently at two different points comprising: a primary resistor having one end connected to one terminal of said circuit; a secondary resistor having one end connected to the other terminal of said circuit; primary contacts connected to successive points in said primary resistor; secondary contacts connected to successive points in said secondary resistor; intermediate contacts each directly connected to one of said secondary contacts; means for progressively connecting together all of said secondary contacts; and a slider adapted to connect any one of said primary contacts with a corresponding one of said intermediate contacts.

2. An apparatus for inserting resistance in an electric circuit comprising: two resistors; equalizing means for cutting out one resistor as the other resistor is cut in progressively; and means for short circuiting one of said resistors.

3. An apparatus for inserting resistance in an electric circuit comprising: two resistors; equalizing means for cutting out one resistor as the other resistor is cut in progressively; and means independent of said equalizing means for short circuiting one of said resistors.

4. An apparatus for regulating the resistance in an electric circuit comprising: a primary resistor; a secondary resistor; a series of primary contacts, each primary contact being connected to a tap from said primary resistor; a series of secondary contacts, each secondary contact being connected to a tap from said secondary resistor; an equalizing means for so connecting one of said primary contacts to a cooperating secondary contact that said primary resistor is cut out of circuit as said secondary resistor is cut into circuit; and means for connecting together all or part of said series of secondary contacts.

5. An apparatus for regulating the resistance in an electric circuit comprising: a primary resistor; a secondary resistor; a series of primary contacts, each primary contact being connected to a tap from said primary resistor; a series of secondary contacts, each secondary contact being connected to a tap from said secondary resistor; an equalizing means for so connecting one of said primary contacts to a cooperating secondary contact that said primary resistor is cut out of circuit as said secondary resistor is cut into circuit; and a bridging member adapted to successively connect all of said secondary contacts together.

6. An apparatus for regulating the resistance in an electric circuit comprising: a

primary resistor; a secondary resistor; a series of primary contacts, each primary contact being connected to a tap from said primary resistor; a series of secondary contacts, each secondary contact being connected to a tap from said secondary resistor; an equalizing means for so connecting one of said primary contacts to a cooperating secondary contact that said primary resistor is cut out of circuit as said secondary resistor is cut into circuit; and a bridging member connected to the first of said secondary contacts and so disposed that it can connect said first secondary contact successively with each of the other secondary contacts.

7. An apparatus for controlling resistance in an electric circuit comprising: a primary resistor; taps provided upon said primary resistor; two secondary resistors; taps provided upon each of said secondary resistors; and switch means enabling the connection of successive taps from the primary resistor with corresponding taps from either of the secondary resistors so that the resistors thus connected present a mutually complementary resistance within the circuit.

8. An apparatus for controlling resistance in an electric circuit comprising: a primary resistor; taps provided upon said primary resistor; two secondary resistors; taps provided upon each of said secondary resistors; switch means enabling the connection of successive taps from the primary resistor with corresponding taps from either of the secondary resistors so that the resistors thus connected present a mutually complementary resistance within the circuit; and means normally shorting the taps of the secondary resistors so that operation of the switch controls only the amount of the primary resistor in the circuit.

9. An apparatus for controlling resistance in an electric circuit comprising: a primary resistor; taps provided upon said primary resistor; two secondary resistors; taps provided upon each of said secondary resistors; switch means enabling the connection of successive taps from the primary resistor with corresponding taps from either of the secondary resistors so that the resistors thus connected present a mutually complementary resistance within the circuit; and means normally shorting the taps of the secondary resistors so that operation of the switch controls only the amount of the primary resistor in the circuit, said shorting means being shiftable to free the taps of a given secondary resistor from a short.

In testimony whereof, I have hereunto set my hand at Los Angeles, California, this 20th day of September, 1922.

CRANFORD P. WALKER.