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ELECTRICAL CONTROL SYSTEM

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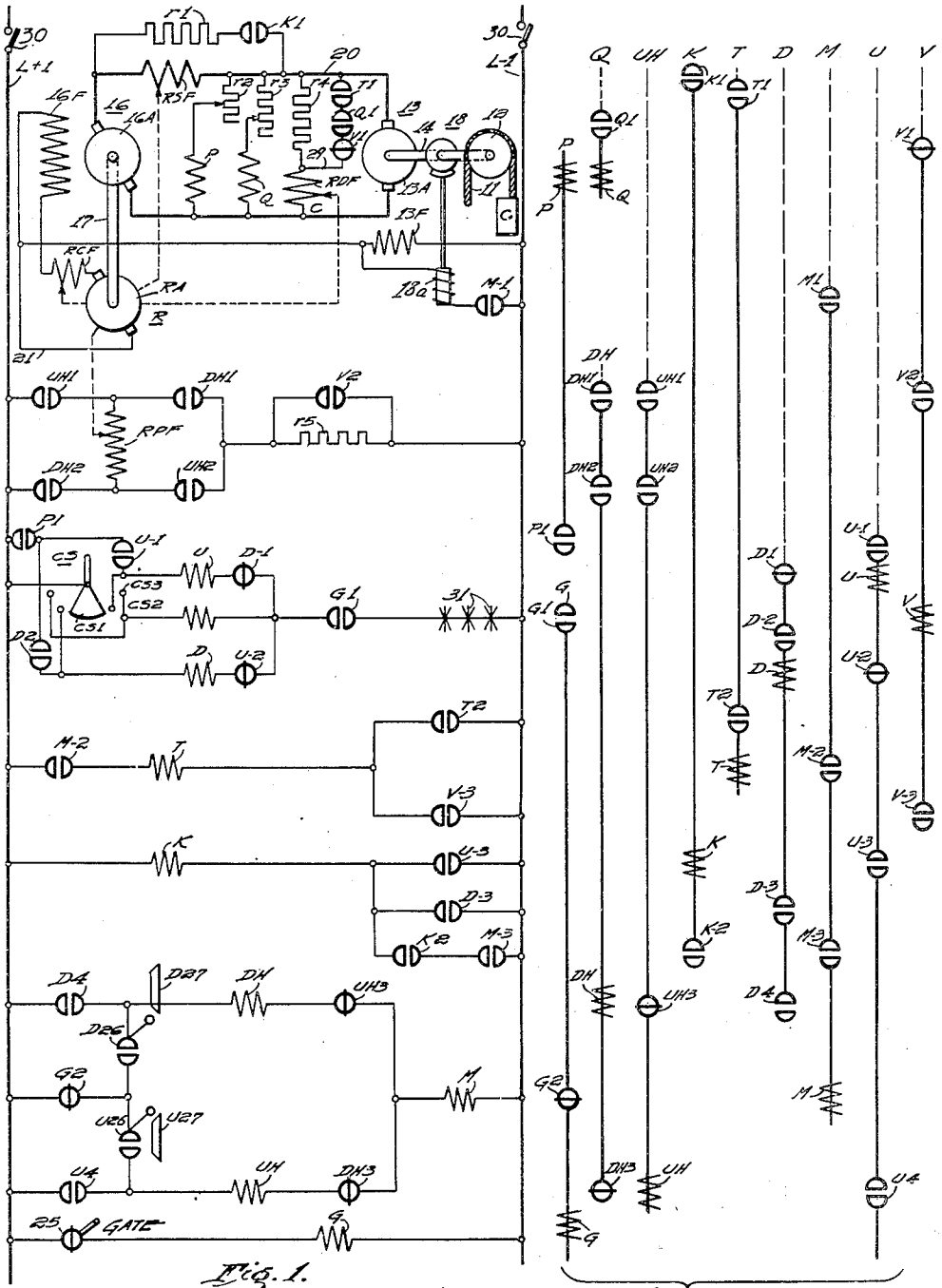


Fig. 1.

Fig. 1A.

WITNESSES:

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ELECTRICAL CONTROL SYSTEM

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Our invention relates to electrical control systems of the variable voltage type and, more particularly, to such systems of this character as include regulators and are suitable for the operation and control of elevator hoisting motors.

One object of the invention is to provide a variable voltage control system having a regulator which will respond more quickly to changes in the control operations than the systems heretofore used.

Another object is to provide a regulator so connected in a variable voltage system that it will operate without any sluggishness for controlling the generator of the system.

Another object is to provide a variable voltage control system embodying a regulator in which the regulator will influence the variable voltage system to give a normal degree of acceleration during a normal run of an elevator car but which will give a greater than normal degree of retardation of the car during its deceleration to a stop.

A further object is to provide an elevator car control system which will give a normal degree of acceleration to the car during normal runs but which will give a greater degree of acceleration during leveling operations.

A further object is to provide a variable voltage control embodying a regulator which will prevent an elevator car from dropping slightly away from the floor at which it is stopped when it is being leveled upwards with a heavy load, in the event that the cables stretch sufficiently during the loading operation to require the car to be releveled.

It is also an object to provide for "forcing" the regulator of a variable voltage system during predetermined operations of the system in order to secure more desirable operation of the system as a whole.

Other objects of the invention will be apparent from the following description taken in conjunction with the accompanying drawing, in which:

Figure 1 is a diagrammatic representation in straight line style of an elevator control system embodying our invention; and

Fig. 1A is an explanatory illustration of the relays embodied in the control system of Fig. 1. The illustration of the relays in Fig. 1A shows them with their coils and contact members disposed in horizontal alignment with their positions in the straight-line circuits of Fig. 1, so that the identification of any relay and the position of its coil and its contact members in the straight-line circuits of Fig. 1 may be readily returned.

Referring more particularly to the drawing, we have illustrated a suitable cable 11 as passing over a hoisting drum 12 for use in supporting an elevator car C. A hoisting motor 13 is provided for operating the hoisting drum by means of a shaft 14 to raise or lower the car, and a generator 16, driven by any suitable constant speed motor (not shown), is provided for supplying electrical energy to the hoisting motor. The generator is usually designed to operate at 230 volts.

A regulating generator R (hereinafter called the regulator) is provided for exciting the generator and regulating its output. The regulator R is mounted on a shaft 17 connected to the generator armature 16A so that the regulator will be driven at the same speed as the generator armature.

An electromagnetic brake 18, provided with a magnetizing coil 18a, is associated with the shaft 14 for stopping and holding the car when the power to the hoisting motor is cut off.

A car switch CS may be mounted in the car for use by the car attendant in causing the car to start and stop. The car switch is connected for operating a control system provided with a pair of supply conductors L+1 and L—1, which may be connected, for energization, to any suitable source of supply. The field winding 13F of the hoisting motor is connected across the supply conductors L+1 and L—1 to provide constant energization for the motor.

A variable voltage system of control is provided for controlling the operation of the hoisting motor 13 wherein the hoisting motor armature 13A is connected in a closed circuit 20 with the armature 16A of the generator 16. The generator is provided with a separately excited field winding 16F which is connected for energization in a loop circuit 21 with the armature RA of the regulator R so that the output of the generator and consequently the speed and direction of operation of the hoisting motor 13 may be controlled by controlling the operation of the regulator.

The regulator is provided with a self-excited field winding RCF, a pattern field winding RPF, a differential field winding RDF and a series field winding RSF.

The self-exciting field winding RCF is connected in a loop circuit 21 in series with the regulator armature RA and the generator field winding 16F. The total resistance of this cir-

cuit should be made equal to the volts that the regulator will produce when one ampere flows through its self-exciting field winding. In other words, the circuit is tuned so that perfect regulation will be obtained with no hunting effects.

The pattern field winding RPF is disposed to be connected across the supply conductors L+1 and L−1 so that the generator voltage and the direction of the output of the regulator may be controlled by controlling the direction and the value of the current in the pattern field. For a given excitation of the pattern field, the regulator will produce a voltage which will excite the generator field winding 16F. As soon as current starts to flow through the generator field winding circuit, the self-exciting field winding RCF excites the regulator to force the current through the generator field winding.

The differential field winding RDF is connected across the terminals of the generator armature 16A. A resistor *r*6 is inserted in series with the differential field winding RDF. The differential field winding RDF with its resistor *r*6 and the pattern field winding RPF are designed to produce the same and opposite voltage in the regulator for a given excitation of the pattern field. Under these conditions, the generator voltage will always build up to the value indicated by the pattern field. If, for any reason, a drop in voltage takes place in the generator that causes the normal strength of the differential field to be less than that of the pattern field, thus creating a voltage differential in the regulator which, by the action of its self-exciting field, will quickly and smoothly bring the generator voltage to the value indicated by the pattern field. In other words, the desired and the actual voltage in the generator will remain the same by reason of the effect of the pattern field and the differential field, regardless of any load condition in the generator tending to change the voltage. This means that by the use of the regulator in the manner indicated, we have not only applied exciting current to the generator field but also have corrected it for variations in the generator voltage, regardless of whether this variation is caused by armature reaction, saturation, resistance or brush drop.

As the current in the generator field increases, the excitation of the regulator differential field also increases, the strength of this field being such that when the generator reaches the voltage predetermined by the pattern field, the regulator stops building up, maintaining the required generator shunt field excitation to produce that voltage.

A shunt circuit 28 is disposed around the resistor *r*4 and so controlled by the high speed relay V, the forcing relay Q and the decelerating relay T that it shorts the resistor *r*4 when the car is decelerating from normal high speed to a stop, thus providing a greater than normal excitation for the differential field to produce a greater rate of retardation in the elevator than would be obtained with the normal differential field. The point at which the shorting of the resistor *r*4 takes place to secure a stronger differential field is when the speed relay V has been deenergized and the forcing relay Q and the decelerating relay T have not been deenergized.

The regulator series field RSF is connected in series in the loop circuit 17 between the armatures of the generator and the hoisting motor. A resistor *r*1 is associated with the winding RSF and is connected in shunt relation thereto by an acceleration relay K while the car is making a normal run. The field winding RSF and its resistor *r*1 are designed to cause the regulator to give the generator field winding 16F sufficient excitation to compensate for the RI drop in the hoisting motor. As the current increases in the armature of the generator, the voltage will rise just enough to overcome the RI drop of the current flowing through the hoisting motor armature. The net result will be a flat speed for the hoisting motor regardless of load and regardless of the selected value of that speed. Anything which tends to disturb this relation will be automatically compensated for by the reaction of the field windings previously described.

An up direction relay UH and a down direction relay DH are provided for connecting the pattern field RPF to the supply conductors and for controlling the direction of the output of the regulator and thereby control the direction of operation of the car.

When the car is in normal operation in serving the floors and is not being leveled at a floor, the direction relays are controlled by an up-direction switch U and a down-direction switch D, which are, in turn, controlled directly by the car switch CS, but when the car is stopping at a floor, the direction relays are controlled by a pair of leveling switches U26 and D26.

The elevator may be provided with any suitable leveling apparatus for causing the car to level at any floors at which it stops in case the cables stretch while the car is being leveled or the car moves away from the floor for any other reason while the stop is being made. In the present illustration, we have shown a very simple leveling apparatus comprising the "up" cam switch U26 and the "down" cam switch D26. The switches U26 and D26 are mounted on the car in position to be operated by cams U27 and D27 at each floor. When the car makes a stop at the floor and moves below the floor, the leveling switch U26 engages the "up" cam U27 and thereby energizes the "up" direction relay UH to cause the car to move upwardly until the cam switch slides off the upper end of the cam. If the car moves upwardly from its position level with the floor, the "down" switch D26 will engage the cam D27 and thereby energize the down direction relay DH to move the car downwardly until the switch D26 slides off the lower end of the cam D27. The circuit for the leveling switches is controlled by the gate relay contact G2 so that the leveling switches are effective only when the car has stopped at a floor and opened its gate (not shown). It is usual to provide means for withdrawing the leveling switches when the car passes a floor at which no stop is to be made, but such details are old in the art and, therefore, are not included in the present diagram.

The speed of the elevator car during its normal runs is controlled by a high speed relay V operated by the car switch CS. The relay V controls the speed of the car by controlling a resistor *r*5 connected in the circuit of the pattern field RPF.

A gate relay G, controlled by the car gate, is provided for preventing floor to floor runs of the car and to condition the leveling system for operation while the gate is open. The gate relay is controlled by a cam switch 25 disposed to be closed by the closing of the gate and opened by the opening of the gate, so that the gate relay will be energized only when the gate is closed.

A decelerating control relay P is provided for preventing the car on a normal run from being suddenly stopped, after the high speed relay V is deenergized, before its speed has decreased to a value low enough to permit an easy stop by deenergizing the generator and applying the brake. The relay P is a counter-electromotive force relay connected across the loop circuit 20 so that it is responsive to the voltage of the generator, and it may be so designed that it will close its contacts when the generator voltage rises to 125 volts and to open its contacts when the generator voltage drops to 75 volts. In this manner, it is responsive to the speed of the car because the voltage of the generator and the speed of the car have a predetermined relation to each other.

The acceleration control relay K is provided for placing the resistor r1 in shunt relation with the regulator field winding RSF when the car is making a normal run in serving the floors. The relay K is energized when either the up direction switch or the down direction switch is closed to run the car, and it thereupon closes self-holding contacts K2 which causes it to remain energized until the running relay M is deenergized when the car makes a stop. The relay K is energized only while the car is running and is not energized during a leveling operation and it maintains the regulator field winding RSF in condition for normal running of the car.

The regulator forcing relay Q is provided for controlling the use of the resistor r4 in connection with the regulator differential field winding RPF under certain conditions. The relay Q is a counter-electromotive force relay also connected across the loop circuit 20 so that it will respond to the voltage of the generator. The relay Q is designed to open its contacts QR when the generator voltage rises to 100 volts and to open its contacts when the generator voltage falls to 50 volts.

The decelerating relay T, controlled by the running relay M and the high speed relay V, is provided for assisting in the control of the use of the resistor r4 in the circuit of the regulator differential field winding RDF.

It is believed that the invention will be better understood by the following assumed operation. It will be assumed that the car is standing at its lower terminal (not shown) and that the generator 16 and the regulator R are operating at constant speed and that the line switches 30 have been closed to supply energy to the supply conductors L+1 and L−1, thereby energizing the field winding 13F of the hoisting motor 13 and the gate relay G.

The rotation of the regulator armature RA does not affect the loop circuit 21 or the generator field winding 16F because, as before stated, the self-exciting field winding RCF of the regulator is so designed that it generates just sufficient voltage to send the current through the loop circuit in which the generator field winding is disposed. Hence, the generator field winding is not energized and the generator does not now supply any current to the hoisting motor.

It will be assumed now that the attendant in the car moves the car switch CS in counter-clockwise direction to cause the car to move upwardly.

Briefly, the movement of the car switch for up direction energizes the up direction switch U, which energizes the up direction relay UH and the running relay M to energize the pattern field RPF and release the brake 18. The energized pattern field RPF causes the regulator R to energize the field 16F of the generator, which causes the generator 16 to generate current to energize the hoisting motor 13 and thereby move the car upwardly.

This operation, in detail, is as follows: The movement of the car switch closes the contact members CS1 and CS2 to energize the up direction switch U by the circuit: L+1, CS, CS1, CS2, U, D1, G1, 31, L−1. The energized up direction switch U closes its self-holding contact members U1, closes its contact members U3 and U4, and opens its contact members U2.

The closing of the contact members U3 energizes the acceleration control relay K by the circuit: L+, K, U3, L−.

The energized relay K closes its self-holding contact members K2 and its contact members K1 for connecting the resistor r1 in shunt with the field winding RSF so that that field will be energized in its normal manner during the normal run of the car to its next stop.

The closing of the contact members U4 energizes the up direction relay UH and the running relay M by the circuit: L+, U4, UH, DH3, M, L−. The energized relay M releases the brake 18 and prepares other circuits for operation. The energized relay UH closes its contact members UH1 and UH2 and opens its contact members UH3. The closed contact members UH1 and UH2 energize the pattern field RPF by the circuit: L+, UH1, RPF, UH2, r5, L−. As soon as current starts to flow through the pattern field circuit, the regulator field RCF self excites the regulator to force current through the generator field. As the current in the generator field increases, the excitation of the regulator differential field RDF also increases, the strength of this field being such that when the generator reaches the voltage predetermined by the pattern field, the regulator stops building up and maintains the required generator field winding excitation to produce that voltage. The excitation of the generator field 16F causes its armature 16A to supply the required amount of current for operating the hoisting motor 13 through the loop circuit 20 which connects the armatures of the generator and the hoisting motor.

When the car switch was thrown to the "up" position, it also closed its contacts CS1 and CS3, thereby energizing the high speed relay by the circuit: L+, CS1, CS3, V, G1, 31, L−. The high speed relay V now opens its contact members V1 and closes its contact members V2. The closing of the contact members V2 short circuits the resistor r5 in the circuit of the pattern field winding RPF and thereby increases the energization of that field winding to increase the current supplied by the regulator to the generator field winding, thus causing the car to follow a normal acceleration until it reaches its normally high speed, after which it continues to run at a constant speed until it is decelerated for a stop.

If for any reason the loading on the car affects the hoisting motor sufficiently to cause a drop in the voltage of the generator, the strength of the regulator differential field will be less than that of the pattern field and the voltage differential will be set up in the regulator, which by the action of its self-exciting field, will quickly and smoothly bring the generator voltage to the value indicated by the controller or pattern field.

Furthermore, as stated before, the regulator series field winding RSF will cause the regulator R to give the generator field winding 16F sufficient excitation to compensate for the RI drop

in the hoisting motor 13 and the net result will be a constant speed for the hoisting motor regardless of the load and regardless of the selected value of that speed, and everything which tends to disturb this relation will be automatically compensated for by the reaction of the field windings as previously described.

As soon as the generator voltage rises to a predetermined value, say, 75 volts, the relay P is energized to close its contact members P1 in the holding circuit for the up direction switch U for the purpose of preventing deenergization of that switch to stop the car until after the car is decelerated to a suitable stopping speed by the high speed relay V when making the next stop.

As the generator voltage rises further to, say, 100 volts, the relay Q is energized to close its contact members Q1 in the shunt circuit around the resistor *r*4 but that does not affect the resistor at this time because the contact members V1 in that circuit are now open. However it helps to prepare that circuit for operation when the car is decelerating to a stop.

At the time the high speed relay was energized it closed its contact members V3, thereby energizing the decelerating relay T by the circuit: L+, M2, T, V3, L—. The energized relay T closes its self-holding contact members T2 and also its contact members T1 in the shunt circuit 29 to help prepare that circuit for operation when the car is to be decelerated to a stop. The relay T now stays energized until the car is stopped.

The car is now moving up the hatchway at its normal high speed and we shall assume that it approaches a floor at which the attendant desires to make a stop, and that he thereupon moves the car switch CS to open its contact members CS1 and CS3 to decelerate the car from high speed to a stopping speed.

The opening of the contact members CS1 and CS3 deenergizes the high speed relay V, which in turn opens its contact members V2 and thereby reinserts the resistor *r*5 in circuit with the pattern field RPF. The inclusion of the resistor *r*5 in this field winding decreases its energization and thereby causes a corresponding decrease in the output of the regulator R to the loop circuit 21, including the generator field winding 16F. The decrease in the energization of the generator field winding causes the generator armature to supply less current to the hoisting motor and thereby decreases the speed of the car.

It should be noted here that the effect of the decreased current flowing in the loop circuit 20 causes the differential field winding RDF of the regulator to be so changed in energization that it cooperates with the pattern field to cause the regulator to quickly and smoothly bring the generator voltage down to the value indicated by the pattern field.

The deenergized high speed relay V closes its back contacts V1 and thereby completes the shunt circuit 29 around the resistor *r*4 because the contact members T1 and Q1 of the decelerating relay T and the regulator forcing relay Q are still closed. The short circuiting of the resistor *r*4 by the closed shunt circuit 29 gives a greater than normal excitation of the differential field RDF. This produces a rate of retardation in the elevator considerably greater than would be obtained with the normally excited differential field. This stronger differential field is maintained while the car is decelerating until the relay Q becomes deenergized.

As the speed of the car decreases, the generator voltage decreases and, when the generator voltage decreases to a predetermined low voltage, say, 50 volts, the relay Q is deenergized to a point where it opens its contact members Q1 and thereby reinserts the resistor *r*4 in the circuit of the differential field. This is, of course, at a relatively low voltage and, therefore, at a relatively low speed of the car, and during the time the shunt circuit remained closed, the car was very effectively retarded in a manner very desirable in controls of various types of which this is one embodiment.

When the generator voltage dropped to a predetermined voltage, say, 75 volts, the relay P was sufficiently deenergized to open its contact members P1 in the self-holding circuit of the up direction switch U, thus leaving the circuits of that switch so arranged that it may be deenergized at any time by the centering of the car switch. Thus it is seen that the provision of the relay P prevents the direction switch from being deenergized to stop the car immediately after the relay V is deenergized to decrease the speed of the car. It is a safety device to prevent the sudden stopping of the car while it is running at its normal high speed.

It will be assumed now that the car arrives within stopping distance of the floor at which the stop is to be made, that it has decelerated to its stopping speed, and that the attendant moves the car switch to its center position, thus opening the contact members CS1 and CS2 to stop the car at the floor desired. The opening of the contact members CS1 and CS2 deenergizes the up direction switch U, which, in turn, opens its contact members U1, U3 and U4 and closes its back contact members U2.

The opening of the contact members U4 deenergizes the up direction relay UH and the running relay M. The deenergized relay UH opens its contact members UH1 and UH2, thus deenergizing the pattern field RPF. The deenergization of the pattern field causes the regulator to stop supplying voltage to the generator field winding 16F, which, in turn, causes the generator armature 16A to stop supplying current to the hoisting motor 13, so that it stops moving the car.

The deenergization of the running relay M opens its contact members M1, M2 and M3. The opening of the contact members M1 deenergizes the brake coil 18*a* and causes the brake 18 to stop the car and hold it at the floor. The opening of the contact members M2 deenergizes the decelerating relay T to open its contact members T1 in the shunt circuit 29 around the resistor *r*4. The opening of the contact members M3 opens the self-holding circuit of the acceleration control relay K, which, in turn, opens its contact members K1 and removes the resistor *r*1 from its shunt relation to the series field winding RSF so that winding will effect a more rapid acceleration of the output of the regulator than normal if a leveling operation takes place while the car is stopping at the floor.

The car is now standing at the floor and it will be assumed that the attendant opens the car gate (not shown) and proceeds to load the car. The opening of the car gate opens the gate switch 25, thus deenergizing the gate relay G to open its contact members G1 and close its contact members G2. The opening of the contact members

G1 prevents the direction switches from being energized to start the car on a normal run while the gate is open. The closing of the contact members G2 prepares the leveling system for operation if a leveling operation is necessary while the car is at the floor.

It will be assumed now that the load taken on the car causes the cables to stretch, thus causing the car to sink below the level of the floor at which it is stopped. As the car starts to move downwardly it causes the switch U26 to engage the cam U27. This closes the switch U26, thus energizing the up direction relay UH to return the car upwardly to a position level with the floor at which it is stopped. The circuit of relay UH extends: L+, G2, U26, UH, DH3, M, L—.

It will be noted that the running relay M is also energized by this circuit to close its contact members M1, thus releasing the brake 18 so that the car may be moved upwardly.

The energized relay UH closes its contact members UH1 and UH2, thus energizing the pattern field RPF to move the car upwardly as described previously in connection with the normal floor to floor run. However, in this leveling operation, the up direction switch U is not energized and the resistor r1 is not connected in shunt relation to the series field winding RSF, thus causing the full current of the generator to pass through the series field winding RSF. The full current of the generator causes a much stronger excitation of the series field winding during the leveling operation than occurs during the normal running operation of the car. This condition is normally considered as over compounded but we have found from experience that the regulator may be over compounded during leveling operation and that we thereby secure a quick response and rapid acceleration in the leveling operation.

As the car is moved upwardly in the leveling operation, the switch U26 leaves the cam U27 as the car levels with the floor and is thereby opened to deenergize the up direction relay UH and the running relay M. The deenergized relay UH opens its contact members UH1 and UH2, thus deenergizing the pattern field RPF to stop the car and the deenergized relay M opens its contact members M1 and thereby applies the brake 18 to hold the car in its floor level position.

By the foregoing description it will be seen that we have provided a variable voltage system of control embodying a regulator which gives a normal rate of acceleration and a desirable rate of retardation for a car during a normal floor to floor run and which provides a quick response and rapid acceleration during leveling operations.

Although we have illustrated and described only one specific embodiment of our invention, it is to be understood that many changes therein and modifications thereof may be made without departing from the spirit and scope of the invention.

We claim as our invention:

1. A variable voltage system comprising a power generator having an armature and a field winding and a motor connected in a loop circuit with said armature, a regulating generator for energizing the field winding of the power generator, said regulating generator having an armature and a plurality of field windings including a series field winding connected to carry a portion of the current flowing in the loop circuit connecting the power generator armature and the motor, and a differential field winding connected across the terminals of the power generator armature, a control means for the system, and means responsive to one operation of the control means for increasing the value of the series field winding to cause a greater than normal rate of acceleration of the motor and responsive to another operation of the control means for increasing the value of the differential field winding to cause a greater than normal retardation of the motor.

2. A variable voltage system comprising a power generator having an armature and a field winding and a motor connected in a loop circuit with said armature, a regulating generator for energizing the field winding of the power generator, said regulating generator having an armature and a plurality of field windings including a series field winding connected to carry a portion of the current flowing in the loop circuit connecting the power generator armature and the motor, and a differential field winding connected across the terminals of the power generator armature, a control means for the system, and means responsive to one operation of the control means for increasing the value of the series field winding to cause a greater than normal rate of acceleration of the motor.

3. A variable voltage system comprising a power generator having an armature and a field winding and a motor connected in a loop circuit with said armature, a regulating generator for energizing the field winding of the power generator, said regulating generator having an armature and a plurality of field windings including a series field winding connected to carry a portion of the current flowing in the loop circuit connecting the power generator armature and the motor, and a differential field winding connected across the terminals of the power generator armature, a control means for the system, and means responsive to one operation of the control means for increasing the value of the differential field winding to cause a greater than normal retardation of the motor.

4. A variable voltage system for operating an elevator car comprising a power generator provided with an armature and a field winding and a motor connected in a loop circuit with said armature, a regulating generator for energizing a field winding of the power generator; said regulating generator having an armature, a series field winding connected to carry at least a portion of the current flowing in the loop circuit connecting the power generator and the motor, a differential field winding connected across the terminals of the power generator armature, a self-exciting field winding connected in loop circuit with the power generator field winding and the regulating generator armature, and a pattern field winding connected to an external supply of electrical energy for controlling the output of electrical energy by the regulating generator to the power generator; a control means for causing the motor to accelerate or decelerate the car, means responsive to operation of the control means in accelerating the car for a normal run for causing one degree of excitation of the series field winding to produce a normal rate of acceleration of the car while it is on a normal run and responsive to operation of the control means in leveling the car at a floor for causing a greater degree of excitation of the series field winding to secure a greater than normal rate of acceleration of the car while it is being leveled.

5. A variable voltage system for operating an

elevator car comprising a power generator provided with an armature and a field winding and a motor connected in a loop circuit with said armature, a regulating generator for energizing a field winding of the power generator, said regulating generator having an armature, a series field winding connected to carry at least a portion of the current flowing in the loop circuit connecting the power generator and the motor, a differential field winding connected across the terminals of the power generator armature, a self-exciting field winding connected in loop circuit with the power generator field winding and the regulating generator armature, and a pattern field winding connected to an external supply of electrical energy for controlling the output of electrical energy by the regulating generator to the power generator, a control means for causing the motor to start, accelerate, run, decelerate and stop the car, and means responsive to operation of the control means in starting, accelerating and running the car for causing a normal excitation of the differential field winding and responsive to operation of the control means in decelerating the car for causing a greater than normal excitation of the differential field winding to secure an increased retardation of the car when it is decelerating to a stop.

6. A variable voltage system of control comprising a power generator provided with an armature and a field winding and a motor connected in a loop circuit with said armature, a regulating generator for energizing a field winding of the power generator, said regulating generator having an armature, a series field winding connected to carry at least a portion of the current flowing in the loop circuit connecting the power generator and the motor, a differential field winding connected across the terminals of the power generator armature, a self-exciting field winding connected in loop circuit with the power generator field winding and the regulating generator armature, and a pattern field winding connected to an external supply of electrical energy for controlling the output of electrical energy by the regulating generator to the power generator, a resistor associated with the series field winding for controlling the degree of excitation of that winding, a resistor associated with the differential field winding for controlling the degree of excitation of that winding, and a control means for rendering the first named resistor effective for one rate of acceleration of the motor and ineffective for another rate of acceleration of the motor and for rendering the second named resistor effective when the motor is accelerating and for rendering it ineffective when the motor is decelerating.

7. A variable voltage system for operating an elevator car having a car gate, said system comprising a power generator provided with an armature and a field winding and a motor connected in loop circuit with said armature; a regulating generator for energizing the power generator field winding, said regulating generator having a plurality of field windings, including a series field winding connected in the loop circuit in series with the power generator armature, a resistor associated with the series field winding, means responsive to the closed position of the car gate when the car is being moved in a floor to floor run for controlling the resistor to cause a normal excitation of the series field winding and responsive to the open position of the car gate when the car is being leveled for controlling the resistor to cause a greater than normal excitation of the series field winding.

8. A variable voltage system for operating an elevator car, said system comprising a power generator having an armature and a field winding and a motor connected in loop circuit with said armature; a regulating generator for energizing the power generator field winding, said regulating generator having a plurality of field windings including a differential field winding connected across the loop circuit in series with the power generator, means for controlling the connection of the regulating generator to a source of electrical energy for causing it to effect the starting, running, deceleration and stopping of the car, and means responsive to operation of the control means in decelerating the car for causing the differential field winding to receive a greater degree of excitation while the car is being decelerated than it receives when the car is being accelerated to thereby increase the retardation of the car.

9. A variable voltage system for operating an elevator car, said system comprising a power generator having an armature and a field winding and a motor connected in loop circuit with said armature; a regulating generator for energizing the power generator field winding, said regulating generator having a plurality of field windings including a differential field winding connected across the loop circuit in series with the power generator, means for controlling the connection of the regulating generator to a source of electrical energy for causing it to effect the starting, running, deceleration and stopping of the car, means responsive to the operation of the control means in decelerating the car for causing the differential field winding to receive a greater degree of excitation while the car is being decelerated than it receives when the car is being accelerated to thereby increase the retardation of the car, and a counter-electromotive force relay connected across the loop circuit for controlling the period during which the differential field winding receives said greater degree of excitation.

10. A variable voltage system for operating an elevator car, said system comprising a power generator having an armature and a field winding and a motor connected in loop circuit with said armature; a regulating generator for energizing the power generator field winding, said regulating generator having a plurality of field windings including a differential field winding connected across the loop circuit in series with the power generator, means for controlling the connection of the regulating generator to a source of electrical energy for causing it to effect the starting, running, deceleration and stopping of the car, means responsive to operation of the control means in decelerating the car for causing the differential field winding to receive a greater degree of excitation while the car is being decelerated than it receives when the car is being accelerated to thereby increase the retardation of the car, a counter-electromotive force relay connected across the loop circuit for controlling the period during which the differential field winding receives said greater degree of excitation, and a decelerating relay for preventing the differential field winding from receiving said greater degree of excitation when the car is not decelerating from its normal high speed.

11. A variable voltage system of control for operating an elevator car, said system comprising a power generator provided with an arma-

ture and a field winding, a motor connected in a loop circuit with said armature, and a regulating generator, said regulating generator having an armature and a plurality of field windings including series field winding and a differential field winding; a pair of direction switches for causing the car to make a floor to floor run, a pair of leveling switches for causing the car to level at a floor at which it is stopped, means responsive to operation of a direction switch in moving the car for causing the series field winding and the differential field winding to have predetermined normal degrees of excitation while the car is accelerating during a floor to floor run, means responsive to operation of a direction switch to decelerate a car for causing the differential field to receive a greater than normal degree of excitation, and means responsive to operation of a leveling switch and the inactive position of the direction switches for causing the series field winding to receive a greater than normal excitation while the car is being leveled.

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