E. L. GALE, Sr.

MOTOR CONTROL SYSTEM.

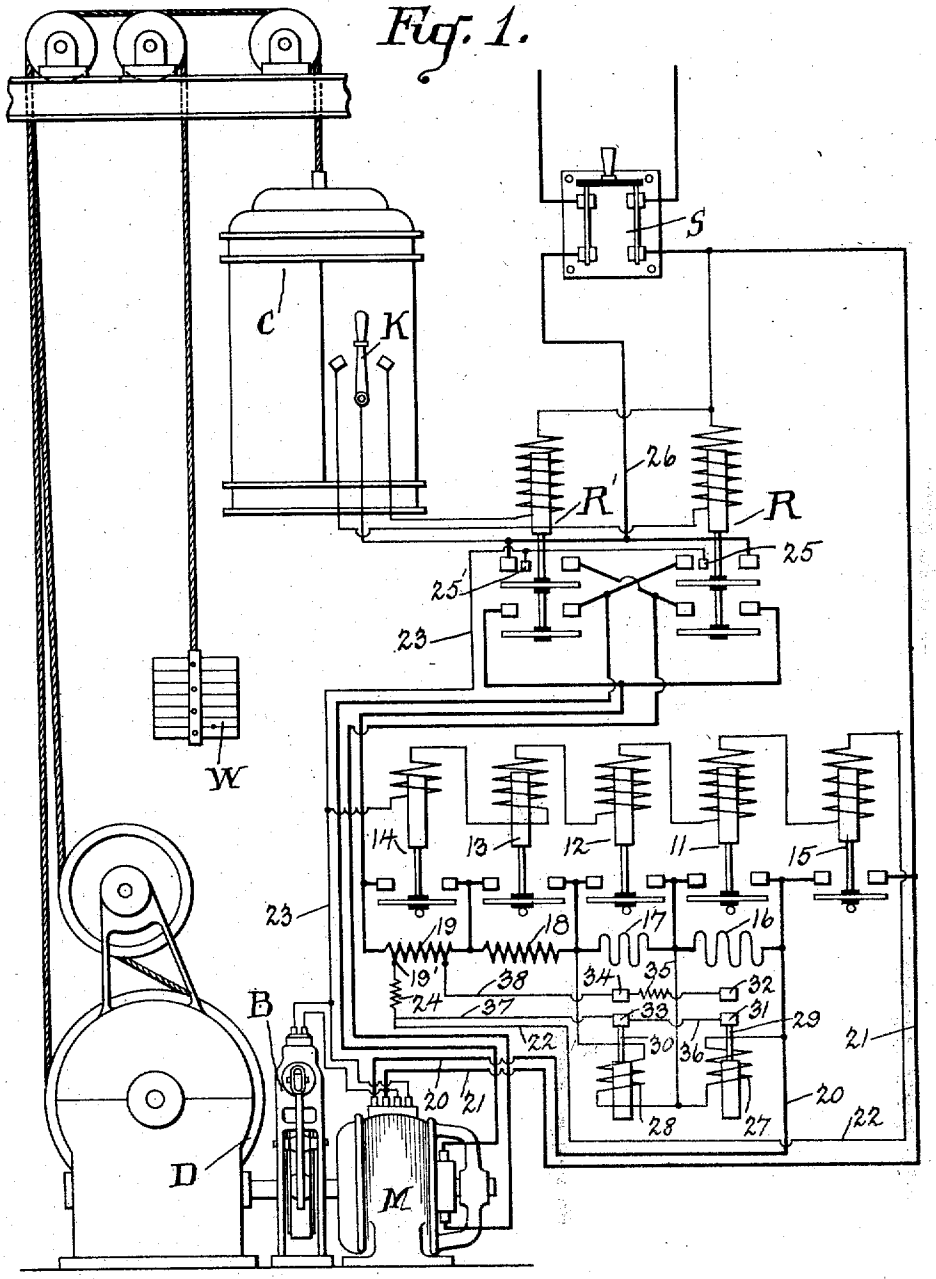
APPLICATION FILED JUNE 20, 1910.

986,277.

Patented Mar. 7, 1911.

2 SHEETS—SHEET 1.

Fig. 1.



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2 SHEETS—SHEET 2.

Fig. 2.

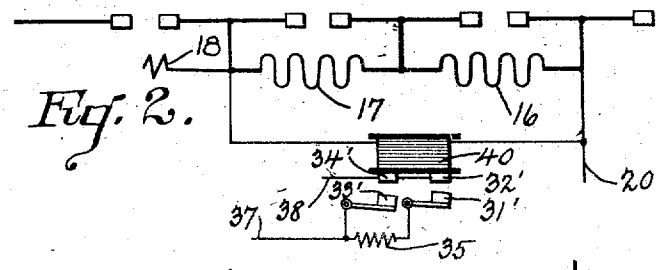


Fig. 3.

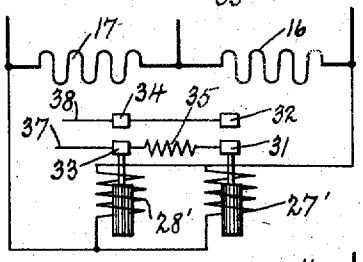


Fig. 4.

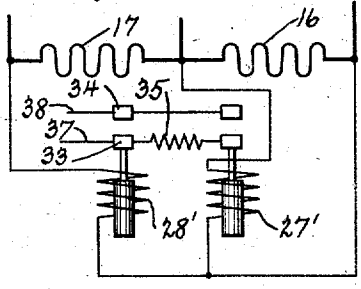


Fig. 5.

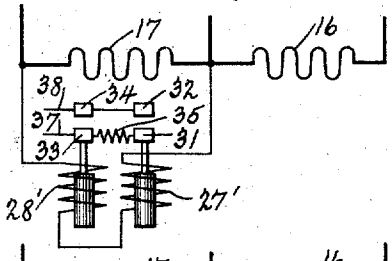
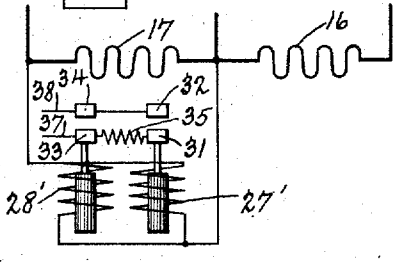


Fig. 6.



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UNITED STATES PATENT OFFICE.

ERNEST L. GALE, SR., OF YONKERS, NEW YORK, ASSIGNOR TO OTIS ELEVATOR COMPANY, OF JERSEY CITY, NEW JERSEY, A CORPORATION OF NEW JERSEY.

MOTOR-CONTROL SYSTEM.

986,277. Specification of Letters Patent. Patented Mar. 7, 1911.

Application filed June 20, 1910. Serial No. 567,770.

To all whom it may concern:

Be it known that I, ERNEST L. GALE, Sr., a citizen of the United States, residing at Yonkers, in the county of Westchester and State of New York, have invented a new and useful Improvement in Motor-Control Systems, of which the following is a specification.

My invention relates to the controlling of electric motors, and one of the objects is to provide means for the starting and accelerating of an electric motor under various conditions and particularly when the motor is started with a load.

In the accompanying drawings Figure 1 shows my invention applied to a motor which operates an elevator; Figs. 2, 3, 4, 5 and 6 show various modifications in the connection and arrangement of certain accelerating devices, all of which are contemplated by my invention.

Referring more particularly to Fig. 1, a well known arrangement of the motor M, brake B and traction drum D are shown in connection with the elevator car C and the counterweight W. The controller switch K in the car is operable to close a circuit through reversing switch R or R′ and thereby to impel the motor M in the corresponding direction of rotation. The main switch S is to open and close circuit connections with the current supply mains.

The starting and accelerating apparatus for the motor M will now be described: Resistances 16, 17, 18 and 19 are connected in series with the motor series field, only the leads 20 and 21 of the latter being shown. These resistances, including the series field, are automatically cut out by means of the electromagnetic switch devices 11, 12, 13, 14 and 15, respectively, the magnet windings thereof preferably being connected in series, one connection being made through conductor 22, resistance 24, a portion of resistance 19, and thence through the reversing connections to one side of the motor armature, the other connection being made by way of conductor 23, auxiliary contact 25 or 25′ to the main lead 26 whenever either reversing switch is closed. Thus it is seen that the said magnet windings are connected in series with the resistance 24 and a portion of resistance 19, all in parallel or around the motor armature, and adapted to depend for energization upon the drop of potential in the motor armature.

Resistances 16 and 17 are such as have a relatively high temperature coefficient, and as current continues to flow therethrough, the ohmic resistance increases. In the ordinary acceleration of the motor M the accelerating magnets will close in succession to cut out portions of the resistance, but under load conditions, the load on the motor may be so great that the motor can not speed up sufficiently to effect the operative energization of the magnet windings. In such an event the starting current flows for a time through the starting resistances and the series field, and the ohmic resistance of the high temperature coefficient resistances is increased. To the terminals of these resistances 16 and 17 are connected the magnet windings 27 and 28 which control the circuit closing devices 29 and 30 respectively, and when energized, effect the joining of contacts 31 and 32, and 33 and 34. These magnet windings 27 and 28 receive sufficient current operatively to energize them only when the ohmic resistances of the high temperature coefficient resistances have increased to a predetermined limit and are so adapted and adjusted that the circuit closing device 29 is first operated. The operation of this device unites the contacts 31 and 32 and closes a circuit in parallel with the resistance 24. This parallel circuit is traced through conductor 37, contact 33, conductor 36, contacts 31, 32, resistance 35, contact 34, conductor 38, part of resistance 19 to the point 19′. This allows more current to flow in the accelerating magnets and the increased current may be sufficient to energize the magnet winding for switch device 11. After this switch device 11 has operated, if the load on the motor is still so great as to prevent further acceleration of the motor, the current flowing through the high temperature coefficient resistance 17 will increase the ohmic resistance to such an extent that the magnet winding 28 connected to the terminals thereof will receive sufficient current to cause the operation of the circuit closing device 30, thereby joining the contacts 33 and 34. This latter operation short-circuits the resistance 35 and places the resistance 24 and a portion of the main resistance 19 in parallel in circuit with the accelerating

magnets. The effect of this is materially to increase the current through the said magnet windings and to effect the closure of the next accelerating magnet 12, which, in turn, will cause the speed of the motor to be further increased. Thereafter, unless the motor is loaded beyond its capacity, the acceleration is effected by the successive operation of the accelerating magnets 13, 14 and 15. Thus it is seen that the acceleration of the motor lightly and heavily loaded is entirely automatic, and for the loaded conditions the operation of the auxiliary magnets 27 and 28 is automatically selective as to whether one or both of the said magnets will operate.

In elevator apparatus it is desirable that for light loads the maximum speed and quickest acceleration commensurate with good practice be attained, and also that for heavier loads, adequate provision be made for automatic acceleration of the motor.

Various modifications and arrangements of the auxiliary magnets are contemplated by my invention and Figs. 2 to 6, inclusive, show some of the most evident embodiments thereof. In Fig. 2 an accelerating magnet 40 is connected around both of the high temperature coefficient resistances 16 and 17 in series and the contacts 31′ and 32′, and 33′ and 34′, are joined in succession in the ordinary way when the potential drop across the two resistances in series reaches a predetermined value. Fig. 3 shows the two magnet windings 27′ and 28′ connected in parallel across the two resistances 16 and 17 and so designed that they operate in the proper succession. In Fig. 4 one magnet winding 27 is connected around resistance 16, and the other magnet winding 28′ is connected around the two resistances 16 and 17 in series. Or the two magnets 27′ and 28′ may be connected in series (Fig. 5) or in parallel (Fig. 6) around one of the high temperature coefficient resistances. In other respects the contacts, resistances, and connections are the same or similar to those shown in the preferred embodiment (Fig. 1).

Although I have thus shown and described my invention, I desire not to be limited to the construction, combination and arrangement herein set forth, as it is evident that those skilled in the arts to which this invention appertains may make various changes without departing from the spirit and scope thereof.

What I claim and desire to secure by Letters Patent of the United States is:—

1. In motor controlling apparatus, the combination with an electric motor, of sectional starting resistance therefor, parts thereof being of relatively high temperature coefficients, electro-responsive accelerating devices, and means dependent upon the increase of potential drop in said high temperature coefficient resistances to effect successive strengthening of the said accelerating devices.

2. In motor controlling apparatus, the combination with an electric motor, of sectional starting resistance therefor, parts thereof being of relatively high and low temperature coefficients, means for cutting out said resistance gradually as the motor increases in speed, and means dependent upon increase of potential drop in said high temperature coefficient resistance tending successively to expedite the operation of said cutting out means.

3. In motor controlling apparatus, the combination with an electric motor, of sectional starting resistance therefor, parts thereof being of relatively high and low temperature coefficients, means for cutting out said resistance gradually as the motor increases in speed, and means dependent upon increase of potential drop in said high temperature coefficient resistance tending successively to expedite the operation of said cutting out means when the motor does not start or does not increase in speed sufficiently to cause the operation of said cutting out means.

4. In motor controlling apparatus, the combination with an electric motor, of sectional starting resistance therefor, parts thereof being of relatively high and low temperature coefficients, electro-responsive resistance cut-out devices dependent for operation upon the speed of the motor, and electro-responsive magnets dependent for energization upon the increase of potential drop in said high temperature coefficient resistances and operative successively to strengthen the energization of the electro-responsive resistance cut-out devices.

5. In motor controlling apparatus, the combination with an electric motor, of sectional starting resistance therefor, parts thereof being of a relatively high temperature coefficient, electromagnetic resistance cut-out devices to short-circuit portions of the starting resistance, and means dependent upon the variation of potential across the high temperature coefficient resistances automatically to effect successive strengthening of the said electromagnetic devices.

6. In motor controlling apparatus, the combination with an electric motor, of sectional starting resistance therefor, parts thereof being of relatively high temperature coefficient, electromagnetic resistance cut-out devices connected across the motor armature, and magnets connected to the terminals of the high temperature coefficient resistances operative selectively to increase the magnetism of the said cut-out devices when the load on the motor is large.

7. In motor controlling apparatus, the combination with an electric motor, of sec-

tional starting resistance therefor, parts thereof being of relatively high temperature coefficient, electromagnetic resistance cut-out devices connected across the motor armature, and magnets connected around the high temperature coefficient resistances operative selectively, automatically and successively to strengthen said electromagnetic devices when the load on the motor exceeds a predetermined value.

8. In motor controlling apparatus, the combination of an electric motor, accelerating magnets, resistance in series with said accelerating magnets in a circuit across the motor armature, sectional starting resistance, sections thereof being of high temperature coefficient and connected in series, electromagnets connected to the sections of high temperature coefficient resistance so as to be dependent for energization upon the drops of potential in said sections, and switches operated by the electromagnets after current flows through said sections a predetermined length of time successively to reduce the resistance in series with the accelerating magnets.

9. In motor controlling apparatus, the combination of an electric motor, accelerating magnets connected in series, resistance in series with said magnets in a circuit connected directly across the motor armature, starting resistance in series with the motor armature, sections thereof being of comparatively high temperature coefficient, additional resistance, a magnet connected to terminals of one of said sections and operative to insert the additional resistance in parallel with the first named resistance when the motor does not accelerate with a prescribed load, and another magnet connected to terminals of another of said sections and operative selectively to further increase the energizing current in the said accelerating magnets.

In testimony whereof, I have signed my name to this specification in the presence of two subscribing witnesses.

ERNEST L. GALE, Sr.

Witnesses:
Edward H. Steele,
George D. Rose.