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F. W. NEWELL.

SINGLE PUSH BUTTON AUTOMATICALLY CONTROLLED ELECTRIC ELEVATOR SYSTEM.

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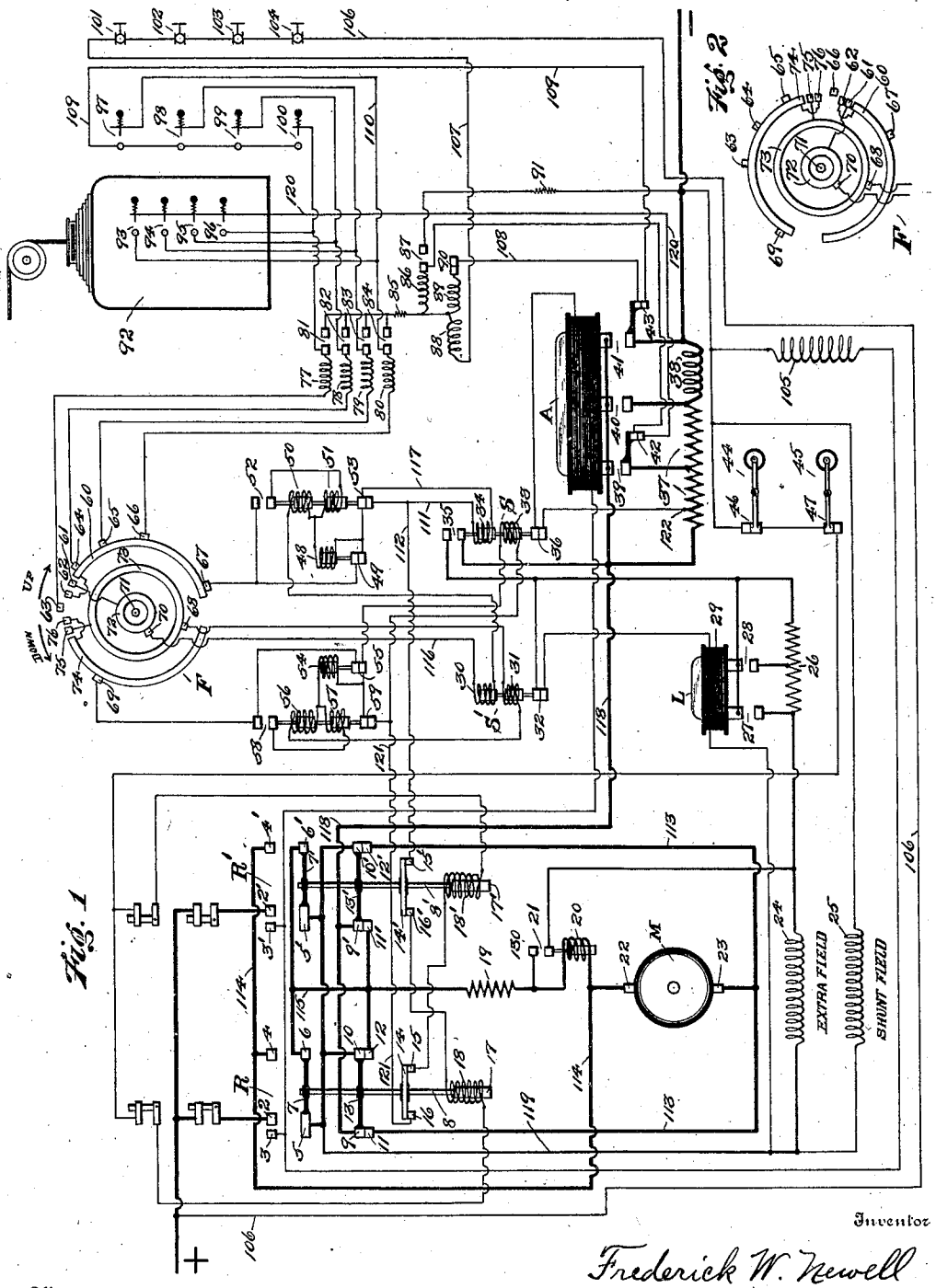

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SINGLE-PUSH-BUTTON AUTOMATICALLY-CONTROLLED ELECTRIC-ELEVATOR SYSTEM.

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To all whom it may concern:

Be it known that I, FREDERICK W. NEWELL, a citizen of the United States, residing at Hastings-upon-Hudson, in the county of Westchester and State of New York, have invented a new and useful Improvement in Single-Push-Button Automatically-Controlled Electric-Elevator Systems, of which the following is a specification.

My invention relates to electric elevators, and more particularly that class of elevators which are set in motion by the pushing of a button and whose subsequent operation is brought about by automatic means.

The object of my invention is the provision of means for automatically reducing the speed of an elevator-car and varying such reduction of speed in accordiance with the load as the car approaches the point at which it is desired to be stopped, so that the car shall be brought gradually to a stop substantially level with any desired floor or landing, regardless of its direction of travel, speed, or load.

Further objects will appear hereinafter, the novel combinations being set forth in the claims.

In the accompanying drawings, Figure 1 illustrates an electrical elevator system which embodies my invention as applied to an automatic elevator having four landings, with operating-buttons at each landing for controlling the same; and Fig. 2 is a detail view of the floor-controller, showing the same in another position.

On automatic electric elevators in use at the present time which employ the usual means for stopping at any desired landing the tendency is when the car is heavily loaded and going from a lower level to a higher one, to fall short of the floor-landing on stopping; also, in going from a higer level to a lower one the tendency is for the car to overrun the floor-landing. My invention operates to counteract this undesirable feature, and I accomplish this end by means which will be described in connection with the following description.

Referring now to the drawings, + and − designate the source of electrical supply.

R and R′ designate the reversing-switches, and since they are similar in construction a description of one applies equally well to the other.

The switch R comprises a solenoid 18, which is adapted when energized to raise the core or plunger 17, at the upper end of which is fastened a rod 8. The rod 8 has mounted upon it a contact-disk 14, which is adapted to bridge or short-circuit when in its lower position, as shown, the fixed contacts 16 and 15. The rod 8 also carries upon it two insulated pieces 13 and 7. The upper one, 7, carries upon it the contacts 5 and 6. Directly above are shown fixed contacts 2, 3, and 4. These contacts are adapted to be engaged by the movable contacts 5 and 6, respectively, when the latter are in their upper or raised position. The insulated piece 13 carries upon it the contacts 9 and 10, which engage the fixed contacts 11 and 12, respectively, when the rod 8 is in its lower position.

M represents diagrammatically the hoisting-motor.

22 and 23 designate the armature-brushes.

20 designates a magnet-coil, which when energized is adapted to close the contacts 21, which at all other times are out of engagement with each other.

19 designates a resistance which is for the purpose of absorbing energy from the motor-armature when the latter is being brought to rest.

25 is the shunt-field of the motor, while 24 designates the extra field, having in series with it the resistance 26, this latter being controlled by the load-magnet L, which comprises a magnet-frame about which is wound the coil 29, and it is adapted to operate the contacts 27 and 28 consecutively in a well-known way to cut out or short-circuit the resistance 26.

S′ designates a magnet comprising the coils 30 and 31, either one of which when energized causes the contacts 32 to become separated. At all other times these contacts are in engagement.

S designates the slow-speed magnet, comprising two coils 33 and 34, either one of which when energized operates to close the contacts 35 and at the same time to open or separate the normally closed contacts 36.

A is the accelerating-magnet, which operates to short-circuit the motor-starting re-

sistance 37 and series field 38 by means of the contacts 39, 40, and 41, these contacts being adapted to operate consecutively in a well-known way. When the contacts 39 are closed, the contacts 42 are separated. In like manner the contacts 43 are separated when the contacts 41 are closed.

44 and 45 designate limit-switches, which are usually operated by the car or counter-weight and are adapted to open their contacts 46 and 47, respectively, whenever the elevator-car overruns its normal travel, and thereby interrupting any circuit to the magnet-solenoids of the reversing-switches R and R', the contacts controlled by these limit-switches being in series with the common return of the coils of the reversing-switches R and R'.

48 designates a magnet which operates to separate the contacts 49 when sufficiently energized. 50 and 51 designate the magnet-coils of a switch which operates when energized to close the contacts 52 and at the same time to open the contacts 53. Similarly 54 designates a magnet which operates to separate the contacts 55 when energized, while 56 and 57 are magnet-coils of a switch which operates when energized to close the contacts 58 and at the same time to open the contacts 59.

F designates the floor-controller, which operates to automatically slow down the hoisting-motor and stop the same at any desired floor or landing. It comprises the contact-rings 72 and 73 and the contact-segments 74, 75, 76, 62, 61, and 60. These contact segments and rings are rigidly fastened to some insulating-base and the whole rotatably mounted upon the shaft 71, which latter may be geared or otherwise connected to the car or to some moving part of the hoisting machinery. A number of stationary contact-brushes 67, 66, 65, 64, 63, 69, 68, and 70 are adapted to engage the several contact rings and segments as the latter are being revolved by the hoisting machinery or car.

77, 78, 79, and 80 designate the floor-relays, and each comprises a magnet-coil which when energized operates to close the contacts 81, 82, 83, and 84, respectively.

85 is a resistance.

86 designates a magnet operating to close the contacts 87.

88 and 89 are magnet-coils having one terminal in common and being wound in opposition, so that when both are energized at the same time the magnetic effect of one coil neutralizes that of the other. Either coil 88 or 89 when energized alone has sufficient strength to open the contacts 90, which are at all other times in their closed position.

91 is an additional resistance.

The elevator-car 92 carries four open-circuit push-buttons 93, 94, 95, and 96, each button being connected to a corresponding floor-relay. 97, 98, 99, and 100 designate the landing-buttons. These are also what are known as "open-circuit" buttons and, like the car-buttons, are connected to the corresponding floor-relays.

101, 102, 103, and 104 designate the door-contacts. These door-contacts are connected in series with each other and together form a closed circuit when all of the landing-doors are closed. Upon opening any one of these doors a circuit through these contacts is at once broken.

105 designates the releasing-coil of the motor-brake, the brake being applied except at such times as the coil 105 is energized to release the same.

Having described the various parts of a control-system embodying my invention, I will now point out its operation.

A wire 106 connects the + main with the door-contacts 104, 103, 102, and 101. Assuming these doors to be closed, the circuit continues by wire 107 to a terminal of magnet-coil 88 through the coils 88 and 89 and contacts 90 and by way of wire 108 and contacts 43 to the wire 109, this latter being the common wire of the landing-buttons 100, 99, 98, and 97. Upon pushing the button 97 the circuit is closed by wire 110 through the magnet-coil of floor-relay 80 to the floor-controller brush 66. Now the brush 66 normally engages the contact-segment 60 of the floor-controller F, and so, also, does the brush 67. The circuit therefore continues by brushes 66 and 67 to the contacts 49 and 53 and by wires 111 and 112 to the contact 15' of the reversing-switch R'. As before pointed out, the contacts 15' and 16' are bridged by the contact-piece 14' when the reversing-switch R' is in its lower position. The circuit from contact 15' is therefore continued to the contact 16' and thence to one terminal of the solenoid 18 of the reversing-switch R. The other terminal of the solenoid 18 is connected, through the limit-switches 44 and 45, directly to the − main.

It will be seen that upon pushing the button 97 a circuit was completed from the + to the − main, including the magnet-coils 88 and 89, magnet 80, floor-controller F, and solenoid 18. Now since both coils 88 and 89 are energized, as before pointed out, they will not operate to open the contacts 90. 80 will be energized, however, and operate to close the contacts 84. This establishes a circuit parallel to the coil 89, contacts 90, and button 97 by way of the resistance 85. As soon as the button 97 is released the circuit through the coil 89 is broken at the button; but the coil 88 remains energized and now operates to open the contacts 90, thus open-circuiting the wire 109, which is common to all of the landing-buttons 97, 98, 99, and 100, thus preventing any interference to normal operation of the system should any of these

buttons be operated while the contacts 90 are held separated by the magnet-coil 88. The solenoid 18 is now fully energized and will raise the core 17, together with the contacts 5, 6, 9, and 10, also the contact-piece 14, the latter preventing any possible circuit through these contacts to solenoid 18′ of the reversing-switch R′. The same also holds good when the reversing-switch R′ is in its upper or raised position, for in this case the separation of the contact-piece 14′ from the contacts 15′ and 16′ would prevent any circuit to the solenoid 18 of the reversing-switch R. It will therefore be seen that the circuit to one reversing-switch solenoid is closed through contacts controlled by the other reversing-switch, the result being to render it impossible for both reversing-switches to be raised at the same time.

The contact 5 engages the fixed contacts 2 and 3, and the contact 6 engages the fixed contact 4 at the same time that the contacts 9 and 10 are raised out of engagement with the fixed contacts 11 and 12, respectively. The contact 5 is now connected to the + main by contact 2, and current will flow to contact 10′ of the switch R′, and since contact 10′ engages 12′ a circuit is closed by wire 113 to the motor-armature brush 23, passing through the motor-armature to brush 22 and wire 114 to the contact 4. This latter contact engages contact 6, which is connected to the contact 11′ by the wire 115. The contact 11′ engages the contact 9′, which is connected to the starting resistance 37 by wire 118.

The portion of the armature-circuit from brush 22 through wire 114, contacts 4 and 6, and wire 115 is of substantially zero resistance. Parallel to this portion of the armature-circuit are connected the coil 20 and resistance 19. The resistance of this parallel circuit is such that little or no current will flow therethrough, and therefore the magnet 20 will not have sufficient strength to close the contacts 21. The circuit of the motor-armature is completed from wire 114, contacts 4 and 6, wire 115, contacts 11′ and 9′, wire 118, resistance 37, series-field 38 to the − main.

The shunt-field 25 has one terminal connected to contact 5, which is adapted to be connected by contact 2 to the + main. The other terminal of the shunt-field is connected directly to the − main. The brake-magnet 105 is connected on one side to the + main by contacts 3, 5, and 2 and on its other side directly to the − main. Therefore both the shunt-field and brake-magnet receive current at the full-line potential.

When the reversing-switch operates in the manner stated, the brake is released and the motor starts, current to the motor-armature being limited by the starting resistance 37.

The accelerating-magnet A is in shunt to a circuit comprising the motor-armature and a small portion of the resistance 37 from contact 3 to the point 122. The contacts 36 of magnet-switch S include the circuit to the accelerating-magnet A, and since they are at the present time in contact the coil of magnet A will receive current depending upon the counter electromotive force and speed of the motor-armature. As the motor accelerates the current in the coil of accelerating-magnet A will rise, while the latter is sufficiently energized to operate the contacts 39, 40, and 41 successively to cut out or short-circuit the starting resistance 37 and series field 39 in a well-known way and at the same time open the contacts 42 and 43, which are in series with the circuit, including the common wire of the car and floor buttons, respectively. The hoisting-motor is now running at full speed as a shunt-motor. At the same time the floor-controller F has been revolving about the shaft 71 in a clockwise or right-handed direction.

As the elevator-car nears the desired landing (in this case the fourth floor, since the button 97, corresponding to that floor, was pushed) the floor-controller contact-brush 66 runs off the segment 60 and onto the small segment 61, the brush 66 being wide enough to bridge the gap between the segments 60 and 61. The circuit to brush 67 is by the segment 60 and is broken when the contact-brush 66 passes onto the segment 61. Segment 61 is connected by wire to the ring 72, which is in contact with the brush 70. The circuit to the reversing-switch solenoid 18 is now completed through the wire 116, coil 30 of switch S′, through coil 50, coil 48, wire 117, coil 34 of switch S, and by wires 111 and 112 to the solenoid 18. The circuit from the floor-controller to the solenoid 18 now includes the coils 30, 50, 48, and 34, each of which will become energized. The coil 30 operates to open the contacts 32, preventing a circuit to the magnet L, and the magnet-coil 50 operates to close the contacts 52 and open the contacts 53, the latter forming a short circuit to the magnet-coil 34 of switch S when in a closed position. The magnet-coil 34 of switch S will then be sufficiently energized to cause the same to close the contacts 35 and open the contacts 36. The energizing of coil 48 causes it to open the contacts 49. Now the contacts 36 include a circuit to the accelerating-magnet A and upon opening them will cause A to become deënergized and drop the contacts 39, 40, and 41, reinserting the starting resistance and series field into the armature-circuit. At substantially the same time the contacts 35 are closed. This closes a circuit through the extra field 24 and resistance 26, they being connected in shunt to the motor-armature. The extra-field circuit may be traced from the + main to contact 5, which is connected

directly to the brush 23 by contacts 10′ and 12′ and wire 113. From contact 5 the circuit continues through field 24, resistance 26, contacts 35, to and through the resistance 37, field 38, to the — main. The contacts 35 are also connected by wire 118 and contacts 11′ and 9′, wire 115, contacts 6 and 4, and by wire 114 to the brush 22. The motor will now run at a reduced speed, owing to the reduced current in the armature and increase in field strength. Shortly before the car reaches the desired landing the brush 66 runs onto the segment 62, which is connected by wire to segment 60. The circuit to the reversing-switch solenoid 18 is now completed through the brush 67, contacts 52, coil 51, coil 48, wire 117, coil 34 of switch S, and by wires 111 and 112 to the coil 18. It will be seen that the circuit which previously supplied the coil 30 of switch S′ is now broken at the floor-controller segment 61 as soon as the latter has passed out of engagement with the contact-brush 66. The circuit to switch S′ having been broken, the contacts 32 are brought into electrical contact and establish a circuit to the load-magnet L, this magnet being connected in parallel to a circuit comprising the extra field 24 and resistance 26. It is therefore also connected across the motor-armature. The load-magnet L will now be energized to operate more or less of its contacts, according to the load on the motor and the consequent speed of the motor-armature. This would result in proportioning the strength of the extra field to the speed and load of the car, since the energization of the magnet is dependent upon the potential across the motor-armature, and owing to the fact that the starting resistance and series field are in circuit with the motor-armature if the latter is generating back into the line, due to the action of the loaded car, the voltage across the armature may assume a value somewhat higher than the line-potential. This voltage is the same as that across the terminals of the load-magnet. Consequently the latter would close all of its contacts, thus short-circuiting the resistances 26 and causing an extra powerful magnetic field, which would produce a strong dynamic braking effect upon the armature and causing the latter to immediately adjust its speed of rotation in proportion to the strength of field and load upon the car.

The next operation of the floor-controller takes place when the brush 66 runs off the segment 62, the car in the meanwhile having reached a position almost opposite the desired landing. This will result in opening the circuit feeding the various magnets, and they will become deënergized and drop their contacts. The reversing-switch R will return to its lower position and by so doing will open the circuit to the motor and also the brake 105, causing the latter to be applied. At the same time the stop resistance 19, having in series with it the magnet-coil 20, will be thrown across the motor-armature, connection being made from brush 23, wire 113, contacts 12′ 10′ to contacts 10 and 12, through 19 and 20, to the brush 22. Current will at once flow through resistance 19 and coil 20, the said current being generated by the motor, and will energize coil 20 sufficiently to cause it to close the contacts 21. This will result in local circuiting the extra field 24 and form a retaining-circuit for the switch 130, one terminal 22 of the motor-armature M being connected through the coil 20 and contacts 21 to the field-coil 24 and by contacts 10′ and 12′ and by wire 113 to brush 23. Thus resistance 19 and coil 20 are connected in parallel and the system constitutes an effective electro dynamic brake.

In order to show the operation from the car ,92, let it be assumed that the various parts are in the positions shown on the drawings and the car-button 93 is operated. A circuit will then be established from the + main to and through wire 106, door-contacts 104, 103, 102, and 101, wire 107, coil 88, coil 86, contacts 42, wire 120, which is common to all of the car-buttons, and by the button 93 to the floor-relay coil 80 and from there to the floor-controller brush 66. From this point the circuit is the same as described in connection with the operation of a landing-button, such as button 97. The operating-current through the button 93 passes through the coil 88 and not coil 89. The contacts 90 are therefore at once opened, thereby open-circuiting the wire 109, which is common to all of the landing-buttons, and preventing any interference from them should they be operated while current is flowing through the operating-circuit. Since the coil 86 now receives current, being in series with the coil 88 and coil 80 of the floor-relay, the contacts 87, controlled by coil 86, will be closed. This will establish another circuit to the — line by way of contacts 87 and resistance 91. This additional circuit is from the + main to and through wire 106, the door-contacts 104, 103, 102, and 101, wire 107, coil 88, coil 86, resistance 91, and to the — main. When the circuit through the floor-relay 80 is broken by the floor-controller, as has been previously pointed out, to stop the car at the desired landing, this additional circuit remains unbroken, and since the contacts 90 are held open, the coil 88 being energized, any operation from the landing-buttons will not produce any effect until the current in this additional or self-holding circuit is broken, allowing the contacts 90 to engage each other. The only way to break this circuit is by opening one of the landing-doors. This would cause the coils 88 and 86 to become deënergized and restore their respective contacts to their original positions. From this it will be seen

that after the operator in the car has pushed one of the buttons there can be no further operation of either the car or landing buttons until after the car has stopped and the landing-door has been opened and shut again, thus providing a safety device of great value.

After the motor has started the accelerating-magnet A operates to open the contacts 42 and 43, and since these contacts are in series with the common wire of the car and landing buttons, respectively, this would prevent any operation of the buttons until the car has stopped and the magnet A has returned the conacts 42 and 43 to their engaging positions. This operation provides an additional safety device, rendering all of the buttons inoperative after the motor has started. If instead of operating the buttons 97 or 93 any other buttons had been pushed, the circuits throughout the system would be the same and the car in every case would go to the floor corresponding to the button pushed and automatically stop there.

The position of the floor-controller as shown on the drawings indicates that the elevator-car is at the bottom landing. Consequently when in this position there can be no further movement of the controller in an anticlockwise direction.

As the car rises the floor-controller is revolved in a right-handed or clockwise direction. Therefore to show the operation when it is desired to lower the car, the same being at the top landing, let it be assumed that the floor-controller is in such position that the brushes 66, 65, and 64 will be in contact with the segment 74, and therefore in electrical connection with the brush 69. As the car is at the top landing the brush 66 will have passed off of the segment 62, deënergizing the brush 66, and consequently the buttons 93 and 97. If any of the other buttons are now pushed, a circuit through that button and the corresponding floor-relay, together with other coils described before in connection with an ascending car, will flow by means of segment 74 to the brush 69, which is connected to contacts operated by the magnet-coils 56, 57, and 54. The connections of these coils are similar to the connections of the coils 50, 51, and 48, before described, the only difference being that the coils 56, 57, and 54 control circuits leading to the coil 33 of switch S and coil 31 of switch S′ and the coil 18′ of reversing-switch R′. When coil 18′ is energized, it raises its core and connected contacts in a manner similar to that of switch R. Only in this case the operation of switch R′ opens the circuit to 18 at the contact-piece 14′. Current is now supplied to the motor and other part of the apparatus just as before, with the exception that current flows through the motor-armature in a reverse direction, causing the car to descend. The circuit to the motor now being traced from the — main to and through the contacts 2′ and 5′, contacts 10 and 12, wire 115, contacts 4′ and 6′, wire 114, brush 22, the armature, brush 23, contacts 9 and 11, wire 118, starting resistance 37, series field 38, to the — main.

A general review of the operation of a system of elevator control embodying my invention shows that the motor when first started has its shunt-field fully excited, the starting resistance and series field being in circuit. The motor next automatically cuts out the starting resistance and series field, finally running at full speed as a shunt-motor only. As the car nears the predetermined landing the starting resistance, together with the series field, are again placed in circuit. At about the same time an extra field having a resistance in series with it is placed in shunt to the motor-armature. This reduces the motor speed. The next operation is just before the car reaches the landing, and consists in cutting out or short-circuiting more or less of the resistance in series with the extra field in proportion to the load upon the car, thus bringing the car to the landing at a speed which insures the car stopping substantially level with the landing. Next the brake is applied to stop the motor, the action of which brake is augmented at the same time by a dynamic braking effect produced by the current generated by the motor-armature.

Without limiting myself to the precise construction of details and arrangement of parts herein shown and described, what I claim, and desire to secure by Letters Patent, is—

1. The combination with a motor, car and stations, of motor-controlling means for reducing the speed of the car before stopping, means for varying such reduction of speed in accordance with the load, electromagnetic means for controlling the aforesaid means, additional electromagnetic means for controlling said first-named electromagnetic means, and circuits and connections for controlling both of said electromagnetic means.

2. The combination with a motor, car and stations, of automatic motor-controlling means connected to reduce the speed of the motor as the car approaches a predetermined point in its travel, means for varying such reduction in speed in proportion to the load, independent electromagnetic means for controlling the aforesaid means, a floor-controller and additional electromagnetic means coacting with said floor-controller for controlling said independent electromagnetic means.

3. The combination with a motor, car and stations, of motor-controlling means for reducing the speed of said motor and varying such reduction of speed in accordance with the load, and electromagnetic means comprising "up" and "down" coils for controlling said motor-controlling means.

4. The combination with a car and its mo-

tor, of switches at a plurality of floors or stations, means for starting the motor from any one of said stations, automatic means for reducing the speed of said motor as the car approaches a predetermined point in its travel, means for varying such reduction in speed in accordance with the load, a floor-controller, and double magnets coacting with said floor-controller for controlling said speed-reducing and speed-varying means.

5. The combination with a motor and a car, of motor-controlling means connected to automatically reduce the speed of the motor as the car approaches a predetermined point in its travel and vary such reduction of speed in proportion to the load, and means comprising doubly-wound magnets for controlling said motor-controlling means.

6. The combination with a car and its motor, of means for reducing the speed of the motor as the car approaches a predetermined point in its travel, means coacting with said speed-reducing means for varying such reduction in speed in proportion to the load, an electromagnet having "up" and "down" coils for controlling said speed-reducing means, an additional electromagnet having "up" and "down" coils for controlling said speed-varying means, and circuits and connections for controlling said electromagnets.

7. In an automatic push-button-controlled elevator system, the combination with a car and its motor, of motor-controlling means for automatically reducing the speed of the motor as the car approaches a predetermined floor-level and varying such reduction in speed in proportion to the load to stop the car substantially level with the floor, doubly-wound magnets for controlling said speed reducing and varying means, and means for controlling the energization of said magnets.

8. The combination with a car and its motor, of switches at a plurality of stations, means for excluding control of the car after being started from a station, means connected to reduce the speed of the motor as the car approaches a predetermined floor-level and vary such reduction of speed by an amount proportionate to the load, electromagnetic means for controlling said speed-reducing means, additional electromagnetic means for controlling said first-named electromagnetic means, and circuits and connections for both of said electromagnetic means.

9. The combination with a car and its motor, of push-buttons one at each floor or station, means for controlling said motor from one of said push-buttons to the exclusion of the others, means for automatically reducing the speed of said motor as the car approaches a predetermined point in its travel and varying such reduction of speed by an amount proportionate to the load, doubly-wound magnets for controlling said speed-reducing and speed-varying means, and circuits and connections automatically varied to energize or deënergize said magnets at the proper time.

10. The combination with a car and its motor, of switches at a plurality of stations, means for controlling said motor from any one of said stations to the exclusion of the other stations, means for stopping the car at the same point with varying loads; and "up" and "down" magnets for controlling said stopping means.

11. In an elevator system, the combination with a car and its motor, of motor-controlling means for automatically reducing the speed of the motor and varying such reduction of speed in proportion to the duty, a relay for controlling said speed-reducing means, an additional relay for controlling said speed-varying means, electromagnetic means for controlling said first-named relay, and circuits and connections automatically varied to effect the stopping of the car at the same point with varying loads.

12. The combination with a car and its motor, of motor-controlling means connected to change the speed of the motor upon the approach of the car to a predetermined point in its travel, means coacting with said motor-controlling means for regulating said change of speed in accordance with the load, and means comprising magnets each having a plurality of windings for controlling said regulating means.

13. In an electric elevator system, the combination with an electric motor, of means connected to start and stop said motor from any landing, motor-controlling means connected to automatically reduce the speed of the motor before the car stops at the limits of its travel or at any predetermined intermediate point and to vary such reduction of speed by an amount determined by the load, magnets for controlling said speed-reducing and speed-varying means when the car travels upwardly and additional magnets for controlling said last-named means when the car travels downwardly.

14. In a push-button-controlled elevator system, the combination with a car and its motor, of electric circuits and connections for operating same, means for automatically reducing the speed of the motor as the car approaches a predetermined point, means for varying such reduction of speed in proportion to the load, electromagnetic means for controlling said speed-reducing and speed-varying means when the car travels in one direction, additional electromagnetic means for controlling same when the car travels in the opposite direction, and means for varying said circuits and connections to operate said electromagnetic means.

15. The combination with a car and its motor, of starting resistance in circuit with the motor-armature, an accelerating-magnet for varying said resistance, an electrorecep-

tive device for interrupting the circuit to said accelerating-magnet when the car is traveling upwardly and approaching a predetermined stopping-point, and an additional electroreceptive device for interrupting said accelerating-magnet circuit when the car is traveling downwardly and approaching a predetermined stopping-point.

16. The combination with an electric motor, of a variable resistance in series with the motor-armature, an electroresponsive device for controlling said variable resistance, separable contacts in series with said electroresponsive device, an electromagnet having a plurality of magnet-coils independent of each other, and means for energizing one of said coils when the motor rotates in one direction and another of said coils when the motor rotates in the reverse direction.

17. The combination with a motor, of a variable resistance in series with the motor-armature, an accelerating-magnet, a doubly-wound electromagnet for controlling said accelerating-magnet, means for automatically energizing one of the windings when the motor travels in one direction and for energizing the other when the motor travels in the opposite direction.

18. The combination with a car and its motor, of an extra field and a resistance in series therewith, a doubly-wound magnetic relay for throwing said extra field and resistance across the motor-armature to reduce the speed of the motor as the car approaches a predetermined point, and means for energizing one of the windings of said magnet when the car travels upwardly and the other winding when the car travels downwardly.

19. The combination with a motor, of starting resistance in series with the motor-armature, an accelerating-magnet for controlling said resistance, an extra field with resistance in series therewith, and an electroresponsive device for controlling both the accelerating-magnet circuit and the circuit of said extra field and resistance.

20. The combination with a car and its motor, of a variable resistance in series with the motor-armature, an electromagnet for controlling said resistance, a normally open circuit including an extra field-coil, a single device for interrupting the circuit to said electromagnet and closing the circuit to said extra field-coil.

21. The combination with a car and its motor, of a variable resistance in circuit with the motor-armature, an electromagnet for controlling said resistance, an extra field-coil in a normally open circuit across the motor-armature, a doubly-wound magnet for interrupting the circuit of said electromagnet and closing said normally open extra field-circuit.

22. The combination with an electric motor, of motor-controlling means therefor, an extra field with a variable resistance in series therewith, means for connecting said extra field and resistance across the motor-armature, an electromagnet for varying said resistance in accordance with the load, and a doubly-wound electromagnet for controlling the circuit of said first-named electromagnet, means for energizing one of the windings of said doubly-wound electromagnet at a predetermined time when the motor travels in one direction and for energizing the other winding at a predetermined time when the motor travels in the opposite direction.

23. The combination with an electric motor, of motor-controlling means, an extra field-coil, an electromagnet in circuit with the motor-armature, and contacts controlled by said electromagnet for placing said extra field-coil in series with the motor-armature and said electromagnet.

24. The combination with a motor, of controlling means therefor, an electromagnet and a resistance in circuit with said motor, an extra field, and contacts controlled by said electromagnet and coacting with said motor-controlling means for placing said resistance and the extra field-circuit in parallel in a local circuit with the motor-armature.

25. The combination with an electric motor, of an electroreceptive device, a resistance, means for automatically placing said resistance and electroreceptive device in a local circuit in series with the motor-armature, an extra field-circuit for the motor, and means controlled by said electroreceptive device for automatically placing said extra field in shunt to said resistance.

26. The combination with an electric motor, of a solenoid and a resistance normally in a local circuit in series with the motor-armature, motor-controlling means, an extra field for the motor, and means controlled by said solenoid for placing the extra field in parallel to said resistance.

27. In an electrodynamic brake, the combination with a motor, of an electroresponsive device and a resistance in a normally closed circuit in series with the motor-armature, an extra field controlled by said electroresponsive device, and means for controlling the motor.

28. The combination with a motor, of reversing-switches therefor, a resistance, an electroresponsive device, means coacting with said reversing-switches for connecting said resistance and electroresponsive device in series with the motor-armature in a local circuit, and an extra field controlled by said electroresponsive device to place said extra field in shunt to said resistance when the motor acts as a generator to constitute an electrodynamic brake.

29. The combination with a car and its motor, of motor-controlling means, an extra field with a variable resistance in series therewith, a starting resistance in series with the

motor-armature, an electromagnet for controlling said starting resistance, normally open contacts for the extra field-circuit, normally closed contacts for the electromagnet-circuit, an additional electromagnet for closing said normally open contacts to connect the extra field-circuit across the motor-armature, and also for opening said normally closed contacts to deënergize said first-named electromagnet, contacts for normally short-circuiting said additional magnet, means for controlling said last-named contacts to effect the energization of said additional magnet, a load-magnet for varying the resistance in series with the extra field, a relay for controlling said load-magnet, and means for controlling said relay.

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

FREDERICK W. NEWELL.

Witnesses:

CHARLES M. NISSEN,

CHARLES B. MANVILLE.