June 16, 1936. J. F. CLANCY 2,044,152

AUTOMATIC LEVELING DEVICE FOR ELEVATORS

Filed May 11, 1922 4 Sheets-Sheet 1

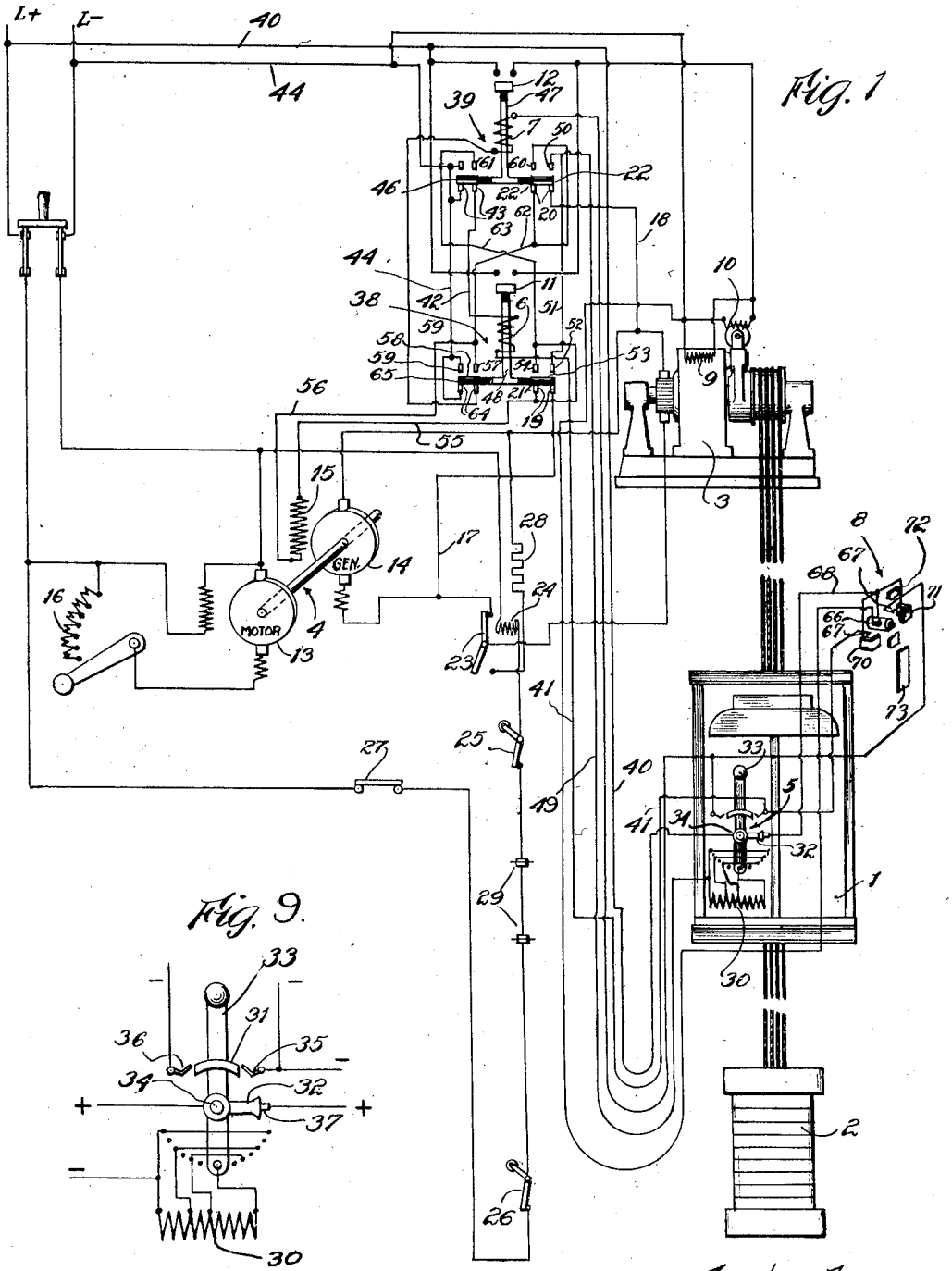


Fig. 1

Fig. 9.

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AUTOMATIC LEVELING DEVICE FOR ELEVATORS

Filed May 11, 1922 4 Sheets-Sheet 2

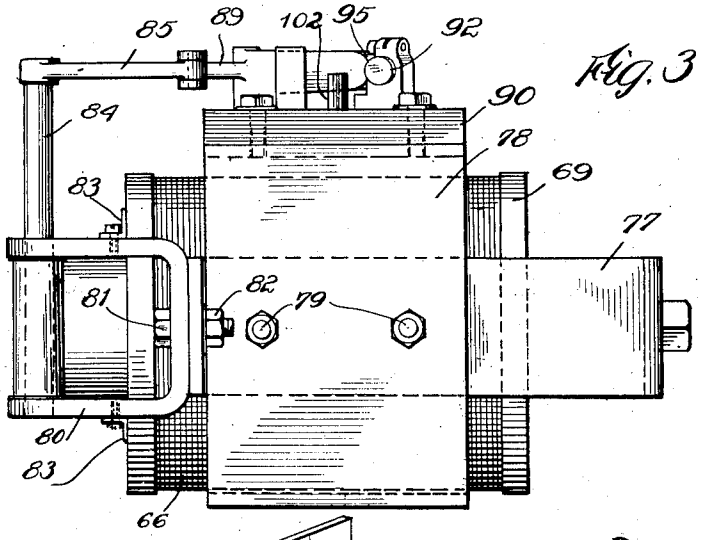


Fig. 3

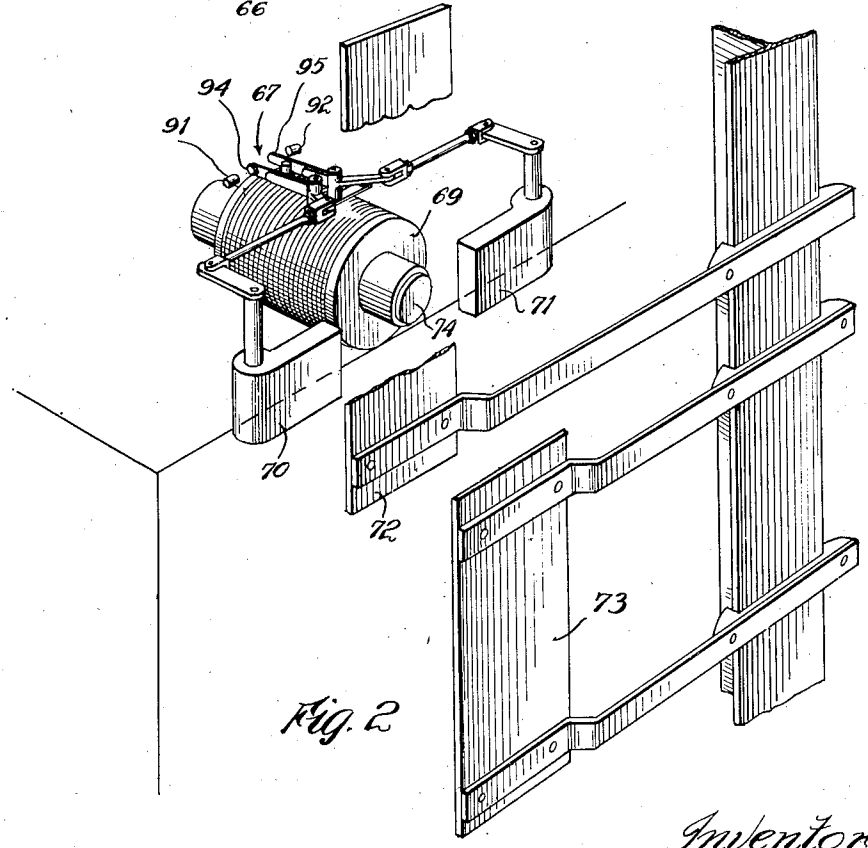


Fig. 2

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AUTOMATIC LEVELING DEVICE FOR ELEVATORS

Filed May 11, 1922 4 Sheets-Sheet 3

Fig. 4

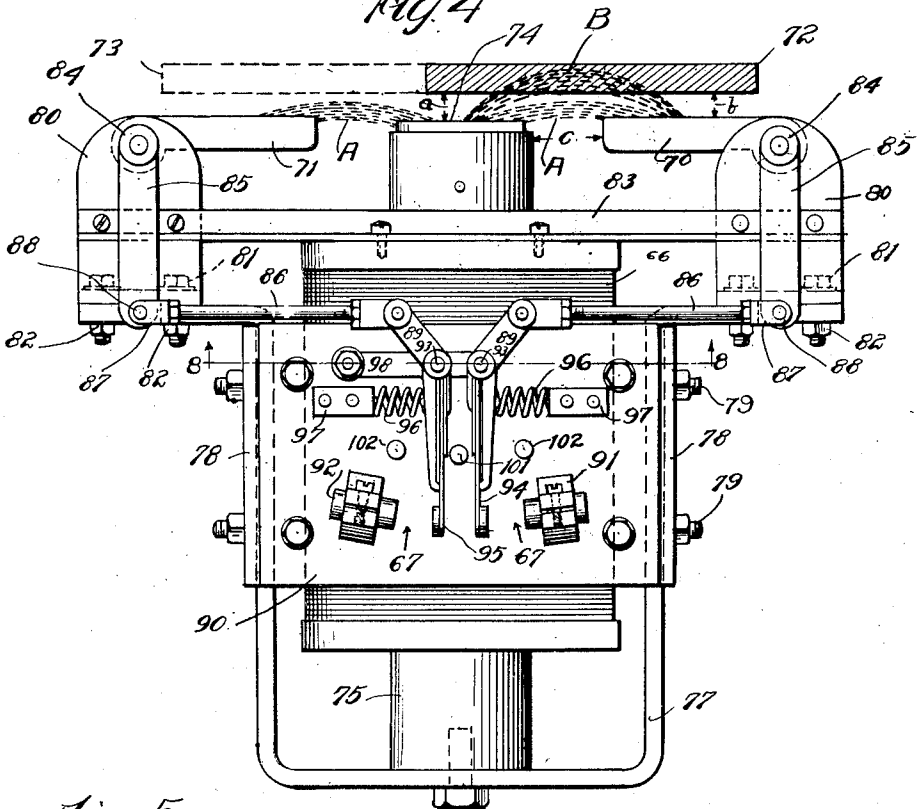
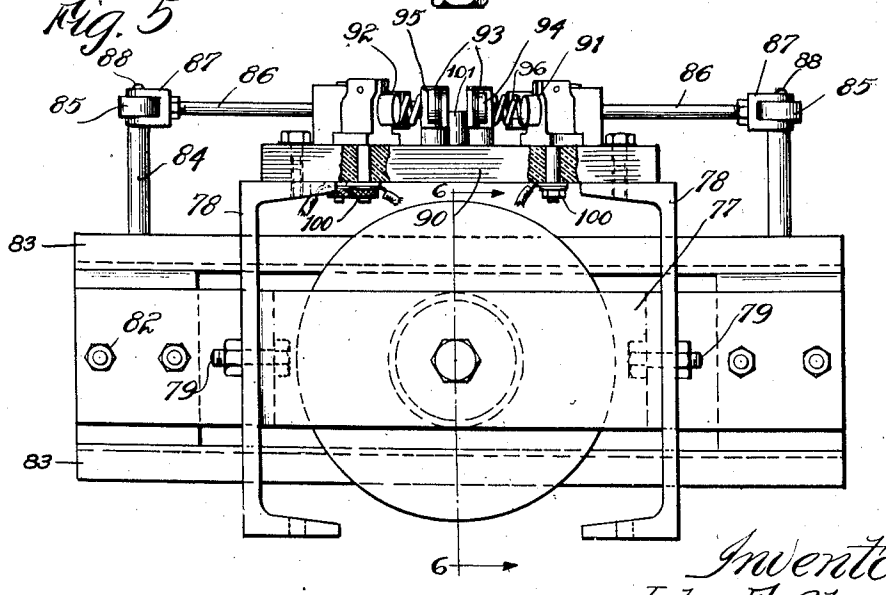


Fig. 5



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AUTOMATIC LEVELING DEVICE FOR ELEVATORS

Filed May 11, 1922 4 Sheets-Sheet 4

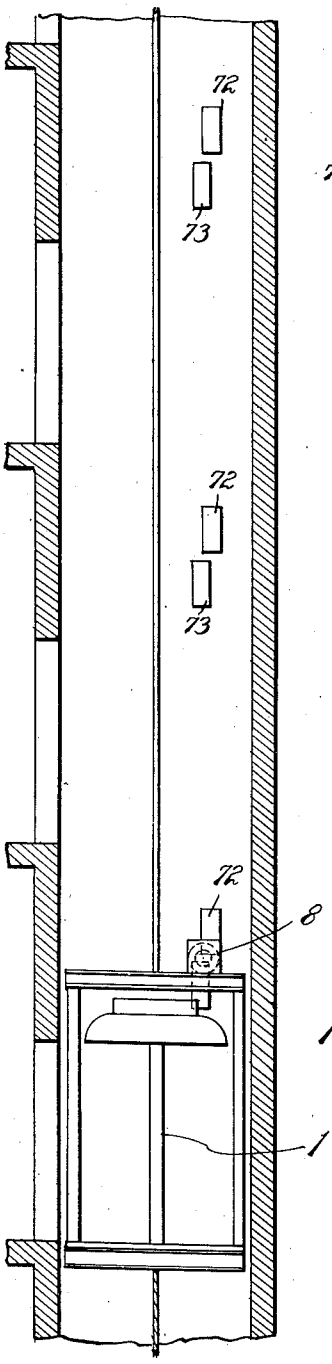


Fig. 7

Fig. 6

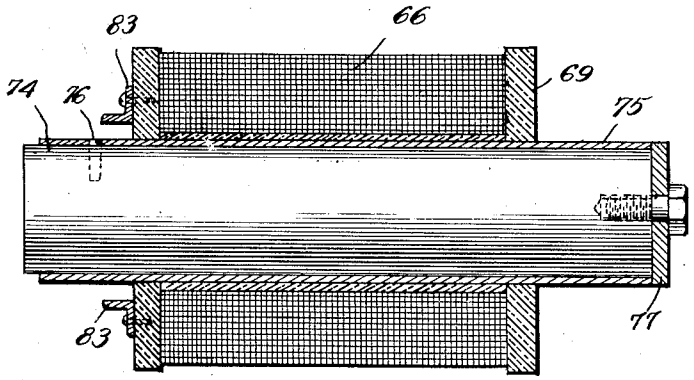
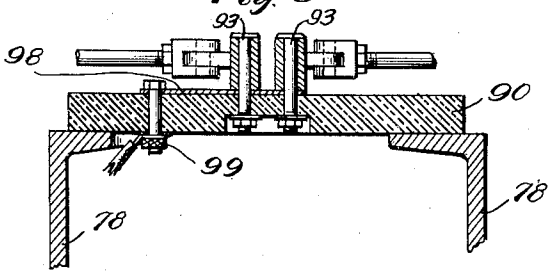


Fig. 8



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Patented June 16, 1936 2,044,152

UNITED STATES PATENT OFFICE

2,044,152

AUTOMATIC LEVELING DEVICE FOR ELEVATORS

John F. Clancy, Chicago, Ill., assignor to Westinghouse Electric Elevator Company, Chicago, Ill., a corporation of Illinois

Application May 11, 1922, Serial No. 559,997

37 Claims. (Cl. 172—152)

My invention relates to improvements in elevators and has particular reference to electric elevators equipped with means for effecting an automatic leveling of the cage with a landing.

The primary object of my invention is to provide a controlling means whereby the elevator cage can be stopped positively on a level with the floor landing, and whereby said cage can be kept at that level regardless of loading conditions.

A further object is to provide such means which, in the event that the main power circuit has been prematurely shut off and the slow leveling operation begun, can be manually operated to increase the speed of the cage so as to hasten the leveling operation in progress, without again closing said main power circuit.

A further object is to provide a means whereby the control of the speed of the elevator during the leveling operation can be effected with facility so that the only perceptible action noticeable to an observer would be the actual momentary change of speed of the elevator cage.

It is well known that to accomplish the satisfactory leveling of an elevator cage with a landing, the speed of the elevator cage must be materially reduced just before arriving at the stopping point. In a great number of instances in the prior art this result has been accomplished by employing an auxiliary motor to furnish the traction power during the leveling operation. Such an arrangement necessitates a complete change of motor connections, and entails a complexity of construction and operation, and a high cost of installation. A further object of my invention, therefore is to provide a means whereby both the rapid transit and the slow leveling of the elevator cage is accomplished through the use of the same motor thereby avoiding the necessity of making a complete change of motor connections whenever it is desired to change from one kind of operation to the other.

It is obvious that to accomplish successful leveling of the cage such operation must begin at a reasonable distance before the stopping point so that the speed can be sufficiently reduced before reaching said point to make a complete stop. It frequently happens in elevator operation that the manipulator of the control lever attempts to stop the cage when at or almost at the landing. In such case there is not sufficient time to effect an exact landing, and the cage overruns its mark. One of the objects of my invention is to provide a leveling means which, if the cage overruns its landing, will automatically reverse the motor operation and institute a leveling operation in the opposite direction without any further action on the part of the operator.

A further object is to provide an elevator in which all the phases of operation are controlled by a single means, such as a manually operated lever.

Another object is to provide an elevator in which the use of cams and disappearing switches to govern the movement and leveling of the cage is dispensed with, thereby avoiding any necessary connection between the cage and the hatchway.

A final object is to provide a leveling device which is simple in construction and operation, cheap to install, easily and conveniently controlled, and smooth and noiseless in operation.

Further and specific objects of my invention will become apparent as the following description proceeds.

The objects of the invention thus generally stated are attained by the construction and arrangement illustrated in the accompanying drawings forming part hereof, wherein:

Fig. 1 is a general schematic representation of the elevator system as a whole.

Fig. 2 is a perspective view showing the leveling device and the plates which cooperate therewith in their relative position.

Fig. 3 is a side view of the leveling device.

Fig. 4 is a plan view of the leveling device.

Fig. 5 is a rear view of the leveling device.

Fig. 6 is a sectional view of the electromagnet for the leveling device taken along line 6—6 of Fig. 5.

Fig. 7 is a diagrammatic representation of the elevator hatchway showing a plurality of landings and the relative positions of the cage, leveling device and plates.

Fig. 8 is a sectional view taken along line 8—8 of Fig. 4.

Fig. 9 is an enlarged view of the manually operated switch device.

To illustrate a preferred embodiment of my invention, I show a gearless traction machine with variable voltage control, although it is to be clearly understood that the invention need not necessarily be confined to use with such a combination.

In general, the elevator cage 1, having a counterweight 2, is caused to travel by a hoisting motor 3. A motor-generator set 4 receiving power from the main line terminals L plus and L minus supplies the hoisting motor with a variable voltage. The voltage delivered by the motor-generator set 4 is controlled by the hand operated switch device 5, which under normal running

conditions closes a circuit containing a solenoid 6 or 7 and which under leveling conditions further places a magnetic leveling device 8 into the same circuit. Although the invention as herein illustrated is shown as using direct current, it is to be understood that said invention can readily be adapted to the use of alternating current.

The hoisting motor 3 in the present instance is of the shunt wound type, the shunt field being indicated at 9. This shunt field can be permanently excited, if desired, so that the operation of the motor will begin whenever voltage is impressed across the armature. In the present illustration, however, the circuit passing through the shunt field and coil 10 of the brake magnet is broken when the motor is inoperative, and is adapted to be closed by either of two plates 11 and 12 carried by the cores of the solenoids 6 or 7.

The motor-generator set 4 comprises a motor 13 and a generator 14, the armature of the latter being connected to the armature of the motor 3. In the present instance both machines are of a compound wound type, the generator having a separately excited field winding shown at 15. The motor 13 receives its power from the main line terminals, a starting box 16 of any suitable construction being used to start its operation whenever the elevator is to be ready for use. It can readily be seen that the operation of the motor 3, and consequently of the elevator, is controlled by the field winding 15, the speed and direction of rotation of said motor depending directly upon the amount and direction of the exciting current in said winding. The field winding 15 is adapted to be excited at the will of the operator who likewise controls the degree of excitation and the direction of the exciting current through said winding in a manner to be presently disclosed.

To completely stop the motor 3, the circuit through the winding 15 is broken. To prevent further generation of current by the generator 14 due to the residual magnetism in its fields, the separately excited field winding 15 is connected across the armature of said generator by wires 17 and 18 and back contacts 19 and 20; so that an opposed voltage will be impressed across said field, thereby hastening its dying out and making the stop certain and quick. The back contacts 19 and 20 are closed by plates 21 and 22 carried by the cores of the solenoids.

To insure a quick and positive stop in case of emergency, the circuit through the armature of the motor 3 includes a double throw switch 23 which is controlled by an electro-magnet having a coil 24. The exciting circuit for the coil is connected across the main line terminals, and includes an emergency switch 27 located in the cage and limit switches 25 and 26. Exciting the coil 24 serves to close the circuit through the armatures of the motor 3 and generator 14. If the circuit through the coil 24 is broken, the switch 23 will place a resistance 28 across the armature of the motor 3 thereby producing a dynamic braking effect which will aid in bringing the car quickly to rest. If desired, door switches 29 may also be inserted in the circuit through the coil 24 thereby making it impossible to start the motor if all doors are not closed.

The switch device for controlling the current through the winding 15 comprises in the present instance a resistance 30, contact members 31 and 32, and an actuating lever 33 for positioning the contact members and for varying said resistance. The actuating lever 33 is pivoted between its ends at 34, and comprises an upper arm and a lower arm. Swinging of the lever functions to vary the size of the resistance 30, said resistance being at its maximum when the lever 33 is in its central position and being progressively decreased when said lever is swung either to the left or right. The contact members 31 and 32, which are segmental in form, are also pivoted at 34 and in effect form part of the lever 33, being movable in either direction by swinging the latter. The relative arrangement is such that when the lever is in a central position, the contact member 31 is positioned between two contacts 35 and 36, and the contact member 32 is positioned centrally on a contact 37.

The segmental faces of the contact members are wide enough to allow a variation of the resistance 30 by an angular displacement of the lever 33 without breaking their connection with their respective contacts. Since the member 31 comprises a much larger segment than member 32, this allowable movement of the lever 33 is greatest with respect to the former. The arrangement and construction of the contact members is such that, in swinging the control lever in any direction, one electrical connection is made before the other is broken.

Two circuits, which are connected in parallel, are closed when the lever 33 is moved sufficiently to the right or left, one of said circuits including the winding 15 and the variable resistance 30, and conveniently designated as the field circuit, in all following references thereto, and the other circuit including a solenoid actuating an electromagnetic switch and suitably called the actuating circuit in all following allusions thereto. The actuating circuit comprises two parts, one including solenoid 6 which operates the electromagnetic switch 38 and the other including solenoid 7 which operates the electromagnetic switch 39, said parts terminating in contacts 35 and 36, respectively.

For purposes of illustration let it be assumed that the upper end of the lever 33 is thrown to the right. The actuating circuit which is thereby closed can be traced as follows: From the plus main, through wire 40, segmental contact 31, contact 35, wire 41, solenoid 6, wire 42, interlock switch contacts 43 and wire 44 to the minus main of the line. The interlock switch which forms part of the electromagnetic switch 39 is closed by a plate 46 carried by the solenoid core 47 and is closed only when solenoid 7 is unexcited, and said core is in its lowermost position. It is obvious that with this arrangement only one electromagnetic switch can operate at one time for if both solenoids were excited simultaneously, the actuating circuit would be broken. In passing current through the solenoid 6, the core 48 moves up and operates to close the field circuit, which can be traced as follows: from the plus main, through wire 40, lever 33, resistance 30, wire 49, contact 50, wire 51, contact 52, contact plate 53, contact 54, through the attached conductor to one end of the field winding 15, from the other end of 15 by conductor 56 to contact plate 53, contact 54, wire 55, winding 15, wire 56, contact 57, contact plate 58, contact 59, and wire 44 to the minus line. The contact plates 53 and 58 are mounted upon the movable solenoid core 48 and are insulated thereupon. Moving the lever fur-

ther to the right merely acts to increase the current in the shunt field. The electrical circuits are so connected that the cage descends when lever 33 is thrown to the right. If lever 33 is thrown to the left the electromagnetic switch 39 closes, thereby reversing the direction of the current through the winding 15 and causing the cage to ascend. This reversal of current in the field winding is effected by connecting contacts 60 and 57, and 61 and 54 by cross wires 62 and 63, respectively. It will be noticed that when the cage is ascending, the interlock switch contacts 64 will be closed by the plate 65 carried by the core 48.

To cause the cage to stop exactly at a landing it is necessary to start a leveling operation when still a short distance remains to be traversed. This distance is, of course, dependent upon the normal speed of the car, being greater for a high-speed car, and less for a low-speed car. Such operation is instituted by swinging the lever 33 into a central position, whereupon the segmental contact member 32 will close a circuit passing through the coil 66 of the leveling device 8. The leveling device will prevent a break in the actuating circuit by closing the switch 67 and holding it closed until the landing is reached, thereby shunting the previous connection. This shunt will pass through the lever 33, wire 68, and switch 67 to contact 35 or 36. It can be seen that under leveling conditions, the resistance in the field circuit is at its maximum, wherefore the motor 3 will operate at a slow speed.

The leveling device in the exemplary form herein shown comprises the coil 66, a spool shaped housing 69 for supporting said coil, the two-way switch 67, and a pair of magnetic levers 70 and 71 for actuating said switch. A pair of metallic plates 72 and 73, permanently secured to the elevator hatchway, cooperate with the device to cause it to function, when the coil is excited and adjacent to either one of said plates.

The coil 66 is provided with a core 74 which extends through the spool housing 69 and sleeve 75 and is secured thereto at 76. The housing is supported at its rear end by the main frame 77, the latter being secured to two oppositely positioned channel irons 78 by means of bolts 79. The channel irons are preferably secured to the top of the elevator cage, although any other suitable position may be selected if so desired. The ends of the main frame 77 after passing between the channel irons are bent outwardly. A bearing member 80, which in the present instance comprises an iron strip bent into the form of a channel, is secured to each out turned end of the main frame, by bolts 81 and nuts 82. Two angle irons 83 connect the bearing members 80 and are secured to the front face of the core 74 so as to support the casing 69. The magnetic levers 70 and 71 are pivotally mounted in the bearing members, and are provided with upwardly extending shafts 84 which are journalled in the legs of said members. Two levers 85, which extend rearwardly and approximately at right angles to the magnetic levers 70 and 71 are rigidly secured at one end to the upper ends of the shafts 84. The rear ends of the levers 85 are pivotally connected to rods 86 by means of forked connectors 87 and pins 88. Said rods are similarly connected to the forearms of the bell crank levers 89.

The insulating plate 90 secured to the top of the channels 78 supports the fixed contacts 91 and 92, which are of the Westinghouse type, and the two bell crank levers 89 which are pivoted at 93. The rear arms of the bell crank levers 89 support the yielding contacts 94 and 95, and are normally held in a central inoperative position by the springs 96 and spring stops 97 which are also supported by the plate 90. The yielding contacts 94 and 95 are connected electrically by plate 98 which acts as a pivot base for the levers 89. A suitable binding post 99 connects plate 98 to the plus main of the line. The fixed contacts 91 and 92 are provided with suitable binding posts 100 for connecting them respectively with contacts 35 and 36. The bell crank levers 89 are limited in their movement in one direction by stop 101 and in the opposite direction by the fixed contacts or in extreme cases by the stops 102.

Referring to Figs. 2 and 7, the plates 72 and 73 are positioned respectively above and below the stopping points of the levers 70 and 71 in their movement with the cage, when the floor level has been reached. The leveling device is secured to the cage in such a position that the levers 70 and 71 will pass adjacent to and across the faces of the plates 72 and 73, respectively.

In operation, if the lever 33 is thrown into its central position, the coil 66 will be excited and the contacts 94 and 95 will be connected to the positive terminal of the line. Lines of force will then pass through the core 74, and from said core to the levers 70 and 71 as shown at A in Fig. 4. If, as an example, the lever 70 is adjacent to plate 72, the lines of force will, however, pass through the latter as shown at B, because the sum of the air gaps *a* and *b* is less than air gap *c*. The lever 70 will then swing outwardly toward the plate 72 thereby closing contacts 91 and 94. The outward movement of the lever is limited by the closing of the switch and the spring 96, or in extreme cases by the stop 102. From the description it can be seen that the leveling device will close the actuating circuit by closing the shunt through the switch 67, only when the cage is near the landing, i. e., when the leveling device is adjacent the plates in the hatchway, that it will break said circuit when the cage is exactly at the landing, and that it will again close said circuit to bring the cage back to the exact landing if a heavy load should have caused said cage to settle due to elongation of the hoisting cable.

The time at which a leveling operation can be started depends entirely upon the length of the plates 72 and 73. The operation of the system as a whole will now be described.

To start the elevator cage to descend, the motor generator set being in operation, the lever 33 is thrown to the right so as to close the actuating circuit. The electromagnetic switch 38 will then close the field circuit and the motor 3 will begin to operate, the speed of said motor depending upon the position of the lever 33. To increase the speed, the lever is moved further to the right thereby reducing the resistance in the field circuit.

To stop the cage at a landing, the lever 33 is swung into a central position when the car is a short distance from the landing, at which time the coil 66 is opposite the plate 72. This operation closes the exciting circuit for coil 66 and also greatly reduces the speed of the motor 3, by increasing the field resistance 30 to its maximum. Since the lever 70 is now directly opposite the plate 72, it will be drawn outwardly im-

mediately, thereby causing the contact 94 to engage contact 91 so as to shunt the break in the actuating circuit. If it should be desired to increase the speed of the leveling operation, some of the resistance may be cut out, without breaking the newly formed circuit, by swinging the lever 33 a little from its central position. Such regulation is possible because of the circular face of the segmental member 32. It is obvious that unless one of the plates 72 or 73 is opposite the levers 70 and 71, no leveling will ensue, when the lever is thrown into its central position, and the cage will stop. When the landing has been reached, the lever will have passed the face of the plate 72, and will be returned to its initial position thereby breaking the actuating circuit. Such break will cause the electromagnetic switches to drop, thereby breaking the field circuit, and placing a reversed voltage across said field. The excitation in the generator fields will then quickly die out, and the motor 3 will stop operating. If the cage overruns its landing point due to tardiness on the part of the operator, or if said cage due to a heavy load sinks below the landing, the lever 71 will be opposite plate 73 and will close the circuit through the solenoid 7, thereby causing a reversed travel until the desired elevation has again been arrived at.

To cause the cage to ascend, the operation is similar, the lever being thrown to the left to operate the electromagnetic switch 39. In this case the lever 71 and plate 73 govern the leveling in stopping.

I desire to point out that while the invention has been herein illustrated and described with considerable particularity, I contemplate that various changes in form, construction and arrangement of parts may be made by those skilled in the art, but without departing from the spirit and scope of the invention as expressed in the appended claims.

I claim as my invention:

1. An electric elevator having, in combination, a cage, a motor for driving said cage, a switch device in said cage for controlling all phases of operation of said motor, said switch device comprising a double-throw lever, a pair of segmental contacts and a resistance, one of said segmental contacts acting to institute a wide range of variable motor operation and the other of said contacts acting to institute an automatic leveling operation when the former is in its inoperative position and the cage is near a landing.

2. An electric elevator having, in combination, a cage, a motor for driving said cage, a plurality of plates secured in the elevator hatchway at a definite relation to each landing, an electromagnet supported on said cage, a lever supported at each side of said electromagnet, each lever being positioned so as to pass vertically across the face of certain of said plates, said plates cooperating with said levers to effect a pivotal movement of the latter when said magnet is excited, and means controlled by movement of said levers for controlling said motor.

3. An electric elevator having, in combination, a hatchway, a cage in said hatchway, a motor for driving said cage, and a leveling means comprising a pair of plates arranged one above the other, and a leveling device having a pair of levers, said levers being so arranged that one passes relatively closely across the face of one plate and the other passes relatively closely across the face of the other plate, magnetically cooperating therewith to control the operation of said motor, said pair of plates and said device being mounted one in said hatchway and one on said cage.

4. An electric elevator having, in combination a cage, a motor for driving said cage, a leveling device comprising an electromagnet, a double switch, and a pair of levers for operating said switch, said levers being disposed in the path of the lines of force from said electromagnet when the latter is excited and being held in an inoperative position thereby, and a pair of plates secured in the elevator hatchway adjacent to the path of travel of said leveling device, each of said plates, when adjacent to said device, acting at separate times to change the path of said lines of force whereby one of said levers will be pivoted out of its inoperative position.

5. An electric elevator having, in combination, a cage, a motor for driving said cage, electromagnetic means for effecting a leveling operation of said motor comprising an electromagnet, a switch, a lever for operating said switch, said lever being normally held in one position by the lines of force emanating from said magnet, and a plate adjacent to said lever and said electromagnet which acts to divert the path of said lines of force through itself, whereby said lines of force will swing said lever into another position, with a consequent closing of said switch.

6. In an electric elevator, in combination, a leveling device comprising an electromagnet, a support for said electromagnet, a pair of levers mounted on said support at one end of said electromagnet, bell-crank levers operatively connected to said first mentioned levers, one arm of each bell-crank lever carrying a yielding contact, and fixed contacts opposite said first mentioned contacts, said contacts being forced into engagement by an outward pivoting of either of said first mentioned levers.

7. In an electric elevator, in combination, an electromagnet, a support for said electromagnet, a bearing supported at the front and side of said electromagnet, a lever having a pivotal shaft mounted in said bearing, a second lever secured to said shaft, a third lever pivoted between its ends and carrying a contact on one end, an operable connection between the other end of said last mentioned lever and the free end of said second mentioned lever, and a fixed contact positioned adjacent to said first mentioned contact, said contacts being brought together by a pivotal movement of said first mentioned lever.

8. An electric elevator having, in combination, a hatchway, a cage in said hatchway, driving means for said cage, two magnetizable plates for each landing secured to said hatchway in closely staggered relation to each other, and in a definite fixed position with respect to said landing, and electromagnetic means on said cage adapted to coact magnetically with said plates for controlling the operation of said driving means to level said cage with said landing.

9. An electric elevator having, in combination, a hatchway, a cage in said hatchway, driving means for said cage, a pair of metallic plates, said plates being arranged in closely staggered relation, and electromagnetic means adapted to magnetically coact with said plates to control the operation of said driving means to level said cage with reference to a predetermined position, said pair of plates and said means being mounted one in the hatchway and one on said cage.

10. An electric elevator having, in combination,

a cage, a motor for driving said cage, a switch device for controlling the speed and direction of revolution of said motor, and a leveling device in the control system operable by said switch device for stopping said motor when the cage is at a certain point, said switch device still being operable by the operator to effect a limited speed control of said motor while the leveling device is in control of said motor before the motor has stopped running without again assuming full direct control thereof to the exclusion of the leveling device.

11. An electric elevator having, in combination, a hatchway, a cage in said hatchway, means for driving said cage, an electromagnet, a lever for controlling the operation of said driving means, said lever being held in one position by the lines of force emanating from said electromagnet, and means for diverting the path of travel of said lines of force whereby said lever will be held in a different position by said lines of force, said electromagnet and said means being mounted one in said hatchway and one on said cage for relative movement across each other.

12. An electric elevator having, in combination, a cage, a motor for driving said cage, a circuit for controlling the operation of said motor, said circuit including a resistance, a second circuit for closing said first mentioned circuit, means for varying said resistance, said means being operable to close said second circuit over a wide variation in resistance and being inoperable to close said second circuit when said resistance is substantially at its maximum, and other means for closing said second circuit when said first mentioned means is in its inoperable position, said first mentioned means still being operable to vary said resistance over a limited range.

13. An electric elevator having, in combination, a hatchway, a cage in said hatchway, means for driving said cage and leveling means for controlling the operation of said means, said leveling means comprising an electromagnet, a switch, a lever for operating said switch, said lever being normally held in one position by the lines of force emanating from said electromagnet, and a conducting member adapted to be positioned adjacent said lever when said cage is at a predetermined point in said hatchway, said member being adapted to divert the path of said lines of force through itself so as to swing said lever into another position to close said switch, said electromagnet and said member being mounted one in said hatchway and one on said cage.

14. An electric elevator-control system comprising motive means for said elevator, having a separately excited field winding, a field circuit therefor including a variable resistor, "up" and "down" switching means for selectively energizing said field circuit with current in opposed directions, an actuating circuit for each switching means, automatic leveling means for selectively controlling said actuating circuits and additional switch means for also selectively controlling said actuating circuits and for varying said resistor while said actuating circuits are under the control of either the leveling means or the additional switch means.

15. An electric elevator having, in combination, a cage, a motor for driving said cage, and means for instituting a leveling operation of said motor, said means comprising a set of magnetizable plates secured to the elevator hatchway and an electromagnetic leveling device carried by said cage for movement past said plates, and operable by the magnetic pull between the device and said plates to control said leveling operation.

16. In a relay, two relatively movable members, a magnetizable plate carried by one of said members, a movable armature carried by the other of said members operable by the magnetic pull exerted between said magnetizable plate and said armature when said plate and said armature are adjacent each other, an electromagnet also carried by said last named member for magnetizing said plate, and control means operable by movement of said armature and means for selectively energizing said electromagnet.

17. In a control device, two relatively movable members, an electromagnet carried by one of said members defining a path of magnetic flux, a magnetizable element carried by the other of said members so disposed as to enter said magnetic path when said magnet and said element are adjacent each other, a movable armature carried by said first member, means mounting said armature in said magnetic path between said magnet and said element, in such manner as to be movable by the flux passing between said armature and said element, and controlling means operable by movement of said armature.

18. In a controlling device, two relatively movable members, a magnet and a movable armature therefor carried by one of said members, means for mounting said armature in the magnetic circuit of said magnet, in a manner to be normally unaffected by said magnet, a magnetizable plate carried by the other of said members and so disposed thereon to enter the magnetic circuit between the magnet and said armature when said magnet and said plate are adjacent each other to render the magnet effective to cause movement of said armature and control means operable by movement of said armature.

19. In a relay, two relatively movable members, a magnetizable element carried by one of said members, an energizable coil and a movable armature carried by the other of said members, said coil being arranged to magnetize said magnetizable element only when said coil and said element are adjacent each other, means mounting said armature for actuation by the magnetic pull exerted between the element and said armature, and switch means operable by movement of said armature.

20. In a relay, two relatively movable members, a magnetizable element carried by one of said members, an electromagnet carried by the other of said members arranged to set up a magnetic circuit between said magnet and said element, when said magnet and said element are adjacent each other, movable armature carried by said other member disposed in said magnetic circuit between said magnet and said element, and actuable by the magnetic pull exerted between said armature and said element, and switch means operable by movement of said armature.

21. In a relay, two relatively movable members, an electromagnet carried by one of said members for defining a normal path of magnetic flux, a movable armature carried by said one member disposed in said normal magnetic path, a magnetizable element carried by the other of said members for diverting the flux from said normal path to a new path, when said magnet and said element are adjacent each other, said new path including said element between said armature and one of the poles of said magnet, means mounting said armature for movement

when said path is changed, and control means operable by movement of said armature.

22. In a relay two relatively movable members, a plurality of normally demagnetized elements constructed of magnetizable material carried by one of said members, a plurality of movable armatures each carried by the other of said members for actuation by the magnetic pull exerted between said armature and one of said elements respectively, when said armature and said respective element are adjacent each other, an energizable coil also carried by said last-named member for magnetizing each of said elements when the respective element and said coil are adjacent each other, and a plurality of control means, one for each of said armatures, actuated by movement of the respective armature.

23. An electric elevator having, in combination, a cage, a motor for driving said cage, and means for instituting a leveling operation of said motor, said means comprising a plurality of normally demagnetized elements constructed of magnetizable material secured to the elevator hatchway, a plurality of movable armatures, each carried by said car, for actuation by the magnetic pull exerted between one of said elements and said armature when said armature and said element are adjacent each other, an energizable coil also carried by the car for magnetizing all of said elements when said elements and said coil are adjacent each other, and control means associated with each of said armatures for actuation by movement of the respective armature.

24. In an electric elevator control system, a car member, a shaft member, a normally demagnetized element constructed of magnetizable material carried by one of said members, a movable armature carried by the other of said members for actuation by the magnetic pull exerted between the element and said armature when said armature and element are adjacent each other, an energizable coil also carried by said last-named member for magnetizing said element when said element and said coil are adjacent each other, and control means actuated by movement of said armature.

25. In a control system for multi-speed elevators, wherein a car switch is moved to stop the car as it approaches a landing, means for stopping said car level with said landing comprising a normally demagnetized element constructed of magnetizable material stationarily mounted adjacent said landing, a movable armature carried by said car for actuation by the magnetic pull exerted between said element and said armature when said armature and said element are adjacent each other, an energizable coil also carried by said car for magnetizing said element when said element and said coil are adjacent each other, circuit-controlling means actuated by movement of said armature and means actuated by movement of said car switch to stop said car for energizing said coil.

26. In combination with an elevator car, a motor therefor, a car switch and circuits for energizing said motor to move the car up or down, means for stopping said car level with the landing, including a pair of normally demagnetized elements constructed of magnetizable material, stationarily secured in the elevator hatchway adjacent said landing, a pair of movable armatures carried by said car, each arranged for actuation by the magnetic pull exerted between one of said elements and the associated armature when said element and said armature are adjacent each other, an energizable coil also carried by said car for magnetizing both said elements when said elements and said coil are adjacent each other, means controlled by movement of one of said armatures for stopping said car when traveling in one direction and means controlled by movement of the other of said armatures for stopping said car when traveling in the opposite direction.

27. In an elevator control system, an elevator member and a hatchway member in which said elevator operates, motive means for said elevator member, means for controlling said motive means including a magnetizable element carried by one of said members, an electromagnet carried by the other of said members arranged to set up a magnetic circuit between the magnetizable element and said magnet, a movable armature carried by said other member disposed in said magnetic circuit between said magnet and said magnetizable element, and actuable by the magnetic pull between said element and said armature, and controlling means for said motive means operable by movement of said armature.

28. In combination, an elevator car, an electromagnet, means to close an energizing circuit for said electro-magnet, and magnetizable means forming a zone which by movement of the car therethrough, brings said electro-magnet and magnetizable means into attractive relation and which, when the car is substantially level with a landing, brings said electro-magnet and magnetizable means out of attractive relation, and a switch movable from a normal position by such attractive relation and returned to said position mechanically.

29. In combination, an elevator car, a hoisting motor, electro-magnetic means, magnetizable means, the first and second named means being brought into attractive relation by movement of the car, and circuit controlling mechanism to control said motor to level the car with a landing, actuated to circuit closing position by movement of one of the above named means as effected by the magnetic attraction between the two said means, and actuated mechanically to circuit-opening position when the car is substantially level with a landing.

30. In combination, an elevator car, a hoisting motor, electro-responsive means, means in the car to close an energizing circuit for said electro-responsive means at will, means to be actuated by said electro-responsive means, and means operable by movement of the car to render the magnetic attraction of the energized electro-responsive means effective and ineffective to actuate the said means to be actuated thereby, said last named means rendering said electro-responsive means ineffective when the car is substantially level with a landing.

31. In combination, an elevator car, a hoisting motor, magnetizing means, a magnetizable member, said means and member being moved into and out of attractive relation by movement of the car, said means and member being out of attractive relation with the car substantially level with a landing and means controlled by said means and member to control said hoisting motor to level said car with a landing.

32. In combination, an elevator car, a hoisting motor, switch mechanism to control said motor, and means to actuate said switch mechanism comprising a magnetizing member and a

magnetizable member, one member on the car and the other in the hatchway so that both members are brought into and out of attractive relation by movement of the car, said members being out of attractive relation when the car is substantially level with a landing.

33. In combination, an elevator car, a hoisting motor, switch mechanism to control said motor, and means to actuate said switch mechanism to control said motor to level the car with a landing, comprising a magnetizing member and a magnetizable member, one member on the car and the other in the hatchway so that both members are brought into and out of attractive relation by movement of the car, said switch mechanism closed by said members in attractive relation, said members in non-attractive relation with the car substantially level with a landing so that said switch mechanism is opened by reason of said members being in nonattractive relation.

34. Leveling switch mechanism for elevators comprising up and down switch arms mechanically independent, and electro-responsive means having magnetic lines thereof rendered effective and ineffective to actuate said arms by movement of the car.

35. In combination, an elevator car, a single switch on the car effective to control the leveling of the car at all landings for one direction of car movement, a single switch on the car effective to control the leveling of the car at all landings for the other direction of car movement, and actuating means for said switches comprising magnetizing and magnetizable elements movable into and out of attractive relation by movement of the car.

36. In combination, an elevator car, up car control contactors and down car control contactors, and magnetizing and magnetizable elements out of attractive relation with the car substantially level with the landing, movement of the car away from the landing in either direction bringing said elements into attractve relation to cause movement of one of said elements to close circuit either the up or down contactors.

37. A system of control for elevators, comprising a switch having a winding energizable manually at will to predetermine the stop of the car, a hoisting motor, means to control the motor to continue it in operation automatically, said means rendered effective by manual operation, said switch effective to control said motor to discontinue its hoisting operation, and means controllable in accordance with car position to form a path for the magnetic lines of said magnet so that said winding when energized is effective to actuate such switch only when in attractive relation with said means.

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