J. D. IHLDER.

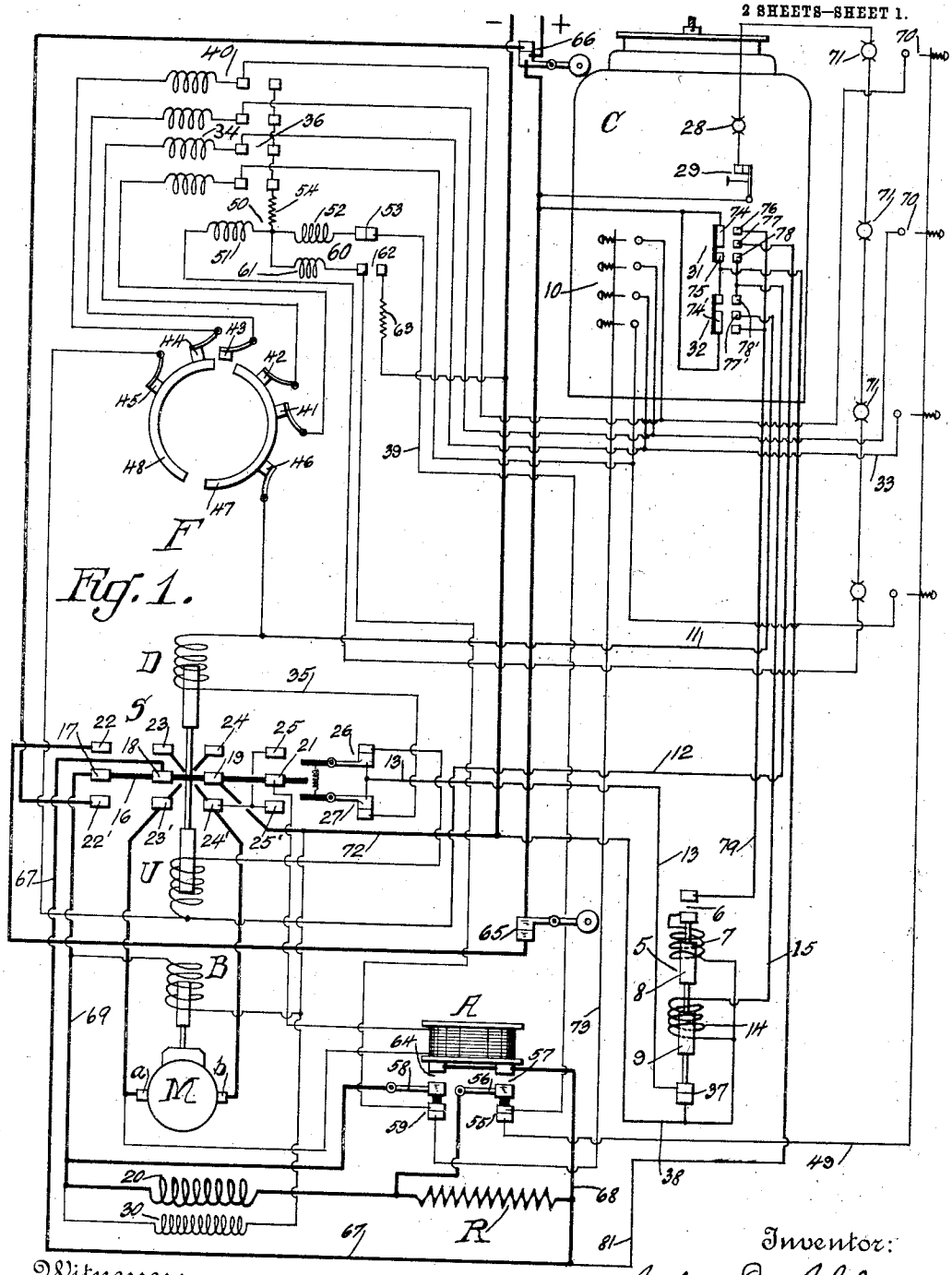
ELEVATOR CONTROL.

APPLICATION FILED OCT. 31, 1908.

1,040,546.

Patented Oct. 8, 1912.

2 SHEETS—SHEET 1.



Witnesses:

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2 SHEETS—SHEET 2.

Fig. 4.

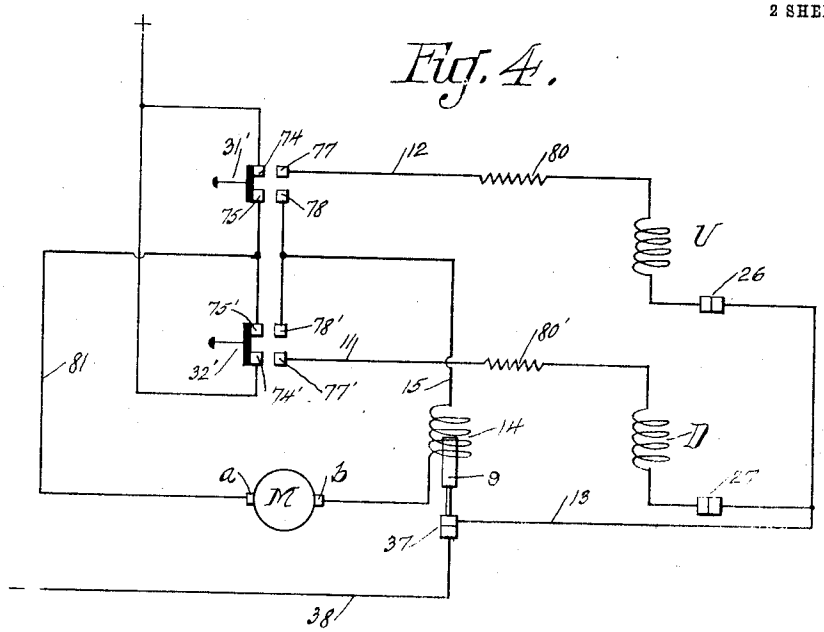


Fig. 2.

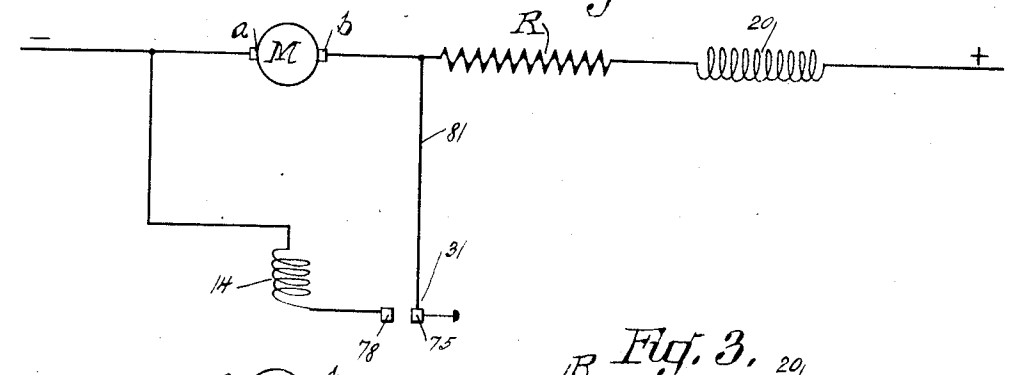
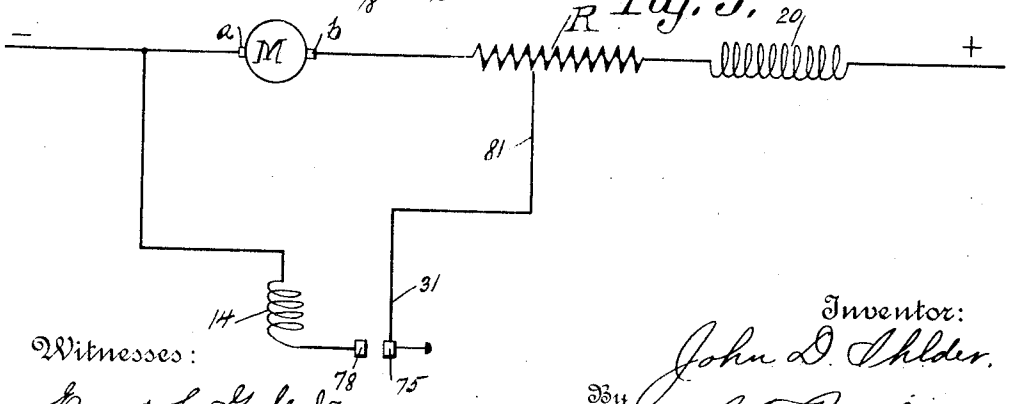


Fig. 3.



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UNITED STATES PATENT OFFICE.

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ELEVATOR CONTROL.

1,040,546. Specification of Letters Patent. Patented Oct. 8, 1912.

Application filed October 31, 1908. Serial No. 460,525.

To all whom it may concern:

Be it known that I, JOHN D. IHLDER, a citizen of the United States, residing in New York, in the county of New York and State of New York, have invented a new and useful Improvement in Elevator Control, of which the following is a specification.

My invention relates to improvements in push-button elevators, and one of its objects is the provision of means for making an exact landing at any predetermined point under varying loads without depending upon the skill of the operator.

A further object of the invention is the provision of means under the control of the operator for automatically making an exact landing.

Other objects of my invention will appear hereinafter, the novel combinations of elements being set forth in the appended claims.

In the accompanying drawings, Figure 1 is a complete wiring diagram of an automatic controlling system for electric elevators embodying my invention; Fig. 2 is a fragmentary wiring diagram showing a portion of Fig. 1; Fig. 3 is a wiring diagram similar to Fig. 2 showing a modification; and Fig. 4 is a wiring diagram showing a further modification.

Similar reference characters denote similar parts throughout the figures.

My invention relates more particularly to an improvement upon the system of electrical operation of elevators shown and described in Patent No. 683,689, granted to me on October 1, 1901, for an improvement in electric operation of elevators.

While my present invention, as shown, embodies substantially the same general arrangement of electrical circuits as shown and described in Patent No. 683,689 before referred to, and the ends sought to be attained are of the same general character as the objects hereinbefore set forth, my improvement consists in so arranging the circuits for controlling the elevator motor that, after the car has been started by pressing any one of the push-buttons and has finally come to rest at the particular floor or landing to which it was sent, by pressing an additional button the car will move in either direction a short distance only.

In push-button operated elevators in which the destination of the car is determined by pushing a corresponding button, the entire operation of the elevator apparatus as regards starting, accelerating, stopping and reversing is performed automatically. In such elevator systems it is found that the car will not always stop exactly at the desired landing, due to varying loads carried in the car. That is to say, if the elevator apparatus is adjusted to automatically stop adjacent any floor landing with a certain load, by varying this load the car will tend to overrun or fall short of an exact landing by a small amount. While in general this feature is of small moment, particularly where the elevator is used for passenger service alone, in many cases it is very desirable, if not absolutely necessary, to effect an exact landing of the car regardless of the load; such is the case where trucks are to be loaded or unloaded from the car. To effect such an exact landing without depending upon the skill of the operator, and without a refined or complicated system of control, I provide a simple controlling system which will automatically bring the car substantially adjacent the desired floor landing, varying more or less according to the load, and I then provide additional push buttons, one for an upward motion and one for a downward motion, and having circuits connected thereto, so that upon pressing one of these buttons the car will move a short distance only, several applications of the button being necessary to effect a longer movement. Or these buttons may be so arranged that they need not be operated several times to give a longer movement, a single operation of a button causing the car to move in automatic successive steps, allowing the operator to stop the movement at any step or when the car is exactly opposite the desired landing.

The following description taken in connection with the accompanying drawings shows how I purpose to accomplish the desired ends.

In the drawings the heavy black lines represent the motor circuits, while the light lines are the operating circuits.

Referring to Fig. 1, M designates an electric motor which may be connected to operate the elevator car C in any desired manner, such as the usual worm gearing and cable drum. B is a brake magnet which operates when energized to release the ordinary spring-pressed brake mechanism and

allow the motor to rotate, the brake being applied at all other times. S designates a motor-reversing switch, and, while this switch may vary in construction and operation, I prefer the construction shown and described in my patent before referred to. It comprises two oppositely arranged electro-magnets D and U which operate when energized to move an armature 16 upon which is mounted a series of contacts 17, 18, 19 and 21 adapted to electrically engage corresponding fixed contacts arranged on either side of the contact carrier 16. The fixed contacts are designated by 22, 23, 24 and 25 on one side, and 22′, 23′, 24′ and 25′ on the other side. 26 and 27 designate non-interference contacts which are normally in engagement with each other, but which have moved out of contact by the contact carrier 16 when the latter is moved to one side or the other by the magnets D or U. A designates an accelerating magnet which operates to cut out or short-circuit the starting resistance R and series field winding 20. 30 is the shunt field winding which remains energized whenever the motor M is in operation. A push-button switch 70 is arranged at each floor landing, while door contacts 71 are arranged upon the doors at these landings. The car contains a series of push-button switches 10, each button corresponding to a floor; also a safety switch 29 and car gate contact 28. Other push-button switches 31 and 32 are carried in the car. The floor buttons 70 and car buttons 10 are connected to corresponding relays 40 which are connected by means of the brushes 41, 42, 43 and 44 to a floor controller F. This floor controller F comprises two contact segments 47 and 48 which are adapted to make contact with the stationary brushes 41, 42, 43, 44, 45 and 46, the brushes 45 and 46 being connected to the reversing switch magnets U and D, respectively. The conducting segments 47 and 48 may be mounted upon some suitable insulating base which is arranged to be rotated in harmony with a moving part of the elevator apparatus, such as the hoisting drum shaft. The magnet 50 is a doubly wound magnet having its windings connected in opposition, while the magnet 60 is a safety car magnet. + and — designate conductors which connect the system of electrical circuits to some suitable source of electrical supply.

The drawing shows the car at rest at the third floor landing, the operating circuit being broken at the contact brush 43 of the floor controller. In order to show the operation of the apparatus, let it be assumed that the floor button 70 at the second floor is pressed. This establishes a circuit as follows: from the + main through the safety switch 29, car gate contact 28, landing door contacts 71, windings 51 and 52 of magnet 50, normally closed switch 53, contact 55 controlled by the accelerating magnet A, wire 49, push-button 70 at the second floor, wire 33, relay 34, brush 42, contact segment 47, brush 46, to and through the reversing switch magnet D, and by wire 35, contacts 27, wire 13, contacts 37, and wire 38 to the — main. This circuit just traced includes the magnet winding of the floor relay 34 and the reversing switch magnet D, both of which will become energized. The magnet 34 closes the switch 36 while the magnet D operates the reversing switch S, so that the contacts 17, 18, 19 and 21 carried upon the bar 16 are moved into electrical engagement with the fixed contacts 22, 23, 24 and 25, respectively. The bar 16 at the same time opens the switch 26. Upon closing the switch 36 a circuit is established through this switch and the resistance 54, which circuit is parallel to the circuit through the winding 52 of the differentially wound magnet 50 and the push-button 70, and the current in this winding 52 is thereby reduced to such an amount that the winding 51 is enabled to separate the contacts 53 and thus open the circuit for all of the push-buttons 70 through the wires 39 and 49. As soon as the switch 36 is closed, the push-button 70 at the second floor may be released, the controlling circuit being maintained closed at this switch until it is finally broken at the desired moment by the floor controller F when the car reaches its destination.

It will be seen that upon the operation of the reversing switch S a circuit will be closed through the motor M. This circuit may be traced as follows: from the positive main through the normally closed limit switch contacts 65, contacts 22 and 17 of the reversing switch, wire 69, series field 20, starting resistance R, wires 68 and 67, contacts 18 and 23 to the brush *b*, thence through the motor armature to brush *a*, contacts 24 and 19, and by wire 72 to the negative main. The shunt field 30 and brake magnet B are connected directly across the mains through the wires 69 and contacts 17 and 22 on one side and the wire 72 on the other side. The motor M therefore receives current which is limited in amount by the resistance R, and runs at slow speed, the brake being released by the energization of its magnet B. The motor is automatically brought up to full speed by means of the accelerating magnet A, the winding of which is connected across the brushes *a* and *b* of the motor upon the closing of the reversing switch S. The accelerating magnet A closes the switches 57 and 64 in the order named, thereby cutting out or short-circuiting the starting resistance R and the series

field 20, and thus bringing the motor up to full speed, the direction of rotation of the motor being such as to cause the elevator car to descend. The closing of the switches 57 and 64 opens the switches 55 and 59 which interrupts the circuit through the floor switches 70 and through the car switches 10, thereby rendering these push-buttons inoperative while the car is in motion.

The rotation of the motor will cause the floor controller segments 47 and 48 to rotate in a clockwise direction, and it will be seen that the operating circuit before described will be maintained until these segments have rotated sufficiently to allow the segment 47 to move out of electrical engagement with the brush 42 which will break the circuit of the reversing switch magnet D, releasing the bar 16 of the reversing switch and stopping the motor, the elevator car coming to rest at the second floor. It will be seen that when the controlling circuit is opened by the rotation of the floor controller segments when the car has arrived at the desired floor landing, the magnet 50, together with the other magnets in circuit, becomes de-energized, so that the system is again in position to be operated by pushing any particular push-button.

In case one of the car buttons 10 is pushed, the operating circuit is somewhat different than the circuit established by operating one of the floor buttons. To illustrate this operation, let it be assumed that the car is at the third floor landing as before, and one of the car buttons 10 corresponding to the second floor is pressed. The operating circuit is now closed from the + main through the safety switch 29, car gate contact 28, landing door contacts 71, winding 51 of the differential magnet 50, winding 61 of the safety car magnet 60, switch 59 of the accelerating apparatus, wire 73 to the car switches 10, and from here on the circuit continues through the floor relay 34, floor controller contacts, and reversing switch magnet D as before pointed out in connection with a floor button operation. The winding 52 of the magnet 50 does not receive current, hence the magnet winding 51 is enabled to immediately separate the contacts 53, thereby open-circuiting the floor buttons 70 and rendering them inoperative. Since the circuit includes the magnet 60, the same is energized to close the switch 62 which establishes a local circuit through the winding 51, winding 61, contacts 62, and resistance 63. It is readily seen that this local circuit is not opened by the floor controller when the car reaches its destination and the motor is stopped, and as long as this circuit remains closed it is impossible to again start the car by operating any one of the floor buttons, since their circuit is open at the contacts 53 of the relay 50. In order to open this local circuit, it will be necessary for the operator in the car to either press the safety button 29 or to open the gate on the car, thereby open-circuiting the magnets 50 and 60 and allowing their parts to return to normal position.

To prevent with certainty the possibility of interference from a floor with the operation of the motor when it is being operated from the car, and vice versa, and to prevent interference from either set of buttons when the motor is running, the back contacts 55 and 59 have been provided. The contacts 55 being in a circuit which supplies current to the floor buttons 70, while the contacts 59 are in a circuit which supplies current to the car buttons 10, it is readily seen that when the motor is running and these contacts have been separated by the accelerating magnet A, any operation of either the car or floor buttons has no effect on the system until after the motor has come to rest with the car at its destination.

When it is desired to send the car to an upper floor, the operating circuit is substantially the same as before, excepting in this case the circuit is closed through the segmental contact 48 and reversing switch magnet U. The latter upon becoming energized swings the contacts 17, 18, 19 and 21 into engagement with the fixed contacts 22′, 23′, 24′ and 25′, respectively, the circuits to the motor being the same as before excepting that the current flows through the motor armature in a reverse direction, that is, from the brush *a* to the brush *b*, and consequently the motor will rotate in an opposite direction and thus effect an upward movement of the elevator car C. It will be noticed that when the magnet D is energized to operate the reversing switch S, the circuit through the magnet U is open at the switch 26, while when the magnet U is energized the circuit through the magnet D is open at the switch 27, so that it is impossible to have both of the magnets D and U energized at the same time and thus cause a false operation. The limit switches controlling the normally closed switches 65 and 66 are arranged to be opened by the car when the same overruns its normal limit of travel in either an upward or downward direction, thereby opening the circuit to the motor and stopping the car. This description of a push button controlled elevator system is substantially the same as given in the patent before referred to, and, while such system is preferred by me for many reasons, other systems of elevator control which operate to bring an elevator car approximately to a landing may be used. In all such systems of elevator control, there is always the tendency for the elevator car to overrun or fall short of an exact landing, due to varying loads in the car, and I will now describe

the means by which I bring the car from an approximate to an exact level with the landing.

In addition to the push-buttons 10 and 70, by means of which the movements of the car are normally controlled, I provide push-buttons or other circuit-closing devices 31 and 32 which may be located in the car C as shown or located at the floor landings or other suitable places as desired. These buttons are similar to each other, and each comprises two movable contacts, as 74 and 75, and three fixed contacts, as 76, 77 and 78. The contact 74 is adapted to engage both of the contacts 76 and 77, while the contact 75 is adapted to engage the contact 78 when the button 31 is pressed.

5 designates an electrically operated switching device comprising two magnet cores 8 and 9 connected together and movable into the magnet windings 7 and 14, respectively. Each magnet when energized tends to lift its core and thereby separate the contacts 37 below and connect the contacts 6 above.

In order to illustrate the operation of the switches 31 and 32, let it be assumed that the elevator car is heavily loaded, and, after traveling from an upper floor, has been automatically stopped at the third floor landing, the heavy load in the car causing the latter to overrun the exact floor level. An operator at this floor desires to bring the car exactly opposite the floor level and he steps into the car and presses the push-button 31 corresponding to an upward movement of the car. The operation of the button 31 closes circuits which are as follows: from the positive main to the contact 74 and contacts 76 and 77. The circuit does not continue by way of contact 76, since this contact is open-circuited at the contacts 6. A circuit is closed, however, through the contact 77 by way of the wire 12, magnet U of the reversing switch, through the non-interference contacts 26, and by way of wire 13, contacts 37 and wire 38 to the negative main. The magnet U is thus connected directly across the mains, and the reversing switch S immediately operates to close the motor and brake circuits in a direction to cause the car to ascend. At the same time that the push-button contact 74 closes a circuit through the contact 77, the contact 75 electrically engages the contact 78, thereby connecting the magnet winding 14 in parallel with the motor armature. This circuit may be traced as follows: from the brush *a* through the contacts 23′ and 18, wires 67 and 81, contacts 75 and 78 of the push-button switch 31, wire 15, magnet winding 14, wires 38 and 72, reversing switch contacts 19 and 24′, and to the armature brush *b*. The magnet winding 14 is so adjusted that it will become sufficiently energized to lift its core 9 and thereby separate the contacts 37 when the motor armature attains a predetermined speed, which may be a few revolutions or nearly full speed, as desired. This adjustment limits the distance which the car will travel, since, when the magnet 14 lifts its core and separates the contacts 37, it opens the circuit through the reversing switch magnet U at these contacts and the reversing switch opens the motor and brake circuits and stops the motor, hoisting apparatus and car. The contacts 6 of the magnet switch 5 are brought together at substantially the same time that the contacts 37 are separated, and by bringing the contacts 6 together a circuit is closed from the + main through the push-button contacts 74 and 76, wire 79, contacts 6, magnet winding 7, and by wire 38 to the — main. The magnet winding 7 is thus connected through the push-button 31 directly across the mains and this circuit is maintained closed as long as the push-button 31 is held compressed. It is readily seen that as long as the push-button 31 remains in closed position and the core 8 is held up by the magnet 7, the contacts 37 will be separated, thereby open-circuiting the reversing switch magnet U through the wire 13 and preventing the reversing switch from again being operated to start the motor. As soon, however, as the push-button 31 is released and the circuit through the winding 7 is broken at the push-button contacts 76 and 74, the cores 8 and 9 return to their original positions with the contacts 37 once more in electrical engagement with each other and the contacts 6 separate as shown on the drawing. If the short upward movement given the car by operating the push-button 31 is not sufficient to bring the car exactly opposite the desired floor level, the button may be again compressed, giving the car a further upward movement, and this button may be operated as many times as is necessary to bring the car exactly opposite the required floor level.

The distance which the car will move at each operation of the push-button depends upon the adjustment of the magnet switch 5. Since the winding 14 is connected by the push-button 31 directly across the motor armature, its magnetizing power is proportional to the voltage across the motor armature, and as this voltage or drop in potential is substantially proportional to the counter-electro-motive force and speed of the motor, the adjustment of the magnet switch 5 may be made by varying the number of turns on the winding 14, or by regulating the position of the magnet core 9 with respect to the magnet winding 14, or by varying the weight of the core 9, or in other well known ways. In this manner the magnet switch 5 may be made to operate when

the motor has made a few revolutions only or not until the motor has come up to full speed, the distance of car travel for each application of the push-button being thus regulated from a fraction of an inch to several inches or more, as desired. Since each operation of the push-button 31 allows the car to move only a limited distance, an inexperienced operator may readily bring the car exactly to the desired floor level without danger of overrunning.

Should the elevator car automatically stop at a point above the desired floor level, the push-button 32 corresponding to a downward movement of the car is operated. In this case a circuit is closed through the magnet D of the reversing switch by way of the push-button contact 77′, and the reversing switch is operated to start the motor in a direction to lower the car, the operation of the magnet switch 5 being precisely the same as when the button 31 was operated. As before pointed out, the magnet winding 14 is connected through either of the push-buttons 31 or 32 across the armature brushes, and this circuit is only closed when the reversing switch S is operated; and since the connection of this magnet to the armature brushes is made upon the connection into circuit of the reversing switch contacts 18 and 19, it follows that the circuit through the magnet winding 14 is never reversed in direction, hence the magnet switch 5 responds more quickly to the varying voltage at the armature brushes as the motor accelerates in speed. I sometimes find it advantageous to connect the magnet winding 14 in such manner that it not only spans the motor armature, but also a part of the starting resistance R. This connection is illustrated in Fig. 3.

Referring to Fig. 2, which is a fragmentary diagram taken from Fig. 1 and showing the circuit of the magnet winding 14, it is seen that the wire 81 is connected to a point on the motor circuit between the motor armature and the starting resistance. This is the arrangement as described in connection with Fig. 1. In Fig. 3 the same arrangement of circuits prevails, excepting here the wire 81 is connected to some point on the starting resistance R in such manner that the terminals of the winding 14 not only span the motor armature, but also a portion of the starting resistance. The amount of resistance R included in the circuit may be varied at will by changing the connecting point of the wire 81 with the resistance.

In a modification of my device it is not necessary to operate the push-buttons 31 or 32 a number of times in order to produce a corresponding periodic movement of the elevator car, a single pressure on the push-button producing automatic successive steps of movement of the car, allowing the operator to stop this movement at any time by merely releasing the push-button. In this manner the car will move along a short distance at a time until the desired floor level is reached, when the operator releases the button and the car comes to rest. I accomplish the above result by leaving off the push-button contacts 76 and 76′ and also doing away with the magnet winding 7, core 8, and contacts 6. The wiring diagram thus modified is shown in Fig. 4 and the operation is as follows: Upon pressing the push-button 31′, two circuits are closed, one of which is from the positive main through contacts 74 and 77, wire 12, resistance 80, reversing switch magnet U, contacts 26, wire 13, contacts 37, and by the wire 38 to the negative main; the other circuit is from the armature brush *a* through contacts 75 and 78, wire 15, magnet winding 14, to the armature brush *b*. The first-named circuit includes the resistance 80, reversing switch magnet U, and contacts 37. The reversing switch is therefore operated and closes the motor circuits, causing the car to ascend. The second-named circuit connects the magnet winding 14 across the armature brushes *a* and *b*, and this magnet winding will gather strength as the motor increases its speed until it is powerful enough to lift its core 9 and thereby separate the contacts 37. As soon as these contacts become separated, the circuit through the reversing switch magnet U becomes broken and the motor circuit is thereby opened and the elevator car comes to rest. As the motor comes to rest the current in the magnet winding 14 ceases and the contacts 37 once more come into electrical engagement with each other, again closing a circuit through the reversing switch magnet U, and the same operation or cycle of operations is repeated. Thus it is seen that as long as the button 31′ remains compressed the elevator car will automatically move a short distance, stop, and then move again, this succession of steps being repeated until the push-button is finally released. The operation of the push-button 32′ produces similar results, only in this case the magnet D of the reversing switch is energized and the car travels in an opposite direction. While the magnet winding 14 of Fig. 4 may be connected through the reversing switch contacts across the armature brushes as shown in Fig. 1, I prefer to connect the terminals of this magnet directly to the armature brushes, thereby producing a longer time interval for each step instead of having the circuit of the magnet 14 broken as soon as the reversing switch opens its contacts, the current dying out as the motor comes to rest. The resistances 80 and 80′ are in circuit with the reversing switch magnets U and D, respectively, only when the push-buttons 31′ and 32′ are operated, and may be used or not as desired,

the object of their use being to limit the current flow in these magnets when the reversing switch S is operated from the buttons 31′ and 32′, for in this case the reversing switch magnets are subjected to the full line potential, while in the regular operation of the motor-controlling system these magnets have in circuit with them one of the floor relays, the resistance 54, and the winding 51 of magnet 50.

It is evident that my invention as applied to an automatic system of elevator control enables an unskilled operator to make an exact landing, regardless of the position of the car with respect to said landing and without danger of overrunning the landing.

Obviously those skilled in the art may make various changes in the details and arrangement of parts without departing from the spirit and scope of the invention as defined by the claims. I wish, therefore, not to be limited to the precise construction herein disclosed.

What I claim is:—

1. In an elevator system, the combination with a car, of automatically controlled apparatus for bringing the car to any desired floor landing, and automatic means for effecting a small additional movement or movements of the car.

2. In an elevator system, the combination with a car, of a motor, apparatus for operating the motor to bring the car to rest at or near any desired floor landing, and means for effecting a short additional movement of the motor in either direction.

3. In an elevator system, the combination with a car, of an electric motor, controlling mechanism for automatically effecting the travel of the car through a predetermined distance, and manually operable means for controlling the motor circuits to effect a small additional movement or movements of the car.

4. The combination with an electric motor, of controlling circuits and mechanism for effecting the operation of the motor through comparatively long ranges of movement, and additional circuits and connections for effecting successive movements of the motor through short distances only.

5. The combination with an electric motor, of controlling circuits and mechanism for automatically effecting the normal operation of the motor, and automatic means for effecting step-by-step movements of the motor.

6. The combination with an electric motor, of controlling and operating circuits and mechanism therefor, means for effecting short operations of said motor and means depending upon the counter-electro-motive-force of said motor for automatically cutting off the current supply after each short operation of the motor.

7. The combination with an electric motor, of automatically controlled means for imparting a continuous rotation to the motor armature during its normal operation, and automatic means for effecting a step by step operation of the motor.

8. The combination with an electric motor, of controlling circuits and mechanism for effecting a continuous rotation of the motor armature during its normal operation, and manually-controlled means for automatically effecting an intermittent rotation of the armature through a series of short steps.

9. The combination with an electric motor, of means for supplying current thereto, and means dependent upon the motor for automatically cutting off the current supply to stop the motor before the motor has reached its normal speed.

10. The combination with an electric motor, of a normally open controlling circuit therefor, means for closing said circuit and effecting a supply of current to the motor, and a device controlled by the speed of the motor for opening said circuit before the motor has developed a normal speed.

11. The combination with an electric motor comprising a rotary armature, of a normally open controlling circuit for the motor, a manual device for closing the circuit, and a normally closed electro-magnetic switch in said circuit, said switch having its magnet winding connected in parallel with the motor armature and designed to open the switch before the motor reaches its normal speed.

12. The combination with an electric motor comprising a rotary armature, of a controlling circuit for the motor, a normally open push-button switch in said circuit, and a normally closed electro-magnetic switch in said circuit and having its magnet winding connected across the motor armature and designed to open the normally closed switch when the motor has developed a fraction of its normal counter-electro-motive force.

13. The combination with an electric motor comprising a rotary armature, of an electro-magnetic reversing switch, a normally open circuit including a magnet winding of the reversing switch, means for closing said circuit, a normally closed switch in said circuit, and an electro-magnet for operating said last-named switch and having its winding connected to receive current varying with the speed of the armature and designed to open the switch when the armature has developed a fraction only of its normal speed.

14. The combination with an electric motor comprising a rotary armature, of a controlling circuit, a normally open push-button switch in said circuit, a normally closed switch in said circuit, means for automatically opening said normally closed

switch when the motor has developed a fraction of its normal speed, and a device for holding said last-named switch open when said means has operated.

15. The combination with an electric motor having a rotary armature, of a controlling circuit, a normally open manual switch in said circuit, a normally closed electro-magnetic switch in said circuit and having its winding in a circuit in parallel with the armature, and a second magnet winding forming a holding means for said switch.

16. The combination with an electric motor, of a controlling circuit therefor, a normally open manual switch in said circuit, an electro-magnetic device comprising a normally closed switch in said circuit and a normally open switch, a magnet winding for said device in a circuit in parallel with the motor armature, a second magnet winding for said device, and a circuit therefor including said normally open switch and also normally open at said manual switch.

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

JOHN D. IHLDER.

Witnesses:

JOHN R. EVERS,

JAMES G. BETHELL.