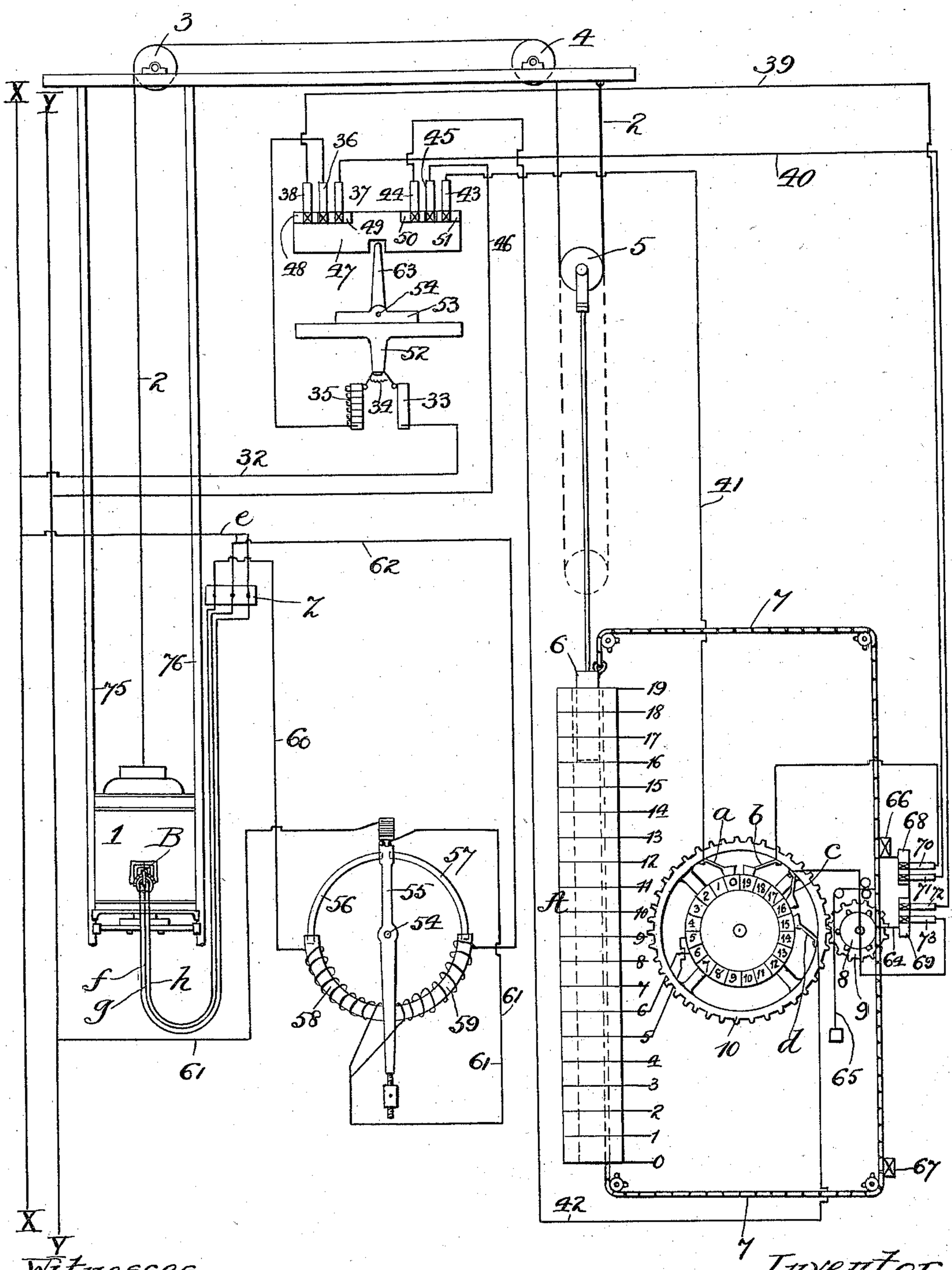
(No Model.)

H. R. SMITH.

ELECTRIC ELEVATOR.

No. 555,979. Patented Mar. 10, 1896.



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UNITED STATES PATENT OFFICE.

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ELECTRIC ELEVATOR.

SPECIFICATION forming part of Letters Patent No. 555,979, dated March 10, 1896.

Application filed March 23, 1895. Serial No. 542,937. (No model.)

To all whom it may concern:

Be it known that I, HUMPHREY RUSSELL SMITH, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented new and useful Improvements in Electric Elevators, of which the following is a specification.

This invention relates to electric elevators; and its object is to provide a novel and useful arrangement of devices for controlling an elevator electrically, to improve and simplify the construction of the same, to cheapen the cost of construction and to render the same more efficient in operation.

The invention consists substantially in the construction, combination, location and relative arrangement of parts, all as will be more fully hereinafter set forth, as shown in the accompanying drawing, and finally more specifically pointed out in the appended claims.

The drawing illustrates diagrammatically a construction and arrangement of parts embodying the principles of my invention.

Reference-sign 1 indicates a car to which is suitably attached the hoisting-cable 2, which may be of any suitable or desirable arrangement. In the form shown the hoisting-cable 2 passes over suitable guide-pulleys 3 4, and forming a bight is finally secured to some convenient fixed part, but, of course, it will be readily understood that any other suitable or desirable arrangement may be employed, and said cable may be of any suitable number of runs in order to multiply the speed a desired amount. Arranged in the bight formed in the hoisting-cable is a traveling sheave 5, suitably attached to move with and to be moved by a soft-iron bar 6, which may be of a weight sufficient to counterbalance the weight of the car, and, in addition, any desired proportion of the weight of the load which the car is designed to carry.

In carrying out the principles of my invention the counterweight 6 is designed to constitute the core of a helix or solenoid A, so that when the coils of the solenoid are excited by the passage therethrough of an electric current a magnetic attraction is exerted upon weight 6, thereby causing it to travel through the solenoid and thereby effect a travel of the car. By providing suitable means for varying the current through the coils of the solenoid any desired variation in degree of magnetic attraction exerted upon weight 6 may be secured, thereby effecting a movement of the car under varying conditions of load and at varying speeds of travel, the weight 6 not only serving as the counterweight for the car, but also constituting as the core of the solenoid the motor for effecting the movement of the car.

In order to effect the best results and in the most direct and economical manner in the adaptation of my invention, I construct the solenoid A of a series of sections, numbered from 0 to 19, respectively, and, preferably, when suitably arranged in their operative relation, forming a hollow cylinder in which core and counterweight 6 is adapted to travel, the length of the built-up solenoid being any suitable or desirable multiple of the length of the weight, dependent somewhat upon the exigencies of each particular structure, and instead of exciting all the coils of the solenoid throughout the entire length thereof I provide an arrangement wherein the several sections of the solenoid are automatically and successively cut in and out of the circuit of the exciting-current, thereby effecting a continuous travel of the core or weight 6. Any suitable or convenient arrangement for accomplishing this result may be employed.

I have shown a simple arrangement illustrative of the principle involved; but I do not desire to be limited or restricted to any particular form of mechanism or arrangement of parts for accomplishing this result. In the form shown I provide in any suitable or convenient location a series of contacts, numbered from 0 to 19, corresponding in arrangement to the number of sections of the solenoid A, and each connected electrically with its corresponding section, as shown. A set of brushes *a b c d* are arranged to travel over the contacts in order to make or break the circuit through the coils of the solenoid-section, the brushes being arranged a distance apart corresponding to the number of consecutive solenoid-sections which it is desired to simultaneously excite and dependent somewhat upon the relative lengths of the solenoid A and its core 6. It is desirable that the travel

of brushes *a b c d* over the contacts be synchronous with the travel of the core through the solenoid both as to speed and direction. I have shown a simple embodiment of this idea, wherein a chain-sprocket or other flexible connection 7 is connected at the respective ends thereof to the core 6 to travel therewith. Suitably and conveniently arranged to be actuated by the movement of connection 7 is a sprocket-wheel 8, arranged to actuate by its movement a gear-wheel 9, which meshes with and drives a toothed ring 10, carrying the brushes *a b c d*. In this form the contacts 0 to 19 are circularly arranged.

It will be seen from the foregoing that as the core 6 proceeds upon its travel throughout the solenoid the brushes *a b c d* pass consecutively over the contacts and cut in and out successively the various coils composing the built-up solenoid. For instance, assuming that brushes *b* and *d* are the positive and negative brushes respectively of the same circuit, and that the parts are in the relative positions shown in the drawing, now if the current is turned on it will pass from brush *b* to contact 19, and thence to its corresponding coil 19 of the solenoid and successively through the several coils of the solenoid to coil 15, thence out through the connection between said coil and contact 15, thence through said contact, brush *d* and the negative line-wire. It will be observed that the combined counterweight and core 6, as shown, projects at one end slightly beyond coil 19 of the solenoid, and at the other end is just on the point of entering coil 15.

By passing the exciting-current through the coils 19 to 15 a solenoidal effect is attained in said coils, which, under a well-known rule of action of solenoidal constructions, causes the core 6 to move to a medial position with respect to the relative lengths of said core and the part of solenoid A which has been excited—namely, that part included in coils 19 to 15. In the form shown, therefore, the core 6 will descend. This movement of the core will cause a corresponding movement of connection 7, and hence of gears 8 9 and brush-ring 10, the brush-ring being moved rotarily to the right from the position thereof shown in the drawing, and hence moving brushes *b* and *d*, respectively, into contact with contacts 18 and 14. This movement will cause coil 19 of the solenoid to be cut out and coil 14 to be cut into the exciting-circuit, thereby causing the core 6 to move still farther through the solenoid, and so on throughout the entire length of the solenoid, the coils of the solenoid being successively cut in and cut out of the exciting-circuit as the core proceeds upon its travel, and thereby exciting only that portion of the solenoid required to be excited to effect the movement of the solenoid a short distance. By this arrangement the amount of the current required to excite the solenoid is greatly economized, and the entire force of the exciting-current of the solenoid is applied in the most effective and direct manner to accomplish the work required. By suitably constructing the core 6 of a weight sufficient to counterbalance the weight of the car, and, in addition, any desired proportion of the load designed to be carried by the car, only a comparatively small attractive force is necessary to be applied to core 6 to effect a movement of the car in the practical application of the principle of my invention.

Similarly to the operation above described a reverse movement of the core is effected—that is, the core 6 may be moved in the opposite direction—by cutting out the lowermost coil of the solenoid, as in the form shown, and cutting in the next succeeding upper one of the several sections comprising the part to be excited. In this case brushes *c* and *a* constitute, respectively, the positive and negative brushes of the exciting-circuit.

By reference to the drawing it will be seen that as the core 6 proceeds upon its travel through solenoid A from its position, as shown, the solenoid-coils beginning with coil 19 are successively cut out of the circuit, and the coils beginning with coil 14 are successively cut in the circuit throughout the length of the solenoid until the coil designated by O is cut in. It will be understood that when this point is reached the brushes will have traveled over the contacts until brush *d* stands on the *o* contact.

The relative arrangement of the several brushes *a b c d*, as shown, is such that brushes *a* and *b* are with respect to each other on adjacent contacts and brushes *c d* are with respect to each other on adjacent contacts, and that three contacts intervene between the members of each pair of brushes *a c* and *b d*. Therefore when the negative brush *d* stands on the *o* contact—that is, when the core 6 has reached the limit of its travel in one direction—the corresponding positive brush *b* stands on contact 4, and in the particular arrangement shown when the brush *d* is on the *o* contact the adjacent brush *c* stands on the contact numbered 1 and its corresponding brush *a* stands on contact 5. If, when this condition arises, the current is reversed and instead of being passed from the higher-numbered solenoid-coils through the lower-numbered coils is passed from the lower through the higher numbered coils—that is, instead of completing the circuit through the solenoid-coils and brushes *b d* respectively as positive and negative brushes if the current is made to pass through the solenoid-coils and brushes *c* and *a* respectively as positive and negative brushes—the reverse of the above-described movement takes place, and its travel in the opposite direction is effected.

It will be understood that I do not desire to be limited to the exact relative arrangement of the several brushes *a b c d* shown and described, as such relative arrangement may be varied or altered at will to suit the necessities of each particular case.

In the practical application of my invention it is important that the electric current sent through the solenoid-coils be controllable at will both as to strength and intensity and as to direction. It is also important that this control be exercised from the car.

I will now describe a convenient arrangement of current-controlling devices, though I desire it to be distinctly understood that I do not limit myself to the exact details of construction or arrangement shown and described, as the principle involved may be embodied in a wide variety of details and still fall within the spirit and scope of my invention.

The circuit for supplying current to the coils of the solenoid leads from the positive wire X of the main circuit through a suitable connection 32 to a contact-strip 33, thence through a suitably-arranged brush 34 to and through a resistance-box 35, thence to a brush 36 adapted to be brought into electrical connection with either brush 37 or brush 38. From brush 38 the circuit leads through connection 39 in any suitable manner, as will be more fully hereinafter explained, to traveling brush *b*, and from brush 37 the circuit leads through a connection 40, as will be more fully hereinafter explained, to traveling brush *c*. The brushes *a* and *d* are in electrical connection through connections 41 42 respectively with brushes 43 44, which are adapted to be brought alternately into electrical contact with a brush 45, having connection through 46 to the negative wire Y of the main circuit.

The members of each set of brushes 37 38 and 43 44 may be brought into electrical connection alternately with brushes 36 and 45, respectively, in any suitable or convenient way. I have shown a simple construction for effecting this result, wherein a plate 47 is arranged adjacent to the sets of brushes and carries adjacent to each set of brushes a pair of contact-strips 48 49 50 51. When plate 47 is moved, say to the right from the position shown, the contact-strips 48 50 are moved to complete the circuit between brushes 38 36 of one set and brushes 44 45 of the other set. In like manner when the plate 47 is moved to the left the above connections are first broken, and upon further movement of said plate the contact-strips 49 51 move into position to complete the circuit between brushes 36 37 of one set and brushes 43 45 of the other set. Assuming that plate 47 has been moved to the right, as above explained, then the circuit is as follows: from the positive wire X through connection 32 to strip 33, through brush 34, resistance-box 35 to brush 36, through strip 48 to brush 38, through connection 39 to brush *b*, through contact 19, and thence to the corresponding coil 19 of the solenoid, and thence through the adjacent coils consecutively to coil 15, thence to contact 15, through brush *d*, connection 42 to brush 44, through strip 50 to brush 45, thence to the negative wire Y of the main circuit through connection 46. The effect will be that the coils of the first four sections of the solenoid will be excited and the core 6 will be moved thereby and will effect a movement of the brush-ring 10 in a direction opposed to the direction of travel of the hands of a clock, hence shifting the brushes *b d* to break connection with contacts 19 and 15, respectively, and to make connection with contacts 18 and 14, respectively, thereby cutting out the coils of the section 19 of the solenoid and cutting in the coils of section 14, and hence effecting a further and continuous movement of core 6, and so on throughout the entire travel thereof in one direction, this movement of the core effecting a corresponding movement of the car. Now suppose the plate 47 is shifted to the left the contact between brushes 38 36 and between 44 45 is broken and that between the brushes 36 37 and between 45 43 is made, the circuit in this case being from brush 36, through strip 49 to brush 37, thence through connection 40 to brush *c*, thence through the contact upon which brush *c* may bear, thence through the coils of the corresponding section of the solenoid to and through the adjacent solenoid-sections till that particular coil is reached which is connected to the particular contact upon which brush *a* bears, thence out through connection 41, brush 43, strip 51, brush 45 and connection 46 to the negative wire of the main line. This operation will, in a manner similar to that above described, effect a reversal of the movement of the core 6, and hence also of the car, as will be readily understood.

As it is important that the intensity of the current employed to excite the coils of the solenoid be controllable in order, in the practical application of my invention, to provide for varying conditions of speed and load, any suitably-arranged apparatus for accomplishing this result may be provided. I have shown a form of arrangement and apparatus whereby this result is secured and wherein I interpose in the circuit leading from the main wire X to brush 36 a resistance-box 35, composed of a series of resistance-coils through which the current passes on its way to the coils of the solenoid when the circuit is suitably closed. Any suitably-arranged apparatus may be provided for automatically cutting in or out any desired number of the resistance-coils in box 35, thereby controlling the intensity of the solenoid-energizing current. I have shown a form of apparatus for accomplishing this result, wherein a contact-strip 33 is included in the connection 32 from the positive wire X of the main supply-circuit and is arranged adjacent to resistance-box 35. A brush 34 is constructed and arranged to make constant contact between strip 33 and box 35. The normal connection between said brush and resistance-box is such that the current passes through all the resistance-coils. By suitably moving the brush from its normal position more and more of the resistance-coils are cut

out of the circuit the farther the brush is moved.

In elevator constructions it is important that the movement of brush 34 be controllable from the car. Any suitable means, either mechanical or electrical, may be employed for effecting this movement from the car. I have shown a form of apparatus for accomplishing this result by electrical means, wherein the brush 34 is mounted upon a suitably-sliding piece 52, adapted to be moved by the engagement therewith of a winged or flanged bar 53, mounted upon to rock with a shaft or support 54. The wings or flanges upon bar 53 extend on opposite sides of the pivot of said bar, and hence the piece 52 is slid in the same direction, whichever direction the bar 53 is rocked. Mounted upon to rock with the support or shaft 54 is an arm 55, carrying soft-iron bars 56 57, arranged to form cores for solenoids 58 59, respectively. The coils of solenoid 58 are included in a circuit 60, leading from a plug-box Z, thence through the solenoid-coils, thence through the connection 51 to the negative wire Y of the main circuit, and the coils of solenoid 59 are included in a circuit 62, leading from the plug-box Z through the solenoid-coils, thence to the negative wire Y through connections 61. A connection *e* is made from the positive wire of the main circuit to plug-box Z, and the several connections *e*, 62 and 60 are connected through suitable conductors *f g h* with a switch-box B, carried by the car, constructed and adapted to complete the circuit from the positive feed-wire X, through either solenoid 58 or 59 at will, to the negative wire Y of the main circuit. The specific construction and arrangement of switch B and the solenoidal construction above mentioned are more fully described and shown in my prior application, Serial No. 540,455, filed March 4, 1895, and therefore do not require further description herein.

It will be seen from the foregoing that core 56 or core 57 is attracted according as solenoids 58 or 59 are excited, and by suitably manipulating the switch-lever on the car said solenoids may be excited at will. It will also be observed from the foregoing description that whether the shaft or support 54 is rocked to the right or the left the same movement of brush 34 is effected, and that the amount of movement of said brush is dependent upon the distance through which bar 55 is rocked. Therefore by suitably regulating and controlling the intensity of the current through solenoids 58 and 59 the amount of rocking of said arm may be regulated, and hence also the intensity of the current through the circuit, including the resistance-box 35.

Any suitable means for shifting contact-strips 48 49 50 51 to reverse the working current may be employed. I have shown an illustrative embodiment of the idea involved, wherein this shifting may be effected from the car and is dependent upon and operated by the same mechanism that shifts brush 34. In this embodiment an arm 63 is mounted to rock with the shaft or support 54, and is arranged to suitably engage plate 47 to slide the same back and forth according to the direction in which said arm is rocked.

In order to prevent and avoid accidents due to the carelessness or negligence of the car-conductor in failing to properly break the working circuit when the car has reached the extreme limit of its travel, or in case the circuits should become accidentally disarranged, or from any other cause there should be a failure to break the working circuit at the proper time, it is important to provide automatic means, in addition to the reversing and breaking mechanism above described, adapted to operate as a safety device or stop to break the working circuit when the car reaches the extreme limits of its travel and dependent for its operation upon the movement of the car. This idea may be embodied in a wide variety of arrangements, and while I have shown a form of apparatus for carrying out this idea I do not desire to be limited or restricted to the specific construction and arrangement thereof. In the form shown I arrange adjacent to the connection 7 a plate 64, adapted to be normally held in position by any suitable means, as a weighted cord 65, arranged to return said plate to its normal position when released after being moved in one direction or the other, as hereinafter more fully explained. Carried by connection 7 are two blocks 66 67, spaced a distance apart corresponding to the distance through which the core 6 travels in going from one to the other of its extreme limits. Stops 66 67 are arranged to engage and move plate 64 when the core approaches its limit of travel. Upon plate 64 is mounted contact-plates 68 69, each adapted when said plate is moved to make or break contact with the members of the pairs of brushes 70 71 and 72 73, respectively. Instead of the brushes *b* and *c* being included directly in the circuit connections 39 and 40, respectively, said connections lead to the brushes 71 and 72, respectively, and the circuit is completed or broken from said brushes to brushes *b* or *c*, according as plate 64 is moved in one direction or the other, the normal position of said plate being such as to close said circuits.

Suppose the parts to be in the position shown. The circuits through connections 39 40 are completed to brushes *b* and *c*, and the current *t* may be reversed at will by suitably shifting plate 47, as above described. Now suppose the core 6 has been moved through the solenoid H and is approaching the lower limit of its travel. The block 67 engages the plate 64 and moves it along with the connection 7, thereby moving the strips 68 out of contact with brush 71, and hence automatically breaking the circuit and arresting the movement of the core, and hence, also, of the car.

It will be seen that strips 68 and 69 are of

sufficient length and proper relative arrangement so that when plate 64 is moved in a direction to break contact between brushes 70 and 71 the contact between brushes 72 73 is retained, thereby automatically breaking one circuit, but leaving the circuit for the reversing-current in operative connection. The same is true when plate 64 is moved in a direction to break the contact between brushes 72 73, the same movement leaving brushes 70 71 in electrical connection.

Any suitable or convenient grip mechanism adapted to grip the guides 75 76, in which the car moves in its travel, may be mounted on the car for arresting the movement of the car when the working circuit through solenoid A has been broken.

Having now fully explained the object and nature of my invention, and having described a form of apparatus, its function and mode of operation, embodying the same, what I claim as new and of my own invention, and desire to secure by Letters Patent of the United States, is—

1. In an electric elevator, a car, a hoisting-cable therefor, a magnetic piece suspended from said cable, a motor, comprising a solenoid, said magnetic piece forming the core of said solenoid, and means for energizing said solenoid; as and for the purpose set forth.

2. In an electric elevator, a car, a hoisting-cable therefor, a magnetic piece carried by said cable, a motor, comprising a solenoid, said magnetic piece forming the core of said solenoid, means for energizing various portions of said solenoid, whereby said core is moved and said car operated; as and for the purpose set forth.

3. In an electric elevator, a sectional solenoid a car, a hoisting-cable therefor, carrying a magnetic piece forming the core of said solenoid, and means for successively energizing the sections of said solenoid; as and for the purpose set forth.

4. In an electric elevator, a car, a hoisting-cable therefor, carrying a magnetic piece, a motor, comprising a solenoid, said magnetic piece forming the core of said solenoid, and means, controllable from the car, for energizing various portions of said solenoid; as and for the purpose set forth.

5. In an elevator a car, a counterweight therefor, and a solenoid, said counterweight forming the core of said solenoid; as and for the purpose set forth.

6. In an elevator, a car, a hoisting-cable therefor, a magnetic weight connected to said hoisting-cable, a solenoid the weight forming the core of said solenoid, and means for energizing said solenoid; as and for the purpose set forth.

7. In an apparatus of the class described, a car, a hoisting-cable therefor, a magnetic piece suspended from said hoisting-cable, and electrical means for attracting and repelling said magnetic piece, whereby said car is operated; as and for the purpose set forth.

8. In an elevator a car, a hoisting-cable therefor, a magnetic piece connected to said cable, a solenoid, said magnetic piece forming the core of said solenoid, and connections for energizing the solenoid; as and for the purpose set forth.

9. In an elevator a car, a hoisting-cable therefor, a magnetic piece connected to said cable, a solenoid, said magnetic piece forming the core of said solenoid, an electric circuit for said solenoid, and means arranged in said circuit for admitting current to said solenoid, and means arranged in said circuit for varying the energizing-current; as and for the purpose set forth.

10. In an elevator, a car, a hoisting-cable therefor, a magnetic piece connected to said cable, a solenoid, said magnetic piece forming the core of said solenoid, an electric circuit for said solenoid, and means arranged in said circuit for admitting the current to different portions of said solenoid therein; as and for the purpose set forth.

11. In an elevator a car, a hoisting-cable therefor, a magnetic piece connected to said hoisting-cable, means for moving said magnetic piece, comprising a sectional solenoid, said piece forming the core of said solenoid; as and for the purpose set forth.

12. In an elevator, a car, a hoisting-cable therefor, a magnetic piece connected to said hoisting-cable, means for moving said magnetic piece, comprising a sectional solenoid, said magnetic piece forming the core for said solenoid, and connections whereby only a portion of the sections of said solenoid are energized at the same time; as and for the purpose set forth.

13. In an elevator, a car, a hoisting-cable, operating means for said cable, comprising a magnetic piece, a solenoid, said magnetic piece forming the core of said solenoid, and means operating from the car for controlling the energizing-current of said solenoid; as and for the purpose set forth.

14. In an elevator, a car, a hoisting-cable, operating means therefor, comprising a solenoid, a circuit for the same, and means arranged in said circuit for energizing successive portions of said solenoid; as and for the purpose set forth.

15. In an elevator, a car, a hoisting-cable therefor, a hoisting-motor, comprising a solenoid, a circuit for the same, means arranged in said circuit and controllable from the car for varying the strength of the current of said circuit, the core of said solenoid connected to said hoisting-cable to actuate the same; as and for the purpose set forth.

16. In an elevator, a car, a hoisting means therefor, comprising a sectional solenoid, a hoisting-cable connected respectively to said car and to the core of said solenoid, an elec-

trical circuit for said solenoid, and means arranged in said circuit for cutting in and out successively the sections of said solenoid, whereby said core is moved and said car operated; as and for the purpose set forth.

17. In an elevator, a car, controlling means therefor, comprising a sectional solenoid, a circuit for said solenoid, and automatic means arranged in said circuit for cutting in and out of circuit the sections of said solenoid; as and for the purpose set forth.

18. In an elevator, a car, controlling means therefor, comprising a sectional solenoid, a circuit for said solenoid, and a switching device arranged in said circuit for automatically cutting in and out of circuit successively the sections of said solenoid; as and for the purpose set forth.

19. In an elevator a car, controlling means therefor, comprising a sectional solenoid, a circuit for the same, and means operated by the movement of the solenoid-core for cutting in and out of circuit successively the sections of said solenoid; as and for the purpose set forth.

20. In an elevator, a car, a hoisting-cable therefor, a magnetic piece carried by said cable, said magnetic piece forming the core of a sectional solenoid, a series of contacts corresponding in arrangement to the sections of said solenoid, and each contact in electrical connection with its corresponding section of the solenoid, a circuit for said solenoid, brushes arranged in said circuit adapted to complete the circuit through said contacts, and means for shifting said brushes; as and for the purpose set forth.

21. In an elevator, a car, a hoisting-cable therefor, a magnetic piece carried by said cable, said magnetic piece forming the core of a sectional solenoid, a series of contacts corresponding in number to the sections of said solenoid and each connected to its corresponding solenoidal section, a circuit for said solenoid, movable brushes arranged in said circuit and arranged to bear on said contacts to complete the circuit through one or more of said solenoidal sections, and means for moving said brushes; as and for the purpose set forth.

22. In an elevator, a car, a hoisting-cable therefor, a magnetic piece carried by said cable, said magnetic piece forming the core of a sectional solenoid, a series of contacts corresponding in number to the sections of said solenoid and each connected to its corresponding section, a circuit for said solenoid, movable brushes arranged in said circuit to bear on said contacts, whereby the circuit through one or more of said sections is completed, and means for shifting said brushes automatically, whereby said sections are successively cut in and out of the circuit; as and for the purpose set forth.

23. In an elevator, a car, a hoisting-cable therefor, a magnetic piece carried by said cable, said magnetic piece forming the core of a sectional solenoid, a series of contacts corresponding in number to the solenoidal sections, and each contact in electrical connection with its corresponding solenoidal section, a circuit for said solenoid, movable brushes arranged in said circuit to bear upon contacts, whereby the circuit is completed through one or more of said solenoidal sections, and means actuated by the movement of the solenoid-core for shifting said brushes whereby the solenoidal sections are progressively cut in and out of the circuit; as and for the purpose set forth.

24. In an elevator, a car, a hoisting-cable therefor, a magnetic piece carried by said cable, said magnetic piece forming the core of a sectional solenoid, a series of circularly-arranged contacts corresponding in number to the number of solenoidal sections, and electrical connections between each contact and section, a circuit for said solenoid-brushes arranged therein, and means for moving said brushes in contact with said contacts, whereby the circuit is made progressively through the solenoidal sections; as and for the purpose set forth.

25. In an elevator, a car, a hoisting-cable therefor, a magnetic piece carried by said cable, said magnetic piece forming the core of a sectional solenoid, a series of circularly-arranged contacts, each in electrical connection with a section of said solenoid, a circuit for said solenoid, a ring arranged adjacent to said contacts and carrying brushes arranged in said circuit, and means for rotating said ring about said contacts, whereby the circuit is made and broken progressively through the sections of said solenoid; as and for the purpose set forth.

26. In an elevator, a car, a hoisting-cable therefor, a magnetic piece carried by said cable, said magnetic piece forming the core of a sectional solenoid, a series of circularly-arranged contacts, each in electrical connection with a solenoidal section, a circuit for said solenoid, a ring carrying brushes arranged in said circuit, said brushes adapted to travel over said contacts when said ring is turned; as and for the purpose set forth.

27. In an elevator, a car, a hoisting-cable therefor, a magnetic piece carried by said cable, said magnetic piece forming the core of a sectional solenoid, a series of circularly-arranged contacts, each in electrical connection with a solenoidal section, a circuit for said solenoid, a ring carrying brushes arranged in said circuit, said brushes adapted to travel over said contacts when said ring is turned, and means actuated by the movement of the solenoid-core for turning said ring; as and for the purpose set forth.

28. In an elevator, a car, a hoisting-cable therefor, a magnetic piece carried by said cable, said magnetic piece forming the core of a sectional solenoid, a series of contacts, each in electrical connection with a section of the solenoid, a circuit for said solenoid including

brushes arranged to travel over said contacts, a core, a traveling part connected to travel with said core, and means actuated thereby for moving said brushes over said contacts; as and for the purpose set forth.

29. In an elevator, a car, a hoisting-cable therefor, a magnetic piece carried by said cable, said magnetic piece forming the core of a sectional solenoid, a series of contacts, each in electrical connection with a section of the solenoid, a circuit for said solenoid, including brushes arranged to travel over said contacts, a core, a flexible connection attached to travel with said core, and means whereby the movement of said connection is imparted to said brushes; as and for the purpose set forth.

30. In an elevator, a car, a motor for controlling the same comprising a solenoid, a circuit for said solenoid, and means included in said circuit for arresting the action of the solenoid at the limits of travel of the car; as and for the purpose set forth.

31. In an elevator, a car, a motor for controlling the same, comprising a solenoid, a circuit for said solenoid, and automatic means included in said circuit for arresting the action of the solenoid at the limits of travel of the car; as and for the purpose set forth.

32. In an elevator, a car, a hoisting-cable therefor, a motor comprising a solenoid, a circuit for the same, connections between said hoisting-cable and the core of said solenoid, means for automatically arresting the action of said solenoid at the extreme limits of travel of the car; as and for the purpose set forth.

33. In an elevator, a car, a hoisting-cable therefor, a motor comprising a solenoid, a circuit for the same, connections between the core of said solenoid and said hoisting-cable whereby movement of the core effects a movement of the car, and means actuated by the movement of the solenoid-core for arresting the movement of the car at the limits of travel thereof; as and for the purpose set forth.

34. In an elevator, a car, a hoisting-cable therefor, a motor comprising a solenoid, connections between said hoisting-cable and the core of said solenoid, whereby movement of the latter effects a movement of the car, a circuit for said solenoid, a traveling current-shifting device, arranged to automatically shift the current from said solenoid at the limits of travel of the car; as and for the purpose set forth.

35. In an electric elevator a car, an electrically-operated motor for controlling the same, comprising a solenoid, connections between the core of said solenoid and the hoisting-cable of said car, a circuit for said motor and means for automatically interrupting the working circuit of said motor at the extreme limits of travel of the car; as and for the purpose set forth.

In witness whereof I have hereunto set my hand this 20th of March, 1895.

HUMPHREY RUSSELL SMITH.

Witnesses:
S. E. DARBY,
M. I. CAVANAGH.