No. 772,086. PATENTED OCT. 11, 1904.

E. R. CARICHOFF.

ELECTRIC ELEVATOR APPARATUS.

APPLICATION FILED JULY 29, 1903.

NO MODEL. 2 SHEETS—SHEET 1.

Fig. 1.

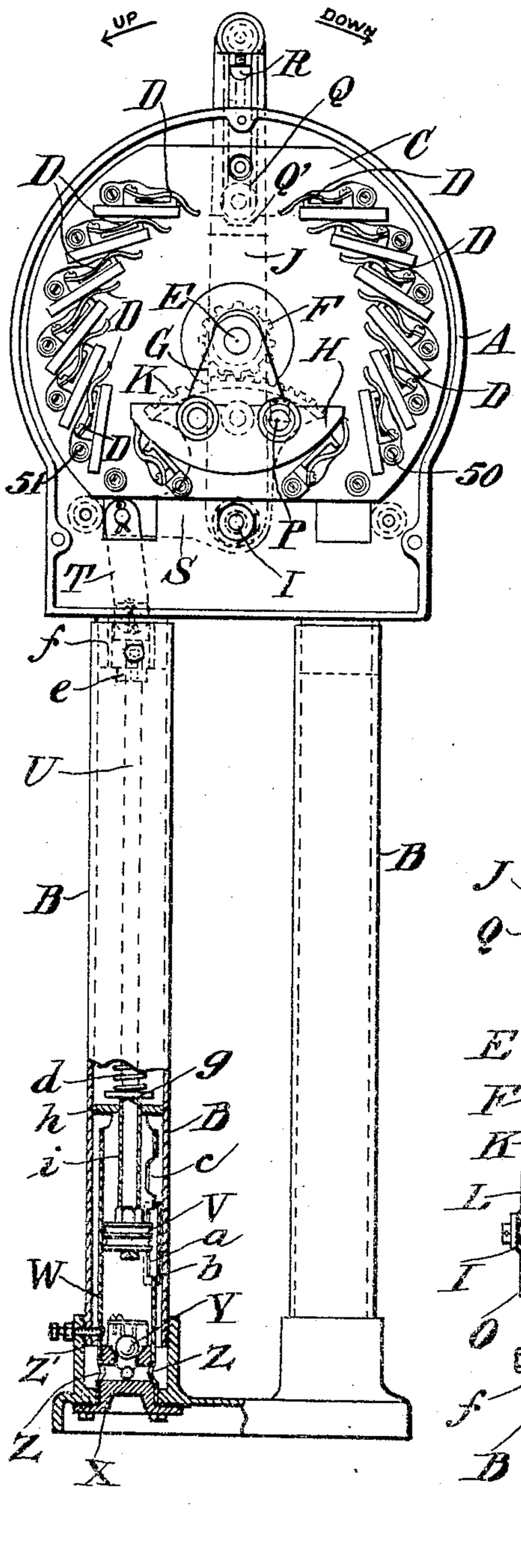


Fig. 2.

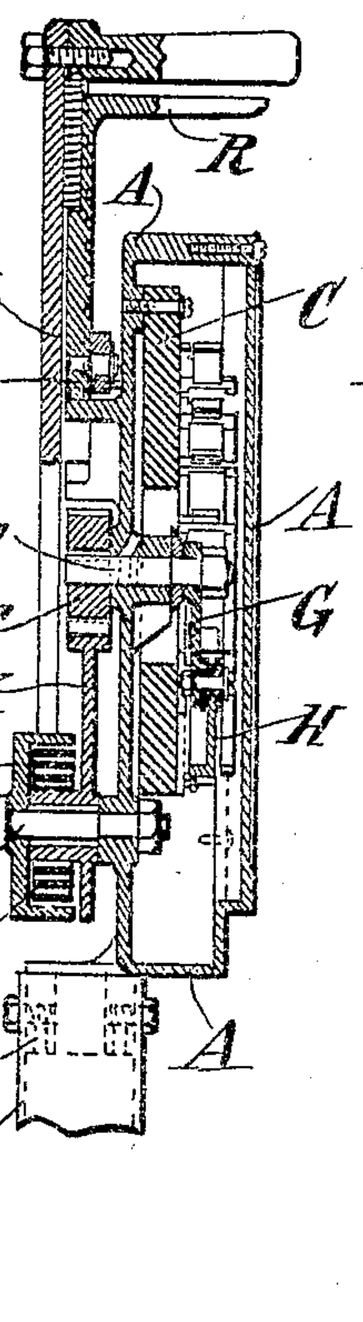
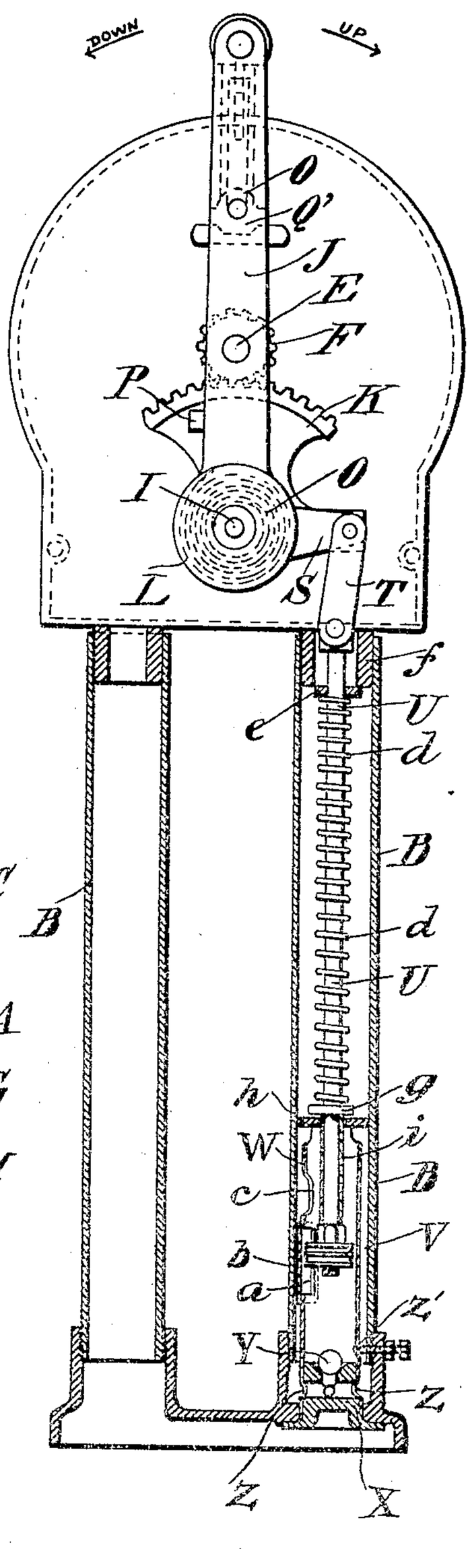


Fig. 3.



Witnesses
Jesse H. Van Alstyne
Henry E. Kirby

Eugene R. Carichoff, Inventor
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NO MODEL. 2 SHEETS—SHEET 2.

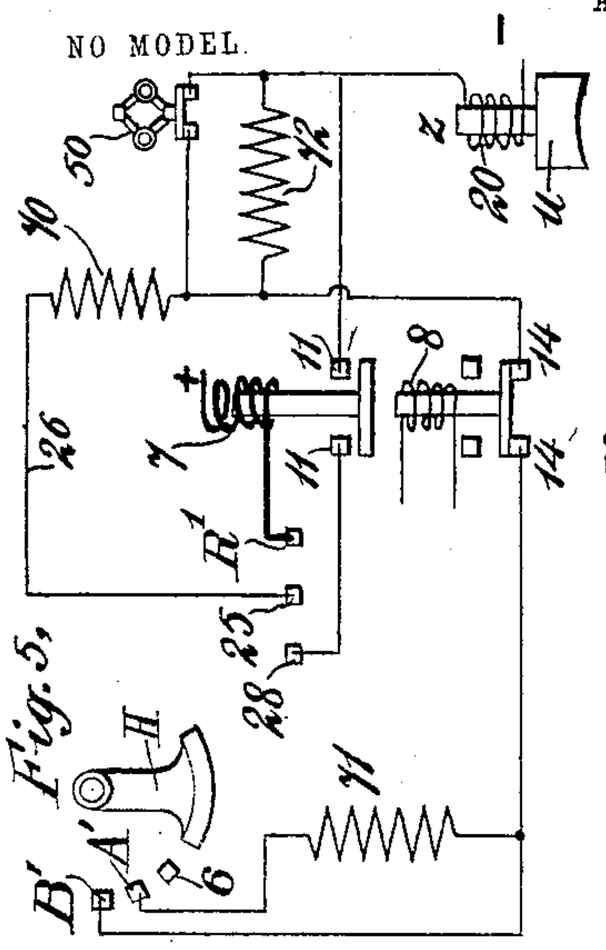

Fig. 5.

Fig. 4.

Witnesses
Jesse H. Van Alstyne
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No. 772,086. Patented October 11, 1904.

UNITED STATES PATENT OFFICE.

EUGENE R. CARICHOFF, OF EAST ORANGE, NEW JERSEY, ASSIGNOR TO OTIS ELEVATOR COMPANY, OF EAST ORANGE, NEW JERSEY, A CORPORATION OF NEW JERSEY.

ELECTRIC-ELEVATOR APPARATUS.

SPECIFICATION forming part of Letters Patent No. 772,086, dated October 11, 1904.

Application filed July 29, 1903. Serial No. 167,462. (No model.)

To all whom it may concern:

Be it known that I, EUGENE R. CARICHOFF, a citizen of the United States, and a resident of East Orange, Essex county, New Jersey, have invented certain new and useful Improvements in Electric-Elevator Apparatus, of which the following is a specification.

This invention relates to elevator apparatus, but more particularly to apparatus controlling electric elevators; but the invention is applicable to and may be used in other connections.

The object of this invention is to improve upon apparatus of the above class, to increase the facility of handling it, and to simplify its parts.

My invention provides what might be called a "semi-automatic" system of control, whereby the operation of the motor may be readily controlled from the car positively and with certainty.

Further objects of the invention will hereinafter appear; and to these ends the invention consists of apparatus for carrying out the above objects embodying the features of construction, combinations of elements, and arrangement of parts having the general mode of operation substantially as set forth in this specification and shown in the accompanying drawings and specifically pointed out in the claims.

Referring to the drawings, Figure 1 is a front elevation, partly in section, of a switch embodying a part of the invention. Fig. 2 is a vertical sectional side view of the switch. Fig. 3 is a rear elevation of the switch, partly in section. Fig. 4 is a diagrammatic representation of circuits and apparatus for controlling an elevator and connected to the device illustrated in Figs. 1, 2, and 3. Fig. 5 is a diagrammatic representation of a modification of the circuits and apparatus whereby resistance is automatically inserted in the brake-magnet circuit.

Like characters of reference indicate corresponding parts in the different figures.

Referring to the drawings, Figs. 1, 2, and 3 represent a switch adapted to be used upon an elevator-car for controlling the apparatus. It consists of a suitable casing A, shown in this instance supported upon hollow columns B, one of which is adapted to contain the conducting-wires and the other of which contains a dash-pot for the switch, constructed to operate as will be described. Within the casing A is suitably secured a base C, which may be of slate or other suitable insulating material, upon which are mounted suitable fingers or brushes D, forming contacts to which the several conducting-wires of the apparatus are connected, as illustrated diagrammatically in Fig. 4. Mounted in a suitable bearing in the casing A is a shaft E, provided with a pinion F at one end, fast thereto and arranged outside of the casing, while at the other end an arm G is provided, fast upon the shaft. A contact-segment H is shown suitably connected to but insulated from the arm G, whereby circuits may be completed between the contacts D as the contact-segment H is moved about the shaft E as a center. Means are provided for rotating the shaft E. As shown, a stud I is supported on the casing A and a lever J is pivoted upon said stud I. A toothed segment K is also pivoted upon said stud I, and, as shown, meshes with the pinion F. Within the hub L of the lever J is shown a suitable flat spring O, one end of which is connected to the segment K, while the other end is connected to the hub L of the lever, so that the segment K is connected to be operated by the lever through the spring. The segment K is provided with a stop P, against which the lever J abuts to positively operate the segment in one direction—as, for instance, when moving the switch to cause the car to move down. When the lever J is moved in the other direction to send the car up, the segment K is moved by means of the spring O. According to this construction the spring O always tends to press the stop P against the lever J, and means are provided for maintaining said lever in a central position, as by means of the spring-pressed latch Q, provided with a finger-piece R, said latch being adapted to enter a recess Q', provided upon the casing A.

As shown, the segment K is provided with an arm S, connected by a link T with a rod U, which extends downwardly through the hollow support B and is connected to operate the piston V of the dash-pot. The dash-pot comprises a section of metal tubing W, affixed to a base-piece X. Between the section of tubing W and the walls of the support B is shown a space for the circulation of the oil or other fluid in the dash-pot. The lower portion of the tubing W, as shown, is provided with a ball-valve Y or other suitable valve and ports Z, which freely admit the oil when the piston V is ascending, but which check the passage of the oil when the piston is descending. As shown, in one side of the tube W, forming the dash-pot, are several openings, in this instance two being shown. One of these openings *a* is covered with a piece of metal *b*, so that the cavity formed acts as a by-pass for the oil, thereby permitting the piston V to move freely while passing this point. As shown, the upper opening *c* in the tube W is not covered. In the operation of the apparatus the movement of the piston V is retarded at different points in its downward passage. At Z′ is shown an adjustable port through which the oil escapes when the piston V is descending and the ball-valve Y is closed and by means of which the retarding effect of the dash-pot may be regulated. The rod U forms a guide for a spiral spring *d*, which is arranged under compression between an upper washer *e*, bearing against the upper end *f* of the column B, and a lower washer *g*, adapted to bear upon a larger washer *h*, which is supported by the section of tube or dash-pot W. At the lower end of the rod U is a sleeve *i*, connected to the piston V. According to this construction it will be seen that the spring *d* acts as a centering device and that the rod U, and consequently the switch-segment K, cannot be moved from the central position without compressing the said spring *d*. The flat clock-spring O in the hub of the switch-handle should be stronger than the spiral spring *d*, for in the operation of the device the spring O compresses the spring *d* and at the same time operates the switch when the switch-handle J is moved in one direction—as, for instance, in the up direction.

Referring then briefly to the operation of the switch, it will be seen that as the handle J is moved in one direction—as, for instance, in the down direction or to the right in Fig. 1—the segment K will be carried positively to the right, because of the stop P, which bears against the lever J, and the pinion F will be rotated, thereby rotating the shaft E, which causes rotation of the contact-segment H to the right or in the same direction that the handle J is moved. The piston V will be moved upwardly in the dash-pot freely, because the ball-valve Y will open. The spring *d* will be compressed. This compression of spring *d* will tend to bring the lever back to its central position. The operator will hold the lever J over until he desires to stop the motor, when he will return it to its central position. When the lever J is moved in the other direction, there will be no positive engagement with the segment K, and the force of the spring O is brought into play both to compress the spring *d* and to move the segment K to the left, thereby causing rotation of the contact-segment H to the left to coöperate with the contacts D at the left of the switch. The piston V will be forced downward in the dash-pot W, and its movement will be retarded, so that although the lever J may be moved rapidly to the left, Fig. 1, or in the up direction there will not be a corresponding rapid movement of the contact-plate H, for its operation is retarded through the dash-pot, which is regulated by the adjustable port Z′, and by this means delicacy and certainty of operation are obtained. When the piston V passes the openings *a* and *c* in the dash-pot, it will have no retarding effect, and so at these points the piston and the contact-segment H will move rapidly. The operator can bring the contact-segment back to its central position positively by centering the lever J.

In connection with the switch described I have diagrammatically illustrated circuits and apparatus for operating an elevator, which circuits and apparatus embody a magnet-controller connected to be operated from the car.

Referring to Fig. 4, *j* represents a suitable electric motor which may be of any suitable type, preferably a slow-speed motor with strongly-compounded winding, the shunt-field *k* being connected directly across the main lines *l o* in parallel with the armature and the series *p* connected in series with the armature. The car *q* is represented diagrammatically, and upon the armature-shaft *r* is provided a suitable drum *s*, representing diagrammatically means for operating the car by means of the rope *t*, shown broken away for clearness of illustration. In this instance the elevator to which this apparatus is connected is of the type in which the load is lifted by the motor *j*, but descends by gravity under control of the same motor, which is reversed in direction and is driven by the car as a generator. The car therefore is understood to be heavier even with minimum load than its counterweight, if it has one.

A suitable brake-shoe *u* is shown in connection with the apparatus and is connected to be lifted by a brake-magnet whose windings are so connected with other devices that the brake *u* may be either entirely lifted or only partially lifted or "eased."

Controlling devices for elevators in common use serve the purpose of protecting the motor from excessive current in starting and cut-out resistance in such manner as to secure

some degree of smoothness in stopping and starting; but owing to the extremely variable loads which it is necessary to handle and the impossibility of smoothness in operation one of the prime requirements of controlling devices is that of particular delicacy in operation. As hereinbefore stated, one of the objects of this invention is to obtain the delicacy of operation required, and to this end the car-switch described is shown operating in conjunction, in Fig. 4, with a magnet-controller for the motor, comprising a series of magnets connected to control resistance for the motor and also connected to control the brake-circuits, these magnets being so connected that every function of the controller may be governed by the car-switch, thus giving the operator perfect control of both the motor and the brake. In connection with this apparatus suitable means are provided both in the switch and in the controller for automatically regulating the motor and brake circuits, guarding against bad effects which might arise should the operator be inexperienced or careless.

As stated, the operating-switch is shown diagrammatically upon the car *q*. The contact-segment H is shown in a central position, with the contacts D at each side. Those on the up side comprise contacts 6 1 2 3 4 5, and those on the down side comprise contacts 6 A′ B′ 3 4 5. Any suitable number of contacts may be provided as desired, depending upon the number of circuits to be controlled. In the actual operation of the switch the contact-plate H is insulated from the arm which carries it, but in the diagrammatic view of Fig. 4, for convenience of illustration, the positive lead *v* is connected directly to the pivotal shaft of the switch, but in the actual operation of the device the positive lead is placed in electrical connection with the segment H, as shown in Fig. 1, by additional contacts 50 and 51. The magnets 1^a 2^a 3^a 4^a 5^a 6^a, provided with the cores *w* and insulated contact-pieces *x*, control the operation of the motor and the brake. The magnets referred to are connected to the switch on the car through a flexible cable.

At 38 is shown a switch the purpose of which is to connect the positive main through the conductor *v* to the car-switch, thus making it operative as it does when 38 is moved upward, or else to a similar switch *y*, preferably placed on or near the motor-controller, thus making *y* operative as it does when 38 is moved downward. This switch *y* has a contact-segment H^2 and contact-pieces 6′, 1′, 2′, and 3′ on the up side and contact-pieces 6′, A^2, B^2, and 3′ on the down side. These parts correspond to similar parts of the car-switch, and as their function is the same it will not be necessary to describe them further. This switch, if desired, may be the counterpart of the car-switch.

By the operation of the controlling-magnets 1^a to 6^a resistances R^2, R^3, R^4, R^5, R^6, R^7, R^8, R^9, and R^{10} are controlled and also contacts R^{11}, R′, and 25.

The brake-magnet *z* comprises the main winding 20 and the auxiliary winding 21.

A magnet 7, connected in the main circuit, is provided with a core 9 and contact 10 and is connected to control the contacts 11. Another magnet 8, connected in a shunt across the brushes of the motor, is provided with a core 12 and contact 13 and is connected to control contacts 14 and 15.

22 represents a resistance connected to be included in a short circuit around the armature of the motor when the car reaches the lower limit of its travel, and when the car reaches the upper limit of its travel a switch 23 is adapted to be opened to break the circuit of the motor.

With the parts in the position shown in Fig. 4 the contact *x* of magnet 1^a is shown bridging contacts R^{11}, which completes a short circuit around the armature through a portion of the resistances referred to—namely, R^6— and through the series field *p*. The first movement of lever J of the car-switch to either the right or left will close a circuit at contact 6 from the positive main, conductors *v* and 80, through magnet 6^a, to the negative main. This will cause 6^a to become energized, and it will draw up its core *w* and cause its contact *x* to bridge the resistance R^6 instead of resistance R^7, as shown in the drawings. If the operator wishes the car to go up, he will move the lever J to the left, Fig. 4, and the next circuit to become closed will be that through magnet 1^a by connecting conductor *v* to conductor 81 at contact 1. When controlling-magnet 1^a is energized, lifting its core *w*, the upper contacts R′ are bridged, and the circuit of the motor is completed from the positive main *o*, through magnet 7 and resistances R^2 R^3 R^4 R^5 R^7, the motor-armature, and series field, to the negative main. A contact 25 is also included in circuit, which includes the auxiliary brake-magnet coil 21 in circuit by means of wires 26, thereby partially lifting or easing the brake. Magnet 8 is also thrown across the brushes of the motor, for when the contact *x* of magnet 1^a is down the magnet 8 is short-circuited. Resistance R^2 is preferably very high, so that the motor is not started when magnet 1^a is energized. When the controlling-magnet 2^a is energized by moving segment H of the car-switch up to contact 2, it will be seen that resistance R^2 is short-circuited, and at the same time a contact 28 is included in circuit for completing the circuit of the main brake-coil 20 through wires 30 and 26. Since the magnet 7 was included in circuit when contacts R′ were bridged, it will be seen that a complete circuit is made through the main coil of the brake-magnet, because contacts 11 are bridged if there is any

current flowing through the motor-armature. When magnets 3^a, 4^a, and 5^a are energized, resistances R^3, R^4, and R^5 are short-circuited. The extreme position of the car-switch will allow the contact-segment H to run off from the contact 6. The circuit through 6^a will be broken and its contact *x* will drop, thus short-circuiting the resistance R^7. Thus step by step the resistance will be removed from the armature-circuit. The object of having magnet 6^a operate as described is to prevent a complete armature short circuit in the event of all the magnets being suddenly deënergized, and thus dropping their cores. It will be seen that magnet 7 in the main circuit acts as a safety device for the brake, controlling the circuit of the brake, for should the current in the motor-armature be interrupted the current in this magnet would cease and the brake would be applied. When magnet 8 is energized, contacts 15 15 are bridged, and a separate circuit is completed by means of wire 35 to the magnet 1^a. When magnet 8 is deenergized, a circuit is completed, through contacts 14 14, as shown in the position of the parts in Fig. 4, from the car-switch, by means of wire 36, to the main coil of the brake-magnet. Magnet 8 comprises a shunt-coil connected, as described, across the brushes of the motor and is maintained energized as long as there is a moderate degree of potential in the armature-circuit. This arrangement prevents the main current from being cut off while the armature is revolving rapidly and guards against an armature short circuit while the car is going up.

At 50 a centrifugal governor is shown controlling contacts in the circuit of the main coil 20 of the brake-magnet *z*. If it is desired to use this arrangement, the governor may be connected, by any suitable means, to some moving part of the elevator mechanism, so that upon an undue increase of speed it will act to partially apply the brake.

In the description of the operation of the car-switch it will be understood that the operation is the same for the switch *y*, which latter switch is mainly used for testing. The small switch 38, as already described, is arranged to switch the current either to the car or to the testing-switch, as desired.

The operation of the apparatus from the car-switch may be described as follows: When in the central position, the handle J is locked and all the magnets are deënergized, as shown in Fig. 4. Let it be assumed that it is desirous to move the car upward. On the first movement of the handle J for up-circuit is completed through contact 6 on the up side of the switch, and magnet 6^a is energized through wire 80, thereby putting in all the resistance in the up-circuit. Upon further movement of the switch-handle contact 1 is included in circuit and magnet 1^a is energized through wire 81, thereby completing the main circuit to the motor and partially lifting the brake. As stated, the resistance of R^2 is so great that the car does not start up. Further movement of the switch-handle J energizes magnet 2^a through wire 82, thereby short-circuiting resistance R^2 and completing the circuit of the main coil of the brake-magnet, which completely lifts the brake. The car now starts up slowly. To make a stop from this low speed, the handle J is turned back just far enough to deënergize magnet 2^a, where the handle is held until the car stops. The handle J is then returned to the center. Having started the car up at a slow speed, the handle J may be so advanced as to energize magnets 3^a, 4^a, and 5^a in succession through wires 83, 84, and 85, and then contact-segment H is moved out of contact with contact 6, thereby deënergizing magnet 6^a and short-circuiting resistance R^7, thus removing all of the resistance from the up-circuit. It will be seen that the speed of the motor is increased as each magnet operates until full speed is reached. To slow up from full speed, the handle J of the switch is returned toward contact 2 and held until the desired speed is obtained. To stop short from full speed, the handle J is returned to the center, and when this is done all the magnets excepting 1^a are deenergized. Magnet 1^a remains energized because its circuit is maintained completed through contacts 15 and wire 35, controlled by magnet 8. Under this condition of circuits the motor continues to receive current from the line through all of the resistances of the up-circuit excepting resistance R^7, short-circuited by magnet 6^a. The main brake-circuit, it will be seen, has been opened by the deënergizing of magnet 2^a, and the brake is therefore applied with some force, though not to its full power, and the speed of the car is gradually checked. The counter electromotive force of the armature causes current to pass through magnet 8, thereby maintaining it energized until the armature speed has been greatly reduced. When the speed of the armature becomes very slow, magnet 8 is deënergized, thereby deënergizing magnet 1^a, which then operates to break the main line, applying the brake with full power. By this very simple arrangement of circuits and apparatus the danger of a sudden stop on the up-trip is entirely avoided. When the car reaches the upper end of its travel, it will open the switch 23, thus cutting off the current from the whole system, applying the brake, and stopping the car. The first movement of the switch-handle J in the downward direction connects contact 6 at the down side of the switch into circuit, which energizes magnet 6^a, thereby short-circuiting resistance R^6, and thus all of the resistance in the down-circuit is removed therefrom. In the further movement of the switch contact A′ is included in circuit, thereby completing the circuit of

the auxiliary winding of the brake-magnet *z* through wire 40, which eases the brake and permits a very slow motion of the armature, the motor acting as a generator and being driven by the weight of the car and the load. When contact B′ is included in circuit, a circuit is completed through the main coil of the brake-magnet by wire 36 and contacts 14, which are bridged by contact 13 of magnet 8. Magnet 8 in this instance is short circuited by contact *x* of magnet 1^a. The brake is therefore lifted, and the car now starts down slowly, the series field being the only resistance in the armature-circuit of the motor. Further movement of the switch-handle J completes the circuits of magnets 3^a, 4^a, and 5^a through wires 83, 84, and 85, thus including resistances R^{10}, R^9, and R^8 in the armature-circuit. When the contact-plate H is moved clear of contact 6, magnet 6^a is deënergized, thereby including resistance R^6 in circuit, so that all of the resistance is gradually included in the armature-circuit, which permits an increased speed of the armature, the motor acting as a generator. The handle J may be moved rapidly to full-speed position and may be returned rapidly to a partially-reduced-speed position; but the movement of contact-plate H is retarded by the action of the dash-pot, as hereinbefore described in connection with the switch. When the contact-arm 45 of the down-limit resistance 22 is actuated by the movement of the car as it reaches the down limit of its travel, a short circuit is completed about the motor through the resistance 22 and the series field, which brings the motor to a stop.

In some instances it may be desirable to use auxiliary limits arranged to break the circuit of magnet 2^a, and thereby partially apply the brake and insert resistance in the armature-circuit. In Fig. 4 an auxiliary limit-switch 55 is shown in the circuit of magnet 2^a, which may be arranged to be operated by the movement of the car.

Sometimes it may be desirable to use but one winding on the brake-magnet and to obtain the effects desired by the insertion of resistance in the magnet-circuit. This arrangement will accomplish the same results as hereinbefore described and requires but a slight change in the diagram of circuits. Fig. 5 shows this modification. In this case when the operator starts the car up and causes the magnet 1^a to be raised the circuit through the brake-magnet 20 will be closed through the resistance 70 and the brake partly released. When magnet 2^a is raised, this resistance 70 will be short-circuited and the brake fully released. When the operator turns the car-switch for the downward travel of the car, the brake will be partly released when the contact-segment H is brought in contact with the contact A′, for a circuit will then be established through the resistance 71 and the brake-magnet 20, and the brake will be fully released when contact-segment H touches contact B′, for then the resistance 71 will be short-circuited. In either of these cases the effect on the brake will be the opposite when the car-switch is brought back toward the center—that is, the brake will first be applied lightly and then with full power as resistance is thrown into the circuit of its magnet, and then the circuit is broken. The governor 50 in this case may be arranged to normally short-circuit a resistance 72 and to throw this resistance 72 into the brake-magnet circuit whenever the car speed becomes excessive when running down. Of course it may be arranged to act in the same way on the up motion, if desired.

The objects and advantages of the intermittent dash-pot, already described, may be briefly set forth as follows: When the operator starts the car up, it is desired to energize the magnets 6^a, 1^a, and 2^a promptly. First 6^a puts all the resistance in the armature-circuit. Then 1^a closes the armature-circuit and eases the brake; but the car will not start until the large resistance R^2 is cut out of the circuit by 2^a. So in order to insure a prompt start it is desirable to make these three steps quickly. The result is produced by the cut-out or by-pass, as already described. When the car is running down at full speed and the car-switch is in the full down position, the piston V is at the upper part of the dash-pot by the opening *c*. So when the operator desires to stop the car the first few steps for slowing down may be made quickly, as the dash-pot has no retarding effect until its piston V has passed the opening *c;* but the rest of the operation will be made slowly under the action of the dash-pot, so that it will be impossible for the operator to make a sudden and disagreeable stop.

Obviously some features of this invention may be used without others, and the invention may be embodied in widely-varying forms.

Therefore, without limiting myself to the construction shown and described or enumerating equivalents, I claim, and desire to secure by Letters Patent, the following:

1. In an electric switch, the combination with an operating-handle and a contact connected to be operated thereby, of a dash-pot constructed to operate with varying degrees of retardation in the movement of the switch, and opposing springs of different strengths connected to control the operation of the contact, the stronger spring being connected to actuate the contact in one direction, and the weaker spring acting as a centering device.

2. In an electric switch, the combination with the operating-handle, of a contact connected to be moved by said handle positively in one direction, a spring interposed between said handle and the contact whereby the contact is moved in the other direction by means of a spring, and a dash-pot connected to retard

the movement of said contact under the influence of the spring and constructed to operate with varying force at different points in the movement of said contact.

3. In an electric switch, the combination with the operating-handle, of a contact connected to be moved by said handle positively in one direction, a spring interposed between said handle and the contact whereby the contact is moved in the other direction by means of a spring, a dash-pot connected to retard the movement of said contact under the influence of the spring and constructed to operate with varying force at different points in the movement of said contact, and another spring weaker than said first-named spring acting in opposition thereto tending to return the switch-contact to the central position.

4. In an electric switch, the combination of a switch-operating lever, a segment connected to be positively operated by said lever in one direction, and a spring connection between the lever and segment for operating the segment in the other direction, a contact-arm connected to be operated by said segment, a dash-pot having a piston and rod connected to the segment, and a spring operating in conjunction with the dash-pot and acting as a centering device for the switch.

5. In an electric switch, the combination of a switch-operating lever, a segment connected to be positively operated by said lever in one direction, and a spring connection between the lever and segment for operating the segment in the other direction, a contact-arm connected to be operated by said segment, a dash-pot having a piston and rod connected to the segment, passage-ways adapted to vary the resistance of the dash-pot in different points in the movement of the piston, and a spring operating in conjunction with the dash-pot and acting as a centering device.

6. In electric-elevator-controlling apparatus, the combination with the car and motor, of controlling-circuits and devices therefor, a switch on the car connected in said circuits, and means operating in connection with said switch and constructed to produce varying retardation of the switch at different points in the operation of said switch.

7. In electric-elevator-controlling apparatus, the combination with the car and motor, of controlling-circuits and devices therefor, a switch on the car connected in said circuits, and a retarding device for said switch constructed to operate with varying force at different points in the movement of said switch.

8. In electric-elevator-controlling apparatus, the combination with the car and motor, of controlling-circuits and devices therefor, a switch on the car connected in said circuits, and a dash-pot connected to said switch and constructed with passages so arranged as to produce varying retardation of the switch at different points in the movement of said switch.

9. In controlling apparatus for elevators, the combination with the car and motor, of controlling-circuits and devices, a main magnet and contacts for closing the main circuit, a magnet connected in a shunt-circuit across the brushes of the armature of the motor and arranged to control the circuit of said main magnet, whereby the main magnet will be maintained energized until the armature speed is reduced to a predetermined degree.

10. In a motor-controlling apparatus the combination of two controlling-circuits each containing resistance, one of said circuits being in parallel with the motor-armature and the other in series therewith, and a magnet arranged to remove resistance from one circuit and insert resistance into the other circuit.

11. In elevator-controlling apparatus, the combination with the motor, of an up-circuit and a down-circuit both containing resistance, and a magnet arranged to control a portion of said resistance in such manner that as resistance is removed from one circuit by the magnet, resistance is inserted in the other circuit in either direction of movement of the magnet-core.

12. In motor-controlling apparatus, the combination with the motor and a brake, of means controlled by the speed of the motor for preventing the more than a partial application of the brake until the speed has fallen to a predetermined amount.

13. In an electric-elevator-controlling apparatus the combination with the car and motor, of controlling-circuits and devices therefor, a switch on the car connected in said circuits, a brake on the motor controlled by said switch and means controlled by the speed of the motor for preventing the full application of the brake.

14. In an electric-elevator-controlling apparatus, the combination with the car and motor, of controlling-circuits and devices therefor, a switch on the car connected in said circuits, a brake on the motor controlled by said switch arranged to be released or applied with varying degrees of force, and means for partially applying said brake whenever the car speed becomes excessive.

15. In motor-controlling apparatus, the combination of a motor and an electric brake having a plurality of windings, controlling-circuits and devices therefor and a switch connected in said circuits arranged to control the motor and to connect one or more of said brake-magnet windings in electrical circuit.

16. In motor-controlling apparatus, the combination of a motor and an electric brake having a plurality of windings, controlling-circuits and devices therefor, a switch connected in said circuits arranged to connect one or more of said brake-magnet windings in electrical circuit, and a speed-governor arranged to open a part of said brake-magnet-windings circuits.

17. In an elevator-controlling apparatus, the combination with the car, of a motor adapted to operate as a motor for one direction of the car travel and as a generator for the other direction of the car travel, separate controlling-circuits containing resistances for each of said operations, and one series of magnets connected to control both of said controlling-circuits and resistances.

18. In a motor-controlling apparatus, the combination with the motor, of two controlling-circuits containing resistance, and a magnet arranged to prevent the complete armature short circuit through either controlling-circuit.

19. In an elevator-controlling apparatus, the combination with the car, of a motor adapted to operate as a motor for one direction of the car travel and as a generator for the other direction of the car travel, a manually-operated switch connected in separate controlling-circuits containing resistances for each of said operations, and one series of magnets connected to control both of said controlling-circuits and resistances.

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

EUGENE R. CARICHOFF.

Witnesses:

ERNEST W. MARSHALL,

W. H. BRADY.