(No Model.)

5 Sheets—Sheet 1.

R. EICKEMEYER.

ELECTRIC ELEVATOR.

No. 454,462.

Patented June 23, 1891.

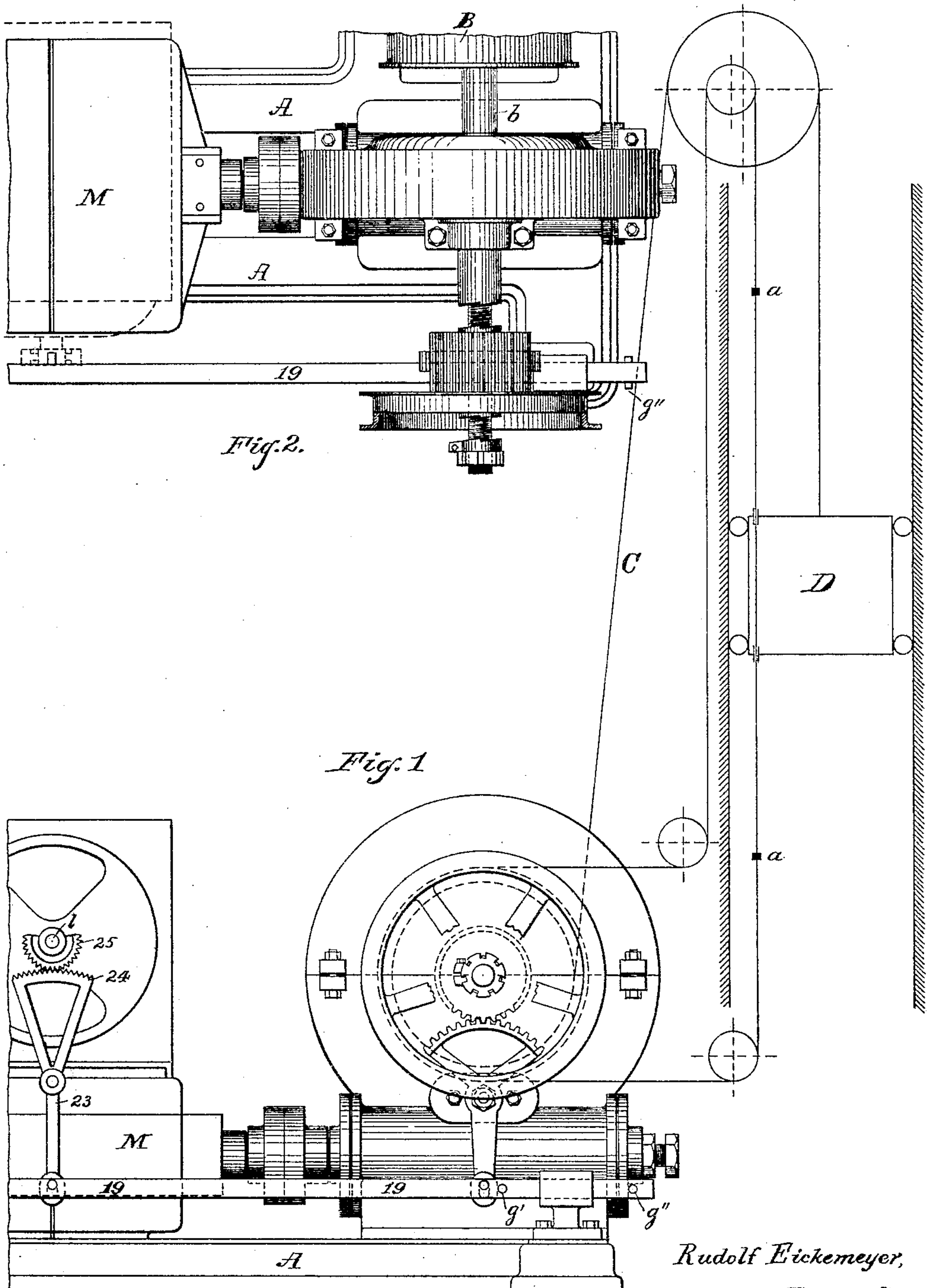

Fig. 2.

Fig. 1

Witnesses: J. C. Spaeth, E. E. Gregg

Rudolf Eickemeyer, Inventor.

McTighe & Worthington, Attorneys.

(No Model.) 5 Sheets—Sheet 2.

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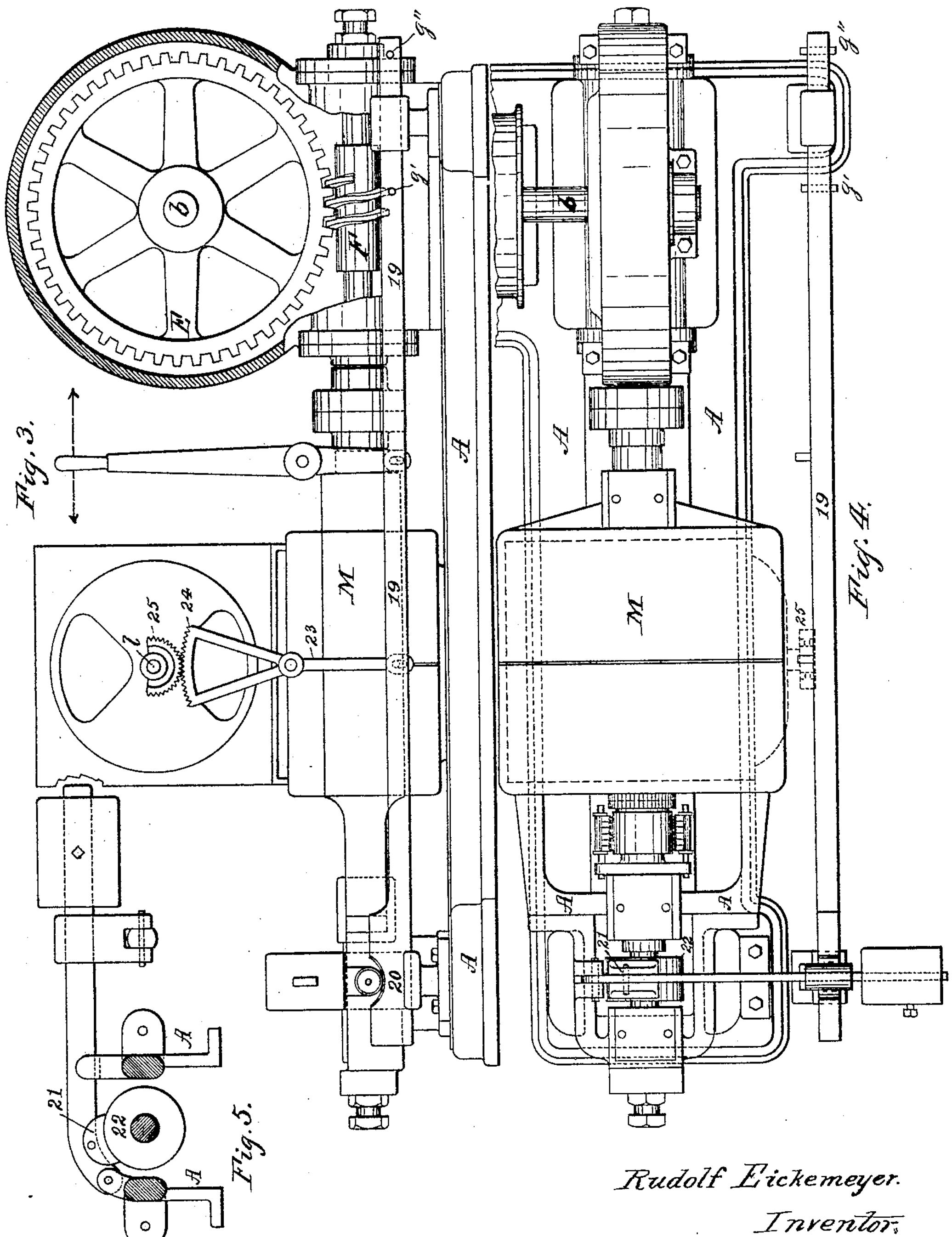

Witnesses: J. C. Spaeth, C. E. Gregg.

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(No Model.) 5 Sheets—Sheet 3.

R. EICKEMEYER.

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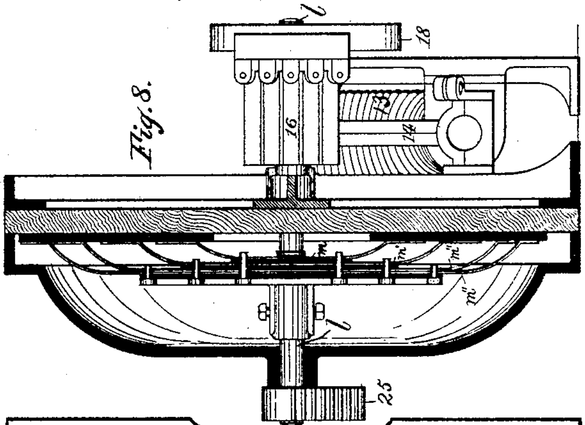

Fig. 8.

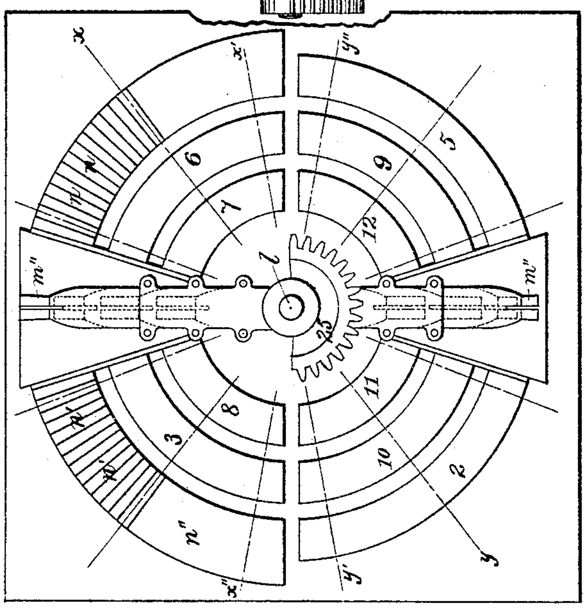

Fig. 7.

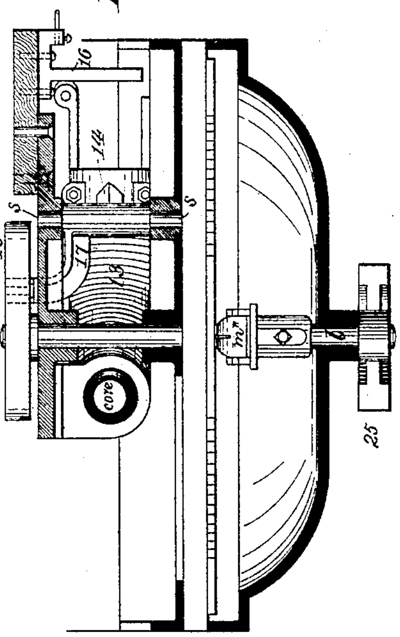

Fig. 9.

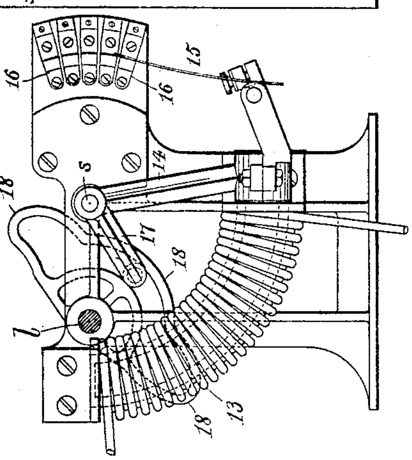

Fig. 6.

Witnesses:
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(No Model.)

5 Sheets—Sheet 4.

R. EICKEMEYER.

ELECTRIC ELEVATOR.

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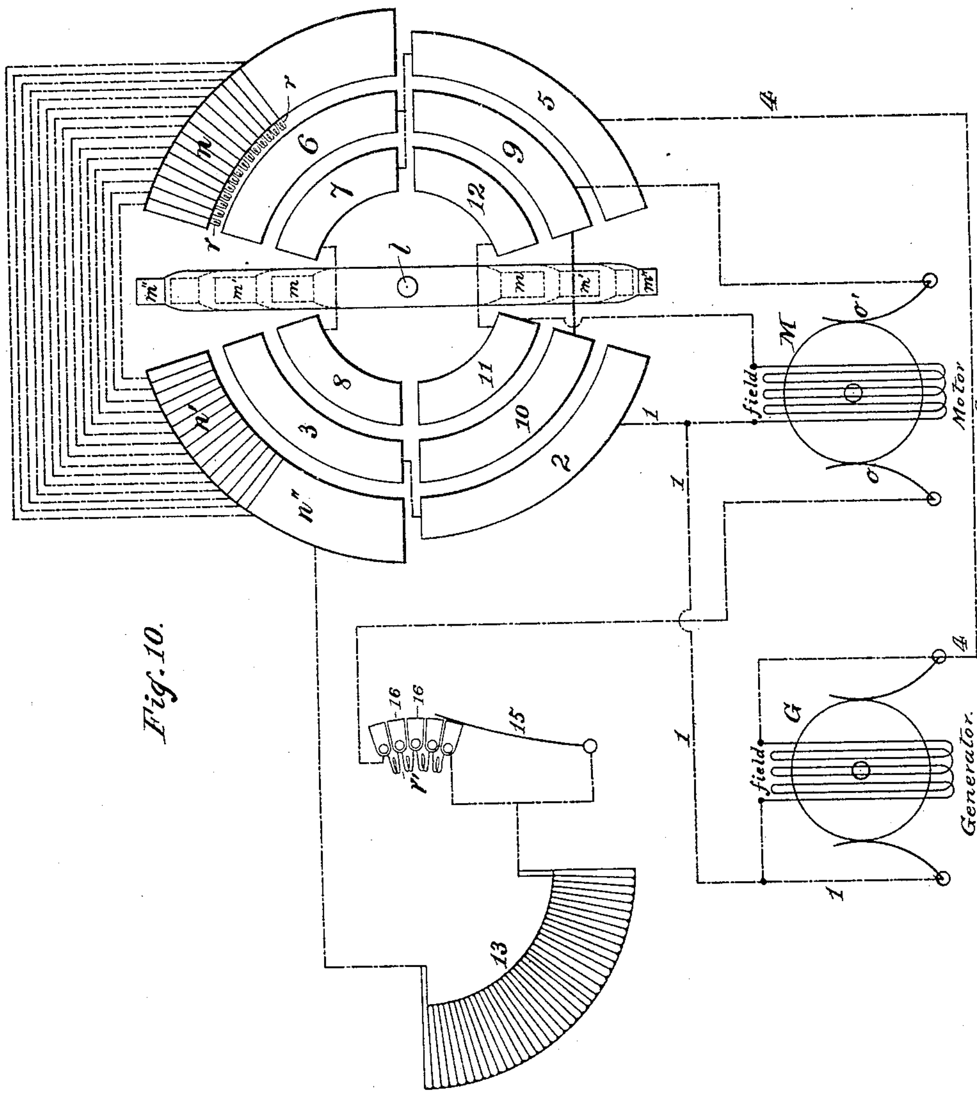

Fig. 10.

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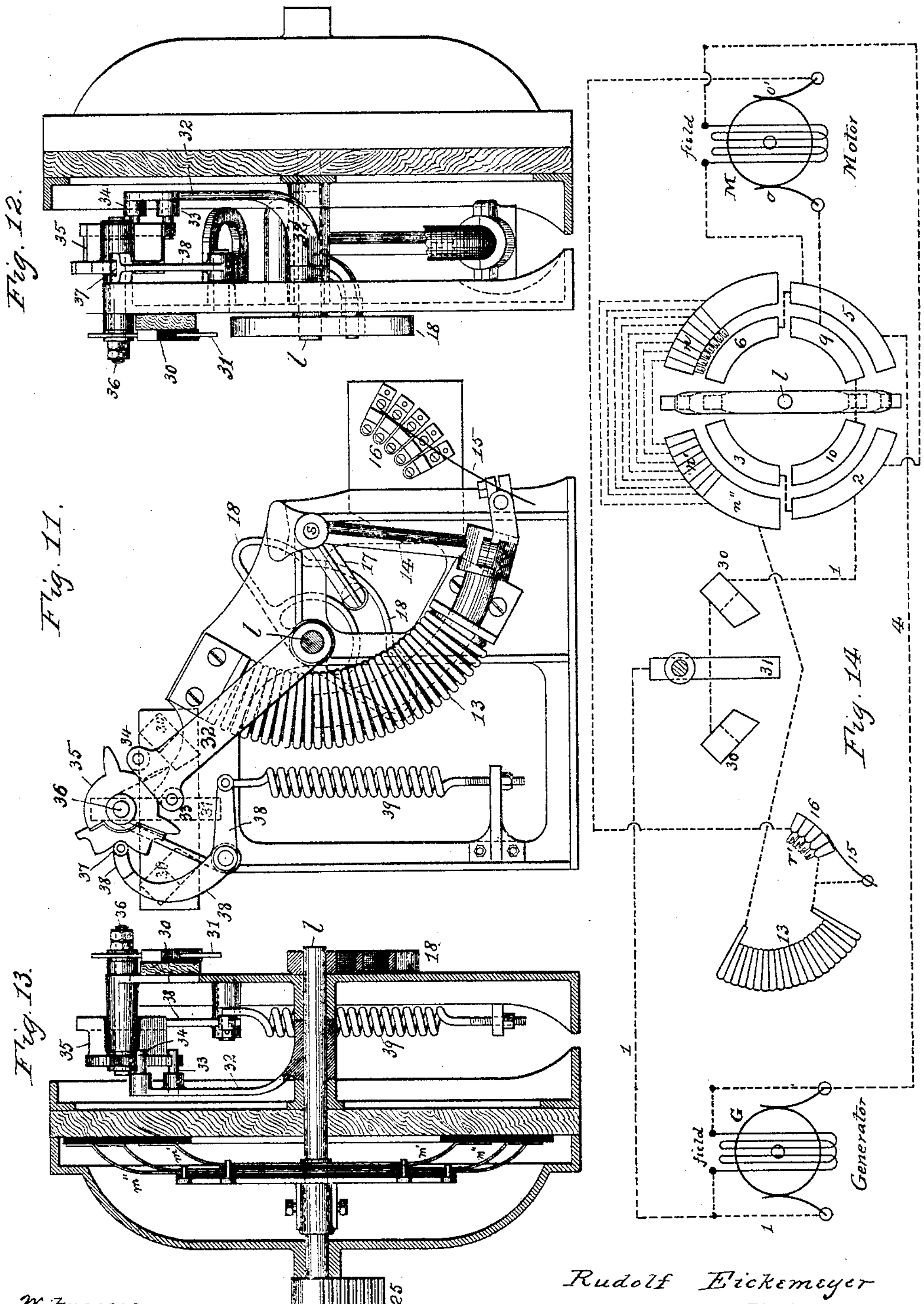
THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

(No Model.) 5 Sheets—Sheet 5.

R. EICKEMEYER.

ELECTRIC ELEVATOR.

No. 454,462. Patented June 23, 1891.



Witnesses:—

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UNITED STATES PATENT OFFICE.

RUDOLF EICKEMEYER, OF YONKERS, NEW YORK.

ELECTRIC ELEVATOR.

SPECIFICATION forming part of Letters Patent No. 454,462, dated June 23, 1891.

Application filed May 14, 1890. Serial No. 351,753. (No model.)

To all whom it may concern:

Be it known that I, RUDOLF EICKEMEYER, a citizen of the United States, residing at Yonkers, in the county of Westchester and State of New York, have invented certain new and useful Improvements in Electric Elevators; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to elevating machinery of that class in which the traveling car or platform is moved upwardly or downwardly by causing the cable to which it is attached to wind or unwind on a hoisting-drum or equivalent device, such hoisting-drum being controlled by the operator on the car or platform by means of a hand rope, lever, or other mechanical or electrical device adapted to the purpose.

The object of my invention is to provide for the operation of the elevating machinery by an electric motor which can be readily started, stopped, or reversed at any moment in such manner that no damage can be inflicted upon it, and also to provide means for automatically protecting the armature of the motor from receiving such currents as are dangerous thereto when the counter electromotive force is insufficient to protect it.

To these and other ends my invention consists in the combination and arrangement of devices and instrumentalities substantially as hereinafter more fully described, and pointed out in the claims.

In the accompanying drawings, which form part of this specification, Figure 1 is a side elevation of the hoisting mechanism, the attachment of the car being in diagram. Fig. 2 is a corresponding plan view of the hoisting mechanism. Fig. 3 is a side elevation of the electric motor and drum-operating devices, partly in section, to show the gearing. Fig. 4 is a plan view of the same, a part of the winding-drum and bed-plate being cut away. Fig. 5 is a sectional elevation of the brake attachment of the machine. Fig. 6 is a front elevation of the safety attachment of the machine on an enlarged scale and detached from the machine. Fig. 7 is a front view of the switching and reversing devices, detached, on an enlarged scale. Fig. 8 is a transverse vertical, and Fig 9 a horizontal, section of the same. Fig. 10 is a diagram showing the relations of the circuits and connections. Fig. 11 is a front elevation of a modification, showing means for producing a sudden and wide separation of the terminals of the circuit. Fig. 12 is a side elevation, partly sectional, of the same. Fig. 13 is a sectional elevation of the same, taken from an opposite point of view; and Fig. 14 is a diagram of the complete circuits as used with such modification.

The winding-drum and its driving mechanism are mounted on a bed-plate A, which is supported upon a suitable foundation.

B is the winding-drum, upon which the rope C (by means of which the car D is operated) is wound and unwound to raise or lower the car. The drum B is secured and supported on a shaft *b*, which is mounted on suitable bearings on the bed-plate A. To revolve the drum, a worm-gear E is secured upon the shaft *b*, in which a worm F meshes, and this worm F is coupled directly to the shaft of the motor M. The motor shown is one of the well-known type already patented by me, and while other shunt-wound motors may be used I prefer this type, as it radiates but very little magnetism, and can therefore be placed in any position in a building without any danger to the watches of visitors or attendants.

To operate the mechanism I have devised certain improvements in switching and reversing and safety appliances, which are mounted, preferably, upon the motor, and are operated by means of the rope in the car or by a hand-lever on the machine itself, or by other equivalent means. The motor I employ is what is known as a "shunt-wound motor," which is within certain limits self-regulating, and I arrange the various elements so that the following cycle of operations takes place: When at rest no current passes, both field and armature being cut out. To start the motor in either direction, current is first admitted to the field-winding to excite the field. Then current is gradually put in the armature-circuit until the whole current in the circuit is put on the machine. The resistance in the armature when standing still is so low, however, that its coils would burn out should the motor for some reason or other not be able to start—for example, if the elevator be overloaded or stuck in some way. To guard against this I have devised a self-acting safety device by means of which a certain amount of external resistance is included in the armature-circuit so long as the current which the armature would otherwise receive is beyond the limit it could safely carry. As the motor starts and the counter-electro-motive force in the armature increases this external resistance is automatically reduced or removed. To stop the motor the resistance, which meantime has been automatically removed from the armature-circuit, is first put in again mechanically, and then the current is gradually taken out of the armature-circuit and at last out of the field-circuit.

In the diagram Fig. 10 I have illustrated the switching, reversing, and safety devices, showing the various connections in the generator and motor circuits, the dotted lines representing the electric connections. The generator G is connected on the one hand by the line 1 with the curved plates 2 and 3 on the switch-board, and on the other hand by the line 4 with the plates 5, 6, 7, and 8. One terminal of the field-circuit of the motor M is connected to the plates 2 and 3, (which are always directly connected with one terminal of the generator,) and the other terminal of the field-circuit of the motor M is connected with plates 11 and 12 directly. In the center of the curved bars of the switch-board is a shaft l, upon which three superimposed brushes are mounted, but insulated from each other. (See Figs. 7, 8, and 9.) In the position shown in Figs. 7 and 10 the brushes rest upon insulating material, preferably slate or glass. The shaft l is by a gear and lever so controlled by the hand-lever or hand-rope that the arm carrying these brushes can be turned to the right or left in a manner more particularly described later on. The plates 7 and 8 are in circuit with one terminal of the generator through plate 5 and the plates 11 and 12 with one terminal of the field-coil of the motor, whose other terminal is in circuit with the remaining terminal of the generator. The shorter of the brushes m is of such dimensions that it will connect electrically the plates 8 and 12 of the inner ring of contact-plates when the brushes are turned from the perpendicular in one direction and the plates 7 and 11 when turned in the opposite direction. In either case the current from the generator flows through the field-coil of the motor in the same direction and excites the field. The electric current should be gradually applied to the armature, and hence it is necessary to appropriately reduce the current, and I have provided for this purpose a rheostat or series of resistance-coils, which are cut out or put in by the operator, and I have so arranged the switch-blocks and brushes that the same resistance-coils are used whether the current from the generator flows in one direction or the opposite through the armature of the motor. The terminals of the resistance-coils indicated at r, Fig. 10, are connected to the insulated switch-blocks, as at n, and each one of these blocks is connected by a wire, as shown in dotted lines, to a block placed in a corresponding position, as at n'. Resistance-blocks of a somewhat similar character have been heretofore organized with contact brushes or springs, carried upon levers connected with commutator-brushes, and employed for shifting said brushes for reversing electric motors. In my organization the oppositely-located sets of coupled resistance-blocks are employed with a switching arm or bar, which puts the blocks at the one side or the other into direct electric connection with contact-blocks respectively in circuit with the positive and negative line-wires, thereby enabling the current to be applied to the armature-circuit of the motor in either direction, and whichever way the current may be applied said resistances perform their protecting duty. The brushes m' and m'' are of such length that m' will electrically connect opposite pairs of curved plates in the middle ring, and the brush m'' will connect opposite pairs of the curved plates in the outer ring.

I have stated before the manner in which the terminals of the generator are connected to the switch-plates, and I will now explain the action of the brushes m' and m'' when the latter are turned to one side or the other. Suppose we turn them in a right-handed direction until we reach the line $x\ y$, Fig. 7. As soon as the brushes have turned far enough to come in contact with the curved switch-blocks a circuit is made through the armature of the motor M. The current will pass, as indicated in Fig. 10, from the line 1 to plate 2, through the brush m'' to first block at n, through the resistance-coils r, thence over to the plate n'', through the coil 13 of the automatic regulator, through the resistance-coils r' of said regulator to one brush o of the motor, through the armature of the motor to the other brush o', and thence through plates 9 and 10 and brush m' to plate 6, which is electrically connected to plate 5, whence by line 4 the circuit of the generator is completed. As we continue the motion of the switch-brushes one resistance-coil after another is cut out until, when the brushes reach the line $x\ y$, all of the resistance-coils r are cut out and only the resistance-coils r' remain in the armature-circuit. If the brushes be returned to their original positions, the resistance-coils r are gradually put into the circuit again, and when the brushes reach the insulating-block the circuit is broken. If the brushes are now turned toward the left-hand, so as to come in contact with the switch-blocks at n', the circuit is made again; but the current will now pass through the armature in opposite direction to that previously taken. Entering from line 1, its path will be from plate 3 through the brush *m'*, to plate 9, to the brush *o'*, through the armature to brush *o*, through the resistance and regulator coils *r'* and 13 to plate *n''*, through brush *m''* to plate 5, and thus to the other terminal of the generator. It is evident that when a suitable current is supplied the motor will revolve in one or the opposite direction when the switch-board brushes are turned in one or opposite position from the perpendicular line.

The automatic safety device is shown detached from the machine in Fig. 6. It consists substantially of a suction-coil 13, into which a curved iron core (shown in Fig. 6 by dotted lines) is loosely fitted, one end of the core being attached to an arm of a bell-crank lever 14, which is pivotally mounted on a rock-shaft having its bearings in a suitable frame, as at *s*. (See Fig. 9.) On a suitable projection of the lever 14 I have mounted a brush 15, which is in contact with one of a number of switch-blocks 16, which are the terminals of resistance-coils *r'*. The short arm 17 of the bell-crank 14 has a small roller which is fitted into a cam 18, fixed on the rock-shaft *l*.

In Figs. 1, 2, 3, and 4 I have shown an arrangement in which a bar 19 is moved longitudinally by the hand-rope, as illustrated in Figs. 1 and 2, or by a hand-lever, as shown in Figs. 3 and 4. This bar is provided with stops at *g'* and *g''*, which limit its motion, and at 20 is so shaped that it forms the cam which operates the brake. As shown in the figures, the bar is in its central position, and by a pull at the operating-rope or by means of the hand-lever it can be moved longitudinally to the right or left until it is stopped by the pins *g'* or *g''*. This movement to the right or left lifts the weighted brake-block 21 from the brake-wheel 22 on the shaft of the motor M, and the armature is now free to revolve. I have made use of this bar as one of the elements which serve to operate my switching mechanism, but only because I have taken for illustration a form of elevator mechanism in which such a bar and brake are commonly used; but obviously the switching devices could be operated with equal facility directly by the hand-lever, by the operating-rope, or otherwise.

To cause the shaft *l* to revolve when the bar 19 is moved, I have mounted on the frame of the motor a pivoted lever 23, which is slotted to receive a pin in the bar 19, and is provided with a toothed segment 24 at its upper end, which meshes with another segment 25 on the shaft *l*. The lever 23, segments 24 25, and motion are so proportioned that when the bar 19 is moved from one stop to the other—that is, when it is caused to make the longest possible longitudinal motion—it will cause the shaft *l* to make about two-fifths of a revolution, and thus impart a motion to the switch-brushes which will bring them from the line *x' y'* to the line *x'' y''*, or vice versa. If we now assume that the switch-board brushes and bar 19 are in the position shown in the drawings, we find that the brake is set or in its operative position, the brushes in vertical position with both circuits of the motor open, and that the bell-crank lever 14 is held by the cam 18 in such a position that the iron core is completely inclosed in the suction-coil 13. If we now start the bar 19 in one direction until it is stopped by one of the pins, the brushes will move over the switch-board until they are in the position *x' y'* or *x'' y''*. The cam 18, which is fixed on the shaft *l* moves correspondingly, and it is so shaped that it will hold the lever 14 until the brushes on the switch-board have cut out all the resistance at *r*.

As shown in the drawings, the cam 18 has a circular path in the middle and is widened out on both ends, and while the roller on the arm 17 occupies said curved slot the magnet-core is held in the solenoid; but as soon as the roller on the arm 17 is out of this circular path the lever 14 is free to move, and the iron core is then capable of swinging outwardly from the coil *s*, and the brush 15 can move over the semi-cylindrical faced switch-block and cut out the resistance *r'*; but the coil 13 is in circuit with the armature, and it is of such a number of turns that it will hold the iron core in place and prevent its cutting-out movement should the current which flows in the armature-circuit for any reason be excessive and liable to injure the machine.

When the machine stops, by moving the bar 19 in the opposite direction the cam 18 will first bring the iron core into the suction-coil 13, and thus put the resistances *r'* successively into the armature-circuit. The resistance-coils *r* are then successively put in, and finally the armature-circuit is broken. Continuing the motion a little further, the field-circuit is also opened, and the brake now holds the machine until the bar 19 is again moved in one or the other direction, when the same operations are repeated.

By the application of the various devices herein described I have succeeded in surrounding the machinery used in electric elevators with such safeguards as will absolutely protect the electric motor therein from any possibility of damage which would arise from an abnormal current if the same were permitted to flow through the armature.

As will be seen, when it is desired to start the motor the circuit is first closed under such conditions that a considerable resistance is in series with the armature, which resistance is gradually diminished as the speed of the armature rises. It will also be observed that from the first moment of closing the circuit until the maximum has been reached the field-magnet coils receive a maximum current, and the result is that during all periods of operation of the motor the field-magnet is at a maximum strength.

The automatic safety device is of special importance. The lever 14, which carries the core, is so arranged that should any mechanical accident happen—such, for instance, as the derangement of the switch-gearing—the system will gravitate into the position shown in Fig. 6 by suitable arrangement of the center of gravity of the swinging system. In such case, if no current was being supplied to the armature no harm would occur; but if there was a current in the armature-winding the suction-coil would promptly draw the core inwardly and put in the resistance required for reducing the current in the armature to a safety limit. In this position (shown in Fig. 6) all of the resistance coils r' are included in series in the armature-circuit, which is the proper position for starting the motor in operation. There is an enforced position for the system due to the limitation on the movement of the elbow-crank lever 14 17 by the circular portion of the cam 18, which compels the brush 15 to remain in such position as to include all the resistances r' when starting and stopping the motor; but in starting, after a certain movement of the brushes $m\ m'\ m''$ has taken place, the cam has been mechanically turned to a position which releases the system from this mechanical restraint, and thereafter the position of the brush 15 on the blocks 16 is determined automatically by the main current which flows through the armature, which in turn is dependent on the speed at which the armature is rotated. In stopping the motor the movement given the cam 18 mechanically causes the circular portion of the cam to compel the swinging core to resume its position of safety with the brush 15 in the position shown in Figs. 6 and 10. The result is very important, as stated, and positively prevents the occurrence of any set of circumstances which would tend to cause the flow of a destructive current through the coils of the armature.

The automatic stopping of the car D when near the upper and lower limits of its travel is conveniently effected by means of the obstructions or balls a on the operating-rope. Should the operator for any reason neglect to control the motor, suitable projections on the car will strike these limit-stops a, and the further movement of the car will cause the required movement of the operating-rope and effect the movement of the bar 19, as hereinbefore described, thereby bringing the switching mechanism into operation and applying the friction-brake on the shaft of the motor. It is to be understood that this automatic operation of the switch by or through the movements of the car in no manner pertains to the operation of a switch which is automatically moved or restored from its operative position to its normal or inoperative position by means of devices which are operative wholly independently of the car or its movements, as in certain electric elevator organizations not devised by me, but of which I am cognizant.

In the arrangement so far shown I have used three brushes $m\ m'\ m''$. Brushes m' and m'' have been used to cut out and reverse the current of the armature, and the brush m has been used to close and open the circuit of the field-coils of the motor. When for any reason this last brush is moved a short distance only from the edges of the plates 11 or 12, or is moved but slowly therefrom, it may happen that an arc is formed and may be maintained for some time, and the brush may thus not only fail to fully open the circuit when desired, but may also be more or less damaged by the formation of the arc. To avoid this, I have substituted the modified form shown in Figs. 11, 12, 13, and 14, in which the switch is operated partly by hand and partly by a spring, the hand movement bringing the mechanism into such position that the required movement of the field-switch is carried on by means of the power stored in the spring. I have for this purpose discarded the plates 11 and 12 and substituted for them two blocks 30 30, suitably mounted on the frame-work, and for the brush m I have substituted the metallic bar 31. The two blocks 30 are in circuit with the generator in the same relations as the plates 11 and 12, hereinbefore described, and the bar 31 is connected with the other terminal of the generator. The circuit of the motor is closed into the line whenever the bar 31 is placed in contact with either of the blocks 30, and at any intermediate point between these two positions the circuit is open.

I prefer to construct and operate this device as follows: Upon the shaft l, heretofore described, I secure the arm 32, Fig. 11, having at its outer end the laterally-projecting pins 33 34, and on a rock-shaft 36, suitably journaled, I place a wheel or cam 35, having three teeth so arranged as to engage with one or the other of the pins 33 34 of the arm 32. On the wheel 35 I also construct a cam, which has three suitably-shaped notches, and I arrange a bell-crank lever 38, having a friction-roller 37 bearing into one or other of the said notches and forced therein by a spring 39 of sufficient tension for the purpose. In the position shown in Fig. 11 the roller 37 is bearing into the middle notch and the arm 32 has its pins 33 34 midway between the teeth on the wheel 35. In this relation of the parts the metallic bar 31 occupies the position of open circuit and no current flows from the line through the coils of the motor. If now the arm 32 is moved to one side by the rotation of the shaft l, as hereinbefore set forth, one of the pins 33 34 will come in contact with the middle tooth on wheel 35, and if such motion continues will cause the wheel 35 to turn, thereby rotating shaft 36 and moving the bar 31 accordingly. As the motion continues the roller of the bell-crank 38 rotates up the side of the adjacent notch on the cam until it has reached the highest point, when the spring will cause the wheel 35 to move rapidly in the same direction, thus swinging the switch-bar 31 into contact with one of the blocks 33 or 34, and thus close the circuit of the motor. The arm 32, as already described, may now continue its motion along with the brushes $m' m''$; but when the motor is to be stopped and the motion of the arm 32 has been reversed by shaft l the pins will again engage with the teeth on the wheel 35, and the action just described again takes place by the roller 37 rising on the cam to the highest point, and the further movement causes the spring 39 to exert its force and throw the wheel 35 and with it the bar 31 into the position of open circuit, as shown in Fig. 11. I thus secure a rapid motion in both closing and opening the circuit of the motor and prevent the formation of any arc at the point of opening and closing.

In Figs. 11, 12, 13, and 14 the connections are shown in such relations that the whole current flows through the switch 30 31; but this is not necessary, as obviously the former arrangement can be adopted equally well and the switch 30 31 used for the field-magnet circuit only.

In my novel organization the elevator-car is not only hoisted by the operation of the motor, but it is also actually lowered by driving the motor backwardly, said motor being reversed by a reversal of current in the armature-circuit without changing the current in the field-coils as distinguished from prior modes of operation, involving the descent of a car by gravity or the reversal of the motor by reversing current in the field-coils, or by means of a current in one direction applied alternately to oppositely-wound field-coils.

In devising the organization selected by me for illustrating a desirable and well-tested embodiment of the several features of my invention I have preserved the most desirable and effective features of well-known and highly-approved hoisting mechanism and its controlling devices, and I have combined therewith the electric motor, its electric connections, and controlling devices in such a manner as to secure complete harmony of operation throughout the apparatus with highly effective and satisfactory results. It is, however, to be understood that in matters of detail wide variations may be made in the mechanical and electrical arrangements shown without materially affecting results or departing from the main features of my invention.

I claim as I my invention—

1. In elevator machinery, the combination, with the traveling car or platform, of an electric motor adapted to both hoist and lower the car, a movable switching device adapted, according to its position, to open and close the motor-circuit and admit current in respectively opposite directions through the armature-circuit, and mechanical means accessible to an attendant on the car or platform for controlling the position of said movable switching device.

2. In elevator machinery, the combination, with the traveling car or platform, of an electric motor adapted to both hoist and lower the car, a movable switching device adapted, according to its position, to open and close the motor-circuit and to admit current in respectively opposite directions through the armature-circuit, and means for mechanically varying the current in the armature-circuit.

3. In elevator machinery, the combination, with the traveling car or platform, of an electric motor, a movable switching device adapted, according to its position, to open and close the motor-circuit and to admit current in respectively opposite directions through the armature-circuit, and means for automatically controlling the current in the armature-circuit dependent for operation on the strength of current flowing therein.

4. In elevator machinery, the combination, with the traveling car or platform, of an electric motor, a movable switching device adapted, according to its position, to open and close the motor-circuit and to admit current in respectively opposite directions through the armature-circuit, means for mechanically varying the current in the armature-circuit during the first movement of said switching device, and mechanism adapted to be placed in operative position by the continued movement of said switching device for automatically controlling the current in the armature-circuit dependent for operation on the strength of current flowing therein.

5. In elevator machinery, the combination, with the traveling car or platform, of a shunt-wound electric motor adapted to drive the same, a movable switching device adapted to close the field-magnet circuit, a resistance in the armature-circuit, and means for in part automatically controlling it, these operating (while the field-magnet circuit in kept closed) to first interpose resistance in the armature-circuit, then to remove a part thereof, and finally to automatically cut out the remainder of the resistance, and means on the car or platform for controlling the position of the switching device.

6. In elevator machinery, the combination, with the traveling car or platform, of an electric motor adapted to drive the same, a movable switching device adapted, according to its position, to open and close the motor-circuit and to admit current in respectively opposite directions through the armature-circuit, means for mechanically varying the current in the armature-circuit, and means on the car or platform for controlling the position of said movable switching device.

7. In elevator machinery, the combination, with the traveling car or platform, of a shunt-wound electric motor, a movable switching device adapted, according to its position, to open and close the armature-circuit thereof, and spring-controlled mechanism dependent for operation upon the action of said switching device and arranged to suddenly and widely open the field-magnet circuit when required.

8. In elevator machinery, the combination, with the traveling car or platform, of an electric motor adapted to drive the same, a movable switching device adapted, according to its position, to open and close the motor-circuit and admit current in respectively opposite directions through the armature-circuit, and a rope or cable along the path of the car or platform operatively connected to said switching device.

9. In elevator machinery, the combination, with the traveling car or platform, of a shunt-wound electric motor adapted to drive the same, and a movable switching device, and a resistance in the armature-circuit, said switching device adapted, first, to close the field-magnet circuit, then to close the armature-circuit through a resistance, and finally to gradually cut said resistance out of the armature-circuit.

10. In elevator machinery, the combination, with the traveling car or platform, of a shunt-wound electric motor adapted to drive the same, a movable switching device, two independent resistances adapted to be included in the armature-circuit, and interposed mechanism, including a helix or solenoid and its core, whereby in starting the motor the switching device first causes a closure of the field-magnet circuit; second, a closure of the armature-circuit through both of said resistances, and then gradually cuts out one of them, and finally leaves the other resistance subject to control by the helix, which is variably operated, according to strength of current in the armature-circuit.

11. In elevator machinery, the combination, with the traveling car or platform, of a shunt-wound electric motor adapted to drive the same, a resistance in the armature-circuit, a movable switching device adapted, first, to close the field-magnet circuit, then to close the armature-circuit through the resistance, and finally to gradually cut said resistance out of the armature-circuit, and means on the car or platform for controlling the position of said switching device.

12. In elevator machinery, the combination, with the traveling car or platform, of an electric motor adapted to hoist and lower the same, a movable switching device for closing and opening the motor-circuit, a mechanically-operated friction-brake in operative relation to the motor-shaft, a single controlling device operatively connected to both the switching and brake devices, and a line or rope on the car or platform for operating such single controlling device.

13. In elevator machinery wherein the movement of the car is effected by an electric motor in which the energizing-current is controlled by a mechanically-operated switch-board and rheostat, the combination therewith of a helix in the armature-circuit, a movable core therefor, a variable safety-resistance adapted to be interposed in the same circuit, and a shifting contact for said resistance operatively connected to the movable core.

14. In elevator machinery wherein the movement of the car is effected by an electric motor in which the energizing-current is controlled by a mechanically-operated switch-board and rheostat, the combination therewith of a helix in the armature-circuit, a core adapted to movement into and out of said helix and mechanically connected to the contact-arm of said switch-board, an additional variable resistance adapted to be interposed in the circuit of the armature, a shifting contact for said resistance attached to the movable core and means for first forcibly retaining such additional resistance in the armature-circuit during a predetermined movement of the switch-arm and then releasing it from the mechanical restraint and controlling it by the attraction of the said helix.

15. In a reversing-switch for electric-motor circuits, the combination of a movable arm, contact-blocks in the path of movement of said arm on both sides of its neutral or open-circuit position, other blocks which provide for reversals of current, and a series of resistances interposed between the first-named blocks on one side, and circuit-connections coupling corresponding blocks together, whereby a single set of resistances serves for currents in opposite directions, according to the position of the arm.

16. In a reversing-switch for electric-motor circuits, two circular ranges of contact-blocks, each composed of four blocks, and the blocks of both ranges symmetrically arranged as to position, in combination with two brushes insulated apart and adapted to move together one over one range of blocks and the other over the other range, and circuit-connections to the said blocks so arranged as to effect a reversal of current in said circuit when the brushes move from block to block.

17. The combination, substantially as hereinbefore described, of elevating mechanism including a traveling car, an electric motor for operating said mechanism, current-controlling devices or switching mechanism by means of which the electric current may be varied and also reversed in the armature-circuit, means for cutting off said current, which are automatically operated through or by the movement of the car, and means in the car for mechanically operating the switching mechanism in either direction.

In testimony whereof I affix my signature in presence of two witnesses.

RUDOLF EICKEMEYER.

Witnesses:

T. J. McTighe,

E. C. Grigg.