(No Model.)

R. M. HUNTER.

ELECTRIC ELEVATOR OR HOISTING MACHINE.

No. 575,479. Patented Jan. 19, 1897.

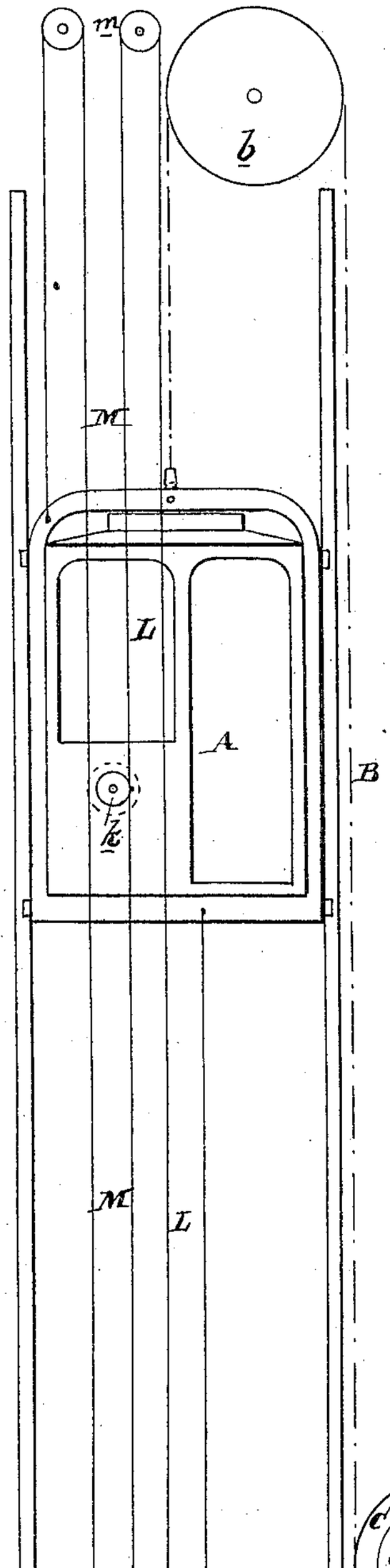


FIG. 1

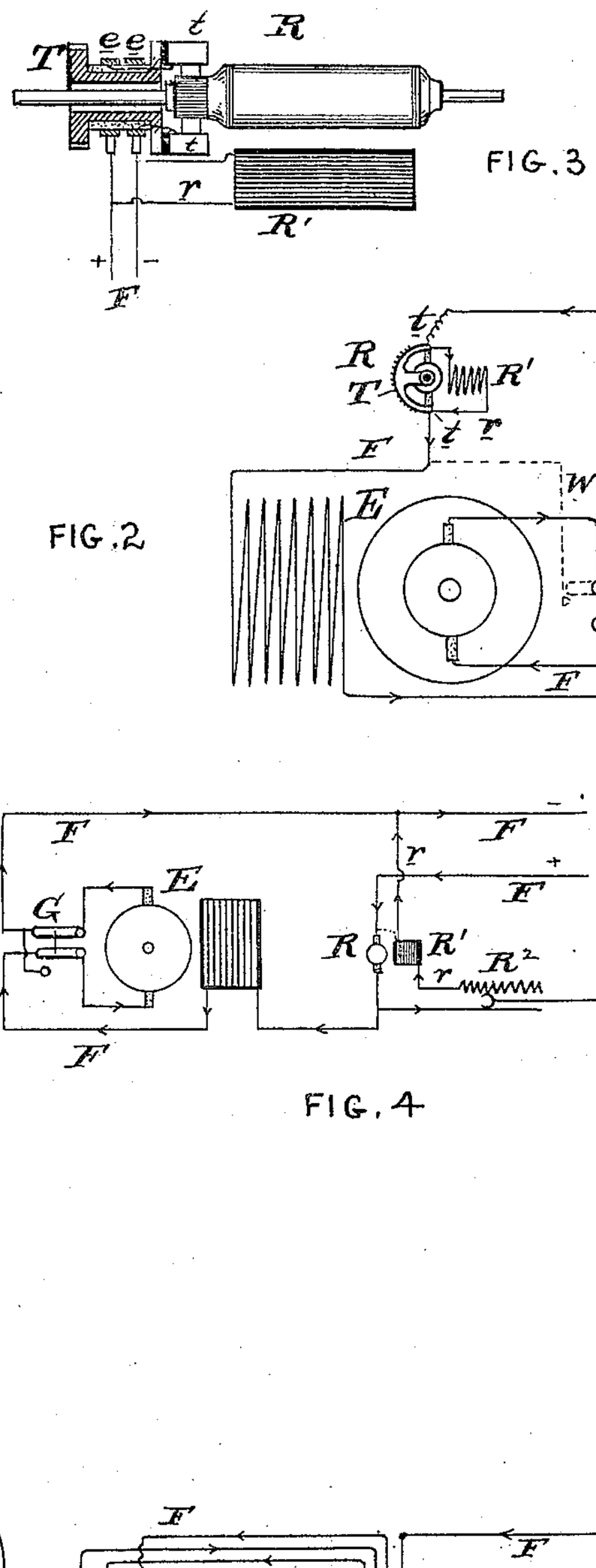
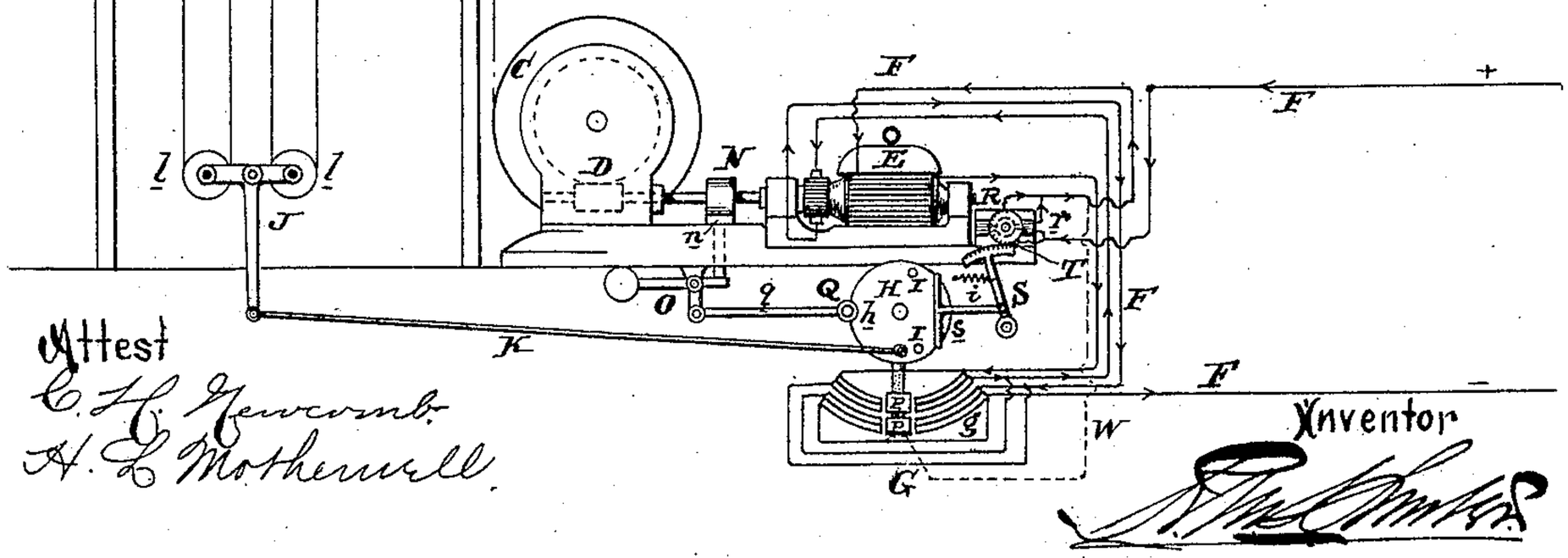


FIG. 3

FIG. 2

FIG. 4



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RUDOLPH M. HUNTER, OF PHILADELPHIA, PENNSYLVANIA.

ELECTRIC ELEVATOR OR HOISTING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 575,479, dated January 19, 1897.

Application filed April 5, 1894. Serial No. 506,389. (No model.)

To all whom it may concern:

Be it known that I, RUDOLPH M. HUNTER, of the city and county of Philadelphia and State of Pennsylvania, have invented an Improvement in Electric Elevators or Hoisting-Machines, of which the following is a specification.

My invention has reference to electric elevators or hoisting-machines; and it consists of certain improvements which are fully set forth in the following specification and shown in the accompanying drawings, which form a part thereof.

This application (Case No. 271) has particular reference to hoisting apparatus of all kinds operated or controlled by electricity.

Heretofore it has been customary in operating electric elevators or hoisting-machines to operate the winding-drum by means of an electric motor and vary the power or speed of the electric motor by a rheostat or resistance-changer operated directly or indirectly from the cage or a distant place. In systems where dead-resistances are required as a means for controlling the current passing to the motor there is a great waste of current in that the current is consumed in heating up the resistances which offer an obstruction to its path. This waste is very material, as elevators and hoisting-machines are frequently stopped and started while in operation for their regular duty.

The object of my invention is to provide a means for controlling the power-motor of an electric elevator from the cage or a distant place, whereby its speed may be varied up to a maximum without the use of dead-resistances, such as commonly found in rheostats, and this I accomplish by opposing to the current flowing through the power-motor a variable counter electromotive force magnetically produced, but independent of that of the power-motor, whereby the current may be checked to any extent desired without material waste.

My improvement therefore comprehends great economy in the operation of electric elevators in addition to the more perfect regulation thereof.

In carrying out my invention I provide the cage with means of any suitable character for raising and lowering it, and these devices I operate with an electric power-motor, preferably of the series type or kind, adapted to the variable duty to which it is subjected in elevator or hoisting work. The electric motor is connected with the line-circuits leading from the source of supply, and in said circuit I arrange a counter-electromotive-force generator, preferably in the form of a small motor adapted to run free and so controlled that its speed may be readily varied to produce in its revolving element a variable counter electromotive force to oppose to the extent desired the initial electromotive force of the line-circuit or source of electric supply. In this manner the current flowing through the large or power motor is varied to a nicety, and both its speed and power is controlled to exactly that which is desired or required. To control the counter-electromotive-force generator I provide suitable devices leading to the cage, whereby the said generator may be operated from the cage while the same is in operation or at rest at any position. In addition to the foregoing features I provide means for reversing the current in the large or power motor so as to raise or lower the cage, and also a brake adapted to be automatically thrown into action when the elevator is at rest or when the current is thrown off the power-motor.

I do not confine myself to the details of construction of the counter-electromotive-force generator or the means employed for moving the cage or for controlling the said generator from the cage, as all of these may be varied or changed without departing from my invention.

It will be further understood that while my invention is especially adapted to electric elevators it is also applicable to all classes of hoisting machinery, such as lifts and cranes, whether of the stationary or traveling kind.

My invention will be better understood by reference to the accompanying drawings, in which—

Figure 1 is an elevation of an electric elevator embodying my improvements. Fig. 2 is a diagram illustrating the electric circuits employed in the said elevator. Fig. 3 is a transverse sectional elevation illustrating the counter-electromotive-force generator, and Fig. 4 is a diagram of electric circuits simi-

lar in character to Fig. 2, but showing a modification thereof.

A is the passenger cage or platform, and may move in guides in the elevator-shaft, as is customary. The cage is elevated or lowered by means of a cable B and a winding-drum C. The cable B passes over a guide-sheave *b* at the top of the shaft. The winding-drum C is combined with an electric motor E through suitable worm and worm wheel or other gearing D.

F is the motor-circuit leading from the source of electrical energy, which may be of any character desired, but preferably of constant potential.

R is a counter-electromotive-force generator, and as shown is a type of small shunt-motor having a high-resistance field R′ in a shunt-circuit *r* about the low-resistance revolving element or armature. The armature of the counter-electromotive-force generator R is directly in the circuit F and in series with the revolving element of the power-motor E.

T is a movable frame carrying the brushes *t* for the generator R, the frame T being provided with teeth with which the teeth on a pivoted segmental rack S mesh, and by which the brushes may be shifted to vary the position of the magnetic poles of the revolving element or armature relative to the poles of the magnetic field, to the end that the armature speed shall be increased or decreased. The armature revolves in suitable bearings and performs no other work than that of its own revolution. Consequently its speed may be raised very high and it may obtain its maximum speed almost instantly. By shifting the brushes the speed may be quickly reduced, and, if desired, the armature may be brought to rest with rapidity. The resistance of the armature or revolving element of the generator R should be such as to be capable of carrying the maximum current which would be necessary to the power-motor E, but as the power-motor is in active operation when the revolving element of the generator R is made to approach a condition of rest it is evident that the cross-section of the wire making up the conductors of the armature might be considerably less than the cross-section of the wire upon the power-motor E. It is also evident that as the revolving element of the generator is allowed to rotate freely without doing work, no practical current which would be turned upon it could injure it, since it would respond with so great rapidity that no heating effect could result before its counter electromotive force would shut off the supply of current from the line.

The generator R is an exceedingly small affair compared with the power-motor E, the only requirements being that it shall be capable of carrying the necessary current for the motor E, and have capacity for a very high velocity. By moving the brushes *t* a most gradual and perfect adjustment of the power-motor E may be had, and the change in the speed of the motor E may be more gradual than is possible with any other method of regulation. The brushes *t* may be carried by an adjustable sleeve, furnished with a pinion T, which pinion meshes with a segmental pivoted rack S, adapted to be pulled in one direction by a spring *i* and be moved in the other direction by a slide *s*, having a surface with which pins or rollers I upon a pivoted disk H are adapted to come in contact. The brushes *t* may be connected with the electric circuits by any flexible electrical connection, but an excellent manner is to provide the brush-holders with two rings *e*, respectively, connected to the two brushes and having sliding contacts as terminals from the circuit F, as is clearly indicated in Fig. 3.

In the condition shown in Fig. 1, the brushes of the generator R are in the position to give the highest speed to the armature. If the disk H be rotated in either direction, it is evident that after a short movement one or other of the pins or rollers I will come into contact with the slide *s* and move the segmental rack S against the action of the spring *i*. The disk H is operated by a link K, connecting with a T-shaped crank device J, which is rocked upon an axis by means of any suitable controlling device leading to the cage A. One form of such controlling device is shown, and consists of two cables L and M, one of which, L, connects with the bottom of the cage A, then passes down around a sheave *l* on one arm of the device J, then passes upward to a drum *k* on the cage, and adapted to be turned by hand from within the cage, and the other of which cables, M, being connected to the top of the cage and passes up over a sheave *m* at the top of the shaft, thence downward and around a sheave *l* on another arm of the device J, and thence upward and secured to the same side of the drum *k* on the cage. It will now be seen that by turning the drum *k* one of the cables L will be lengthened and the other shortened, causing the necessary oscillation or movement of the device J. If the drum *k* is rotated in one direction, the disk H is rotated so that one of the pins or rollers I comes into action with the slide *s*, and if the drum *k* is rotated in the opposite direction, a reverse movement is given to the disk H and the other pin or roller comes into action. It is evident that any suitable controlling device extending to the cage of the elevator for operating the disk H or the controlling-generator R may be employed.

The disk H is provided with two contacts P, which move over curved contact-blocks *g*, which contact-blocks are connected with the motor-circuits F in such a manner that if the blocks P are moved in one direction the motor E is operated to lift the cage, and if moved in the opposite direction the motor is operated to lower the cage. The device *g* and P therefore act as a current-reverser for the power-motor, in that it reverses the current

in the armature relatively to the field. As shown, the reversing-switch completely severs the circuit, through the power-motor E, when the elevator-cage is at rest; but it is evident that, if desired, the circuit may be completed through the contact P, as indicated by the dotted lines W in Fig. 1, if it is desired to keep the generator of counter electromotive force R in continuous operation.

N is a brake-wheel on the motor-shaft, and *n* is a brake-shoe adapted to be thrown against the brake-wheel. Any movement of the disk H causes the roller Q to ride up out of the notch *h* in the periphery of the disk, and, through the action of a rod *q*, move the lever O to withdraw the pressure of the brake-shoe from the brake-wheel. In this manner the brake is automatically applied and removed, being applied when the elevator is at rest and removed when the motor is started up to elevate or lower the cage. The parts are so organized that any movement of the disk H throws off the brake simultaneously or thereabout when closing the circuit F. After this action is performed the operation of the generator R is gradually slowed down, so as to permit more current traversing the power-motor E.

When the switch G is in the position shown in Fig. 2, the current traverses the revolving elements of both the generator R and the power-motor E in series. If the switch is thrown so as to cover the dotted contacts, then the current will flow through the generator R, over dotted circuit W, and into the line with the motor E cut out, said circuit corresponding in effect to the circuit shown in dotted lines in Fig. 1.

It is evident that while the field-coils R′ are shown as in a shunt-circuit *r* around the revolving element of the counter-electromotive-force generator R, the shunt-circuit *r* might not only be shunted relative to revolving element of the counter-electromotive-force generator but might also be shunted relatively to the power-motor E, as indicated in Fig. 4. This field R′ may also have its strength controlled by a suitable resistance-changer R^2 to vary the counter electromotive force. As shown in Fig. 4, the resistance-changer is operated by a bell-crank J′, and may be adapted to be moved by any suitable control device from the cage. By varying the resistance in the field-circuit the counter electromotive force of the generator R may be varied as desired. In Fig. 4 a dotted line shows that instead of the shunt-circuit *r* being connected to the motor-circuit F beyond the motor E it might be connected upon each side of the revolving element of the generator R, as in Fig. 2.

While I have shown a shunt-motor as a preferable form, it is evident that any other suitable construction of motor may be employed. For instance, any series motor adapted to run at high speed might be employed, as such motor would generate a counter electromotive force proportional to its speed and capable of variation by the adjustment of the poles of the revolving element relatively to the poles of the field.

It will be readily understood that it is immaterial to my invention in what manner the poles of the revolving element are adjusted relatively to the poles of the field, for instead of moving the brushes the field-magnets themselves might be moved on. In fact the relative movement between the said poles may be accomplished in any manner desired.

My invention comprehends any means which will control the speed of rotation of the revolving element of the high-speed counter-electromotive-force generator R, whether said variation in speed is controlled mechanically or electrically, the object being to control the counter electromotive force generated in accordance with the requirements irrespective of whether the same is varied by variation in the speed of the revolving element, variation in the position of the brushes, variation in the position of the poles of the field relative to those of the revolving element, or variation in the relative magnetic induction between the field and the revolving element, as all of these are equivalent means of regulation under my generic invention.

I do not confine myself to any particular construction or details of the apparatus, as the various parts may be modified or changed from that shown, so long as they accomplish the results herein specified, that is to say, controlling the power-motor of the elevating device by an induced counter electromotive force varying in pressure and produced by magnetic induction.

What I claim as new, and desire to secure by Letters Patent, is—

1. In an electric elevator or hoisting apparatus, the combination of a vertically-moving cage or elevating device, power devices for raising or lowering the same, and an electric motor mechanically connected to operate the power device and receiving current from a source of electrical energy, with a counter-electromotive-force regulator consisting of electric conductors in series with the motor moving in a magnetic field and provided with flexible means to vary the speed or movement of the said conductors extending to and controllable from the cage or moving part of the elevator or hoisting apparatus.

2. In an electric elevator or hoisting apparatus, the combination of a vertically-moving cage or elevating device, power devices for raising or lowering the same, an electric motor mechanically connected to operate the power device and receiving current from a source of electrical energy, with a counter-electromotive-force regulator consisting of electric conductors in series with the motor moving in a magnetic field and provided with means to vary the speed or movement of the said conductors, and connecting devices extending to the cage or elevating device for

controlling the counter electromotive force from a distance.

3. In an electric elevator or hoisting apparatus, the combination of a vertically-moving cage or elevating device, power devices for raising or lowering the same, an electric motor mechanically connected to operate the power device and receiving current from a source of electrical energy, with a counter-electromotive-force regulator consisting of electric conductors in series with the motor moving in a magnetic field and provided with means to vary the speed or movement of the said conductors, connecting devices extending to the cage or elevating device for controlling the counter electromotive force from the said cage, and a reversing-switch to reverse the motor from the cage to reverse the movement thereof.

4. In an electric elevator or hoisting apparatus, the combination of a vertically-moving cage or elevating device, power devices for raising or lowering the same, an electric motor mechanically connected to operate the power device and receiving current from a source of electrical energy, with a counter-electromotive-force regulator consisting of electric conductors in series with the motor moving in a magnetic field and provided with means to vary the speed or movement of the said conductors, connecting devices extending to the cage or elevating device for controlling the counter electromotive force from the said cage, a reversing-switch to reverse the motor from the cage to reverse the movement thereof, at a time when the counter-electromotive-force generator has been caused to generate its greatest counter electromotive force, and a brake also controlled from the cage for arresting the movement of the motor when the cage is at rest and when the counter-electromotive-force generator is generating the greatest counter electromotive force and adapted to be thrown out of action when the cage is moved.

5. In an electric elevator or hoisting apparatus, the combination of a vertically-moving cage or elevating device, power devices for raising or lowering the same, an electric motor mechanically connected to operate the power device and receiving current from a source of electrical energy, with a counter-electromotive-force regulator consisting of electric conductors in series with the motor as an entirety and moving in a magnetic field, and means extending to a distance to vary the speed of movement of the conductors for producing a difference in speed thereof to vary the supply-current to the motor.

6. In an electric elevator or hoisting apparatus, the combination of a vertically-moving cage or elevating device, power devices for raising or lowering the same, an electric motor mechanically connected to operate the power device and receiving current from a source of electrical energy, with a counter-electromotive-force regulator consisting of electric conductors in series with the motor moving in a magnetic field and provided with movable brushes to vary the speed of movement of the conductors, and hand-operated devices extending to the cage for shifting the brushes of the counter-electromotive-force generator into different positions relatively to the field-poles to vary the current flowing through the power-motor.

7. In an electric elevator or hoisting apparatus, the combination of a vertically-moving cage or elevating device, power devices for raising or lowering the same, an electric motor mechanically connected to operate the power device and receive a current from a source of electrical energy, with a counter-electromotive-force generator consisting of electric conductors in series with the motor moving in a magnetic field and provided with means to vary the speed of movement of the conductors, field-magnet coils of high resistance to maintain a constant field in the generator supplied with current independently of the current traversing the moving electric conductors of the generator, a reversing-switch to reverse the direction of rotation of the motor, controlling devices extending to the cage for operating the reversing-switch, and means for timing the several parts whereby the reversing-switch cannot be shifted when the conductors of the counter-electromotive-force generator are moving slowly and the counter electromotive force generated thereby is low.

8. In an electric elevator or hoisting apparatus, the combination of a vertically-moving cage or elevating device, power devices for raising or lowering the same, an electric motor mechanically connected to operate the power device and receiving current from a source of electrical energy, a counter-electromotive-force generator consisting of electric conductors in series with the motor and revolving within a magnetic field, means to shift the position of the magnetic poles produced by the revolving electric conductors within the field, and controlling devices extending to the cage for operating the said pole-shifting devices.

9. In an electric elevator or hoisting apparatus, the combination of a vertically-moving cage or elevating device, power devices for raising or lowering the same, an electric power-motor mechanically connected to operate the power device and receiving current from a source of electrical energy, a counter-electromotive-force generator to control the operation of the electric motor consisting of a revolving armature operating within a magnetic field and in series with a power-motor, and hand-control devices for varying the speed of the counter-electromotive-force-regulating armature from the moving cage or elevating device.

10. In an electric elevator or hoisting apparatus, the combination of a vertically-moving cage or elevating device, power devices

for raising or lowering the same, an electric power-motor mechanically connected to operate the power device and receiving current from a source of electrical energy a counter-electromotive-force generator to control the operation of the electric power-motor consisting of a revolving armature operating within a magnetic field and in series with a power-motor, hand-control devices for varying the speed of the counter-electromotive-force-regulating armature from the moving cage or elevating devices, and means to reverse the direction of rotation of the motor also operated from the cage or elevating device.

11. In an electric elevator or hoisting apparatus, the combination of a vertically-moving cage or elevating device, power devices for raising or lowering the same, a slow-speed power electric motor mechanically connected to operate the power device and receiving current from a source of electrical energy, a high-speed generating-motor for generating a counter electromotive force, electric circuits connecting the armatures of the two motors in series, mechanical devices for shifting the magnetic poles of the armature of the high-speed or generating motor relatively to the field-poles thereof to vary the counter electromotive force thereof for the purpose of controlling the current delivered to the slow-speed or power motor, and controlling devices extending to the cage or elevating device for operating the said mechanical devices.

12. In an electric elevator or hoisting apparatus, the combination of a vertically-moving cage or elevating device, power devices for raising or lowering the same, a slow-speed electric motor mechanically connected to operate the power device and receiving current from a source of electrical energy, a counter-electromotive-force-generating motor having its revolving element electrically connected in series with the revolving element of the power-motor, means to maintain a substantially constant magnetic field in the vicinity of the generating-motor irrespective of the counter electromotive force of its revolving element, devices for shifting the poles of said revolving element relatively to the poles of the magnetic field in said last-mentioned or generating motor whereby its counter electromotive force is varied and opposes the initial electromotive force of the operating-current of electricity to vary the speed of the power-motor, and means extending to the cage for operating the pole-shifting devices from the cage to vary the speed of the elevator-cage or elevating device.

13. In an electric elevator or hoisting apparatus, the combination of a vertically-moving cage or elevating device, power devices for raising or lowering the same, an electric motor mechanically connected to operate the power device and receiving current from a source of electrical energy, a counter-electromotive-force-generating motor having its revolving element electrically connected in series with the power-motor, means to maintain a substantially constant magnetic field in the vicinity of the generating-motor irrespective of the counter electromotive force of its revolving element, devices for shifting the poles of said revolving element relatively to the poles of the magnetic field in said last-mentioned or generating motor whereby its counter electromotive force is varied and opposes the initial electromotive force of the operating-current of electricity to vary the speed of the power-motor, and means extending to the cage for operating the poles, shifting devices from the cage to vary the speed of the elevator, and a current-reversing switch for the power-motor also controlled from the cage.

14. In an electric elevator or hoisting apparatus, the combination of a vertically-moving cage or elevating device, power devices for raising or lowering the same, an electric motor mechanically connected to operate the power device and receiving current from a source of electrical energy, a regulating-generator having its armature connected in series with the power-motor, and flexible means to vary the speed of rotation extending to the cage or elevating device.

15. In an electric elevator, or hoisting apparatus, the combination of a vertically-moving cage or elevating device, power devices for raising or lowering the same, an electric motor mechanically connected to operate the power device and receiving current from a source of electrical energy, a controlling-generator for generating counter electromotive force having a revolving element connected in series with the power-motor and moving in a magnetic field, a rack-and-pinion device for shifting the poles of said generator, a movable slide to move the rack, a rotary disk having pins or projections for moving the slide similarly for a rotation of the disk in either direction, and controlling devices extending to the cage or elevating device for moving the said disk.

16. The herein-described method of reversing the movement of an electrically-operated elevator which consists in supplying current to an electric power-motor, producing by magnetic induction in the motor-circuit an induced counter electromotive force independent of that of the power-motor to control the speed of movement of the said power-motor, gradually increasing the counter electromotive force to cause the power-motor to slow its speed and ultimately to stop, then reversing the current in one of the elements of the power-motor to reverse its rotation, and finally gradually reducing the induced counter electromotive force to increase the speed of the power-motor.

17. The herein-described method of reversing the movement of an electrically-operated elevator which consists in supplying currents to a power-motor, producing by a magnetic

induction in the motor-circuit an induced counter electromotive force independent of that of the power-motor to control the speed of movement of the said power-motor, gradually increasing the counter electromotive force to cause the power-motor to slow its speed and ultimately to stop, then reversing the current in one of the elements of the power-motor to reverse its rotation, finally gradually reducing the induced counter electromotive force to increase the speed of the power-motor, and controlling the said operations from the moving cage irrespective of its movement.

18. In an electric elevator or hoisting apparatus, the combination of a vertically-moving cage or elevating device, power devices for raising or lowering the same, an electric motor mechanically connected to operate the power device and receiving current from a source of electrical energy, a controlling-generator for generating counter electric motive force having a revolving element connected in series with the power-motor and moving in a magnetic field, means for shifting the poles of said generator to vary the counter electromotive force independent of the action of the power-motor, means extending to the elevator-cage for shifting said poles for the purpose of increasing the speed of the counter-electromotive-force generator until its counter electromotive force substantially equals the initial electromotive force of the line-current, means for reversing the current in the power-motor when the counter electromotive force of the regulator is at its highest for the purpose of reversing the power-motor, and means extending to the cage for shifting the poles of the counter electromotive force for the purpose of operating the power-motor in the reverse direction.

19. In an electric elevator or hoisting apparatus, the combination of a vertically-moving cage or elevating device, power devices for raising or lowering the same, an electric motor mechanically connected to operate the power device and receiving current from a source of electrical energy, a controlling generator for generating counter electromotive force having a revolving element connected in series with the power-motor and moving in a magnetic field, means for increasing and decreasing the counter electromotive force of said controlling-generator, a reversing-switch for the power-motor, and controlling devices between the moving cage of the elevator and the current-reversing switch, and means for increasing and decreasing the counter electromotive force of the controlling-generator whereby the counter electromotive force is at its maximum when the current in the power-motor is reversed.

20. In an electric elevator or hoisting apparatus, the combination of a vertically-moving cage or elevating device, power devices for raising or lowering the same, an electric motor mechanically connected to operate the power device and receiving current from a source of electrical energy, a controlling-generator for generating counter electromotive force having a revolving element connected in series with the power-motor and moving in a magnetic field, means for increasing and decreasing the counter electromotive force of said controlling-generator, a reversing-switch for the power-motor, controlling devices between the moving cage of the elevator and the current-reversing switch, means for increasing and decreasing the counter electromotive force of the controlling-generator whereby the counter electromotive force is at its maximum when the current in the power-motor is reversed, and a mechanical brake acting upon the power-motor for the purpose of arresting its rotation when the counter electromotive force is at its maximum.

21. In an electric elevator or hoisting apparatus, the combination of a vertically-moving cage or elevating device, power devices for raising or lowering the same, an electric motor mechanically connected to operate the power device and receiving current from a source of electrical energy, a controlling-generator for generating counter electromotive force having a revolving element connected in series with the power-motor and moving in a magnetic field, means for increasing and decreasing the counter electromotive force of said controlling-generator, a reversing-switch for the power-motor, controlling devices between the moving cage of the elevator and the current-reversing switch, means for increasing and decreasing the counter electromotive force of the controlling-generator whereby the counter electromotive force is at its maximum when the current in the power-motor is reversed, and means for interrupting the current in the power-motor in the act of reversing it when the counter electromotive force is at its highest.

22. In an electric elevator or hoisting apparatus, the combination of a vertically-moving cage or elevating device, power devices for raising or lowering the same, an electric motor mechanically connected to operate the power device and receiving current from a source of electrical energy, a controlling-generator for generating counter electromotive force having a revolving element connected in series with the power-motor and moving in a magnetic field, means for varying the counter electromotive force of the controlling-generator, a switch for cutting the power-motor out of circuit, and connecting devices extending to the moving cage or elevating device whereby the electric circuit to the power-motor is broken when the counter electromotive force is at its maximum.

23. In an electric elevator or hoisting apparatus, the combination of a vertically-moving cage or elevating device, power devices for raising or lowering the same, an electric motor mechanically connected to operate the power device and receiving current from a source of electrical energy, a controlling-gen-

erator for generating counter electromotive force having a revolving element connected in series with the power-motor and moving in a magnetic field, means for varying the counter electromotive force of the controlling-generator, a switch for cutting the power-motor out of circuit, connecting devices extending to the moving cage or elevating device whereby the electric circuit to the power-motor is broken when the counter electromotive force is at its maximum, and means to reverse the current in the power-motor prior to changing the counter electromotive force of the controlling-generator.

24. The herein-described method of operating electric hoisting or elevating machines, consisting in supplying to the power-motor an electric current, opposing to said current an induced counter electromotive force produced by magnetic induction independent of that of the power-motor, and gradually increasing or decreasing the regulating counter electromotive force from the moving cage or elevating device to vary the speed and power of the power-motor and the movement of the cage or elevating device.

In testimony of which invention I have hereunto set my hand.

R. M. HUNTER.

Witnesses:
H. L. MOTHERWELL,
ERNEST HOWARD HUNTER.