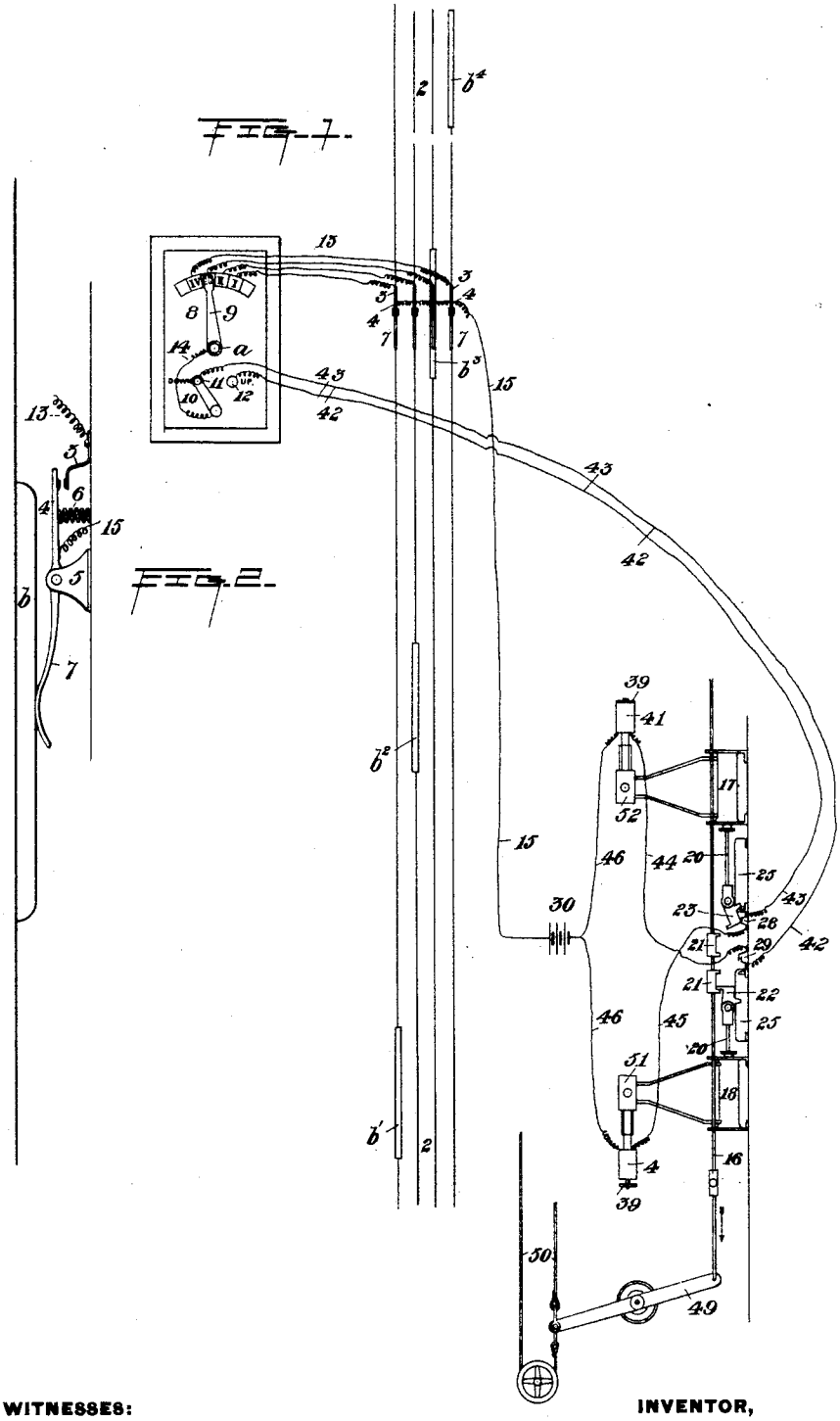
(No Model.) 3 Sheets—Sheet 1.

# R. F. McFEELY.

## ELECTRICAL APPARATUS FOR CONTROLLING ELEVATORS.

No. 404,361. Patented May 28, 1889.




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(No Model.) 3 Sheets—Sheet 2.

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## ELECTRICAL APPARATUS FOR CONTROLLING ELEVATORS.

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FIG. 4.

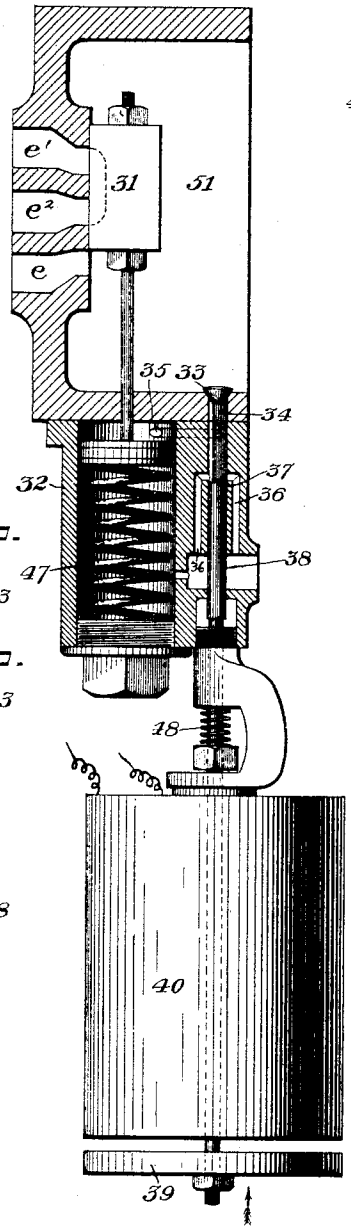



FIG. 5.




FIG. 6.

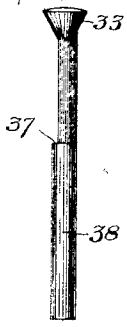
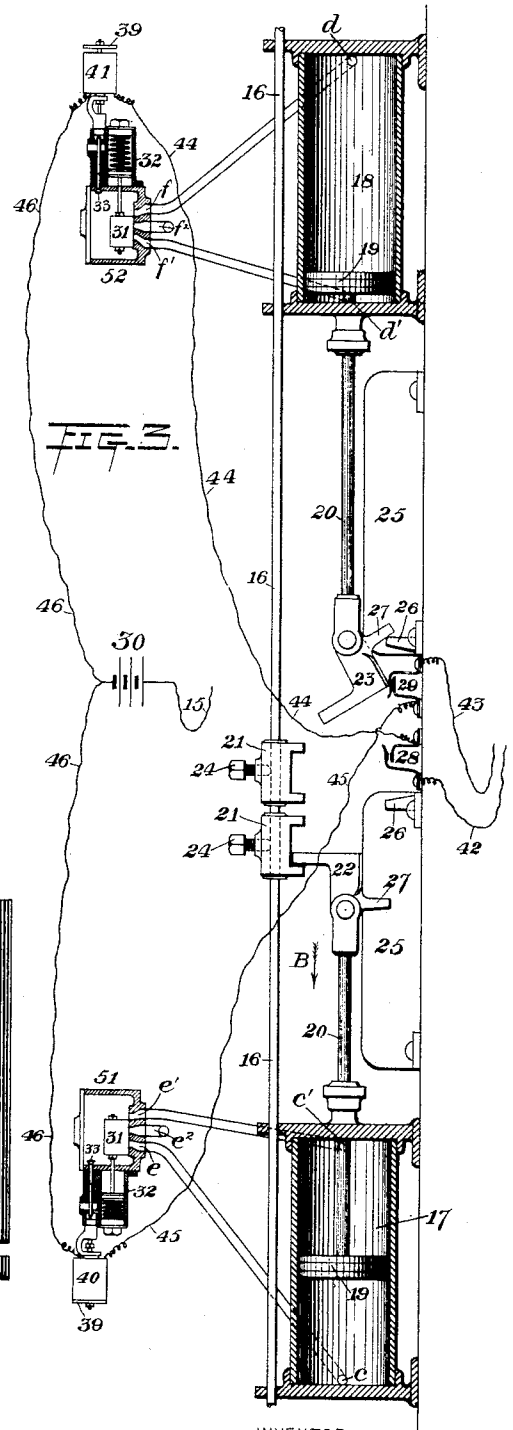






FIG. 3.




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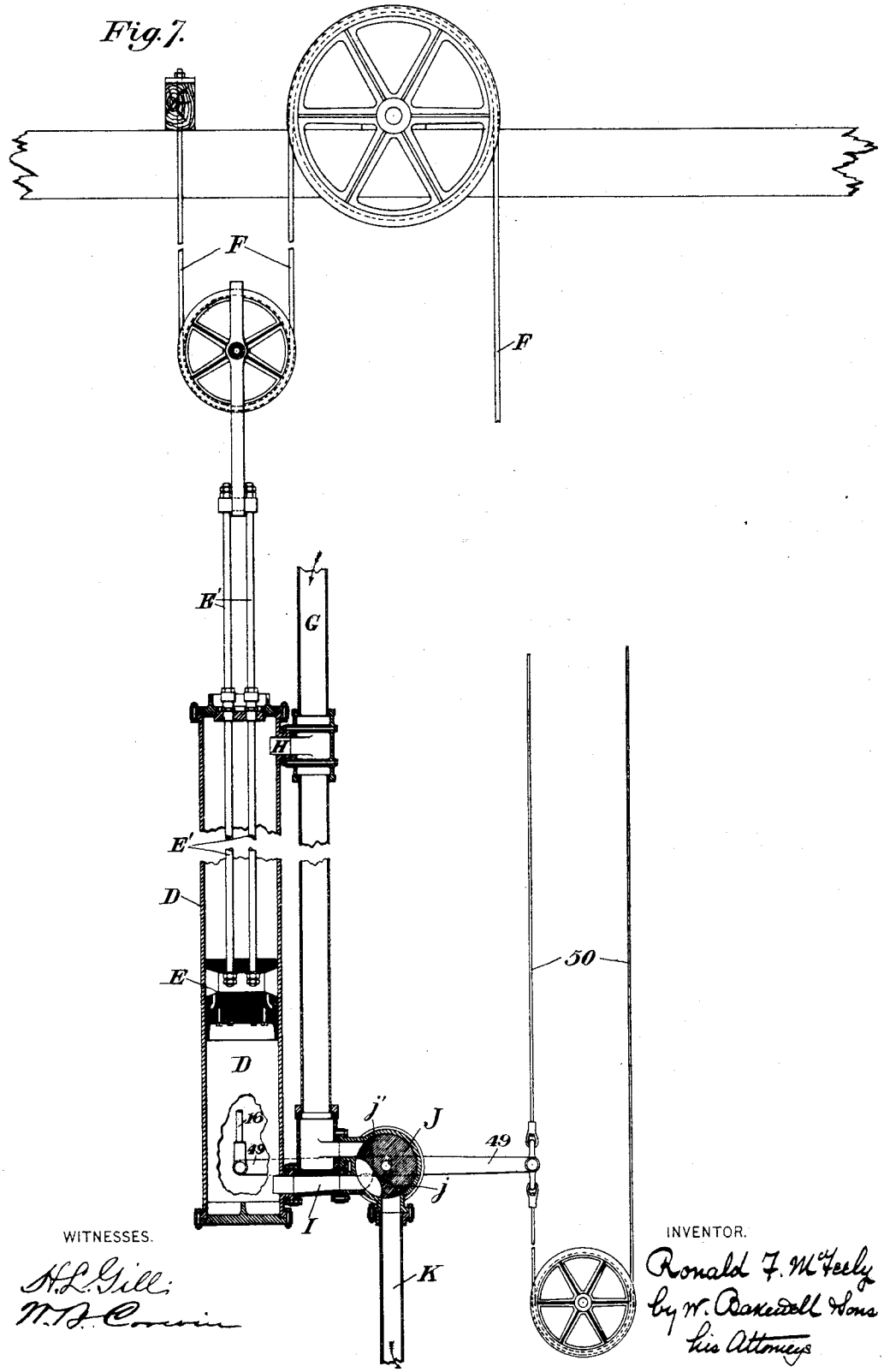
(No Model.) 3 Sheets—Sheet 3.

# R. F. McFEELY.

## ELECTRICAL APPARATUS FOR CONTROLLING ELEVATORS.

No. 404,361. Patented May 28, 1889.

*Fig. 7.*




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# UNITED STATES PATENT OFFICE.

RONALD F. McFEELY, OF PITTSBURG, PENNSYLVANIA, ASSIGNOR TO THE ELECTRO-HYDRAULIC COMPANY, OF SAME PLACE.

## ELECTRICAL APPARATUS FOR CONTROLLING ELEVATORS.

SPECIFICATION forming part of Letters Patent No. 404,361, dated May 28, 1889.

Application filed August 17, 1888. Serial No. 282,994. (No model.)

*To all whom it may concern:*

Be it known that I, RONALD F. McFEELY, of Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Electrical Apparatus for Controlling Elevators; and I do hereby declare the following to be a full, clear, and exact description thereof.

My invention has for its object, first, to provide a device for operating the valve of an elevator by means of an electric current which is so controlled from the elevator as that the stopping of the car at the desired level is effected automatically by proper setting of the apparatus; second, in an improved apparatus and circuit by which the movements of the car are effected with certainty and safety and without the sudden jars which are observed in the use of electrical apparatus heretofore known and used for the same purpose.

I shall describe my invention with reference to the accompanying drawings, in which—

Figure 1 is a diagram plan view illustrating the arrangement of the electric circuit, the circuit-breaker, and the switches on the car. Fig. 2 is an enlarged detail side view of one of the circuit-breakers. Fig. 3 is an enlarged side view, partly in section, showing in detail the construction of the auxiliary valve and the elevator-valve motor. Fig. 4 is a side view, partly in section, of one of the auxiliary slide-valves. Figs. 5 and 6 are detail views of parts. Fig. 7 is a view showing the application of my improved apparatus to the operation of the valve of the hydraulic motor of an elevator, the parts of which motor are of the usual construction and are shown in vertical section.

Like symbols of reference indicate like parts in each.

In the drawings, Figs. 1 and 2, 2 represents the elevator-shaft, on the side of which at the several floor-levels are projections or cam-strips $b$, arranged out of line with each other, each one being arranged in a different vertical line. I have marked these cam-strips with the symbols $b'$, $b^2$, $b^3$, and $b^4$, respectively, so as to indicate the strips at the first, second, third, and fourth floors of the building.

On the outside of the elevator-car are metallic contact-pieces 3, corresponding in number to the number of landings in the building, and each contact-piece 3 is provided with a metallic contact-lever, 4, pivoted to an insulated block, 5, and provided with a spring, 6, which tends to hold it in contact with its contact-plate 3, Fig. 2. Each of these levers has a projecting arm, 7, which is so placed on the elevator-car that when it is carried by the car to a position opposite to one of the strips $b$ it shall be engaged and moved thereby, so as to break the contact of the lever with the contact-piece 3. For this purpose one of the levers is placed so as to be operated by the strip $b'$, another by the strip $b^2$, &c.

8 is a switch-board, which is placed in the elevator-car within convenient reach of the attendant. It consists of a series of metallic contact-blocks corresponding in number to the number of contact-plates 3, and preferably arranged in the arc of a circle. In the apparatus shown in the drawings there are four of these blocks, each one of which bears a number indicating the floor of the building to which it refers.

9 is a radially-movable switch-lever, which is pivoted at a point, $a$, so as to be movable thereon into contact with any of the contact-blocks of the board 8.

10 is a second switch, which is similarly pivoted at $a'$, and is movable thereon into contact with either of two contact-plates, 11 and 12. The switch-lever 10 is used to determine the direction of motion of the elevator-car, and the lever 9 is used to determine the extent of the motion, as I will explain hereinafter. The several contact-plates 3 on the elevator-car are connected by separate wires or conductors 13 with the respective blocks of the switch-board 8. The switch 9 is connected by a conductor, 14, with the switch 10, and the several contact-levers 4 are provided with a conductor, 15, which is in circuit with a battery, 30, located in a suitable place.

I shall now describe the construction of the valve-operating mechanism and the manner of its connection with the controlling-circuit which I have just described.

16 is the rod, which is connected with and

operates the valve stem or lever 49 of the main motor-valve of the elevator, by motion of which rod in one direction or the other the elevator-valve is operated, and the elevator-motor thereby caused to move correspondingly to lift or lower the car. The apparatus which I have invented is designed to produce the necessary motions of this valve-rod. To this end I supply two small power-cylinders, 17 and 18, each of which is provided with a piston, 19, and piston-rod 20. These cylinders are actuated by the power of steam, water, or any other suitable motive fluid, which is admitted to the cylinders through ports *c c'* and *d d'*, Fig. 3. On the elevator-valve rod 16 two notched or jogged dogs, 21, are fixed, preferably by means of set-screws 24, so that they may be adjustable thereon, and at the ends of the piston-rods 20 are hooks or dogs 22 and 23, which are pivotally attached to the rods, as shown in Fig. 3, and which are so set relatively to the dogs 21 as to be capable of engagement therewith. The pivoted dogs are supported in the longitudinal motion of the piston-rods by means of guides 25, which are fixed in position parallel with the piston-rods. While the dogs 22 23 are in contact with or rest upon the guides 25, they are held thereby in position to engage the dogs 21. When the hooks reach the forward ends of the guides in the motion of the pistons, they drop on their pivots out of the way of the dogs. This drop may be effected simply by gravity, but preferably by means of stops 26 at the forward ends of the guides, which engage lugs 27 on the hooks and cause the latter to tilt forward when the pistons reach the forward ends of their strokes. Between the guides 25 are circuit-closers 28 and 29, which are adapted to be closed by the action of heels on the hooks 22 and 23 when the latter have been tilted forward by the lugs 26.

The valve mechanism of the cylinders 17 and 18 is arranged as follows: 51 and 52 are the valve-chests, which are provided with ports *e e' f f'*, communicating with the ports of the said cylinders. Each valve-chest has also an intermediate exhaust-port, $e^2 f^2$, and a slide-valve, 31, in each cylinder controls the action of these ports, as will be readily understood. The rod of the slide-valve of each valve-chest is connected with the piston of a small cylinder, 32, and at the back of each piston is a spring, 47, which tends to project the slide-valves 31 so as to expose the ports *e* and *f* and to open communication between the valve-chest and the rear ends of the cylinders 17 or 18, as the case may be. The reverse movement of the slide-valves is effected by means of the action of the motive fluid on the front of the pistons of the cylinders 32. The fluid is admitted to these cylinders by means of small valves 33, which control ports 34, leading from the valve-chests and provided with branch supply-ports 35, leading to the cylinders 32, and with branch exhaust-ports 36. There are two of the ports 36 for each cylinder on opposite sides of the stems of the valve 33. They communicate with a common exhaust-port and act to balance the pressure of the exhaust on the valve-stem. Parts of the stems 38 of the valves 33 are rounded, so as to form small sliding valves 37, which are adapted to move over and to close the exhaust-ports 36 when the stems of the valves 33 are moved so as to open the ports of the latter valve. The valve-stems 38 are fixed to the armatures 39 of electro-magnets 40 and 41, respectively.

The following is the arrangement of the electric circuits: The contact-plates 11 and 12 in the elevator-car are connected by conductors 43 and 42 with contact-plates of the circuit-closers 29 and 28, respectively. The second contact-plate of the circuit-closer 28 is connected by a conductor, 44, to one end of the coil of the magnet 41, and the second contact-plate of the circuit-closer 29 is connected by a conductor, 45, to one end of the coil of the magnet 40, the other ends of the coils of the magnets 40 and 41 being connected by conductors 46 to the battery 30.

The operation of the apparatus is as follows: Normally—that is, when the elevator is at rest—the main-valve rod 16 is in such position that the space between the dogs 21 is directly opposite the middle point between the circuit-closers 28 and 29, and the pistons 19 of both cylinders 17 and 18 are projected to their full extent, so that the hooks 22 and 23, being tilted forward by the action of the stops 26 and lugs 27, rest on the circuit-closers 28 and 29 and hold the terminal plates thereof in contact. Suppose, now, that the elevator-car is at the third floor of the building and that it be desired to cause its descent to the second floor. To effect this the attendant moves the switch-lever 10 into engagement with the contact-plate 11 and then moves the switch-lever 9 into contact with the block numbered II on the switch-board 8. The effect of this is to cause a current to pass from the battery 30, through the conductor 15, through the second of the series of levers 4, thence through the contact-block No. II of the switch-board, switch-lever 9, conductor 14, switch-lever 10, conductor 43, circuit-closer 29, conductor 45, magnet 40, and conductor 46, to the battery 30. The consequent exciting of the magnet 40 moves the armature 39 in the direction of the arrow in Fig. 4, thereby unseating the valve 33 and opening the port 34, and thereupon the motive fluid passes from the valve-chest 29, through the ports 34 and 35, into the cylinder 32, and pushes back its piston so as to move the slide-valve 31 sufficiently to uncover the port *e'* and to connect the port *e* with the exhaust-port $e^2$. Motive fluid is thereby admitted from the valve-chest through the port *e'* to the port *c'* of the cylinder 17 in front of the piston 19, and this piston is caused to move in the direction of the arrow B. (Shown in Fig. 3.) This piston carries with it the piston-rod 20 and piv-

oted hook 22, and the first motion thereof, causing the hook to engage the corner of the guide 25, raises the hook so that its end shall engage one of the dogs 21 on the valve-rod 16. The continued motion of the piston 19 acts on the valve-rod 16 through the hook 22 and dog 21, thus moving the valve-rod down until the piston reaches the lower end of its cylinder 17. This motion of the valve-rod 16 opens the valve of the main elevator-motor and causes the elevator to descend. When the elevator reaches the second floor of the building, that one of the several levers 4 which is in circuit with the contact-block 2 engages the cam-strip $b^2$ and is thereby moved, as shown in Fig. 2, so as to break the circuit by disengaging the lever from its contact-plate 3. The magnet 40 is thereupon instantly demagnetized and the armature 39 is released, so as to permit the stem 38 of the valve 33 to be moved by the action of a suitable spring, 48, to close the valve 33 and to move the slide-valve 37, so as to uncover the small exhaust-ports 36. The motive fluid then escapes from the cylinder 32 in front of its piston, and the spring 47 projects the slide-valve 31, so as to uncover the port $e$ and to connect the port $e'$ with the exhaust-port $e^2$. The motive fluid then enters the cylinder 17 through the port $c$ in front of the piston 19, so as to move this piston back, and the fluid in advance of the piston escapes from the cylinder through the port $c'$, valve-port $e'$, and exhaust-port $e^2$. The effect of this is to cause the motion of the hook 22 at the end of the piston-rod 20 to push back the dog 21 to its original position, and thereby to move the main-valve rod 16 sufficiently to close the main valve and to stop the elevator. When the piston 19 reaches the end of its back-stroke, the hook 22 tilts forward, as before described, and brings into contact the terminals of the circuit-closer 28, the parts being then in their original positions, as above described. If now it be desired to cause the elevator to descend farther to the first floor of the building, the attendant moves the lever 9 into contact with the correspondingly-numbered block (No. I) of the switch-board 8, thus causing a repetition of the action of the apparatus which I have just described, the car moving down until it comes to the proper floor, when the circuit being broken and demagnetizing the magnet 40 causes the car to come to rest. If it be desired to move the car up instead of down, the attendant shifts the switch-lever 10, so as to break its contact with the plate 11 and to bring it into contact with the plate 12, and the lever 9 is moved to that block of the switch-board which corresponds in number to the number of the floor to which it is desired to bring the elevator. This motion of the switch-lever 10 cuts the magnet 40 entirely out of circuit and puts the other magnet, 41, into circuit, so that the electric current passing through the latter magnet operates the slide-valve 31 of the valve-chest 52 in a manner similar to that before described with reference to the valve-chest 51, and thereby operates the piston 19 of the cylinder 18 so as to move this piston down. The effect of the motion of this piston is similar to that which I have described above with reference to the piston of the cylinder 17; but it acts in a contrary direction, so as to move the main-valve rod 16 down. This causes the ascent of the elevator, and when the elevator reaches the proper floor the circuit is automatically broken, as before described, the magnet 41 demagnetized, the valve 31 reversed, and the piston 19 moved back, so as to move the valve-rod 16 and to stop the car. The action of the apparatus in thus starting and stopping the elevator-car is better than the action of electrical apparatus of the sort heretofore known or used, because it subjects the car to no sudden shocks or jars. This is so because the motion of the pistons 19 is necessarily slow and regular, and the rapidity of their motion can easily be governed by regulating the quantity of motive fluid supplied to the cylinders 17 and 18.

It will be noticed from the foregoing description that while either of the magnets 40 or 41 is in circuit and magnetized the other magnet is cut out of circuit by reason of the separation of the contact-plates of the circuit-closer 28 or 29. Thus when one magnet begins to act and moves the piston 19 of its cylinder so as to effect the starting of the elevator the other magnet, whose function is to effect the reverse motion of the elevator, is cut out of circuit by reason of the separation of the shoe of the hook 22 or 23 from the circuit-closer, and this second magnet cannot be brought into action until the shoe of the hook is returned to its original position and the elevator-car has been completely stopped. Sudden shocks or jerks of the car by reason of carelessness of the elevator-attendant are thus entirely prevented, and the car when moving cannot be reversed until it is brought to rest with the usual gradual action above explained.

In connection with the electrical apparatus which I have described I prefer to use the ordinary endless rope, 50, one branch of which passes through the elevator-car within reach of the attendant. This rope is connected with the main-valve lever 49, which is operated thereby, as will be readily understood by those familiar with the subject. This is a convenient adjunct to the electrical apparatus, because if the latter should get out of order the rope may still be used, and by reason of the automatically-detachable feature of the valve-rod 16 with the pistons the operation of one system in no wise interferes with the other. For the purpose of illustrating the application of the apparatus above described in the operation of valves of motors I show in Fig. 7 its connection with the valve pertaining to the motor of an elevator-car. From this illustration it will be apparent to those

skilled in the art that with suitable modifications the apparatus may be applied to the operation of valves of other sorts and used for other purposes.

In Fig. 7, D is the hydraulic cylinder of an elevator-motor. E is the piston; E′, the piston-rod; F, the cable or chain connecting the piston-rod to the elevator car or lift. G is the supply-pipe leading from an elevated water-tank or other supply of water under pressure. H is a port leading from the pipe G into the upper end of the cylinder D. I is a port leading into the cylinder at the base thereof. J is a rotary valve, whose stem is connected to the lever 49, above described.

The longitudinal motions of the rod 16, produced in the manner above stated, rotate the valve J, so that it may be brought thereby into any of the three positions indicated by dotted and full lines. When in the position shown by full lines in Fig. 7, the exhaust-pipe K is closed and the piston E is at rest. If the valve be brought into the position indicated by the dotted line *j*, the connection of the port I with the exhaust-pipe K is established, and the water entering the cylinder through the port H will force down the piston E, so as to raise the elevator-car. By putting the valve in the position indicated in the dotted lines *j′* the pipes G and I are connected, the piston E is thereby balanced by equal pressure on opposite sides, and the car will descend by gravity.

The apparatus which I have described is susceptible of many modifications in form and arrangement of parts, such as will suggest themselves to those skilled in the art. For example, I have shown the apparatus adapted for use with conductors composed of wires which extend in a cable from the elevator-car to the valve-controlling apparatus; but other arrangements of the conductors may be employed. I have also illustrated the operation of the magnets with an open circuit; but the apparatus may be modified so as to operate them with a closed circuit as well. Other arrangements of the switches 9 and 10 than I have shown and described may be employed.

I claim as my invention—

1. The combination, with the main motor, its controlling-valve, and the valve rod or stem, of independent secondary motors having pistons which move the said valve rod or stem to effect motion of the main motor in contrary directions, mechanism for disconnecting the respective pistons of the secondary motors from the said valve rod or stem at a middle point of the travel of the latter, valves controlling the secondary motors, and electro-magnets controlling said valves, and an electric circuit and switch mechanism by which the magnets may be caused to operate either of said secondary-motor valves, substantially as and for the purposes described.

2. The combination, with the main motor of an elevator-car and its controlling-valve, of an electro-magnet for operating said valve, an electric circuit, several branch circuits, switch mechanism on the car by which any of said branch circuits may be included in the main circuit, and circuit breakers or closers on the car, one of the contacts of each being movable, and mechanism adapted to move the same and to break or to close the branch circuits as the car reaches or approaches the several floors of the building, whereby the action of said magnet is effected automatically to cause the stopping of the car, substantially as and for the purposes described.

3. The combination, with the motor of an elevator-car, of separate electro-magnets, one of which effects the motion of the valve to drive the motor in one direction and the other of which effects the motion of the valve to drive the motor in the other direction, an electric circuit, several branch circuits, a switch on the car by which any of the said branch circuits may be included in the main circuit, circuit breakers or closers on the car, one of the contacts of each being movable, and mechanism adapted to move the same and to break or to close the branch circuits as the car reaches or approaches the several floors of the building, whereby the action of said magnets is effected automatically to cause the stopping of the car, and a second switch by which either of the said magnets may be put in circuit, substantially as and for the purposes described.

4. In an electrical apparatus for controlling the valve of an elevator-car motor, wherein there is an electro-magnet and an electric circuit extending through the car, a device for automatically controlling said circuit, which consists in a circuit closer or breaker having a contact, 3, a movable contact-piece adapted to engage therewith, and a projection in the elevator-shaft which engages the movable contact-piece and operates the same as the car passes, substantially as and for the purposes described.

5. In an electrical apparatus for controlling the valve of a motor, the combination of two electro-magnets and their operative circuits adapted to effect the motion of the motor-valve in opposite directions, circuit-closers interposed in the said circuit, and mechanism, substantially as described, which on the exciting of one of the electro-magnets and the consequent operation of the motor-valve in one direction is actuated to break the circuit of the other magnet, substantially as and for the purposes described.

6. In an electrical apparatus for controlling the valve of a motor, the combination, with the main-motor-valve rod or stem, of secondary motors 17 and 18, having piston-rods 20, and provided with engaging devices—such as hooks—which engage projections on said valve stem or rod, whereby motion of one of said secondary motors will effect motion of the main-valve stem in the proper direction, and an electric circuit extending from the elevator-

car and controlling the valves of the secondary motor, substantially as and for the purposes described.

7. In an electrical apparatus for controlling the valve of a motor, the combination, with the main-motor-valve rod or stem, of secondary motors 17 and 18, having piston-rods 20, and provided with engaging devices—such as hooks—which engage projections on said valve stem or rod, whereby motion of one of said secondary motors will effect motion of the main-valve stem in the proper direction, and an electric circuit controlling the valves of the secondary motor, said hooks being movable into and out of engagement with the said projections, and devices at the ends of the paths of said piston-rod which move the hooks out of engagement with the projections, substantially as and for the purposes described.

8. In an electrical apparatus for controlling the valve of a motor, the combination, with the main-motor-valve rod or stem, of secondary motors 17 and 18, having piston-rods 20, and provided with engaging devices—such as hooks—which engage projections on said valve stem or rod, whereby motion of one of said secondary motors will effect motion of the main-valve stem in the proper direction, electro-magnets which control the valves of the secondary motors, and circuit-closers arranged in the paths of said piston-rods, so that when the piston-rods are at their normal position they shall close the said circuit-closers, and that when the piston-rods leave said positions the circuit-closers shall be open, each of said rods controlling the circuit-closer of the circuit of the magnet which controls the valve pertaining to the other piston-rod, substantially as and for the purposes described.

9. In an electrical apparatus for controlling the valve of a motor, the combination of a main-motor-valve rod or stem, of secondary motors 17 and 18, having piston-rods 20 and pivoted hooks at the ends of said rods, which are adapted to engage projections on the said valve stem or rod, supports 25, which guide and support the said hooks in their motions, and stops 26, which engage the said hooks and move the same out of the path of said projections when the piston-rods reach the ends of their strokes, and electro-magnets controlling the valves of said secondary motors, substantially as and for the purposes described.

10. In an electrical apparatus for controlling the valve of a motor, the combination of a main-motor-valve rod or stem, of secondary motors 17 and 18, having piston-rods 20 and pivoted hooks at the ends of said rods, which are adapted to engage projections on the said valve stem or rod, supports 25, which guide and support the said hooks in their motions, stops 26, which engage the said hooks and move the same out of the paths of said projections when the piston-rods reach the ends of their strokes, electro-magnets controlling the valves of said secondary motors, and circuit-closers in the circuits of said magnets, said circuit-closers being situated at the ends of the paths of said hooks, substantially as and for the purposes described.

11. In an electrical apparatus for controlling the main valve of a motor, the combination of a secondary motor which operates the said main valve, a valve controlling the secondary motor, a cylinder, 32, and its piston, which is connected with the valve of the secondary motor, a valve, 33, which controls a port leading to the cylinder 32, and an electro-magnet which controls the valve 33, substantially as and for the purposes described.

12. In an electrical apparatus for controlling the main valve of a motor, the combination of a secondary motor which operates the said main valve, a valve controlling the secondary motor, a cylinder, 32, and its piston, which is connected with the valve of the secondary motor, a valve, 33, which controls a port leading to the cylinder 32 on one side of its piston to produce motion thereof in one direction, a spring bearing on the piston to produce motion thereof in the other direction, and an electro-magnet which controls the valve 33, substantially as and for the purposes described.

13. In an apparatus for controlling the valve of an elevator, the combination, with the said valve and its stem or rod, of a mechanical connection—such as a rope—between the elevator-car and the valve-stem, a secondary motor and its controlling electrical circuit, which operates the main-valve stem, and mechanism which automatically detaches the valve stem or rod from the secondary motor when the latter reaches the end of its stroke, whereby the valve may be freely operated by the rope, substantially as and for the purposes described.

In testimony whereof I have hereunto set my hand this 10th day of August, A. D. 1888.

RONALD F. MCFEELY.

Witnesses:
W. P. POTTER,
THOMAS W. BAKEWELL.