No. 694,158. Patented Feb. 25, 1902.

B. N. JONES.

AUTOMATIC CONTROL SYSTEM FOR ELEVATORS.

(Application filed Apr. 30, 1901.)

(No Model.) 2 Sheets—Sheet 1.

Fig. 1

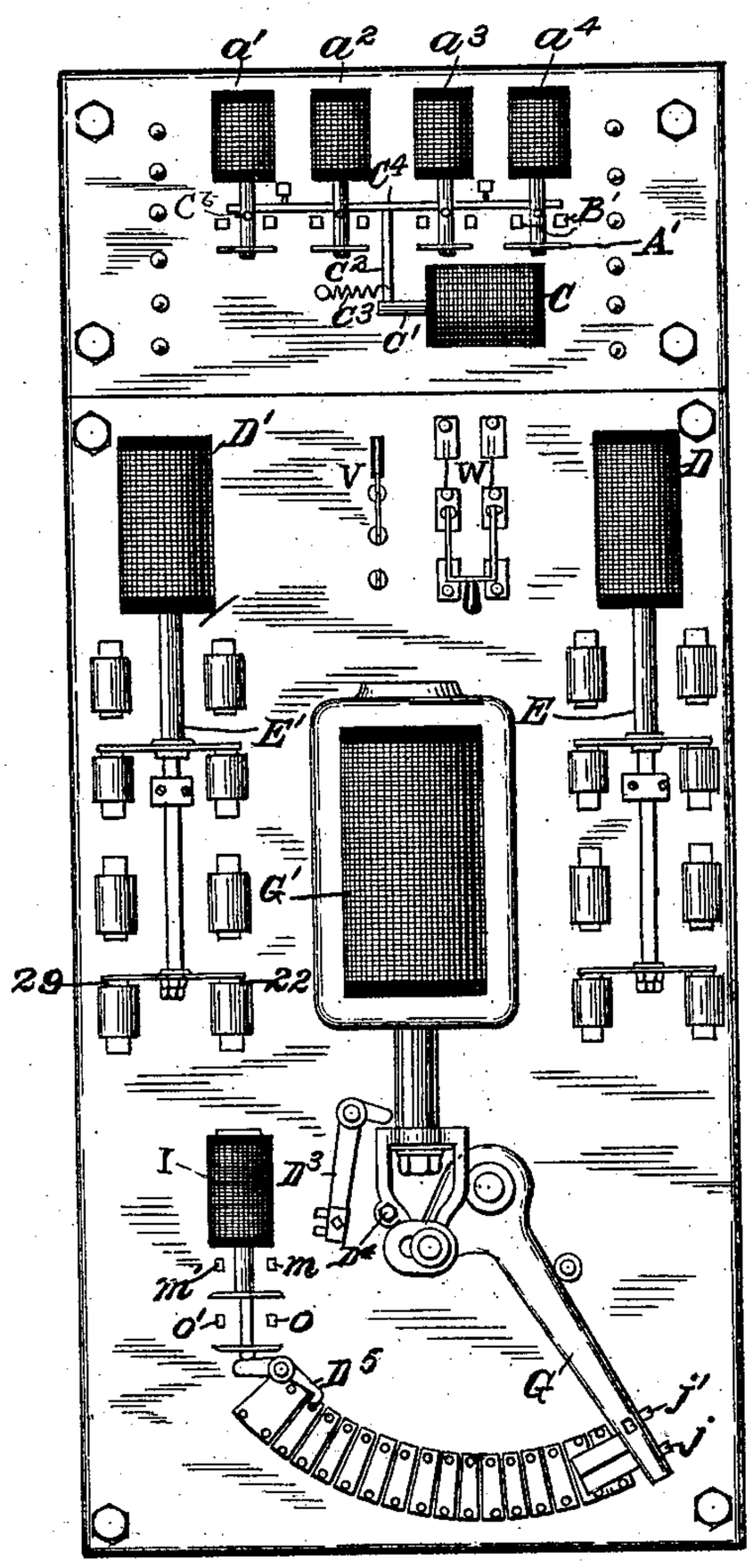
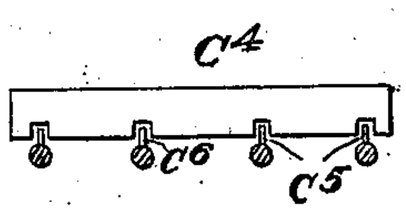


Fig. 2



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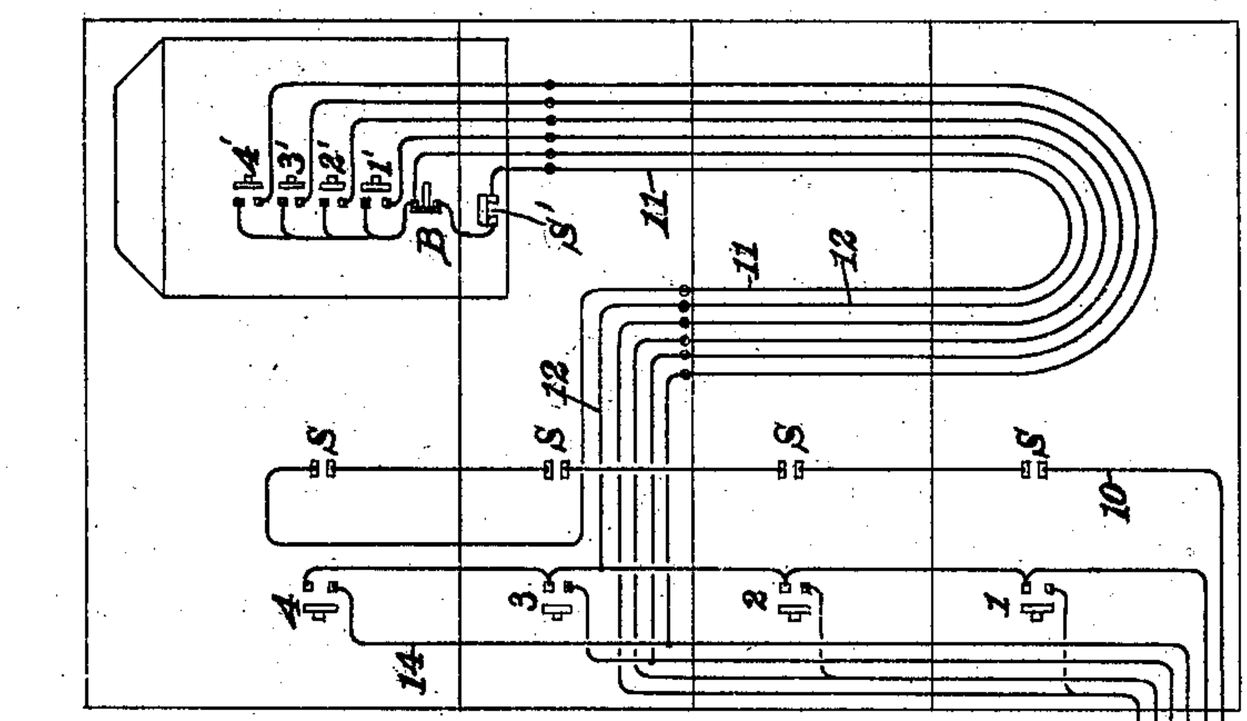

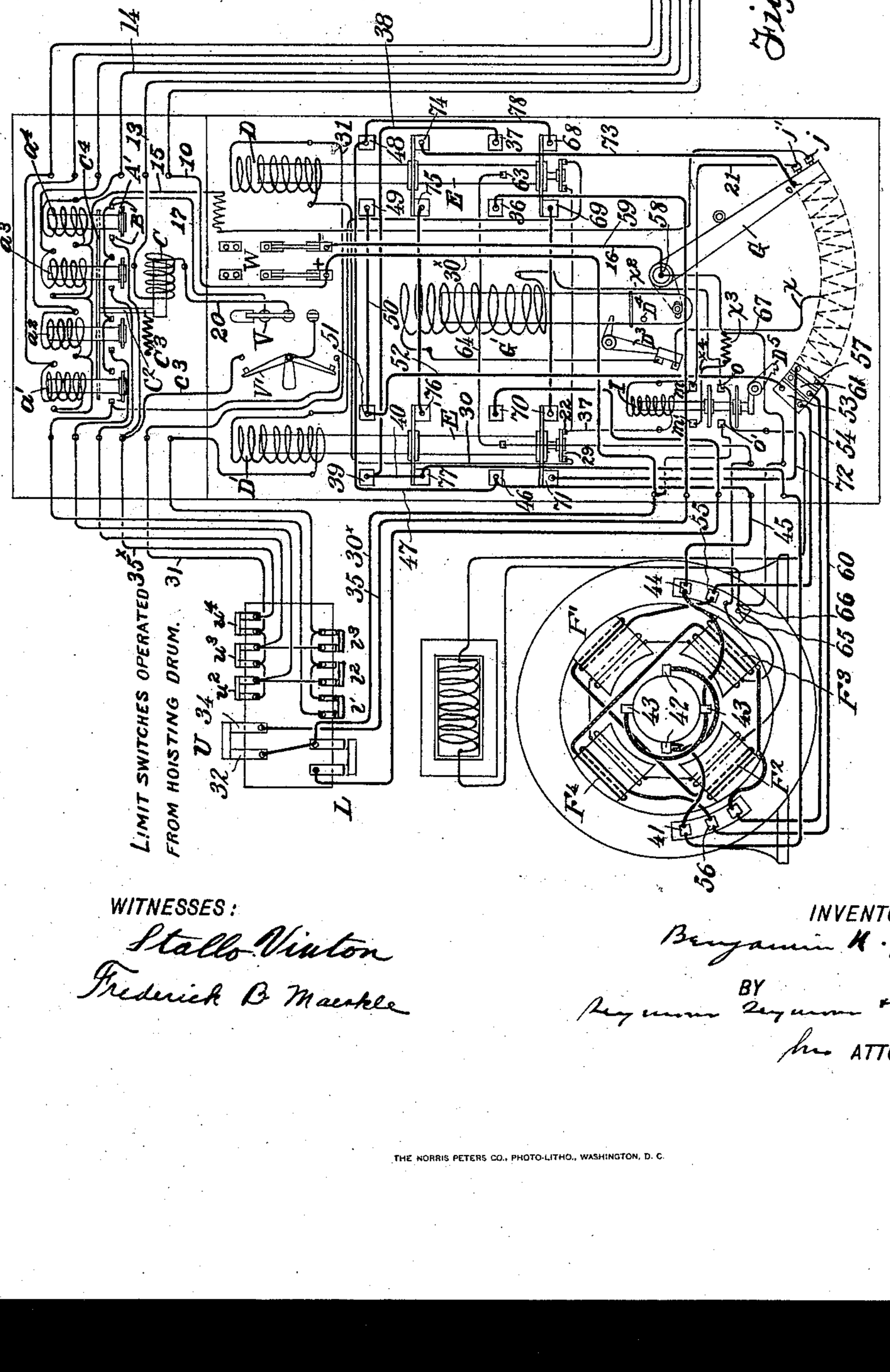

Fig. 3

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BENJAMIN N. JONES, OF EAST ORANGE, NEW JERSEY.

AUTOMATIC CONTROL SYSTEM FOR ELEVATORS.

SPECIFICATION forming part of Letters Patent No. 694,158, dated February 25, 1902.

Application filed April 30, 1901. Serial No. 58,189. (No model.)

To all whom it may concern:

Be it known that I, BENJAMIN N. JONES, a citizen of the United States, and a resident of East Orange, county of Essex, State of New Jersey, have invented certain new and useful Improvements in Automatic Control Systems for Elevators, of which the following is a specification.

It is the object of my invention to provide an automatic device electrically controlled by which an elevator may be called to any landing by simply pressing a button and by which it may be sent to any landing by pressing the corresponding button within the car and by which when the circuit is closed through one floor-relay the other push-button circuits are positively locked in the inoperative position.

In the drawings forming part of this specification, Figure 1 is an illustration of parts of my improved control arranged on a switchboard. Fig. 2 is a detail of the automatic locking device for the floor-relays. Fig. 3 is a wiring diagram showing the general arrangement of the system.

A push-button circuit is established for each floor and one corresponding to each floor in the car, and the wiring is such that either of these buttons corresponding to a certain floor will operate the corresponding floor-relay. The landing push-buttons are represented by the figures 1, 2, 3, and 4 (see Fig. 3) and the push-buttons in the car by 1′, 2′, 3′, and 4′. The floor-relays are represented by a', a^2, a^3, and a^4. These relays consist of an ordinary magnet or solenoid, to the lower end of the core of which is attached the contact-piece A′, which when engaging the contacts B′ will close the control-circuit. The circuit being established through the relay, the core will be drawn up until the contact is made, as will be readily observed. As has been stated, when this contact has been made the control-circuit is established. In this circuit is a magnet or solenoid C, which operates a mechanical locking device, which will lock the core of the floor-relay in use in the operative position and all the others in the inoperative position. This mechanism consists of a bar C^2, attached to the core C′ of the magnet C. To the bar C^2 is attached one end of a spring C^3, the other end being attached to the switchboard. At the upper end of the bar C^2 is another bar C^4. The bar C^4 is provided with a series of notches C^5, which in the normal position of the parts will permit the passage of pins C^6 on the cores of the floor-relays. It will be seen, therefore, that if the circuit is closed through any relay the core of that relay will be drawn up, the pin C^6 passing through the notch in the bar C^4. At the same time C^3 will become magnetized, the control-circuit being closed, and the core will be drawn to the right, (looking at Fig. 3,) carrying with it the bar C^4, the notches in which are now in such position that the cores of the other relays cannot be raised, but are positively locked in the inoperative position, while the one raised will be locked in that position.

In the control-circuit are directing-magnets D for the up circuit, and D′ for the down circuit. These magnets operate through their cores the circuit makers and breakers E and E′ in a manner well known in the art. In the same circuit and in series with these magnets is a circuit-breaker relay I, the core of which when drawn up by the closing of the control-circuit will make contacts, as hereinafter described.

A main resistance-regulating arm or controlling device is provided, which in its normal position throws in the full resistance, but which upon being moved gradually cuts out the resistance until the arm reaches the point where all resistance is cut out. This resistance-regulating arm is indicated at G and is of an ordinary type. It is operated by the accelerating-magnet G′, which when energized will swing the resistance-regulating arm by drawing up the core, as is clearly evident from the drawing. In the circuit through this accelerating-magnet is a switch D^3, which will be operated by a pin D^4 striking one arm of the switch when the resistance-regulating arm has reached the point where all the accelerating resistance is cut out. The effect of this will be that at such time the accelerating-magnet will be demagnetized and the resistance-regulating arm free to return to its normal position were not means provided for retaining it in its position. The means I provide consist in a latch D^5, pivoted to the board and so arranged that when the resistance-

regulating arm is in the above-described position it will catch and hold the same, the latch being normally free to swing by its own weight or by the force of a spring, if desired. The circuit-breaker relay I is immediately above this latch, and when the elevator is in operation the core of this relay is raised, thus allowing the latch to hang in such position as to catch and hold the resistance-regulating arm. When, however, the controlling-circuit is broken, the core of the circuit-breaker relay will fall, strike the latch, and automatically release the same, thus allowing the resistance-regulating arm to move back to its normal position, which it will do by the weight of the core to which it is connected. The resistance-regulating arm in its normal position—that is, when the elevator is stopped—is against two contact-pins j and j', the former of which is in the push-button circuit and the latter of which is in the controlling-circuit, as will hereinafter be more fully described. It will be seen, therefore, that as the resistance-regulating arm starts to move each of these circuits will be broken. It will be seen that as the locking-magnet, the directing-magnet, and the circuit-breaker relay are all in series such motion of the resistance-regulating arm would immediately break the control-circuit, thus preventing the elevator from moving were not means provided to maintain the control-circuit; but as the closing of the control-circuit operates the circuit-breaker relay I and raises the core thereof it establishes a circuit through the contacts m m', so that the control-circuit will remain closed even though the resistance-regulating arm moves away from the contact j'. This operation will be hereinafter described at greater length. The object of breaking the circuit at j and j' is that when the resistance-regulating arm has once started to move and the elevator for any reason has subsequently stopped the control-circuit and push-button circuits cannot again be established until the resistance-regulating arm has returned to its normal position, thus avoiding the sudden starting of the elevator.

The usual upper and lower main limit-switches are provided in the circuits, being represented, respectively, by U and L, Fig. 3. These limit-switches are operated by arms on a shaft driven by the hoisting-engine in the well-known manner. There are also provided upper and lower floor limit-switches, which are represented by u^2, u^3, and u^4 for the upper limits and l', l^2, and l^3 for the lower limits. (See Fig. 3.) These floor limit-switches are operated from the drum-shaft of the hoisting-engine and so arranged that when the car is going up each upper-floor limit-switch will be opened when the car is at or near that landing and the lower limit-switches closed, and going down the reverse action takes place, the upper limit-switches being closed and the lower ones opened. In the control-circuit is a series of door-switches, which are denominated by S, Fig. 3. Any door, therefore, which is opened will break the control-circuit.

I provide in the car an emergency stop-button B. This being operated will break the control-circuit and stop the car, so that the person in the car can prevent interference with the car by persons outside and can stop the car at any moment if he so desires, notwithstanding the fact that he may previously have pressed the button to send the car to the desired landing. On entering the car and closing the door should any person outside press the button calling the car before the person in the car presses the button for the floor to which he wishes to go the emergency-stop puts it in his power to stop the car and throw the entire system in its normal position, after which he may send the car to any landing desired by pressing the proper button.

The electric brake, the motor, its connection, and the general arrangement of the main circuit need not be described, as they may be of any kind or description.

W represents the main current-switch. This may be of any common or well-known type. To the positive terminal of this switch is connected the positive conductor from the dynamo or other source of supply, and to the negative terminal is connected the negative wire from said dynamo or source of supply.

The controlling-switch is represented at V. The switch V serves no other purpose than to cut out the push-button circuit. When thrown down, the car can be only operated by hand through the medium of the switch V'. Supposing the car to be down, if the switch V' is moved so that the contact is made at the upper contact-point the circuit heretofore described is established, save that as the current cannot now pass through the wire 17 and switch V a complete circuit is established through the upper contact, through wire 35 to the limit u^4, through that limit and through wire 31 to the directing-magnet D of the up-circuit breaker. Otherwise the circuit is as heretofore traced for sending the car up. The car will move up until either the switch V' is moved to break the circuit or the car reaches its extreme position, at which point the upper limit will be automatically opened, as heretofore described. It will be seen, therefore, that when the switch V is thrown down the push-button circuit is cut out, and consequently the car can be operated only by the switch, it being out of the power of anybody on the floor or in the cars to operate the elevator.

The operation of the device so far as described is as follows: Let us suppose the car is at the bottom floor and that it is desired to call it to the fourth floor. Upon pressing the push-button 4 (see Fig. 3) the floor-relay circuit or push-button circuit is established through the wire 14, through the coil of the relay a^4, through the wire 15, contact j, resistance-regulating arm G, the wire 16, to the negative side of the main switch W,

through the source of supply to the positive side of the main switch, through the wire 10, through the door-switches S by wire 11 to switch S′, through the stop-button B, wire 12, to and through the contacts of push-button 4, thus energizing the floor-relay, the core of which will be drawn up, closing the control-circuit through the contacts B′. This contact being made, the control-circuit is established as follows: starting from the positive side of the main switch, through the wire 10, through the door-switches S, through the wire 11, through the emergency-stop B, through the wire 12, through the wire 13 to and through the coil of the locking-magnet C to one side of the controlling switch V, through wire 17, through the contacts B′, through the wire $35^{\times}$ to floor limit-switch u^4, through wire 31 to and through the coil of the directing-magnet D, through wire 30, through contact 29 across to contact 22 of the down-circuit breaker, through wire 37 to and through the coil of the circuit-breaker relay I, through wire 21, through contact J′, to and through the resistance-regulating-arm wire 16 to the negative side of the main switch, to and through the source of supply to the positive side of said switch, thus completing the circuit. As a result of this the locking-magnet will be energized, thus locking the core on relay 4 up in the operative position and the cores of all the other relays in the inoperative position, as heretofore described. Directing-magnet D will be energized and its core being raised will close the main circuit. The core of the circuit-breaker relay I is also energized and its core raised, making circuits through the contacts m m' and through the contacts o o', leaving the latch D^5 in position to catch and hold the resistance-regulating arm. At the same time the accelerating-magnet G′ is energized by a circuit being made as follows: starting from the negative side of the main switch, down to and through the resistance-regulating arm, through the resistance-coils, to and through the wire x, through the switch D^3, to and through the coil of the accelerating-magnet, through the wire x^2, to and through the contacts o o', now connected by the raising of the circuit-breaker-relay core, to the main wire, and back to the positive side of the switch. The accelerating-magnet being thus energized will cause its core to rise, thus moving the resistance-regulating arm to the left, (looking at Fig. 3,) thus gradually accelerating the speed by cutting out the resistance until the arm has reached the point where all the resistance is cut out, at which time it will be caught and held by the latch, as heretofore described, and as the switch D^3 will at the same time be moved, as heretofore described, the accelerating-magnet will become demagnetized and the resistance-regulating arm will be free to move to its normal position upon the release of the latch. Upon the movement of the resistance-regulating arm the push-button circuit is at once broken through the contact j, and the control-circuit through the contact j' is also broken; but the control-circuit is not broken thereby, because the core of the circuit-breaker relay having been raised connection is made between the contacts m m'. Consequently the circuit starting from the negative side of the main switch is established through the main wire, the pivot-pin on the resistance-regulating arm, the wire x^3, the wire x^4, through the contacts m m', and thence through the circuit-breaker-relay coil I and the same control-circuit, as heretofore described; but by breaking the control-circuit through j' such a condition is created that when the control-circuit is broken by the stopping of the car or from any cause it cannot again be established until the resistance-regulating arm is again in its normal position. Thus the starting of the elevator at any save the starting speed is prevented. The breaking of the push-button circuit is an additional precaution to prevent interference with the car should the positive locking device for any cause fail to work. When the car has reached the fourth floor, the floor-limit switch will operate, thus breaking the control-circuit, allowing the circuit-breaker E to fall, thus opening the main circuit and stopping the motor, while at the same time the breaking of the control-circuit deënergizes the locking-magnet and the circuit-breaker-relay magnet, they being in series with the directing-magnet in the control-circuit, and thus the automatic locking device is released, the core of the floor-relay will fall, the core of the circuit-breaker relay will fall, releasing the latch and allowing the resistance-regulating arm to return to its normal position.

It will be seen from this description that the car may be called to any floor, and the person entering the car and closing the door may send the car to any floor desired by pressing the proper button, and that interference with the car by other persons is absolutely prevented.

The main motor-circuit through the reversing-switch and resistance-coil is as follows when car is running up: from + side of main switch by wire $30^{\times}$ to contact 32 on main upper limit-switch, to contact 34 on same switch, by wire 35 to contact 36 on the up reversing-switch, to contact 37 when switch is closed, by wire 38 to contact 39, by wire 40 to terminal 41 on motor, to brushes 42 42, from brushes 43 43 to terminal 44, by wire 45 to contact 46, by wire 47 to contact 48, to contact 49 when switch is closed, by wire 50 to contact 51, by wire 52 to contact-plate 53 on resistance-regulator, by wire 54 to terminal 55 on motor, through series field-coils F′ F^2 F^3 F^4 to terminal 56 on motor, by wire 60 to one end 57 of the resistance-coil, through the resistance-coil and contact-arm to terminal 58, by wire 59 to the negative (—) side of main switch, to and through the source of supply, thus completing the circuit. As the contact-arm approaches the contact 57 it short-circuits the

successive coils which form the whole resistance, and when arm is in contact with 57 it will be seen that the resistance-coils are entirely eliminated from the motor-circuit as the current passes through the regulator-arm direct to contact 58 and thence to — side of main switch. When regulator-arm reaches contact 61, the two field-coils F^3 and F^4 are "cut out" as their circuit from terminal 56 by wire 60 to contact 57 and then to contact 58 is open at contact 57, the regulator-arm having passed beyond contact 57. When regulator-arm reaches contact 53, the field-coils F' and F^2 are cut out in the same manner, their circuit being opened at contact 61. When the regulator-arm is in the full-speed position or on contact 53, the motor operates as shunt-motor, its shunt-fields being energized by the circuit established at contact 63 when reversing-switch is closed, by wire 64 to terminal 65, through the four shunt-coils to terminal 66, by wire 67 to contact 58, and thence to negative (—) side of main switch, the positive side of main switch being connected to contact 36 by wires 30 and 35 through the upper limit-switch contacts 32 and 34.

By following the motor-circuits as described above it will be seen that there is no division of the resistance-coil at the point X. One end of the regulator solenoid-coil is connected at the point X, which point is variable, to take advantage of the difference of potential existing at that point and the R H end of the resistance-coil when the reversing-switch is first closed to start the motor. When the reversing-switch is opened to cut off the current-supply and stop the motor, a circuit around the motor-armature through the resistance-coil is closed as follows: from motor-brushes 42 to terminal 41, by wire 40 to contact 77 on reversing-switch, to contact 76, to contact 75, to contact 74, by wire 73 to and through the resistance-coil, by wire 72 to contact 71, to contact 70, to contact 69, to contact 68, by wire 78 to contact 48, by wire 47 to contact 46, by wire 45 to terminal 44, to motor-brushes 43 43, thus completing the circuit around the armature of the motor, the action being that the armature becomes a generator and assists in stopping the hoisting-machine.

It is desirable to provide what may be termed "an automatic throttling device," which will prevent the starting of the elevator if the load thereon is in excess of the limit allowed.

It will be noticed from the above description that the wire x, forming a part of the circuit through the accelerating-magnet, is connected to the main resistance at a point clearly indicated in Fig. 3. With predetermined flow of current through the resistance the reduction of pressure at the point where this wire x is connected is so great that it will not energize the accelerating-magnet with sufficient force to move the resistance-regulating arm. If, however, the load on the car is not too great, the motor will be started and the counter electromotive force will increase the pressure at that point by reducing the flow, consequently causing the resistance-regulating arm to be moved, gradually accelerating the speed. If the load is above the limit, however, the motor of course cannot turn, and as the resistance-regulating arm cannot therefore be moved to cut out resistance the result will be that the elevator will not start. By this means I prevent the sudden starting of the motor against a weight too great for it to lift and insure in all cases its gradual starting.

I have provided in the controlling-circuit in the car a slack-cable stop S', whose use is sufficiently well known in the art not to require further description save to say that should the elevator be blocked in its descent while the motor is still working the breaking of the circuit at this point will prevent the hoisting-cables from unwinding.

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

1. In an electric control system for elevators the combination of the operating and control circuits, a relay to close the control-circuit for each floor, a push-button for operating said relay and means for positively engaging and mechanically locking, in the inoperative position, all relays, save the one first actuated, substantially as described.

2. The combination of a control-circuit, a push-button on each floor, a push-button for each floor in the car, a single relay for each floor adapted, when actuated, to close the control-circuit, and connections whereby the operation of either of the push-buttons will actuate said relay, substantially as described.

3. The combination of a control-circuit, a push-button on each floor, a push-button for each floor in the car, a relay for each floor adapted, when actuated, to close the control-circuit, connection whereby the operation of either of the push-buttons will actuate said relay and a locking device for positively engaging and mechanically locking said relay in the operative position and the other floor-relays in the inoperative position, substantially as described.

4. The combination of floor-relays, circuit-closing device actuated thereby and means for positively engaging and mechanically locking one of the circuit-closing devices in the operative and the other in the inoperative position, substantially as described.

5. In an electric control device for elevators the combination of relays for closing the control-circuit for each floor, a magnet in the control-circuit and a lock for the circuit-closing device operated thereby, a directing-magnet in circuit with the last-named magnet, and means on the car and floor for operating said relay, substantially as described.

6. In an electric control system for eleva-

tors the combination of a control-circuit a relay for closing the circuit for each floor, a push-button for each floor on the car and at the floor, and connections whereby the operation of either push-button will actuate the relay and close the control-circuit, regardless of the position of the car, substantially as described.

7. In an electric elevator the combination of a resistance-regulating arm, mechanical means for positively locking the same when in the position where all resistance is cut out, and mechanical means operated by the failure of current-supply for releasing said arm, substantially as described.

8. In a control system for electric elevators the combination in the control-circuit, a push-button circuit for closing the same, a resistance-regulating arm in the main circuit and means whereby the circuit through the push-buttons is opened when the arm moves, substantially as described.

9. The combination of a main circuit, a control-circuit, a resistance-regulating arm and connections for preventing the closing of the control-circuit until said resistance-regulating arm is in its normal position, substantially as described.

10. In an electric system for elevators the combination of a motor, a main supply, a resistance between the two, a resistance-regulating arm, a magnet for actuating the same, the magnet being connected across the resistance, whereby the movement of the elevator is prevented when excess of load is present, substantially as described.

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