March 15, 1938. V. MOLANDER 2,111,459

ELEVATOR DOOR CONTROL SYSTEM

Filed April 27, 1934 3 Sheets-Sheet 1

Fig. 1.

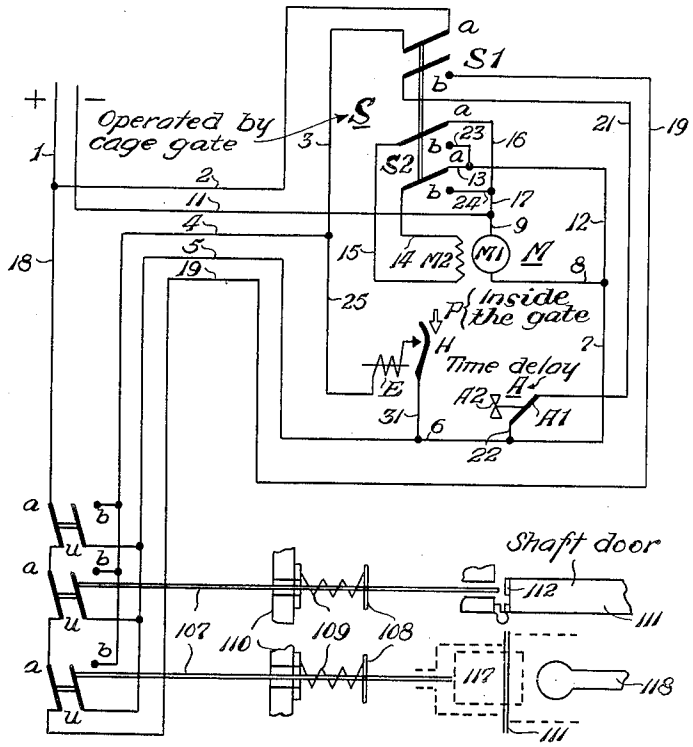
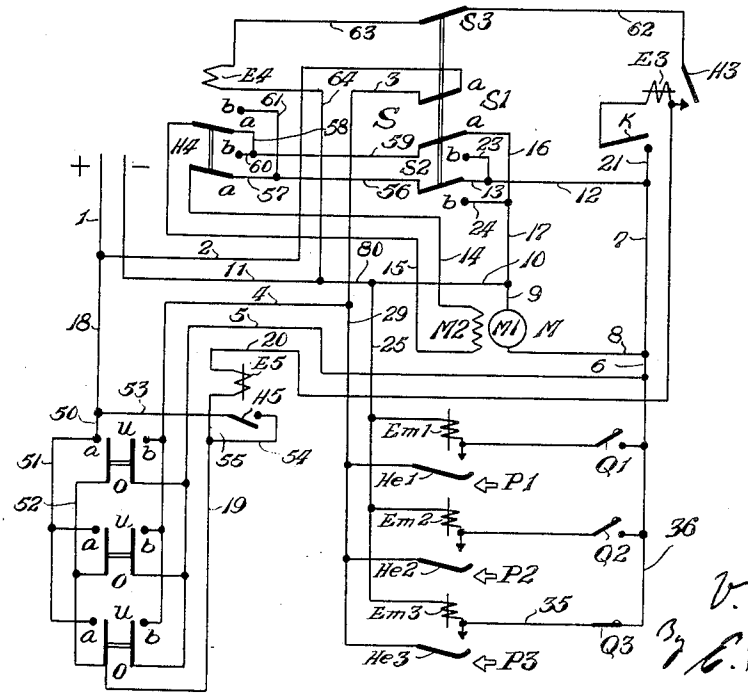


Fig. 3.



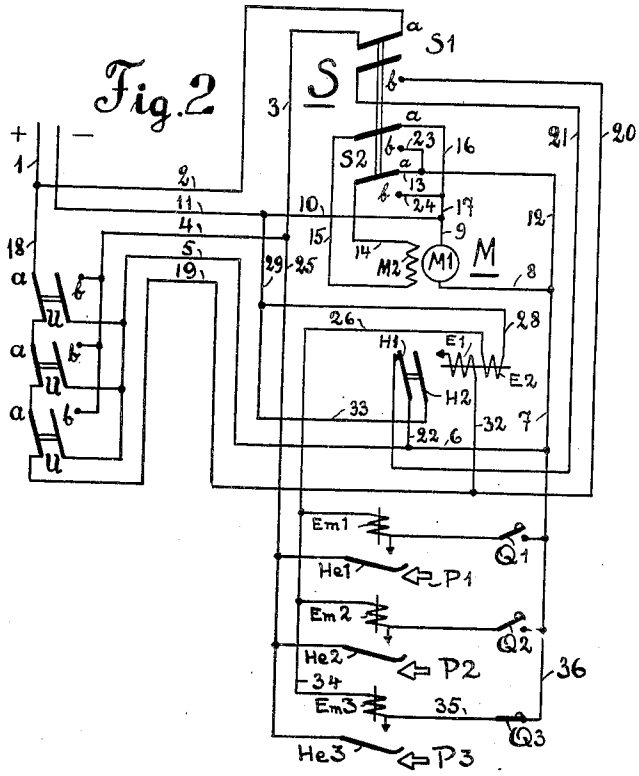
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March 15, 1938. V. MOLANDER 2,111,459

ELEVATOR DOOR CONTROL SYSTEM

Filed April 27, 1934 3 Sheets-Sheet 2

Fig. 2



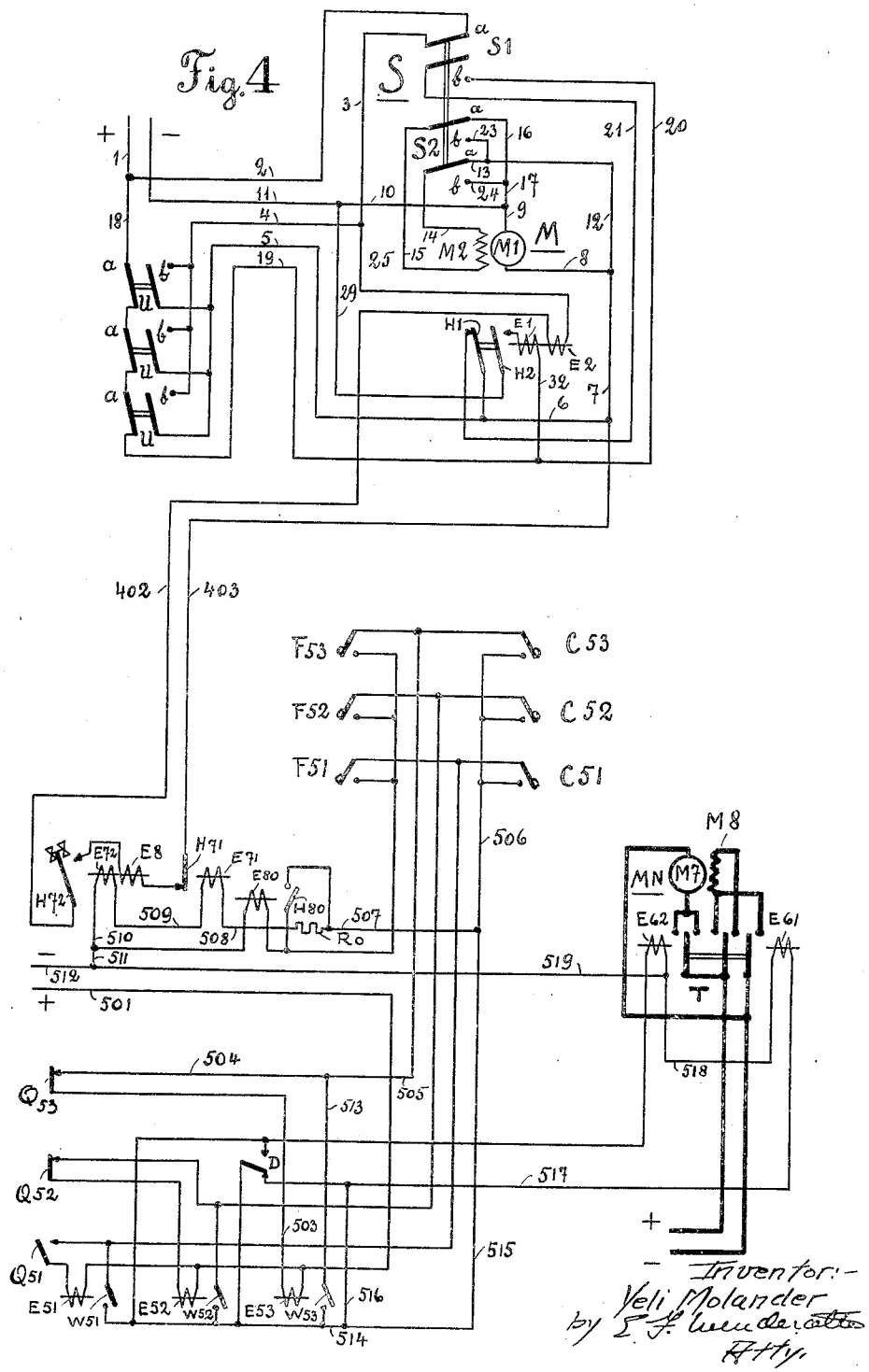
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March 15, 1938. V. MOLANDER 2,111,459

ELEVATOR DOOR CONTROL SYSTEM

Filed April 27, 1934 3 Sheets-Sheet 3

Fig. 4



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UNITED STATES PATENT OFFICE

2,111,459

ELEVATOR DOOR CONTROL SYSTEM

Veli Molander, Helsinki, Finland

Application April 27, 1934, Serial No. 722,795
In Germany May 18, 1933

6 Claims. (Cl. 187—29)

This invention relates to automatic gates for electric elevators.

The object of this invention is to provide a simple and reliable device by which the elevator gate in electric elevators opens automatically by aid of a motor particularly provided for opening and closing the gate, when the manually actuated elevator shaft door is opened, so that the lift can be entered, whereupon, after the shaft door is closed, the elevator gate closes again automatically.

A further object of the invention is to provide a device by which the elevator gate, when the elevator arrives at the desired floor, can be opened by actuating a push-button, whereupon, after the shaft door is opened and closed again, the gate automatically shuts, so that the lift can be used again.

A further object of the invention is to provide an improved device, by which the "opening" of the gate of the elevator, when the required floor is reached, is effected through a system of contacts which are simultaneously mechanically actuated by the action of respective floor-push-buttons belonging to the elevating system of the lift, and which system puts the elevator gate into operation at the corresponding floor.

Still further the invention is to prevent the gate from remaining open, when the operator opens the shaft door for a short time only and shuts it again immediately afterwards.

Further objects of the invention will be seen from the description below and from the claims.

The device works as well with direct as with alternating current, and changed correspondingly, with three-phase electric current. In the following description only a few examples of execution, when using direct current, will be described.

The accompanying drawings illustrate the principle of the invention.

Fig. 1 is a simple form of an arrangement according to the invention.

Fig. 2 is an arrangement, supplemented by bridge devices, for opening the gate automatically when the elevator arrives at the desired floor.

Fig. 3 shows an arrangement modified by an extension of the lift door switch.

Fig. 4 is a modification for opening the gate automatically, when the current of the driving motor in the elevator system is shut off.

In the figures, M indicates an electric motor as a whole which operates a mechanism not shown and adapted to open and to close the cage gate of an elevator car. The armature of the motor is designated by M1 and the field winding by M2. For causing the opening movement of the gate the motor has a gate-opening motor circuit and for causing the closing of same gate it has a gate-closing motor circuit.

A switch operated by the cage gate is designated as a whole by the letter S and comprises two parts designated by S1 and S2. The part S1 when in position *a*, is adapted to close the gate-opening motor circuit and to hold the gate-closing motor circuit broken, and when in position *b* to close the gate-closing motor circuit and to hold the gate-opening motor circuit broken. The part S2 when in position *a* is adapted to control the direction of rotation of the motor in such manner that the motor, aided by the mechanism which is not shown, opens the cage gate, and when in position *b*, it causes the motor to rotate so as to close the gate.

The switch U, shown diagrammatically in Fig. 1, is adapted to be operated either by the shaft door 111 or by the bolt 117 of the lock of this door. The opening movement of the door, either that of the door itself or that of its lock, actuates the switch by means of a rod 107. Between the casing 110 of the switch U and a flange 108 rigidly secured to the rod 107, a spring 109 is arranged, which spring abuts the rod 107 against a plate 112 fixed on the shaft door 111, or against the bolt 117 of the lock. When the shaft door 111 is closed, the said plate 112 will, by means of the said rod 107, hold the switch U in such position that the line 18 is connected with the line 19, whereby the gate-closing motor circuit is closed while the gate-opening motor circuit is interrupted. This position of switch U is called "position *a*". When the shaft door 111 is opened, the said spring 109, by means of the said flange 108 and rod 107, will bring the switch U into its second position, called "position *b*", and thereby causing the interconnection of the lines 4 and 5. In this position the switch U will close the gate-opening circuit and hold the gate-closing motor circuit interrupted. A modified construction of the switch is shown diagrammatically in Fig. 3. This switch U is likewise operated by the shaft door or its lock, but it takes up a zero-position when the shaft door is closed. When the shaft door is opened the switch takes its position *b*; when the door is closed again the switch passes from its position *b* back again to the zero-position, but via its position *a*, which thus will be touched only in passing.

The switches S and U cooperate in controlling two circuits viz. a gate-opening circuit and gate-

closing motor circuit, which circuits actuate the motor M.

Referring to Fig. 1, assume that one of the shaft doors is being opened by hand. Then the spring 109, shuts the switch U into its position *b*. The current may be traced from the + pole by way of lines 1 and 2 through the switch S1, this switch being in position *a*, by way of lines 3 and 4, through switch U, this switch being in position *b*, lines 5, 6, 7 and 8, through the motor armature M1, and lines 9 and 11 to the minus-pole. From the line 7 the current runs simultaneously by way of lines 12 and 13 through switch S2, which is in position *a*, by way of line 14, through field winding M2 of the motor, line 15, through switch S2, which is in position *a*, and lines 16, 17 and 11 to the minus-pole. This gate-opening motor circuit now actuates the motor M and brings about the movement of the mechanism not shown which opens the gate. The gate having reached the open position, the switch S is thereby brought into position *b*, whereby the opening circuit is broken. When thereafter the shaft door is closed the shaft 107 brings the switch U into its position *a*. Thereby the gate-closing circuit is closed, the current running from the plus-pole by way of lines 1 and 18 through the switch U in position *a*, line 19, through switch S1 in position *b*, line 21, switch A1 of a time delay A, lines 22, 7 and 8, through motor armature M1, and lines 9 and 11 to the minus-pole, and from the line 7 simultaneously by way of lines 12 and 23 through switch S2 in position *b*, line 15, through field windings M2 of the motor, line 14, switch S2 in position *b* and lines 24 and 17 to line 11 and from there to the minus-pole. This gate-closing motor circuit will make the motor M rotate in opposite direction, thus closing the gate. When the gate reaches the closed position it shuts the switch S back to the position *a*, whereby the gate-closing motor circuit is broken. When the passenger leaves the cage he operates a push-button P arranged inside the gate and which brings the lever H in contact with the electro-magnet E, for actuating a bridging circuit, automatically opening the gate. When this circuit is closed, current runs from the plus-pole by way of lines 1 and 2 through switch S1 in position *a*, lines 3 and 25 through electro-magnet E, lever H, lines 31, 6 and 7 and then following the gate opening motor circuit. This circuit is closed for continuous current, when the electro-magnet E attracts the lever H. The gate opens automatically, and when it arrives at the extreme open position, it moves the switch S into the position *b*, thus breaking the circuit. At this time the electro-magnet E is left without current and the lever H returns to its original position. In order to break the gate-closing motor circuit viz. to prevent the gate from being closed immediately, a time delay designated as a whole by letter A is provided in said circuit, to be operated by the cage gate. The time delay A comprises a switch A1 in the gate-closing circuit and a retarder A2, which latter keeps the switch A1 disconnected for a predetermined time, say 3 seconds. The gate, when arriving at its open position, actuates the time delay A, which holds the gate-closing motor circuit broken at the switch A1 so that time space is won long enough to open the shaft door.

It is nevertheless possible to develop the construction in such a manner that it results in the opening of the gate without pressing the button P when the desired landing is reached, e. g. in the manner shown in Fig. 2.

Referring to Fig. 2 buttons P1, P2, P3 etc. are provided, mechanically connected to the buttons of the elevator system. Each of the first-named buttons closes a bridging circuit corresponding to a floor landing. To each of the buttons corresponds an electro-magnet *Em*1, *Em*2, *Em*3, etc. When any of the buttons P1, P2, etc. is pressed a corresponding lever He1, He2, He3 etc. is brought into contact position and is continuously attracted by the corresponding electro-magnet, whereby a corresponding bridging circuit is closed. Separate switches Q1, Q2, Q3 etc. on the cage wall correspond respectively to these parallel connected electro-magnetic bridging devices. Each of these switches is pressed into its contact position by a separate projection (not shown) disposed in the shaft only at the corresponding floor.

The cage gate is opened in the following way:— The person entering the cage, after having closed the shaft door and thereby caused the closing of the cage gate, desires, for instance, to go from the first floor to the third. He presses the button corresponding to the third floor, which button mechanically operates the button P3. When the button P3 is operated, the lever He3 simultaneously is brought into its contact position. The current then passes from the plus-pole by way of lines 1 and 2, through switch S1 in position *a*, lines 3 and 25, through lever He3 and electro-magnet *Em*3, lines 34 and 26, through electro-magnet E2, lines 28, 29 and 11 to the minus-pole. Because of the energization of the electro-magnet *Em*3 a current flows continuously. The energization of the electro-magnet E2 results in a continuous attraction of the lever H2, thus causing a continuous activity of electro-magnet E1 by means of a current running from the plus-pole by way of lines 1 and 18, switches U in positions *a*, lines 19 and 32, electro-magnet E1, lever H2, lines 33, 29 and 11 to the minus-pole. In this position the lever H2 pulls the lever H1 out of contact with line 21. The closing motor circuit remains continuously disconnected. When the cage stops on the third floor the switch Q3 is pressed into its contact or closed position. The current then passes from the lever He3 by way of line 35, through the switch Q3, lines 36 and 7 simultaneously through the armature M1 and the field winding M2 of the motor M in the direction of the gate-opening motion (*a* position of switch S) to the minus-pole. On reaching the open extreme position of the cage gate the switch S passes into its position *b*. The electro-magnets *Em*3 and E2 are thereby disconnected and the lever He3 freed. The electro-magnet E1 remains energized so that the lever H2 remains continuously attracted, keeping the gate-closing motor circuit broken by the lever H1. When leaving the cage, the operator opens the shaft door, the switch U being moved into its position *b*. Th electro-magnet E1 is thereby disconnected and the lever H1 is now freed, resuming its original position and restoring the electric contact of lines 21 and 22 whereby the gate-closing circuit is completed. When the shaft door is again closed the switch U returns to its position *a* and connects the motor current in the sense of the gate-closing motion.

In Fig. 3 is shown a network for preventing the cage gate from stopping between the extreme positions when the shaft door is opened and thereafter is immediately closed again, before the cage gate has had time to attain its extreme open posi-

tion. The gate may be closed by changing the current in the motor field winding M2 by aid of an auxiliary circuit and a suitable coupling system.

In the extreme closed position of the gate a switch K is open; but this switch will be closed immediately when the gate leaves said position. If the shaft door should be opened by an outside person when the lift passes a landing, the gate immediately begins to open. When the shaft door is shut before the gate has reached its extreme open position, the switch S remains in its position *a*, thereby keeping the supplement S3 of this switch in closed position. The current at first passes by way of lines 1, 18 and 50 through the switch U in position *a*, lines 52, 19 and 55 and later on, upon energization of electro-magnet E5, by way of lines 1, 18, 53 through lever H5, lines 54 and 55, through the bridging electro-magnet E5 and by way of line 20 to the electro-magnet E3 and therefrom through the switch K by way of lines 21, 7 and 8 through the armature M1 of the motor and lines 9, 10, 80 and 11 to the minus-pole, and simultaneously from line 21 by way of lines 12 and 13 through switch S2 in position *a*, lines 56 and 57, through a relay-switch H4 in position *a*, line 14, through field winding M2 of the motor, line 15, through the relay-switch H4 in position *a*, lines 58 and 59, through switch S2, in position *a*, and lines 16, 17, 10, 80 and 11 to the minus-pole. Nevertheless, although the gate-closing motor circuit is thus energized, the gate does not continue its opening movement, because the electro-magnet E3 simultaneously attracts its lever H3, which lever thereby couples the current circuit by way of line 62 through the switch S3, line 63, through the electro-magnet E4, and lines 64 and 11 into the minus-pole. The electro-magnet E4 thereby attracts the relay-switch H4, which breaks the opening current and completes a closing circuit by changing the direction of the current in field winding M2 of the motor, thereby closing the gate. The current now runs from the line 56, line 61, through switch H4 in position *b*, line 15, through field winding M2, line 14, through switch H4 in position *b*, line 60 to line 59. When the gate has reached its extreme closed position, the current is broken at the switch K and the electro-magnets E5, E3 and E4 release their levers. The current circuits thus will become deenergized. The further operation of the arrangement is the same as disclosed in relation to the foregoing figures.

In all the foregoing examples it is possible to cause the automatic opening of the cage gate in such manner that the gate-opening motor circuit, for instance by the aid of a relay which is operated by the motor current of the lifting system, is energized by interrupting the lifting motor current, when the desired landing is reached.

Referring to Fig. 4, a simple diagram of an electric elevator system provided with one of the above forms for carrying out the present invention is illustrated to show how the gate-opening motor circuit can be closed, when the elevator lifting system is deenergized upon the cage reaching the desired landing. The details of that portion of the view, the equivalent of which is not shown in Fig. 2, does not per se form part of my invention, and is old in the art. The motor of the elevating system, which is fed by a separate power supply, is designated as a whole by MN, its armature M7 and its field winding by M8, while the switch controlling the direction of rotation of the motor is designated T. Said switch T is controlled by a weak current passing, when the cage moves in upward direction, through the electro-magnet E61 and, when the cage moves in downward direction, through the electro-magnet E62, thus closing or cutting off the power current or reversing the direction of the same. If the switch T is not influenced by either of the two electro-magnets, it is in a non-connecting or neutral position. For controlling the operation of the cage, switches F are provided, one at each floor landing. The switch at the first floor is designated by F51, the switch at the second by F52, the switch at the third by F53, etc. For the same purpose switches C51, C52, C53 etc. are provided inside the cage, these switches corresponding to the first, second, third, etc. floor landings respectively. For operating the electro-magnets E61 and E62, bridging circuits are closed by levers W51, W52, W53, etc. cooperating with electro-magnets E51, E52, E53 etc. When the cage is passing a landing floor, a switch arranged at the level of said floor in the shaft is touched and disconnects the bridging circuit in the corresponding floor level, such switches Q being provided at each landing floor, switch Q51 at the first landing floor, at the second landing floor switch Q52, at the third landing floor Q53 etc. Moreover, switches E are provided in the shaft at every landing floor level except at the first and the last one. When the cage is passing a landing floor in one direction (up or down), the switch D of this landing floor is changed over in such way that the corresponding bridging circuit, if connected with the electro-magnets E61 or E62, is set for a passage in the opposite direction of the cage. Electro-magnets E71 and E72 are arranged in the weak current circuit and are disposed to be actuated provided that the weak current circuit has been closed by means of pressing one of the push-buttons inside the cage, C51, C52, C53 etc. When the cage stops at the desired floor landing the electro-magnets E71 and E72 are disengaged and allow the gate-opening motor current to operate. For preventing the electro-magnets E71 and E72 from being actuated by pressing the floor landing switches F51, F52, F53 etc., an electro-magnet E80 has been provided, which magnet, when actuated by pressing of said buttons F51, F52, F53 etc. attracts the lever H80, thus preventing by aid of resistance R_0 the electro-magnets E71 and E72 from being actuated. Assume that the cage is at the first floor and the passenger in the cage presses the button C53 for the third floor. The current then flows from the plus-pole by way of line 501, through electro-magnet E53, line 503, through switch Q53, lines 504, 505, through the switch C53, lines 506, 507, through the resistance R_0, line 508, through electro-magnet E71, line 509, through electro-magnet E72, lines 510, 511, 512 to the minus-pole. The electro-magnet E53, now energized, attracts the lever W53 into contact position, whereby the current simultaneously is made to flow from line 504, line 513, through lever W53 to line 514, line 514, 515, 507, thus forming a bridging circuit for the button C53. Passing through line 514, the current simultaneously flows by way of lines 516 and 517, through the up-direction electro-magnet E61, lines 518 and 519, line 512, to the minus pole. When energized, the electro-magnet E61 attracts the switch T, which switch now closes the power circuit of the motor MN in the elevating system, causing the movement in the up-direction of the cage in the ele-

vator shaft. Passing through the electro-magnets E71 and E72, the relay current actuates said electro-magnets, which consequently attract their corresponding levers H71 and H72. Lever H72 has a retarder, which acts in the two directions of movement of the lever. In consequence thereof the movement of the lever H72 is slower than the movement of the lever H71, so that this last-named lever has already left its contact position when the lever H72, attracted by the electro-magnet E72, comes into contact with the contact point of the electro-magnet E8. Thus the gate-opening motor circuit, which is controlled by the levers H71 and H72, will remain deenergized owing to the position of the lever H71. When the cage leaves the first floor landing, the switch Q51 is closed. When the cage is passing the second floor landing, the switch D of this landing will be momentarily closed and prepared for connecting the bridging or stick circuit corresponding to this floor, the current of which circuit is to actuate the down-direction electro-magnet E62. When the cage arrives at the third floor landing, the switch Q53 is opened and breaks the relay current circuit. This results in the demagnetization of the electro-magnet E61, which releases the switch T and allows the same to take its non-connecting position. At the same moment the power current is interrupted and the cage stops at the third floor landing. At the same time as the relay current is interrupted, both the electro-magnet E71 and the electro-magnet E72 are deenergized, as a result of which the levers H71 and H72 are released. The lever H71 will immediately resume its contact position in line 403. The lever H72 is retarded by its retarder and remains for a moment in its contacting position. At this time the gate-opening motor current is closed momentarily, and the current flows from the plus-pole, lines 1 and 2, through switch S1 in position *a*, lines 3 and 25, through electro-magnet E2, line 402, through lever H72, electro-magnet E8 and lever H71, lines 403, 7 and 8, through armature M1 of the electric motor M, lines 9, 10, and 11 to the minus-pole, and simultaneously from line 7, lines 12 and 13, through switch S2 in position *a*, line 14, through the winding M2 of motor M, line 15, through switch S2 in position *a*, and lines 16, and 17 to line 10 and 11 to the minus pole. By the lever H72, attracted by the electro-magnet E8, a continuous current will be closed, which now causes the motor M to open the cage gate. On energization of electro-magnet E2, the lever H2 is attracted and connects the bridging or stick circuit which has already been described with reference to the preceding Fig. 2, for breaking the gate-closing motor circuit. The further operation is as described in the foregoing (see e. g. the description of Fig. 3).

The current lines may also be led in such manner that the switches of the various floors and also in the cage are connected with a by-pass circuit operating with low tension current and causing the closing or opening of the motor-driving circuit for opening and closing the cage gate.

The arrangement naturally can be used just as well on passenger elevators as on freight elevators, and the object and advantages of this improvement may be made available in a great variety of forms within the scope of the invention, which is not limited to the details herein shown and described.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:—

1. In an elevator system, a shaft door, a cage gate, mechanism for opening and closing said cage gate, means for causing, upon opening of said shaft door, the operation of the mechanism for automatically opening said cage gate and for causing, upon closing of said shaft door, the operation of said mechanism for automatically closing said cage gate.

2. In an elevator system, a shaft door at each of a plurality of landings, a cage gate, mechanism for opening and closing said cage gate, said mechanism comprising an electric motor, a gate-opening motor circuit, a gate-closing motor circuit, said two circuits being adapted to cause the actuation of said electric motor for operating said mechanism, switches operated by said shaft doors, a switch operated by said cage gate, said switches cooperating and being disposed, upon opening of the shaft door at the floor at which the cage is positioned, to close said gate-opening motor circuit to operate said mechanism for opening the gate, the current being interrupted on arrival at the open extreme position of the gate, and, upon closing of said shaft door to close said gate-closing motor circuit for causing said mechanism to close said gate, the current being interrupted on arrival at the closed position of the gate.

3. In an elevator system, a shaft door at each of a plurality of landings, a cage gate, mechanism for opening and closing said cage gate, said mechanism comprising an electric motor for causing the operation of said mechanism, a gate-opening and a gate-closing motor circuit for said electric motor, switches operated by said shaft doors, a switch operated by said cage gate, said switches cooperating to control said circuit, electro-magnetic means for bridging said opening motor circuit for continuous current, and means disposed to be operated by a passenger for closing said bridging means.

4. In an elevator system a cage, a shaft door at each of a plurality of landings, a cage gate, a mechanism for opening and closing said cage gate, said mechanism comprising an electric motor for causing the operation of said mechanism, a gate-opening motor circuit and a gate-closing motor circuit for said electric motor, switches operated by said shaft doors, and a switch operated by said cage gate, said switches cooperating to close one of said circuits and to keep the other of same disconnected, electro-magnetic means for closing said cage gate-opening motor circuit, electro-magnetic means for maintaining said cage gate-closing motor circuit broken until the shaft door is opened, electro-magnetic means, the circuit of which is adapted for manual closure, for energizing both first-named electro-magnetic means and adapted to prepare said gate-opening circuit for being closed, such last-named electro-magnetic means being provided parallel to and in a number corresponding to that of the landings, means disposed to be operated by a passenger for actuating that one of the last-named means which corresponds to the desired landing, and switches at each landing to connect, upon arrival at the desired landing, said already-prepared electro-magnetic means to the gate-opening motor circuit for actuating said mechanism for opening said gate.

5. In an elevator system, a shaft door at each of a plurality of landings, a cage gate, mechanism for opening and closing said cage gate, said

mechanism comprising an electric motor, a gate-opening motor circuit, a gate-closing motor circuit, said two circuits being adapted to cause the actuation of said electric motor for operating said mechanism, switches operated by said shaft doors, a switch operated by said cage gate, said switches cooperating, upon opening of the shaft door at the floor at which the cage is positioned, to close said gate-opening motor circuit to operate said mechanism for opening the cage gate, the current being interrupted on arrival at the open extreme position of the gate and, upon closing of said shaft door, to close said gate-closing motor circuit for causing said mechanism to close said gate, the current being interrupted on arrival at the closed position of the gate, a supplementary switch operated by said cage gate and adapted to be closed on the arrival at the closed extreme position of the gate and to remain closed until the biasing to the open extreme position of the gate, and to be disconnected at other times, an auxiliary circuit disposed so as to be closed by said supplementary switch, an electro-magnet in said auxiliary circuit, means for changing the direction of rotation of said electric motor and adapted to be attracted by said electro-magnet, a switch adapted to break said gate-closing motor circuit as an incident to said cage gate being in the closed position, and to close the circuit immediately after said gate leaves this position, electromagnetic means in said gate-closing motor circuit adapted to connect said gate-closing motor circuit to said auxiliary circuit for causing, upon said supplementary switch being closed, the energization of said electro-magnet to attract last-named means to change the direction of rotation of said motor for causing a closing movement of said gate despite the fact that the first-named switches, operated by the shaft doors, and the switch operated by the cage gate, keep said motor circuit disconnected.

6. In an elevator system, an elevating electric motor, controlling circuits for said electric motor, a shaft door at each of a plurality of landings, a cage gate, mechanism for opening and closing said cage gate, said mechanism comprising an electric motor for causing the operation of said mechanism, a gate-opening motor circuit and a gate-closing motor circuit for the last-named electric motor, switches operated by said shaft doors, a switch operated by said cage gate, said switches cooperating to close one of last-named circuits and to keep the other of same disconnected, electromagnetic means for closing said gate-opening motor circuit, an electromagnet in said gate-opening motor circuit, electromagnetic means for maintaining said gate-closing motor circuit broken until the shaft door is opened and adapted to be energized by said electromagnet, electromagnetic means for preparing said gate-opening motor circuit for being closed and adapted to be energized upon actuation of said controlling circuits, an electromagnet in said controlling circuits, a switch adapted, upon actuation of said controlling circuits, to be attracted by the last-named electromagnet for continuously breaking said already-prepared gate-opening motor circuit and, upon de-energization of said controlling circuits, upon arrival of the cage to the desired landing, to be freed from last-named electromagnet for closing said already-prepared gate-opening motor circuit for actuating the first-named electromagnet and for actuating said mechanism for opening said gate.

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