J. E. BOYCE.

MEANS FOR OPERATING ELEVATOR DOOR LOCKS.

APPLICATION FILED JULY 11, 1905.

952,698.

Patented Mar. 22, 1910.

2 SHEETS—SHEET 1.

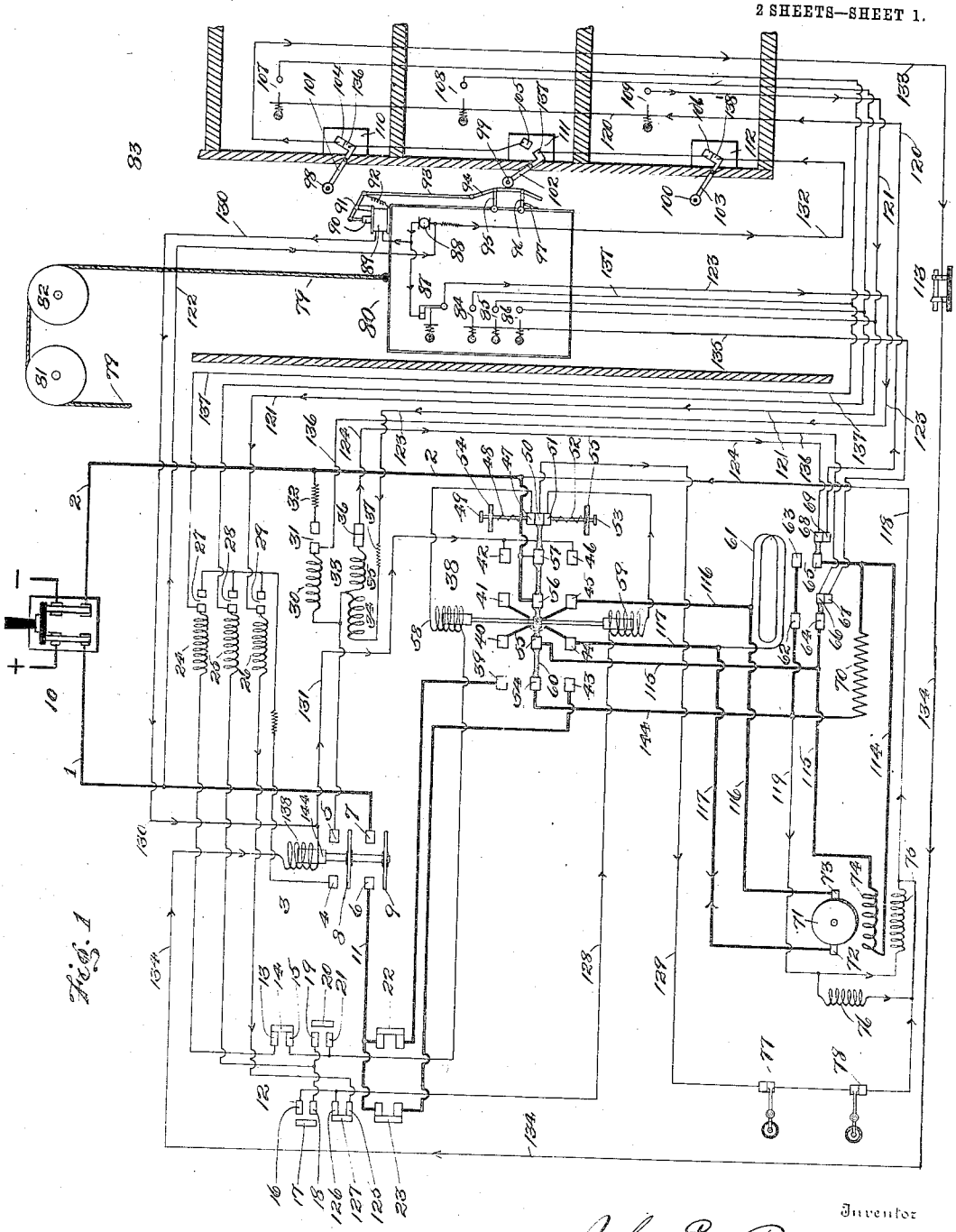

Fig. 1.

Witnesses

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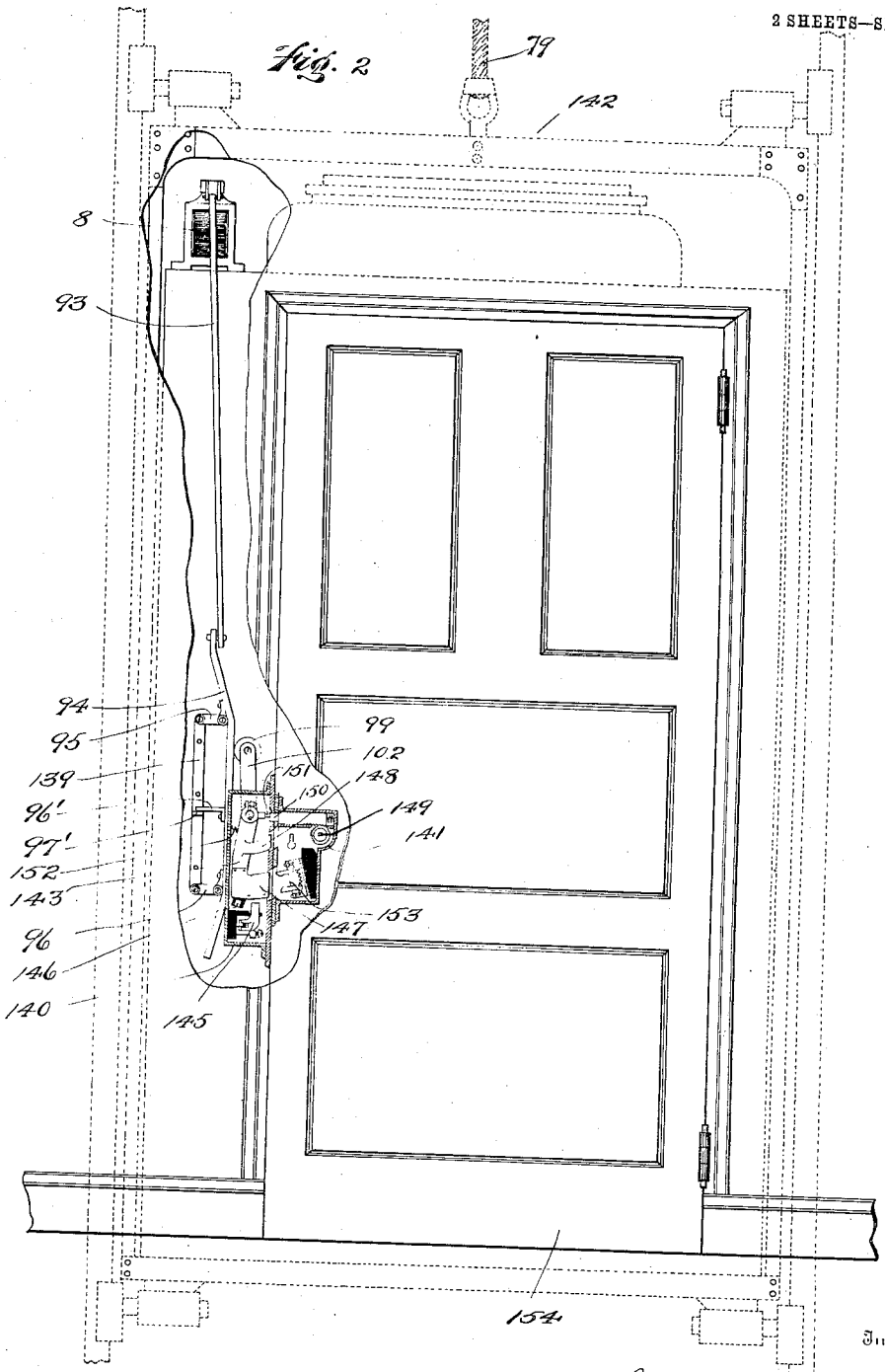
2 SHEETS—SHEET 2.

Fig. 2



Witnesses

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UNITED STATES PATENT OFFICE.

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MEANS FOR OPERATING ELEVATOR-DOOR LOCKS.

952,698. Specification of Letters Patent. Patented Mar. 22, 1910.

Application filed July 11, 1905. Serial No. 269,183.

To all whom it may concern:

Be it known that I, JOHN E. BOYCE, a citizen of the United States of America, residing in the city, county, and State of New York, have invented new and useful Improvements in Means for Operating Elevator-Door Locks, of which the following is a specification.

My invention relates to single push-button controlled electric elevator systems, and has for its object to provide a system of control which embodies novel means for preventing any operation of an elevator other than normal.

A further object is to provide automatic means for preventing an elevator car from being moved until all hatchway doors are closed and locked and preventing a door from being opened except at such time as the elevator car has come to rest adjacent to a hatchway landing.

Further objects will appear more fully hereinafter, the novel combinations of elements being set forth in the claims.

In the accompanying drawing, Figure 1 illustrates diagrammatically a single push-button elevator system embodying my invention in which three floors or landings are shown although any number of floor landings may be used necessitating merely a duplication of certain parts of the apparatus as shown. Fig. 2 shows a form of door lock which I may use and which I have claimed in an application co-pending herewith, filed July 11, 1905, Serial No. 269,182.

In Fig. 1, 10 designates a main line switch which serves to connect the source of electrical supply denoted by + and — to the feed wires 1 and 2.

3 designates an electrically operated switch comprising a solenoid 138 and core 144, the latter operating to lift, when sufficiently energized, two contact disks 8 and 9 which are insulated therefrom and from each other. The contact disk 8 upon being lifted will place into electrical connection the stationary contacts 4 and 5. In like manner the disk 9 when lifted connects together the stationary contacts 6 and 7.

12 designates a floor controller and comprises a number of stationary contacts such as 13, 15 and 16, 18, etc. These stationary contacts are arranged in pairs, each pair having a movable contact or bridging piece such as 14 and 17, etc., which serves to bridge or connect together the contacts in each pair. These bridging pieces are operated upon the movement of the elevator car, being positively connected to some moving part of the hoisting machinery. Therefore, the position of the various bridging pieces on the floor controller with respect to their stationary contacts is dependent upon the position of the elevator car in the hatchway. 22 and 23 designate similar contacts which are also a part of the floor controller 12, the bridging pieces of each pair of contacts 22 and 23 being always in contact with their respective stationary contacts during the normal travel of the car in the hatchway.

24, 25 and 26 designate floor relays each comprising a magnet coil which operates when energized to close the contacts 27, 28 and 29, respectively, each floor relay corresponding to one of the floor landings.

30 designates a magnet controlling the contacts 31, while 33 is a doubly wound magnet controlling the contacts 36. The magnet 33 has two coils 34 and 35 wound about the same core and are wound in opposition, that is, when both are receiving current at the same time the magnetization set up by one winding is neutralized by the action of the other winding, current flowing in opposite directions in the two windings.

38 designates the reversing switch the action of which determines the direction of rotation of the hoisting motor and consequently the direction of travel of the elevator car. This reversing switch comprises a number of stationary contacts 39, 40, 41 and 42, and also 43, 44, 45 and 46. Mounted between these sets of contacts are movable contacts 54, 55, 56 and 57 all of which are mounted upon and carried by an insulated carrier 60. The insulated carrier 60, together with the contacts mounted thereon, is adapted to be swung to one side or the other by means of the solenoids 58 and 59, thereby causing the movable contacts to engage the various fixed

contacts, the latter being placed in proper position to be engaged thereby. The contact 50 on the carrier 60 is normally engaged by the spring-pressed contacts 47 and 51, and by means of the springs 48 and 52 the contacts 50 and consequently the carrier 60 are normally held in their central or intermediate position. When the carrier is pulled to one side or the other by the solenoid 58 or the solenoid 59 acting on their respective cores which are rigidly connected to the carrier 60, the contact 50 will be moved to one side or the other against the action of the spring 48 or the spring 52. Should the solenoid 58 be energized, the spring 48 will be compressed as the carrier 60 swings to its extreme position. The contact 50 remains in engagement with the contact 47 but when the stop piece 53 engages the stationary piece 55 the contact 50 leaves the contact 51. In a similar manner if the solenoid 59 is energized, the spring 52 will be compressed, contacts 50 and 51 will remain in engagement and contact 50 will leave contact 47 when the stop piece 49 meets with the stationary piece 54. When the solenoid 58 or 59 is deënergized, the spring 48 or 52 serves the purpose of returning the carrier to central position.

61 designates the operating magnet of an accelerating or resistance controlling device comprising the fixed contacts 62 and 63 and two movable contacts 64 and 65, the latter being adapted when operated by the magnet 61 to engage the fixed contacts 62 and 63, respectively. The movable contact 64 carries a small contact 66 which is insulated from it and is in electrical contact with a fixed contact 67 at all times except when moved out of engagement therewith by the excitation of the controlling magnet 61. 68 is a similar contact carried by the contact 65 and engaging with the fixed contact 69 under the same conditions as before mentioned in connection with the contact 66.

70 designates the accelerating resistance in series with the hoisting motor-armature 71.

72 and 73 are the armature brushes, 74 is the series field while 75 is the shunt field.

76 designates the magnet brake which may be of any preferred construction employing magnetic means for releasing the brake shoes.

77 and 78 designate limit switches, each comprising two contacts normally in engagement with each and so placed with respect to the car or counterweight as to be moved out of engagement should the car exceed its normal run.

80 designates an elevator car supported by the hoisting cable 79 in the hatchway 83, the cable passing over the overhead sheaves 82 and 81, to the drum of the hoisting machine operated by the motor. Open-circuit push-buttons 84, 85 and 86 are carried by the car, each button corresponding to a floor landing.

87 designates a closed circuit safety button the purpose of which is to enable the car operator to stop the machine at any time during the car travel.

88 is a contact carried by the car gate, the same being closed only when the gate is closed.

Upon the top of the car is mounted a solenoid 89 having a plunger 90 to which is fastened a lever pivoted near its center at 91 and having its other end connected by the rod or bar 93 to the cam or rail 94 which is movably attached to the elevator car by the links 95 and 96 which are pivoted to the car.

97 is a small stop piece which limits the downward movement of the cam 94. A small spring 92 tends at all times to keep the cam in its outward position against the stop, such position being the one shown on the drawing. Upon the solenoid 89 becoming energized, the plunger 90 will be pulled downwardly against the action of the spring 92 thus lifting the cam or rail 94 through the lever and rod or bar 93. As the cam is lifted by the solenoid the links 95 and 96 will cause the cam to move inwardly toward the side of the car.

In the path of the cam 94 which is carried by the car, are door locks represented diagrammatically at 110, 111 and 112. Each door lock has a fixed contact 104, 105 and 106 adapted to coöperate with the contacts 136, 137 and 138′, respectively, at the lower ends of the levers 101, 102 and 103. A form of lock especially adapted to this system is disclosed and specifically claimed in my co-pending application filed July 11, 1905, Serial No. 269,182. The specific combination with said lock of the contacts in the lock and the electro-magnetic cam device for operating same is also disclosed and claimed in said application.

The pivoted lever arms 101, 102 and 103, respectively, carry at their upper or outer ends rollers 98, 99 and 100. These rollers extend out into the hatchway and are adapted to be engaged by the magnet controlled cam 94 carried by the car when the cam is in its outward position. Upon such engagement, which may take place while the car is opposite any one landing, the roller is forced upwardly carrying the contact mounted thereon out of engagement with the corresponding fixed contact thereby interrupting any circuit included in that of the door lock contacts, the latter being connected in series as shown. Should the solenoid 89 be energized to retract the cam 94 and hold the same in disengaging position as

the car passes a floor landing, the adjacent door lock roller will not be engaged by the cam and the door lock contacts will remain closed. This operation will be more fully described hereinafter.

107, 108 and 109 designate open-circuit hall push-buttons located at each landing and are connected to corresponding floor relay magnets 24, 25 and 26, respectively. 113 designates a slack cable switch, the same being designed to open its contacts should the hoisting cable for any reason become slack. The heavy black lines represent the motor-armature and series field circuits, all other circuits being shown by light black lines.

The operation of my system is as follows:—Potential being on the main line and the switch 10 closed, the feed wires 1 and 2 will be energized and a circuit will be established from the + main by wire 1 to the contact 7. Assuming that the disk 9 is in raised position connecting together contacts 7 and 6, the circuit continues by wire 11 through the contacts 22 and 23 to the reversing switch contacts 39 and 43. In order to get a circuit to the motor it is first necessary to operate the reversing switch 38. Assuming the solenoid 58 to be fully excited the contact 54 will engage contact 39, contact 55 will engage contact 40; 56, 41; and 57, 42. The contact 50 will compress the spring 48 and will also be carried out of engagement with the contact 51. The circuit now continues from contact 39 to contact 54, and by wire 144 to the accelerating resistance 70, and by wire 114 through the series field 74, wire 115 to the contact 55. The contact 55 engages contact 40, therefore the circuit continues by contact 45 and wire 116 to armature brush 73, through the armature 71 to brush 72 and wire 117 to contacts 44 and 41, the contact 41 engaging the contact 56 which latter is connected to the — main by the wire 2. A circuit has thus been completed through the motor-armature, series field and accelerating resistance. At the same time, the shunt field 75 gets current, being connected by wire 119 on one side to the + main through the reversing switch 38 and by wire 118 to the — main. The brake magnet 76 being connected in parallel to the shunt field of the motor will be energized to release the brake; the motor is now free to start the elevator car. The accelerating magnet 61 being connected across the armature terminals 116 and 117 will be energized with gradually increasing strength as the motor starts from rest until it becomes powerful enough to raise the contact 65 into engagement with the contact 63 at the same time separating the contacts 68 and 69. Since the contacts 63 and 65 are connected across the terminals of the resistance 70 the latter will be short-circuited, causing the armature to revolve at a higher speed. The magnet 61 increases further in strength until it lifts the contact 64 into engagement with the contact 62, thus short-circuiting the series field 74, since its terminal wires 115 and 114 are now connected together electrically by the contacts 64, 62, 63 and 65. The closing of contacts 62 and 64 opens the small contacts 66 and 67. The motor now runs at full speed being excited by the shunt field only, having the motor-armature connected across the power mains and receiving current at the full line constant potential. Should the reversing switch 36 be operated in the reverse direction, that is, by energizing the solenoid 59, current would flow from the positive or + main by way of contacts 43 and 54 through the resistance 70, series field 74 by wire 114 and by wire 115 and contacts 55 and 44 to the armature brush 72. The circuit continues through the armature 71 to the brush 73 and wire 116 through the contacts 45 and 56, the latter being connected to the negative or — main 2. The circuit to the brake magnet and shunt field remains the same as in the first case when the switch 38 was operated in the opposite direction.

It will be seen that the direction of flow of current through the motor-armature depends upon which solenoid of the reversing switch is energized, consequently the direction of rotation of the motor will depend upon whether the solenoid 58 or 59 be energized. One terminal of the solenoid 58 is connected to the contact 47; therefore, should the solenoid 59 be energized, the contact 50, which connects both solenoids with an energizing circuit, will swing out of engagement with the contact 47, thereby preventing the solenoid 58 from receiving any current since it will be open-circuited at the contact 47. In a similar manner when the solenoid 58 is energized to operate the reversing switch 38 the solenoid 59 will be open-circuited at the contact 51. This non-interfering feature or interlocking device prevents both solenoids of the reversing switch from receiving current at the same time which would make the proper operation of the switch uncertain.

In order to show the operation of the system upon pushing a button, let it be assumed that the elevator car is at the second floor landing and a person on the first floor wishes to have the car descend to that floor. The button 109 at the first floor landing will now be pressed which will complete a circuit as follows:—Starting from the + main via wire 122, a circuit is closed through the gate contact 88 and safety button 87 through the resistance 37 to the left hand

terminal of magnet coil 34 by means of wire 123. The circuit continues through coils 34 and 35 and through the contacts 36, which latter are at present closed, and by way of wire 124 to the contacts 68 and 69. As was pointed out before, the contacts 68 and 69 are in engagement with each other except when the motor is running. The machine not having started as yet, these contacts are together and therefore the circuit is closed through them to the wire 120 which latter is common to all of the floor buttons 107, 108 and 109. The circuit continues through the button 109 to the magnet coil of the floor relay 26 by the wire 121. Passing through this coil the circuit goes to the floor controller contact 125. The bridge piece 127 connects this contact with the contact 126 which latter is connected by the wire 128 to one terminal of the solenoid 59 of the reversing switch. The other end of this solenoid is connected through the contacts 51 and 50 by wire 129 to the limit switches 77 and 78, which are closed at this time, so that the circuit continues by wire 118 to the — or negative main 2. A circuit has now been completed through the gate contact 88, safety button 87, magnet coils 34 and 35, push-button 109, floor relay 26, floor controller 12, reversing switch solenoid 59 and limit switches 77 and 78. The contacts 36 will remain closed since both coils 34 and 35 are excited. The floor relay 26 will close its contacts 29 while the reversing switch will be operated by the solenoid 59 to close the contacts 54, 55, 56 and 57 against the contacts 43, 44, 45 and 46, respectively.

The operation of the reversing switch 38 closes a circuit through the solenoid 89 of the magnet cam carried by the car, this circuit being from the + wire 1 by wire 122 and gate contact 88 through the solenoid 89 to wire 130 and by wire 131 to the reversing switch contacts 42 and 46. Now the contact 46 is at this time in electrical contact with the contact 57 which latter is connected to the — main 2. The solenoid 89 will therefore receive current at line potential and will operate to lift the cam 94 out of engagement with the door lock roller 99. The contacts 105 of the door lock 111 will at once be closed, assuming, of course, that the hall door is in closed position. The closing of these contacts will complete a circuit through the main line magnet as follows:— From the + main 1 by wires 122, 132 to and through the door lock contacts 106, 105 and 104, wire 133, slack cable switch 113, wire 134, solenoid 138 of magnet switch 3, wire 131, contacts 46 and 57 to the — main. The coil of magnet 3 will now become energized and will raise its plunger together with the disks or contact makers 9 and 8. The disk 9, by completing the circuit to the motor and brake, allows the motor to start, the circuit to the motor being heretofore broken at the contacts 6 and 7.

The bridging of the contacts 4 and 5 by the contact disk 8 throws a short-circuit around the magnet coil 35 and push-button 109. The push-button may now be released since the circuit just closed by the magnet switch 3 is self-sustaining or in other words a self-holding or retaining circuit, and since the magnet coil 35 has been short-circuited by the same operation the magnetizing effect of the same becomes practically zero. The coil 34, however, remains fully energized and now is enabled to open the contacts 36, the neutralizing effect of the magnet coil 35 having been removed.

Since a circuit through any of the floor buttons 107, 108 or 109 must by necessity pass through the contacts 36, as the wire 120 common to these buttons is connected thereto, it follows that after the contacts 36 have been opened by the operation of the magnet switch 3 any further manipulation of the floor push-buttons will have no effect whatever. The contacts 68 and 69 are for the same purpose, for just as soon as they become separated by the counter electro-motive force generated by the motor armature acting through the accelerating magnet coil 61, the landing buttons are isolated as before in connection with the contacts 36. Thus a double safeguard is provided to prevent a false operation and at the same time preventing any further effective manipulation of the buttons until the motor has come to rest, thereby allowing the contacts 68 and 69 to once more take a position in which they are closed or in electrical connection with each other.

The motor accelerates automatically and lowers the car until the floor controller which is being driven by the hoisting machinery moves the bridging piece 127 away from the contacts 126 and 125. This will take place just as the car reaches its predetermined destination, at the bottom floor in this case. This action of the floor controller will open the circuit between the floor relay 26 and reversing switch solenoid 59. Both will become deënergized as well as the magnet 34 and allow their respective contacts to return to their first positions. The opening of the reversing switch contacts breaks a circuit to the solenoid 138 of magnet switch 3 at the contacts 4, 6 and also to the solenoid 89 of the magnet cam through the wire 130. At the same time current to the motor is shut off and the brake is applied, stopping the car at the bottom floor. Upon the deënergization of the magnet solenoid 89, the

spring 92 acting in conjunction with the weights of the various parts, causes the cam 94 to be pushed downwardly and outwardly until limited in its movement by the stop 97. This outward movement of the cam forces the roller 100, which is now adjacent to the cam 94, inwardly, thereby separating the contacts 106, 138′ which include a circuit to the magnet of switch 3, thus making it impossible to operate the switch 3 until the contacts 106, 138′ have been closed again.

The operation from one of the car buttons 84, 85 or 86 is practically the same as that from the hall or landing buttons, with this difference,—namely, the safety magnet 30 is brought into action. Assuming the parts to be in the position shown on the drawing, that is, the elevator car at rest at the second floor landing, let the car button 84 be pressed, this button corresponding to the third or top floor. The circuit closed by operating the car button 84 starts from the + main 1 by wire 122, through the gate contact 88 and safety button 87 and by wire 123 and resistance 37 to the left hand terminal of magnet coil 34; from here it continues through coil 34 to the coil 30 of the safety magnet. The current can not pass through coil 35 as before pointed out since there is an open circuit at the different landing buttons connected to the wire 120. The circuit from coil 30 continues by wire 136 to the contacts 66 and 67 of the accelerating magnet 61, the circuit being maintained at these contacts since the motor has not as yet started; from the contact 67 by wire 135, which is common to the car buttons 84, 85 and 86, the circuit is closed through the button 84 and wire 137 to the coil of the floor relay 24, passing through this coil 24 to contact 13 of the floor controller, and to the solenoid 58 of the reversing switch by way of the bridging piece 14 and contact 15. The other terminal of solenoid 58 is connected to the contacts 47 and 50 and by wire 129 through the limit switches 77 and 78 to the — main 2 by way of the wire 118. The energization of coil 34 will cause the contacts 36 to open, thereby preventing any interference from the hall buttons and at the same time the safety magnet 30 will close its contacts 31. Upon the closing of these last-named contacts 31, another circuit is established from the positive main to the negative main including the car gate contact, safety car button 87, coil 34, coil 30 and the contacts 31, and resistance 32. This is a self-maintaining or retaining circuit and is conducive to two results: it prevents any operation from the floor buttons and makes it imperative upon the part of the car operator to open the car gate, upon the car arriving at its destination, thereby breaking this circuit, returning the parts to their non-operative position, and again closing the car gate, before any further operation of the elevator car from the landing button is possible.

The circuit closed by car button 84 through the floor relay 24, floor controller 12 and reversing switch solenoid 58 closes the floor relay contacts 27 and operates to close the reversing switch 38 bringing together the contacts 39, 40, 41 and 42, and 54, 55, 56 and 57, respectively. This operation of the reversing switch places the motor circuits in proper relation to produce an upward travel of the elevator car. The motor does not start as yet since its circuit is still open at the contacts 6 and 7. The main line switch 3 is connected to the main — 2 as soon as the reversing switch has closed the contacts 57 and 42 as before pointed out, the solenoid 59 being at the same time open-circuited at the contact 51. The circuit to the solenoid 89 of the magnet cam 94 is also closed at the contact 42 through the wires 131 and 130. The magnet 89 will then raise the cam 94 and allow the door contacts 105, 137 to close thereby completing a circuit to the main line magnet solenoid 138 by way of the wires 133 and 134.

The motor circuit is now completed by the closing of the contacts of switch 3 and the elevator car is raised until the top floor landing is reached, the accelerating magnet 61 operating as before to automatically bring the motor up to full running speed. The car buttons are open-circuited at the contacts 67 and 66 directly after the motor starts, preventing any further operation therefrom until the motor has come to rest and the contacts 66 and 67 once more placed into contact with each other.

Upon the car reaching the top floor landing corresponding to the bottom 84 the floor controller 12 operates to move the bridging piece 14 out of engagement with the contacts 13 and 15 and also to replace the bridge piece 17 so as to make contact with the contacts 16 and 18. The solenoid 58 is thereby open-circuited, the reversing switch contacts returning to their intermediate position, stopping the motor and applying the brake. At the same time the magnet solenoid 138 is deënergized together with the solenoid 89 of the magnet cam causing the latter to be thrust outwardly, forcing back the roller 98 and separating the door contacts 104, 136. Should the car for any reason over-run its normal travel, one or the other of the floor controller switches 23 or 22 will open, thereby causing the machine to stop. The limit switches 77 and 78 operated by the car itself are an extra precaution and accomplish the same object, viz., to stop the car upon over-

running its normal travel by opening the supply circuit through the wire 118, thus deënergizing the contact 50.

In reviewing the circuits that have just been traced together with the various operations produced by the action of the several magnets and parts controlled thereby, it will be seen that upon pressing a button to start the car a corresponding floor relay together with the reversing switch are energized, thereby placing the motor connections in proper position to raise or lower the car as the case may be. Also the operation of the reversing switch supplies the magnet cam with current allowing its operating solenoid to become energized and retract the cam, this operation closing the door lock circuit which includes the magnet of the main line switch and also allowing the door to be automatically locked. After the door lock contacts have been closed the main line magnet is enabled to close its contacts thereby starting the motor. The push-button has also at the same time a shunt circuit thrown around it by the operation of the main line magnet switch making it no longer necessary to keep the push-button compressed. Contacts are provided which depend for their operation upon the motor, which include a circuit supplying the various buttons with current and in this way prevents any further operation from any push-button after the motor attains full speed and until the motor has again been brought to rest either automatically by the action of the floor controller or voluntarily by pressing the safety button in the car. The various landing doors can be opened only when unlocked by the action of the magnet cam carried by the car, and the magnet cam can not be placed in an unlocking position until the car has been brought to rest at the proper floor. Then, and then only, is it possible to open the landing door. While such door is open the car can not be moved since the contacts carried by the door lock are of necessity, owing to their construction, open-circuited while such door is open, and since these contacts include a circuit to the main line magnet it will be evident that current can not be supplied to the motor until the landing doors are all closed, and locked, thereby bringing their respective contacts into electrical connection with each other and making it possible to start the hoisting motor.

Referring to Fig. 2, 79 designates the hoisting cable for suspending the car 142 which is shown in dotted lines associated with suitable guideways. Portions of the well door and wall are broken away to show clearly the magnetic cam and the door lock. The strip 139 is rigidly secured to the car body and has an intermediate stop 97′ adapted to be engaged by the projection 96′ which is secured to the cam 94. This stop serves the purpose of limiting the downward movement of the cam 94 when the same is released by the magnet 89 and drawn downwardly by means of the spring 92. In the lock casing 140 is pivotally mounted a locking lever 143 having two locking bolts 148 and 147, the latter being also a contact device which co-acts with the circuit closer 153 and the two insulated terminals 145. The wire 132 is connected to these terminals so that when the locking lever is in locking position the circuit may be traced from one terminal 145 to one of the insulated contacts 146, circuit closer 153, the other of the insulated contacts 146, and thence to the other terminal 145. It will be noticed that the door must be closed before the circuit including wire 132 can be closed as the circuit closer 153 is in the keeper casing 141 which is in the door 154 itself. Furthermore, it is evident that the parts are shown so adjusted that the door will necessarily be locked before the circuit closer 153 can electrically connect the terminals 145. When the solenoid 89 is energized the arm 102, which is rigidly connected to the locking lever 143, is released so that the spring 152 will force the locking bolts 148 and 147 to locking position. When the parts are in the positions shown in Fig. 2, the door may be opened by turning the knob connected to the spindle 149 and thus withdrawing the latch 150. Should the cam 94 be moved upwardly while the door is open, the spring-pressed pin 151 would engage the upper edge of the adjacent opening in the face-plate of the lock casing and hold the locking bolts in an intermediate position so that the insulated contacts 146 would not engage the insulated terminals 145. The purpose of this arrangement is to prevent the exposed contacts which engage directly with the circuit closer 153 from being energized when the door is in open position. The end of the bolt 148 is beveled so that the striking plate of the keeper casing may force the locking lever to the left until the latch 150 releases the pin 151 when the bolts are thrown to locking position. This mechanism is more fully described in my copending application hereinbefore referred to.

Although I have herein shown an electromagnet, which is in reality an electric motor having a reciprocating armature, I desire it to be understood that it is within the province of my invention to substitute for this form of motor any other desired form of motor, as, for example, the ordinary direct current motor with a rotating armature.

I desire it to be further understood that with slight modifications my invention may

be used for other purposes than controlling the locking of elevator doors, as for example, the automatic operation of means for locking doors adjacent the path of travel of railway cars.

Having thus fully described my invention and without limiting myself to the details of construction and arrangement of parts herein described and shown, what I claim and desire to have protected by Letters Patent of the United States is:

1. The combination with a car, of a door, locking means for said door, mechanical lock-releasing means, and means permitting the operation of said lock-releasing means only when the car is at rest opposite said door.

2. The combination with a car provided with a door-way, of a door, locking means for said door, and means permitting the automatic release of said locking means to unlocking position only when the car doorway is opposite said door.

3. The combination with a car, of a door adjacent the path of travel thereof, a lock for said door, and means permitting the mechanical operation of said lock to unlocking position only when the car is at rest opposite said door.

4. The combination with a car having a passage way, of a door adjacent the path of travel of said car, locking mechanism for said door, and means permitting the operation of said locking mechanism to mechanically unlock the door only when the passageway of said car is opposite said door and the car is at rest.

5. The combination with a car having a door-way, of a door adjacent the path of travel of said car, locking means for said door, and means operable only when the car is at rest with the car door-way opposite said door for automatically operating said locking means to mechanically unlocking position.

6. The combination with an elevator, of an elevator door, a door lock, and means operable only when the car is at rest opposite said door for effecting mechanical operation of said door lock.

7. The combination with an elevator, of an elevator door, a door lock, an operating circuit controlled by said lock, and automatic means for operating said door lock to mechanically unlock said door when the car is brought to rest opposite the same.

8. The combination with an elevator, of a hatchway door, means for locking said door, mechanical means for operating said door-locking-means to unlocking position, electric means for controlling said mechanical-operating-means, and an operating circuit controlled by said locking-means.

9. The combination with an elevator, of a hatchway door, means for locking said door, mechanical means for actuating said locking means to unlock the door, and means permitting the operation of said mechanical means only when the car has been brought to rest opposite said door.

10. The combination with an elevator car, of a hatchway door, means for locking said door, a mechanical device for actuating said locking means to unlocking position, and automatic means operable only when the car is at rest opposite said door to permit said mechanical device to effect the unlocking of the door.

11. The combination with an elevator car, of means for moving the same, a well door, locking mechanism for said door, a mechanical unlocking device, and means permitting the operation of said unlocking device to unlock the door only when the car is at rest opposite said door.

12. The combination with an elevator car, of a hatchway door, a door-lock, means carried wholly by the car for releasing said lock, and automatic means operable only when the car is at rest opposite said door for moving said releasing-means to releasing position.

13. The combination with an elevator car, of hatchway doors, locks for said doors, means for moving said car, automatic means for controlling said moving-means, means carried by the car for operating said locks, and means co-acting with said locks for rendering said controlling-means inoperative except when all the doors are closed and locked.

14. The combination with an elevator car, of means for moving the same, means for controlling said moving-means, a hatchway door, a lock for said door, and means co-acting with said controlling-means for preventing the car from being started except when said door is closed and locked against manual operation.

15. The combination with a car, of means for operating same, a door, locking means for said door, and means permitting the car being moved away from said door only when the door is closed and locked against manual operation.

16. The combination with a car, of a door adjacent the path of travel of said car, locking means for said door, means for operating said car, and means for rendering said operating-means inoperative except when the door is closed and locked against manual operation.

17. The combination with a car having a door-way, of means for moving said car, controlling means for said moving means, a door adjacent the path of travel of said car,

locking mechanism for said door, and means for rendering said controlling-means inoperative to prevent said car from being started away from said door except when the door is closed and locked against manual operation.

18. The combination with a car having a door-way, of means for operating said car, a door adjacent the path of travel of said car, locking means therefor, means for releasing said locking means only when the car is at rest with its door-way opposite said door, and means co-acting with said locking means for preventing the car from being operated except when the door is closed and locked.

19. The combination with a car, of a plurality of doors, locking mechanism for each door, means carried by the car for operating said locking mechanism, said operating-means being operable to actuate said locking mechanism to unlocking position only when the car is opposite said locking mechanism, and means co-acting with said locking mechanism for preventing said car from being started until after the door is closed and locked.

20. The combination with an elevator car, of means for operating same, a hatchway door, locking means therefor, a circuit closer co-acting with said door-locking-means, a controlling circuit including said circuit closer, and means permitting the automatic unlocking of said door and the opening of said circuit closer only when the car is at rest opposite said door.

21. The combination with an elevator car, of a magnetic cam carried thereby, a hatchway door, a lock for said door, means for operating said car, means co-acting with said cam for operating same to effect the release of said lock only when the car is at rest opposite said door, and further means co-acting with said car-operating-means for preventing the car from being started until after the door is closed and locked.

22. The combination with a car and its motor, of motor-controlling means, a hatchway door, a lock for said door, and means carried by the car for unlocking said door, and means co-acting with said motor-controlling means for operating said unlocking-means only when the car is opposite said door and at rest.

23. The combination with a push-button-controlled elevator system including a car, of hatchway doors, a lock for each of said doors, means for unlocking said doors, means controlled from any landing or from the car for operating said unlocking-means, and means for preventing the unlocking of the doors except when the car has stopped opposite a door.

24. The combination with an elevator car and its motor, of reversing switches for said motor, a well door, a lock for said door, means operable upon the movement of said switches to normal for operating said door-lock.

25. The combination with a car and its motor, of reversing switches for said motor, a well door, locking mechanism for said door, and means carried by the car for operating said locking mechanism upon the restoration of either of said reversing switches to normal.

26. The combination with a car and its motor, of reversing switches for said motor, a well door, a lock for said door, and means dependent upon said reversing switches for effecting the actuation of said locking mechanism to unlocking position upon the stopping of the motor.

27. The combination with a car and its motor, of reversing switches for said motor, a well door, locking mechanism for said door, means for actuating said locking mechanism to unlocking position, a magnet for moving said actuating means to disengaging position, and means co-acting with said reversing switches for effecting the release of said actuating means when the reversing switches are in normal position.

28. The combination with a car, of means for moving the same, a door adjacent the path of travel of said car, lock mechanism for said door, apparatus for operating said lock mechanism, appliances operable only when the door is closed and locked for starting said moving means, and devices co-acting with said starting appliances for actuating said operating apparatus.

29. The combination with a car, of electric means for moving the same, a door adjacent the path of travel of said car, lock mechanism for said door, a circuit-closer in the controlling circuit of said moving-means and operated by said lock mechanism, means for operating said lock mechanism, an electro-responsive device for actuating said lock-operating-means, and apparatus for starting, operating and stopping said moving-means.

30. The combination with a car, of electric means for moving the same, a door adjacent the path of travel of said car, lock mechanism for said door, means for operating said lock mechanism, an electro-responsive device for actuating said operating means, means for starting said moving-means, and means in circuit with said electro-responsive device for controlling said starting means.

31. The combination with a car and its motor, of apparatus for operating said motor, a door adjacent the path of travel of said car, lock mechanism for said door, me-

chanical means carried wholly by the car for automatically unlocking said lock mechanism, appliances for controlling said motor-operating apparatus, and means co-acting with said controlling appliances for actuating said unlocking means to effect the locking of the door.

32. The combination with a car and its motor, of motor-controlling means, a main line switch, means for operating said switch, a door adjacent the path of travel of said car, lock mechanism for said door, a magnetic cam for operating said lock mechanism, and circuits and connections for effecting the actuation of said magnetic cam upon the operation of said switch-operating-means.

33. The combination with a car and its motor, of motor-controlling means, a switch for closing the circuit to said motor-controlling means, an electro-responsive device for operating said switch, a door adjacent the path of travel of said car, lock mechanism for said door, means for operating said lock mechanism, and an additional electro-responsive device in circuit with said first-named electro-responsive device for actuating said lock mechanism operating-means.

34. The combination with an elevator car, of a hatchway door, lock mechanism for said door, a movable cam carried by the car for operating said lock mechanism, means for operating said car, a switch for controlling said car-operating-means, an electromagnet for actuating said switch, and an additional electromagnet in circuit with said first-named electromagnet for actuating said movable cam.

35. The combination with an elevator car and its motor, of motor-controlling means, a switch for closing a circuit to said motor-controlling means, an electromagnet for operating said switch, a well door, lock mechanism for said door, cam mechanism for operating said lock mechanism to lock or unlock said door, and an additional electromagnet in parallel with said first-named electromagnet for actuating said cam mechanism.

36. The combination with an elevator car and its motor, of circuits and connections of a single push-button controlled elevator system for controlling said motor, well doors, lock mechanism for each of said doors, an electromagnetic cam carried by the car for operating said lock mechanisms to lock or unlock any one of said doors at a time, a main line switch, an electromagnet for operating said switch, and additional circuits connecting said electromagnets in parallel to effect the actuation of said cam upon the closing of said main line switch.

37. The combination with an elevator car, of means for operating the same, a hatchway door, lock mechanism for said door, a cam carried by the car for operating said lock mechanism, a motor for actuating said cam, and circuits and connections permitting the operation of said motor only when the car is at rest opposite said door.

38. In an elevator system, the combination with a solenoid mounted on the car, of means for supplying current to said solenoid when the car is in motion, appliances for interrupting the current through said solenoid when the car stops, an armature for the solenoid, a contact rail for operating door locks, a spring for moving said contact rail in one direction, and connections for transmitting motion from said armature to said rail to move same in the opposite direction when said solenoid receives current.

39. In an elevator system, the combination with a solenoid mounted on an elevator car, of means for supplying current to said solenoid when the car is in motion, appliances for interrupting the current through said solenoid when the car stops, an armature for said solenoid, a pivoted lever of the first class connected to said armature, a spring acting on said lever to normally hold said armature in its initial position, a rail connected to said lever and normally held in its outer position, and a door lock having an arm for unlocking it projecting into the path of said rail when in such outer position, said rail being movable to its inner position against the action of said spring when the armature is actuated by the solenoid.

In testimony whereof, I have signed my name to this specification in the presence of two subscribing witnesses.

JOHN E. BOYCE.

Witnesses:
FRANK T. BROWN,
CHARLES M. NISSEN.