F. E. TOWN.

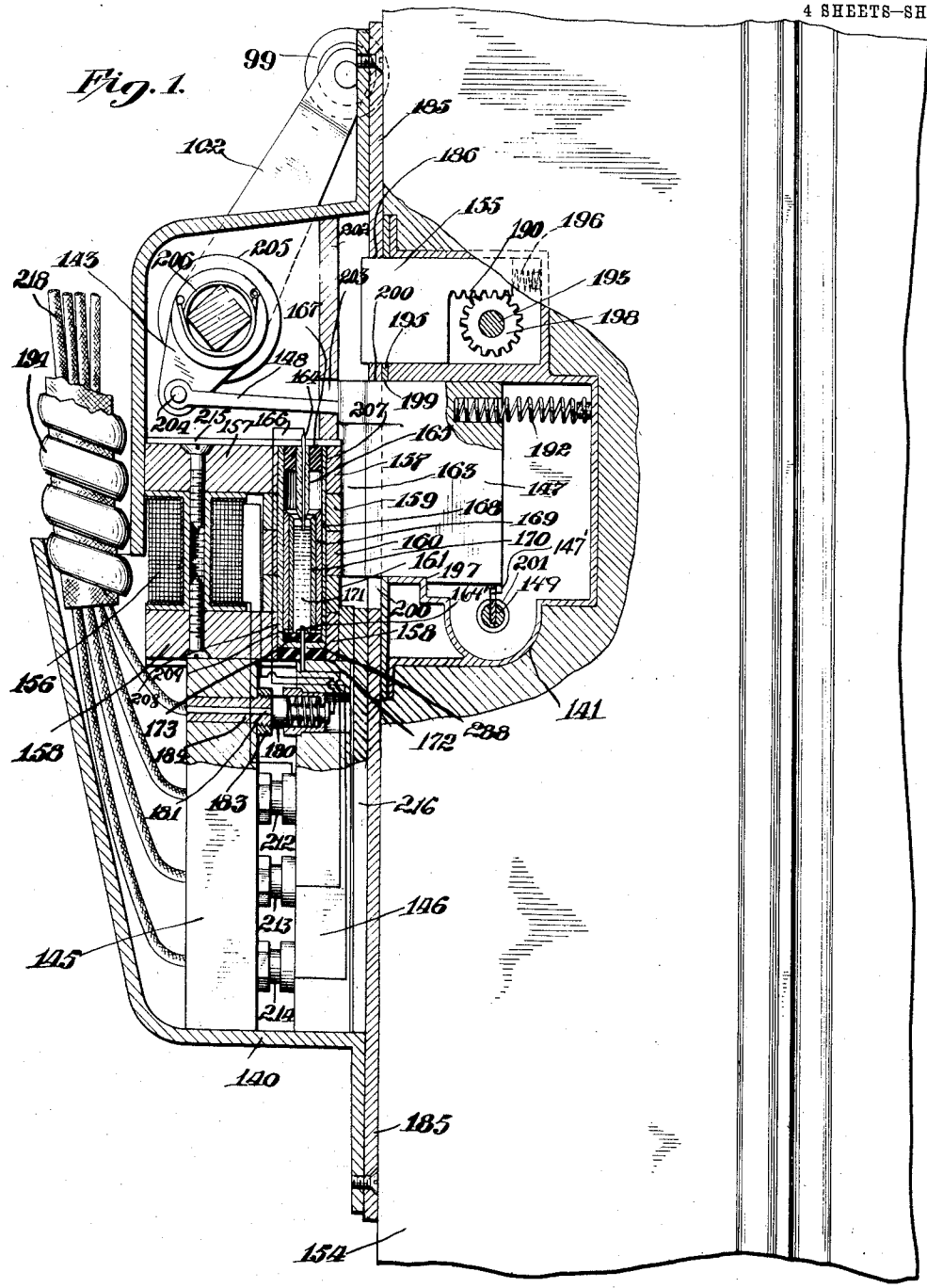
ELEVATOR DOOR LOCK.

APPLICATION FILED MAY 31, 1906.

986,327. Patented Mar. 7, 1911.

4 SHEETS—SHEET 1.

Fig. 1.



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4 SHEETS—SHEET 3.

Fig. 2.

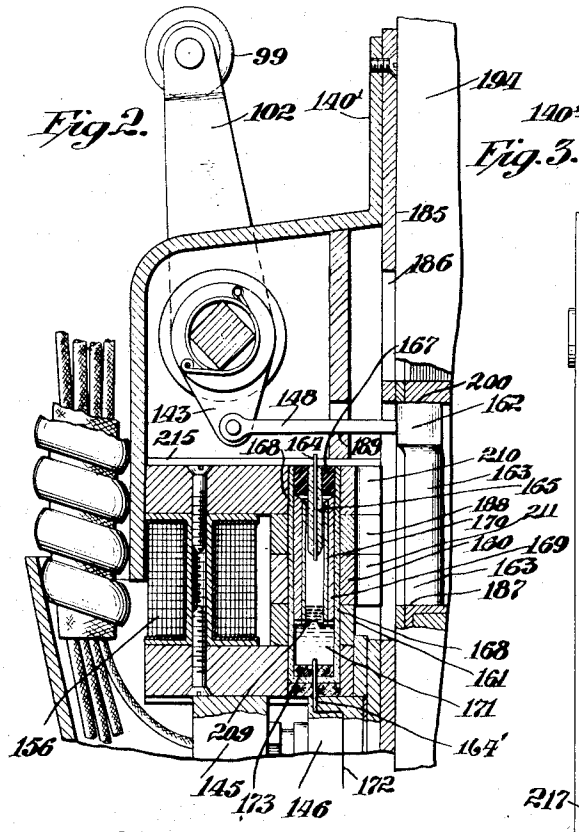


Fig. 3.

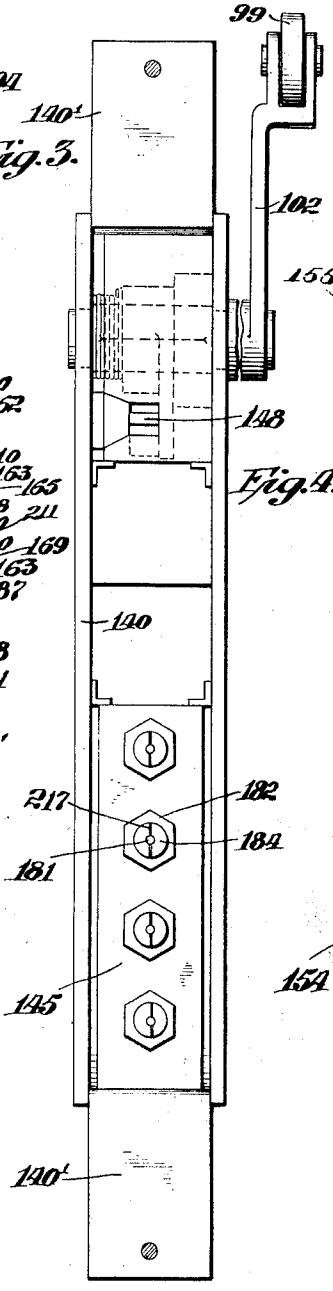


Fig. 4.

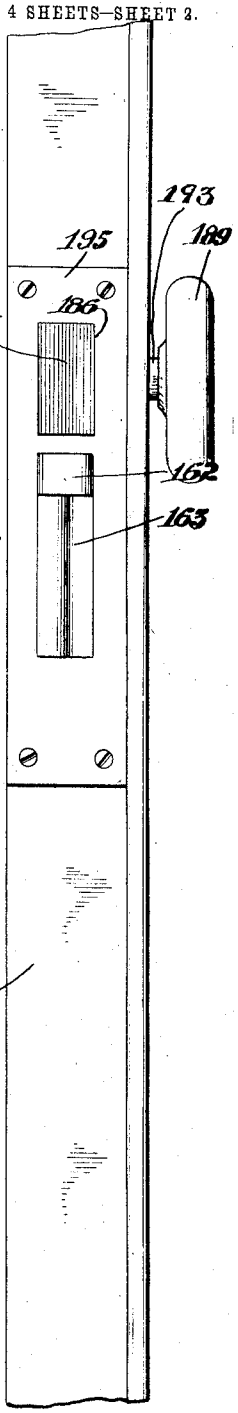
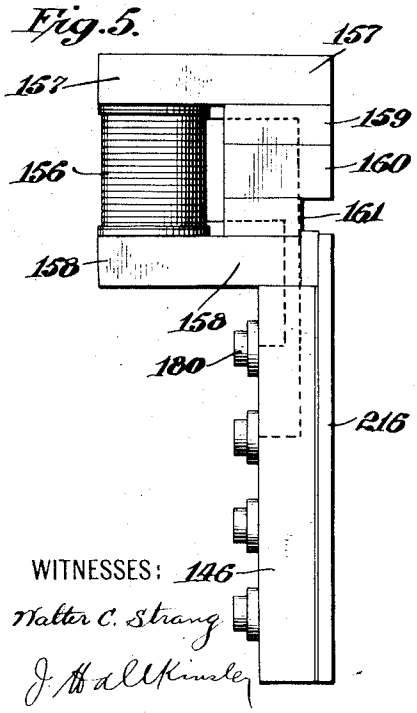


Fig. 5.



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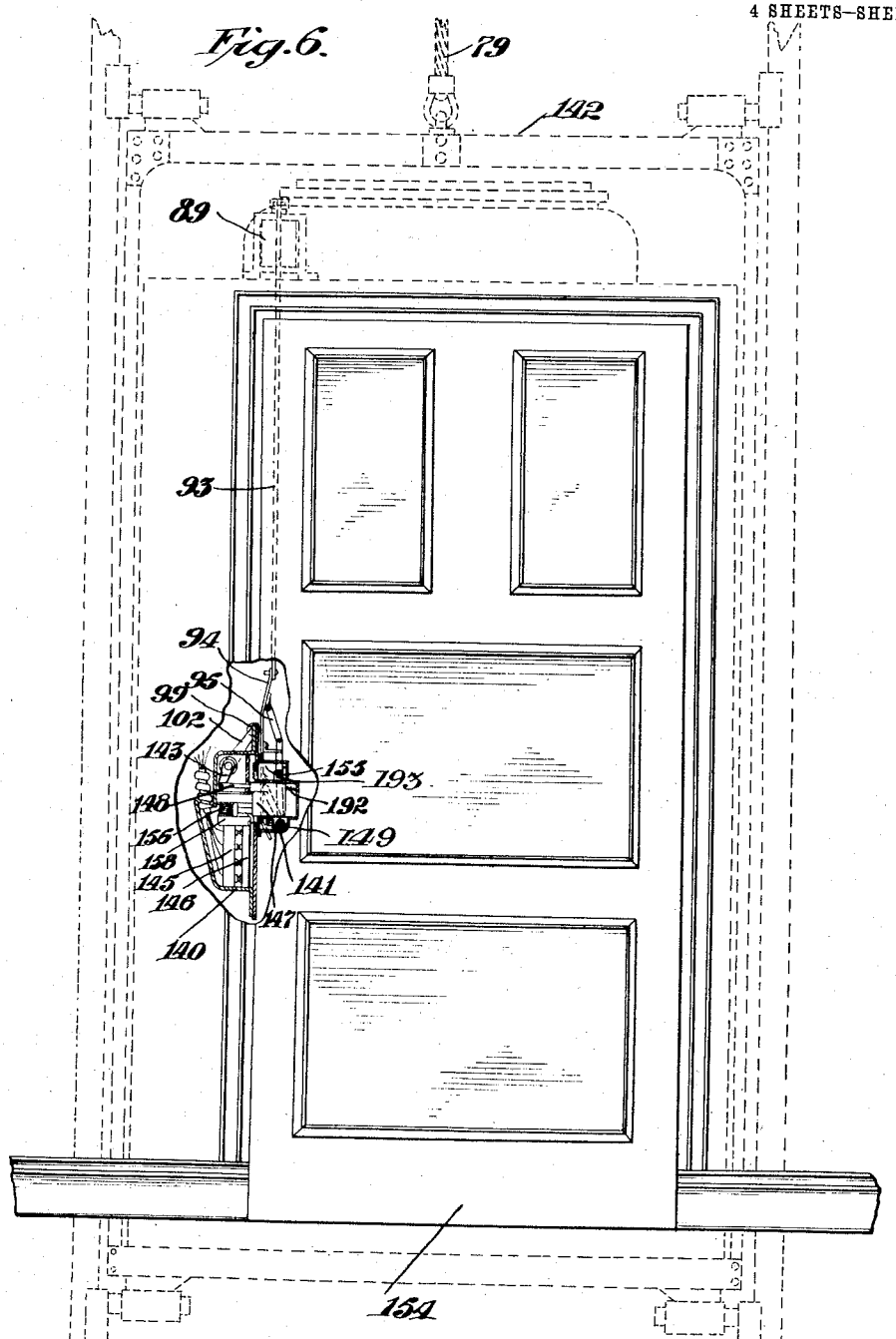
4 SHEETS—SHEET 3.

Fig. 6.



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4 SHEETS—SHEET 4.

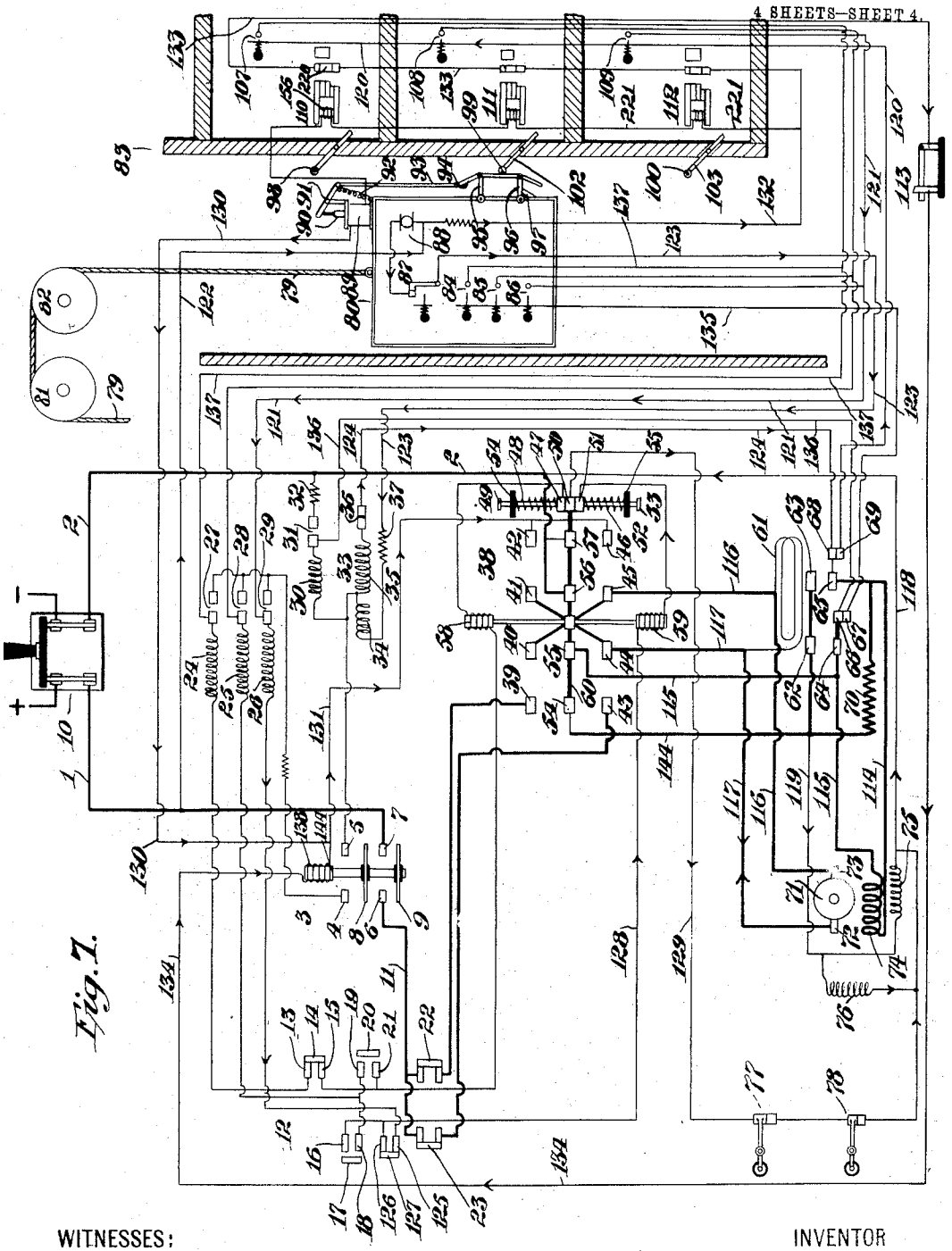

Fig. 7.

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UNITED STATES PATENT OFFICE.

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ELEVATOR-DOOR LOCK.

986,327. Specification of Letters Patent. Patented Mar. 7, 1911.

Application filed May 31. 1906. Serial No. 319,483.

To all whom it may concern:

Be it known that I, FREDERIC E. TOWN, a citizen of the United States, residing in New York city, in the county of New York and State of New York, have invented a new and useful Improvement in Elevator-Door Locks, of which the following is a specification.

My invention relates to locks for doors, and although it may have a general application, it is particularly adapted to elevator doors of single push-button automatic elevator systems.

One of the objects of my invention is the provision of magnetic means co-acting with the door lock for effecting the closure of the door circuit.

Another object of the present invention is to provide magnetic means for controlling elevator apparatus that necessitates the locking of the door before the car can be started.

A further object of this invention is to provide a combination door lock and circuit-closer which shall be free from exposed electric terminals.

Another object of my invention is to provide a combined door lock, circuit controller and terminal-carrier in which the circuit controller and terminal carrier can be easily removed and replaced by another of like structure.

Other objects of the invention will appear hereinafter, the novel combinations of elements being pointed out in the claims.

Referring to the drawings, Figure 1 represents my improved door lock and circuit-controller in an elevational sectional view; Fig. 2 represents a portion of Fig. 1 but with the circuit-closer in open position and the door unlocked; Fig. 3 is a front view of the keeper-casing with the circuit-closer and terminal-carrier removed; Fig. 4 is an elevational view of the lock plate and the parts movable through the same; Fig. 5 is an elevational view of the magnetic device for controlling the circuit-closer, and also of the frame for carrying the circuit-closer and certain electric terminals. Fig. 6 represents in elevation, an elevator car and well door, and in a broken away vertical sectional view, the application of my invention to such door; and Fig. 7 is a wiring diagram of a single push-button automatic elevator system in connection with which my invention may be used.

In Fig. 1, 154 designates the elevator door to which is secured in any suitable manner the lock casing 141, and the lock plate 195 shown in elevation in Fig. 4. Any suitable locking device may be used including a beveled latch 155, and a spindle 193, for moving said latch against the action of the spring 196. The latch 155 is adapted to move through the opening 186 in the face-plate 185 of the keeper-casing 140. An ordinary knob 189 is connected to the spindle 193 as indicated in Fig. 4 and within the lock-casing secured to said spindle is a pinion 198 which meshes with the rack 190 of latch 155.

147 designates the locking bolt which must be of some magnetic material, preferably soft iron. This locking bolt is moved outwardly through the opening 199 in the face-plate 195 of the lock-casing, and when the door is closed, also through the opening 200 in the face-plate 185 of the keeper-casing. This outward movement is limited by the shoulder 197 in this instance. At a suitable point within the lock-casing 141 is a spring 192 for forcing the bolt 147 outwardly. A key may be inserted through the opening 201 to turn the spindle 149 and thus move the bolt 147 to unlocking position. The connection of the spindle 149 with the bolt 147 when the key is inserted, may be obtained in any well known manner, as for example, by means of a Yale lock or a projection 147'.

Within the keeper-casing 140 is a vertical partition 202, having an opening 203 through which projects an arm 148 which is pivoted at 204 to the lever 143. This lever is pivoted at 205 to the keeper-casing and is provided with a spring 206 so as to move the arm 148 to its left-hand position, as shown in Fig. 1, and also to move the anti-friction roller 99 carried at the end of the lever arm 102 to its right-hand position. A suitable cam carried by the car, as for instance, such a cam as is shown in Fig. 6, is arranged to strike the roller 99 and to move the lever arm 102 to the left as shown in Fig. 2, and at the same time the arm 148 to the right. Inasmuch as the opening 203

is opposite the upper rounded portion 162 of the locking bolt 147, the rod 148 will strike against the part 162 and move the locking bolt 147 to the right against the action of the spring 192 and thus unlock the door. The knob 189 may then be turned to operate the latch 155 so that the door may be opened.

In automatic push-button elevator systems, it is always desirable to have some means for necessitating the closing and locking of the door before the elevator car can start away from the floor. This I accomplish by providing either an electro-magnet or a permanent magnet in the keeper-casing with poles to coöperate with the locking bolt, which, when in locking position, effects the closure of the controlling circuit for the electric motor which operates the elevator hoisting mechanism.

Although I have herein shown one system of automatic push-button elevators, such a system is set forth merely by way of illustration to show the application of my invention, and obviously, therefore, my invention is adapted for automatically controlling any circuit connected to a door lock.

The electro-magnetic mechanism of my improved door lock comprises a solenoid 156 having an iron core with a pole 157 mounted at one end thereof, and a similar pole 158 mounted at the other end. Each of these poles as viewed in Fig. 1 extends to the right and each is provided with an opening 207 and 208 respectively, which in this instance is cylindrical. Through these openings passes a tube 168 of insulating material, preferably glass. If desired, the opening in the pole 158 may not extend entirely therethrough, but merely form a cylindrical recess for the reception of the glass tube 168. This tube may be entirely open at the bottom and closed by means of a plug of cork 173, or said tube may be closed by the material of which it is composed, as shown in Fig. 1. The electro-magnet or permanent magnet may be designed to have any desired strength. Within this tube is adapted to move vertically, a cylindrical piece of magnetic material 169, preferably soft iron. The tube has a certain quantity of mercury 171 or other conducting fluid, placed within it and on this mercury floats the iron tube 169. In order to give this tube 169 greater displacement when drawn down without increasing its weight too much, the interior of the tube may be coated with some insulating material or an additional glass tube 170 placed within the same. The lower ends of the iron tube 169 and the glass tube 170 are notched at 209 so as to prevent sticking of the tube 169 to the bottom when said tube is moved downwardly, and also to insure its quick upward movement upon leaving the cork bottom 173. These details however, may be varied by those skilled in the art as desired, without departing from the principles of my invention. The upper end of the glass tube 169 is closed with insulating material 167, as by means of an ordinary cork, which is provided with a central opening for the insertion of the insulating rod or tube 165. This insulating rod carries the contact terminal 164, which extends downwardly a suitable distance, and is adapted to come in contact with the mercury 171, as shown in Fig. 1. Preferably the rod 165 is composed of glass which has been molded over the platinum wire 164. Through the bottom of the tube 168, extends another contact terminal 164′ which always makes electrical connection with the mercury 171. Preferably the terminal 164′ is a platinum wire as well as the terminal 164. The terminal 164′ may pass upwardly through the insulating bottom 173 of the tube 168, or also through the glass bottom 288 of the tube itself, being secured in position when such tube is made. The parts, as thus associated, constitute a mobile circuit-closer. Short separating blocks 159 and 161 are secured to the poles 157 and 158 respectively, and an additional piece 160 is secured between these. The parts 159 and 161 are made of some non-magnetic material, as for example, brass, while the part 160 is composed of magnetic material similar to the poles 157 and 158, and preferably soft iron. It will therefore be seen that when the poles 157 and 158 with the intermediate parts 159, 160, and 161 are secured in position, an opening 207 extends entirely through the same and in this opening is placed the tube 168.

Normally the iron tube 169 within the glass tube 168 floats on the conducting fluid 171 as indicated in Fig. 2, when the terminals 164 and 164′ are electrically disconnected. At this time the field of the electro-magnet is symmetrically distributed between the poles 157 and 158. The reluctance to the lines of force between the two poles of the electro-magnet is greatest through the parts 159 and 161 which are composed of non-magnetic material. Since the permeability of these parts is substantially the same as that of air, the reluctance is the same as if these were air-gaps, but to make the lock stronger, it is preferable to insert the metal instead of leaving air-gaps. Furthermore, the part 160 of magnetic material is supported in proper position by the pieces of non-magnetic material, although the latter could be omitted if desired, and the part of magnetic material 160 could be secured to and carried by the tube 168, or in any other desired manner. Now when the locking bolt 147 is allowed to be moved to locking position as indicated in Fig. 1, its V-shaped, rounded or semi-cylindrical face, 163, will engage with the corresponding recesses 210, 188 and 211

of the pole 157, non-magnetic part 159, and magnetic intermediate part 160. The locking bolt 147 being composed of magnetic material will provide a path of very low reluctance for the lines of force between the magnet upper pole, and the intermediate block 160. The effect of this operation will be to substantially eliminate the gap between the pole 157 and the intermediate magnetic part 160, and therefore to shift the effective magnetic field downwardly between magnetic part 160 and the pole 158. In other words, the ends of the poles of the electro-magnet are now the part 160 and the pole 158. When the locking bolt 147 is in the position indicated in Fig. 2, the air-gap between the same and the poles of the electro-magnet is too great to have any appreciable effect on the iron tube 169. At this time the electro-magnet when energized tends to place the iron tube 169 midway between its poles 157 and 158, but this action is counter-acted by the floating force of the mercury. The iron tube 169 will therefore take a position at a point slightly above the midway position between the poles 157 and 158 of the electro-magnet. The magnet may be constructed so as to hold the armature 163 firmly in locking position. When the locking bolt 147 is moved into the position shown in Fig. 1, so that the pole 157 is magnetically connected to the intermediate part 160, the iron tube 169 will be attracted downwardly between the pole 158 and part 160, which now is in effect the other pole of the electro-magnet. The iron tube 169 will always tend to place itself in such a position as to close any magnetic gaps, so as to lessen the reluctance to the lines of force in the well known manner. When the iron tube 169 is thus attracted downwardly, the mercury 171 will be displaced and its depth therefore increased until it engages the inner end of the terminal 164, so as to electrically connect the latter with the terminal 164′. The terminals 164 and 164′ are in this instance shown in Fig. 7 as connected in the controlling circuit of a single push-button automatic electric elevator system, and after the door has been closed, a push-button operated to effect the locking of the door and the energization of the corresponding magnet 156, the mercury will be displaced to connect the terminals 164 and 164′, and the car will then respond in the usual manner.

The terminals of the electro-magnet are connected to the spring-pressed electric contacts 180 and 212, while the terminals 164 and 164′ are respectively connected to the spring-pressed contacts 214 and 213 respectively. It will be seen from an inspection of Fig. 5, that the electro-magnet circuit closer and the spring-pressed contacts are secured to each other to form a single device that is removable from the keeper-casing. When placed in position within the keeper-casing, this device is held in position by the horizontal partition 215 and the vertical strip 145 on the one hand, and the keeper-casing face-plate 185 on the other hand. As an additional protection to the contacts carried by the strip 146 of the electro-magnetic device, a plate 216 is secured to such strip 146, so as to be engaged by the face-plate 185 when the parts are in their proper position as shown in Fig. 1.

The vertical strip 145, which is rigidly secured to the keeper-casing 140, carries the binding posts 184, each of which is provided with a clamping nut 183. Each of the binding posts is split at 217 as indicated in Fig. 3, so that when the end 181 of a wire is inserted through the longitudinal opening in the binding post 184, the clamping nut 183 may be turned to securely hold the wire 181 in position, and also make good electrical contact with the binding post. If desired, the end 181 of the wire may be allowed to extend outwardly a short distance and then filed off so as to be perfectly flush with the exposed end of the binding post. This will insure a good electrical connection between the spring-pressed contacts carried by the strip 146, and the binding post carried by the strip 145. The insulated wires 218 may be protected in any suitable manner, as, for example, by metallic flexible tubing 194.

In Fig. 7, 10 designates a main line switch which serves to connect the source of electrical supply denoted by the + 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 which are insulated therefrom and from each other. The contact disk 8 upon being lifted, will place in electrical connection the stationary contacts 4 and 5, and in like manner the disk 9 is adapted to connect the contacts 6 and 7.

The floor controller 12 comprises a number of stationary contacts, 13, 15, and 16, 18, etc. The floor controller is operated by some positive connection with the hoisting machinery. 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 elevator well.

The floor relays 24, 25 and 26 control respectively the contacts 27, 28 and 29, each floor relay corresponding to one of the floor push-buttons, and connected as shown, to the floor controller.

30 and 31 designate respectively the electro-magnet and contacts of an additional relay.

38 designates the reversing switch which is herein shown as of the swinging type,

and 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 the movable contacts 54, 55, 56 and 57, all of which are mounted upon and carried by an insulated carrier 60.

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.

70 designates the starting resistance in series with the motor armature 71.

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

77 and 78 are limit switches.

80 designates an elevator car connected with the hoisting apparatus in the well known manner, and carrying open-circuit push-buttons 84, 85 and 86, each button corresponding to a floor landing.

87 designates the usual safety button, and 88 the contact carried by the car gate, the same being closed only when the gate is closed.

Upon the top of the car is mounted the solenoid 89 having a plunger 90 to which is fastened a lever pivoted at 91 and having its other end connected by the rod 93 to the cam 94 which is movably attached to the elevator car by the links 95 and 96 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 in the drawings. Upon the solenoid becoming energized, the plunger 90 will be pulled downwardly against the action of the spring 92, thus lifting the cam 94 by means of the lever and the rod 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 the anti-friction rollers 98, 99 and 100 of my improved door locks. These door locks are represented diagrammatically at 110, 111 and 112, and comprise the parts hereinbefore described.

It will be seen that the electro-magnets 156 are connected in series with each other by the wire 221, and the circuit closers 220 are connected with each other by the wire 133.

The rollers 99 which are carried by the lever arms 102, extend out into the hatchway and are adapted to be engaged by the magnet-controlled cam 94 carried by the car when such cam is in its outward position. Upon such engagement, which may take place while the car is opposite any landing, the roller is forced upwardly or to the left as viewed in Fig. 2, carrying the rod 148 to the right, thus moving the locking bolt 147 to the right and unlocking the door. The pole 157 and the magnetic-intermediate part 160 being thus magnetically disconnected, the iron tube 169 will be released and again float on the mercury 171 within the glass tube 168. The mobile circuit-closer will therefore be placed in open position by reason of the disengagement of the mercury with the terminal 164, and therefore the circuit 133 will be interrupted. It should be noted that the circuit 133 is interrupted at the reversing switch by the normal operation of stopping and therefore no arcing will occur in the mercury switch when the latter is opened.

The operation of the push-button elevator system illustrated in Fig. 7, is fully explained in a co-pending application of John E. Boyce, Serial # 269,183, filed July 11, 1905, for an improvement in means for operating an elevator door lock. I do not herein claim such a system in combination with a door lock, as this is broadly claimed in said application of John E. Boyce. My invention comprises the door lock *per se* or in combination with such parts connected directly thereto that may coöperate therewith. The operation of the elevator system, although fully described in the Boyce application referred to, will be briefly explained at this point so as to show clearly the application of my invention.

Let it be assumed that the elevator car is at the second floor landing and a person at the first floor wishes to have the car descend to that floor. Upon the operation of the button 109, the circuit will be closed from the positive main by way of wire 122, gate contact 88, safety button 87, wire 123, resistance 37, coils 34 and 35, contacts 36, wire 124, contacts 68 and 69, wire 120, push button 109, wire 121, coil 26, floor controller contact 125, bridge piece 127, contact 126, wire 128, solenoid 59 of the reversing switch, contacts 51 and 50, wire 129, limit switches 77 and 78, and wire 118 to the negative main. The contacts 36 will remain closed since both coils 34 and 35 are excited. The floor relay-magnet 26 will close the contacts 29 while the reversing switch will be operated by the solenoid to close the contacts 54, 55, 56 and 57, against the contacts 43, 44, 45 and 46. The operation of the reversing switch 38 closes the circuit from the positive main through the wire 122, gate contact 88, wires 132, 221, electro-magnets 156 of the door locks solenoid 89 of the electro-magnetic cam carried by the car, wires 130, 131, contacts 46, 57, and wires 129, 118 to the negative main. The solenoid 89 will therefore receive current at the potential of the

line and will operate to lift the cam 94 out of engagement with the door lock roller 99. The spring 206 will at once operate to move the rod 148 to the left as viewed in Figs. 1 and 2, and allow the locking bolt 147 to be moved to locking position so as to effect a closure of the mobile circuit closer as well as the locking of the door. The closing of this mobile circuit closer will complete a circuit from the positive main by wires 122, 132, 133, slack cable switch 113, wire 134, solenoid 138 of magnet switch 3, wire 131, contacts 46 and 57 and the — main. The solenoid 138 of the magnet switch 3 will now lift the disks or contact makers 8 and 9, respectively, against the contacts 4, 5, and 6, 7. The disk 9 completes the circuit to the motor and brake, and allows the motor to start. The bridging of the contacts 4, 5, by the contact disk 8 throws a short circuit around the magnet coil 35 and push button 109. This has the effect of excluding control of the car from any other station until the car has been started and sent to the designated landing. The motor accelerates automatically and lowers the car until the floor controller which is being driven by the hoisting apparatus, moves the bridging piece 127 away from the contacts 126 and 125. This will occur as the car approaches its predetermined destination, at the bottom floor in this instance. This action of the floor controller will open the circuit between the floor relay 26 and the 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 the circuit including the solenoid 138 of the magnet switch 3 at the contacts 46, 57, 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 deenergization of the magnet solenoid 89, the spring 92 acting in conjunction with the weights of the various parts, causes the cam 94 to be moved downwardly and outwardly until limited by the stop 97. This outward movement of the cam forces the roller 100 which is now adjacent to the cam 94, inwardly, thereby moving the rod 148 to the right as indicated in Fig. 2, and consequently the locking bolt 147 into unlocking position. This has the effect of so changing the magnetic path for the lines of force of the electro-magnet 156 that the mobile circuit-closer is opened. Since this circuit-closer is in circuit with the magnet of the switch 3, it will now be impossible to operate the switch 3 until the mercury circuit-closer has been placed in closed position again.

It should be noted 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 automatically effecting the closure of the door lock circuit which includes the magnet of the main line switch 3, 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 3 making it no longer necessary to keep the push-button compressed. Contacts 66, 67 and 68, 69 are provided which depend for their operation upon the accelerating magnet, and are included in circuits 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, or by means of a key and the magnet cam cannot be placed in unlocking position until the car has been brought to rest to the proper floor. Then, and only then, is it possible ordinarily to open the landing door. While such door is open, the car cannot be moved since the contacts of the door lock are of necessity, owing to their construction, disconnected through the mercury while such door is open, and since these contacts include a circuit to the main line magnet, it will be evident that current cannot 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. It will be noticed that the door must be closed before the circuit including wire 133 can be closed, as the circuit-closer 220 is in the keeper-casing 140 which is in the door jamb. Furthermore, it is evident that the parts are shown so adjusted that the door will necessarily be locked before the circuit-closer 220 can electrically connect the terminals 164 and 164'. When the solenoid 89 is energized, the arm 102, which is rigidly connected to the locking rod 148, is released so that the spring 192 will force the locking bolt 147 to locking position. When the parts are in the position shown in Fig. 2, the door may be

opened by turning the knob 189 connected to the spindle 193, and thus withdrawing the latch 155.

Although I have herein shown an electro-magnet solenoid 89, for operating the plunger 90, which construction is in reality an electric motor having a reciprocating armature, it is obvious that it is within the province of my invention to substitute for this form of motor any other form, as, for example, the ordinary direct current motor with a rotating armature. I desire it to be further understood that with slight modification, 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 to 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 disclosed, 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 adjacent the path of travel of said car, a locking device for said door, apparatus for operating said car, and an electro-magnetic circuit-closer magnetically controlled by the locking device for rendering said operating apparatus inoperative except when the door is closed and locked.

2. The combination with a car having a doorway, of means for moving the said car, controlling apparatus for said moving means, a door adjacent the path of travel of said car, locking mechanism for said door, and a liquid circuit-closer co-acting with and controlled by said locking mechanism and controlling apparatus to prevent said car from being started away from said door except when the door is closed and locked.

3. The combination with a car, of a plurality of doors, locking mechanism for each door, means carried by the car for mechanically operating said mechanism, said operating means being operable to actuate said locking mechanism to unlocking position only when the car is opposite said locking mechanism, and an electro-magnetic circuit-closer co-acting directly with and including said locking mechanism in the magnetic circuit for preventing said car from being started until after the door is closed and locked.

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

5. The combination with an elevator car, of a magnetically operated cam carried thereby, a hatchway door, a lock for said door, means for operating said car, mechanism co-acting with said cam for operating the same to effect the release of said lock only when the car is at rest opposite said door, and an electro-magnetic circuit-closer having its magnetic circuit controlled by the position of the door and co-acting with said lock and said car operating-means for preventing the car from being started until after the door is closed and locked.

6. 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, apparatus for preventing the unlocking of the doors except when the car has stopped opposite a door, and electro-magnetic mobile circuit-closers co-acting with said locks and said operating means for preventing the starting of the car until the door is closed and locked.

7. The combination with an elevator and means for controlling the same, of a well door, locking mechanism for said door, a mobile circuit-closer, and magnetic means including a part carried by the door and dependent upon the closure and locking of said door for the operation of the mobile circuit-closer.

8. The combination with an elevator and means for controlling the same, of a well door, locking mechanism for said door comprising a locking bolt, an electro-magnet, a circuit-closer, and means effecting the operation of said circuit-closer when the electro-magnet is energized and the locking bolt is in closed and locking position.

9. The combination with an elevator, of a well door, locking means therefor comprising a locking bolt of magnetic material, an electro-magnet having one of its poles extended to said locking bolt when the door is in closed position, a mobile circuit-closer between the poles of the said electro-magnet, sections of non-magnetic material adjacent the poles of said electro-magnet, a section of magnetic material between said sections of non-magnetic material, and means for energizing said electro-magnet to effect the operation of said circuit-closer when the door is in closed position.

10. The combination with an elevator, of a well door, locking mechanism for said door and comprising a lock casing and a keeper casing, a locking bolt having an exposed portion, composed of magnetic material, an electro-magnetic device in the keeper casing, a mercury circuit-closer between the poles of

said magnetic device, and a section of magnetic material mounted between said poles but out of magnetic contact therewith, one of said poles and said magnetic section being arranged in the path of the magnetic portion of the locking bolt, to be magnetically connected by the latter and thereby effect the operation of the mercury circuit-closer when the electro-magnetic device is supplied with current.

11. The combination with an elevator, of a well door, a lock casing carried by the door, a keeper casing opposite said lock casing when the door is in closed position, an electro-magnet carried by said keeper casing, a piece of magnetic material between the poles of said electro-magnet but magnetically separated therefrom when the door is in open position, a locking bolt carried by the lock casing and magnetically connecting one of the poles of said electro-magnet and said piece of magnetic material when the door is in closed position, a receptacle between the poles of said electro-magnet for electric conducting liquid, a plurality of contacts, and a magnetic device for displacing said liquid to electrically connect said contacts when the door is in closed position and the locking bolt magnetically connects one of the poles of said electro-magnet and the intermediate piece of magnetic material.

12. The combination with an elevator, of a well door, locking mechanism for said door comprising a locking bolt having an exposed portion composed of magnetic material, an electro-magnet, a plurality of sections of non-magnetic material with an intermediate section of magnetic material between the poles of said electro-magnet, a receptacle for containing liquid-conducting material, a plurality of electric contacts, and a magnetic device in said receptacle for displacing said liquid to effect the connection of said contacts when the door is closed, and said locking bolt magnetically connects one of the poles of the electro-magnet and said intermediate section of magnetic material.

13. The combination with an elevator, of a well door, locking mechanism comprising a locking bolt having its exposed portion composed of magnetic material, a section of magnetic material between the poles of said electro-magnet, a tube of insulating material passing through said poles, an electric terminal extending into said tube at each end thereof, a tube of magnetic material fitting within said tube of insulating material, a lining for said tube of magnetic material, and liquid conducting material in said tube of insulating material to effect the electric connection of said terminals when one of the poles of the electro-magnet and said section of magnetic material is magnetically connected by the locking bolt when the door is in closed and locked position.

14. The combination with an elevator, of a well door, locking apparatus for said door, controlling means for the elevator, and an electro-magnetic circuit-closer removably carried by said locking apparatus.

15. The combination with an elevator, of a well door, locking apparatus comprising a lock casing, and a keeper casing, and an electro-magnetic circuit-closer removably connected with said keeper casing.

16. The combination with an elevator, of a well door, locking apparatus, an electro-magnet, a mobile circuit-closer, terminals for said electro-magnet and said circuit-closer, binding posts opposite said terminals, and a frame for rigidly connecting and carrying said electro-magnet, circuit-closer and terminals, said frame being removably secured to a portion of the locking mechanism.

17. The combination with a car, of controlling apparatus therefor, a door adjacent the path of movement of the car, door-locking mechanism, a mercury circuit-closer cooperating with said mechanism to place itself in closed position only when the door is closed and locked, and means effecting the interruption of current through said circuit-closer before the latter is opened.

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

FREDERIC E. TOWN.

Witnesses:
W. H. STOKES,
CHARLES M. NISSEN.