

Feb. 24, 1931.

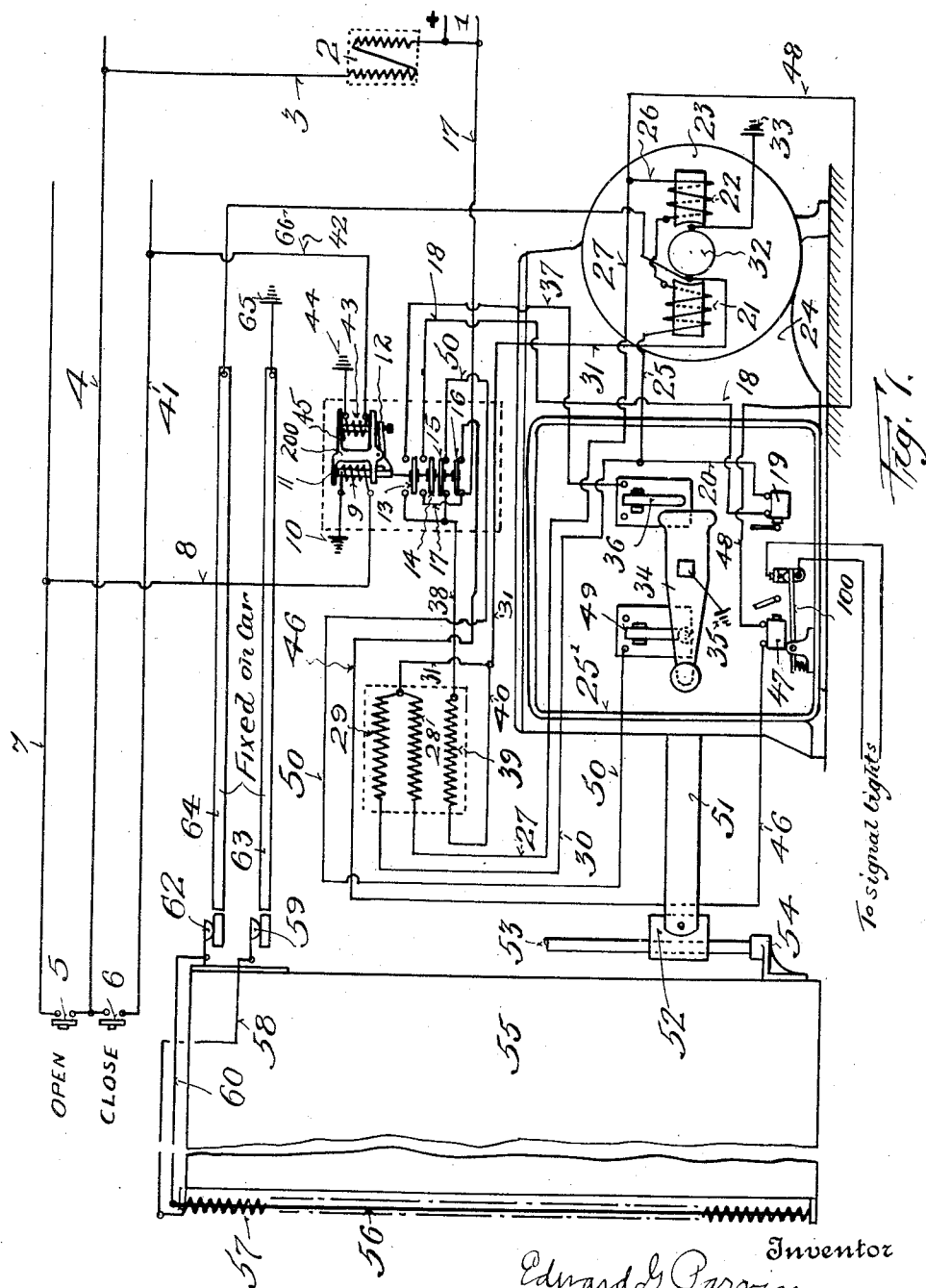
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1,793,716

ELECTRIC ENGINE DEVICE FOR SAFETY DOORS

Filed April 28, 1928

4 Sheets-Sheet 1



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4 Sheets-Sheet 2

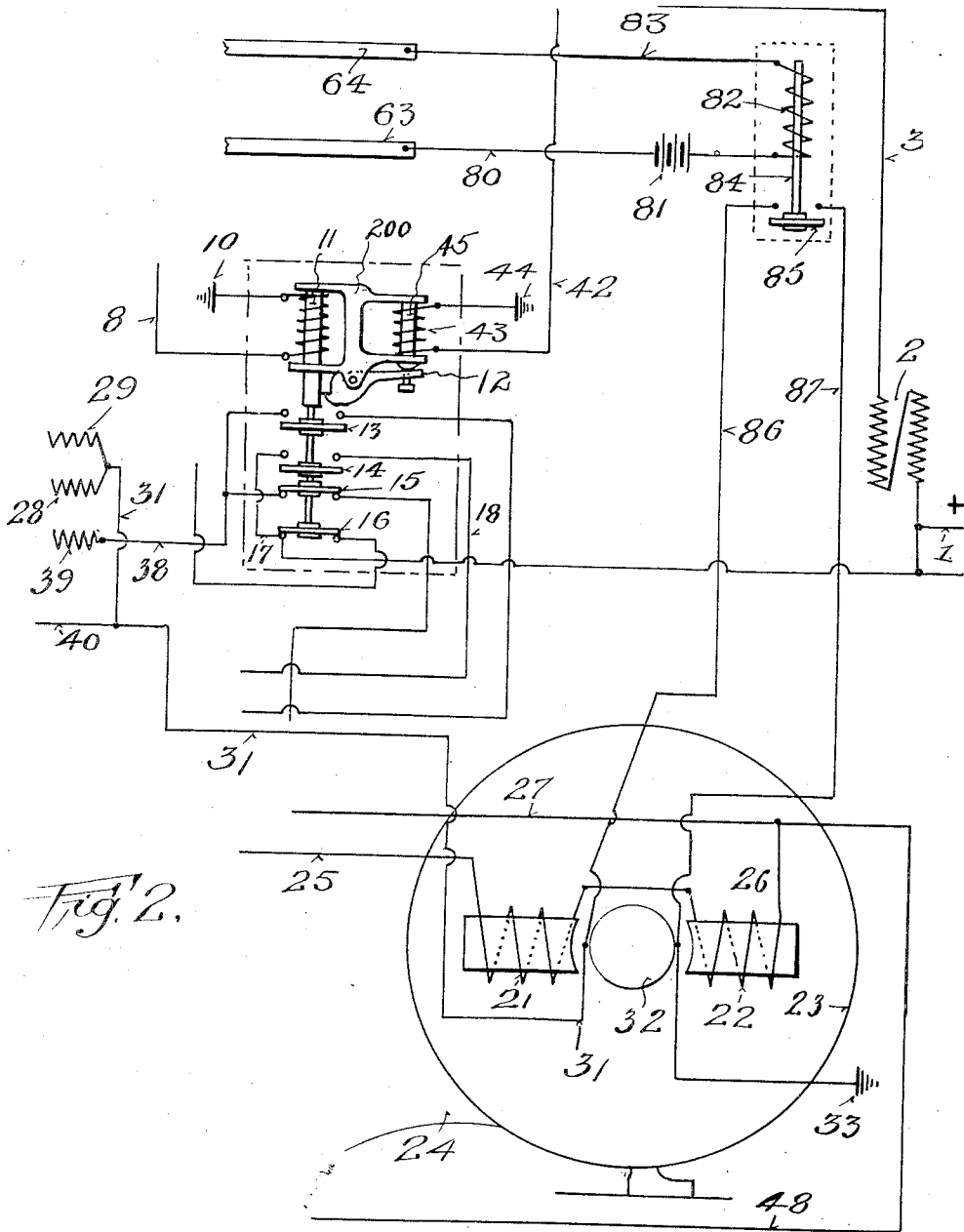


Fig. 2.

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4 Sheets-Sheet 3

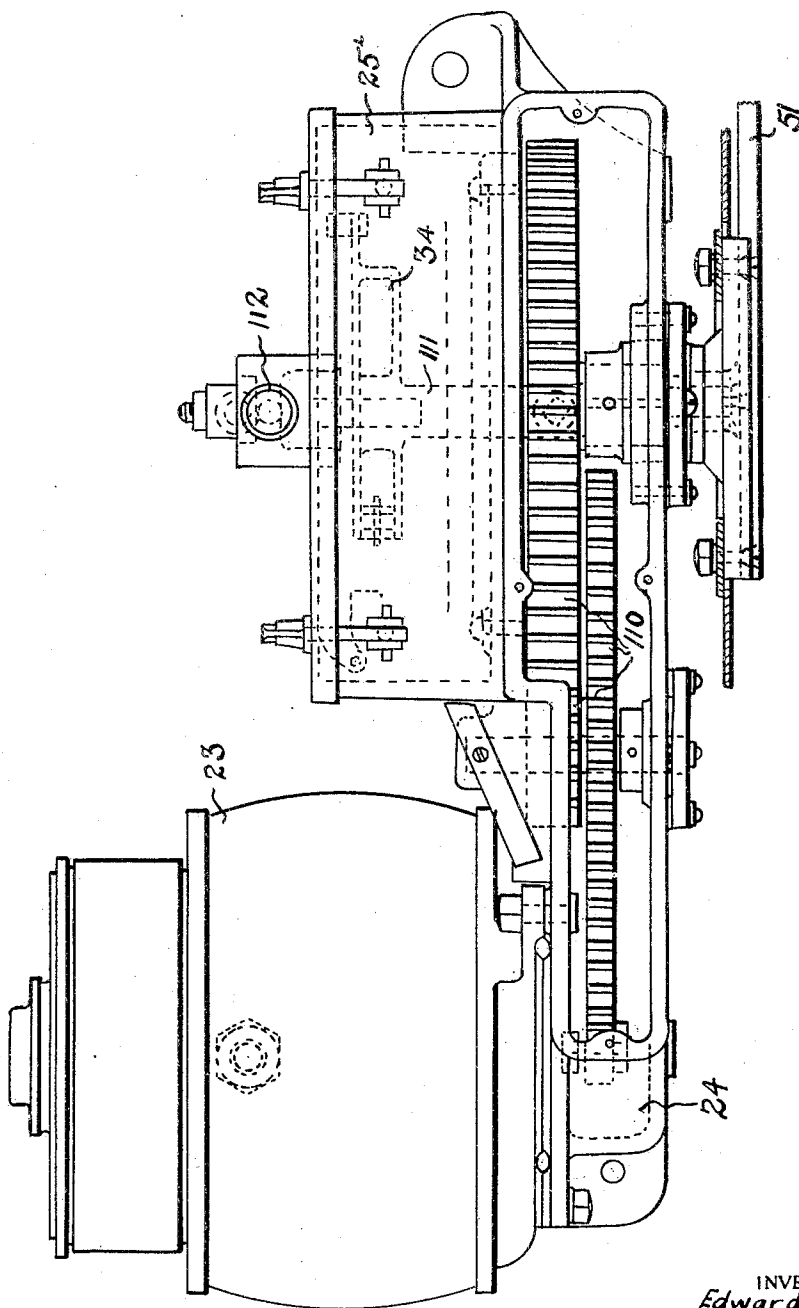


Fig. 3.

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4 Sheets-Sheet 4

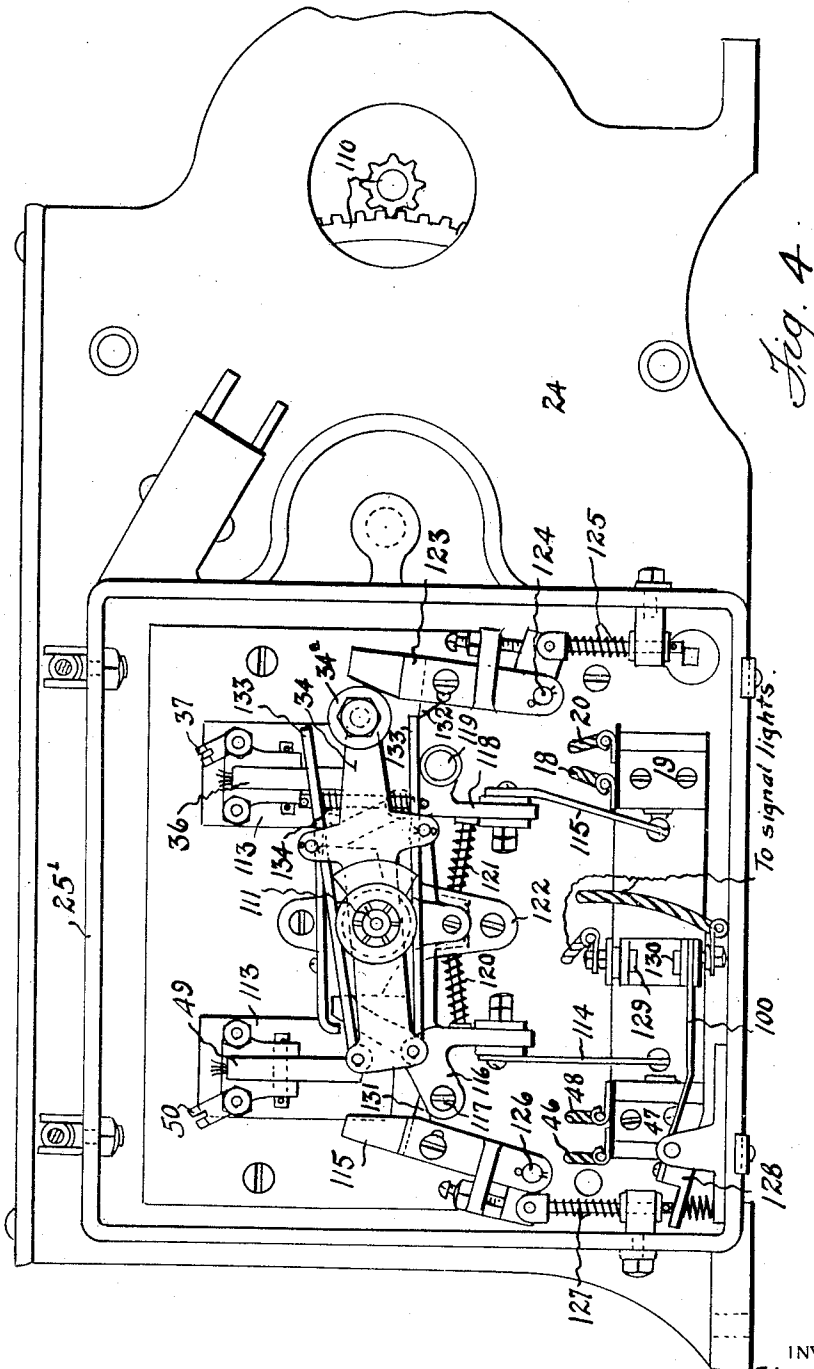


Fig. 4

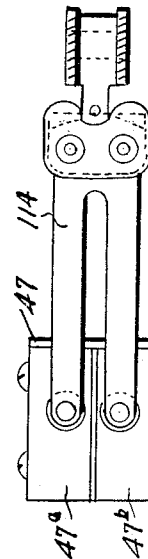


Fig. 5

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## UNITED STATES PATENT OFFICE

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## ELECTRIC-ENGINE DEVICE FOR SAFETY DOORS

Application filed April 28, 1928. Serial No. 273,756.

This invention relates in general to doors and the like which are operated by means of an electric motor.

One of the objects of this device is the provision of means whereby a door connected to an electric engine may be opened and closed merely by pushing buttons controlling appropriate switches.

A further object of this invention is the provision of a door operated by means of an electric engine which may open or close the door without causing slamming thereof near the end of the stroke in either direction by the simple operation of closing a switch.

A further object of this invention is the provision of apparatus of this type employing dynamic braking for slowing down the operation of the motor at the end of the stroke of the door in either direction.

A still further object of this invention is the provision of means mounted on the edge of the door and connected to the motor to cause the motor and the door connected thereto to stop moving when the door strikes an obstruction.

A still further object of this invention is the provision in apparatus of the above type of a construction which permits the door to continue to close upon the removal of the obstruction from the path of the door.

These and other objects, as will appear from the following disclosure, are secured by means of this invention.

This invention resides substantially in the combination, construction, arrangement, relative location of parts, and circuitual connections, all as will more fully appear hereinafter.

Referring to the drawings—

Figure 1 is a diagrammatic illustration showing the electrical association of elements embodying the principles of this invention;

Fig. 2 is a modified form of the invention employing a relay for securing the desired results;

Fig. 3 is an elevational view with a portion removed of the motor switch mechanism and driving connections;

Fig. 4 is a top plan view of the switching mechanism with the cover removed; and

Fig. 5 is a side elevational view of one of the switches.

In the art of operating doors, gates, and the like by means of motive power devices it has been usual to employ pneumatic and electric engines for operating the doors. This invention is specifically directed to the type of construction employing an electric motor for operating the door, gate, or the like. A practical aspect of this art involves some form of means for effecting the slowing down of the operation of the door and motor towards the end of their movement in either direction. Since an electric motor usually revolves at a rather high rate of speed it is necessary to provide some means for preventing injury thereto at or near the end of the stroke when the door connected thereto nears the end of its travel.

The apparatus of this invention provides means whereby the initiation of the operation of the device is effected by a hand switch and the rest of the operations are automatic. The closing of the switch causes a relay to start the motor in operation and as a result the door begins to open or close. Near the end of the stroke mechanism operated by the movement of the door exerts a resistance against the armature of the motor to effect a dynamic braking operation so that the motor begins to slow down and as a result when the door is completely opened or closed the motor is at substantially a stand still. Just at the end of the stroke of the device in either direction mechanism operates to interrupt the circuit for the motor so as to leave it in condition to be operated in the opposite direction.

A further feature of this invention involves the application of a switching means on the end of the door so that when the door strikes an obstruction a short circuit is put across the armature of the motor causing it to come to a stand still which prevents possible injury to anyone in the path of the door. In one form of the device a relay is employed for effecting this short circuit.

For a better understanding of the inven-

tion reference is now made to the drawings. It may be pointed out here that the general circuit arrangement and the motor and switching construction have been disclosed in great detail in the co-pending application of Paris R. Forman, Serial No. 258,863, filed March 3, 1928. In the modification shown in Fig. 1 the wire 1 connects with the positive side of the current source. This wire is connected to the resistance 2 and through wires 3 and 4 to the switch buttons marked "Open" and "Close". Switch 5 is connected through wire 7 and wire 8 to the solenoid winding 9 which is grounded at 10. Mounted in the framework 200 and encircled by the winding 9 is a vertically slidable plunger 11 which supports on its lower end the contact discs 13, 14, 15 and 16. Each disc controls a set of contacts and as appears from the drawings the two upper discs 13 and 14 control the upper sets of contacts and the discs 15 and 16 control the lower sets of contacts. Pivotaly mounted on the frame 200 is a lever 12 arranged so as to maintain the plunger 11 in raised position.

The first and third from the bottom left-hand contacts are connected together by means of wire 17 which continues to and connects with the wire 1. The third from the bottom right-hand contact connects by wire 18 to the switch 19, the other terminal of the switch being connected by wire 20 to one end of resistance 29 which is connected with resistance 28, the other end of which connects through wire 27 and wire 26 to the field winding 22 of the motor 23. This field winding 22 is in series with the other portion 21 of the field winding which connects by wire 25 to wire 20. It is pointed out that with arm 34, which is rotatably mounted in the position shown in the drawing, switch 19 completes the circuit between wires 18 and 20, as indicated by the position of the switch arm adjacent switch 19. The exact detailed construction of these switch arms and the other mechanism in box 25' has been set forth in the copending application indicated above. The motor 23 is mounted on a framework 24 which also supports the casing 25' within which the various mechanisms are mounted. The arm 34 which is mounted on a vertically rotatable shaft is connected by means of gears with the motor 23, as has been set forth in the above mentioned disclosure.

The wire 31 connects the common point of resistances 28 and 29 with one terminal of the armature 32, the other terminal of which is grounded at 33. The arm 34 is grounded at 35. At 36 is a contact arranged to engage with arm 34 when it is in the other extreme which is 180° from the full line position shown in the drawings. The contact 36 is connected by wire 37 to the upper right hand contact of the relay switch.

The second and fourth left-hand contacts

from the bottom of the relay switch are connected by means of wire 38 to one end of the resistance 39, the other end of which is connected by wire 40 to wire 31. One terminal of switch 6 is connected by means of wires 41 and 42 to the winding 43 which is grounded at 44. 45 is a vertically slidable plunger within the winding 43 and attached to one end of the pivoted lever 12. The lower right-hand contact of the relay switch is connected by wire 46 to one terminal of switch 47, the other terminal of which is connected by wire 48 to wire 26. Switch 47, like switch 19, consists of two contacts to which the wires indicated in the drawings are attached. The switches 47 and 19 are constructed so that they are alternately open. For instance, switch 47 is open, as indicated, when arm 34 is in the position shown. When this arm swings 180° to its other position switch 47 is closed and switch 19 is open. 49 is another contact arranged in the path of arm 34 so as to contact therewith, as shown in Fig. 1, and is connected by wire 50 to the second right-hand contact from the bottom of the relay.

The arm 51 is operatively connected to the rotatable shaft on which arm 34 is mounted so as to be rotated in either direction upon the operation of the motor. The end of the arm 51 is pivotally connected to a collar 52 arranged to slide on the vertical rod 53 attached by means of brackets 54 to the rear edge of door 55. This is a well known type of construction and alone forms no part of this invention.

Mounted on the front edge of the door is a bare wire or small rod 56 which forms one contact of a switch and is connected by means of wire 60 to a spring finger 62 mounted on the back edge of the door. Encircling the contact 56 is a bare spring or coiled member 57 forming the other contact of the switch on the door and is connected by means of wire 58 to the spring finger 59 on the rear edge of the door. Mounted on the car body and in the path of the moving door so as to be engaged by the spring fingers 59 and 62 are the fixed contacts 63 and 64 made in the form of long continuous strips of metal. Contact 63 is grounded at 65 and contact 64 is connected through wire 66 to one terminal of armature 32.

It is, of course, understood that spring fingers 59 and 62 are mounted on the door to move with it and insulated from it and each other. Likewise the contacts 56 and 57 mounted on the front edge of the door to move with it are insulated from each other. These contacts are, of course, normally insulated from each other at their supported ends and mounted so that in normal position they are spaced from each other as shown.

The operation of this form of the device is as follows: Mechanism, as shown in Fig. 1, represents the door closed position there-

of. When push button switch 5 is closed current travels from the positive side of the current source through wire 1, resistance 2, wire 3, wire 4, switch 5, wire 7, wire 8, winding 9, and thence to ground at 10. This energizes the winding 9 and causes the plunger 11 to move upwardly in the framework 200. Lever 12 drops down so that the left-hand end thereof catches under the edge of plunger 11 and holds it in raised position. This will be more clear from Fig. 2.

As a result of the upward movement of plunger 11 discs 13 and 14 complete the circuits connected to the two upper sets of contacts and discs 15 and 16 interrupt the circuits connected to the two lower sets of contacts. Current then flows from the positive side of the current source through wires 1 and 17, contact disc 14, wire 18, switch 19, wires 20 and 25, field windings 21 and 22, wires 26 and 27, resistance 28, wire 31, armature 32, and thence to ground at 33. In other words, motor 23, which is a series wound motor, is connected to the current source through wire 27. As a result of the energization of the motor it begins to revolve causing arms 34 and 51 to revolve in a clockwise direction. The movement of arm 51 causes the door 55 to move to the right. When arm 34 is revolved a sufficient distance to contact with contact 36 resistance 39 is connected across the armature as follows: Contact 36 is connected by wire 37 to the upper right-hand contact of the relay, which contact is connected to the upper left-hand contact by disc 13. This contact is connected through wire 38 to resistance 39, the other terminal of which is connected through wires 40 and 31 to armature 32 which is grounded at 33. As a result the armature is short circuited through the resistance 39 and as the armature is in the electro-magnetic field produced by the field windings 21 and 22 a current is set up in the armature which reacts against the field and causes the motor to rapidly retard in its movement. Just as the motor and door reach the end of their stroke the arm 34 causes the circuit to the motor to be interrupted at switch 19, as has been clearly set forth in the above entitled copending application.

The door is now fully opened and when it is desired to close it push button switch 6 is closed. Current then flows from the positive side of the current source through wire 1, resistance 2, wires 3 and 4, switch 6, wires 41 and 42, winding 43, and thence to ground at 44. This energizes the winding 43 and raises plunger 45 carrying with it the pivoted arm 12. This movement of the pivoted arm 12 releases plunger 11 which returns to its normal position shown in the drawings. Current then flows from the positive side of the current source through wires 1 and 17, contact disc 16, wire 46, switch 47 (which

is now closed), wire 48, wire 26, field windings 22 and 21, wires 25 and 30, resistance 29, wire 31, armature 32, and thence to ground at 33. This reverses the direction of flow of the current through fields of the motor and it then begins to revolve in the reverse direction causing arms 34 and 51 to move in a counterclockwise direction. As before, when the door is nearly closed, arm 34 engages contact 49 which places the resistance 39 across the armature 32 as follows: Contact 49 engages arm 34 which is grounded and is connected by wire 50 to disc 15 of the relay which in turn is connected by wire 38 to resistance 39 which connects through wires 40 and 31 to the armature 32 which is grounded at 33. Thus dynamic braking is effected near the end of the stroke during the door closing operation.

As clearly disclosed in the above cited copending application the switch 100 is arranged to close a circuit connecting the wires marked "To signal lights" when the arm 34 is in the full position shown in Fig. 1. This arrangement forms no part of this invention.

If during the door closing operation the front edge of the door should strike an obstruction, such as a person passing through the doorway, contacts 56 and 57 engage each other to put a direct short circuit across the armature of the motor as follows: Strip 63 is grounded at 65 and connects with spring finger 59 which is connected by wire 58 to contact 57. Contact 56 is connected by wire 60 to spring finger 62 which engages the contact 64 which is in turn connected by wire 66 to one terminal of armature 32, the other terminal being grounded at 33. As a result, when the circuiting contact connected to contacts 56 and 57 is completed a direct short circuit is put on the armature and it comes to a stop. As soon as the obstruction is removed this circuit is broken at the contacts 56 and 57 and the motor proceeds in its door closing operation.

The actual mechanism which has been generally described in connection with Fig. 1 is shown in greater detail in Figs. 3 to 5, inclusive. At 24 is the supporting framework and casing on which is mounted the motor 23 and the switch mechanism casing 25'. Journaled in this framework is the shaft 111 on which is mounted the switch operating arm 34 and the door operating arm 51. The shaft of motor 23 is connected to shaft 111 through the gear train 110. Shaft 111 is provided with a handle 112 exterior of casing 25' by means of which the switch mechanism can be operated manually when desired.

The mechanism within casing 25' is more clearly disclosed in Figs. 4 and 5. The arm 34 with a roller 34<sup>a</sup> at one end thereof is shown mounted on the shaft 111. The contact arms 49 and 36 are shown pivotally supported on their insulating plates 113. The

switch arms 114 and 115 are mounted on and insulated from the pivotally supported levers 116 and 118. The levers 116 and 118 are pivotally supported within the casing in any suitable manner. Arm 116 is provided with a projecting pin 117 and arm 118 is likewise provided with a projecting pin 119. Counter clockwise rotation of arm 116 and counter clockwise rotation of arm 118 are resiliently resisted by means of springs 120 and 121, respectively, which abut against a fixed support 122. Pivotally supported at 124 is a bell crank lever 123 which is urged in counter clockwise direction by a spring and guide rod 125. Likewise pivotally supported at 126 is a bell crank lever 115 which is urged in clockwise direction by means of the spring and guide rod 127. This guide rod presses against a pivotally supported insulating block 128, to which is secured the switch arm 100. 129 is an insulated contact supported in the path of movement of contact 130 which is mounted on and insulated from arm 100. The wires to these contacts extend to the signal lights. Switch arms 114 and 115 cooperate with the fixed contact units 47 and 19, respectively. Each of these units are constructed similarly. As shown in Fig. 5 in connection with unit 47, for example, there are two fixed contacts 47<sup>a</sup> and 47<sup>b</sup> which are mounted so as to be insulated from each other. Arm 114 interconnects these contacts, as will be clearly understood. Bell crank lever 115 is provided with a projecting lug 131, and likewise bell crank lever 123 is provided with a projecting lever 132. Pivotally mounted on arm 34 are the two bars 133 between which is mounted a spring 134 which urges them apart. These bars 133 are limited in their outward movement by stops on the arm 34.

Although the operation of this mechanism is clear in connection with the previously described operation, it will be reviewed here. When the roller end of arm 34 is pointing to the left, it has by its roller engaged with bell crank lever 115, causing it to rotate in a counter clockwise direction so that protection 131 is moved sufficiently to the left, so that the cooperating bar 133 may move past it. This bar strikes pin 117 on lever 116, causing arm 114 to rotate in a counter clockwise direction to move out of engagement with its parts. In this position of the parts, spring 121 has caused switch arm 15 to engage its contacts. Also, switch arm 100 has been moved so that contacts 129 and 130 engage. As pointed out, the parts are then in a position where the door is closed. When the door opens the roller end of arm 34 rotates in a clockwise direction until it engages the incline surface of bell crank lever 123 by its roller 34<sup>a</sup>. At this time the other bar 133 engages stops 132, so that as arm 34 continues to move spring 134 is compressed. On sufficient movement, however, of arm 34, its roller 34<sup>a</sup> moving down

the incline surface of bell crank lever 123 will move this lever sufficiently to the right to let stop 132 free bar 133. Spring 134 then snaps the bar outwardly, causing it to engage pin 119 to snap lever 118 to a position where the switch arm 115 disengages with its cooperating contacts. In the meantime, of course, switch arm 114 has left its contacts and contact 130 has moved away from contact 129, since spring 127 has returned lever 115 to the position shown in Fig. 4 and with it the rod within the spring, so that arm 100 may move to the position shown in Fig. 4. As the roller end of arms 133 approaches the end of its movement in either direction it contacts with either contact 49 or 36 to complete circuits as described above.

In the modification shown in Fig. 2 the only difference from that in Fig. 1 is that the contacts 63 and 64 are connected through wires 80 and 83 and the current source 81 to the solenoid winding 82. This winding has a vertically movable plunger 84 with a contact disc 85 attached thereto. This disc controls two contacts to which the wires 86 and 87 are connected, which wires are also connected across the armature 32 of the motor. As before, when the contacts 56 and 57 are closed the winding 82 is energized and disc 85 closes the circuit which includes the wires 86 and 87. The armature 32 is short circuited and the motor comes to a stop until the obstruction in the path of the door is removed so that the circuit to winding 82 is interrupted at contacts 56 and 57.

From the foregoing disclosure it is apparent that I have devised a new and novel combination of elements which operates sufficiently for the purposes pointed out in this disclosure. I am well aware that numerous changes in the details of construction and relative arrangement and connection of parts will readily occur to those skilled in this art and I do not, therefore, desire to be limited to the illustration shown in the drawings as one embodiment of my invention but rather to the principles and scope of the invention as defined in the appended claims. It is apparent that these principles may be applied to other systems of door controlling mechanism operated by electric motors.

What I seek to secure by United States Letters Patent is:

1. In a door operating mechanism of the type described, the combination with a movable door, of an electric engine, means for operatively connecting said door to said engine and a switch mounted on the front edge of said door and connected to said engine so that the engine is short circuited when the door strikes an obstruction to bring it to a standstill.

2. In a mechanism of the type described, the combination with a movable door, of a reversible electric engine, means for connect-

ing said engine to said door, circuits for said engines, means for causing the operation of the engine in either direction, and means mounted on the edge of the door and connected in said engine circuit so as to short circuit the engine and bring it to a standstill when the door meets an obstruction.

3. In a mechanism of the type described, the combination with a movable door, contact elements mounted on the front edge of said door, spring fingers mounted on said door, stationary contacts arranged to engage said spring fingers upon movement of the door, of an electric motor, means connecting said motor with said door to cause its movement upon the operation of the motor, circuits for said motor, and connections between the motor and said stationary contacts whereby the motor is short-circuited and brought to a standstill when the contacts on the front edge of the door engage each other by reason of the door striking an obstacle.

4. In apparatus of the type described, the combination with a reversible electric motor, circuits for said motor including switches for operating it in either direction, and means operated by the motor in either direction for effecting dynamic braking of the motor near the end of its stroke in either direction, of a movable door, means for connecting the motor with the door to move it in either direction, and means mounted on the edge of the door and connected to said motor whereby the armature is short circuited when the door strikes an obstruction causing them to come to a standstill.

In testimony whereof I have hereunto set my hand on this 25th day of April A. D., 1928.

EDWARD G. PARVIN.

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