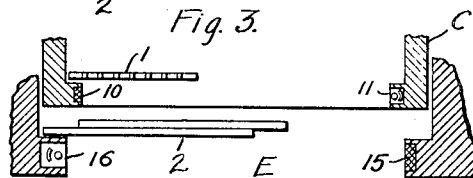
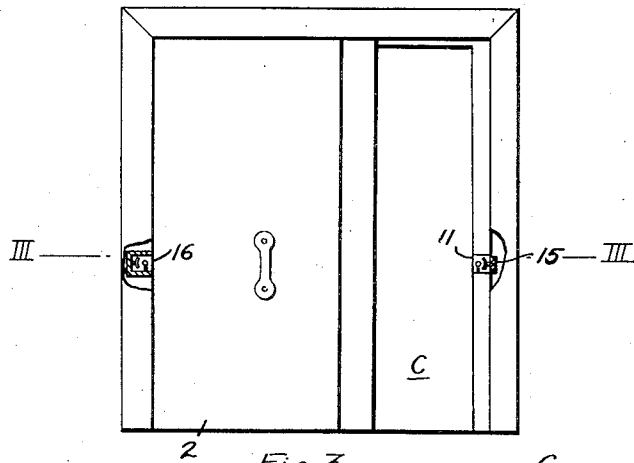


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INVENTORS.  
Luther J. Kinnard  
& James Dunlop.  
BY  
Oberly E. Carr  
ATTORNEY

## UNITED STATES PATENT OFFICE

LUTHER J. KINNARD, OF CHICAGO, AND JAMES DUNLOP, OF PARK RIDGE, ILLINOIS,  
ASSIGNORS, BY MESNE ASSIGNMENTS, TO WESTINGHOUSE ELECTRIC ELEVATOR  
COMPANY, A CORPORATION OF ILLINOIS

## SELENIUM CELL DOOR CLOSER

Application filed January 18, 1929. Serial No. 333,493.

Our invention relates to a door or gate-operating system for elevators and more particularly to safety apparatus for use in connection with such doors or gates.

5 The object of our invention, in general, is the provision of a door-operating apparatus that shall be simple and efficient in operation and capable of being readily and economically manufactured, installed and maintained.

10 A more specific object of our invention is to provide for preventing an elevator door or gate from closing while a person is in the entrance to the elevator.

15 It is also an object of our invention to provide for reopening the elevator door or gate and retaining it in such open position for a predetermined length of time when anyone steps into the entrance to the elevator while the door is in the act of closing.

20 Other objects of our invention will, in part, be obvious and will, in part, appear hereinafter.

For an illustration of one of the various forms our invention may take, reference may be had to the accompanying drawings in which

25 Figure 1 is a diagrammatic representation of the manner in which light-sensitive cells and cooperating light sources may be employed in connection with a power-operated elevator door or gate for effecting a safe operation thereof in accordance with our invention.

30 Fig. 2 is a view, in front elevation, of the entrance to an elevator, illustrating the positions in which the light-sensitive cells and the cooperating light sources, illustrated in Fig. 1, may be disposed; and

35 Fig. 3 is a sectional view taken along line III—III of Fig. 2.

40 The drawings illustrate an elevator car C as suspended by a cable Ca and standing at a hatchway entrance E. As shown, a gate or door 1 is disposed within the car C for closing the car entrance, while a pair of sliding doors 2 are provided for closing the hatchway entrance.

45 The means for operating the car gate 1 comprises a door-closing magnet 3 and a door-opening magnet 4, the circuits of which are se-

lectively controlled by a door relay 5. The circuit for the coil of the door relay 5, in turn, is controlled by a cam-operated switch 6 that may be disposed at such point in the elevator shaft that it will be actuated by a cam 7 on the car C when the car arrives at a landing. While we have illustrated the cam switch 6 as mounted in the hatchway, it will be understood by those skilled in the elevator art that any other type of switch which will be closed when the car is at a position opposite entrance E (such as a floor-selector switch) may be substituted therefor. Inasmuch as the door 2 in the landing doorway E may be connected to the car gate 1 for operation, therewith in any usual manner, a specific description thereof has been omitted.

As shown, the circuit for the door-opening magnet 4 is not only connected in series with the contact members b of the door relay 5 and the contact members a of the cam-operated switch 6, but it is also connected in series with the normally closed contact members of a control relay 8. The relay 8 is controlled by the elevator-control circuits (not shown) in such manner that it will be energized to keep its contact members open while the car is running and will be deenergized to close its contact members when the car stops. Therefore, the circuit for opening the car gate can be completed only when the car stops. If it were not for the control relay 8, the cam-operated switch 6 would complete the circuit for the door-opening magnet 4 and cause the gate to open every time the car arrived at a floor, regardless of whether or not a stop was made.

50 In operating an elevator having a power-controlled gate, it is desirable to provide some means for preventing the passengers from being injured by a premature closing of the gate while they are entering or leaving the car. Therefore, we have devised a means for preventing the gate from closing until the doorway, or entrance, to the car is clear. This means comprises a suitable light-sensitive device, such as a photoelectric cell 10, and a cooperating source of light, such as an electric lamp 11, that are mounted in the entrance to the car C for operating a safety re-

lay 12, the contact members of which are included in the circuit for the door-operating mechanism.

The light-sensitive cell 10 may be of any suitable type, such as a selenium or other cell having the photo-electric property of changing its resistance to the passage of electric current, or having similar characteristics, under varied conditions of light.

As shown, the light-sensitive cell 10 is mounted in one side of the frame of the elevator doorway, while the cooperating lamp 11 is disposed at the opposite side of the doorway frame in such manner and at such a height from the floor that light from the lamp will act upon the cell when the doorway is clear but will be prevented from shining upon the cell when anyone is in the entrance to the car.

As an additional safeguard, a similar light-sensitive cell 15 and an operating light source 16, are mounted in similar positions in the frame of the hatchway door 2 and connected to a safety relay 17, the contact members of which are also included in series relation with the contact members of the relay 12 in the circuit for the door-operating apparatus.

By reason of the characteristics of the light-sensitive cells 10 and 15, the safety relays 12 and 17 will remain deenergized so long as the entrance to the car is not clear and thereby prevent the door relay 5 from being energized to effect the closing of the car gate 1.

The invention may be understood best from an assumed operation of the apparatus. Assuming that the car C has come to a stop at a floor, then the control relay 8 will be deenergized to close its contact members to partially complete a circuit for the door-opening magnet 4 and the lamps 11 and 16. At the same time, the cam-operated switch 6 will be moved to a closed position by the cam 7 on the car C, and the door-opening magnet 4 will be energized to move the car door or gate 1 from a closed to an open position by the completion of a circuit that extends from supply conductor L1, through conductor 20, the coil of door-closing magnet 4, conductor 21, the contact members *b* of door relay 5, conductor 22, the contact members *a* of the cam-operated switch 6, conductor 23, the contact members of control relay 8, and conductor 24, to supply conductor L2.

The closing of the cam-operated switch 6 will also cause the lamps 11 and 16 at the entrance to the car to be lighted by the completion of a circuit that extends from supply conductor L1, through conductor 25, to a junction point 26, thence, in parallel, through the lamps 11 and 16, to a junction point 27, and thence, through conductor 28, the contact members *b* of the cam-operated switch 6, conductor 23, the contact mem-

bers of the control relay 8 and conductor 24, to supply conductor L2. Assuming that the light provided by the lamps 11 and 16 is prevented from shining upon the light-sensitive cells 10 and 15 by passengers passing between the lights and the cells as they enter and leave the car, no current for energizing the safety relays 12 and 17 will be permitted to pass through the light-sensitive cells 10 and 15. However, as soon as the passengers clear the entrance to the car, the light from the lamps 11 and 16 will effect a change in the light-sensitive cells 10 and 15 that will cause them to permit the passage of sufficient current to energize the safety relays 12 and 17 to complete a circuit for energizing the door relay and effect a closing of the elevator door which circuit extends from supply conductor L1, through conductor 30, to a junction point 31, one branch extending through conductor 32. The coil of safety relay 12, conductor 33, the light sensitive cell 10 and conductors 34 and 35, to supply conductor L2, and the other branch extending from the junction point 31, by way of conductor 36, the coil of safety relay 17, conductor 37, light-sensitive cell 15 and conductors 38 and 35, to supply conductor L2.

The energization of the safety relays 12 and 17 causes them to close their contact members to complete a circuit for energizing the door relay 5 by way of a circuit that extends from supply conductor L1, through a conductor 40, the coil of door relay 5, conductor 41, the contact members of safety relay 12, conductor 42, the contact members of safety relay 17, conductor 44, the contact members *a* of the cam-operated switch 6, conductor 23, the contact members of control relay 8 and conductor 24, to supply conductor L2.

The energization of the door relay 5 opens its contact members *b* to break the circuit for the door-opening magnet 4 and then closes its contact members *a* for energizing the door closing magnet 3 by way of circuit that extends from supply conductor L1, through conductor 46, the contact members *a* of relay 5, conductor 47, the coil of door-closing magnet 3 and conductors 48 and 35, to supply conductor L2, whereupon the door will be moved to a closed position.

It should be noted, however, that the door relay 5 is provided with a dash pot 50 that is arranged to prevent for a predetermined period of time, the door relay from opening its contact members *b* to deenergize the door-opening magnet 4, and from closing its contact members *a* for energizing the door-closing magnet 3. The delay provided by the dashpot 50 prevents the magnet 3 from effecting the closing of the door as soon as it is opened and thereby gives the passengers plenty of time to start entering or leaving the car when it comes to a stop and also pro-

vides plenty of time for clearing the doorway after the passengers have passed through it.

Assume now that the passenger has cleared the entrance to the car and that the door closing magnet 3 has started the door toward its closed position but that another passenger hurries up and steps into the partially open doorway to get on the car. As the second passenger steps into the entrance to the car he will intercept the light from the lamps 11 and 16 to the light-sensitive cells 10 and 15, thereby causing the cells to cut off the flow of current to the safety relay 12 and 17. The deenergization of the safety relays 12 and 17 will open their contact members to deenergize the door relay 5. The deenergization of the door relay 5 will open its contact members *a* to deenergize the door-closing magnet 3 and energize the door-opening relay 4 to reopen the door 1. After the door 1 is reopened, the dash pot 50 will prevent the operation of the door relay 5 and the reenergization of the door-closing magnet 3 for a predetermined period of time, and, therefore, the door will not close until the expiration of a predetermined time after the entrance to the car is cleared.

Assuming further that all the passengers have cleared the entrance to the car and that the door-closing magnet 3 has closed the door, then, as the car leaves the floor at which the stop was made, the cam-operated switch 6 will move to an open position, and the control relay 8 will be energized to open its contact members, thereby breaking the circuit for energizing the door-operating relays 3 and 4 and, at the same time, opening the circuit for the lamps 11 and 16. Inasmuch as the car gate is now in its closed position, and the circuits for the door-opening magnet 4 and the door-closing magnet 3 are both open, the door will remain in its closed position until the car makes another stop, when the control relay 8 and switch 6 will again close their contact-members for completing the circuits for the door-operating mechanism.

Thus, it will be observed that we have provided a door-operating system in which the door is prevented from closing prematurely and causing any injury to the passengers while they are entering or leaving the car.

While we have illustrated and described only one specific embodiment of our invention, we realize that it is susceptible of wide application and we do not desire to be limited to the precise construction illustrated and described.

We claim as our invention:

1. The combination with means for operating a closure in a doorway, of means, including a light-sensitive device and a source of light, operably responsive to the presence of a person in the doorway for controlling the closure operating means.

2. The combination with means for closing

a closure in a doorway, of means, including a light-sensitive device and a light source, operably responsive to the presence of a person in the doorway for preventing the operation of the closure closing means.

3. The combination with means for closing a closure in a doorway, of means, including a light-sensitive device and a light source, operably responsive to the presence of a person in the doorway for preventing the operation of the closure-closing means until the expiration of a predetermined period after the person leaves the doorway.

4. The combination with means for operating a closure for the entrance of an elevator car operable past a landing, of means, including a light sensitive device and a cooperating light source, operably responsive to the presence of a passenger in the entrance to the car for controlling the closure-operating means, and means operably responsive to the stopping of the car at the landing for rendering the light source effective.

5. The combination with means for operating a closure for the entrance of an elevator car operable past a landing doorway, of means, including a light-sensitive device and a cooperating light source disposed in the landing doorway, operably responsive to the presence of a passenger in the landing doorway for controlling the closure-operating means.

6. The combination with means for operating a closure for the entrance of an elevator car and a closure for a cooperating landing doorway, of means, including a light-sensitive device and a cooperating light source disposed in the landing doorway, operably responsive to the presence of a passenger in the landing doorway for controlling the operation of both closures.

7. The combination with means for operating a closure in a doorway, of a light source disposed at one side of said doorway in such position as to direct beams of light substantially horizontally across said doorway, and means operably responsive to the interruption of said beams of light by the presence of a person in the doorway for controlling said operating means.

8. The combination with means for operating a closure in a doorway, of means, including a light-sensitive device and a source of light, operably responsive to the presence of a person in the doorway for causing said closure-operating means to move said closure to a full-open position and retain it in such open position until the passenger clears the doorway.

9. The combination with a closure for a doorway, of electrically operated means for closing said closure, a circuit for energizing said operating means, a light-sensitive device disposed in said circuit and a light source disposed to render said light sensitive device

effective to permit the passage of sufficient current through said circuit to effect the energization of said operating means when said doorway is clear.

5 10. The combination with a closure for a doorway, of electrical means for opening said closure, electrical means for closing said closure, a circuit for each of said opening means and closing means, a switch disposed  
10 when deenergized to complete the circuit for energizing the closure opening means and when energized to complete the circuit for effecting the closing of the closure, a circuit for energizing said switch, a light-sensitive  
15 device disposed in said switch energizing circuit, and a light source disposed to render said light sensitive device effective to permit the passage of sufficient current through said switch circuit to energize said switch when  
20 said doorway is clear.

11. The combination with means for operating a closure for a doorway, of a timing device for preventing the closing of said closure for a predetermined period after it  
25 is opened, and means, including a light sensitive device and a cooperating light source, operably responsive to the presence of a person in the doorway for causing said operating means to move said closure to a full open  
30 position and for resetting the timing device to retain said closure in its re-opened position for a predetermined period.

12. The combination with means for operating a closure for a doorway, of a timing device for retaining said closure in its open position for a predetermined period after it  
35 is opened, means operably responsive to the presence of a person in the doorway for causing said operating means to move said closure to a full open position and for resetting said timing device to retain the closure in  
40 its re-opened position for a predetermined period after the person leaves the doorway.

13. In a door-operating mechanism, the  
45 combination of a door frame, closure means for the opening in said frame, instrumentalities for projecting light rays across said opening, power means for operating said closure means, and means sensitive to a variation in  
50 the intensity of said light rays for interrupting the movements of said closure means.

14. In a door-operating mechanism, the combination of a door frame, closure means for the opening in said frame, instrumentalities for projecting light rays across said opening, power means for operating said closure means, means sensitive to the continuance of light rays for maintaining said power means in door-opening condition and adapted,  
60 upon the interrupting of said light rays, for discontinuing the operation of said closure means in the direction in which it is traveling when said interruption occurs.

15. In a closure-operating mechanism, the  
65 combination of sliding closure means, power

operating mechanism for said closure means, and electric means for automatically rendering said power mechanism in operative upon the presence of a person in the path of said closure.

16. In a closure-operating mechanism, the combination of sliding closure means, power operating means for said closure means, and mechanism including a photo electric device effectual upon a reduction of the intensity  
75 of the rays of light shining upon said photo electric device for rendering said power means ineffective to close said closure.

17. A device of the character described, comprising a reversible motor having forward and reverse field windings, a circuit for each winding, contacts for each circuit, a movable switch member for closing one or the other of said circuits but not both, said switch being normally biased to a position  
80 against one set of contacts, a relay magnet for operating said switch from its biased position to the other contacts and means for producing variations in intensity of current to said relay magnet to shift the current from  
85 one field winding circuit to the other.

18. In a door-operating mechanism, the combination of a door frame, closure means for the opening in said frame, power operating means for said closure means, instrumentalities for projecting rays of light from side to side of said opening, means sensitive to the presence of said rays of light for maintaining said power operating means in closure closing operation, said power means being arranged upon an interruption of said rays of light to reverse operation of said power operating means and return said closure means to open position.

19. In combination, a door, means to operate said door, instrumentalities for projecting rays of light along a selected transverse path relative to said door, and means sensitive to a change in the intensity of said rays of light for stopping further movement of said door in the direction in which it was traveling.

20. In combination with a doorway, a door therefor, mechanism for moving the door, and automatic means governed by the presence of an object in the doorway for checking operation of the door by said mechanism before the door contacts with said object.

21. In combination with a doorway, a door therefor, mechanism for moving the door, and automatic means for controlling the operation of said door-moving mechanism governed by the presence of an object in the doorway independent of contact of the door with that object.

22. In combination with an illuminated passageway, a door therefor, and means responsive to changes in the illumination of said passageway for controlling the movement of said door.

23. The combination with means for oper-

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ating a closure for the entrance of an elevator  
car operable past a landing, of means, includ-  
ing a light sensitive device and a cooperating  
light source, operably responsive to the pres-  
ence of a passenger in the entrance to the car  
5 for controlling the closure-operating means,  
and means operably responsive to the step-  
ping of the car at the landing for rendering  
the controlling means effective.

10 In testimony whereof, we have hereunto  
subscribed our names this 10th day of Janu-  
ary, 1929.

LUTHER J. KINNARD.  
JAMES DUNLOP.

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