

Jan. 16, 1940.

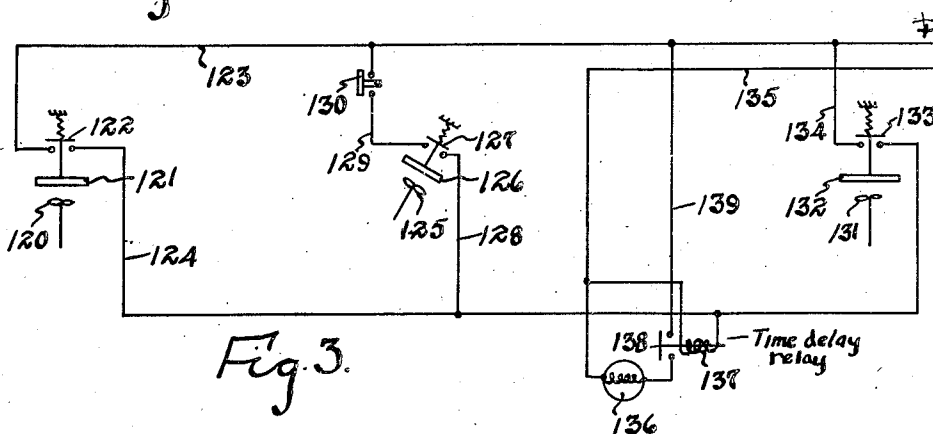
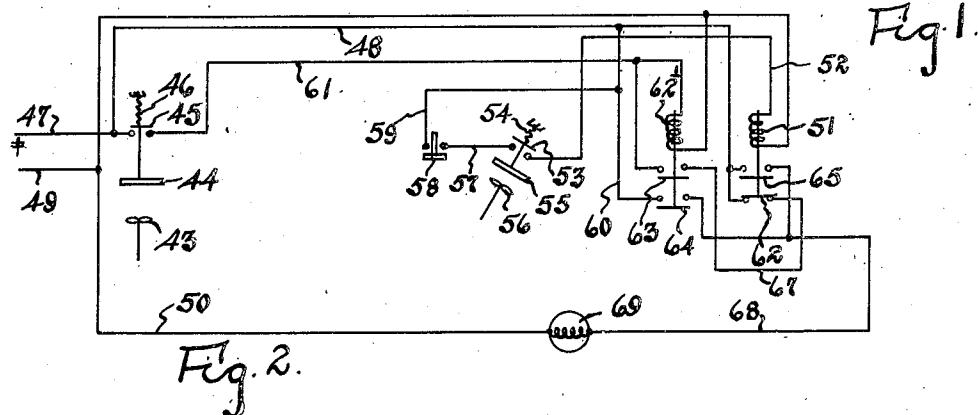
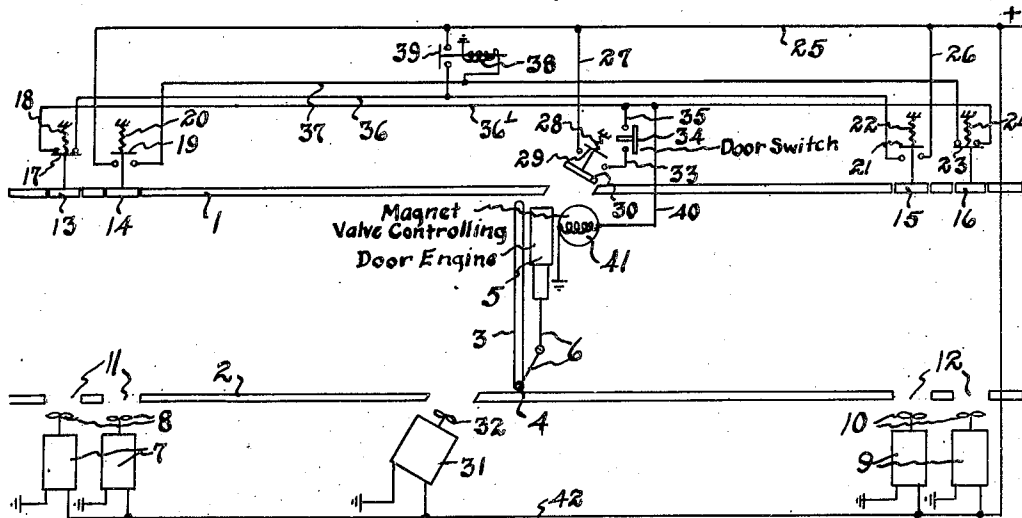
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2,187,173

DOOR CONTROL SYSTEM

Filed Nov. 27, 1937

2 Sheets-Sheet 1



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DOOR CONTROL SYSTEM

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2 Sheets-Sheet 2

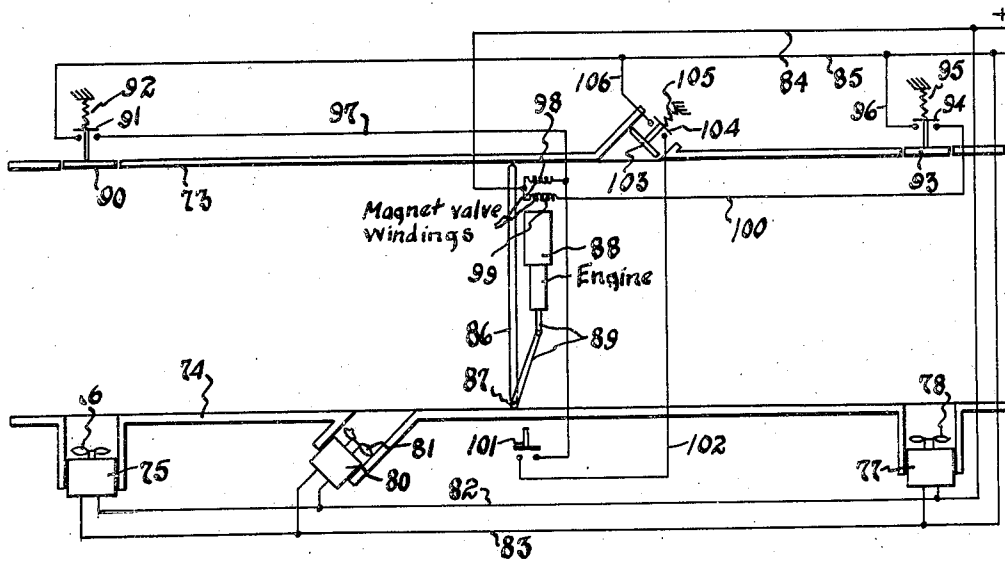


Fig. 4.

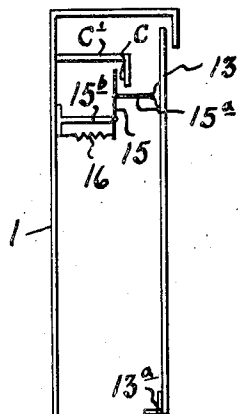


Fig. 5.

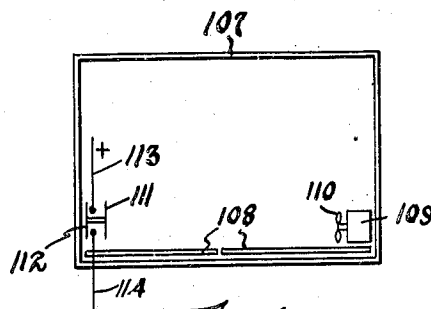


Fig. 6.

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2,187,173

DOOR CONTROL SYSTEM

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Application November 27, 1937, Serial No. 176,940

13 Claims. (Cl. 268—1)

This invention relates to a novel combination of apparatus by means of which electrical circuits for all purposes may be controlled.

A general object of the invention is to provide control apparatus for electrical circuits which includes a control device, the actuation of which is dependent upon the interruption of a stream of air directed thereagainst.

A more specific object of the invention is to provide control apparatus for power operated doors, the initiation of the action of which is subject to the movement of persons to and from the door through air streams projected across the passageway on one or both sides of the door.

The many other objects of the invention which are successfully secured by means of the construction herein disclosed will be apparent from the following description when considered with the attached drawings which are illustrative.

This invention resides substantially in the combination, construction, arrangement and relative location of parts, all as will be fully set forth below.

In the accompanying drawings,

Figure 1 is a diagrammatic view of one form of the system in accordance with this invention, showing mechanism for effecting opening of the door upon the approach of a person from either direction and for effecting the closing thereof upon movement of that person away from the door in either direction.

Figure 2 is a diagrammatic disclosure of a modified arrangement in which movement of persons in one direction only, toward the door, may effect operation thereof.

Figure 3 is a diagrammatic illustration of a modification of the form of system shown in Figure 1 wherein the control is influenced by the movement of persons to and from the doors, in either direction.

Figure 4 is a diagrammatic illustration of a further modified form of arrangement of the type illustrated in Figure 3.

Figure 5 is a view through one of the air operated switch devices showing the relationship of the parts and

Figure 6 is a diagrammatic plan view of an elevator car showing the application of the principles of the invention to the control thereof or the doors thereof.

In accordance with the system herein disclosed, control circuits of all kinds may be influenced, completed or opened by reason of the inclusion therein of air operated switches biased to close or open upon the interruption of an air stream

directed thereagainst. In a specific embodiment of the broad idea of the invention, as applied to door operating systems, doors are either opened and/or closed solely by reason of the movement of a person towards and/or away from the door, characterized in that air streams which are directed across the passageways on one or both sides of the door are interrupted by the movement of a person therethrough.

Referring first to the system of Figure 1, there is illustrated diagrammatically at 1 and 2 a pair of barriers or walls which form a passageway to and from the door on both sides thereof. Extending across the passageway is a door 3 diagrammatically illustrated as supported on a vertical shaft 4 which is caused to turn in a clockwise direction in opening the door by reason of the linkage connection 6 between it and the fluid pressure motor 5. This motor has been illustrated as of the well known differential type commonly employed for this purpose, although it is to be understood that, as will be apparent from this disclosure, the invention herein is equally applicable to use in conjunction with other forms of motive devices such as electrical motors. At one end of the passageway is a pair of motors 7 operating the fan blades 8 so as to direct streams of air through the openings 11 in the barrier 2 across the passageway against the baffles 13 and 14. In a similar way, at the other end of the passageway barriers, is a pair of motors 9 operating the fans 10 which direct streams of air through the openings 12 across the passageway against the baffles 15 and 16. At this point it may be noted that other sources of air streams may be employed, such as a conduit and nozzle system served from a single air pressure source.

The baffles or plates 13, 14, 15 and 16 are supported in any suitable manner, as by means of hinges at the bottom edges thereof, so that they may have a slight movement back and forth at right angles to the length of the passageway. These baffles are, respectively, connected to the switch blades or contacts 17, 19, 21 and 23 and are, respectively, acted upon by means of compression springs 18, 20, 22 and 24. The baffle and switch constructions may take many different forms, one of which has been illustrated in detail in Fig. 5 and will be described later.

The pairs of contacts controlled by the switch blades 17 and 23 are arranged so that the springs 18 and 24 tend to disengage them, the air stream against the associated baffles 13 and 16 acting to hold them in engagement against the reaction of the springs. In the case of the pairs of contacts

controlled by the switch blades 19 and 21 they are positioned so that the springs 20 and 22 tend to cause them to engage but the air streams against the associated baffles 14 and 15 normally hold them disengaged.

The wire 25 is connected to the positive terminal of any suitable source of current and extends to one of the contacts of the pair controlled by the switch blade 19, by a branch wire 26 to one of the pair of contacts controlled by switch blade 21, and by branch 27 to one of the contacts controlled by switch blade 29. The switch blade 29 is connected to a baffle 30 like the other baffles, positioned in an opening adjacent the door and diagonally opposite the fan blades 32 operated by a motor 31. In this arrangement an air stream is directed diagonally across the passageway through the doorway when the door is open. A spring 28 acts on the switch blade 29 tending to engage it with its associated pair of contacts. The other contact of this pair is connected by wire 33 to one contact of a pair in a door switch 34. The other contact of the pair is connected by wire 35 to the wire 36'. The door switch is of the type well known in the art which is open when the door is closed but which closes and remains closed as long as the door is open. It is commonly positioned to be actuated by the door itself.

One contact of each pair controlled by the switch blades 17 and 23 are connected by wire 36'. The other contact of the pair controlled by switch blade 17 is connected by wire 36 to the other contact of the pair controlled by switch blade 21. The other contact of the pair controlled by switch blade 19 is connected by wire 37 to the other contact of the pair controlled by switch blade 23. At 38 is an operating winding for a relay which is connected between wire 37 and ground. The contact 39 of the relay cooperates with a pair of contacts one of which is connected to wire 25 and the other to wire 36. Wire 40 connects wire 36' with one terminal of a winding of a magnet valve 41, the other terminal of which is grounded. One terminal of each of the motors 9 and 31 is grounded and the other terminals are connected by a common wire 42 to the positive supply connection 25. It will of course be apparent that the grounds merely indicate a common return to the negative side of the current source.

Although those skilled in the art will understand the fact, it is nevertheless briefly noted that a differential engine is of the type having two cylinders of different diameters connected in alignment and provided with pistons, likewise of different diameters, which are connected together. The outer end of the smaller cylinder is open to the atmosphere and a constant supply of fluid pressure is provided for the engine between the pistons. Another connection from a suitable pressure fluid source extends to the outer end of the larger cylinder and in this connection the magnet valve is used. The magnet valve is of the well known type such as, for example, that shown in United States Patent No. 1,943,819 issued January 16, 1934. It is simply a magnetically operated two-way valve which opens the large cylinder to exhaust when the winding is deenergized and opens it to the pressure fluid source when the winding is energized cutting off the exhaust.

In the operation of this system it will be assumed that a person is approaching the door 3 through the passageway from the left. In this

movement he interrupts the air stream to baffle 13, it being understood that the fan motors are continuously operating in the form of system illustrated. The interruption of this air stream reduces the pressure on the baffle so that spring 18 opens switch 17. The opening of this switch does not produce any other effect than to simply break the circuit connected thereto, which at this time is dead. The person then interrupts the air stream to baffle 14 removing the pressure therefrom. Thereupon spring 20 causes switch 19 to close so that current flows through wire 25, switch 19, wire 37, relay winding 38 to ground. This operates the relay so that switch 39 immediately sets up a circuit directly from wire 25 to wire 36 so that current flows through wire 36, switch 18, wire 36', switch 23 and wire 37 back to ground through winding 38, providing a holding circuit for it. Current also flown from wire 36' through wire 40 to ground through the operating winding of the magnet valve 41. Operation of the magnet valve cuts off the exhaust for the large cylinder and connects it to the pressure fluid supply source. Pressure is thus applied to the outer face of the large piston (the pressure supplied thereto being the same as that supplied between the pistons and usually from the same source) so that the pressure on both sides of the large piston is equalized leaving the pressure on the small piston unbalanced. Thus the engine operates to open the door. The engine remains in door opened position until the holding circuit to the relay 38 is broken. This is accomplished when the person moving through the passageway interrupts the air stream striking baffle 16 so that spring 24 opens switch 23. The interruption of the air stream to baffle 15 as the person moves through it does nothing more than connect wire 25 to wire 36, through wire 25, which produces no additional operation since wire 25 is already connected to wire 26 through switch 39.

Should the person stop in the doorway with the door open and another person enter the passageway from either end so that the holding circuit to wire 36 through the switches 18 and 23 is broken, the door will not close because even though the circuit to wire 36' is broken it will be maintained as follows: Wire 25, wire 27, switch 29, wire 33, door switch 34 (this of course being closed, the door being open) and wire 35 to wire 36. It is, of course, apparent that a similar set of operations occur in the event that a person approaches the door from the right hand end.

The system of Figure 2 differs from that of Figure 1 in that the door is intended for use in a one way passage. That is to say, the door will only be opened when it is approached from one side. In this case, as before, a passageway 2, if desired, from the door is employed. A motor driven fan 43 directs an air stream across the passageway on the side of the door from which the approach thereto effects operation thereof. The air stream is directed against a baffle or plate 44, similar to those previously described, to which is connected a switch blade or contact 45 under the action of a spring 46. The positive side of a suitable current source is connected by wire 47 to one of the pair of contacts controlled by switch blade 45 and by wire 48 to one contact each of two pairs controlled respectively by the movable contacts 65 and 62 of a relay operated by winding 51. The other side of the current source is connected by wire 49 to a wire 50 which extends to one terminal of the winding of a magnet valve 69 and to one terminal of the wind-

ing 51 and one terminal of the winding 62' of a second relay. The other terminal of the winding 51 is connected by wire 52 to one of the contacts of a pair controlled by the switch blade 53. This switch blade is influenced, as before, by spring 54 and operated by baffle 55 against which an air stream is directed by a fan 56. The other terminal of the pair controlled by switch blade 53 is connected by wire 57 to one contact of the door switch 58. The other contact is connected by wire 59 to a wire 60 which connects the wire 48 with one contact of a pair controlled by the switch blade 64 of the relay whose winding is 62'. The other contact of this pair is connected by wire 68 to the other terminal of the winding of the magnet valve 69 and to the other contact of the pair controlled by switch blade 65. The other contact of the pair controlled by switch blade 62 is connected by wire 67 to the other contact of the pair controlled by switch blade 63. The other contact of the pair controlled by switch blade 65 is connected by wire 61 to one terminal of the relay winding 62' and to one contact of the pair controlled by switch blade 63. The other terminal of winding 62' is connected to wire 50. The air stream from fan 56 is directed diagonally across the passageway and the door opening in the same manner as is the stream from the fan 32 of the arrangement shown in Fig. 1, and the baffle 55 is arranged similar to the baffle 30 of the system of Fig. 1.

In the operation of this system, as a person approaches the door from the left, he interrupts the air stream from fan 43 so that spring 46 may close switch 45. Current then flows from wire 47 through switch 45, wire 51, winding 62' and back through wire 50 to wire 49. The relay operated by winding 62' is thereupon closed, setting up a direct connection from wire 47 through wire 48, wire 60, switch blade 64, wire 68, magnet valve 69 and wire 50, back to wire 49. At the same time a holding circuit for the winding 62' is set up from wire 48 through switch 62, wire 67, switch 63, back to one terminal of the winding 62', the other terminal being permanently connected by wire 50 to wire 49. Thus the relay 62' remains operated, keeping current on the magnet valve. Energization of the magnet valve supplies air to the engine, as before, and the door opens fully. As soon as the door begins to open the door switch 58 closes, completing the circuit through it up to the switch 53. As the person moves through the doorway he interrupts the air stream from the fan 56 so that switch 53 closes, completing the circuit as follows: From the wire 48, through wire 59, switch 58, wire 57, switch 53, wire 52 and winding 51 back to wire 50. This energizes the relay 51 breaking the holding circuit to the relay 62' through switch 62. The result of this is that the circuit to the magnet valve 69 through switch 64 is broken and the door closes. Should a person stop in the doorway the holding circuit to the relay 62' will likewise be broken but the presence of the person in the doorway will maintain the circuit to relay 51 so that switch 55 directly connects wire 48 with wire 68 so that the magnet valve remains energized even though the circuit to it through the switch 64 is broken. Thus the door may not start to close until he moves out of the doorway.

The system of Figure 3 is like that of Figure 1 in that the door may be opened on being approached from either side. In this system the motor-driven fans 120 and 131 are arranged in the passageway on opposite sides of the door so

as to direct streams of air across the passageway. The stream from fan 120 strikes the baffle 121 which is like those previously described. This baffle is connected to the switch plate 122 biased to closed position by a spring, as before. Similarly the baffle 122 is connected to switch plate 123 biased to closing position by a spring. Wire 123 extends from the positive side of a suitable current source and is connected to one of the contacts of a pair controlled by switch plate 122. This wire is connected by wire 134 to one of the contacts of a pair controlled by switch plate 133. The other contacts of each of these pairs are interconnected by the wire 124. Directed diagonally across the passageway is a fan 125 adapted to throw a stream of air across the passageway and through the doorway, as in each of the previous cases. A baffle 126 is in this air stream and is connected to a switch blade 125 biased to closing position by a spring as before. One contact of the pair controlled by switch blade 127 is connected by wire 128 to wire 124 and the other contact of the pair is connected by wire 129 to door switch 130, the other contact of which is connected to wire 123. One terminal of the magnet valve 136, which is like those previously described, is connected by a wire 135 to the negative side of the current source. The other terminal is connected to one of a pair of contacts controlled by the switch blade 138 of a relay whose winding 137 is connected between wires 135 and 124. The other contact of the relay is connected by wire 139 to wire 123.

In the operation of this system a person may approach the door from either side and cause it to open. In approaching it from the left he interrupts the air stream from fan 120 and switch 122 closes so that current flows from wire 123 through switch 122, wire 124, winding 137 and back to the current source through wire 135. This closes the switch 138 so that the magnet valve 136 is energized through wire 139. This relay is of the time delay type well known in many forms in the art, which upon momentary energization is operated to closed position and stays closed for a predetermined period of time, after which it automatically opens. Thus the circuit to the magnet valve 136 is maintained a long enough period so that the person may move through the door after which the relay operates to open the switch 138, deenergizing the magnet valve so that the door closes. However, if a person stops in the doorway and remains there longer than the time period of the relay so that the circuit through it to the magnet valve is broken, a new circuit to the relay has been established through the closed door switch 130 and the closed switch 127 so that the magnet valve remains energized as long as he remains there and the door cannot close. If a person should approach the door from the other side a similar circuit sequence results from closing the switch 133 and need not be described in detail further.

In the system of Figure 4 the passageway is defined by the barriers 73 and 74 having openings in the barrier 74 through which air may be directed by the fans 76 and 78 driven by the motors 75 and 77 respectively. The air stream strikes against the movable baffles 90 and 93 which are respectively connected to the switch blades 91 and 94 and respectively controlled by the switches 92 and 95. The door 86 is mounted across the passageway as in all previous cases and is mounted on a vertical door shaft 87 operatively connected to the differential engine 38

by means of the linkage 89. The magnet valve of which the windings 98 and 99 are the operating windings is of the well known type a form of which is shown in my Patent No. 1,995,718 issued March 26, 1935. As shown therein, magnet valves of this type are provided with two windings, one of which when energized operates to open the valve and hold it open until the other or neutralizing winding is energized when it closes. The positive current lead 84 from the current source is connected to a common terminal of the windings 98 and 99 of the magnet valve. The other terminal of winding 98 is connected by wire 97 to one of the pair of contacts controlled by blade 91, the other of which is connected to the return lead 85 to the current source. This same lead is connected by wire 96 to one of the contacts of the pair controlled by the blade 94, the other of which is connected by wire 100 to the other terminal of winding 99. A fan blade 81 directs an air stream across the passageway at the doorway and is driven by a motor 80 which together with the motors 75 and 77 are connected to the current source, wires 84 and 85 by means of the wires 82 and 83 respectively. A baffle 103 receives the air stream from fan 81 and is connected to a switch blade 104 and controlled by spring 105. One contact of the pair controlled by the blade 104 is connected by wire 106 to wire 85, while the other contact of the pair is connected by wire 102 through the door switch 101 to wire 97. The door switch is as before of the type which is open when the door is closed and is closed so long as the door is open.

In the operation of this system a person moving from left to right interrupts the air stream onto baffle 90 so that switch 91 closes. Current then flows from the source through wire 84, winding 98, wire 97, switch blade 91, and wire 85 back to the current source. The magnet valve is operated and the engine is energized to open the door. The door remains open until the person interrupts the air stream onto baffle 93, at which time switch 94 closes and current flows from wire 84 through the other winding 99 of the magnet valve, wire 100, switch 94, and wire 96 back to the return lead 85. The energization of wire 99 causes the magnet valve to cut the air supply and open the large cylinder of the engine to exhaust. Should a person stop in the doorway cutting off the air stream to baffle 103, switch 104 closes so that current flows through the door switch 101 to the opening winding 98 of the magnet valve, in the event that a person approaching from the right interrupts the air stream to baffle 93 permitting a closing of the circuit to the closing winding 99. Thus the door may not shut on the person in the doorway.

Figure 5 illustrates somewhat diagrammatically and yet in a usable form the manner in which the baffles are mounted in the passageway and connected to the switches. Thus the baffle 13 is connected by a link 15^a to the switch arm 15 which is pivotally mounted on a bracket 15^b. The spring 16 acts on the arm 15 tending to move it against contacts C when the air pressure on the baffle is cut off. The contacts C are mounted on a suitable insulating support C' and the baffle 13 is shown supported at its bottom edge by means of hinges 13^a.

Figure 6 diagrammatically illustrates the manner in which the principle of this invention may be applied to elevators. An elevator carriage is diagrammatically illustrated at 107 having a

pair of doors 108 at the front. A fan 110 driven by the motor 109 is positioned to direct an air stream across the carriage doorway onto baffle 111 connected to a switch blade 112 which is normally out of engagement with the contacts in the circuit comprising the wires 113 and 114. This circuit may extend to different points depending upon the desired operation. For example, the wire 114 may extend to a controller interlock which prevents the starting of the cars as long as the air stream is interrupted by a person in the doorway, so that switch 112 is closed. Under similar circumstances this wire may extend to the control mechanism for the doors to prevent their closing.

From the above description it will be apparent to those skilled in the art that the principles of this invention may be embodied in many specific forms and circuit arrangements, and I do not therefore desire to be strictly limited to the particular forms of circuit arrangement disclosed herein for purposes of illustration, but rather to the scope of the claims as granted me.

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

1. In an apparatus of the type described the combination including a door, a motive device connected thereto for actuating it, a control device for the motive device, means for directing a stream of air across the passageway to the door, and means in the air stream and operated upon the interruption of the air stream for actuating the control device.

2. In an apparatus as described the combination including a door, a motive device connected thereto for actuating it, means for controlling said motive device, and air operated means positioned in front of the door for actuating said means upon the interruption of the air operated means by a person approaching the door.

3. In an apparatus as described the combination including a door, a motive device connected thereto for actuating it, control means for the motor, air pressure operated means for actuating the control means positioned in the passageway to the door, and means for directing a stream of air onto said last means across the passageway.

4. In an apparatus as described the combination including a door, a motive device connected thereto for actuating it, air operated means for actuating said control means positioned at each side of the door and longitudinally spaced therefrom, and means for blowing streams of air across the passageway onto said air operated means whereby interruption of either air stream by a person approaching the door from either side causes said operated means to actuate said control means to open the door.

5. In an apparatus as described the combination including a door, a motive device connected thereto for actuating it, air operated means for actuating said control means positioned at each side of the door and longitudinally spaced therefrom, means for blowing streams of air across the passageway onto said air operated means whereby interruption of either air stream by a person approaching the door from either side causes said operated means to actuate said control means to open the door, air operated means positioned adjacent the door for actuating said control means, and means for directing a stream of air thereagainst across the doorway.

6. In an apparatus of the type described the combination including a door, a motive device connected thereto for actuating it, means for di-

recting a plurality of air streams across the passageway to and from the door on opposite sides thereof and longitudinally spaced therefrom, and means for controlling the motive device including means in said air streams for causing the door to open upon the interruption of an air stream on either side of the door, and for closing it upon interruption of another air stream on either side of the door.

7. In an apparatus of the type described the combination including a door, a motive device connected thereto for operating it, air operated means positioned on either side of the door and longitudinally spaced therefrom for controlling said motive device, and means for directing air streams against said last mentioned means whereby upon the interruption of either air stream the door opens.

8. In an apparatus of the type described the combination including a door, a pressure fluid operated motor connected thereto for operating it, means for controlling the supply of air to and exhaust from said motor, air pressure operated means controlling said means, and means for directing streams of air across the passageway onto said air operated means to hold them in inoperative position, whereby upon the interruption of one of the air streams the air operated means is actuated to operative position.

9. In an apparatus of the type described the combination including a door, an air engine connected thereto, air supply and exhaust means for the engine, means for controlling said last means including control devices positioned adjacent the passageways to and from the door and longitu-

dinally spaced therefrom, and means for directing streams of air across the passageway to hold said control devices in inoperative position.

10. In a combination as described a door, operating mechanism therefor, means for directing a stream of air across the door, and means in the air stream positioned to be interrupted by a person in the doorway for controlling the door operating mechanism.

11. In a combination as described, a door, means for directing a stream of air across the door, and means in the air stream positioned to be interrupted by a person in the doorway for preventing the closing of the doors.

12. In an elevator system the combination including an elevator carriage having a doorway, doors mounted in the doorway, means for directing a stream of air across the doorway, a switch device in said air stream and arranged to close when the air stream is interrupted by a person in the doorway and a circuit connected to said switch for controlling a device related to the operation of said door.

13. In an apparatus of the type described the combination including a passageway having a door therein, a motor connected to the door for opening and closing it, control means for said motor including control devices positioned in the passageway on each side of the door and longitudinally spaced therefrom, and means for directing streams of air across the passageway for holding the control devices in inoperative position.