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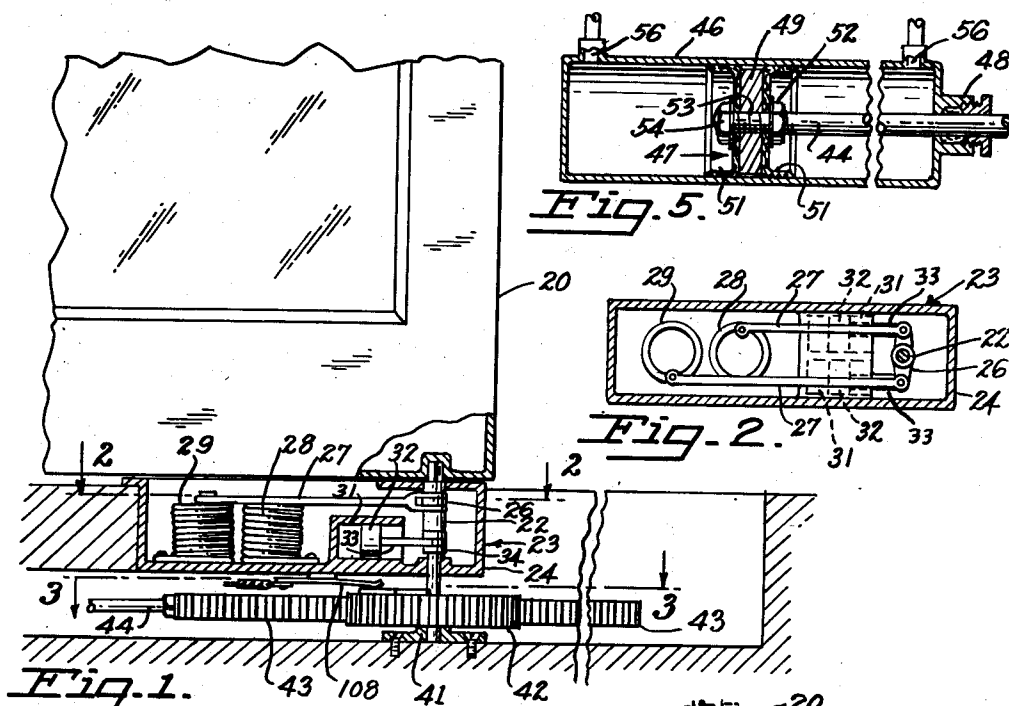
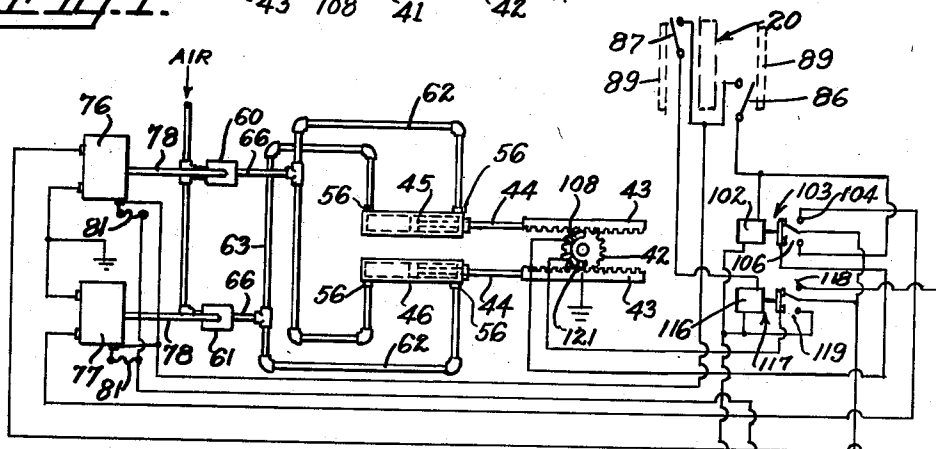
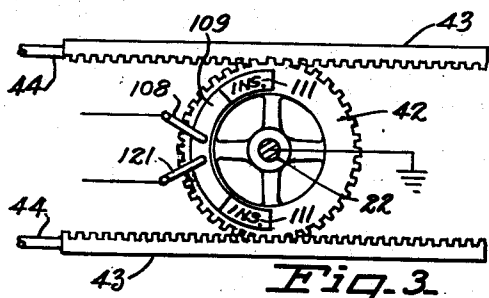
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2,676,796

DOUBLE-ACTING PNEUMATICALLY OPERATED DOOR OPENER

Filed June 5, 1950

2 Sheets-Sheet 1



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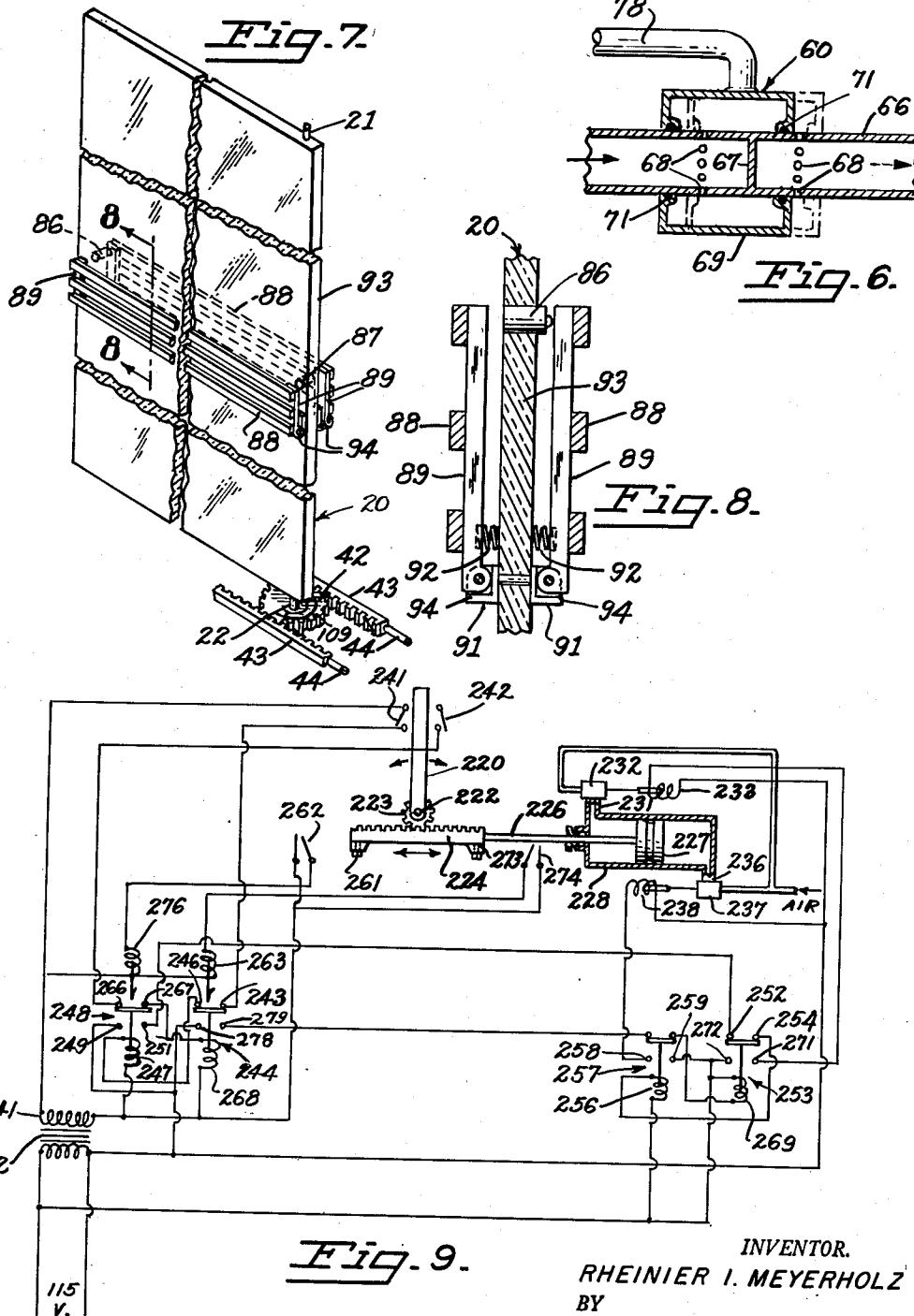


Fig. 9.

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DOUBLE-ACTING PNEUMATICALLY
OPERATED DOOR OPENER

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8 Claims. (Cl. 268—66)

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This invention relates to new and useful improvements in double-acting pneumatically-operated door opener. More particularly the invention relates to a means for opening a swinging door in either direction by pneumatic means set in motion manually by actuation of a switch on the door.

The present invention is intended for use in conjunction with swinging doors having double-acting, floor door checks, such as are in common use at the present time. The invention constitutes an improvement whereby said doors are pneumatically actuated to open in either direction. Pneumatic pistons are connected to the door by mechanical means and said pistons are actuated by solenoids which are energized upon closing of switches associated with the door in such manner that when the door is touched from either side a switch is closed which energizes the proper solenoid to open the door in the direction opposite the side on which the door is touched.

Further provision is made so that if two persons touch the door from opposite sides simultaneously or within a short time of each other, the door is not automatically operated, but rather comes to equilibrium and must be manually moved to open position in order to reset the electrical circuits which operate the door controlling means.

Thus the instant invention provides automatic door opening means for swinging doors operable to open the door in either direction merely upon the touching of a portion of the door which closes a switch, which in turn establishes an electric circuit controlling the operation of the door. The mechanism is simple and relatively inexpensive and affords obvious advantages over such automatic door-opening means as photo-electric cells which are presently used.

Further objects of the present invention will become apparent upon referring to the accompanying specification and drawings in which similar characters of reference represent corresponding parts in the several figures of the drawings.

Referring to the drawings:

Fig. 1 is a fragmentary elevation, partially in section, showing a portion of the door and actuating mechanism.

Fig. 2 is a horizontal section taken substantially along the line 2—2 of Fig. 1.

Fig. 3 is a horizontal section taken substantially along the line 3—3 of Fig. 1.

Fig. 4 is a schematic view of the invention showing a wiring diagram and associated mechanical means.

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Fig. 5 is a vertical section through one of the pneumatic cylinders.

Fig. 6 is a vertical section through a pneumatic valve controlling said pneumatic cylinders.

Fig. 7 is a fragmentary view of a glass door in connection with which the invention may be employed and showing the horizontal rails or push-bars hinged to said door which operate the switches controlling operation of the door-opening mechanism.

Fig. 8 is a vertical section taken substantially along the line 8—8 of Fig. 7.

Fig. 9 is a wiring diagram of a modification of the invention.

As shown in Fig. 1, the instant invention is used to actuate a door 20, said door being hung to swing about a vertical axis adjacent one side edge thereof. Vertical pintles 21 and 22 are fixed to the door at the top and bottom thereof, said pintles extending vertically upward and downward from the door respectively. It is customary at the present time for doors of the general type with which the present invention is connected to employ double-acting door check mechanism 23 which is associated with lower pintle 22, and located in a box 24 below the level of the floor immediately beneath the door. Horizontal link 26 is fixed at about its midpoint adjacent the top of box 24 to pintle 22. To each end of said link 26 is pivotally connected a spring linkage 27, one of said linkages being connected to helical spring 28 and the other said linkage 27 being connected to helical spring 29. Said helical springs 28 and 29 have their axes vertically disposed and the linkage is such that when the door 20 is pushed open in either direction said springs are biased in such manner that they tend to restore the door to closed position. In order to prevent the door from slamming and possibly striking the person opening the door, two check cylinders 31 are provided, said cylinders containing horizontally slidable pistons 32, the rods 33 of which are pivotally connected to opposite ends of horizontal link 34 which is also fixed at its midpoint to pintle 22 in such manner that as the door swings, one piston 32 is moved inwardly of its cylinder 31 and the other piston is moved outwardly of its cylinder. The pistons 32 are so arranged, as well understood in this art, as to check closing movement of the door 20 and thus retard the closing action of springs 28 and 29. All of the foregoing mechanism is used in connection with the present invention, but is of conventional design. Although a preferred form of door check has been illustrated and described, it will be understood

3 that the instant invention may be used in conjunction with other types of door checks, and that the details of the door check constitute no part of the instant invention.

Pintle 22 is elongated and received at its lower end in a bearing 41 affixed to a stationary part of the building. The lower end of the pintle carries gear 42 which rotates with pintle 22. The instant invention causes rotation of said gear and said pintle 22 and thereby opens and closes door 20. Said gear 42 is rotated by means of two horizontally reciprocating racks 43 which move in opposite directions, the teeth of said racks 43 engaging the teeth of said gear 42. When the door is in closed position, each of said racks 43 is approximately at its mid-position. When the mechanism is actuated to open the door in one direction, one of said racks 43 is projected and the other retracted. When it is desired to open the door in the opposite direction racks 43 are oppositely moved. Each of said racks 43 carries at one end a rod 44, and each of said rods is received in an individual pneumatic cylinder 45 or 46 shown in detail in Fig. 5, the ends of said rods remote from said racks 43 being directly connected to pistons 47 slideable within either said cylinder 45 or 46. Packing gland 48 is disposed at one end of each said cylinder 45 or 46 to seal the opening through which rod 44 reciprocates. In order to provide an air-tight seal between said piston 47 and the inner walls of said cylinder 45 or 46, the piston is formed with a round plate 49 through which the end of rod 44 extends and on opposite sides of said plate 49 are cup-shaped packing members 51, the upturned flanges of the cup-shaped members being directed away from said plate 49. Thus, by means of a nut 52 disposed on the threaded portion 53 of said rod 44 and bearing against right-hand cup 51, as viewed in Fig. 5, and nut 54 on the threaded extremity of rod 44 bearing against left-hand cup, the cups 51 may be tightened and held in position. It will be observed that there is a port 55 at each end of said cylinder 45 or 46 through which compressed air may enter in order to drive piston 47 toward either end, and during such movement port 56 at the opposite end is arranged to discharge to the atmosphere. As has been stated, there are two such cylinders 45 and 46, one associated with each of said racks 43.

Compression and exhaust through the left and right-hand ports 55 of each of said cylinders 45 and 46 is controlled by means of two air valves 60 and 61 shown in detail in Fig. 6, valve 60 being connected by means of piping 62 to the right-hand-end port 55 of first cylinder 45 and to the left-hand-end port 56 of second cylinder 46. Valve 61 is connected to the left-hand-end port 56 of said first cylinder 45 and the right-hand-end port 55 of second cylinder 46 by piping 63. Thus, as will be seen particularly with reference to Fig. 4, valve 60 when in open position causes compression at the right-hand end of cylinder 45 and the left-hand end of cylinder 46 which causes one rack 43 to retract and the other rack 43 to project, thereby twisting pintle 22 as viewed from above in Fig. 4 in a counter-clockwise direction. The other valve 61, when in open position, results in pintle 22 being twisted in a clockwise direction. It will be seen that valve 60 (or 61) comprises a hollow tube 66 with a dividing wall 67 sealing off said tube. On either side of said wall 67 is a row of perforations 68. The outer surface of said tube 66 is smooth and slidable thereupon is a cylindrical collar or sleeve member 69, the

inner surfaces of said sleeve 69 being provided with rubber gaskets 71 which seal against the outer surface of tube 66. Compressed air from a suitable source is introduced into the sleeve member 69 through the left-hand end as viewed in Fig. 6. Because passage of said air through the tube is blocked by partition 67, the air passes out through left-hand perforations 68 into the hollow cylinder provided by the sleeve 69 which encompasses tube 66. When the sleeve 69 is in left-hand position as shown in full lines in Fig. 6, further passage of the air is blocked, and it will be seen that the other end of tube 66 (i. e., the right-hand end as viewed in Fig. 6) is open to the atmosphere by reason of right-hand perforation 68 communicating with the atmosphere. When sleeve 69 is moved to the right, i. e., to the dotted-line position as shown in Fig. 6, air entering through the left-hand end of the tube 66 passes through the left-hand perforations 68 into sleeve 69 and thence through right-hand perforations 68 into the right-hand end of the tube 66 which communicates with ports 55 of pneumatic cylinders 45 and 46.

Movement of sleeves 69 on valves 60 and 61 is controlled by solenoids 76 and 77 respectively (see Fig. 4), which are directly connected to said sleeves 69 by means of rigid rods 78 which are attached to the cores of said solenoids. Energization of solenoid 76 causes rod 78 to move sleeve 69 of valve 60 to the right and thereby apply compressed air to the right end of cylinder 45 and left end of cylinder 46 thereby moving upper rack 43 to the left and twisting pintle 22 counter-clockwise, as viewed in Fig. 4. In order to prevent overheating of said solenoids 76 and 77 bimetallic switches 81 are attached thereto and upon overheating of said switches 81 the relay circuits hereinafter described will be broken until the solenoids have cooled.

Actuation of solenoids 76 and 77 is controlled by circuits energized upon closing of micro-switches 86 and 87 located on the door 20 which are manually opened and closed. In the preferred embodiment of my invention, I employ the customary horizontal hand rails 88 or push bars which are frequently placed on doors in public buildings to actuate switches 76 and 77. As seen particularly in Figs. 7 and 8, three horizontal push bars 88 are provided which extend the full width of the door panel. The three bars 88 are connected to vertical members 89 which are pivotally connected at their lower ends to door 20 by hinges 91. A spring 92 is interposed which urges said bars 88 away from the central glass door panel 93 and a stop 94 restrains outward movement of bars 88 from the position shown in Fig. 8. Micro-switch 86 is embedded on one side of door panel 93, and switch 87 on the other side of said door. Thus when the right-hand bars 88 as viewed in Fig. 8 are touched, bars 88 are moved inwardly about the pivot of hinge 91 thereby closing switch 86. Switch 87 is provided at the other end of bars 88 in contact with left-hand bars 88 and when said left-hand bars 88 are touched, said second switch 87 is closed. Thus, a person approaching door 20 from either direction, upon touching rails 88 causes one or the other of said switches 86 and 87 to be closed, depending upon the side of the door from which the approach is made. As will hereinafter appear, if persons approach door 20 from opposite sides and touch rails 88 on opposite sides of the door at about the same time, the mechanism is brought into equilibrium and the

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door 20 must be manually opened in order to reset the relays which actuate the door.

The electrical circuits and pneumatic circuits are illustrated in Fig. 4. A source of electric current is provided which energizes the solenoids 76 and 77, preferably such source being 115 volts. Said source is carried through primary coils of transformer 101 which reduces the secondary side voltage to about 24 volts which reduced voltage is used for the relay circuits. As has been stated, thermal switches 81 are provided on solenoids 76 and 77. Assuming that said switches are closed, i. e., that the solenoids have not overheated, a ground connection is established between one contact of each of said switches 86 and 87, it being understood that both primary and secondary circuits of transformer 101 are grounded. Closing of switch 86 by manual contact completes the circuit to the other secondary pole 105 of transformer 101 through coil 102 of relay 103 and throws relay 103, as viewed in Fig. 4, to the right. This causes contacts 104 to close, and thus a circuit is completed from primary pole 107 of transformer 101 to solenoid 77 and thence to ground. This causes valve 61 to be actuated, which results in door 20 being opened in a direction opposite that from which it has been touched. A holding circuit is also closed by reason of the closing of contacts 106, one contact 106 being connected to secondary pole 105 of transformer 101 and the other contact 106 being connected to sliding contact 100 which engages a metallic segment 109 on the upper surface of gear 42, said metallic segment 109 being grounded as will be seen particularly with reference to Fig. 3. At either end of said segment 109 is an arcuate insulated segment 111. As the gear 42 rotates with pintle 22, the contact 103 engages either metallic segment 109 or insulated arcuate segment 111 depending upon the position of the door 20, and by adjustment of the respective lengths of said metallic and insulated segments 109 and 111, the amount of swing of door 20 may be varied. When the contact 103 engages insulated segment 111, the ground connection is broken. Thereupon current through coil 102 is broken and the contact between contacts 104 is broken, thereby de-energizing the solenoid 77 and allowing the door to close by action of springs 28 and 29. Similarly it will be seen that if the switch 87 is manually closed, and assuming that the thermal switch 81 is closed, coil 113 of relay 117 is closed, closing contacts 118 and energizing solenoid 76 which opens the door in the opposite direction. Similarly a holding circuit is established by reason of energizing coil 116 and closing contacts 119 which, even after release of switch 87 establishes a circuit through coil 116 so long as contact 121 engages the metallic segment portion 109 on gear 42. Immediately upon said contact 121 engaging insulated segment 111, coil 116 is de-energized and breaks contacts 119 and de-energizes solenoid 76 and closes door 20.

If two persons should approach door 20 from opposite directions at or about the same time, both switches 86 and 87 are closed and accordingly both solenoids 76 and 77 are energized. Therefore, the two cylinders 45 and 46 are in equilibrium and since equal force is applied in opposite directions to each of racks 43, door 20 remains stationary. It will be apparent from Fig. 4 that this condition will produce overheating of the coils of solenoids 76 and 77 unless the circuit is broken, but if this condition should exist, then the thermal switches 81 will break and the relays 102 and 106

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will return to normal position. However, if one person manually opens door 20 until one of contacts 108 or 121 is removed from contact with segment 109, by reason of rotation of gear 42, then one or the other of the relays 103 or 117 will be de-energized and the circuits restored to normal. It will be seen that the relative lengths of segments 109, 111 and 111 is such that either contact 108 or contact 121 is always in contact.

An alternative construction is shown diagrammatically in Fig. 9. Pintle 222 of door 220 bears gear 223 which engages rack 224. It will be observed that there is only one rack 224. Rack 224 is directly connected by rod 226 to horizontally reciprocating piston 227 in cylinder 228. Piston 227 and cylinder 228 are similar in construction to piston 47 and cylinder 46. Left-hand port 231 of cylinder 228 is connected through valve 232 to a source of compressed air, said valve 232 being controlled by solenoid 233. The right-hand 236 port of cylinder 228 is connected through valve 237 to a source of compressed air and said valve is controlled by solenoid 238. Switches 241 and 242, one pole of each of which is connected to one secondary pole 241 of transformer 242, are provided on opposite sides of door 220.

Upon closing of switch 241 current flows from pole 241 of transformer 242 through said switch 241 thence to contact 243 of relay 244. Since relay 244 is normally biased upward, contact is then established with contact 246 and thence through coil 247 of relay 248 which causes establishment of contact between contacts 249 and 251. Thereupon current flows from the primary side of transformer through the relay 248 and to contact 252 on relay 253 which is normally biased upward, thence across to contact 254 and through coil 256 of relay 257 and thence back to transformer 242. Relays 244 and 248 are arranged to latch in upper position until released, as hereinafter appears. Energization of coil 256 causes relay 257 to establish contact between contacts 258 and 259 which thereupon establishes a primary circuit through solenoid 238 which actuates valve 237 and causes piston 227 and rack 224 to move to the left as viewed in Fig. 9 and door 220 to swing to the right. When cam 261 on rack 224 contacts switch 262 it establishes a circuit from the secondary side of the transformer through the coil 263 of the latch control of relay 244 and this releases relay 244 and allows it to return to normal position and accordingly breaks the contact through solenoid 238 and restores the piston 227 to normal position.

If, on the other hand, switch 242 on door 220 is closed, relay 244 is energized and latched by reason of closing of contacts 266 and 267 of relay 247 and establishment of a current through coil 268 of relay 246 which closes contacts 278 and 279 of said relay 244 and this in turn energizes coil 269 in relay 253 which closes contacts 271 and 272 of said relay 253 which permits primary current to flow through solenoid 233, thus throwing valve 232 and moving piston 227 and rack 224 to the right, as viewed in Fig. 9, whereupon gear 223 and door 220 are revolved in a counter-clockwise direction as viewed in Fig. 9. When cam 273 on rack 224 contacts switch 274 it establishes a circuit through the secondary side which energizes unlatching coil 276 in relay 248, thus permitting relay 248 to return to normal position. This results in de-energizing solenoid 233 and closes door 220.

7 The position of cams 261 and 273 is made adjustable to govern the swing of the door.

If persons should close switches 241 and 242 simultaneously, coils 247 and 268 would both be energized. However, the latches of relays 244 and 248 are so arranged that only one can be latched at a time and the one latched continues in that condition until unlatching switch 262 or 274 is closed, which occurs only upon full opening of door 220 in one direction or the other. Thus door 220 opens fully in the proper direction depending upon which switch is actuated first.

Although the present invention has been described in some detail by way of illustration and example, it is understood that certain changes and modifications may be made within the spirit of the invention and scope of the appended claims.

I claim:

1. In combination, a door in a doorway, a pintle, said door being arranged to swing about said pintle from closed to open position, a door check biasing said door toward closed position, a gear train comprising a gear on said pintle and a slidable rack meshing with said gear arranged to swing said door to open position, fluid means connected to said rack, valve means controlling said fluid means to control movement of said rack, a solenoid controlling said valve means, a relay controlling energization of said solenoid, a switch, said switch being operable to energize said relay to open said door, an electrical contact and an insulated portion fixed for movement with said gear train, a sliding contact adjacent said electrical contact and said insulated portion, and holding means in said relay arranged to continue energization of said solenoid, said sliding contact being arranged to de-energize said solenoid upon said door swinging through a predetermined angle such that said sliding contact breaks contact with said electrical contact and engages said insulated portion.

2. The combination of claim 1 which also comprises means mechanically actuated by said door to disengage said holding means.

3. In combination, a door in a doorway, a pintle, said door being arranged to swing about said pintle from closed position to an open position on either side of said doorway, a door check connected to said pintle biasing said door toward closed position, a gear on said pintle, a slidable rack meshing with said gear arranged to swing said door into either open position, fluid means connected to said rack, valve means controlling said fluid means to control movement of said rack in either direction, a first and a second solenoid controlling said valve means, a first and a second relay controlling energization of said solenoids, a first and a second switch located on opposite sides of said door and supported thereon each manually actuated upon physical contact, one said switch energizing said first relay and the other said switch energizing said second relay, an arcuate electrical contact fixed to said gear, insulated zones on said gear at either end of said arcuate electrical contact, a first and a second sliding contact adjacent said gear, holding means in each of said relays arranged to continue energization of said solenoids, said sliding contacts being arranged to de-energize said holding means upon said door swinging through a predetermined angle such that said sliding contacts break contact with said arcuate electrical contact and enter one of said insulated zones.

4. In combination, a door in a doorway, a pintle, said door being arranged to swing about said pintle from closed to open position, a door check connected to said pintle biasing said door toward closed position, a gear on said pintle, a linearly slidable rack meshing with said gear arranged to swing said door to open position, pneumatic means connected to said rack, valve means controlling said pneumatic means to control movement of said rack, a solenoid controlling said valve means, a relay controlling energization of said solenoid, a switch on said door and manually actuated upon physical contact, said switch energizing said relay to open said door, an arcuate electrical contact fixed to said gear, an insulated zone on said gear, a sliding contact adjacent said gear, and holding means in said relay arranged to continue energization of said solenoid, said sliding contact being arranged to de-energize said solenoid upon said door swinging through a predetermined angle such that said sliding contact breaks contact with said arcuate electrical contact and enters said insulated zone.

5. In combination with a door supported hingedly within a doorway for swingable movement to open position to either side of said doorway, driving means for opening said door in either direction, a first electrical means arranged upon energization to actuate said driving means appropriate to cause said door to normally swing open to one side of said doorway through a predetermined angle, second electrical means arranged upon energization to actuate said driving means appropriate to cause said door to normally swing open to the other side of said doorway through a predetermined angle, a first switch on one side of said door energizing said first electrical means, a second switch on the opposite side of said door for energizing said second electrical means, a first holding relay in circuit in said first electrical means arranged to continue energization of said first electric means, a second holding relay in circuit in said second electric means to continue energization of said second electrical means, said first and second electrical means and said driving means being balanced to hold said door in equilibrium when said first contact switch is actuated and said second contact switch is actuated before said door has swung through said predetermined angle, and a de-energizing switch arranged to de-energize said first and second holding relays after said door has been swung through said predetermined angle in either direction.

6. In combination, a door in a doorway, a pintle, said door being arranged to swing about said pintle from closed position to an open position on either side of said doorway, means biasing said door to closed position, a gear train rotating said pintle, said gear train comprising a pinion on said pintle and a reciprocable rack arranged to swing said door to open position on either side of said doorway, fluid means connected to said rack, valve means controlling said fluid means to control movement of said rack in either direction, a first and a second solenoid controlling said valve means, a first and a second relay controlling energization of said solenoids, a first and a second switch located on opposite sides of said door, one said switch energizing said first relay and the other said switch energizing said second relay, an electrical contact portion and an insulated portion at each end of said electrical contact portion, said electrical contact portion and said insulated portion all

being movable with one of the elements of said gear train, a first and a second sliding contact positioned adjacent said electrical contact portion and said insulated portions, holding means in each of said relays arranged to maintain energization of said solenoids, said sliding contacts being arranged to de-energize said holding means upon said door swinging through a predetermined angle such that said sliding contacts break contact with said electrical contact portion and engage one of said insulated portions.

7. The combination of claim 6, in which said holding means are arranged to continue energization of both said solenoids after one of said switches has been actuated and the other of said switches has been actuated before said door has swung through said predetermined angle whereby said fluid means is maintained in equilibrium thereby maintaining said door stationary until said door is manually swung through said predetermined angle.

8. In combination, a door in a doorway, a pintle on said door, said door being arranged to swing about said pintle from closed position to an open position on either side of said doorway, a door check connected to said pintle biasing said door toward closed position, a gear on said pintle, a slidable rack meshing with said gear arranged to swing said door into either open position, fluid means connected to said rack, valve means controlling said fluid means to control movement of said rack in either direction,

a first and a second solenoid controlling said valve means, a first and a second relay controlling energization of said solenoids, a first and a second switch located on opposite sides of said door and supported thereon each manually actuated upon physical contact, one said switch energizing said first relay and the other said switch energizing said second relay, holding means in each of said relays arranged to continue energization of said solenoids until said door has swung through a predetermined angle, a third switch at one end of the linear movement of said rack, and a fourth switch at the opposite end of the linear movement of said rack, said third and fourth switches being arranged to de-energize said holding means upon said door swinging through said predetermined angle such that said rack contacts said third or said fourth switch.

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