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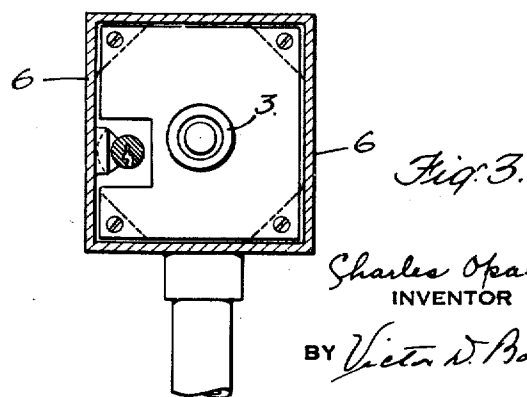
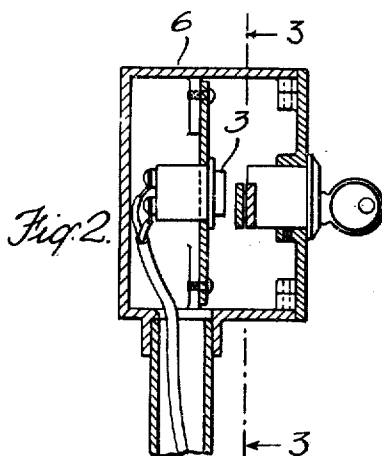
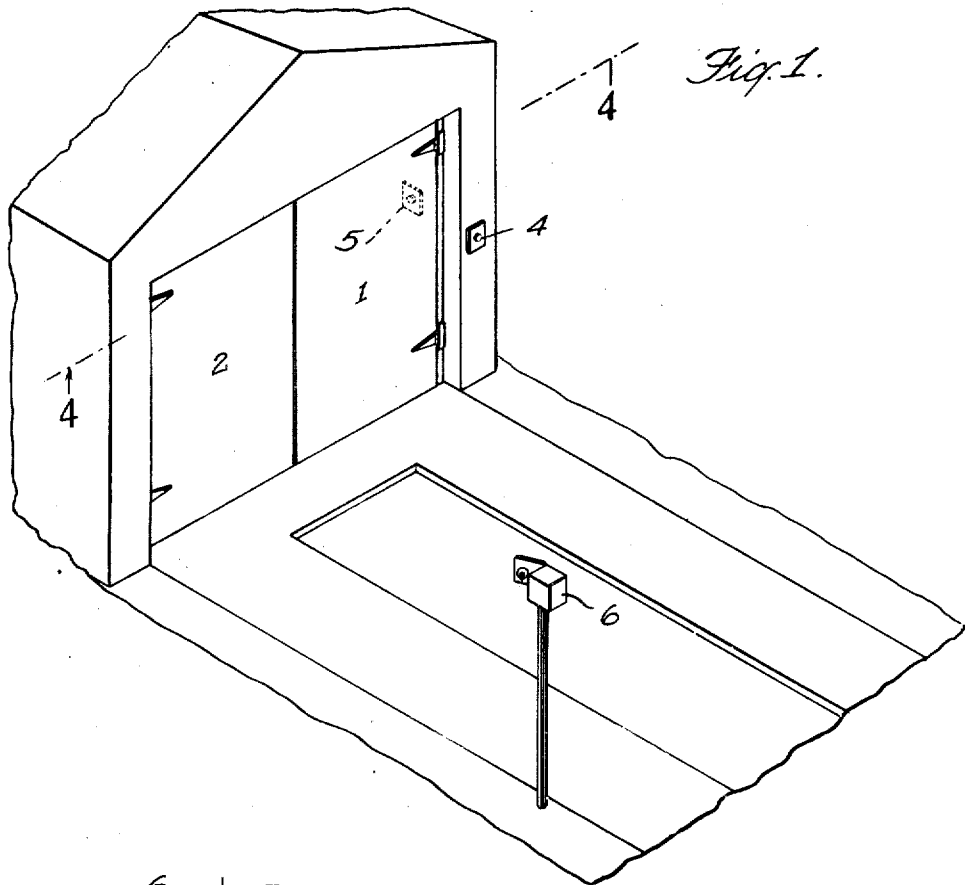
C. OPALEK

2,366,048

DOOR OPERATING MECHANISM

Original Filed June 4, 1942

4 Sheets-Sheet 1



Charles Opalek
INVENTOR

BY Victor D. Borst
ATTORNEY

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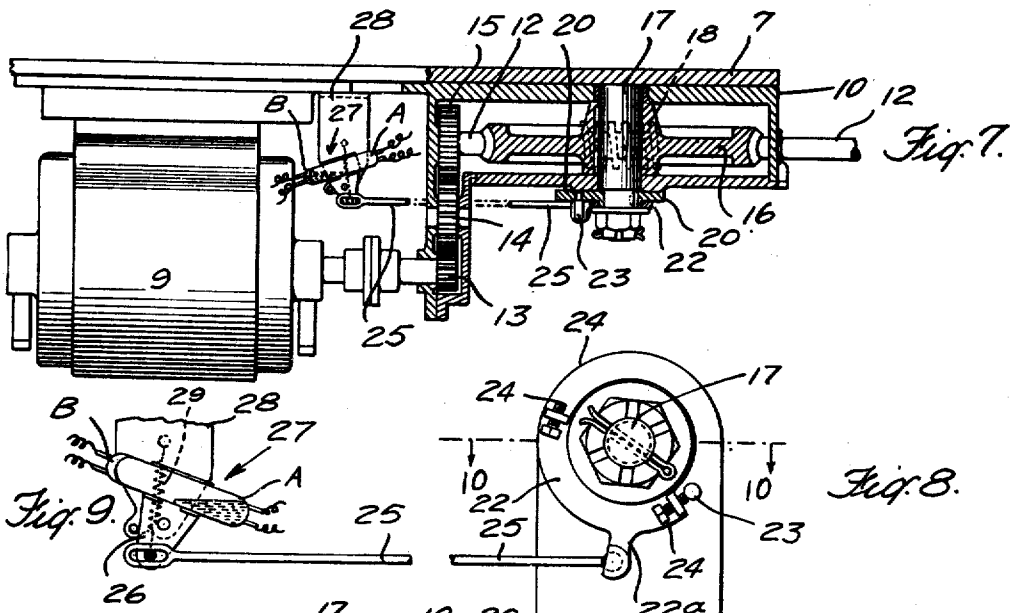
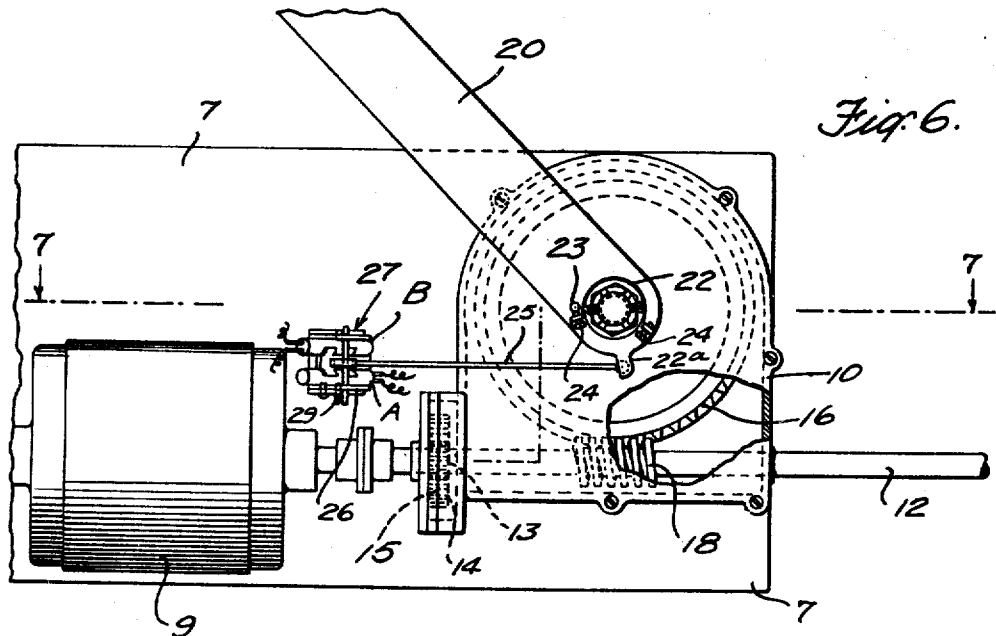
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INVENTOR
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4 Sheets-Sheet 4

Fig. 11.

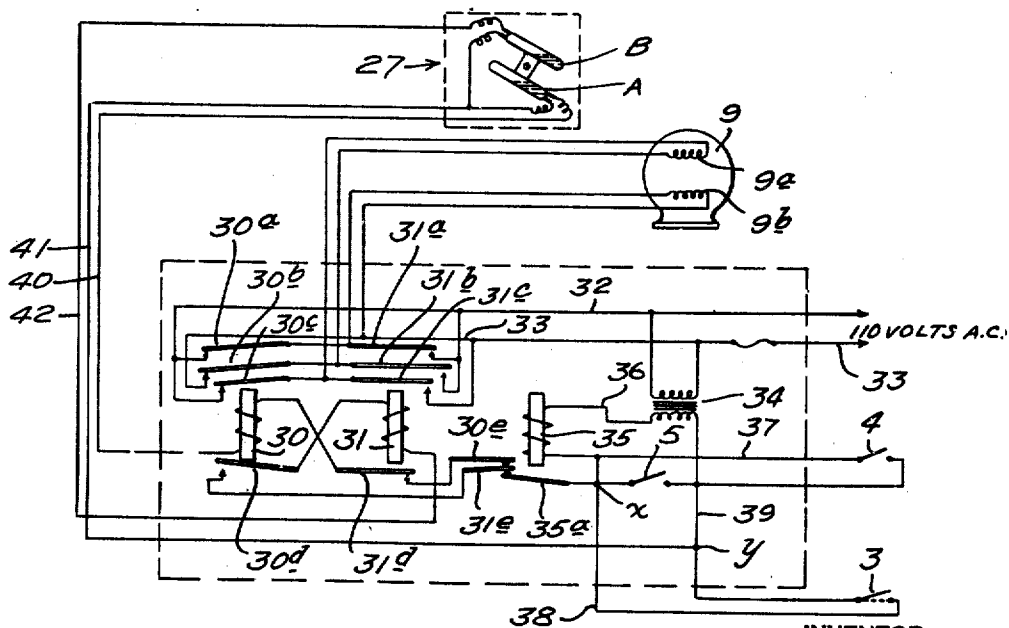
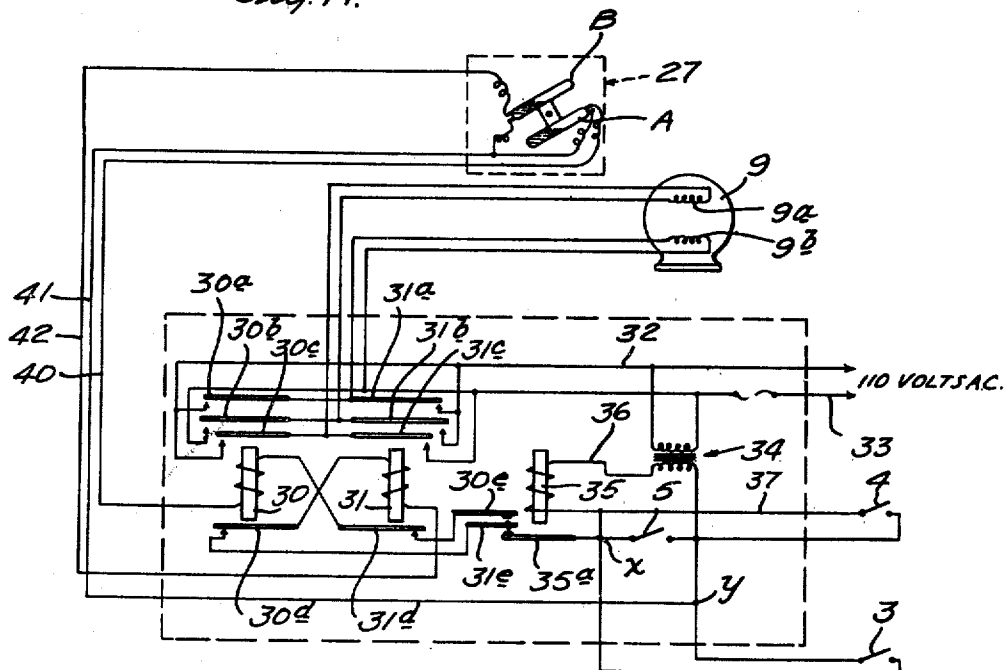


Fig. 12.

INVENTOR
Charles Opalek
BY Victor D. Borot
ATTORNEY

UNITED STATES PATENT OFFICE

2,366,048

DOOR OPERATING MECHANISM

Charles Opalek, Brooklyn, N. Y.

Original application June 4, 1942, Serial No. 445,691. Divided and this application September 20, 1943, Serial No. 503,023

3 Claims. (Cl. 268—63)

The automatic door operating mechanism of this invention is of especial utility in opening and closing garage doors in that it enables the operator to open or close the doors from a position in the car outside the garage, but the advantages are of general application to single or double doors which are hinged.

This application is a division of my copending application Serial No. 445,691, filed June 4, 1942, for Door operating mechanism.

The door actuating mechanism is designed to afford the most efficient leverage and to lock the doors securely in open and closed positions. In the type of mechanical construction which is preferred and which is used for illustration, an electric motor through a reduction gearing including a worm and worm wheel operates a toggle which connects the worm wheel shaft with the door, and the design is such that in both open and closed position the three pivots are in a straight line. If there are two doors the worm shaft is continued across the door opening and has two worms operating two worm wheels, each connected to its individual door. By well known means the length of the worm shaft may be adjustable to accommodate doors of different size.

The electric motor is preferably of the split phase type having two windings one of which is used for reversing the direction of rotation of the motor. The controlling circuit for the motor therefore includes separate contacts for the two windings, those for the one winding being unidirectional and those for the other winding being selectively operable to reverse the connections with the power leads. Selector relays govern the function of the reversing contacts and the energization of these relays is selectively controlled by a reversing switch operated by the door closing mechanism. A transformer furnishes the low voltage current for the selector relays.

The operation is initiated by a manual switch such as a push button. This energizes an electro-magnet which closes other contacts for the selector relays and thus connects the relays to the secondary of the transformer, but the push button shunts the selector relays so long as it is closed. Since the electro-magnet is in series with the selector relays when the contacts governed by it are closed, the electro-magnet remains energized when the button is released.

As will be seen, one advantage of this is the fact that the doors may be stopped at any intermediate position by merely pushing the button. In practice several conveniently located push but-

tons connected in parallel control the energization of the electro-magnet and the shunting of the selector relays.

5 A convenient form of reversible switch is a double mercury switch, one being closed when the other is open. The switch may be operated by a rod that is reciprocated with the movement of the door, the actuation being imparted to it just at the end of the door movement. This sets up the circuit so that the motor will always run in the right direction when a button is pushed.

10 There are many additional advantages in the door operating mechanism of this invention which will appear from the following particular description of the construction illustrated in the accompanying drawings.

15 Fig. 1 is a perspective view of a portion of a building including a pair of hinged doors to which the invention is applied, and the adjacent section of the driveway with a post having an operating button in a lock box mounted thereon.

Fig. 2 is an enlarged section of the box.

20 Fig. 3 is a sectional elevation of the same on line 3—3 of Fig. 2.

25 Fig. 4 is a horizontal section through the doors showing the doors open and a bottom plan view of the operating mechanism as viewed by one standing in the doorway and looking up and as indicated by the line 4—4 of Fig. 1.

30 Fig. 5 is a view the same as Fig. 4 but showing the doors closed and the operating parts correspondingly positioned.

Fig. 6 is an enlargement partially in section of the operating mechanism as shown in the left 35 side of Fig. 4.

Fig. 7 is a sectional elevation on the broken line 7—7 of Fig. 6.

40 Fig. 8 is a detail in plan of the switch operating crank and associated parts, the parts being in the closed position of the door.

Fig. 9 is a detail in elevation of the mercury switch and immediately adjacent parts, the switch being reversed from the position shown in Fig. 7.

45 Fig. 10 is a sectional plan on line 10—10 of Fig. 8.

50 Figs. 11 and 12 are wiring diagrams, the parts in Fig. 11 being in the position they occupy when the doors are open, and in Fig. 12 the position they occupy when the doors are closed and one of the control buttons is closed.

The doors 1 and 2 are hinged and open outwardly. Three operating buttons numbered 3, 4 and 5 are shown, though obviously this number 55 will be suited to the particular needs. The but-

ton 3 is on a post alongside the driveway and for safety sake is shown in a lock box 6, the box being shown open in Fig. 1. Consistently of course the button 4 which is also outside the building should be similarly safeguarded. If desired instead of enclosing in a lock box the switch may be key operated. The button 5 is located on a wall inside the building.

The operating mechanism is preferably supported at the top of the door frame upon plates 7 and 8, one near each door, as shown. An electric motor 9 and a gear box 10 are supported upon the plate 7, and another gear box 11, similar to the gear box 10, is supported upon the plate 8. The motor drives a worm shaft 12 through reduction gearing consisting of a pinion 13 on the motor shaft, an idler 14 and a gear 15 on the worm shaft. In each gear box is a worm wheel 16 keyed on shaft 17 which has bearings in the top and bottom of the gear box. The worm shaft 12 has a worm 18 on it engaging each worm wheel. A coupling joint 19 of standard construction in the worm shaft makes its length adjustable to suit different widths of doors.

The worm wheels 16 are operatively connected to their respective doors through toggles, as shown. These toggles consist of two arms 20 and 21 pivotally joined at one end and their opposite ends attached the one to the worm wheel shaft 17 and the other to the door. The rotation of the shaft 17 therefore operates the toggle to open and close the door. The toggle and operating mechanism are so designed that the three pivot points are in a line both when the door is open and closed, as appears from Figs. 4 and 5. This assures positive locked condition in both positions. The worm drive is irreversible and the doors are therefore securely braced against an extraneous closing force, such as the wind.

Through the reversing switch the door stops the motor and sets the circuit in position to cause the motor to turn in the opposite direction when a button is pushed, at the instant when the toggle arms are in line. This is controlled through a crank member 22 loosely pivoted on a hub on the arm 20 and having a cut-away portion to provide a lost motion effect in the relative movements of the arm and crank. A pin 23 on the arm 20 is positioned to strike the shoulders formed by the cut-away, the effective positions of which are made adjustable by means of screws 24 that engage in outwardly disposed lugs coinciding with the shoulders. A crank arm 22a has a ball and socket joint connection with one end of a rod 25 the other end of which has an eye and pin connection with an arm 26 of a double mercury switch 27 pivoted on a bracket 28 on the plate 7. The slot or eye in the end of the rod 25 allows for a degree of lost motion, and a spring 29 attached at one end to the bracket arm 28 in line with the pivot of the switch, and at its other end to the pin in the eye, causes the switch to snap over center.

The arm 20 is keyed to the shaft 17 and is held in place by a washer and nut, as shown. The spacing is such that the crank member 22 is sufficiently loose to rotate freely. In the closed condition in which the arms 20 and 21 are folded, as appears in Fig. 5, the arms must be spaced to allow for the projecting end of the shaft 7 with the washer and nut thereon. A suitable spacer at the pivot joint of the arms is provided for this purpose.

The mercury switch 27 has two switch elements A and B oppositely disposed so that one is on open contact when the other is closed. In the position shown in Fig. 7 the switch element B has its contacts closed, and in the position shown in Fig. 9 the element A has its contacts closed.

The electric circuit is shown in the diagrams of Figs. 11 and 12. The mercury switch elements A and B respectively control selector relays 30 and 31. Each of these operates three normally open contacts and one normally closed contact. The normally open or front contacts of relay 30 are numbered 30a, 30b and 30c, and the normally closed or back contact is numbered 30d. The corresponding contacts of relay 31 are numbered 31a, 31b, 31c and 31d, respectively. The front contacts control the energization of the two windings of the motor 9, namely, the reversing winding 9a and the unidirectional winding 9b. Each back contact is in circuit with the other solenoid winding and hence the energizing of one solenoid cuts the other one out.

The leads of winding 9a are connected in parallel across contacts 30b, 31b and 30c and 31c. The leads of winding 9b are connected across the power leads 32 and 33 through contacts 30a and 31a in parallel, the fixed contacts of which are both connected with the lead 32.

The connection of the fixed contacts of contacts 30b and 30c with the power leads are reversed relative to those of contacts 31b and 31c. Therefore if solenoid 30 is energized the motor winding 9a is energized 180° out of phase with its energization when solenoid 31 is energized.

The selector relays are energized by a step-down transformer 34. Their connection with the secondary of the transformer includes contacts 30e and 31e, respectively, which coact jointly with armature 35a of electromagnet 35 which may be termed the initiating relay, to close the circuit. Therefore in order for the selector relays to be energized the relay 35 must be energized. As shown the armature 35a acts mechanically to move contact 31e into engagement with contact 30e, and thus when the armature is attracted the two selector relays are in parallel circuit with armature 35a which is conductive and connected into the low voltage circuit, as will appear.

The relay 35 is energized by pushing any one of the push buttons 3, 4 and 5. These are connected in parallel in circuit with the secondary of the transformer and the winding of relay 35, and in shunt with the circuit of selector relays 30 and 31. It will be seen that these two circuits branch at the points x and y. Therefore when a button switch is closed the selector relay circuit the mercury contact of which is closed, is set up but is short circuited by the closed button switch so long as the button is held in. Upon release of the button the particular selector relay picks up and energizes the two motor windings. The motor runs and operates the doors until the mercury switch is reversed.

It is apparent that if it be desired to stop the doors in an intermediate position, this can be done by merely pushing a button which short-circuits the selector relay that is then controlling. When the cause for stopping the movement of the doors has ceased, the button is released and the motor resumes its movement in the same direction.

Fig. 11 shows the condition when the system

is entirely deenergized and the motor circuits are open. The mercury switch is in the position it occupies when the doors are open.

In Fig. 12 the mercury switch is reversed and hence the doors are closed. The mercury contact element A is on contact. This is the one that governs relay 30.

The initiating circuit is indicated by dotted line as having been closed at button 3. This circuit comprises the secondary of transformer 34, wire 36, winding 35, wire 37, wire 38, button 3, and wire 39 back to the transformer. This causes armature 35a to be attracted and to make parallel contact with selector relay circuit contacts 30e and 31e. This sets up the circuit of relay 30 from points x and y as follows: from point x through armature 35a, contact 30e, back contact 31d, winding of relay 30, wire 40, mercury switch contact A, common wire 41 back to point y. From these points the transformer secondary and the winding of relay 35 are in circuit in shunt with button 3, and hence the relay 30 does not become energized until the button is released.

This release energizes relay 30 and the contacts are attracted as shown in Fig. 12. This connects the motor winding into the power circuit in the manner above described.

With the doors open and the mercury switch element B closed, as shown in Fig. 11, the pushing of a button sets up the circuit of selector relay 31 in the following manner: from point x through armature 35a, contact 31e, back contact 30d, winding of relay 31, wire 42, contact B, and common wire 41 back to point y.

Thus there is provided a simple and reliable control system that has few operating parts and is inexpensive, and is entirely safe in its operation. Also the mechanics of the door operating mechanism make it simple but at the same time thoroughly dependable and efficient in its operation.

If desired suitable means may be provided for quickly detaching the automatic mechanism from the doors, in case there is need to move the doors independently, and such means will readily suggest themselves.

It is obvious that changes may be made in the construction shown in the drawings and above particularly described within the principle and scope of the invention.

I claim:

1. For a swinging door, an operating mechanism comprising a reversible electric motor, a

reversing switch arranged selectively in control of the operation of said motor, a worm operated by the motor, a worm wheel driven by the worm, toggle arms having one end of the toggle fixed on the worm wheel shaft and the other end attachable to a door, a crank member loosely pivoted on the worm wheel shaft, a lateral pin on the adjacent toggle arm, circumferentially spaced peripheral projections on the crank arm in the path of the pin and cooperative with the pin to impart a partial rotation to the crank with each extreme movement of the toggle arm, and a rod operatively connecting the crank and reversing switch.

2. For a swinging door, an operating mechanism comprising a reversible electric motor, a shaft, reduction gear means actuated by said motor to drive said shaft, toggle means comprising a pair of pivoted links, one of said links being actuated by said shaft, the other of said links being attachable to said door, said links being so arranged that the toggle is on center in one position when said door is fully open and is on center in the other direction when said door is closed so that said door is thus locked in either position by said links, a member loosely journaled on said shaft, means on said link to actuate said member when said link approaches either limit of its motion, a reversing switch, and a linkage means interconnecting said member and said switch to reverse said switch at each actuation of said member.

3. For a swinging door, an operating mechanism comprising a reversible electric motor, a shaft, reduction gear means actuated by said motor to drive said shaft, toggle means comprising a pair of pivoted links, one of said links being actuated by said shaft, the other of said links being attachable to said door, said links being so arranged that the toggle is on center in one position when said door is fully open and is on center in the other direction when said door is closed so that said door is thus locked in either position by said links, a crank member loosely pivoted on said shaft, a lateral pin on the adjacent link, circumferentially spaced peripheral projections on said crank arm in the path of the pin and cooperative with the pin to impart a partial rotation to the crank with each extreme movement of the toggle link, a reversing switch, and a rod operatively connecting the crank and reversing switch.

CHARLES OPALEK.