

Oct. 20, 1970

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3,534,499

DOOR OPENING APPARATUS

Filed Jan. 27, 1969

2 Sheets-Sheet 1

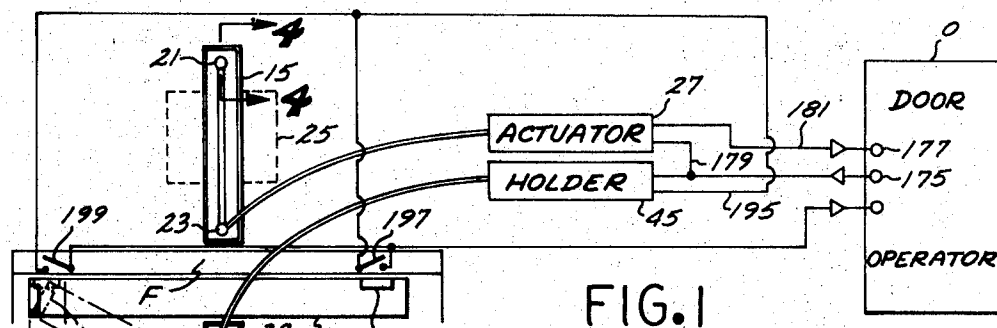


FIG. 1

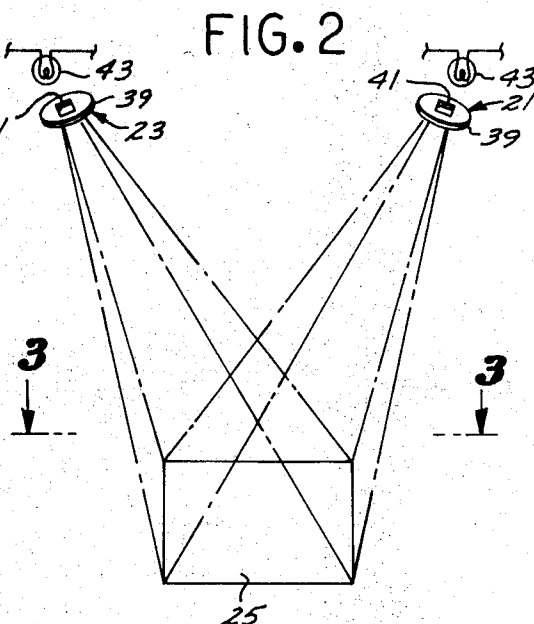


FIG. 2

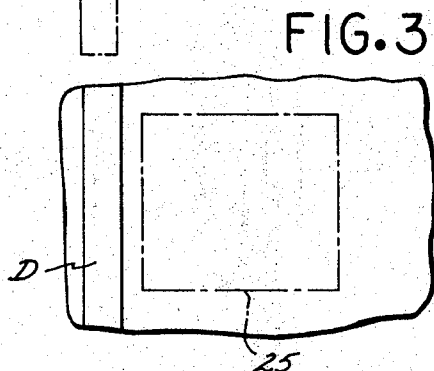


FIG. 3

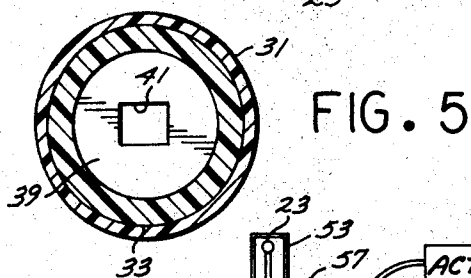


FIG.4

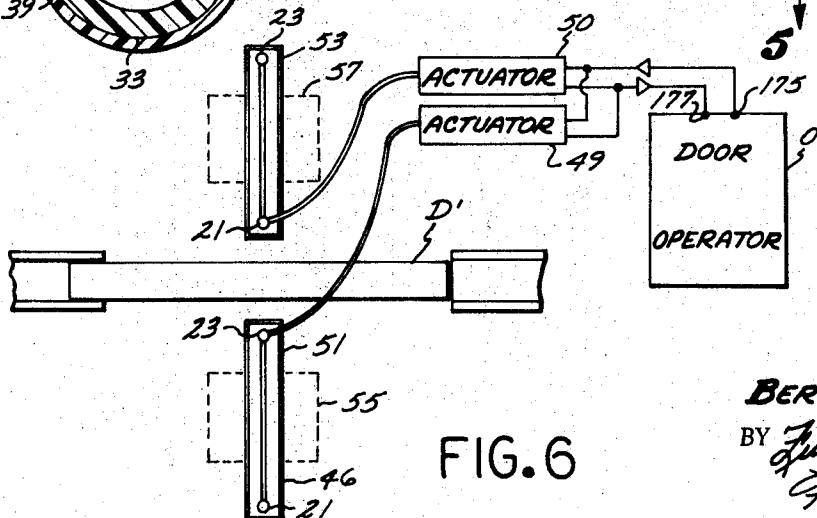


FIG. 5

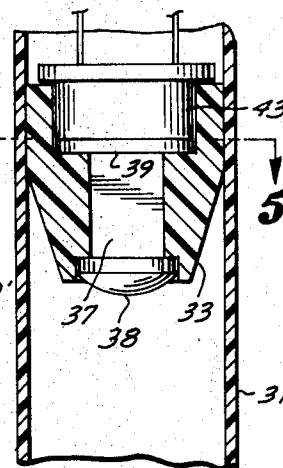


FIG. 6

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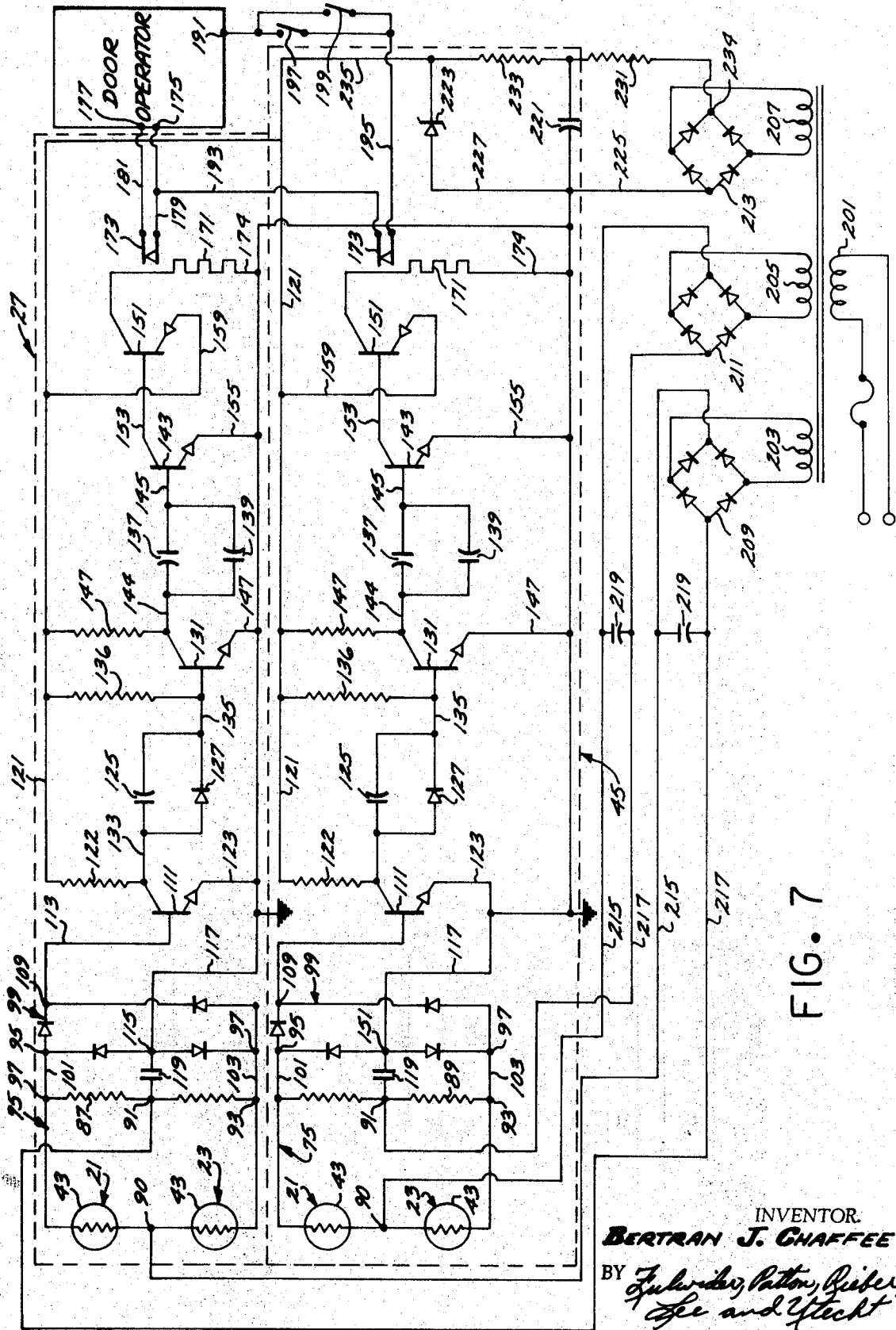
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3,534,499

DOOR OPENING APPARATUS

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7 Claims

ABSTRACT OF THE DISCLOSURE

A door opening apparatus including a pair of spaced apart photoelectric cells supported over the pathway to a door to be opened, both cells being focused on and sensing light reflected from a common area of the pathway. The photocells are in electrical circuitry with means which compares the radiant energy received by each and when the differential in energy reaches a predetermined level such means will actuate a door operator to open the door. Thus, as long as light being reflected from the common area is uninterrupted the light reaching the cells will be the same but when an object enters the pathway, the amount of light reaching the individual cells will differ and the operator will be actuated to open the door.

BACKGROUND OF THE INVENTION

Field of the invention

The present invention relates to an automatic door opening apparatus which is actuated in response to changes in radiant energy.

Description of prior art

Prior art door openers have utilized mats which operate in response to the weight of a person walking thereon but such mats are undesirable because they wear out rapidly: collect dirt, water and ice, causing deterioration of materials and electrical shorting of wiring incorporated therein and because the floor in which they are to be installed must be re-configured. Various other door opening apparatuses, including single photoelectric cells, have been proposed but these apparatuses are characterized by the disadvantages that they actuate in response to any ambient light changes, such as shadows or darkness, and many require artificial light sources.

SUMMARY OF THE INVENTION

The door opening apparatus of the present invention is characterized by a pair of spaced apart radiant energy sensing devices which are disposed on one side of a pathway to a door and are both focused on a common area on the opposite side of the pathway. The devices are in electrical circuitry with means which responds to the devices sensing different amounts of light whereby when a shadow falls on the common area both devices are affected the same and the door remains unactuated. However, when an object passes into the pathway of one, or both, of the devices, each of the devices will receive a different amount of energy thereby activating door opening means.

The objects and advantages of the present invention will become apparent from the following detailed description when taken in conjunction with the appended drawings.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a diagrammatic view of a door opening apparatus embodying the present invention;

FIG. 2 is a diagrammatic view of the radiant energy sensing devices included in the apparatus shown in FIG. 1;

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FIG. 3 is a horizontal sectional view taken along the lines 3—3 of FIG. 2;

FIG. 4 is a vertical sectional view, in enlarged scale, taken along the lines 4—4 of FIG. 1;

FIG. 5 is a horizontal sectional view taken along the lines 5—5 of FIG. 4;

FIG. 6 is a diagrammatic view of a second embodiment of the door opening apparatus of the present invention;

FIG. 7 is a diagrammatic view of an electrical circuit that may be utilized with the door opening apparatus shown in FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The door opening apparatus shown in FIG. 1 includes a mounting beam 15 mounted centrally above and projecting outwardly from the door frame F of the door D to be opened. The beam 15 mounts a pair of photoelectric devices 21 and 23 which are focused on a common area 25 of the approach-way to the door D whereby a person walking along the pathway to the door will pass between such devices and the area 25. The photocell devices 21 and 23 are included in electric circuitry of an actuator 27 which compares the light received by such photocells and actuates the door D in response to an object passing onto the area 25. Thus, a shadow falling on the area 25, or any portion thereof, will cause an equal reduction in the radiant energy reaching each of the photocell devices 21 and 23 and the associated actuator 27 will not be actuated. However, when an object having height passes onto the area 25 or any portion thereof, such object will occupy more of the sensing field of one of the devices 21 or 23 than the other thereby causing a different amount of light to reach one device than the other and causing the actuator 27 to open the door D.

Referring to FIG. 1, the door D is manipulated by operator O which is shown separately therefrom for clarity. Referring to FIGS. 4 and 5, the sensing devices 21 and 23 include a light shield in the form of hollow cylindrical housing 31 having fittings 33 mounted therein. The fittings 33 are formed with axial light passages 37 having optical lenses 38 mounted at the front thereof for directing light rearwardly through a filter 39 having a square aperture 41 therein for passage of light to the photocell 43 itself. Thus, the area 25 of the approach-way sensed by the device 21 at ground level is slightly rectangular and is identical to and superimposed on the area 25 sensed by the device 23.

Referring to FIG. 1, a holder 45 is connected with photocell devices 21 and 23 carried on a support beam 46 mounted centrally over the exit-way from the door D and are focused on a common area 47 of the exit-way from such door. As will be more fully described hereinafter, the holder 45 renders the door opener O inoperable whenever the door D is fully open or closed, and an object enters on the area 47 whereby such object will be protected from swinging of the door D.

The sliding door D' as shown in FIG. 6 is controlled by a pair of door actuators 49 and 50, each similar to the actuator 25, to separately actuate a door operator O'. Beams 51 and 53 project outwardly and inwardly, respectively, from opposite sides of the door and each mounts a pair of photoelectric devices 21 and 23. The devices 21 and 23 on the inside of the door D' sense light from a common area 55 on the inside approach-way to the door, and an object interrupting the light reflected from such area triggers the actuator 49 to actuate the operator O. Similarly, the devices 21 and 23 mounted on the beam 53 sense the light reflected from a common area 57 of the outside approach-way to the door D' and actuate the actuator 50 in response to a light interruption.

Referring to FIG. 7, the actuator 25 and holder 45 include identical circuitry and consequently only the circuitry for the actuator 27 will be described in detail, it being understood that such description also pertains to the holder 45. The actuator 27 includes a photocell-resistance bridge, generally designated 75, and comprised of the pair of photocells 43 included in the respective sensing devices 21 and 23 and a pair of resistors 87 and 89. The bridge 75 includes a pair of input terminals 90 and 91 and a pair of output terminals 92 and 93 which are connected to input terminals 95 and 97, respectively, of a diode bridge 99 by leads 101 and 103, respectively. One output terminal 109 of the diode bridge 99 is connected to the base of a transistor 110 by a lead 113 and the other output terminal 115 is connected to ground by a lead 117. The input terminal 91 of the bridge 75 is also connected to the ground lead 117 by a lead including a capacitor 119 to provide an AC ground path. A positive lead 121 is connected with the collector of the transistor 111 through a resistor 122 and the emitter is grounded through a lead 123. A condenser 125 and diode 127 are connected in parallel between the collector of the transistor 111 and the base of a second transistor 131 by leads 133 and 135, the base lead 135 being connected with the positive lead 121 through a resistor 136.

A pair of capacitors 137 and 139 are connected in parallel between the collector of the transistor 131 and the base of a third transistor 143 by means of leads 144 and 145. The collector of the transistor 131 is connected with the positive lead 121 through a resistor 147 and the emitter is grounded through a lead 147. The transistor 143 is directly coupled with a fourth transistor 151 by a lead 153, the emitter of the transistor 143 being grounded through a lead 155. The emitter of the transistor 151 is connected with the positive lead 121 by a lead 159 and the collector is connected with one side of a coil 171 of a relay, including a switch 173, the other side of such coil being grounded by a lead 174. The terminals of the switch 173 are connected with positive and negative terminals 175 and 177 of the door operator O by leads 179 and 181.

As indicated hereinabove, the circuitry included in the holder 45 is identical with that included in the actuator 27 and the switch 173 of the controlled relay is connected with positive and negative terminals 175 and 191, respectively, of the operator O by means of leads 193 and 195. A pair of normally open magnetically actuated safety switches 197 and 199 are connected in parallel and included in the lead 195, such switches being carried on the frame forming the opening for the door D. Magnets 201 and 203 are mounted at the top of the door D near its free end and pivoted end, respectively, and hold the switches 197 and 199 closed when the door is fully closed or fully open.

Power is provided to the actuator 25 and holder 45 from an AC power source 201 which induces power in three secondary coils 203, 205 and 207. The coils 203, 205 and 207 are connected across the input terminals of diode rectifiers 209, 211 and 213 and the output terminals of the rectifiers 203 and 205 are connected to the positive and negative input terminals 81 and 83, respectively, of the photocell resistor bridges 75 in the actuator 25 and holder 45 by leads 215 and 217; filtering capacitors 219 being connected across such leads. A filtering capacitor 221 and a diode 223 are connected in parallel with the rectifier 207 by leads 225 and 227 and resistors 231 and 233, the positive terminal 234 of such rectifier being connected with the positive leads 121 of the actuator 27 and holder 45 through the resistors 231, 233 and lead 235.

In operation, the door opening apparatus shown in FIG. 1 is responsive to objects having height being disposed on the area 25 and is not actuated by shadows falling on such area. When an object having height approaches the door D and enters into the viewing field (FIG. 2) of the photocell devices 21 or 23, the light being

received by one of the photocells 43 will be less than the light being received by the other, thereby unbalancing the bridge 75. Such unbalancing will provide a potential between the output terminals 92 and 93 thereby effecting a potential across the input terminals 95 and 97 of the diode bridge 99 and providing a triggering potential at the base of the transistor 111. Triggering of transistor 111 provides a voltage across the capacitor 125 and diode 127 and presents a triggering potential at the base of the second transistor 131. It will be clear that as long as the photocell devices 21 and 23 receive different amounts of radiant energy the condenser 125 will prevent fluctuation of the base voltage to the transistor 131 thereby maintaining such transistor triggered. However, when the photocells 21 and 23 again are balanced by the object moving off the area 25 the diode 127 will provide rapid restoration and maintain the operator O unactuated.

Triggering of the transistor 131 provides a potential across the capacitors 137 and 139 and when the discharge potential of such condensers is reached a triggering potential will be imposed on the base of the transistor 143 thereby triggering such transistor and providing a triggering potential to the base of the direct coupled transistor 151 energizing the relay coil 171. It will be clear that the capacitors 137 and 139 provide a relatively high resistance thereby preventing triggering of the transistor 143 until a predetermined potential is reached thus avoiding sporadic actuation of the operator O. Energization of the coil 171 closes the switch 173 thereby passing current from the door operator terminal 175 to the terminal 177 and initiating opening of the door D. Without other interruptions the door D will open and remain open for a predetermined period of time, thereafter being returned to its closed position by the operator O.

Referring to FIGS. 1 and 7, it will be recalled that the photocell devices 21 and 23 included in the holder 45 are focused on the common area 47 of the exitway from the door D. Thus, when a person approaches the door D from the exit side the photocell bridge 75 will be unbalanced thereby closing the associated relay switch 173 and, if either of the safety switches 197 or 199 are closed, providing current from the positive terminal 175 to the holding terminal 191 of the operator O. This renders such operator inoperable and holds the door closed. Thus, an individual standing on the exit side of the swinging door D is protected against a second person approaching from the opposite side and actuating the actuator 27 to open the door D causing it to strike and injure such individual. As noted above, the magnetically operated safety switches 197 and 199 are closed only when the door is either fully closed or fully opened whereby the operator O will be rendered inoperable only when the door is in one of such positions thus preventing the holder 45 from interrupting actuation of the operator O during its opening or closing cycle.

From the foregoing it will be apparent that door opening apparatus of present invention is economical to manufacture and install and provides reliable operation with little or no maintenance. Such apparatus avoids accidental operation by fluctuations of ambient light and does not rely on artificial light sources.

Various modifications and changes may be made with regard to the foregoing detailed description without departing from the spirit of the invention or the scope of the following claims.

I claim:

1. Automatic door opening apparatus for use with an operator connected with the door to be opened and responsive to an electrical signal to open said door, said apparatus comprising:

a pair of spaced apart radiant energy sensing devices disposed on one side of the pathway to said door and sensing radiant energy from a substantially common area on the opposite side of said pathway whereby both said radiant energy sensing devices

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will normally receive the same amount of radiant energy;
 electrical circuitry connecting said radiant energy sensing devices with said operator and including means for comparing the respective amounts of energy received by said radiant energy sensing devices and responsive to a predetermined differential in said amounts of radiant energy to emit said electrical signal whereby said door is opened upon movement of an object along said pathway and between said common area and said devices.

2. Door opening apparatus as set forth in claim 1 wherein:
 said radiant energy sensing devices include light shields having similar apertures for admitting light from said common area only.

3. Door opening apparatus as set forth in claim 1 wherein:
 said radiant energy sensing devices are disposed over the approach-way to said door and said common area is on said approach-way.

4. Door opening apparatus as set forth in claim 1 wherein said operator is rendered inoperable in response to an electrical holding signal and that includes:
 a second pair of spaced apart radiant energy sensing devices disposed on one side of the pathway from said door and sensing radiant energy from a second common area on the opposite side of said pathway from said door whereby said second pair of radiant energy sensing devices will each normally receive equal amounts of radiant energy; and
 electrical circuitry connecting said second pair of radiant energy sensing devices with said operator and including means for comparing the respective amounts of radiant energy received by said second pair of sensing devices and responsive to a second predetermined differential in said amounts of radiant energy to emit said electrical holding signal whereby said door is held closed upon movement of an ob-

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ject along said pathway from said door and between said second common area and said second pair of devices.

5. Door opening apparatus as set forth in claim 4 that includes:
 a safety switch in series with said door holder and said operator, said switch being of the normally open type; and
 means responsive to said door being fully closed to close said safety switch.

6. Door opening apparatus as set forth in claim 4 that includes:
 a safety switch in series with said door holder and said operator, said switch being of the normally open type; and
 means responsive to said door being fully open to close said safety switch.

7. Door opening apparatus as set forth in claim 5 that includes:
 a second safety switch connected in parallel with said first mentioned safety switch, said switch being of the normally open type;
 means responsive to said door being fully open to close said second switch.

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U.S. Cl. X.R.

49—31; 250—206; 307—116; 317—124