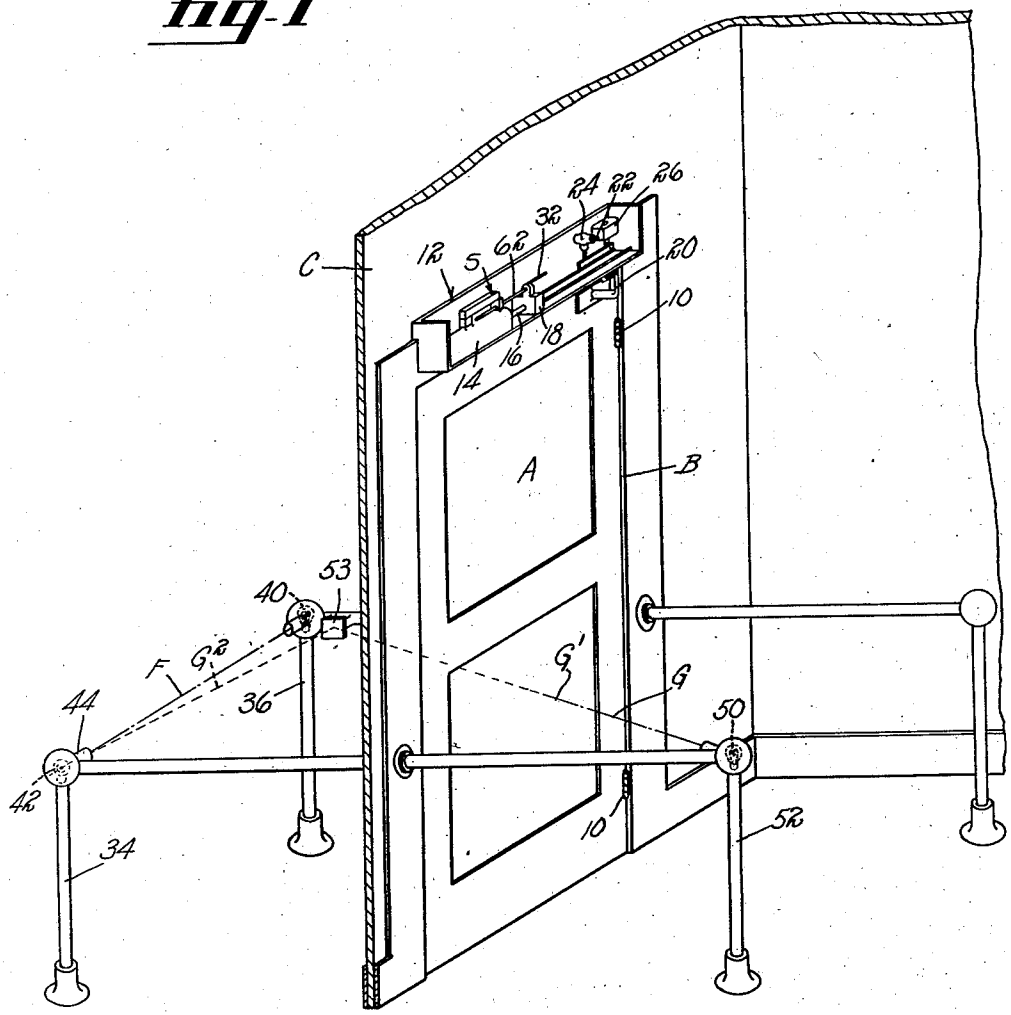
July 23, 1940. S. S. ROBY 2,208,564

APPARATUS FOR OPERATING DOORS

Filed Feb. 11, 1939 2 Sheets-Sheet 1

Fig-1



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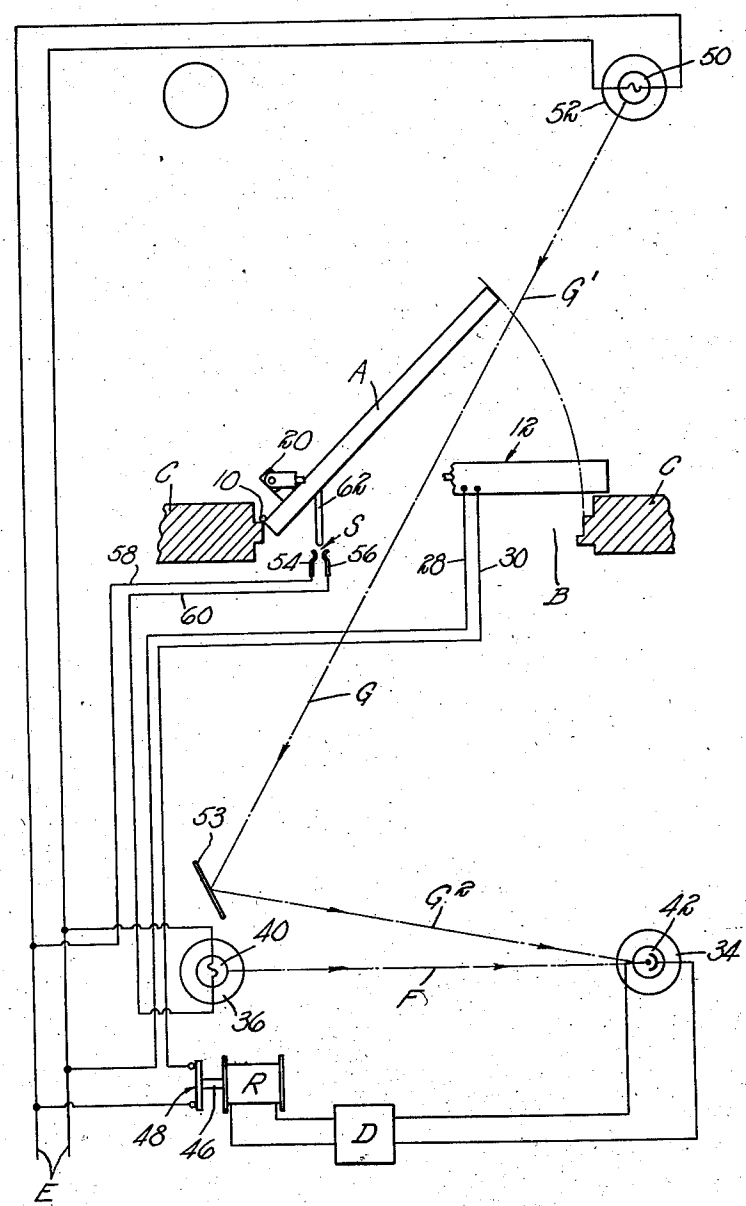
Filed Feb. 11, 1939 2 Sheets-Sheet 2

Fig-2



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APPARATUS FOR OPERATING DOORS

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8 Claims. (Cl. 268—1)

The present invention relates to automatic door opening and closing apparatus of the character which is controlled by the interruption of a beam or beams of light, and more particularly to the type of apparatus illustrated in the copending application to the same inventor, Serial No. 56,069 filed December 24, 1935.

The aim of the present invention is to provide in apparatus of the character described in said application an improved and simplified arrangement wherein the time interval during which the door remains open is automatically controlled by the person or persons passing through the door, thus permitting free and uninterrupted operation through the doorway, while at the same time preventing injuries to the persons passing through the doorway by the door closing on them while in the range of movement of the door.

More particularly, an object of the invention is to provide certain improvements in the construction shown in said application and especially to provide, in combination with the mechanism shown therein for opening and closing the door, a single light sensitive device which is adapted to be responsive to a light beam extending transversely of the door and a compound light beam extending through and transversely of the door, and switch means associated with the door closing and opening operating mechanism and adapted to render one of said beams ineffective when the other of said beams has been rendered effective. By the utilization of a single light sensitive means, the cost of manufacture may be materially reduced, while still maintaining the maximum factor of safety obtained by the arrangement shown in the above-indicated copending application.

Other objects will be in part obvious and in part pointed out more in detail hereinafter.

The invention accordingly consists in the features of construction, combination of elements, and arrangement of parts which will be exemplified in the construction hereafter set forth and the scope of the application of which will be indicated in the appended claims.

In the accompanying drawings:

Figure 1 is a perspective view of a door set in a wall or partition showing the application to the door of a door operating apparatus constructed in accordance with this invention; and

Fig. 2 is a more or less schematic view of the improved door operating apparatus and the electical circuits whereby same is controlled by the light sensitive means.

Referring to the drawings in detail, there is illustrated a door A mounted on hinges 10 and adapted to close a doorway B in a partition C. In the construction illustrated, the door swings open to the right as viewed in Fig. 1. Immediately above the doorway is a casing, generally indicated at 12, enclosing a suitable door operating mechanism. This mechanism is of the same type as that shown in the above-indicated application, and only so much thereof as is necessary to a clear understanding of the invention will be shown and described herein.

The mechanism comprises generally a pneumatic or hydraulic cylinder 14 in which there is provided a suitable piston for operating a piston rod 16, which rod is operatively connected to a cross head 18. The cross head 18 is in turn connected by suitable linkage to an arm 20 secured to the door adjacent the hinged edge thereof, whereby it will be swung to open and closed position as the cross head 18 is moved transversely of the casing 12.

The admission of the controlling medium to the cylinder 14 from the supply line 22 is controlled by a bleed valve 24, which valve is operated by a solenoid or electric magnet 26 connected through suitable leads 28 and 30 (see Fig. 2) to a source of electric energy E. The cross head 18 is further provided with an arm 32 so arranged that when the door is completely opened the solenoid 26 is tripped to close the valve 24, whereupon the door will immediately be moved to closed position by suitable springs or the like (not shown).

In order to provide for the energization of the electric magnet 26 and the consequent operation of the door operating mechanism upon the approach of a person to the door, there is provided a light sensitive means adapted to be affected by the interruption of a beam of light F directed across the path leading to the doorway. In the illustrated disclosure, there is provided a pair of spaced stanchions 34 and 36, each of said stanchions being preferably connected to the adjacent side of the doorway by a suitable railing member 38. In the stanchion 36, there is provided an incandescent bulb 40 which projects the beam of light F, and in the opposite stanchion 34 there is mounted the light sensitive means, such as the photoelectric cell 42 provided with a shield 44 so that substantially the only light it receives is that which is directed thereupon by the established light beams.

As in the copending application, the photoelectric cell 42 is electrically connected to an amplifier D which is in turn connected with the coil 45

of a relay R; the relay being so arranged that whenever the light sensitive cell 42 is energized by an established light beam, the coil 45 of the relay R is energized to lift the armature 46 thereof and maintain the switch 48 open. Whenever the light sensitive cell is darkened by the interception of the light beam directed thereon, the coil of the relay R is deenergized, allowing the armature to drop and close the switch of the relay. As indicated, the switch 48 of the relay is in series with the leads 28 and 30 of the solenoid 26, and whenever the switch 48 of the relay is closed by the deenergization of the coil upon the darkening of the light sensitive cell, the solenoid 28 is energized by power supplied from the source E, and the operating mechanism will move the door to its open position.

With the arrangement so far described, having a single beam F in front of the door and across the path leading thereto, the door will be completely closed after it has been opened (unless another person again intercepts the light beam), and the closing movement of the door would be in no way dependent upon the speed with which a person passes through the doorway. With such an arrangement, it would be necessary that the door have a predetermined movement allowing for such a fixed interval as to permit slow persons to pass through the door without inconvenience and possible injury.

In order to place the closing movement of the door under the automatic and unconscious control of the person or persons passing through the doorway and thus prevent injury to those passing through the doorway, while permitting that the door be closed as soon as practical, there is provided a second light source consisting of an incandescent light 50 mounted or positioned in a stanchion 52 located to the opposite side of the wall or partition from the stanchions 34 and 36 and diagonally opposite to the stanchion 36.

The light source 50 is adapted, when the door has opened a predetermined distance, to project a beam of light G diagonally through the doorway and onto a mirror 53 (which, in practical construction, would be positioned in the stanchion, but, for purposes of clear illustration, has been shown as positioned outside and adjacent same). The mirror is so arranged that the beam will be deflected transversely of the doorway and onto the light sensitive means or photoelectric cell 42 and in effect reestablishing the beam F. With this arrangement, there is provided, when the door is opened, a compound beam G having an interdependent portion G—1 extending diagonally through the doorway and portion G—2 extending transversely of the doorway, which beam, when established, likewise energizes the light sensitive means 42 to open the relay switch 48 and render the door operating mechanism ineffective to open the door. Thus if anyone is passing through the door after the compound beam is established and intercepts either portion G—1 or G—2 thereof, the light sensitive means will cease to be affected thereby and will become deenergized and thus render the door operating means effective to open or maintain open the door A.

However, it is necessary to render the tranverse beam F inoperative when the compound beam becomes operative; otherwise, upon the beam F being reestablished after a person passes same, it would maintain the cell 42 energized and the compound beam G would be ineffective. In order to do this, there is diagrammatically shown a switch S comprising a pair of spaced contacts 54 and 56 arranged in series with the leads 58 and 60 connecting the incandescent light means 40 to the source of electric supply E. When the door A is in closed position, the contacts are closed by a jumper 62, and the jumper maintains same closed until the door has moved to a predetermined open point, allowing the compound beam G to project through the open doorway. Upon the establishment of the compound beam G, the switch S opens to cut out bulb 40 and light beam F. However, inasmuch as portion G—2 of the compound beam extends transversely of the doorway, the device will remain under the full and unconscious control of one or more persons passing therethrough. Obviously as the door A moves to closed position, the closing of switch S will reestablish the transverse beam F just prior to the cutting out of the compound beam G. Thus at no time will anyone approaching the door fail to intercept a transverse light beam, and thus a maximum degree of safety is maintained.

From the foregoing description taken in connection with the accompanying drawings, it will be obvious that when the door is closed the incandescent bulb 40 is in circuit and establishes the beam of light F which maintains the photoelectric cell 42 energized, and the door opening and closing mechanism is thus under the sole control of the transverse beam F. However, the incandescent bulb 50 is also energized, but the beam thereof is intercepted by the door and thus does not reach the photoelectric cell 42. Thus when a person intercepts the light beam F, the cell 42 is deenergized, resulting in the deenergization of the relay R and the energization of the electric magnet 26, whereupon the valve 24 is open and the door mechanism will then swing the door towards its open position. When the door is opened a predetermined extent and out of the path of the light beam G, the beam G will also fall on the photoelectric cell 42 and the door opening and closing mechanism will then be under its control. However, when the door has opened to such an extent, the switch S will be opened to cut the bulb 40 out of circuit and thus cut out the transverse beam F and render the door operating mechanism under the sole control of the beam G.

Thus if the person is passing through the door very slowly, he will intercept the diagonal branch G—1 of the compound beam G and again deenergize the photoelectric cell, whereupon the door will remain in its open position, or, if it has started to swing to closed position, it will again open to full position. If the person has passed completely through the door and the door is swinging to closed position but has not intercepted the beam G—1 at the time a second person approaches, the second person will intercept the branch G—2 of the compound beam, whereupon the door will again swing open. Thus, by making the light sensitive cell 40 responsive to a compound beam, whereby the interception of either branch thereof would deenergize the cell, the door, after being swung to a predetermined position, will always be maintained under the unconscious control of the persons passing therethrough.

As many changes could be made in the above construction and many apparently widely different embodiments of this invention could be made without departing from the scope thereof, it is intended that all matter contained in the above description or shown in the accompanying

drawings shall be interpreted as illustrative and not in a limiting sense.

It is also to be understood that the language used in the following claims is intended to cover all of the generic and specific features of the invention herein described and all statements of the scope of the invention which, as a matter of language, might be said to fall therebetween

I claim as my invention:

1. A door operating device comprising mechanism for opening and closing a door, means for establishing a beam of light transversely of the path leading to the doorway, means for rendering said beam of light ineffective upon opening of the door a predetermined distance, means for establishing a compound beam of light extending diagonally through and transversely of the doorway when said door has been opened a predetermined distance, a light sensitive device responsive to each of said established light beams and affected upon interruption of the established light beam to render said mechanism operative to open the door.

2. A door operating device comprising mechanism for opening and closing a door, means for establishing a beam of light transversely of the path leading to the doorway, means for rendering said beam of light ineffective upon opening of the door a predetermined distance, means for establishing a compound beam of light having one branch extending diagonally through the door and another branch extending transversely of the door when said door has been opened a predetermined distance, a light sensitive device responsive to said transverse beam and affected upon interception thereof to render said mechanism operative to open the door, said light sensitive device also being responsive to said compound beam and affected upon interruption of either branch thereof to render said mechanism operative to open the door.

3. A door operating apparatus comprising mechanism for opening and closing the door, controlling means for said mechanism including an electrical device, means at one side of the door for directing a beam of light transversely of the path leading to the doorway, a photoelectric cell responsive to said beam of light and electrically connected to said device for rendering said mechanism operative to open the door, means associated with the movement of the door for electrically disconnecting said light directing means when the door has been opened to a predetermined position, and means at the other side of the door for directing a second beam of light diagonally through and transversely of the doorway to said photoelectric cell after the door has been opened to said predetermined position to energize said photoelectric cell.

4. A door operating apparatus comprising mechanism for opening and closing the door, provided with means for rendering said mechanism operative to close the door after the door has been opened a predetermined distance, controlling means for said mechanism including an electrical device, means for directing a beam of light transversely of the path leading to the doorway, a photoelectric cell responsive to said beam of light and electrically connected to said device for rendering said mechanism operative to open the door and to maintain it open so long as the beam of light is interrupted, means associated with the movement of the door for electrically disconnecting said light directing means when the door has been opened to said predetermined position, and means for directing a second beam of light through and transversely of the doorway to said photoelectric cell after the door has been opened to said predetermined position to energize said photoelectric cell and providing a second beam of light adapted to be interrupted to cause said photoelectric cell to render said device effective to operate said mechanism to open the door and maintain the door open as long as the beam is interrupted.

5. A door operating apparatus comprising mechanism for opening and closing the door, provided with means for rendering said mechanism operative to close the door after the door has been opened a predetermined distance, controlling means for said mechanism including an electrical device, means for directing a beam of light transversely of a path leading to the doorway, a photoelectric cell responsive to said beam of light and electrically connected to said device for rendering said mechanism operative to open the door and maintain it open so long as the beam of light is interrupted, means associated with the movement of the door for electrically disconnecting the light directing means when the door has been opened to said predetermined position, reflecting means opposite said cell, and means for directing a second beam of light through the doorway to said reflecting means to be reflected to said photoelectric cell after the door has been opened to said predetermined position to re-energize said photoelectric cell.

6. A door operating apparatus comprising mechanism for opening and closing the door, controlling means for said mechanism including an electrical device, means at one side of said door for directing a beam of light transversely of the path leading to the doorway from one side of the path, a photoelectric cell at the other side of the path responsive to said beam of light and electrically connected to said device for rendering said mechanism operative to open the door, means associated with the movement of the door for electrically disconnecting said light directing means when the door has been opened to said predetermined position, reflecting means adjacent said light directing means for reflecting a beam of light to said photoelectric cell, and means at the other side of the door adjacent the side of the path where said photoelectric cell is located for directing a second beam of light through the doorway to said reflecting means after the door has been opened to said predetermined position to re-energize said photoelectric cell.

7. A door operating apparatus comprising means for opening and closing the door provided with means rendering said mechanism operative to close the door after the door has been opened to a predetermined distance, controlling means for said mechanism including an electrical device, means at one side of the door for directing a beam of light transversely of the path leading to the doorway from one side of the path, a photoelectric cell at the other side of the path responsive to said beam of light and electrically connected to said device for rendering said mechanism operative to open the door and to maintain it open so long as the beam of light is interrupted, means associated with the movement of the door for electrically disconnecting said light directing means when the door has been opened to said predetermined position, reflecting means adjacent said light directing means adapted to reflect a beam of light to said photoelectric cell, and means at the other side of the door and at

the side of the path where said photoelectric cell is located for directing a second beam of light diagonally through the doorway to said reflecting means after the door has been opened to said predetermined position, whereby said reflecting means directs a third beam of light to energize said photoelectric cell, said second light directing means and reflecting means providing a pair of beams of light directed through the path of the doorway adapted to be interrupted to cause said photoelectric cell to render said device effective to operate said mechanism to open the door and maintain the door open as long as one of the pair of beams is interrupted.

8. A door operating device comprising a mechanism for opening and closing a door, means for establishing a beam of light transversely of the path leading to the doorway, a light sensitive device responsive to said transverse beam and effective upon interception thereof to render said mechanism operative to open the door, means for rendering said transverse beam of light ineffective upon opening of the door a predetermined distance, means for establishing, upon opening of the door a predetermined distance, a pair of light beams, one extending diagonally through the door and one transversely thereof, said light sensitive device being responsive to said pair of beams when both of said beams are established and effective upon interruption of one of said beams to render said mechanism operative to open the door.

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