

- [54] **SMOKE AND FIRE DETECTOR FOR AUTOMATIC ELEVATOR SYSTEM**
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- [58] Field of Search..... 187/29; 318/480; 337/401; 200/61.02, 61.03

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[57] **ABSTRACT**

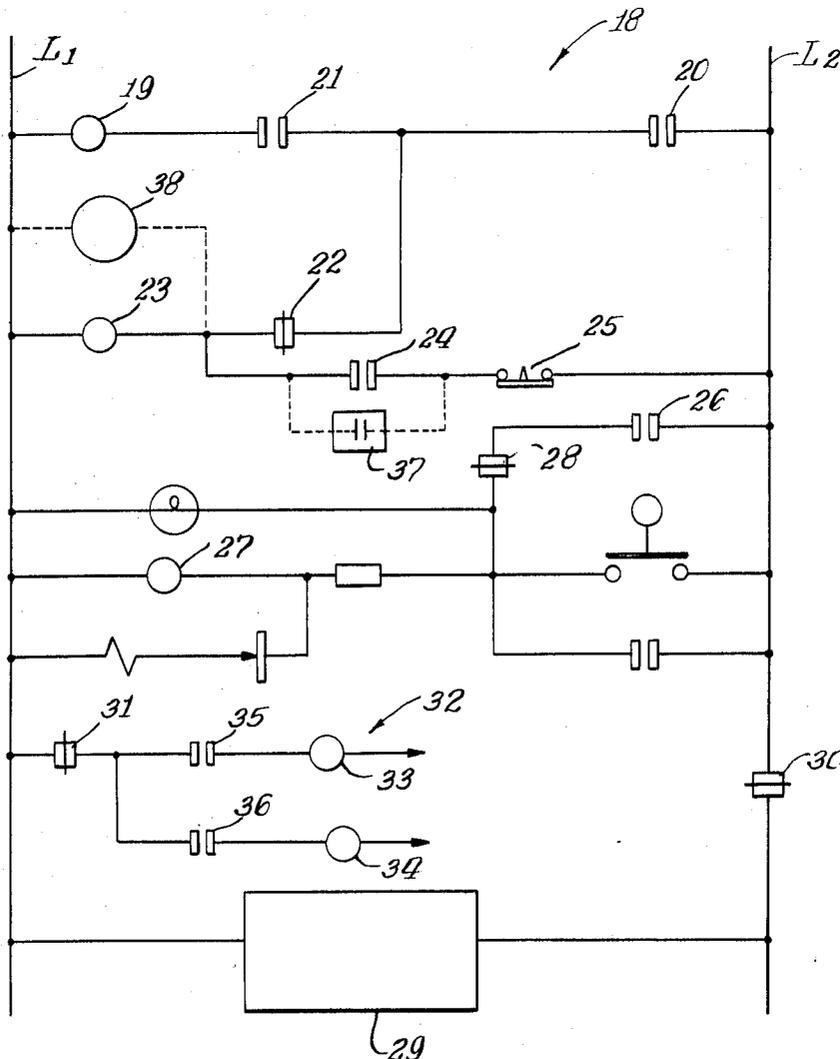
An automatic elevator system having photoelectric means for preventing closing of the elevator door upon detection of an obstruction in the doorway. The system includes control means associated with the photoelectric means for detecting the presence of smoke in the elevator hatchway and conditioning the system as a result of such detection for an emergency mode of operation. The control means further includes means for detecting an abnormally high temperature in the hatchway for similarly conditioning the system. The system may be so conditioned as to cause the elevator car to automatically move to a preselected floor level, such as the main floor level, under such abnormal hatchway conditions.

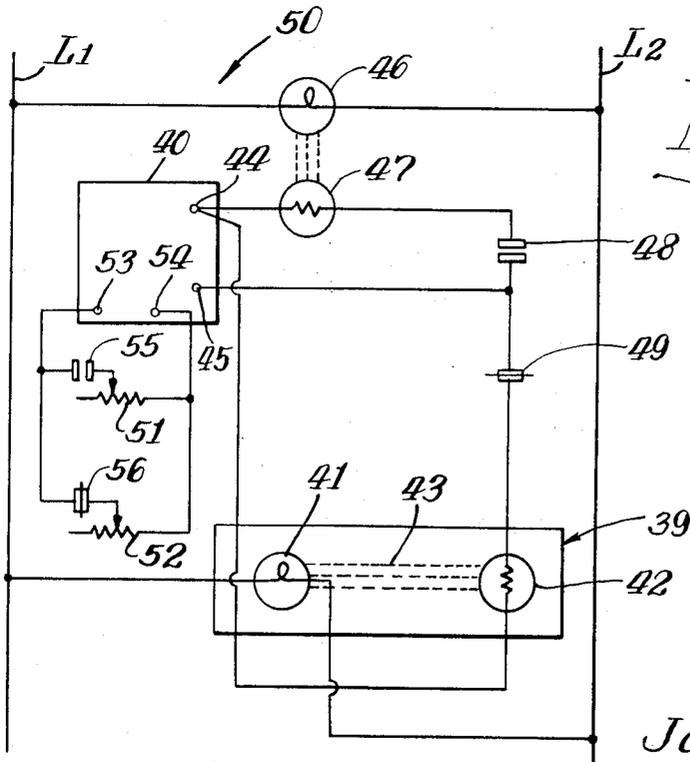
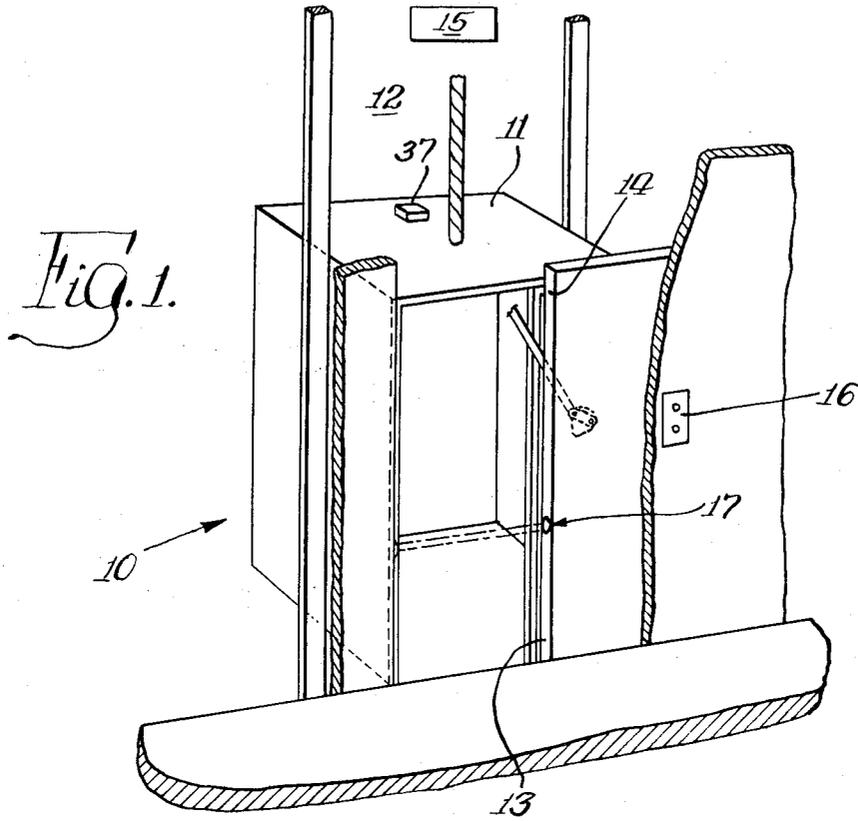
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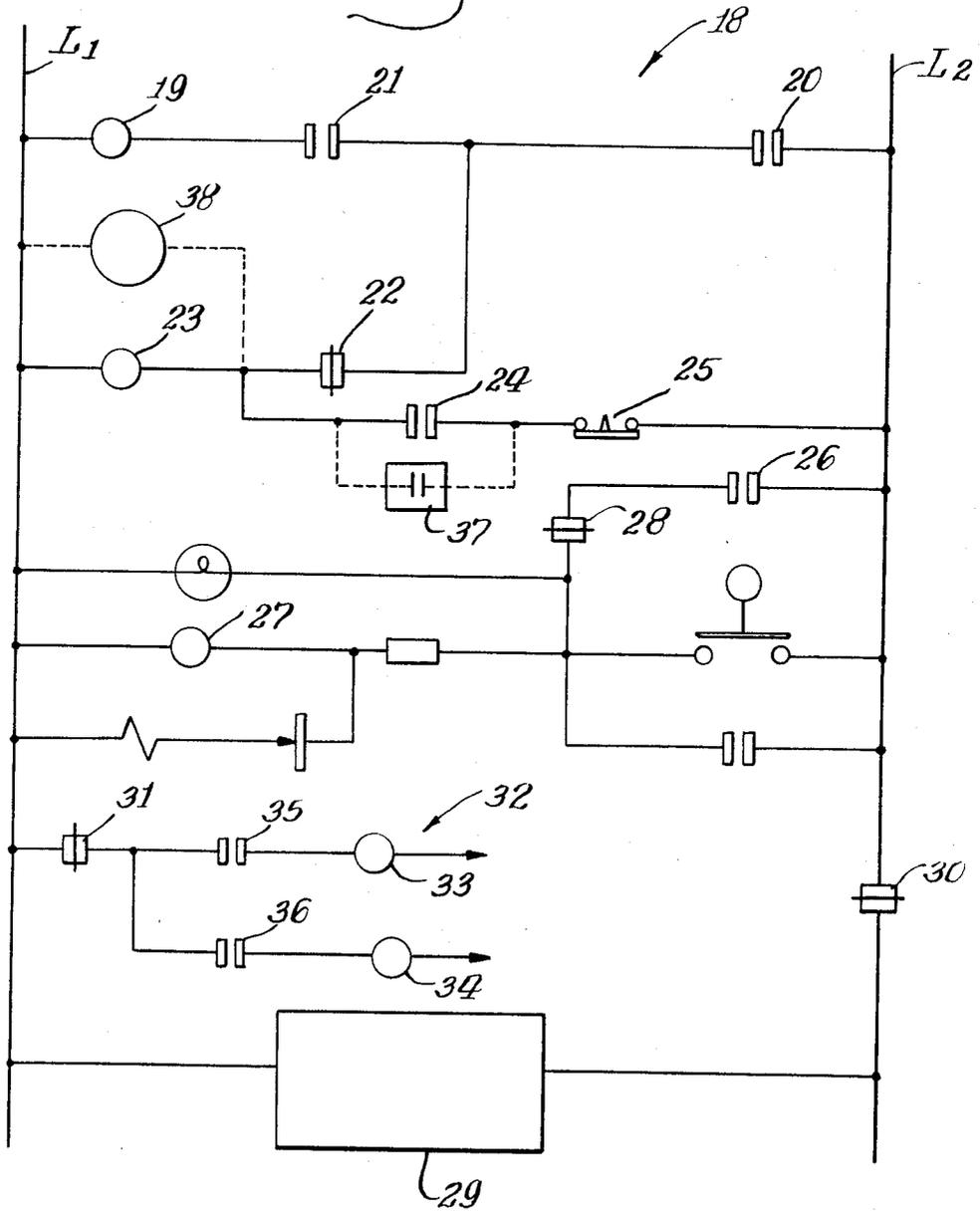
**11 Claims, 3 Drawing Figures**





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Fig. 2.



## SMOKE AND FIRE DETECTOR FOR AUTOMATIC ELEVATOR SYSTEM

### BACKGROUND OF THE INVENTION

#### 1. Field of the Invention

This invention relates to automatic elevator systems and in particular to means for controlling such systems under abnormal conditions such as where smoke or high temperature conditions obtain in the hatchway.

#### 2. Description of the Prior Art

In conventional automatic elevator systems, the elevator cars are called by suitable manipulation of control means at the respective floor levels. Such calling of the cars may be effected notwithstanding the presence of abnormal conditions in the hatchway such as the presence of smoke or high temperatures therein. It has recently been determined to be desirable to provide in combination with the controls of such automatic elevator cars, means for detecting the presence of smoke and high temperatures in the hatchway and causing automatic disposition of the cars at a preselected floor level.

In conventional automatic elevator controls, door closure control safety devices have been employed utilizing photoelectric means for detecting the presence of an obstruction such as a person in the doorway when the door is open or is closing. Responsive to the detection of the presence of such an obstruction, the control either keeps the door open or causes it to reverse direction, as the case may be, permitting the obstruction to be removed before the closing of the door is subsequently effected. The door safety photoelectric means, however, has not been used for any secondary purpose such, for example, as smoke detection.

Known systems for detecting smoke or excessive heat in an elevator hatchway and modifying elevator operation include separate photoelectric devices mounted on top of an elevator car for sensing the presence of smoke, and fusible link means, also mounted on top of the car for high temperature detection. Both are interconnected with the elevator control circuit to cause cars to return to the main floor.

### SUMMARY OF THE INVENTION

The present invention comprehends the utilization of the conventional door-closing photoelectric control means in a novel manner for use in detecting the presence of smoke in the hatchway when the door is closed while permitting the photoelectric means to operate in the normal manner of detecting obstructions when the door is open and in the closing operation mode.

Alternatively, a second photoelectric control means may be provided with suitable switching, permitting the normal photoelectric control means to function in the normal obstruction-detection manner and the second photoelectric control means to provide the smoke detection functioning. The two photoelectric control means utilize a common signal receiving and amplifying means for providing suitable control signals as an incident of the different condition detections.

The invention further comprehends the provision of high temperature sensing means which may be associated with the control for the door-closing obstruction-detection means to provide automatic emergency control of the elevator car as a result of the detection of a high temperature condition in the hatchway.

### BRIEF DESCRIPTION OF THE DRAWINGS

Other features and advantages of the invention will be apparent from the following description taken in connection with the accompanying drawings wherein:

FIG. 1 is a fragmentary perspective view of an elevator car and hatchway landing in an automatic elevator system embodying the invention;

FIG. 2 is a schematic wiring diagram illustrating a preferred form of control for effecting automatic emergency conditioning of the elevator system as the result of a detection of smoke and/or high temperature in the hatchway; and

FIG. 3 is a schematic wiring diagram illustrating a modified form of control for effecting such emergency conditioning of the system.

### DESCRIPTION OF THE PREFERRED EMBODIMENT

In the exemplary embodiment of the invention as disclosed in the drawings, an automatic elevator system generally designated 10 includes an elevator car 11 vertically movable in a hatchway 12 having a plurality of access openings 13 at different floor levels, and doors 14 selectively close or open the doorway openings 13. The elevator car is selectively positioned at the different floor levels and the doors are opened and closed by operating or positioning means indicated in block form at 15, and this means is adequately disclosed in U.S. Pat. No. 3,450,232, owned by applicant's assignee.

Operation of the positioning means 15 may be automatically effected by hall call pushbutton controls 16 at each floor level, and car call pushbutton controls (not shown) are provided within the elevator car for passengers to effect automatic selection of car position.

Closure of the door 14 by its drive motor (not shown) is automatically controlled by a conventional photoelectric device 17 which senses the presence of an obstruction in the doorway when the door is open or in process of closing and either forestalls closing or reopens the door, as the case may be, to require removal of the obstruction before the door may close. Such controls and apparatus are well known to those skilled in the art and require no further elaboration herein.

The present invention comprehends the utilization of the photoelectric control 17 for further providing an automatic emergency conditioning of the elevator system 10 as the result of the detection of the presence of smoke in the hatchway 12 or the presence of an abnormally high temperature condition therein. The improved control generally designated 18 for providing this improved functioning is illustrated schematically in FIG. 2.

As shown in FIG. 2, control 18 is operated from a pair of power supply leads L<sub>1</sub> and L<sub>2</sub>. Control 18 includes portions of the conventional doorway-obstruction control system with additional elements for effecting the desired emergency conditioning of the system as discussed above. Thus, a relay coil 19 comprises the coil of the conventional door control relay which, when energized, modifies the door operation so as to cause the doors to stop and reverse to the open position, or remain in the open position if already disposed therein. The conventional control of relay coil 19 is by means of normally open photoelectric control contacts 20 which close when the light beam across the doorway is interrupted by an obstruction when the

door is in the open condition or closing operation mode. In series between coil 19 and contacts 20, is a second set of normally open contacts 21 which comprise contacts of the conventional door-closing relay. Contacts 21 are closed when the door is open and are open only when the door is fully closed. Thus, in the event that contacts 20 are closed as the result of detection of an obstruction by the photoelectric control 17, relay coil 19 will become energized by virtue of the closed condition of contacts 21 thereby causing the door to move to the fully open position.

If the door is fully closed and there is smoke in the hatchway at the level of the door, the photoelectric control beam will be at least partially obstructed so as to cause closing of the contacts 20. Under the closed door condition, a set of normally closed contacts 22 of the door-closing relay are closed and connected in series with the contacts 20 and a smoke relay coil 23 thereby to energize coil 23. A holding circuit is provided around contacts 22 and 20 by means of normally open contacts 24 operated by smoke relay coil 23 and a "Reset" normally closed, manual pushbutton 25. Thus, notwithstanding the dissipation of the smoke in the hatchway permitting the photoelectric contacts 20 to reopen, the smoke relay coil is maintained energized until the system is reset by the manual operation of push-button 25.

The smoke relay further includes a second set of normally open contacts 26 which are connected in series with the coil 27 of the main floor car call relay and a normally closed set of contacts 28 comprising contacts of the main floor position indication relay which are closed as long as the car is not at the main floor. The power supply to all other car call relays generally designated 29 is interrupted at this time by means of normally closed contacts 30 controlled by smoke relay coil 23 which, as a result of the energization of coil 23, open to break the circuit from relays 29 to power supply lead  $L_2$ . A second set of normally closed contacts 31 controlled by smoke relay coil 23 is connected in series with the normal hall call stopping relay circuit generally designated 32, illustratively including relay coils 33 and 34 and normally open control contacts 35 and 36.

The invention further comprehends the automatic emergency conditioning of the system so as to bring the car to the main floor level in the event of the sensing of an abnormally high temperature in the hatchway 12. Thus, illustratively, a sensor may be mounted on the car 11 and may comprise a normally open temperature-sensitive switch 37 connected in parallel with smoke relay contacts 24. Thus, in the event a high temperature is sensed so as to close contacts of switch 37, smoke relay coil 23 is energized through the "Reset" pushbutton 25 independently of the photoelectric contacts 20. The energization of smoke relay coil 23 effects a conditioning of the elevator system to bring the car to the main floor in the same manner as discussed above relative to the energization of the coil 23 by the closing of contacts 20. Again, the emergency condition is maintained by the holding contacts 24 until such time as the control is reset by manual operation of push-button 25.

If desired, a suitable alarm device 38 may be provided for providing an indication of the emergency condition. Thus, device 38 may comprise an audible device, such as a bell, gong, or siren, or may comprise a visible device, such as flashing lights which may be

connected in parallel with smoke relay coil 23 so as to become energized when the smoke relay coil is energized.

The invention has been described in connection with the conditioning of the elevator system so as to bring the car automatically and expeditiously to the main floor level. As will be obvious to those skilled in the art, any other suitable emergency conditioning of the elevator system may be effected by the smoke relay coil as desired. Thus, illustratively, the car may be brought to a different level other than the main floor level, or the car may be made subject solely to an emergency control call system, etc.

The invention comprehends the utilization of the conventional photoelectric control means provided for the control of the door at the individual floor levels as discussed above. As shown in FIG. 3, a modified form of control 50 embodying the invention comprehends the utilization of a separate photoelectric device 39 functioning in conjunction with the amplifier portion 40 of the photoelectric device 17. The auxiliary smoke sensing device 39 is arranged to provide the same functioning in providing the emergency conditioning of the elevator system as in the arrangement of control 18. Thus, the auxiliary photoelectric sensor 39 includes an illumination source 41 and a photoelectric cell 42 responsive to the light beam 43 for controlling the amplifier 40 through connections 44 and 45 thereof. The photoelectric device 17 includes an illumination source 46 and a photoelectric cell 47 for sensing the obstruction in the elevator doorway opening as discussed above. Illumination source 46 may be connected directly across the power supply leads  $L_1$  and  $L_2$ . Photoelectric cell 47 of the doorway sensor is connected in series with the normally open door-closing relay contacts between terminals 44 and 45. Thus, when the door is closed permitting relay contacts 49 to become closed, photoelectric device 39 controls the operation of the amplifier 40 through the normally closed contacts 49 whereas, when the door 14 is open, photoelectric device 17 controls the operation of the amplifier through the then closed contacts 48. Thus, the photoelectric device 39 functions similarly as smoke relay coil 23 of control 18 in the modified control 50 of FIG. 3.

The sensitivity of the light beam controls of devices 17 and 39 may be adjusted by means of rheostats 51 and 52 connected across amplifier terminals 53 and 54 with rheostat 51 being connected in series with normally open door-closing relay contacts 55 for controlling the door obstruction sensitivity, and rheostat 52 being connected in series with normally closed door-closing contacts 56 for controlling the smoke sensor sensitivity. Thus, the amount of smoke necessary to effect operation of the emergency conditioning control may be accurately preselected by suitable adjustment of rheostat 52 independently of the control of the sensitivity of the door control photoelectric device 17.

The photoelectric amplifier portions of such conventional door closure controls are well known to those skilled in the art and no useful purpose would be served by further elaboration on the detailed structure thereof herein. The inventive concept as brought out in FIG. 3 is the utilization of separate photoelectric cell pickup devices for the door-closing and smoke detection functions in conjunction with a common amplifier portion of the system represented by the conventional amplifier

of the door closure photoelectric device. As shown, the modification of the conventional circuit merely requires the connection of the auxiliary smoke sensing device 39 in parallel with the pickup cell 47 of the conventional photoelectric cell device through the normally closed door closure relay contacts and all other portions of the conventional door closure system remain the same.

Thus, the invention comprehends an extremely simple modification of conventional automatic elevator car control systems to utilize the door closure photoelectric control means as a portion of a smoke control and high temperature control emergency conditioning means. While the changes to the control system are minor, a substantially improved functioning of the elevator system is obtained affording substantially improved safety and automatic control of the system under emergency conditions.

The foregoing disclosure of specific embodiments is illustrative of the broad inventive concepts comprehended by the invention.

I claim:

1. In an automatic elevator system having an elevator car, means for automatically selectively positioning the car at different floor levels in a hatchway provided with access openings, and doors for selectively closing and opening the respective access openings to provide ingress to and egress from said car thereat, the improvement comprising: photoelectric means associated with the respective doors for detecting an obstruction in an access opening when the door is open and preventing automatic closing of the door under such a condition; and control means operatively associated with the door obstruction-detecting photoelectric means for modifying the operation of the elevator car positioning means as an incident of the detection of the presence of smoke in the hatchway by said door obstruction-detecting photoelectric means while the associated door is closed.

2. The automatic elevator system of claim 1 wherein said means for modifying the elevator car positioning means comprises means for causing said elevator car to be positioned at a preselected floor level.

3. The automatic elevator system of claim 1 wherein said means for modifying the elevator car positioning means comprises means for causing said elevator car to be positioned at a main floor level of said hatchway.

4. The automatic elevator system of claim 1 further including thermo-responsive means carried for movement with said elevator car for modifying the operation

of the elevator car positioning means as an incident of sensing an abnormally high temperature condition at said elevator car.

5. The automatic elevator system of claim 4 wherein said thermo-responsive means comprises means for causing said elevator car to be positioned at a preselected floor level.

6. The automatic elevator system of claim 4 wherein said thermo-responsive means comprises means for causing said elevator car to be positioned at a main floor level of said hatchway.

7. The automatic elevator system of claim 1 wherein said control means includes a second photoelectric means operative only when the door is closed to detect the presence of smoke and modify the operation of the elevator car positioning means.

8. The automatic elevator system of claim 1 wherein said control means cancels all previously registered calls to floor levels other than to a preselected floor level as an incident of said detection of the presence of smoke.

9. The automatic elevator system of claim 1 wherein said control means prevents further calls to floor levels other than to a preselected floor level as an incident of said detection of the presence of smoke.

10. In an automatic elevator system having an elevator car, means for automatically selectively positioning the car at different floor levels in a hatchway provided with access openings, and doors for selectively closing and opening the respective access openings to provide ingress to and egress from said car thereat, the improvement comprising: first photoelectric means associated with the respective doors for detecting an obstruction in an access opening when the door is open and preventing automatic closing of the door under such a condition; and second photoelectric means operatively associated with said first, door obstruction-detecting photoelectric means for modifying the operation of said first photoelectric means and the elevator car positioning means as an incident of the detection of the presence of smoke in the hatchway by said second photoelectric means while the associated door is closed.

11. The automatic elevator system of claim 10 wherein said first and second photoelectric means define a single amplifier portion and respective first and second detecting means for providing a detection signal to said amplifier portion when said door is correspondingly respectively open or closed.

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