

[54] **FIRE DISASTER PREVENTION SYSTEM
AND A METHOD TO PREVENT LOSS OF
LIFE**

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Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 211,886, Dec. 27,
1971, abandoned.

[52] U.S. Cl. **49/2, 49/3**

[51] Int. Cl. **E05f 15/20**

[58] Field of Search **49/1-8, 68,
49/31, 29**

[56] **References Cited**

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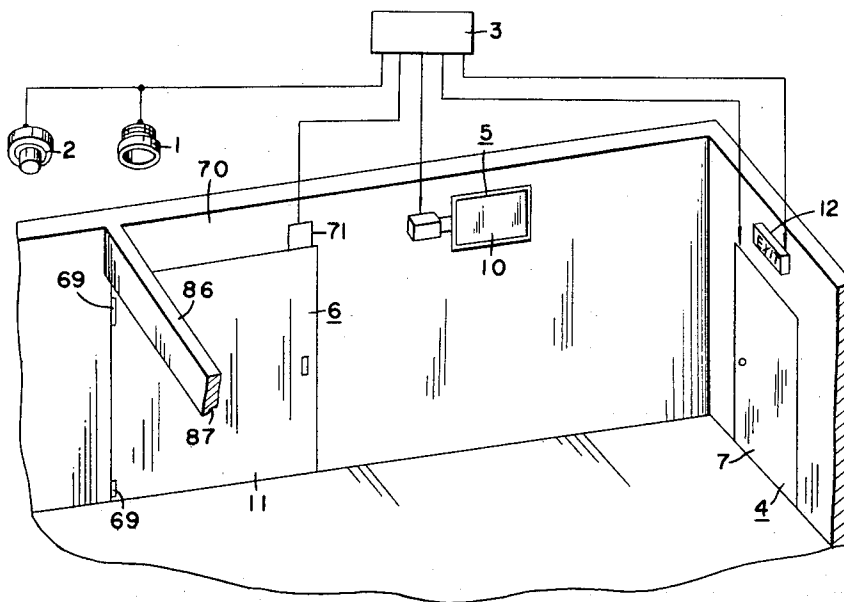
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Primary Examiner—Kenneth Downey
Attorney, Agent, or Firm—Robert E. Burns; Emmanuel J. Lobato; Bruce L. Adams

[57] **ABSTRACT**

A fire disaster prevention system in which normally locked emergency exit doors are automatically unlocked by detection apparatus comprising sensors detecting output signals upon detection of a physical quantity indicating a fire or smoke is present. Fire doors strategically located are released by automatic release means upon receipt of the sensors' output signals and close automatically to isolate the escape accesses from other spaces to preclude fire and smoke from reaching the emergency exits. The unlocking of the emergency exit doors takes place upon detection of the presence of fire or smoke. The fire doors are closed after time has been allowed for the emergency exits to be reached by those in a building provided with the system. The location of the emergency exits is indicated, upon control of the sensors, visually by respective flashing lights and audible signals developed at the emergency exits so that persons are guided thereto in an emergency.

1 Claim, 27 Drawing Figures



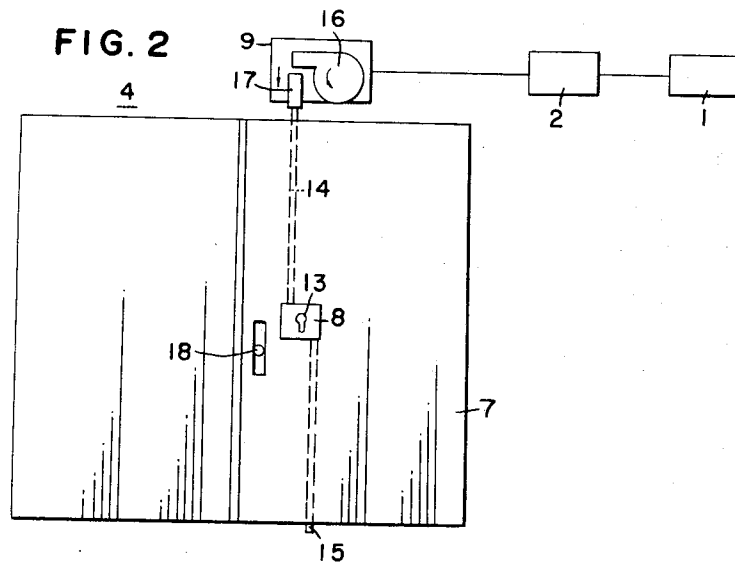
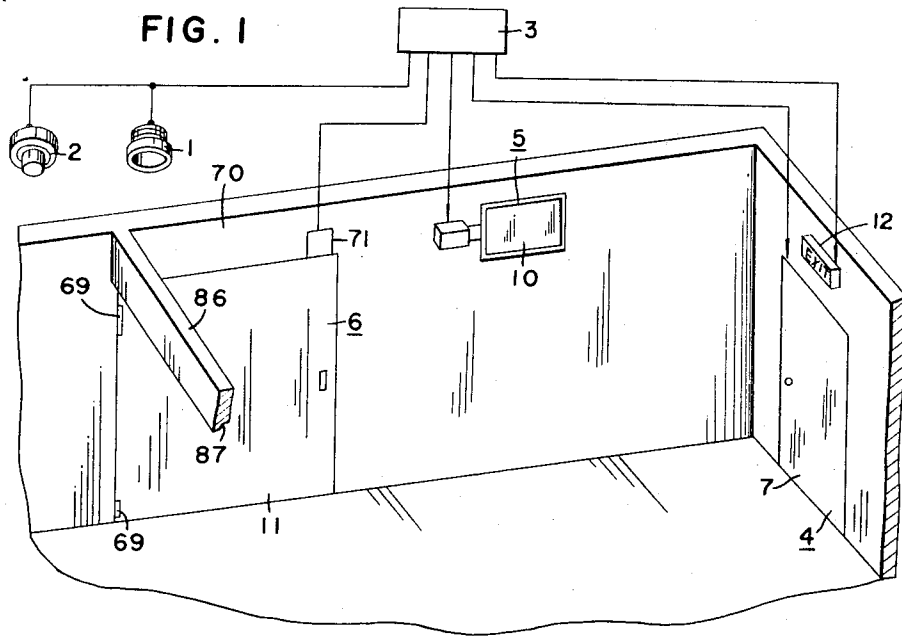


FIG. 3

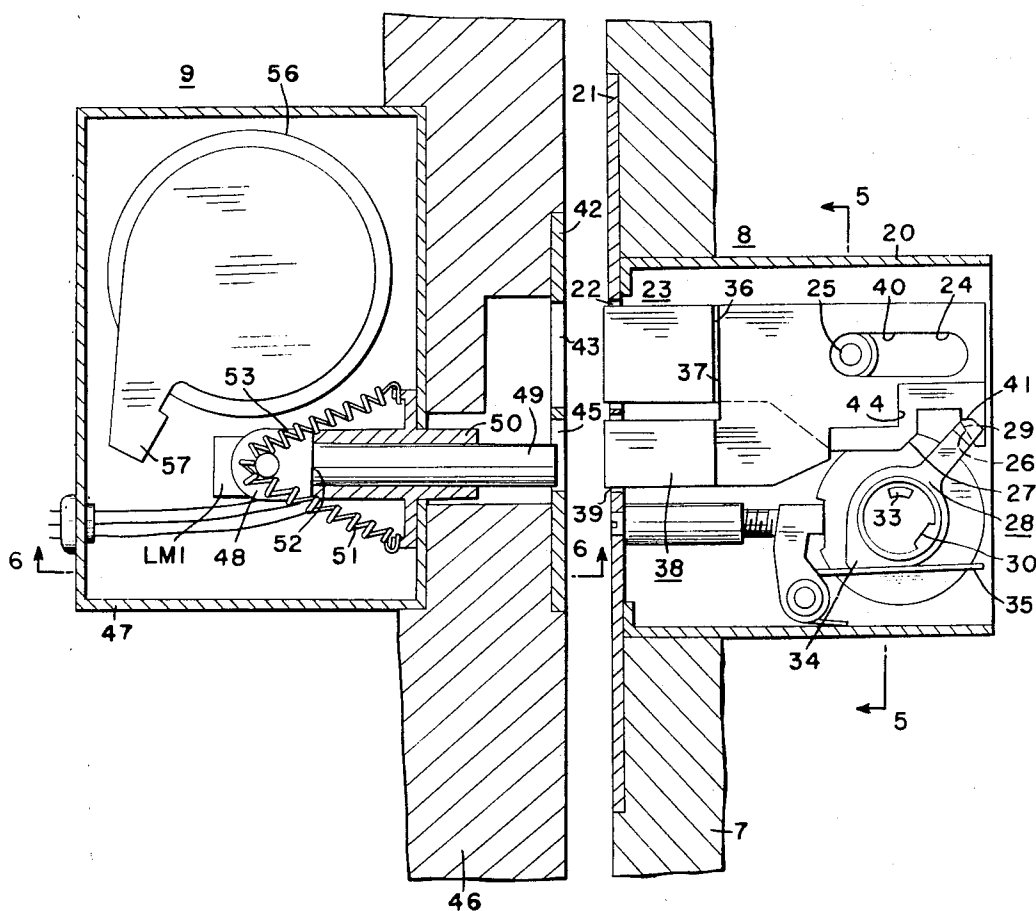


FIG. 5

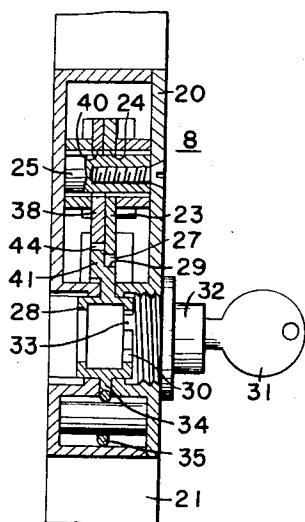


FIG. 6

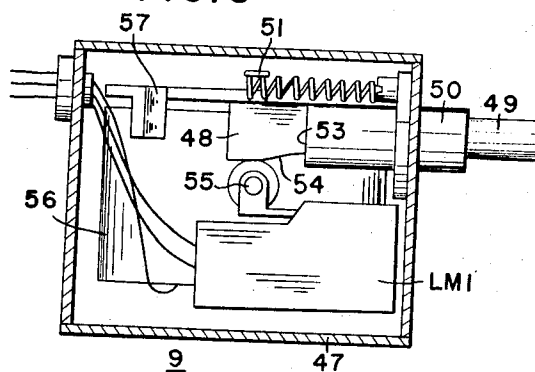


FIG. 7

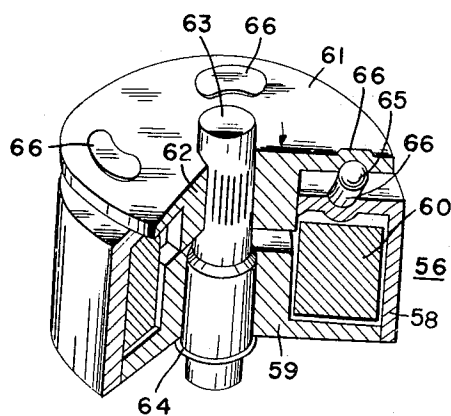


FIG. 8

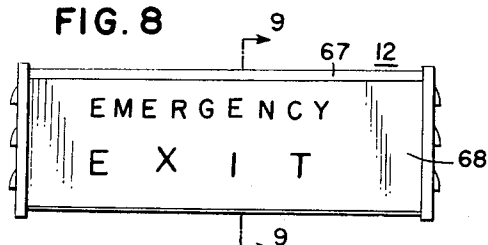


FIG. 9

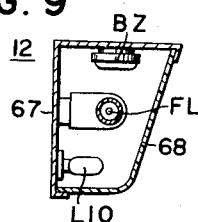


FIG. 10

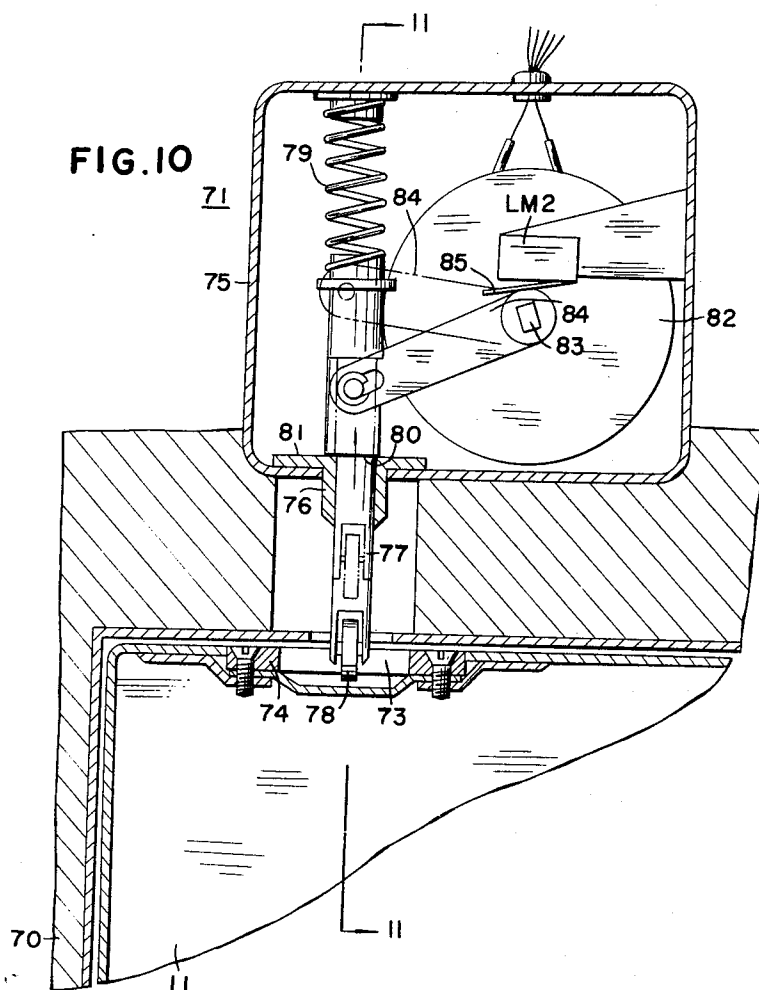


FIG. 11

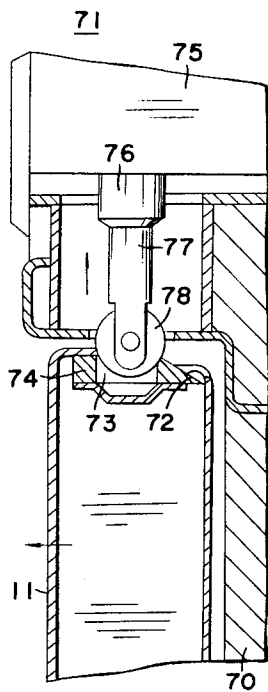


FIG. 12

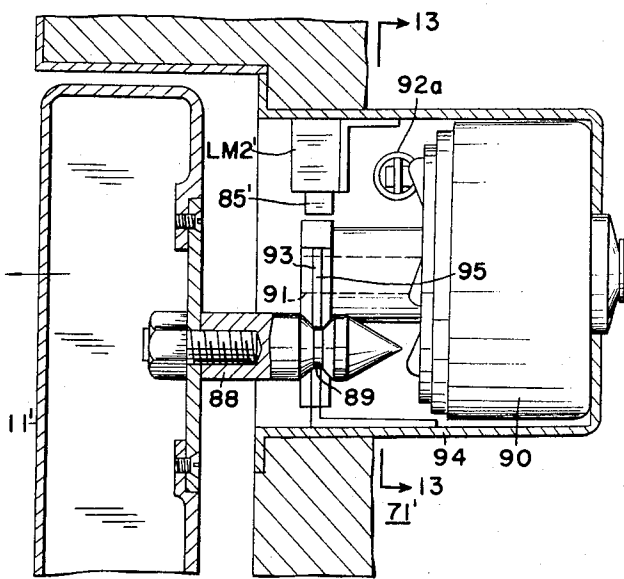


FIG. 13

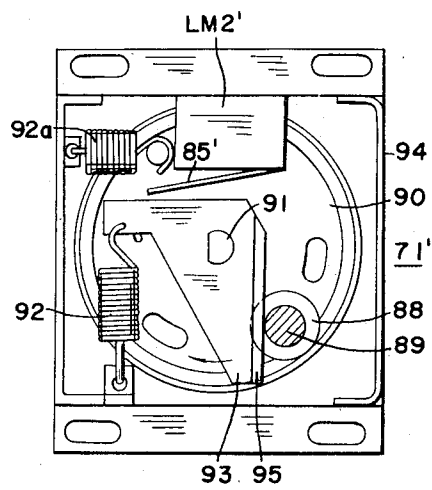


FIG. 14

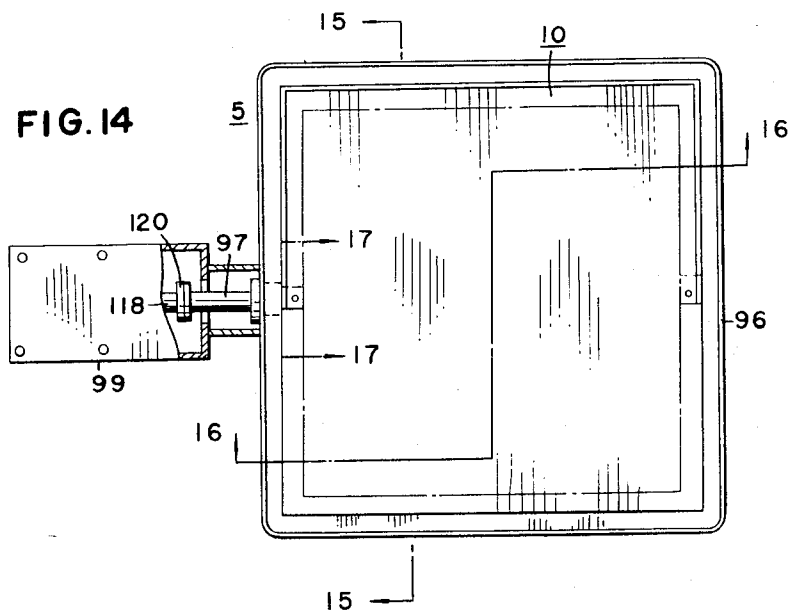


FIG. 15

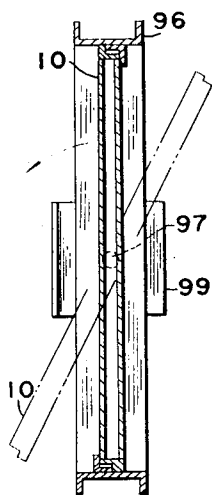


FIG. 16

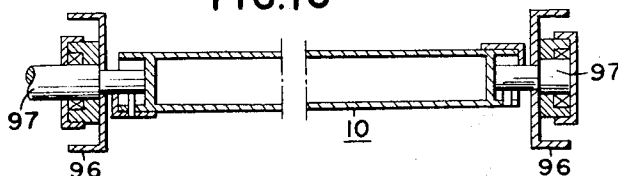


FIG. 17

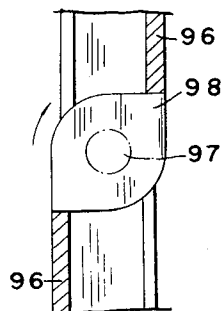


FIG. 19

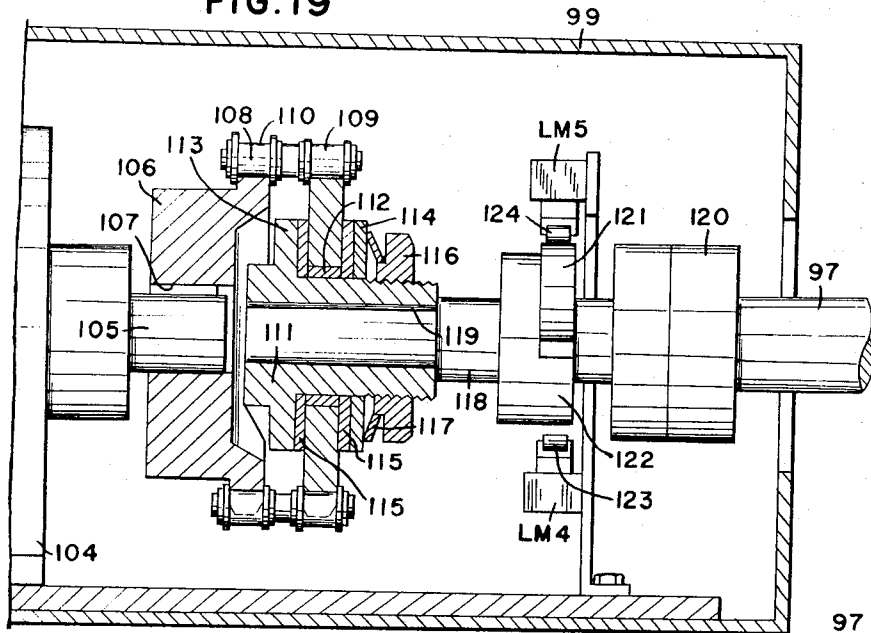


FIG. 18

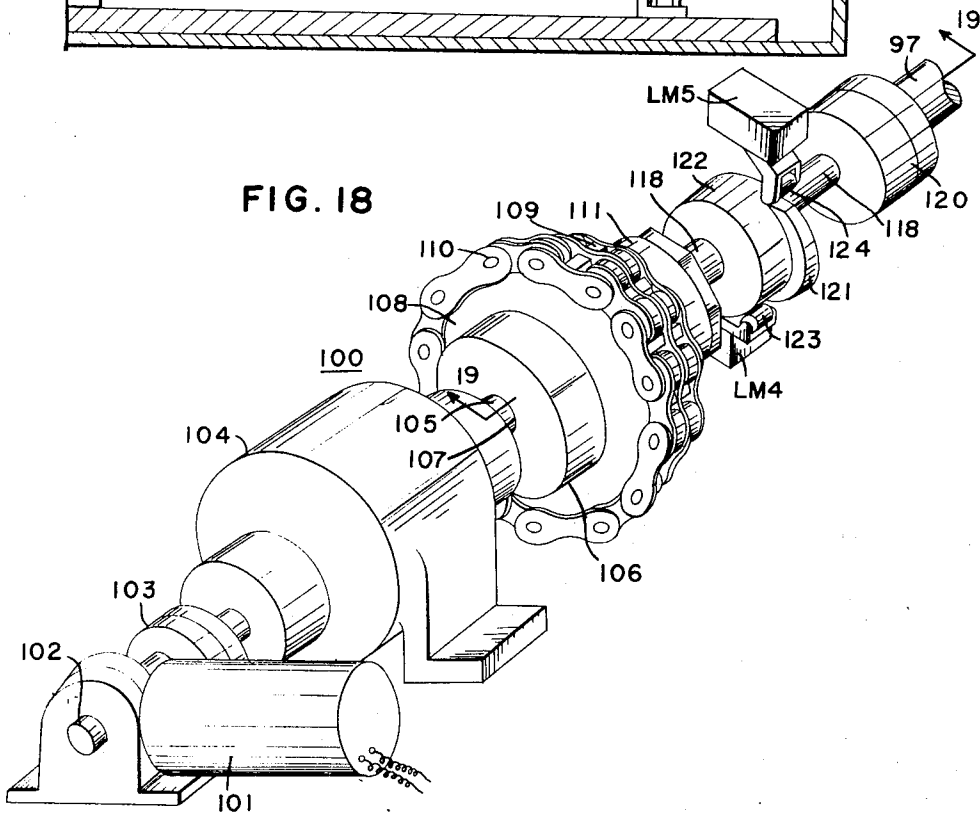


FIG. 20

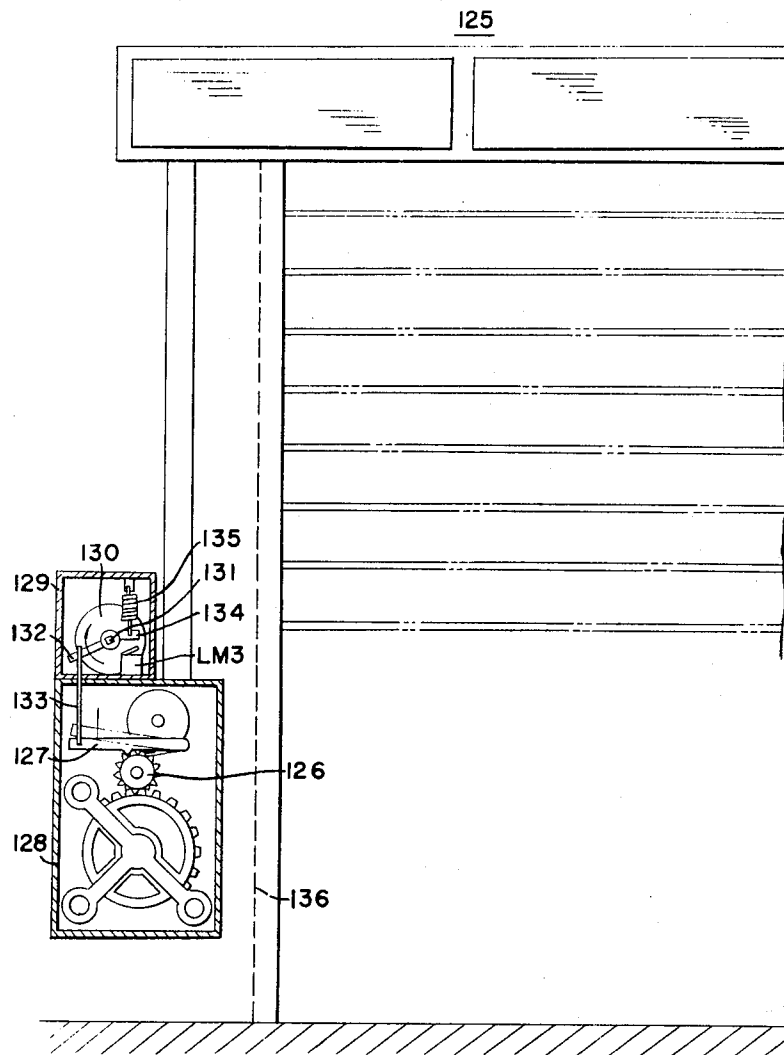


FIG. 21

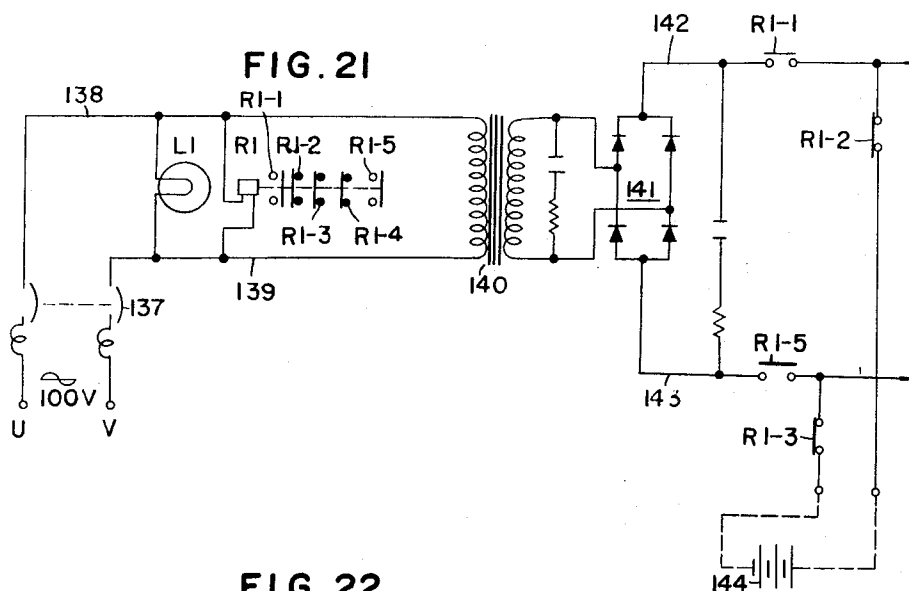


FIG. 22

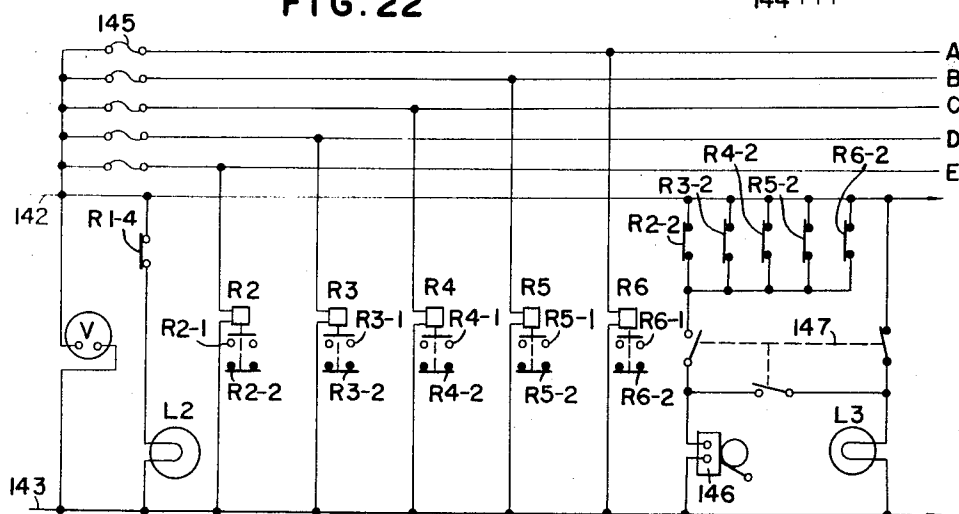


FIG. 23

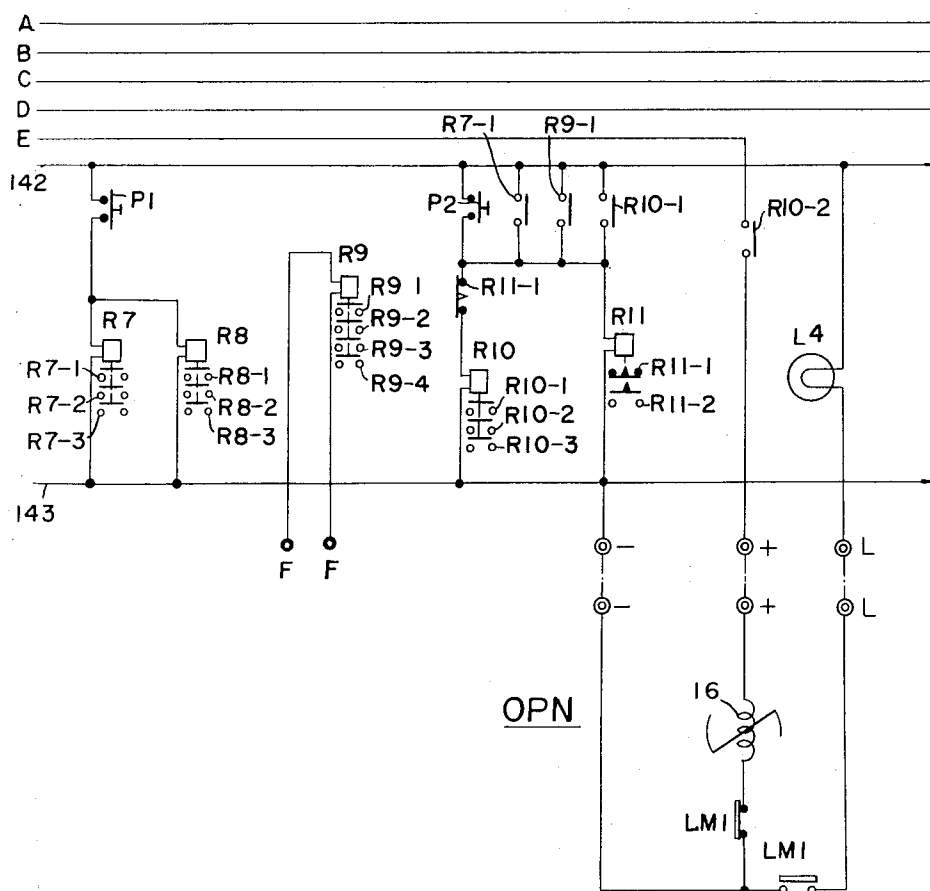


FIG. 24

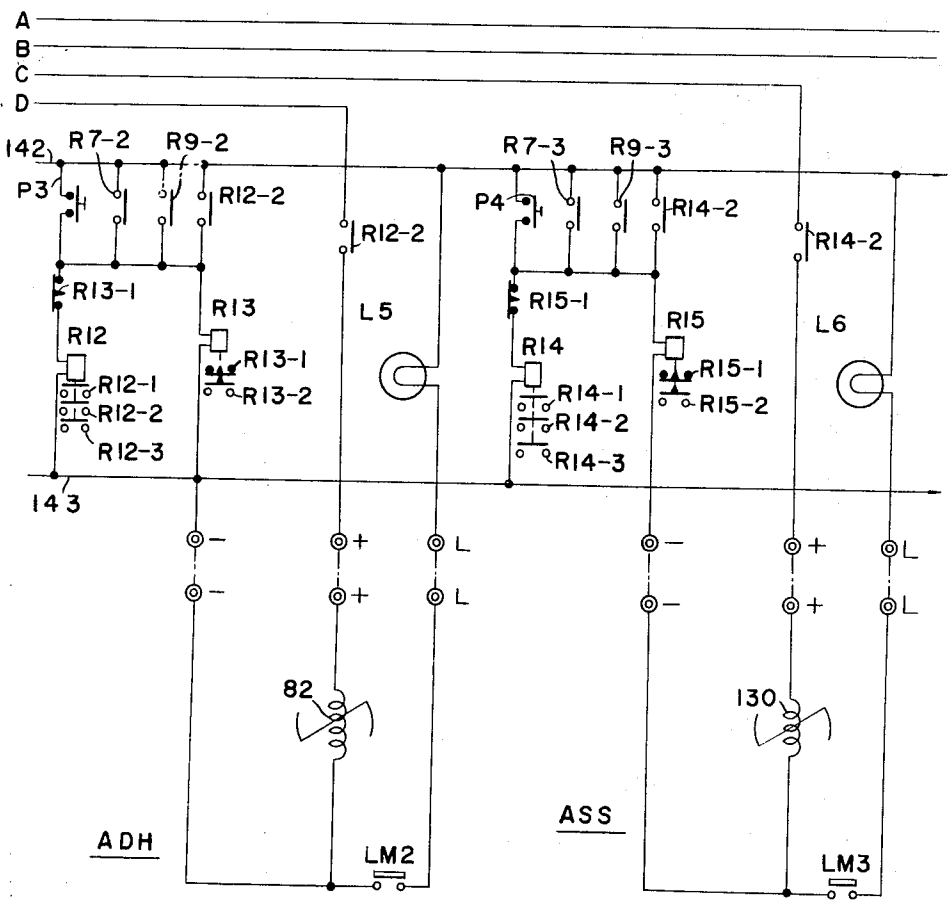


FIG. 25

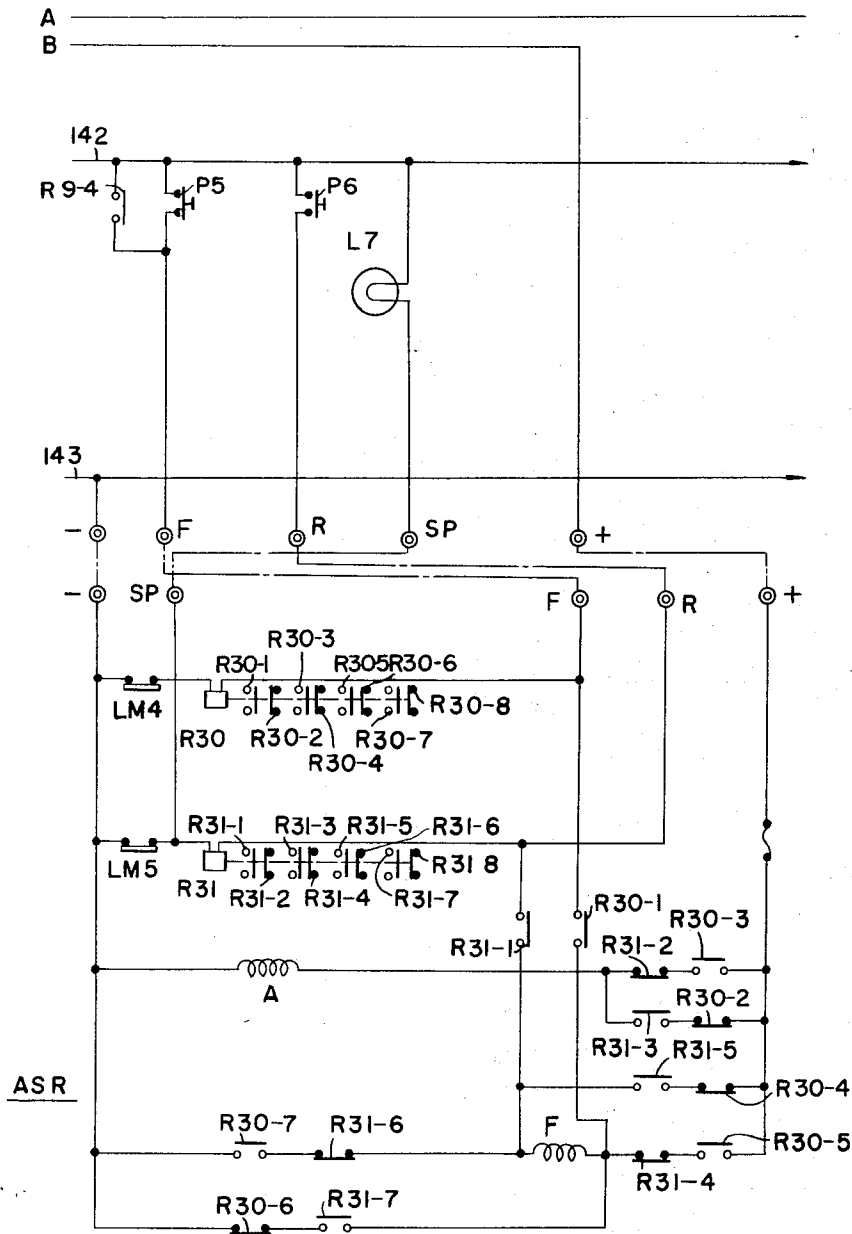


FIG. 26

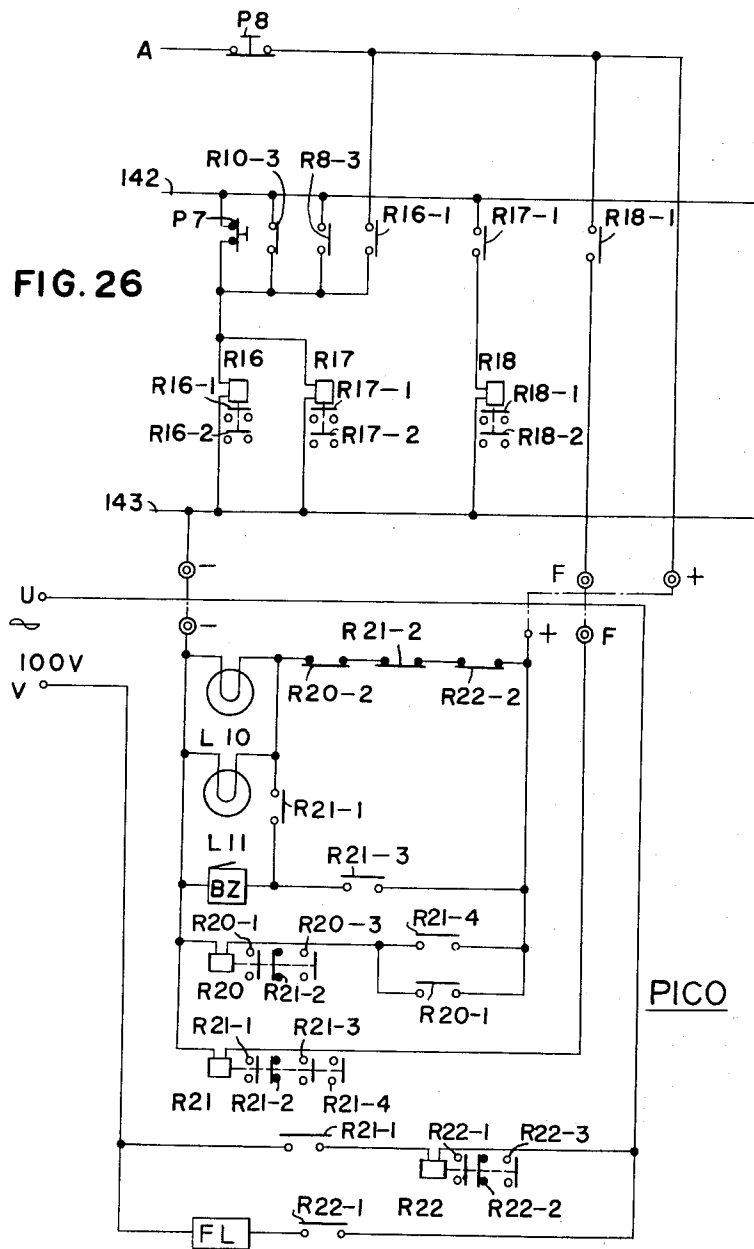
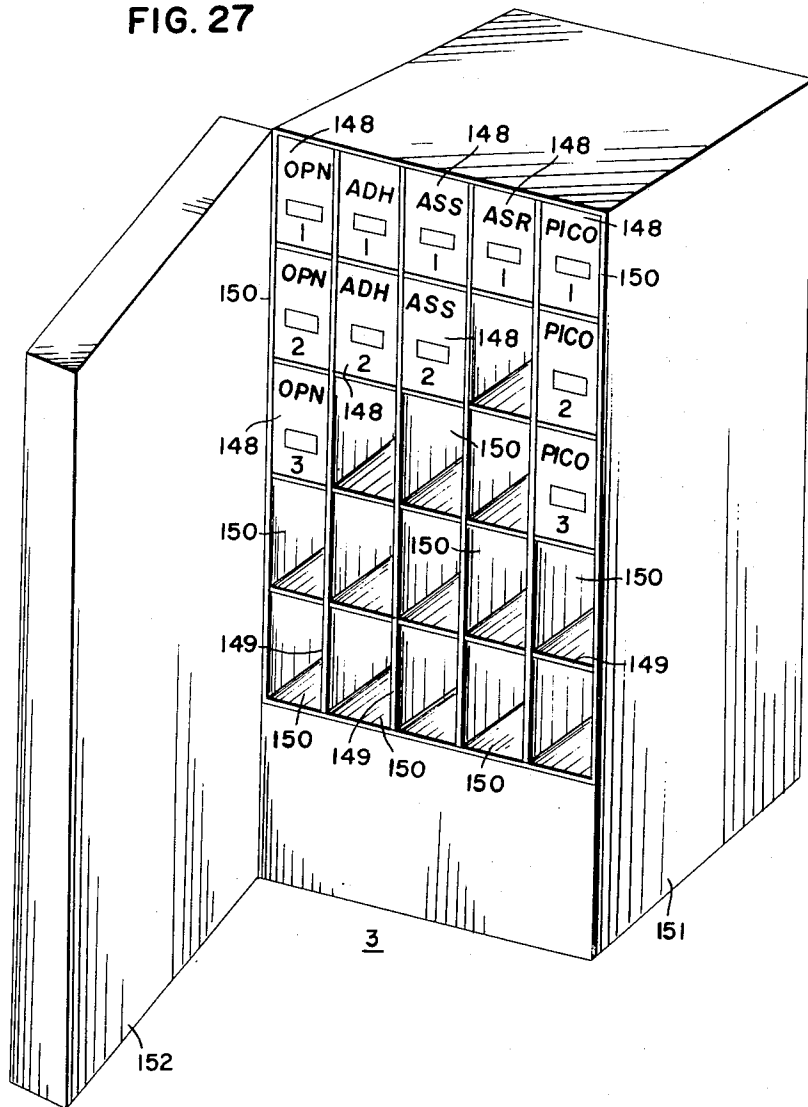


FIG. 27



FIRE DISASTER PREVENTION SYSTEM AND A METHOD TO PREVENT LOSS OF LIFE

This is a continuation-in-part of my earlier application Ser. No. 211,886, filed Dec. 27, 1971, now abandoned.

BACKGROUND OF THE INVENTION

This invention relates generally to a system and method for preventing the loss of human lives in a fire and more particularly to a system and method for preventing a fire disaster.

Modern buildings are still subject to destruction by fire or at least furnishings therein. When a fire occurs in a modern building, the spreading of a fire may be reduced by the use of fire doors and the like. The spread of smoke in modern buildings is sometimes worse than in older buildings because modern buildings will not vent the smoke. Moreover, air conditioning ducts tend to propagate the spreading of smoke. As a matter of fact, smoke spreads faster than the flames in a fire. Generally, smoke will spread laterally about 0.5m/sec and the spread of rising smoke is about 3-4 m/sec.

Burning building materials not only cause smoke, which is dangerous to human life, but generate many other substances which can result in the loss of lives. These dangerous substances may be gaseous such as carbon monoxide or otherwise such as red acid, cyanic acid, phosgene which result in the generation of poisonous gases.

The absence of windows in some modern structures and the complexity of escape paths can make the loss of human lives likely particularly because the usual emergency exits are normally locked and cannot be found by persons who may panic in a fire or because of smoke which tends to cause panic in human beings besides reducing visibility.

SUMMARY OF THE INVENTION

It is a principal object of the present invention to provide a fire disaster prevention system in which provision is made for automatically unlocking normally locked emergency exit doors and closing fire doors to isolate escape avenues to the emergency exit doors while providing time for the emergency exit doors to be reached before the closing of the fire doors.

Another object is to provide a fire disaster prevention system indicating to persons escape avenues and the location of emergency exits.

Still another object is to provide the various devices and components of a fire disaster prevention system.

The fire disaster prevention system provides emergency exit doors mounted closing emergency exits. These doors are normally closed and locked and are not used except in emergencies. A control circuit has sensors that detect the presence of a fire or smoke and generate a signal that opens the locks of the individual emergency exit doors.

The system provides fire doors housed in respective recesses in walls adjacent accesses that are to be closed off to isolate the spaces defining the escape avenues after a reasonable time has expired to allow escape from spaces that are to be isolated from the escape space in which the emergency exit is located. When the sensors sense a physical quantity indicating the presence of a fire, the electrical signal the detecting sensor develops is applied to releasable holding devices that

release the individual fire doors so that the fire doors may be closed by spring-loaded hinges, for example, which swing the fire doors to positions closing off accesses or passageways isolating the escape spaces from other spaces.

The location of the emergency exits are indicated by guide means constituting flashing lights and different intermittent audible signals representative of the various doors are generated in the vicinity of the individual emergency exit doors to guide persons in a building to these escape exits. The guide means is triggered by the signal output of the sensors.

SHORT DESCRIPTION OF THE DRAWINGS

FIG. 1 is a diagram of a disaster prevention system according to the present invention illustrated in a part of a building.

FIG. 2 is a diagrammatic elevation view of an emergency exit door as a part of the system according to the present invention.

FIG. 3 is a cross-section view of a lock used for an emergency door according to the present invention and illustrates the lock in an open or released state.

FIG. 4 is a cross-section view of the lock in FIG. 3 illustrating a locked state thereof.

FIG. 5 is a cross-section view taken along section line 5-5 in FIG. 3.

FIG. 6 is a cross-section view taken along section line 6-6 in FIG. 3.

FIG. 7 is a perspective view of a part of the system according to the present invention, partly cut away.

FIG. 8 is a front elevation view of guide means as a part of the system according to the present invention.

FIG. 9 is a cross-section view taken along section line 9-9 in FIG. 8.

FIG. 10 is a cross-section view on an enlarged scale of an upper end portion of a fire door as a part of the system according to the present invention and a lock of the fire door.

FIG. 11 is a cross-section view taken along section line 11-11 in FIG. 10.

FIG. 12 is a cross-section view of other releasable holding means.

FIG. 13 is a cross-section view taken along section line 13-13 of FIG. 12.

FIG. 14 is a front view of a smoke ejecting means of the system according to the present invention, partly cut away.

FIG. 15 is a cross-section view taken along section line 15-15 in FIG. 14.

FIG. 16 is a cross-section view taken along section line 16-16 in FIG. 14.

FIG. 17 is an enlarged end view taken along section line 17-17 in FIG. 14.

FIG. 18 is a perspective view of a drive for a smoke ejecting means as a part of the system according to the present invention.

FIG. 19 is an enlarged cross-section view taken along section line 19-19 in FIG. 18.

FIG. 20 is a fragmentary elevation view of a shutter and its drive as a part of the system according to the present invention.

FIGS. 21 and FIGS. 22-26 are electric circuit diagrams of the system according to the present invention.

FIG. 27 is a perspective view of an operating control panel as a part of the system according to the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

As shown in FIGS. 1 and 2, a smoke sensor 1 and a heat sensor detect the presence of fire or smoke and generate corresponding output electrical signals corresponding to the detection of the presence of fire or smoke. The output signals are applied to an operating control means or control circuitry 3 which applies the signals as hereinafter explained. The sensors may be of the type illustrated in U.S. Pat. No. 3,382,762. Various fire detectors may be used such as photoelectric smoke sensors or ion type smoke sensors or heat sensors. These sensors 1,2 are illustrated in spaces within a building.

The building has an emergency exit 4 and an outside wall 6 on which is mounted a frame 5 having a smoke-ejection window 10 operable from a closed position to an open position for venting smoke from the building as later described. An emergency exit door 7 closes the emergency exit and is normally locked by a lock 8 as hereinafter explained. A fire door 11 is mounted in a recess on the outside wall and is mounted so that it is releasably held in the recess and when it is released by a control signal from the control circuitry or apparatus 3, it swings into position closing an access or passageway from other spaces leading to the space within which the emergency exit is located.

The emergency exit door 7 has its lock 8 provided with a keyhole 13 for receiving a key for actuating manually two rods 14,15 to a retracted position in which case the lock is open and the door may be opened and to a projected position, the condition shown in FIG. 2, in which the lock is locked and the door is locked. The two rods move axially within passages in the door. The upper rod 14 is engaged by a push rod 17 and the lower rod 15 engages in a receptacle, not shown, in the floor. The upper rod is actuated automatically to its retracted position by a lock-releasing device 9 having a rotary solenoid 16 energized under control of the sensors 1,2. If the presence of smoke or a fire is detected, the solenoid actuates a push-rod 17 that retracts the upper locking rod 14. This rod is connected to the lower locking rod 15 by a rotary plate so that the rods are projected and retracted jointly. The retraction of the upper locking rod retracts the lower locking rod and the escape emergency exit door can then be opened with the knob 18.

The location of the emergency exit is designated to persons seeking escape by guide means 12 which visually and audibly identifies the emergency exit and guides persons to it as later described. The emergency exit is located at one point and the fire door can be considered to be located at a point intermediate the emergency exit and at a point at which a person wanting to escape will generally find himself. The system provides for letting a person start from the point at which he finds himself and be guided to the point of exit and to pass through an access which is subsequently closed by the fire door isolating the space in which the emergency exit is located so that it can readily be found. The isolation prevents smoke and fire from reaching this space and those reaching the space will be able to find the exit and escape.

While the system according to the invention is explained herein with respect to one escape exit and one fire door, the system is obviously used in conjunction of a multiplicity of exits and fire doors. Moreover, the system is used with older buildings modified to use the system or is built into new construction.

Another type of lock usable on the emergency door 7 is shown in FIGS. 3-7 inclusive. As shown, a casing 20 has a front plate 21 mounted on the emergency door 7 and having an opening 22 through which a dead bolt 23 within the casing 20 is projected out of and retracted into the casing. The dead bolt 23 is provided with a slot 24 through which extends a fixed guide pin 25 guiding the dead bolt during its projection and retraction.

The dead bolt has a slant surface 26 juxtapositioned with a slant surface 27 thereof actuated by a lever 28 having a free end 29 that engages the slanted surfaces 26,27 for respectively retracting and projecting the dead bolt. The lever 28 is provided with a projection 30 and is actuated by insertion of a key 31 into a cylinder lock 32 threaded onto the casing 20. Rotation of the key rotates a cam 33 into engagement with the projection 30 for alternatively rotating it in opposite directions. The lever 28 is provided with an annular end as shown in FIG. 5. The annulus thereof has a projection 34 that has flat surfaces that alternately bear on a spring 35 so that the lever 28 is releasably held in two alternate angular positions as shown in FIG. 3 and FIG. 4. These positions correspond to the retracted position of the dead bolt 23 and its projected position.

The dead bolt is provided with a lateral projection having a surface 36 confronting a surface 37 of a rear part of a lock-release bolt 38 which is disposed alongside the rear part of the dead bolt 23. The lock-release bolt 38 is projected from its retracted position through an opening 39 in the front plate 21 of the casing 20. The lock-release bolt is provided with a slot 40 through which the guide pin 25 extends so that its travel is guided and its stroke is limited by the guide pin 25 and its slot 40 as is the case with respect to the dead bolt whose stroke is similarly limited and guided.

The actuating lever 28 is provided with an offset 41, as shown in FIG. 5, on the free end thereof for projecting the lock-release bolt 38. The lock-release bolt is projected by engaging a surface 44 thereon with the offset 41 of the actuating lever 28 when the dead bolt is projected. When the dead bolt is manually retracted, its lateral projection surface 36 engages the confronting surface 37 of the lock-release bolt and carries the lock-release bolt to its retracted position. A plate 42 confronting the front plate 21 is provided with an opening 43 for receiving the dead bolt and has another opening 45 into which the lock-release bolt is projected. This plate 42 is mounted on a door jamb 46 on which is mounted another casing 47 within which is disposed the remainder of the lock mechanism according to the invention.

Within this second casing is disposed a head 48 of a push-rod 49 which extends axially through a guide tube 50. A spring 51 biases the push-rod 49 axially toward the right in the drawing toward the lock-release lever so that a stop surface 52 of the push-rod head abuts an end 53 of the guide tube 50. This push-rod is provided with an axial groove into which extends a guide pin, not shown, in the guide tube 50 so that the push-rod is axially guided without rotation.

When the dead bolt and the lock-release bolt are actuated to a projected position as shown in FIG. 4, the lock-release bolt 38 abuts the push-rod 49 and moves it to its retracted position, toward the left in the drawing, so that the spring 51 is stretched. The actuating lever 28 is releasably held in the position in which it is shown in FIG. 4 by its spring 35 and this maintains the push-rod retracted as shown. The push-rod head 48 has a side camming surface 54 as shown in FIG. 6. When the push-rod is in a projected position, shown in FIGS. 3 and 6, the camming surface 54 engages a cam follower 55 of a limit switch LM1 opening it. The camming surface 54 is constructed with a slant surface allowing the limit switch LM1 to close when the push-rod is in the retracted position shown in FIG. 4.

The lock-release bolt 38 is retracted automatically by actuating the push-rod 49 to a projected position. This is accomplished by a rotary solenoid 56 which actuates a rotary plate 57 having a projection that engages the head of the push-rod and applies sufficient energy thereto so that it and the biasing spring 51 overcome the holding force of the holding spring 35 so that the push-rod moves the lock-release bolt to its retracted position. In being retracted the lock-release bolt shoulder 44 rotates the actuating lever in a clockwise direction, as seen in drawing, so that the lever end 29 engages the rear slanted surface 26 of the dead bolt 23 so that it too is retracted and the lock is accordingly automatically opened when the solenoid receives a control signal from the fire alarm system.

The rotary solenoid 56 is constructed as shown in FIG. 7. It comprises a stationary casing 58 having a base 59. A solenoid coil 60 is housed in the casing. A rotary armature 61 is spaced from the casing and has a hub 62 slidable axially on splines on a rotary shaft 63 provided with a return or restoration spring 64. The casing and rotary armature jointly define three angularly spaced, slanted ball races 66 concentric with the shaft 63 and each housing a respective ball 65. The rotary armature 61 is rotatably supported by the three balls 65. Thus when a control signal from the fire alarm or control apparatus 3 is applied to the solenoid coil 60, the rotary armature is attracted toward the coil and the balls 65 roll from a shallow portion of the ball races to a deep portion so that the armature is rotated and rotation ceases when the balls enter the deepest part of their ball races. When the solenoid is de-energized, the rotary shaft, and therefore, the rotary armature, is restored to their original position. It is, of course, understood that the rotary armature 61 actuates the rotary plate 57 so that its peripheral projection strikes the head 48 of the push-rod 49 and the lock is opened as before described. The rotary plate 57 is likewise restored to a rest position in which its peripheral projection, which actuates the push-rod 49, is spaced from the head of the push-rod as shown in FIGS. 3 and 4.

The closing of the limit switch LM1 energizes flashing alarm-and-guide emergency lamps L10,L11 and a buzzer BZ of the emergency guide means 12 which is an audio-visual guide-and-alarm box within which the alarm-and-guide emergency lamps L10,L11 and the audio alarm and guide buzzer BZ are disposed. This audio-visual guide-and-alarm box 12 is located above the emergency exit door 7 and is constructed as a box or frame 67 provided with a translucent cover 68 and with which a constantly lighted fluorescent lamp FL is disposed. In the event that more than one emergency door

or exit is provided, the individual buzzers thereof can be made to emit individual sounds that are different from those of the other buzzers so that each exit is identified with its own audio guide signal.

The invention provides for automatically closing fire doors in a building to isolate portions of a building in the vicinity of which a fire has been detected. These doors are disposed in strategic points for best isolating a building into different sectors while still maintaining access to escape avenues leading to emergency exits also strategically located with reference to the escape avenues and in some cases to the fire doors.

In FIG. 1 a fire door 11 is illustrated. It is, of course, a diagrammatic illustration and it is not intended to illustrate all the relative positions of fire doors and emergency exits. The various emergency exits and fire doors are located in accordance with the building within which the system according to the invention is used. However, as seen in FIGS. 10-13, a fire door 11 is mounted on spring-biased hinges 69 in a recess in a wall portion 70. The hinges may be spring-loaded to automatically move the fire door 11 to a closed position when released by an automatic release device 71 that holds the fire door housed in its recess in the wall. The top of the fire door is provided with a recess 73 opposed to the release device and defined by a plate 74 having in cross-section a slanted surface 72 that is slanted toward the rear of the door.

The automatic release device 71 is constructed as a casing 75 mounted on a door jamb about the recess. The release device 71 has a fixed guide tube 76 in which a slidably disposed plunger 77 is provided with a roller 78. The plunger is urged toward and into the recess 73 on top of the fire door by a spring 79. Thus when the fire door is opened and disposed in its housing recess in the wall, the slanted surface 72 actuates the roller upwardly and it is actuated to a position in which it is housed in the recess 73 holding the fire door releasably housed in the wall recess.

The plunger 77 has an axial portion of larger diameter within the casing 75 defining an annular shoulder 80 that engages a flange 81 on the guide tube 76 so that a stop is formed thereby controlling the extent of the projection of the plunger 77 downwardly under control of the biasing spring 79.

In order to release the release device a rotary solenoid 82 is provided in the casing having a rotary driven shaft 83 to which is connected an operating lever 84 connected to the plunger as shown for retracting it. When the rotary solenoid receives an energizing signal from the fire alarm control 3, the solenoid actuates the operating lever 84 to the position shown in broken lines against the force of the downwardly biasing spring 79 so that the plunger 77 is retracted and the fire door is released and automatically closes a passageway or opening and is stopped in a closing position by a beam 86 extending across the passageway and having a longitudinal surface 87 against which the fire door is placed by the spring-loaded hinges 69 thereof. Those skilled in the art will understand that a wire, not shown, can be provided for manually retracting the plunger 77 for manually releasing the fire door.

In some cases fire doors according to the invention must be placed in positions in which there is a possibility of a person being trapped behind a fire door that has closed. This presents no problem since the fire door can be readily opened by applying pressure thereto

against the force of the spring-loaded hinges. Moreover, while a fire door hinged as shown in FIG. 1 has been illustrated and described, the principles of the invention are equally applicable to the type of fire doors that slide across an opening for closing it. A release device according to the invention can hold such a door releasably housed within a wall and on application of a control signal can allow the fire door to be projected from its housing by spring means thereby closing a passageway opening. This kind of fire door can likewise be slid into its recess housing in the event a person is trapped behind it upon closing thereof automatically.

Provision is made in the system according to the invention for confirming that the individual fire doors have been closed. Each release device is provided with a limit switch LM2 having a flexible sensor 85 that senses the position of the operating lever 84. When the fire door is in an open position, the limit switch LM2 is open. When the fire door is released, the sensor is deflected and closes the limit switch so that a confirmation lamp L5, disposed for example in a control station, indicating that the corresponding fire door has been released and, therefore, closed, is lighted. This confirmation lamp is lighted in a similar manner if the fire door release mechanism is actuated manually.

The individual fire doors can be releasably held by a release device 71' of the type shown in FIGS. 12 and 13 which is mounted behind the fire door rather than from above as before described. In this device a projection or projecting release bolt 88 is provided on the backside of a fire door 11' and has a neck 89 near a free end thereof. A rotary solenoid 90 having a rotary shaft 91 rotatably mounting a lever 93 biased by a biasing spring 92 in a counterclockwise direction, as viewed in FIG. 13. A second biasing spring 92a biases the rotary solenoid in a counterclockwise direction according to the same figure. Both springs are anchored on a casing 94 housing the release device. The entire device is received in a recess in a wall provided with a large recess within which the fire door 11' is housed as before described. The projecting release bolt 88 has a tapered free end that deflects the lever 93 and a side surface 95 is received in the recess defined by the neck 89 and the door is maintained housed. When a control signal for releasing the fire door is applied to the rotary solenoid 90, the operating lever 93 is rotated in a direction away from the release bolt 88 against the force of the biasing force of the springs applying it against the neck 89 so that the fire door is released and is automatically swung to a closed position as before described. A sensor 85' on a limit switch LM2' senses the rotation of the operating lever and closes the switch to light a confirmation lamp as before described.

A smoke ejecting device, FIGS. 14-19, is provided in the system of the invention. The smoke ejection window 10 is mounted on a wall at a point for ejecting the smoke to the exterior of a building in which the system of the invention is provided. The window 10 is mounted in a frame 96 supporting shafts 97 which are rotated to open and close the window. The window opening is determined by a stop 98 mounted on a shaft 97 that is rotatable through 90° from the closed position determined by the stop 98 which has flat surfaces engaging the frame to determine the closed position of the window illustrated in FIG. 17. In the maximum opening of the window, in which the stop is ninety degrees from

the closed position of the window, a maximum amount of smoke will escape through the window.

A casing 99 is mounted alongside the smoke window, as shown in FIG. 14, housing a drive 100 having an electric d.c. motor 101 driving a shaft 102 coupled through a coupling 103 to a reduction gear 104, for example a CYCLO-REDUCTION GEAR. An output shaft 105 of the reduction gear is received in a coupling body 106 which has an opening or bore 107 within which the output/shaft 105 is keyed. The coupling body 106 has an integral sprocket wheel 108 formed circumferentially thereof coupled to a second sprocket wheel 109 by a roller-type sprocket chain 110 for driving a second coupling body 111 on which a bushing 112 mounts the second sprocket wheel. The sprocket wheel is held between a flange 113 on the second coupling body and friction plate 115 clamped by a plate 114. The second coupling body 111 has an externally threaded axial extension on which is threaded an adjusting nut 116 that varies the force applied to the friction plates 115 by an annular plate spring or washer 117.

When the second sprocket wheel 109 is rotatably driven, if the friction force of the friction plates 115 is greater than the torque of rotation, the second coupling body 111 is rotated together with the second sprocket wheel 109 and if the friction force is less, the second sprocket will rotate relative to the friction plates, therefore the second coupling body will not rotate. Whenever an obstacle prevents or restrains rotation of the second coupling body 111, if the restraining force is less than the friction forces, the second coupling body will rotate, but if the restraint is greater, then the friction plates will slip and the second coupling body will not rotate. Accordingly, if the smoke ejection window is somehow restrained from opening, the friction plates, which comprise a friction clutch, will slip and the window will not be opened as will be seen later.

A rotary shaft 118 is keyed to the second coupling body in a bore 119. This shaft is connected to the smoke ejection window shaft 97 through a coupling 120. An eccentric cam 121 is formed on a rotary cam 122 secured to the rotary output shaft 118 for controlling the extent of the opening of the smoke ejection window. A cam follower 123 on a limit switch LM4 is engaged by the cam 121 when the window has opened a predetermined extent and the limit switch will control the de-energization of the drive motor which is reversible. When the window drive motor is driven in an opposite direction for closing the window, the cam 121 is engaged by a cam follower 124 connected to another limit switch LM5 for controlling the stopping of the drive motor.

The smoke ejection window is controlled at the discretion of the firemen through control circuitry later described. Moreover, a swinging type of smoke ejection window, not shown, may also be provided and this can be releasably locked in a closed position. This type of smoke ejection window is generally of the type that when released, it opens due to its own weight. Such ejection window can be provided on the fire doors. Furthermore, suitable fans may be provided in conjunction with the smoke ejection window disclosed and the swinging type.

A fire prevention shutter 125 of the type illustrated in FIG. 20 may be used in the system according to the invention. The shutter is of the roll-type and can be

raised and lowered to open and close an opening or kept at an optional height or partial opening. A ratchet wheel 126 meshes with a sprocket wheel as shown and is controlled by a pawl 127 all of which are enclosed in a housing 128. A drive housing 129 houses a rotary solenoid 130, excited by a signal from the fire alarm control 3, actuating an operating lever 132 secured to the rotary shaft 131 of the solenoid. The operating lever is coupled to the ratchet pawl 127 by a rigid wire rod 133 so that when the solenoid is energized from a signal from the fire alarm control 3 the ratchet pawl is raised as shown by the arrow, the sprocket wheel 126 is released and the shutter lowers itself, for example by its own weight. An extension 134 on the operating lever 132 actuates a limit switch LM3 whereby a confirmation lamp L6 is lighted at a control center, confirming that the shutter has closed.

When the rotary solenoid is de-energized, the operating lever 132 is restored by a restoration spring 135 and the ratchet pawl 127 is engaged with the ratchet wheel 126 so as to stop lowering of the shutter. The de-energization of the rotary solenoid can be controlled by a delay device. The shutter can be placed in the desired raised position by suitably driving the main sprocket wheel manually or otherwise, in known manner, by means not shown. It is, of course, understood that the main sprocket wheel is coupled to mechanism, for example a chain drive, not shown, for raising the fire prevention shutter 125.

The shutter is guided on guides 136, only one of which is shown. The guides can have disposed therein stops made of a fusible metal that will prevent complete lowering of the shutter and will hold it partially raised. When the fusible stops meet, the shutter is allowed to lower completely.

The principle of the control of the shutter is that when a fire takes place, the smoke generated will rise toward the ceiling of a room or compartment. The partially lowered shutter will assist in retaining smoke from spreading since a large portion thereof will be trapped above the partial opening defined by the partially lowered shutter. The shutter will allow escape of persons passing below the shutter. After a time when the people have escaped, the final lowering permitted by the time-delay device or the fusible stops will allow complete lowering and the shutter will execute its function of isolating the smoke and fire from other spaces. In the event that a person is trapped behind the closed shutter, a knob or handle can be provided on the shutter so that it can be readily lifted. These shutters are provided with counter-weights or other means that make the raising thereof easily possible.

Instead of a shutter of the above type, a panel-type smoke defence wall may be pivotally hinged and disposed parallel to the ceiling in position for being controllably lowered to close an opening into a space, room or compartment. The wall may be releasably held by the type of releasable lock devices heretofore described. When this release device receives a control electrical signals, as before described the wall will be lowered automatically by its own weight.

In FIGS. 21-26 an electric circuit diagram of the system is shown in order to operate each mechanism in interlocked relationship. In FIGS. 23-26 the operating portions of each mechanism are coupled to each indicating portion, respectively, by wires shown by dotted lines. Further, in illustrating contacts a white circle

shows a contact in a "make" condition and a black circle shows a contact in a "break" condition.

In FIG. 21 when a circuit breaker 137 is closed, an a.c. electric current is transmitted to lead wires 138,139 and a pilot lamp L1 is lighted to indicate the power source is operative. A relay R1 is excited so as to operate contact R1-1 to contact R1-5. A transformer 140 has a primary connected to the power source and a secondary connected to a rectifier 141 where the a.c. current is rectified, and applied to lead wires 142,143 for transmission. In case the electric current is interrupted, a d.c. voltage is directly supplied from a battery 144 at contacts R1-2, R1-3 of the relay R1. In this case the lamp L2 is lighted by a contact R1-4. A voltmeter V is provided and the voltage through the circuit is indicated. A plurality of relays R2-R6 is connected to corresponding power lines A-E and is de-energized if the line fuses 145 open, so as to turn on an alarm lamp L3 by closed contacts R2-2 - R6-2 of each relay R2-R6 and an audible signal, indicating the fuses are open in the circuit, is generated by ringing an alarm bell 146. In this case if a change-over switch 147 is switched over, the alarm of the alarm bell 146 can be stopped. (FIG. 22)

In FIG. 23 a push button P1 controls energizing of relays R7,R8 and at the contact point of the relays R7,R8 the following relays R10,R12,R14 and R16 are energized. The relay R9 is energized by an electric signal when the smoke is sensed by a smoke sensor which is coupled to its terminals F,F and is actuated as in the same manner with the push button P1.

Each mechanism described above is interlockingly operated by the relay R9, but for explanations's sake, the case of closing of the push button used for operating each mechanism will be explained as an example. Further, in the circuit diagram, OPN represents a part of the emergency exit means, ADH represents a part of the fire door means, ASS represents a part of the fire shutter means, ASR represents a part of the smoke ejecting means, and PICO represents a part of the emergency exit guiding means.

A push button P2 controls driving of the lock releasing means of the emergency exit, and when this push button is depressed, the relay R10 is excited, and a holding circuit is formed through the contact R10-1 of the relay R10. An output (+) is taken out at the contact R10-2 exciting the rotary solenoid 16 which actuates the push rod 17 in a direction toward the door 7 and releases the door by pushing back the bolt 14 to the inside of the door. The relay R10 is actuated after a lapse of time determined by a delay relay R11 and de-energized. When the door is released, the limit switch LM1 is closed and the confirmation lamp L4 is lighted for indicating a confirmation of the condition established.

When the push button P3 shown in FIG. 24 is depressed, a relay R12 is excited, and similar to the preceding case, the rotary solenoid 82 of the engaging means of the fire door is excited and the lever 84 is rotated so as to release the door 11 and the door is automatically closed. In this case the closed state is confirmed by a lamp L5.

If the push button P4 is depressed, a relay R14 is excited, the rotary solenoid 130 of the shutter driving means is excited, the ratchet lever 132 is pulled up, and the shutter is lowered by a dead weight or its own weight. The lowering of the shutter can be adjusted by

determining the time with a relay R15. In this case, the lowering is confirmed by a lamp L6.

FIG. 25 is a circuit diagram of the smoke ejecting means. When a push button P5 is depressed, a relay R30 is excited and its contacts 30-1 to 30-8 actuated so that current is applied to an armature coil A and a field coil F of the drive motor 101, so as to rotate the motor and release the smoke ejecting window 10. The cam 121 is contacted with the limit switch LM4 at a predetermined angle so as to stop the rotation of the drive motor and the smoke is ejected to the outside. In this case by utilizing the limit switch LM5 the position of the smoke ejecting window is confirmed by igniting the lamp L7.

When a push button P6 is depressed, a relay R31 is excited and its contacts 31-1 to 31-8 actuated so that current is applied to the field coil F reversely rotating the motor 101 and the smoke ejecting window is closed.

FIG. 26 relates to an electric circuit diagram concerning the guiding means. In this figure, when a push button P7 is depressed a relay R16 is excited to form a self-holding circuit at the contact R16-1 of the relay R16. A flicker relay R17 is actuated during the excitation as well as a relay R18 in conjunction with the period of the relay R17 and the power source supplied to the guiding means is interrupted. A relay R22, which is an a.c. relay, lights the fluorescent lamp FL upon the excitation of the relay R22 and in case of power stoppage, it is switched to a d.c. circuit transmitted from the operating means. The buzzer BZ provided in the guiding means and the lamps L10, L11 are intermittently excited with the relay R21, generating an intermittent noise and flashing a light for guiding people who may be hampered by smoke to the emergency exit. The guiding means is automatically actuated by the contact point R10-3 of the relay R10 at the time of the releasing of the emergency door by the lock-releasing means of the emergency exit with an electric signal from the smoke sensor in case of a fire. The flash light and intermittent noise of the guiding means can be stopped by depressing the button P8.

The operating means 3 is illustrated in FIG. 27 and is an example of the disaster prevention system according to the present invention in a building, comprising three emergency means, two fire doors, two fire shutters, one smoke ejecting means and three guiding means.

In the circuit for operating each means an instructing portion is previously assembled into each instructing circuit unit 148, and the rear portion of the unit is provided with a known socket, not shown. There is provided a box 151 having a plurality of receiving spaces 150 divided by a plurality of plates 149, and at the inside of the receiving spaces is provided a known plug, not shown, connectable with the socket of the unit 148. On the front of the box 151 there is provided a front panel 152 secured by a hinge, not shown, provided with a push button, an operation confirming lamp, voltmeter and other necessary devices for operating means. Since the panel is illustrated opened, these devices are hidden in the back of the panel in the figure.

In accordance with the construction of a given building a necessary number of units are prepared; each unit is inserted into a predetermined receiving space 150, and connected with each other by a socket and a plug.

Thus the necessary electric circuit can easily and simply be obtained.

In case more emergency exit means, smoke ejecting means, fire doors, fire shutters, and guiding means are required, for example in case of reconstructing or extending a building, if each unit is inserted into each receiving hole, a circuit is easily increased and can be just as easily decreased.

Further, in case a unit is out of order this unit is removed from the receiving space and simply exchanged with a new unit.

Moreover, if a battery for emergency is provided for actuating each means, in case of a power loss when the lead wires from instructing portions are interrupted, each operation at each means can be carried out.

The function and the operation of the push buttons of each mechanism were explained in the foregoing but, as apparent from the electric circuit diagram, the contacts R9-1 to R9-4 of the relay R9 excited by the smoke sensor are provided in parallel to each push button, so that when a fire occurs, the release of the emergency door 7, the generation of the flash light and intermittent noise of the guiding means 12, the closure of the fire door 11, the lowering of the fire shutter 125, and the release of the smoke ejecting means 10 are automatically, and relatively in time, carried out. Accordingly, any person in a building provided with the system of the invention can immediately escape to a safe place through a safe escape passage without requiring any special knowledge or effort, when and from the place where a fire occurs.

The present invention has been explained with reference to the example in detail, but it will be understood that many variations and changes may be made therein without departing from the spirit and scope of the invention. For instance, the fire door and emergency door may be constructed not only as swinging doors but may also be sliding doors. The lock means of the emergency door can be changed to a link mechanism for actuating it with a smaller force or the rotary solenoid used in each means can be changed to a push-pull type solenoid. In proportion to the structure and size of the building, each means can be optionally adjusted. Other means, for example a known sprinkler system, interphone device or the like, can be used together with the present invention in combination therewith.

The present invention is not to be limited to the above examples but can be modified within the scope of the spirit of the invention as indicated in the following claims.

What I claim and desire to secure by Letters Patent is:

1. A fire disaster prevention system comprising an emergency exit door disposed in use in an emergency exit of a building, lock means for normally locking the exit door including means to automatically open the lock means upon application of an electrical signal, a fire door mounted in use in a position for automatically closing an access and isolating from other spaces a space in which said emergency exit is disposed, releasable holding means releasably holding the fire door in a selected position for movement automatically to said position closing said access comprising means responsive to an electrical signal for operating said releasable holding means to release the fire door after a predetermined period after said lock means has received said electrical signal, detection means mounted in use in

13

one of said other spaces for detecting a physical quantity representative of the existence of a fire and generating an electrical signal applied to said lock means to open it and said releasable means upon detection of said physical quantity, guide means receptive of said signal comprising a flashing light and means emitting a sound in the vicinity of said emergency exit upon appli-

14

cation of a signal from said detection means, and sensing means sensing said lock means is in an open condition unlocking said emergency exit and rendering said guide means effective to the received signal after said emergency door is unlocked.

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