United States Patent [19]

Coulter et al.

[11] **3,908,309**

[45]***Sept. 30, 1975**

[54] **PARTICULATE PRODUCTS OF COMBUSTION DETECTOR FOR CLOSURE FRAME**

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[73] Assignee: **Rixson-Firemark, Inc.,** Franklin Park, Ill.

[*] Notice: The portion of the term of this patent subsequent to Dec. 11, 1990, has been disclaimed.

[22] Filed: **Oct. 9, 1973**

[21] Appl. No.: **404,311**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 216,202, Jan. 7, 1972, Pat. No. 3,777,423.

[52] **U.S. Cl.** ..... **49/31;** 49/2; 49/504; 340/237 S

[51] **Int. Cl.²** **E05F 15/20**

[58] **Field of Search** ..... 49/1, 2, 31, 379, 501, 49/504; 52/1, 221; 16/48.5; 160/1; 250/381; 340/237 S

[56] **References Cited**

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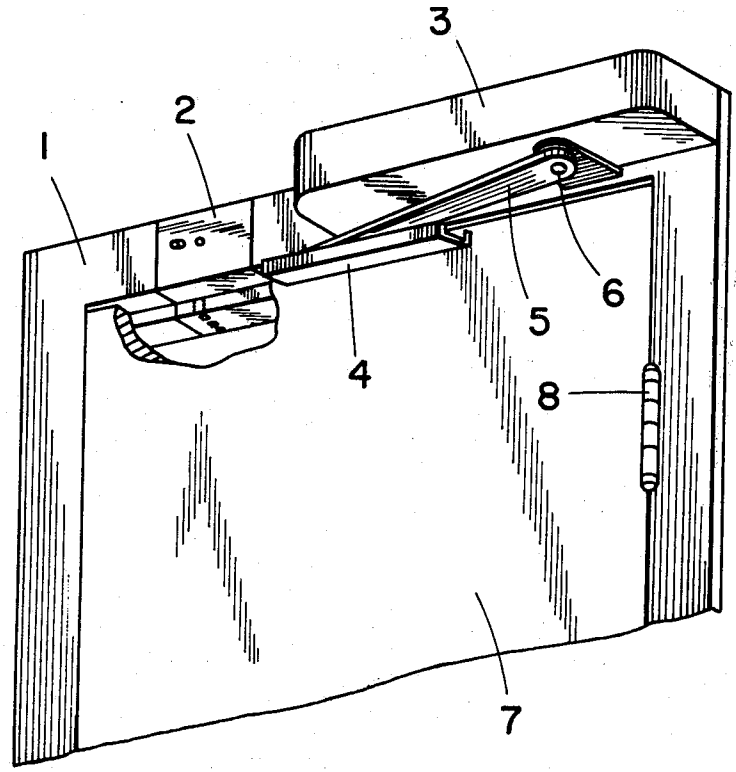
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Primary Examiner—Kenneth Downey

[57] **ABSTRACT**

A door frame having a head member defining the top of a door opening with the head member optionally supporting an electrically actuated door holder-closer. A module having a frame shell section and a detector for the particulate products of combustion supported on the interior of the frame shell section with access openings being formed in the shell section to enable particulate products of combustion to pass through the shell to the detector. A socket formed in the head member receives the module so that any particulate products of combustion flowing through the door opening pass through the module access openings to actuate the detector. The detector is electrically connected to the door holder-closer to effect closing of an otherwise open door in response to the detection of the products of combustion. The detector may be either an ionization or photocell type detector.

10 Claims, 20 Drawing Figures



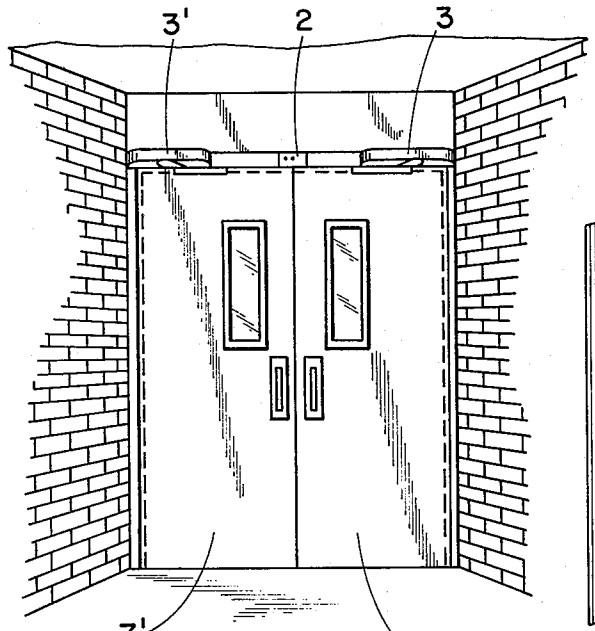


FIG.2

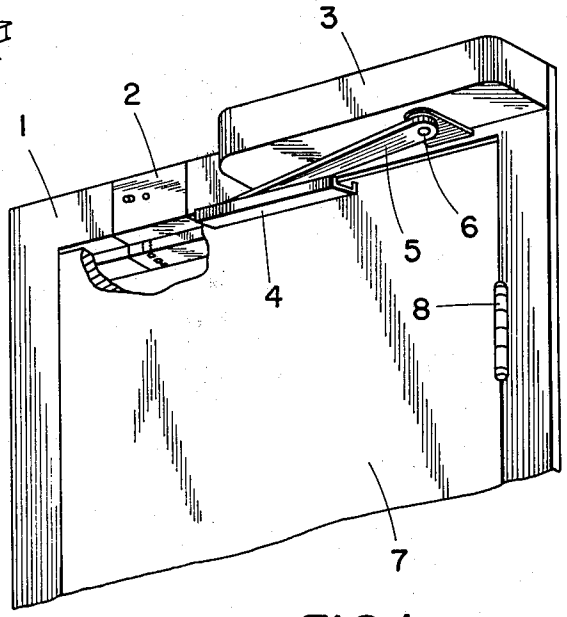


FIG.1

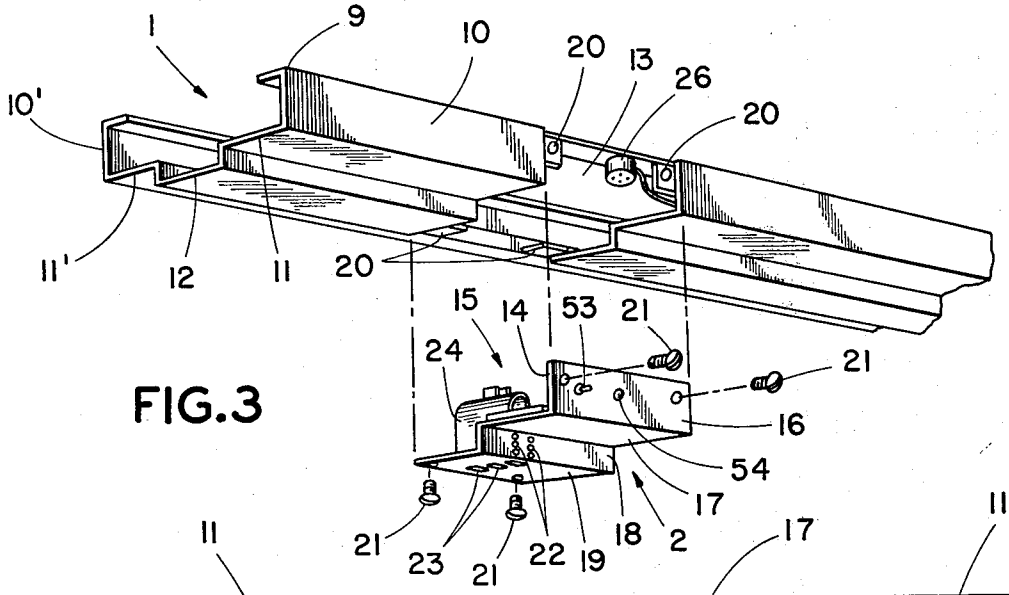


FIG.3

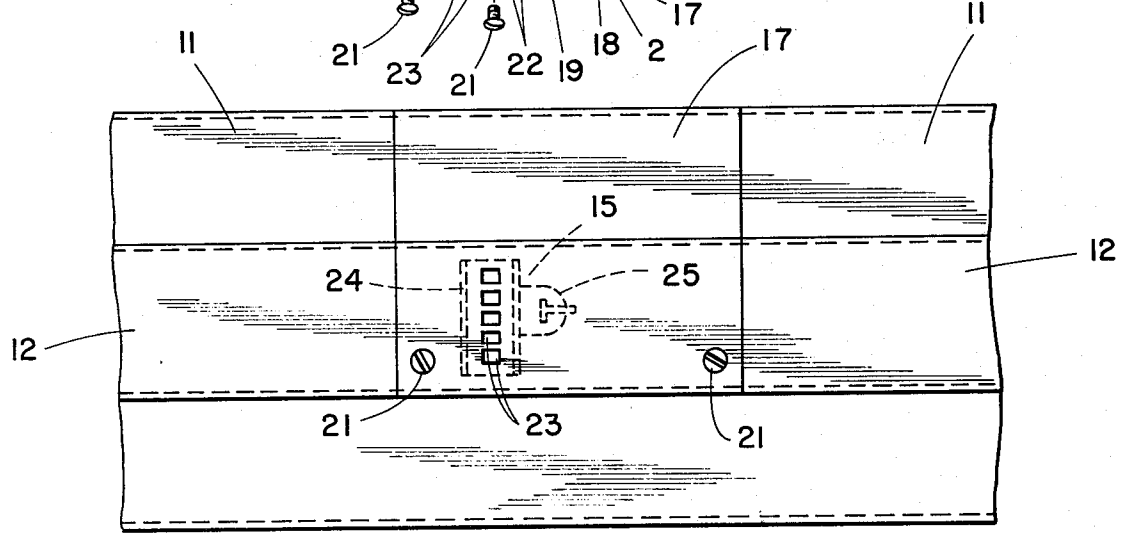


FIG.4

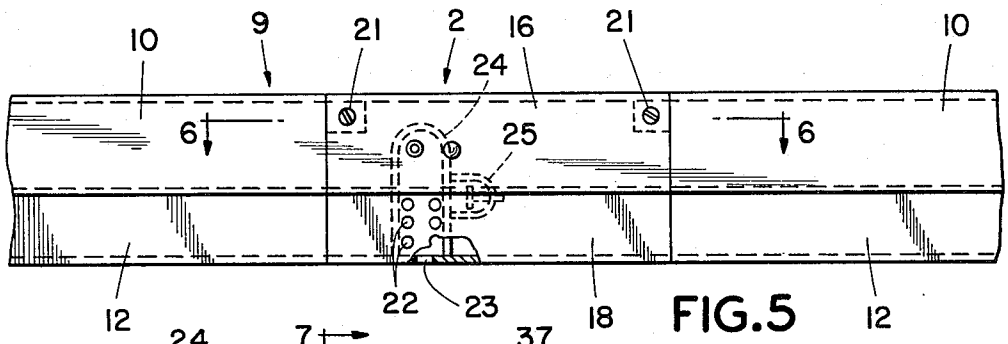


FIG.5

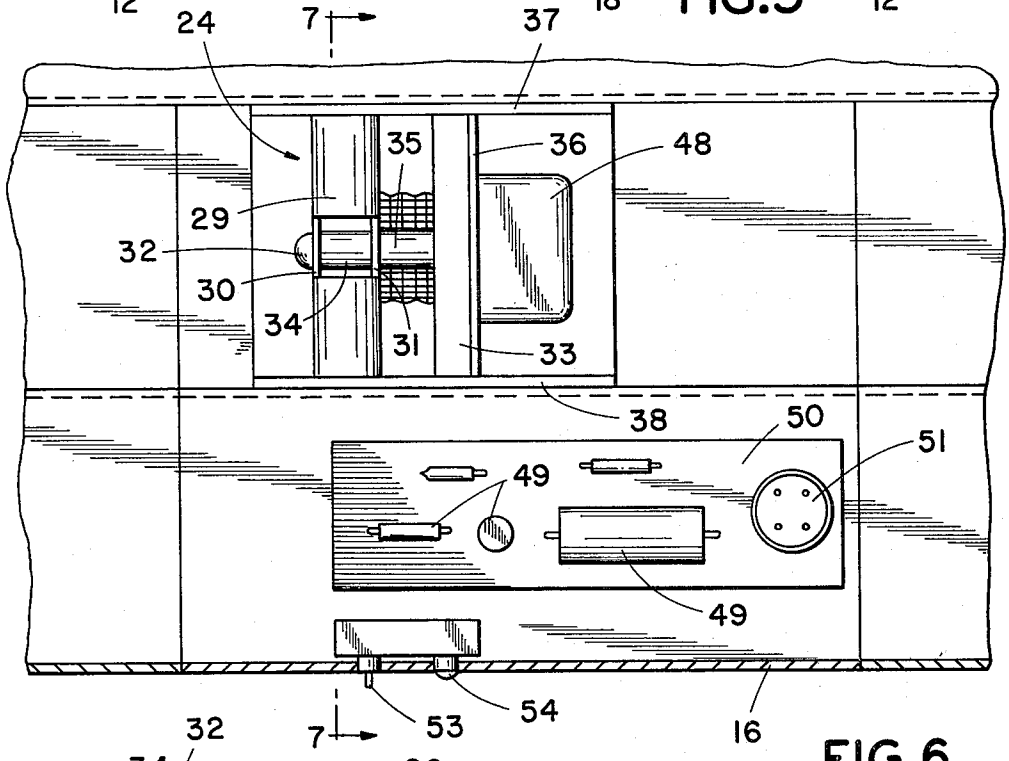


FIG.6

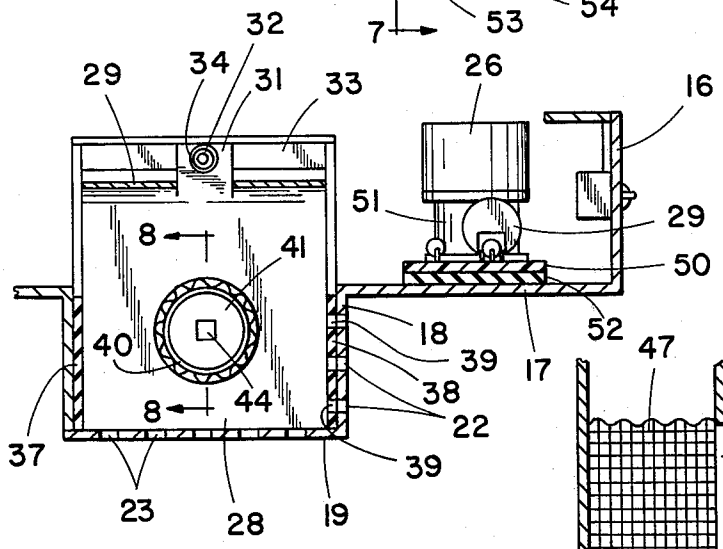


FIG.7

FIG.8

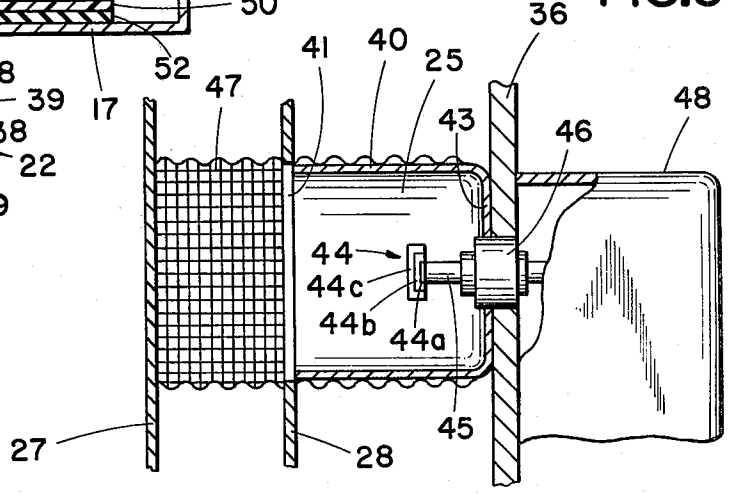


FIG.10

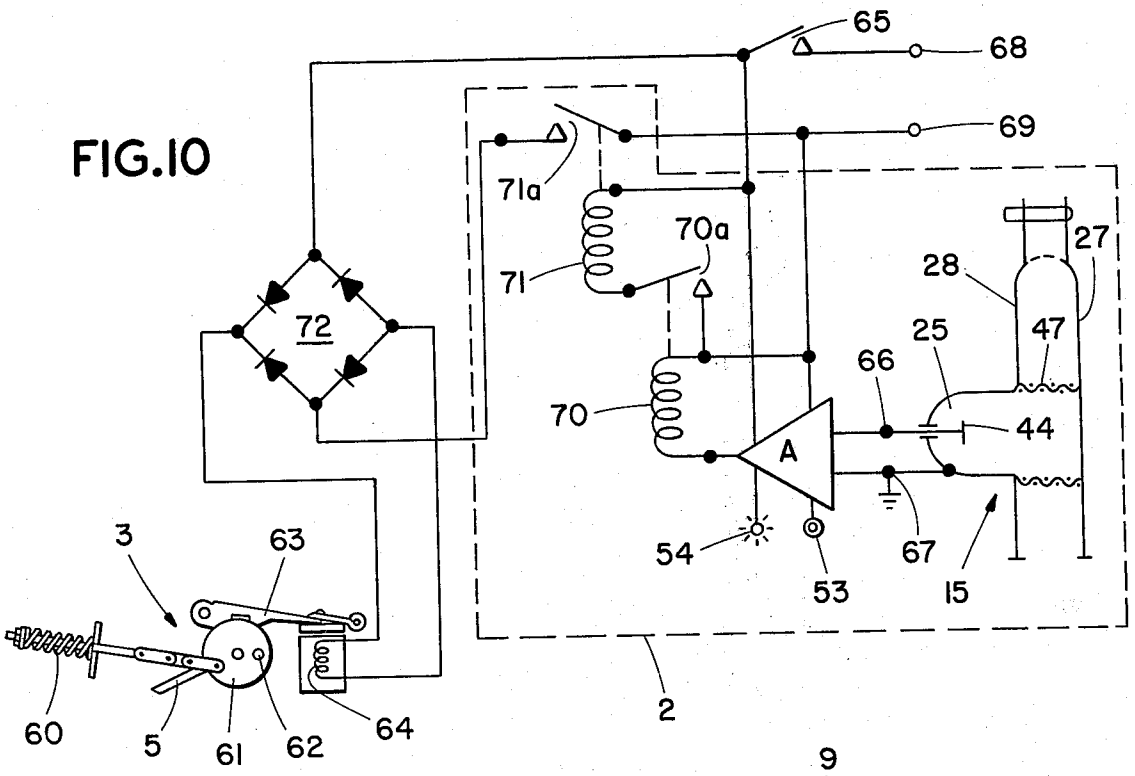
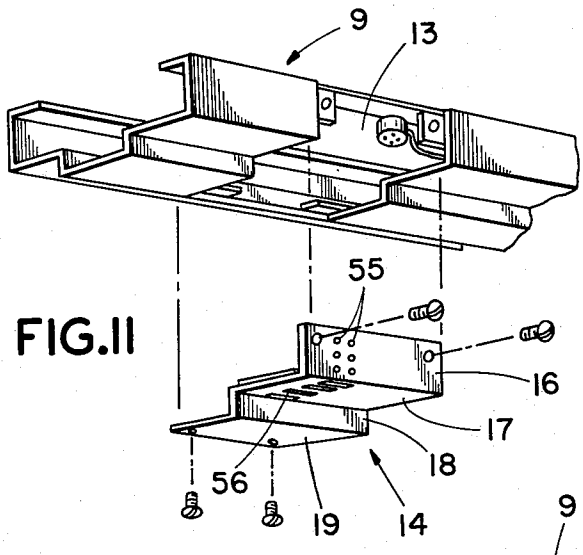


FIG.11



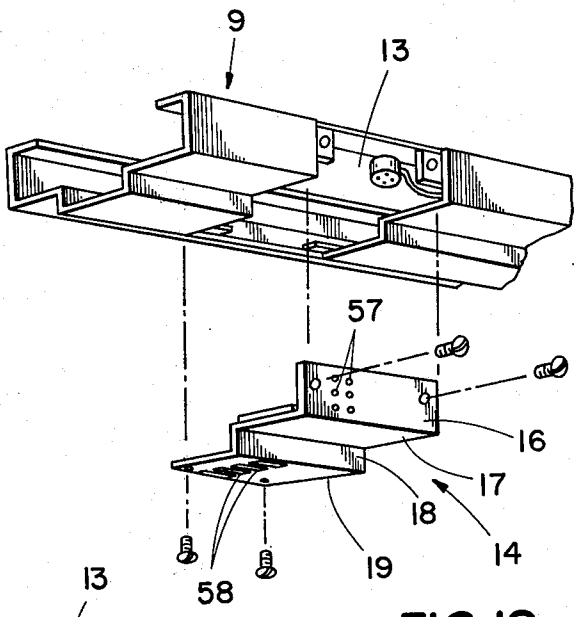
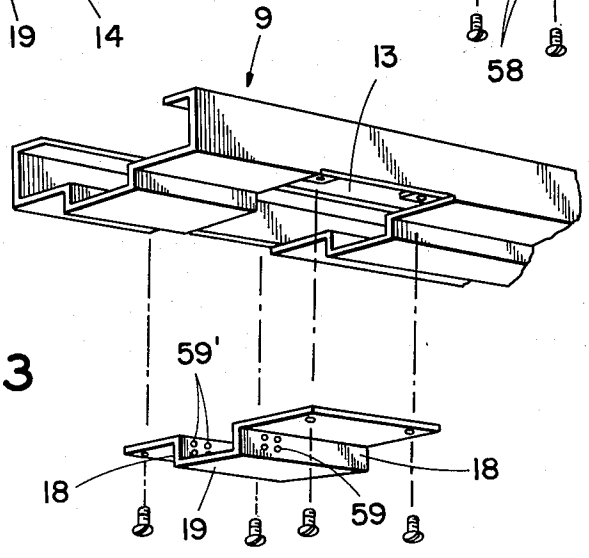


FIG.12

FIG.13



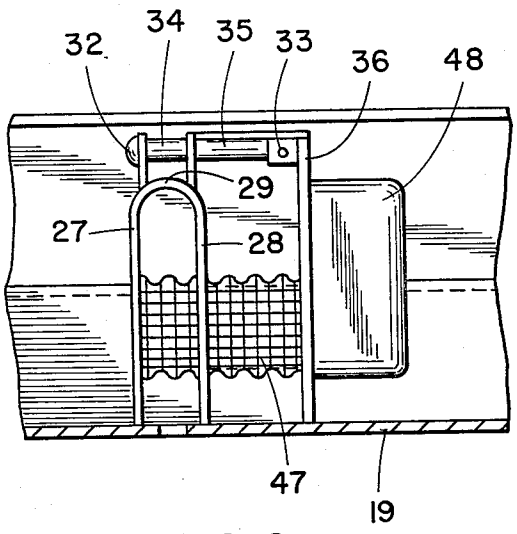


FIG.9

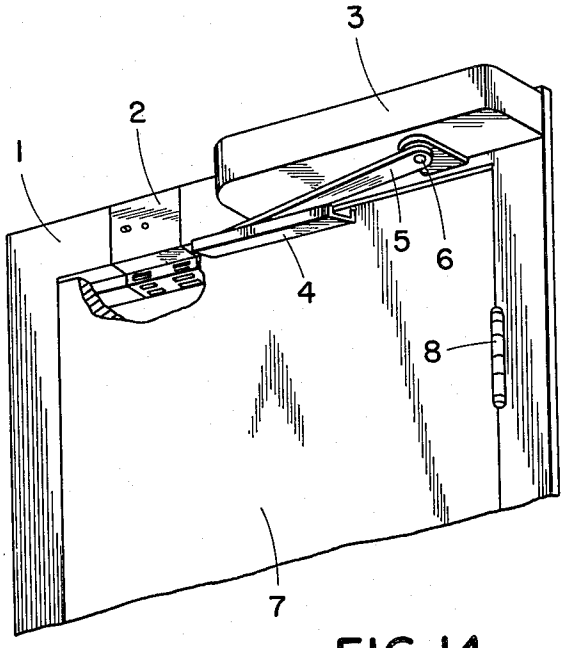


FIG.14

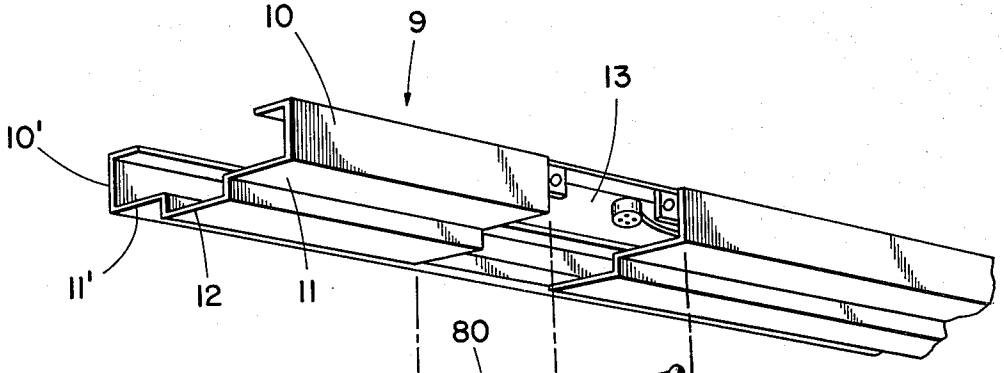
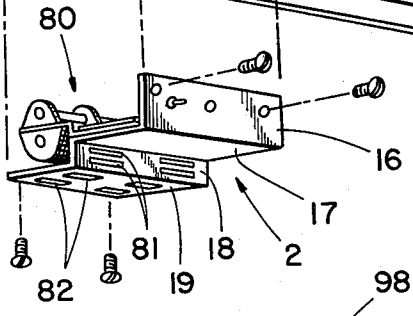


FIG.15



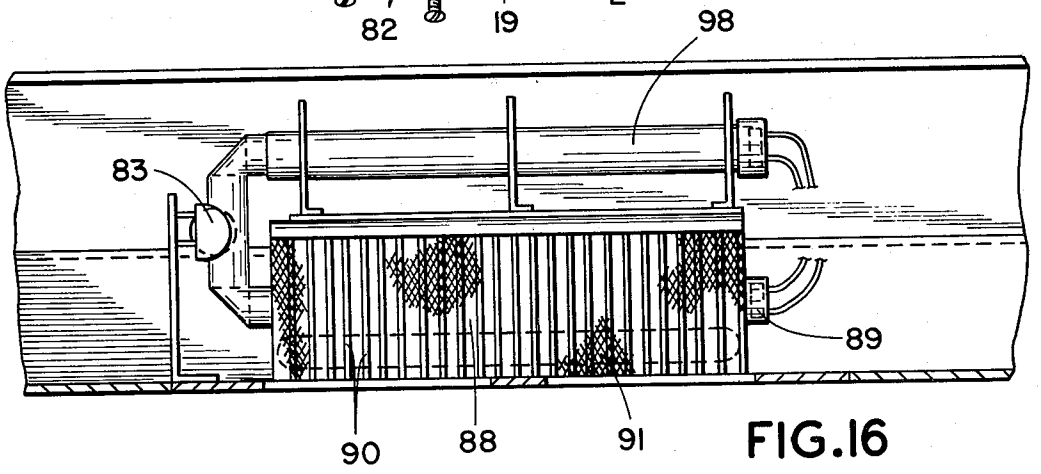


FIG.16

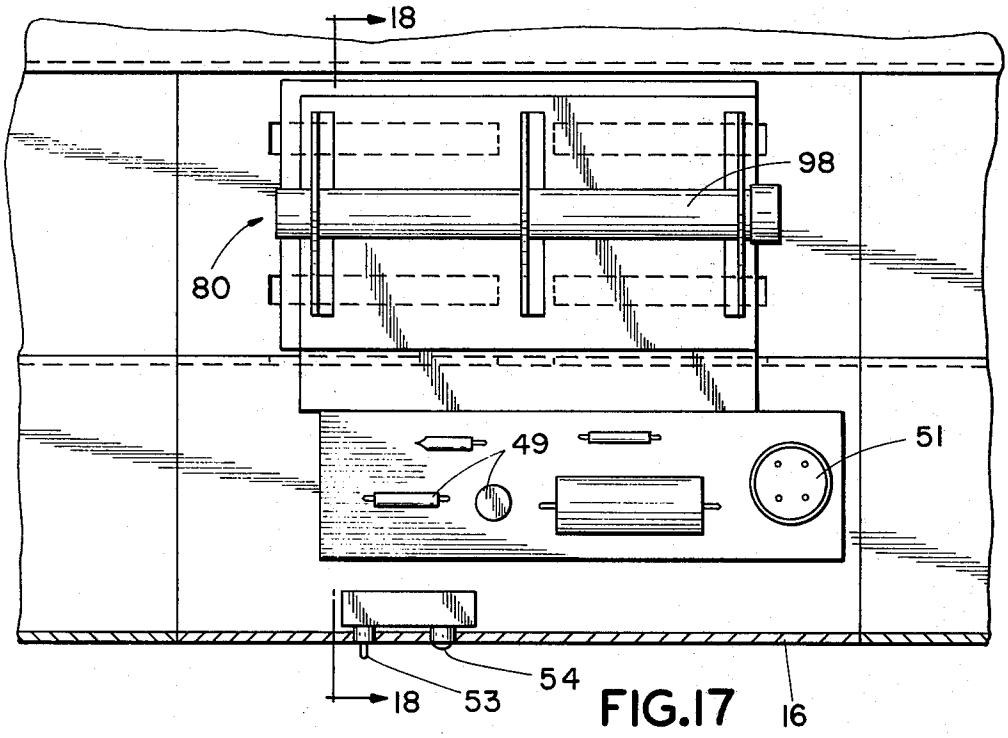


FIG.17

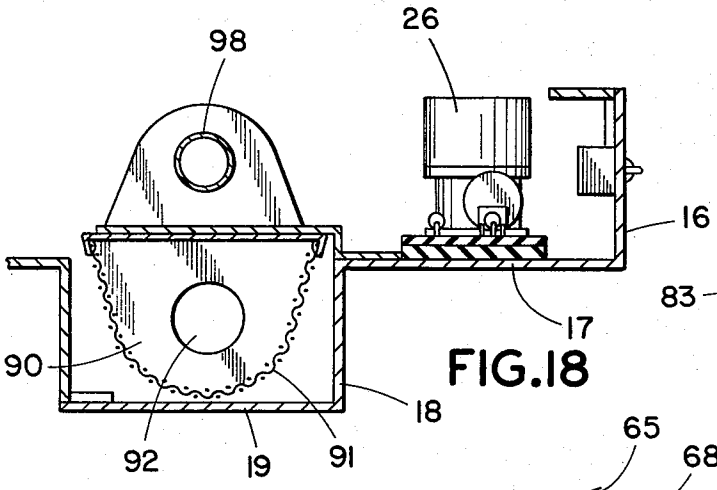


FIG.18

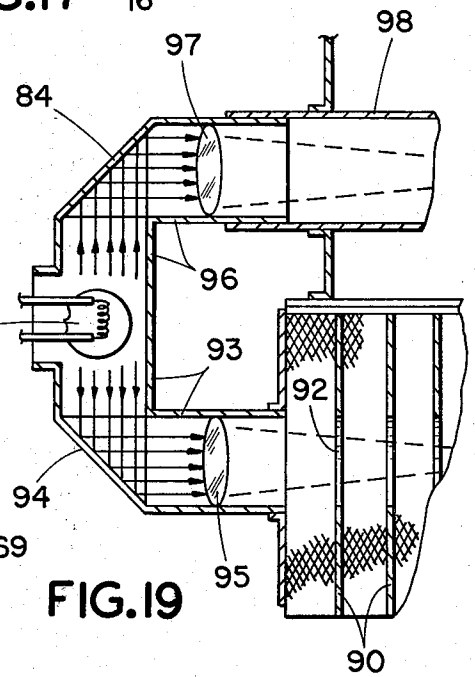


FIG.19

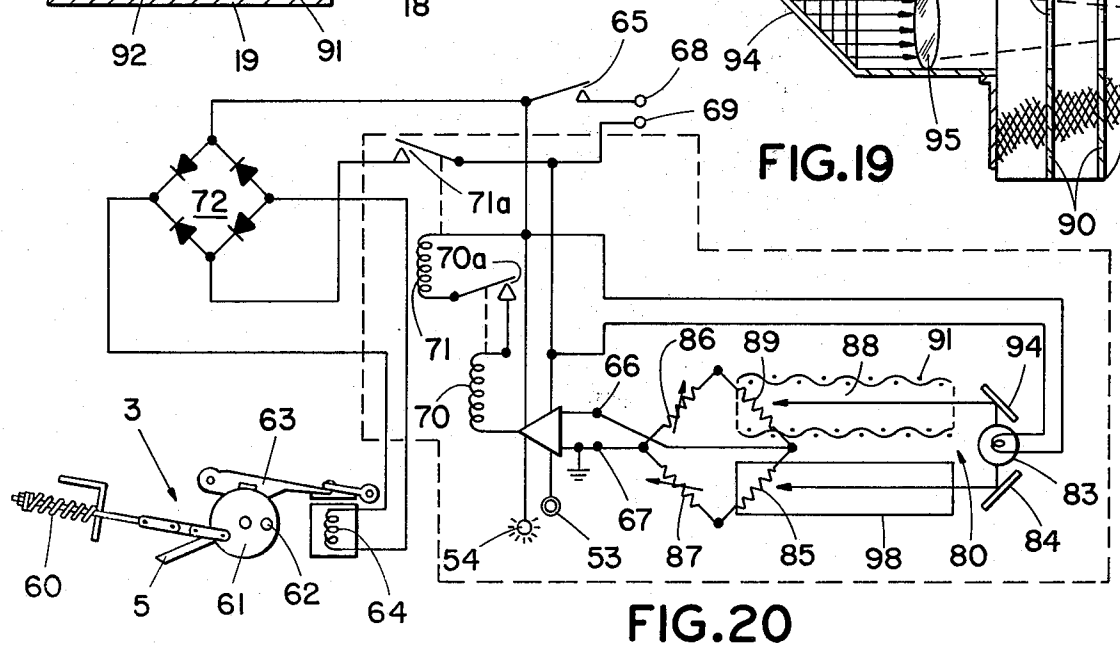


FIG.20

PARTICULATE PRODUCTS OF COMBUSTION DETECTOR FOR CLOSURE FRAME

RELATED APPLICATIONS

This application is related to applicants' copending applications Ser. No. **216,202,** filed Jan. **7, 1972** now U.S. Pat. No. **3,777,423** and Ser. No. **368,827,** filed June **11, 1973,** both for Condition Responsive Door Holder-Closer.

This application is a also a continuation-in-part of U.S. Pat. No. **3,777,423.**

BACKGROUND OF THE INVENTION

The prior art is prolific in door holder-closer structures responsive to the products of combustion to effect an alarm or emergency release of open doors. Where such doors are released by detectors, several approaches have been employed, generally ranging from door release by a complex central fire alarm system characterized by detectors spaced throughout a structure under surveillance to a simple form of a fusible element mounted on the arm of a door closer.

The most common type of quick response detector employed has been a photocell (refraction type) detector or an ionization detector mounted on the ceiling of a corridor, approximately five feet from a fire resistant door to effect a barrier which will prevent passage of the products of combustion from one section of a building to another. As a general rule, if the top of the door, or lintel, extends below the corridor ceiling over eighteen inches, it is standard practice to install a second detector on the opposite side of the door, again approximately 5 feet from the door. The corridor closure may be a single door or a dual door using an electromagnetic door holder-closer on each door. In any event, each detector is located remotely from the controlled holder-closer. Accordingly, at least two units must be separately mounted with interconnecting wiring.

In the event products of combustion are generated, a detector located on the ceiling causes the release of all controlled doors to close the corridors. At this stage, personnel evacuation of a building is possible since the doors will open in the direction of egress from the building. However, in many cases premature and unsafe door closing is effected because the detection of ceiling smoke will occur well before the exitways through the doors become smoke laden. Accordingly, the doors must be manually reopened to permit evacuation of those persons who may have delayed their exit.

Examples of prior art patents relating to condition detectors and also detector responsive doors are as follows:

US PATENT	FILED	INVENTOR	TITLE
1,392,002	6-21-19	Engle	Thermo Control for Fire Doors
2,665,129	1-5-54	Durbin et al	Thermoelectric Door Operating Mechanism
3,009,138	11-14-61	Lindsay	Radioactive Burglar Alarm System
3,039,764	6-19-62	Heinsman et al	Electric Door Operator
3,069,997	12-25-62	Julian	Apparatus for Preventing Exfiltration of Amoke-Laden Air from Smokehouse Enclosures
3,207,273	9-21-65	Jurin	Closure release Device
3,382,762	3-9-61	Basel et al	Smoke Detecting Device
3,430,220	2-25-69	Deuth	Fire Detector
3,445,669	5-20-69	Jordan et al	Radiation Sensitive Carbon Monoxide Detector
3,447,152	5-27-69	Jensen	Fire and Smoke Alarm Device
3,495,353	2-17-70	Forsberg	Door Operating Mechanism
3,496,381	2-17-70	Wisnia	Proximity Control Guard Plate
3,497,995	3-3-70	Forsberg	Height Sensitive Proximity Door Operator System
3,500,368	3-10-70	Magoa Abe	Automatic Ionic Fire Alarm System
3,534,499	10-20-70	Chaffee	Door Opening Apparatus

Applicants' related applications above noted describe door holder-closer structures each incorporating a particulate products of combustion detector as an integral part of the holder-closer structure and within the same housing.

SUMMARY OF THE INVENTION

The invention herein described incorporates a particulate products of combustion detector module located in the door frame. The module is preferably located above the door opening in a socket recess formed in the frame head member. Any products of combustion pass through multiple passageways located within the module to actuate the detector. Location of the detector at this point and within the door effects a major safety advantage. Instead of each controlled door closing at the first evidence of smoke at the ceiling (and the ceiling may be from seven to fourteen feet high), each door will now remain open until the smoke "level" builds downwardly from the ceiling to the height of the door — leaving the doors open for persons to move in either direction — until such time as smoke or products of combustion begin to block the actual exitway.

It is impossible to predict the logic of most persons under a fire or panic condition. Faced with closed doors, many persons will panic even though the doors will manually open with a normal force. Moreover, early door closing is highly disadvantageous for those buildings within which non-ambulatory patients are housed.

The location of the detector near the center of the door opening or, in the case of a double door closure, near the center of the corridor, is an advantageous location to detect smoke or products of combustion. This detector location is effectively attained by this invention because the detector module is preferably centrally located on the head member. There is a natural flow of air or draft through a door opening. This flow will carry the products of combustion through this opening and also effectively through the detector fluid

flow passageways formed in the detector module of this invention. The detectors, however, is not actuated until the exitway is subject to smoke passage; thus, facilitating evacuation until the last possible safe moment.

Additionally, the present invention has the economic advantage that regardless of the height of the corridor ceiling relative to the height of the door, one detector is all that is required to properly monitor the door. The interconnection of separated ceiling detectors and controlled frame mounted holder-closer is eliminated.

From an esthetic aspect, the detector module is formed with the same surface contour as the adjacent head member and without any substantial projection of elements. Accordingly, a pleasing and simple uncluttered appearance results at the door frame.

Moreover, inasmuch as the detector module does not project from the door frame, the incidence of malfunctioning due to vandalism may be substantially reduced.

DETAILED DESCRIPTION OF THE DRAWINGS

In order that all of the structural features for attaining the objects of this invention may be readily understood, reference is herein made to the drawings, wherein:

FIG. 1 is a view showing the application of a first embodiment of the door frame detector module of this invention to a single door controlled by a surface mounted door holder-closer;

FIG. 2 is a view showing the application of the detector module of FIG. 1 in a double door corridor frame;

FIG. 3 is an exploded view showing the detector module of FIG. 1 removed from the associated header frame portion;

FIG. 4 is a bottom view of the detector module showing the bottom row of module openings with the ionization chamber and its shield being shown in broken outline;

FIG. 5 is a side elevation of the structure of FIG. 4 showing the two side rows of module openings with the ionization chamber shield being shown in broken outline;

FIG. 6 is a section view, taken along line 6—6 of FIG. 5, which shows an internal top view of the detector module;

FIG. 7 is a section view taken along line 7—7 of FIG. 6, which shows an internal side elevation view of the detector module;

FIG. 8 is a section view, taken along line 8—8 of FIG. 7, which shows details of the ionization chamber, its protective screen, and also the static shield;

FIG. 9 is a side elevation view of the ionization chamber and its shield;

FIG. 10 is a schematic circuit which shows the fail-safe connection of the ionization chamber module to its associated circuitry, with the principal components of a door holder-closer being diagrammatically shown;

FIG. 11 is a view corresponding generally to that of FIG. 2, but with a second or modified disposition of module openings;

FIG. 12 is a view showing a third disposition of module openings;

FIG. 13 is a view showing a fourth disposition of module openings;

FIG. 14 is a view corresponding generally to that of FIG. 1, but with a photocell detector substituted for an ionization chamber;

FIG. 15 is an exploded view showing the detector module of FIG. 14 removed from the associated header frame portion;

FIG. 16 is an elevation view of the interior of the photocell detector module;

FIG. 17 is a plan view of the photocell detector module;

FIG. 18 is a section view taken along line 18—18 of FIG. 17;

FIG. 19 is a detailed view showing the two source light paths taken in the photocell detector; and

FIG. 20 is a schematic circuit, corresponding generally to that of FIG. 10, but modified to show the photocell detector.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIG. 1, the products of combustion detector and control of this invention is shown applied to a door frame which outlines a single door opening. This door is controlled by an electromechanically operated door holder-closer of the type shown in Gaysowski U.S. Pat. No. 3,648,326 and also in Crane et al U.S. Pat. No. 3,729,771. In particular, door frame 1, which is preferably fabricated from metallic rail sections, is formed with a socket which receives door frame detector module 2. Door holder-closer 3 is surface mounted on the head member of frame 1. The door holder-closer 3 includes a track 4 within which a slide block (not shown) reciprocates. The left end of standard arm 5 is coupled to the slide block. The right end of arm 5 is coupled to the projecting end of a rotating drive spindle 6 which is an integral part of the holder-closer mechanism and which extends from the housing.

As is described in the aforementioned Gaysowski and Crane et al patents, door holder-closer 3 includes as principal components a coil spring, a link chain, a dashpot and an electromagnetic lever assembly. This structure when coupled to door 7, as is shown in FIG. 1, and also when electrically connected to a particulate products of combustion detector, is capable of holding a door open to a desired position. In response to the detection of smoke or other particulate products of combustion, the electromagnetic lever assembly is actuated to enable the coil spring to close the door. This door control action isolates smoke and fire to a given room or area and thus enhances fire safety.

Door 7 is preferably a metallic door which may be supported by a plurality of butt hinges 8 (only one of which is shown) upon door frame 1.

As is described in applicants' copending U.S. Pat. applications Ser. No. 216,202 and Ser. No. 368,827, the head portion of a door is an ideal location for a products of combustion detector. The location of a detector at this area enables a fire detection system to respond to smoke and other products of combustion sources located on either or both sides of the door opening and to hold the door open until such time as the smoke passes from one side of the door frame to the other side. This is an ideal mode of operation from a safety aspect.

The head member of frame 1 receives detector module 2 which is formed and designed as an insert for a socket or opening formed in the head member. Thus, a generally continuous contour is formed at the head member, and the products of combustion detector does not create an unsightly appearance. Additionally, the

vandalism to which projecting members may be subjected is minimized by making detector module 2 appear as an integral part of the door frame. The contour of module 2 is substantially identical to that of the adjacent portions of the head member of frame 1.

Module 2 contains a particulate products of combustion detector, such as an ionization detector or a photocell detector, as a principal internal element. The shell of the module, as will be hereafter outlined in detail, is formed with a plurality of access openings so that the products of combustion can pass into and out of the module and thereby actuate the detector.

FIG. 2 shows the application of a single door frame detector module 2 to control a pair of corridor doors 7 and 7'. Each door 7, 7' is controlled by a door holder-closer 3, 3', respectively. In the structural arrangement of FIG. 2, the detection of the particulate products of combustion by detector module 2 actuates closers 3, 3' so that both doors 7, 7' can be appropriately closed to isolate the double door corridor. As is hereafter outlined, the electrical circuitry of closers 3 and 3' are interconnected so that if detector module 2 detects the particulate products of combustion, both closers are activated simultaneously so as to close doors 7, 7' in response to such detection. It is unnecessary in the application of a pair of doors which close off a hall or corridor to employ individual detectors for each of closers 3, 3' inasmuch as a single detector module is capable of adequately monitoring the relatively wider head member of the closure frame.

FIG. 3 shows detector module 2 removed from head member 9 of frame 1. Head member 9 is one of the many metallic channel constructions commonplace in the steel door frame art. In general, such frame channels are preferably fabricated of metal where integrity to fire is a prime consideration. Head member 9 includes vertically disposed casing or face trim sections 10, 10', horizontally disposed jamb sections 11, 11' and a door stop section 12. In a particular building installation, the channel may or may not be filled with adjacent structural material such as concrete or building mortar.

A portion of the channel of head member 9 is removed to form a socket or opening 13 which is to receive module 2. Module 2 includes as its principal components a metallic frame shell 14 which supports a products of combustion detector 15 as hereinafter set forth in detail. Frame shell 14 is contoured or formed in a manner corresponding to the adjacent contours of head member 9; thus, the shell includes a facing section 16, a jamb section 17, a vertical stop section 18, and a horizontal stop section 19. Four mounting brackets 20 supported by head member 9 project into socket 13. When module 2 is elevated into socket 13 and screws 21 are affixed, the module is held rigidly in place within head member 9. Accordingly, the head member presents a generally uniform contour to the viewer without any substantial projections which would detract from the door frame decor.

Module stop sections 18, 19 are formed with a plurality of access openings 22, 23, respectively. Access openings 22, 23 permit the products of combustion to pass into the interior of the module so that these products may actuate the products of combustion detector 15 to appropriately operate door holder-closer 3 (FIG. 1).

The particular detector 15 shown in FIG. 3 is an ionization type detector and this detector employs as its principal components a U-shaped electrostatic shield 24 which is formed with appropriate passageways so that products of combustion entering the shield may also find their way into the interior of an ionization chamber 25, shown in broken outline in FIG. 4. Fluid flow access (i.e., particulate products of combustion) may be into either of access openings 22 or 23, depending on the particular location of the products of combustion source relative the door frame. In any event, a flow into and out of the detector module by way of the ionization chamber is provided so that early detection can be attained.

FIG. 5 shows electrostatic shield 24 in broken line side elevation. The disposition of access openings 22 and 23 relative U-shaped shield 24 shows that fluid flow from one set of access openings to the other must necessarily flow through electrostatic shield 24 of the ionization detector 15.

Connector 26 (FIG. 3) and its associated electrical conductors located within the channel of head member 9 interconnect detector module 2 and holder-closer 3 and also the line source. The use of a connector enables module 2 to be removed readily from head member 9 so that necessary inspection, repair and replacement of the module can be easily made.

FIGS. 6 through 9 (FIG. 9 on sheet 4) show the principal components which comprise ionization detector 15. These components are housed within and supported on frame shell 14 of detector module 2. Metallic electrostatic shield 24 which is of a U-shaped metallic construction is located within the stop sections 18, 19 of the shell. In particular, the electrostatic shield comprises spaced plates 27 and 28 integrally connected one to the other by means of curved top 29. As is shown in FIGS. 6, 7 and 9, top 29 is slotted so that vertically projecting tabs 30, 31 emanate therefrom. A long screw 32 passes through apertures formed in tabs 30, 31 so that electrostatic shield 24 is supported by this screw on support bar 33. Spacer bushing 34 extends between tabs 30, 31 and spacer bushing 35 extends between tab 31 and support bar 33. Screw 32 passes through bushings 34 and 35.

Ionization chamber support plate 36 is also fixed to support bar 33. Additionally, side plates 37 and 38 extend perpendicularly relative bar 33 and support plate 36. Plates 37 and 38 are spaced so that electrostatic shield 24 and its spaced leglike plates 27, 28 are fixed tightly therebetween. Side plate 38 is formed with a plurality of access openings which are in alignment with stop access openings 22 (FIG. 7). Accordingly, products of combustion entering stop access openings 22, 23 pass between spaced plates 27, 28 of electrostatic shield 24.

Ionization chamber cup 40 extends and is sandwiched between plates 28 and 36 (FIG. 8). Plate 28 is formed with a circular hole 41 (FIGS. 7, 8) which mates with the opening of cup 40. Cup 40 defines ion chamber 25. Cup 40 is generally formed with a cylindrical side wall which is closed at its right end (FIG. 8) by a metallic bottom 43. Radioactive source 44 is supported on the left end of metallic positive electrode post 45 so that the source is centrally located within the ion chamber. Insulator bushing 46 isolates electrode 45 from metallic support plate 36. In a preferred commercial embodiment, radioactive source 44 is a sandwich comprising a silver layer 44*a*, a gold layer 44*b* contain-

ing dispersed Americium oxide and a gold sealing layer 44*c*.

The passing of the particulate products of combustion through the space defined by plates 27, 28 of electrostatic shield 24 through opening 41 into ion chamber 42 affects the electrical conductivity between radioactive source 44 and ion chamber cup 40 so that the appropriate amplifier circuitry can detect such products due to the change in electrical current flow in the ion chamber.

In view of the fact that small particles other than those created by the products of combustion, such as insects, can also create a current flow change within ion chamber 25 which simulates smoke or fire, screen 47 envelops the outside surface of cup 40. This screen also extends between shield plates 27 and 28. Accordingly, all fluid flow into ion chamber 25 must pass through the cylindrical wall of the screen 47. Thus, foreign particles such as insects cannot enter into ion chamber 25.

Additionally, the screen prevents radioactive source 44 from falling from detector module 2 in the event that the source support on post 45 is broken. This is a desirable and necessary safety measure.

The right end of positive electrode 45 (FIG. 8) and associated electrical preamplifier components are shielded within metallic housing 48 supported on the right surface of metallic support plate 36. Additional electrical circuit components generally denominated as 49 are supported on insulator circuit board 50. Insulator circuit board 50 also supports a male socket connector 51 which mates with the electrical connector 26 (FIG. 3) so that the detector module can be connected to external circuitry. Circuit board 50 and its supported components are carried by shell jamb section 17. In view of the fact that the shell is metallic, insulator 52 is sandwiched between elements 17 and 50 to provide the necessary electrical isolation.

Shell face section 16 supports reset pushbutton switch 53 and pilot light 54 (FIG. 6) so that these two components are exposed through appropriately located openings positioned in frame shell 14. The operation of components 53 and 54 is hereafter described with respect to the schematic circuitry of FIG. 10.

FIGS. 11, 12 and 13 show alternative frame shell arrangements for detector module 2. In particular in FIGS. 11 and 12, the frame shells 14 have identical contours with that previously described with reference to the FIGS. 3 and 4. However, in FIG. 11 access holes 55 and 56 are located on shell face section 16 and shell jamb section 17. With reference to FIG. 12, access holes 57 and 58 are located on shell face section 16 and horizontal stop section 19. These alternative hole dispositions of shell section 14 provide different fluid flow characteristics which may be particularly advantageous in securing proper fluid flow of particulate products of combustion in certain locations. In FIG. 13 it should be noted that the door should be located on the far side of the head member 9, so that fluid flow through access holes 57 and 58 will not enable the particulate products of combustion to pass around a closed door.

In FIG. 13 access holes 59 and 59' are located on the vertical portions of stop 12. In this construction, particulate products of combustion can not pass through a closed door in view of the fact that access holes 59 and 59', depending upon which side of stop 12 the door is located, will be covered in response to door closing.

The schematic circuit of FIG. 10 shows the electrical interconnection of door frame detector module 2 to door holder-closer 3. A preferred detailed circuit description for module 2 is described in U.S. Pat. No. 3,673,586, issued to Lyman C. Blackwell for Resistance Controlled Timed Pulse Generator.

In order that the electrical operation of the structure of FIG. 10 may be understood, it will be necessary to describe generally the construction of door holder-closer 3. The closer comprises as its principal components a helical spring 60 (FIG. 10) connected to a dashpot rotor 61. Whenever door 7 (FIG. 1) is opened, standard arm 5 which is connected to dashpot rotor 61, rotates the rotor responsively until roller 62 is engaged by armature latch 63. The engagement of elements 62, 63 will be maintained in the event electromagnet 64 is energized. In the event elements 62, 63 are latched and electromagnet 64 is energized, as hereafter set forth in response to the detection of the particulate products of combustion by detector 15, electromagnet 64 will be deenergized. In response to this deenergization, the latch of elements 62, 63 is broken and the compression force of spring 60 causes a clockwise rotation of the dashpot rotor 61. This rotation of the rotor causes a movement of standard arm 5 which enables door 7 to close.

The schematic circuit of FIG. 10 shows an electrical circuit effecting the interconnection of electromagnet 64 to ionization chamber 25 to effect hold-open and closing of door 7 in a failsafe manner of operation. Additionally, the schematic circuitry incorporates a detector and amplifier unit within module 2 which is failsafe in operation. In particular, if all of the components of the module 2 are properly operating, door 7 will remain in hold-open effected by the latching of roller 62 by armature 63 in response to the manual closing of control switch 65. If, however, module 2 is not properly operating or, alternatively, this unit senses a condition such as smoke, door 7 will be released from a latched hold-open position and closed in response to the closing force exerted by coil spring 60.

The detailed operation of the circuitry of FIG. 17 is as follows:

Assuming module 2 is in proper operating condition and that the ionization chamber 25 input applied to terminals 66 and 67 indicates an absence of a smoke condition, door 7 will be held in the open position in response to the manual closing of switch 65; that is, the closing of switch 65 applies line voltage from terminals 68 and 69 to amplifier A of module 2. The application of line voltage to amplifier A energizes amplifier output relay 70, thereby closing normally open contact 70*a*. The closing of contact 70*a* applies line voltage to the coil of power relay 71. With this occurrence, normally open contact 71*a* is closed, thereby applying line voltage to fullwave bridge rectifier 72 to energize electromagnet 64 with a pulsating-direct-current voltage. The energization of electromagnet 64 drives magnetic armature 63 into locking engagement with roller 62. Thus, so long as electromagnet 64 is energized, door 7 will be held in an open position.

In the event, however, (a) a slight manual closing force is applied to door 7, (b) switch 65 is opened, (c) module 2 malfunctions, or (d) an undesired condition such as smoke is detected by chamber 25, armature 63 will be pivoted from engagement with roller 62, and

spring 60 will close the door to the position shown in FIG. 1.

In the situation of case (a) above, the manual override closing force causes armature 63 to release the latch formed with roller 62.

In situations (b), (c) and (d) above, electromagnet 64 is deenergized, thereby enabling the camming action of roller 62 to elevate armature 63.

In a multiple door installation, such as the corridor application shown in FIG. 2, the electromagnet of holder-closer 3' is merely interconnected with the circuitry for holder-closer 3 so that both electromagnets (corresponding to electromagnet 64) are energized or deenergized simultaneously.

Reset pushbutton switch 53 is connected to amplifier A of module 2 so that the circuitry can be again placed in a detection readiness condition after the closer has released in response to a fire or alarm condition. Switch 53 is accessible for manual operation from the front of frame shell 14 (FIGS. 3 and 6).

Pilot light 54 is also connected to amplifier A of module 2. When the circuitry is in a properly operating supervisory condition, the pilot light will periodically emit light. When smoke is detected, the pilot light will remain on. A deenergized pilot light indicates an electrical malfunction. In a preferred circuit arrangement the circuitry "locks" into an alarm condition (pilot light 54 on) and remains in an alarm condition until the unit is reset by manual operation of switch 53.

FIGS. 14 through 20 describe a second embodiment of this invention in which a photocell detector 80 is employed in lieu of the ionization detector 15 described with reference to the prior Figures. The principal difference in the second embodiment is that the ionization chamber has been replaced by a light tube which senses the obscuration effect of the particulate products of combustion in a path defined by a light source and a photocell detector. Additionally, a compensating tube is employed to compensate for variations which might occur in the light source due to aging.

Referring to FIGS. 14 and 15, the module shell for the second embodiment is essentially the same as that described with reference to FIG. 2. In particular, the shell comprises sections 16, 17, 18 and 19.

The principal difference is that the access holes formed in sections 18 and 19 for the embodiment of FIGS. 14 and 15 are elongated slots which traverse a greater horizontal length. This variation in access holes 81 and 82 is required in order to effect optimum entry of the particulate products of combustion into the photocell detector as hereafter described.

More particularly, these products must pass into elongated detector tube 88 so that light emanating from source 83 (FIGS. 16, 19 and 20) may be absorbed or attenuated in its path of travel to photocell 89. Detector tube 88 is formed by a plurality of spaced support plates 90 which extend from the front to the rear of tube 88. The peripheral edges of support plate 90 carry blackened wire screen 91 whose interstices permit the passage of smoke into the interior chamber of detector tube 88. Each of the plates 90 is formed with a central hole 92. Accordingly, light emanating from source lamp 83 travels through light conduit elbow 93 (FIG. 20) in a path of travel in which the light is reflected from mirror surface 94 through lens 95 through the plurality of axially aligned holes 92 to impinge upon photocell 89.

Light from source 83 also travels through a second path which includes second light conduit elbow 96. Light traveling in this conduit elbow is reflected by mirror 84 and follows a path through lens 97 into closed standard tube 98 to thus impinge upon photocell 85. The interior chamber formed by standard tube 98 is hermetically sealed and, accordingly, products of combustion cannot enter this tube and, therefore, no light absorption occurs within this tube during smoke entry into the inner confines of detector module 2.

Referring now to FIG. 20, photocells 89 and 85 are connected in a bridge circuit with variable resistors 86 and 87. Output terminals 66 and 67 of the bridge circuit correspond to like numbered terminals shown in the schematic circuit of FIG. 10. The only circuit change is the substitution of the photocell particle detector 80 for ionization particle detector 15. Circuit operation is attained which is substantially identical to that previously described with respect to FIG. 10. Variable resistors 86 and 87 are normally adjusted so that with ambient (smoke absent) conditions no signal appears at the output of amplifier A. However, in the event smoke enters detector tube 88 through wire screen 91, the bridge becomes unbalanced and a signal change appears at terminals 66 and 67. This signal change is applied to amplifier circuit A in accordance with the operation previously described with reference to FIG. 10, thus causing door holder-closer 3 to close door 7.

It should be understood that the above described embodiments are merely illustrative and that changes can be made without departing from the scope of the invention.

What is claimed is:

1. In a closure frame having a head member defining the top of a closure opening with the head member supporting an electrically actuated closure holder-closer, the improvement comprising a module including a frame shell section providing a module base and a detector for the particulate products of combustion supported on the interior of the frame shell section with access openings being formed in the shell section to enable particulate products of combustion to pass through the shell to the detector, a socket formed in the head member to receive the module whereby particulate products of combustion passing through the closure opening pass through the module access openings to actuate thereby the detector, and means electrically connecting the detector to the closure holder-closer to effect closing of an otherwise open closure in response to the actuation of the detector upon the detection of the products of combustion.

2. In a door frame having a head member defining the top of a door opening with the head member supporting an electrically actuated door holder, the improvement comprising a module including a frame shell section providing a module base and a detector for the particulate products of combustion supported on the interior of the frame shell section with access openings being formed in the shell section to enable particulate products of combustion to pass through the shell to the detector, a socket formed in the head member to receive the module whereby particulate products of combustion passing through the door opening pass through the module access openings to actuate thereby the detector, and means electrically connecting the detector to the door holder to permit release of an otherwise

open door in response to the actuation of the detector upon the detection of the products of combustion.

3. The combination of claim 2 in which the frame shell section has a contour substantially identical to that portion of the head member adjacent to socket whereby the head member has a substantially continuous surface contour.

4. The combination of claim 3 in which the head member includes a horizontal jamb section, a casing or face section and a closure stop section.

5. The combination of claim 4 in which the access openings are formed in the frame shell section corresponding to the stop of the head member.

6. The combination of claim 4 in which the access openings are formed in the frame shell section corresponding to the horizontal jamb section.

7. The combination of claim 4 in which the access openings are formed in the frame shell section corresponding to the casing or face element.

8. The combination of claim 4 in which the access openings are formed in at least two of the frame member sections.

9. The combination of claim 4 in which the detector is an ionization detector.

10. In a closure frame having a head member defining the top of a closure opening, the improvement comprising a module including a frame shell section providing a module base and a particulate products of combustion detector in which detector an electrical current characteristic is altered in response to the detection of such particulate products of combustion, the detector being supported within the interior of the frame shell section with access openings being formed in the shell section to enable particulate products of combustion to pass through the shell to the detector, and a socket formed in the head member to receive the module whereby particulate products of combustion passing through the closure opening pass through the module access openings to actuate thereby the detector.

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