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Marsocci

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[54] **OPTICAL SMOKE DETECTOR WITH LIGHT SCATTERING TEST DEVICE**

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[52] **U.S. Cl.** ..... **356/103,** 250/574, 340/237 S, 356/207

[51] **Int. Cl.** **G01n 21/00,** G01n 21/12

[58] **Field of Search** ..... 356/103, 104, 207, 243; 340/237 S; 250/574

[56] **References Cited**

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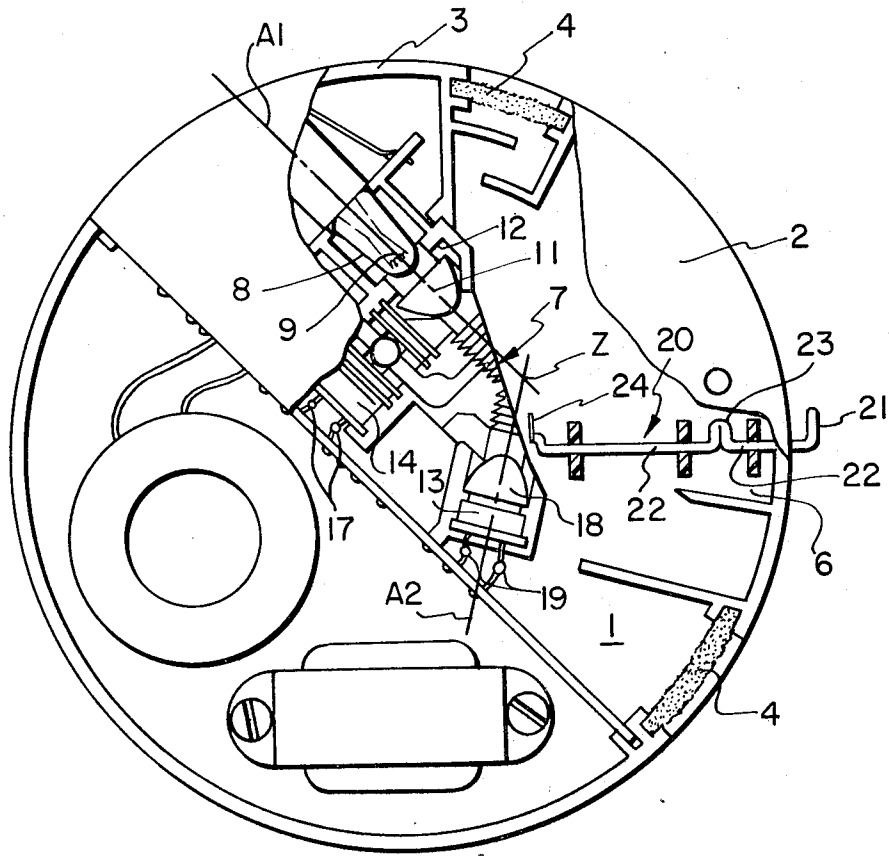
[57] **ABSTRACT**

An optical smoke and like particle detector housing in which light from a lamp is protected along one axis and scattered by particles along a second axis to a photocell has a particle simulating device for testing the operativeness of the cell and its associated alarm circuit. The particle simulating device comprises a thin wire mounted on a bell crank manually operated outside the detector housing to swing the wire through the detection zone at the intersection of the lamp and photocell axes so as to scatter light from the lamp to the cell in the same way and amount as particles in the zone.

5 Claims, 3 Drawing Figures



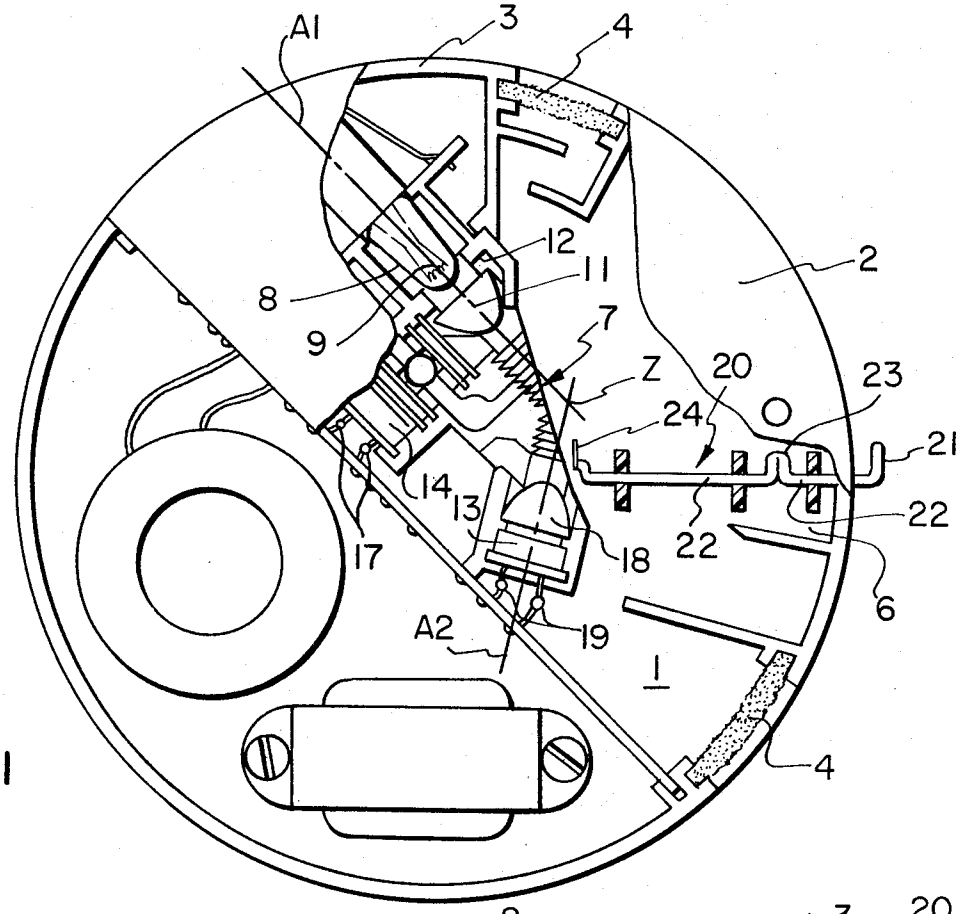


FIG. 1

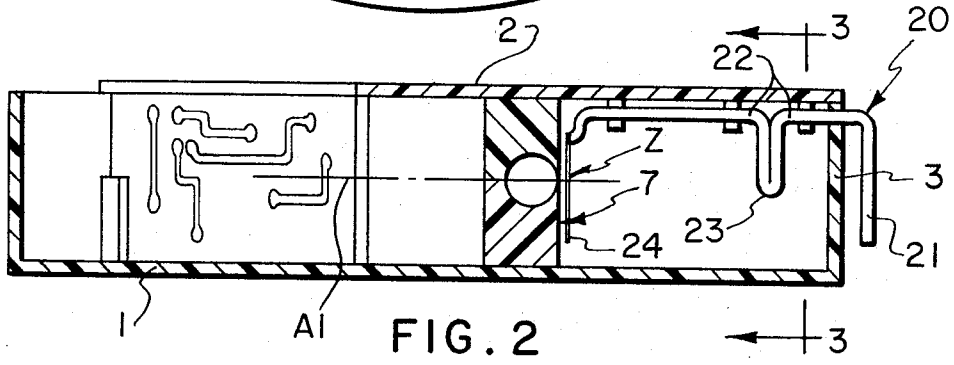


FIG. 2

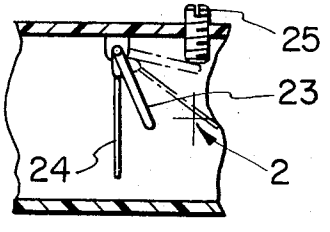


FIG. 3

OPTICAL SMOKE DETECTOR WITH LIGHT SCATTERING TEST DEVICE

BACKGROUND OF THE INVENTION

In optical detectors of smoke and like fluid borne particles of the reflection type a beam of light is directed from an exciter lamp along a path or axis usually located within a dark chamber having ports to admit air but exclude ambient light. Light scattered from particles in the light path is viewed by a photocell which responds by sending a signal to an associated alarm circuit. Typically the optical system, photocell and alarm circuit are designed to respond to a smoke density of between approximately 2 to 10 percent obscuration per foot; that is, a smoke density which in one foot will attenuate the light intensity from 2 to 10 percent.

Owing to the aging of the lamp, photocell and alarm circuit components the alarm point (in smoke density percentage) of the detector will drift over a period of time, the drift usually being upward in percentage corresponding to a decrease in sensitivity of the detector. When the detector ceases to be responsive to smoke densities in excess of 10 percent for example lethal quantities of smoke and accompanying toxic gases can accumulate and the causative fire may spread without warning. In both industrial and residential buildings smoke detectors are expected to function properly without attention and years may pass during which the detector is allowed to drift to an inadequately sensitive state.

Accordingly one object of the present invention is to provide a simple inexpensive test, not merely of the operativeness of a particular detector component such as the photocell, but rather of the ultimate function of the detector, namely to alarm in response to a predetermined smoke density.

A further object is to provide a test which is independent of the position of the filament in the exciter lamp and of consequent variations of the location of the light path in the dark chamber.

SUMMARY OF THE INVENTION

According to the invention an optical particle detector comprises a housing enclosing a dark chamber; a lamp mounted on the housing to direct on a path into the chamber; a photosensitive device on the housing viewing the light path and responsive to light scattered by particles in the path; and a particle simulating member movably mounted on the housing and having a portion movable through the light path at a zone scattering a calibrated intensity of light to the device independently of the presence and accumulation of particles between the lamp and device.

DRAWING

FIG. **1** is a plan view shown partly in section of an optical smoke detector with a testing device according to the invention;

FIG. **2** is a section on line **2—2** of FIG. **1**; and

FIG. **3** is a section on line **3—3** of FIG. **2.**

DESCRIPTION

As shown in FIG. **1** an optical smoke detector comprises a housing with bottom and top walls **1** and **2** and a circular side wall **3.** Porous foam pads **4** in ports through the side wall admit air and air borne particles like smoke while excluding light from a dark chamber

6 which on one side is closed by an optical block **7** similarly as is described in U.S. Pat. No. 3,723,747. The optical block mounts an exciter lamp **8** such as Hudson or GE No. 1 type 755 whose filament **9** is a straight coil. A lamp lens **11** beams a cone of light from the lamp on a path through a passage **12** in the block along an axis A1 across the dark chamber **6.** A detector cell **13** views the chamber through a second passage **14,** a cell lens **16** along an axis A2 120° from the lamp axis A1. Also mounted in the optical block **7** is a compensating photocell **14** described in said U.S. Pat. No. 3,723,747 which receives light directly from the lamp **9** balances certain aging effects in the smoke cell **13.** When smoke, for example, enters the dark chamber **6** through the foam ports **4,** smoke in the detection or intersection zone Z of the light path on axis A1 and the cell viewing path on axis A2 scatters light to the smoke cell **13** causing it to respond with a photoelectric signal. The smoke cell is connected through terminals **16** to an alarm circuit board **18,** the compensating cell **14** being connected to the board through terminals **17.** The lamp, cells and circuit are designed to respond to a predetermined smoke obscuration percentage as previously defined in BACKGROUND OF THE INVENTION, the preferred percentage being close to 2 percent, and up to 10 percent being allowable but increasingly less desirable. The desired or predetermined level of detector response to the amount of light scattered from smoke of such obscuration density may be calibrated as light intensity or the corresponding smoke obscuration percentage.

According to the invention the detector as a whole is tested under the same conditions as with the presence of the predetermined level of smoke in the chamber **6,** by scattering a calibrated amount of light from the light path A1 at the intersection zone Z back along the cell viewing path A2 with a particle simulator **20.** The simulator comprises a wire bell crank having a finger grip **21** outside the circular chamber wall **3,** an axial shaft portion **22** with a central U-bend **23** and a relatively fine wire **24** spot welded to its inner end in the dark chamber **6.** The shaft **2** is pivotally held in snap-in sockets formed in bosses **26** molded in and depending from the plastic top wall **2.** The U-bend portion **23** is angularly offset approximately 25° from the fine wire and limits rotation of the bell crank by engagement with a set screw **25** threaded through the top wall **2.** In normal operation the fine wire **24** hangs vertically out of the light path on axis A1 and the smoke detection zone Z, as shown in FIGS. **2** and **3.**

The fine wire **24** is of a diameter and surface area in proportion to the cross section of the conic light beam on axis A1 at the zone Z such that it effectively scatters a calibrated amount of light corresponding to that scattered by smoke of 2 to 10 percent obscuration density when swung through the zone Z from the solid line position in FIG. **3** to the phantom position **24** . Preferably the calibrated light intensity is equivalent to 5 to 10 percent smoke since detector components are not presently expected to maintain an initial sensitivity to 2 percent smoke for several years and yet are acceptable at approximately 5 to 10 percent smoke level sensitivities. With a No. 1 type 755 lamp **8,** a Clairex type **5M7** smoke cell **13,** and light and cell passages of about one-third inch a fine wire diameter of **34** gauge or about 100th inch diameter scatters a calibrated intensity of light from the detection zone Z to the cell **13** corre-

sponding to the range of 2 to 10 percent smoke. Preferably the whole particle simulator **20** including the fine wire **24** has a dull black oxide finish with a light waxing.

preferably the operability test is made by slowly swinging the particle simulator completely through the light path at the intersection zone Z until the U-bend hits the setscrew **25** after the fine wire has substantially passed through the zone. The set screw can be adjusted to stop the fine wire at a central position in the zone, but because the location of the filament **9** in the lamp **8** varies, the location of the light axis A**1** and the center of the intersection zone Z will shift from lamp to lamp. However, with close tolerance of filament position or by lamp selection the fine wire may be stopped in the zone.

It should be understood that the present disclosure is for the purpose of illustration only and that this invention includes all modifications and equivalents which fall within the scope of the appended claims.

I claim:

1. An opticle particle detector comprising:

a housing enclosing a dark chamber;

a lamp mounted on the housing and means to direct light on a confined path into the chamber;

a photosensitive device on the housing viewing the light path and responsive to light scattered by particles in the light path; and

a particle simulating member having a light scattering surface of predetermined width and of extent at least substantially as great as the cross section of the light beam, the member being mounted on the housing for continuous, unobstructed movement through positions in the light beam to and through a position of predetermined light scatter without selection of the position by the operator, so that during such movement a calibrated intensity of light will be scattered to the device.

2. A particle detector according to claim **1** wherein the photoelectric device is responsive to a calibrated intensity of light scattered from the path to the device by a predetermined particle density to produce an alarm signal, and said particle simulating member being of a size to scatter light of the calibrated intensity.

3. A particle detector according to claim **1** wherein the simulator comprises a rotatable bell crank with a finger grip at one end and a light scattering flag at its other end.

4. A particle detector according to claim **3** wherein the bell crank has an intermediate arm, and an adjustable stop limits movement of the intermediate arm.

5. A detector according to claim **1** wherein the light scattering surface is cylindrical.

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