United States Patent [19]

Hurd

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[54] **OPEN SCREEN SMOKE DETECTOR AND CIRCUIT**

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[73] Assignee: **Avco Corporation**

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[52] **U.S. Cl.** ..... **340/237 S**; 340/237 R

[51] **Int. Cl.²** **G08B 17/10**

[58] **Field of Search** ..... 340/237 R, 237 S

[56] **References Cited**

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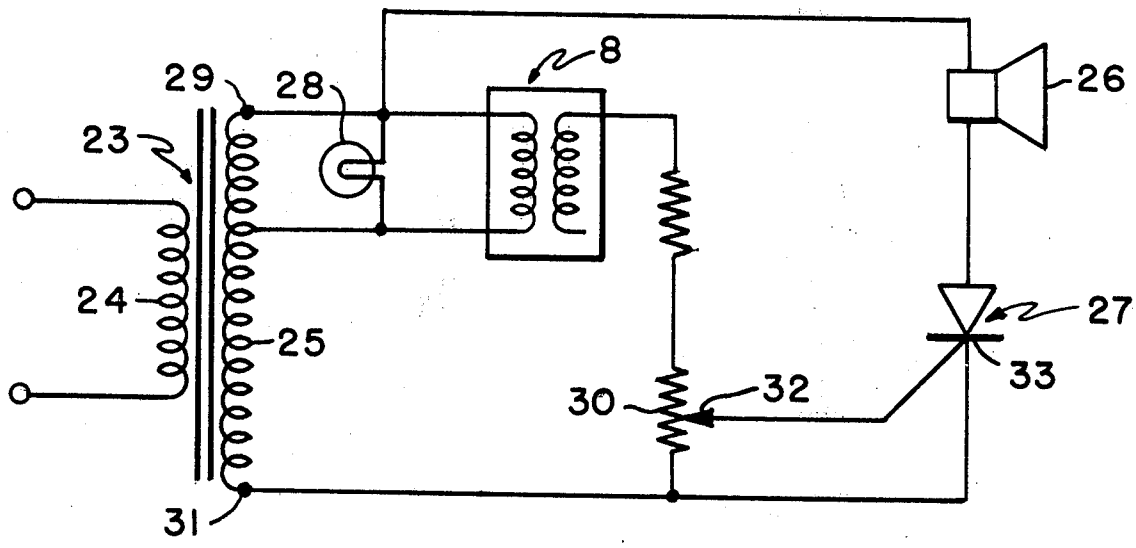
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Assistant Examiner—Daniel Myer
Attorney, Agent, or Firm—Charles M. Hogan

[57] **ABSTRACT**

Herein disclosed is a particularly sensitive smoke detector system featuring a solid state sensor having a wide-mesh screen and employing a warning device in circuit with the anode-cathode path of a silicon control rectifier and an alternating current source. A biasing circuit comprising the solid state sensor is utilized to sense the presence of smoke and to cause the rectifier to pass current and to actuate the warning device when the threshold of the silicon control rectifier is exceeded.

1 Claim, 3 Drawing Figures



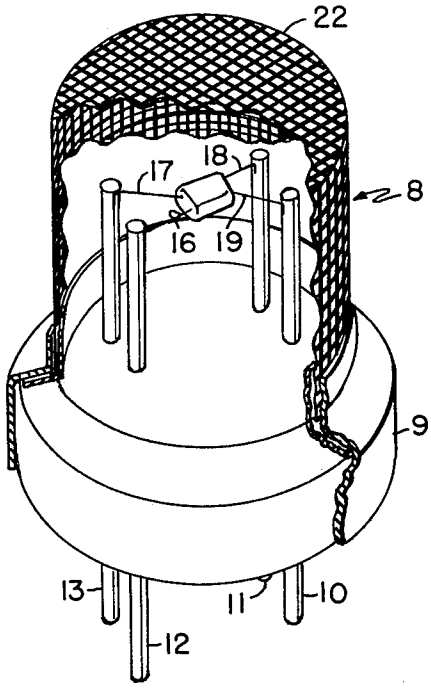


Fig 1

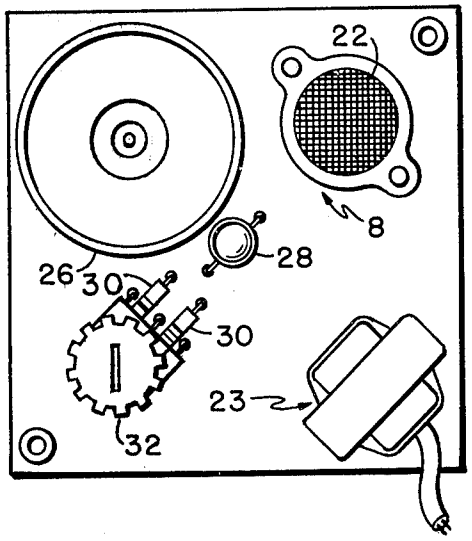


Fig 2

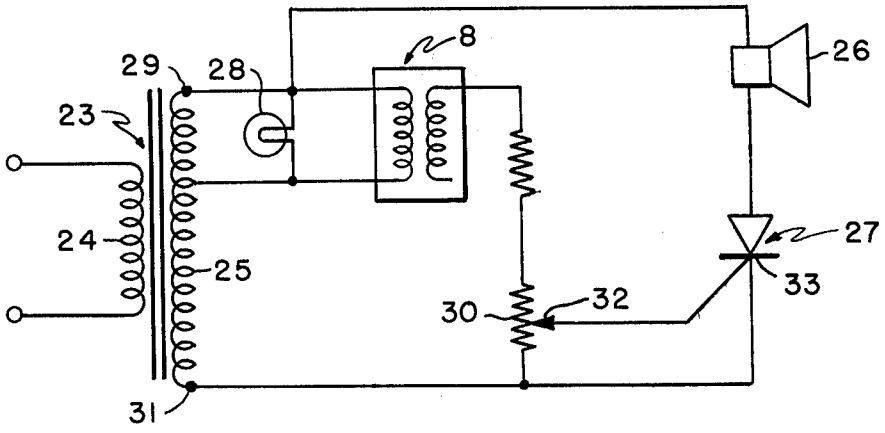


Fig 3

OPEN SCREEN SMOKE DETECTOR AND CIRCUIT

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention comprises an improved smoke detector of the type which utilizes an absorption or solid-state type sensing device, preferably a metal oxide sensor.

2. Description of the Prior Art

The smoke detecting art is well developed. The photoelectric type reflects light from smoke particles onto a photocell. This kind of system does not detect fire at a sufficiently early stage. The ionization system uses a radio active source between capacitor plates to ionize combustion products. It involves maintenance and cleaning problems. Absorption or solid-state systems of the metal oxide type are superior in that they are sensitive to any deoxidizing influence including smoke and many harmful gases which cannot be detected by the photoelectric and ionization systems. However, existing solid-state sensing types of smoke detectors are subject to certain disadvantages and limitations. They are characterized by the use of two layers of 100 mesh screening for the containment of internal flash fires and mechanical protection of the sensor. However, when the absorption type of sensor is used to detect products of combustion, particularly petroleum derived products, an oily residue forms on the prior art screen and produces cohesive smoke particles which greatly impair the sensitivity of the sensor and its response in causing the warning function to be performed.

Another disadvantage of the prior art resides in its conversion of alternating currents into direct currents and its usage of filtering and reset circuitry.

SUMMARY OF THE INVENTION

The principal object of the invention is to provide an improved smoke detecting system which requires no reset circuitry and which maintains high sensitivity and quick response characteristics in the presence of petroleum-derived and other residual-depositing products of combustion.

Another object of the invention is to provide a simplified alternating current version of control circuitry for an absorption type smoke detecting system.

BRIEF DESCRIPTION OF THE DRAWINGS

For a better understanding of the invention, together with other and further objects, advantages and capabilities thereof, reference is made to the following description of the drawings, in which:

FIG. 1 is a perspective view, partially broken away, of an absorption type sensing element as employed in the system in accordance with the invention and as improved with the more open mesh screen provided by the invention;

FIG. 2 is a perspective view of a smoke detection unit including the screen per FIG. 1 and alternating current control circuitry; and

FIG. 3 is a circuit schematic of a preferred form of alternating current smoke detection system per FIGS. 1 and 2 and in accordance with the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT OF THE INVENTION

Referring now specifically to FIG. 1 of the drawings, there is shown an absorption or solid-state sensor element 8 which is of the prior art except for the more open screen provided in accordance with the invention. It comprises a base 9, posts 10, 11, 12 and 13, and a solid-state element suspended by wires 16, 17, 18 and 19. The prior art structure such as the sensor in the MALGARD smoke and gas alarm models 1101 and 1051 currently offered for sale by MalGard Corporation, 598 Monterey Pass Road, Monterey Park, Calif. 91754 incorporated a double layer 100 mesh screen in order to contain flash fires internally, when the sensing device was used as an explosive gas sensor. I have found that such fine screening is not only unnecessary in a household application but it in fact seriously reduces the response characteristics of the sensing system and renders it unacceptable for such application. Accordingly, I provide an open mesh screen 22, for reasons now described. A suitable parameter is a single layer screen 22 of 20 mesh (i.e., 20 wires vertical and 20 wires horizontal per flat square inch sample).

In a specially constructed room, sealed against outside environments, a controlled amount of gasoline was burned as the smoke producing element. With the sensor element suspended from the ceiling of the room and instrumented for testing, and with a standard for smoke density suspended near the element under test, gasoline was ignited. The amount of change of the resistance of the element as plotted against time, starting at ignition and stopping at a predetermined resistive point, was recorded. At each test, the gasoline amount and the time for the standard to respond to its preset limit was recorded to insure commonality between tests.

The results of this testing have shown that prior to changing the screen mesh size, the time from ignition to the resistive set point averaged five minutes. After the screen mesh size was changed, the time from ignition to the resistive set point averaged 100 seconds, thereby indicating a more rapid response to smoke from time of ignition.

From the foregoing, it is apparent that the use of the absorption sensor with a screen for prevention of physical damage to the element, said screen being of sufficient opening to allow unrestricted flow of air, will operate as a smoke detector with all the benefits and none of the liabilities of prior art systems.

Referring now specifically to FIG. 3, the system is connected to a source of alternating current. It includes an iron core transformer 23 having a primary 24 and a secondary 25. The secondary is in series with a suitable warning device, such as a horn 26, and also with the anode-cathode circuit of silicon control rectifier 27.

A monitoring light 28 is placed across a part of the secondary. A series circuit is formed between secondary terminal 29, the sensing element 8, and potentiometer 30, and secondary terminal 31. The potentiometer has a sliding contact 32 connected to control element of the silicon rectifier.

This invention provides a simple means of utilizing the change in resistance that takes place in the gas sensor to produce an audible response. Conventional circuitry per prior art utilizes direct current voltages in conjunction with the sensor to activate an alarm whereas this invention as illustrated in FIG. 3 utilizes alternating current voltages with a resultant significant savings in the number and cost of component parts and a substantial improvement in reliability.

Referring to FIG. 3, the alternating current voltage derived from transformer 23 is impressed across horn 26 and rectifier 27. An additional alternating current

voltage is developed at the gate **33** that is proportional in amplitude to the setting of potentiometer **30** and the value of resistance of the smoke detector sensor **8,** which in turn is dependent upon the amount of gas or smoke affecting the detector. In other words, the presence of smoke or gas decreases the resistance of the sensing element and therefore causes the bias on the gate **33** of the silicon control rectifier to become more positive.

The phase relationship of the alternating voltage across the horn circuit and the gate circuit is the same such that when the SCR (silicon control rectifier) threshold voltage is exceeded, the SCR conducts to produce a response from horn **26.** When the amount of smoke or gas present becomes less than the level required to produce a threshold at the SCR gate, the SCR no longer conducts and there is no necessity to activate a reset switch in order to deactivate horn **26.**

This invention provides a substantial reduction in the number of components conventionally employed and offers the additional advantage of eliminating the necessity for deactivating the alarm following a return of the smoke detected condition to normal status. In addition, this circuit cannot be triggered into a steady state "on" condition by virtue of alternating current line transients or by a momentary unacceptable smoke condition.

While there has been shown and described what is at present considered to be the preferred embodiment of the invention, various modifications and changes may be made therein without departing from the proper scope as defined by the appended claims.

Having described my invention, I claim:

1. In a smoke detector of the variable resistive type the combination of:

a variable resistive sensing element,

a screen for mechanically protecting that element and having a mesh parameter such as to contain flash fires internally without impairing sensitivity to smoke or restricting the flow of air,

said parameter being not more than 20 vertical wires and 20 horizontal wires per flat square inch,

a source of energy,

a warning device,

a silicon control rectifier having a gate and also having an anode-cathode circuit in series with said warning device and said source of energy, and

a control circuit including said resistive element, said control circuit having an input coupled to said source and an output coupled to said gate element in such manner that the presence of smoke decreases the resistance of the resistive element and causes the silicon control rectifier to fire, thereby energizing the warning device.

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