United States Patent

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[54] FIRE ALARM SYSTEM WITH FIRE ZONE LOCATOR USING ZENER DIODE VOLTAGE MONITORING

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[52] **U.S. Cl.**.....**340/227 R,** 307/318, 323/22 Z, 340/176

[51] **Int. Cl.**.....**G08b 17/06**

[58] **Field of Search**.....323/22 Z; 307/318; 324/52; 340/248 A, 248 C, 228 R, 213 R, 412, 415; /

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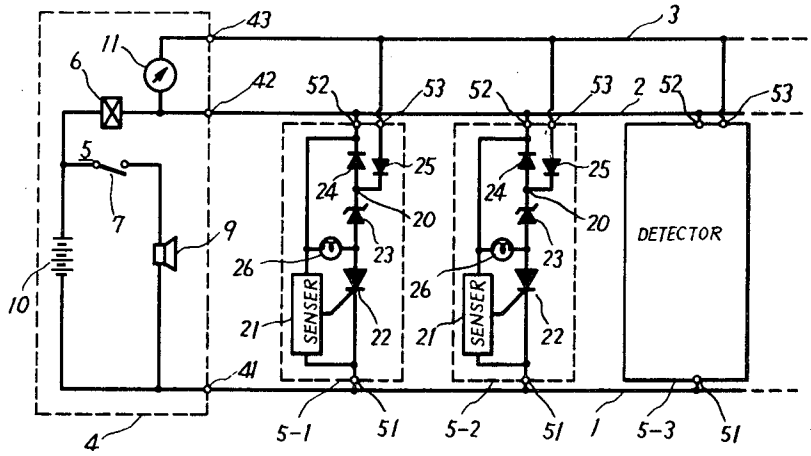
[57] **ABSTRACT**

A fire alarm system having a plurality of detectors operably to actuate a single receiver to sound an alarm upon the presence of fire, said detectors each having a zener diode interposed in the conduction path so that at least part of the current flows through the zener diode, each zener diode having a voltage differing from the zener diodes of the other detectors and said receiver including means sensing the specific zener diode voltage of an actuated detector in order to determine the detector that has been actuated.

4 Claims, 3 Drawing Figures



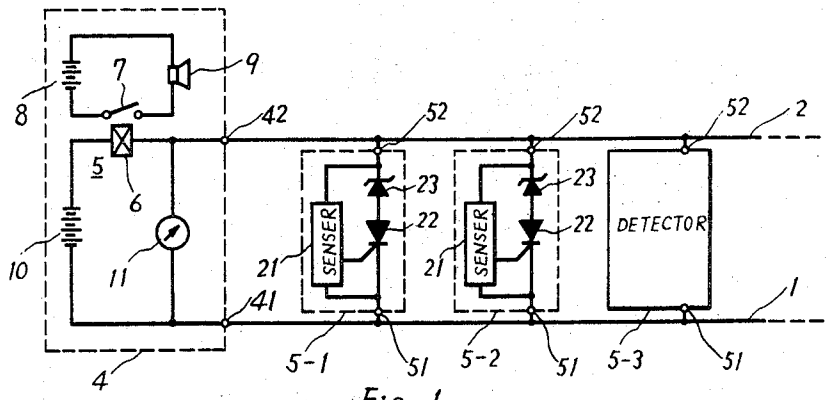


Fig. 1

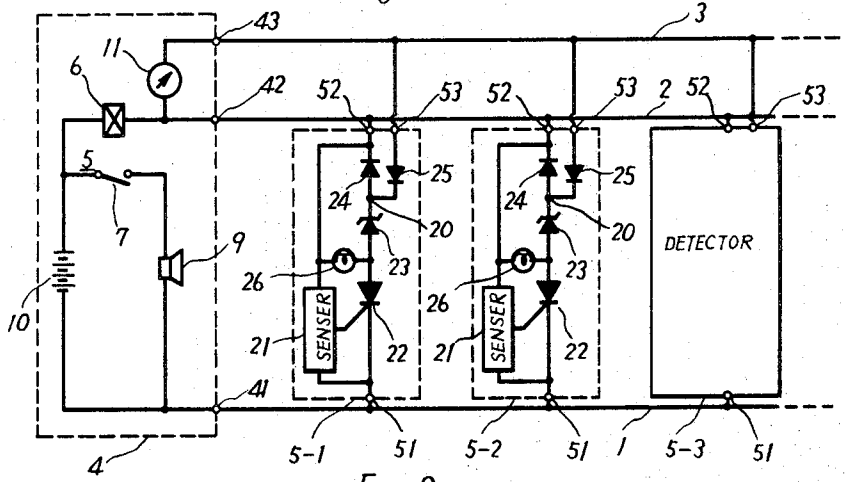


Fig. 2

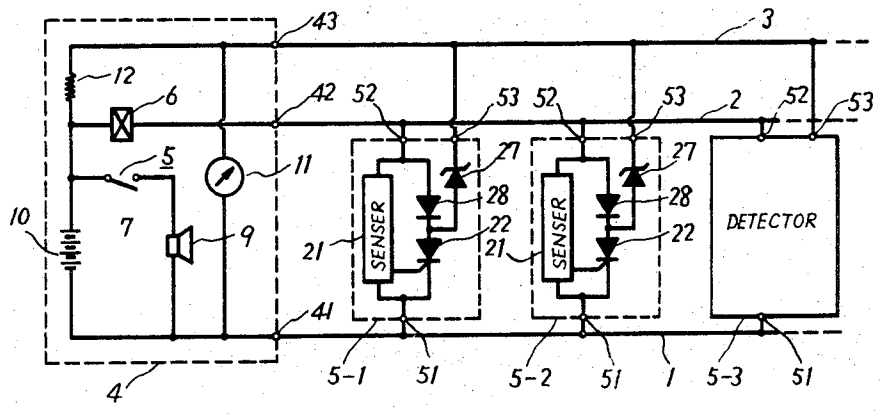


Fig. 3

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FIRE ALARM SYSTEM WITH FIRE ZONE LOCATOR USING ZENER DIODE VOLTAGE MONITORING

This invention relates to a fire alarm system and especially to such a system including novel and improved means for determining the detector which has been excited by a fire.

In the prior art, fire alarm systems, a number of fire or smoke detecting units (hereinafter referred to as detectors) are generally connected in parallel between a pair of conductors which are connected to a single receiving unit (hereinafter referred to as receiver) including a power supply and an alarm device. When any one of the detectors is excited, a closed circuit including the power supply and the alarm device is completed through said detector and an alarm signal is generated from the alarm device. In such a fire alarm system, however, the alarm signal is generated whenever at least one of the detectors is excited, but the particular detector is not known. That is to say, such a system can only detect the start of a fire somewhere on the line but cannot detect where the fire has started. Therefore, the prior alarm system has required other means, such as patrols for finding the site of the fire. However, this is difficult and troublesome work, especially when a large number of detectors are distributed over a wide area or in a tall building.

In order to overcome this difficulty in some of the prior systems the detectors are individually connected through separate conductors directly to the receiver, but such systems involve bulky bundles of cables and a high cost of installation. As another way for overcoming these difficulties involves a system wherein each detector is provided with an oscillator or a band-pass filter having a characteristic frequency peculiar to the detector, but such detectors as well as the receivers used in cooperation with these detectors are complicated in structure, large in size and rather expensive.

Therefore, one object of this invention is to provide a novel and improved fire alarm system composed of simple, compact and inexpensive detectors and a receiver capable of quickly indicating any detector being excited.

According to this invention, each detector includes a zener diode which has a characteristic zener voltage which is different from those of the zener diodes of the other detectors and is connected so that at least a part of the current flowing through the conduction path of the detector when the detector is excited flows through the zener diode, and the receiver includes means for indicating the voltage across the zener diodes of the detectors. When one of the detectors is excited by a fire, the normally blocked conduction path of the detector is driven into conduction and at least a part of the current flows through the zener diode to produce its characteristic zener voltage across it, and this zener voltage is indicated by the indicating means in the receiver. The excited detector can therefore be determined from the value of the zener voltage.

Other objects and features of this invention will become more apparent from the following description and accompanying drawings.

In the drawings:

FIG. 1 is a schematic circuit diagram, partly in block form, of an embodiment of a fire alarm system according to this invention;

FIG. 2 is a similar schematic circuit diagram of another embodiment of a fire alarm system according to this invention; and

FIG. 3 is a similar schematic circuit diagram of a further embodiment of a fire alarm system according to this invention.

In the drawings, like reference numerals are used to denote like structural components.

Referring now to FIG. 1 representing the first embodiment of this invention, a plurality of detectors 5–1, 5–2, 5–3, . . . are connected in parallel between a pair of conductors 1 and 2 by connecting terminals 51 and 52 to the conductors 1 and 2 which in turn are connected to a pair of terminals 41 and 42 of a receiver shown in a dashed square 4. The receiver 4 includes a power supply 10 and an electromagnetic relay 5 having an electromagnet 6 connected in series with the power supply between the both terminals 41 and 42 and normally open contact 7 connected in series with a power supply and a sounding device 9 to form a closed circuit. The receiver 4 also includes a voltage indicator 11 in accordance with this invention, as described in detail hereinafter.

As the detectors 5–1, 5–2, 5–3 . . . each have a similar circuit configuration, only the first detector 5–1 will be described. The detector includes a senser portion 21 which is connected between the terminals 51 and 52 and serves the function of sensing a fire and generating a voltage signal. Though the senser portion is as essential portion of the fire detector, it is not described here since it is well known in the art and does not comprise a part of this invention. The voltage signal produced from the senser is applied to the control electrode of a silicon controlled rectifier (hereinafter referred as SCR) 22 which is connected in series with a zener diode 23 between the both terminals 51 and 52. According to a feature of this invention, the zener diode 23 has a preselected characteristic zener voltage differing from those of the zener diodes in the other detectors.

When the senser portion 21 of the detector senses a fire and generates a voltage signal the SCR 22 is driven into conduction and a closed circuit consisting of the power supply 10 and the electromagnet 6 of the relay 5 in the receiver 4 and the conduction path including the SCR 22 and the zener diode 23 of the detector is completed, thereby the relay 5 is energized to close the contact 7 and actuate the sounding device 9. Though, in this case, impedance of the SCR 22 becomes extremely low, a voltage corresponding to the zener voltage of the zener diode 23 is provided between the both conductors 1 and 2 and is indicated by the voltage indicator 11 in the receiver 4. Therefore, if the characteristic zener voltages of the all detectors are previously noted, the excited detector can be determined from the indication of the indicator 11.

Although the system of this invention is very simple in structure as stated in the above, it has such disadvantage that the voltage between the conductors 1 and 2 and accordingly the voltage applied to the relay 5, varies in accordance with the detector being excited since the characteristic zener voltages of the detectors are different from each other. This will affect inversely the response sensitivity of the alarm device in the receiver 4. The second and third embodiments shown in FIGS. 2 and 3 overcome this difficulty.

In FIG. 2, a plurality of detectors 5–1, 5–2, 5–3 . . . are connected in parallel between the conductors 1 and 2 by means of terminals 51 and 52 and both conductors 1 and 2 in turn are connected to first and second terminals 41 and 42 of a receiver shown in a dashed square 4. The receiver 4 includes a power supply 10 and an electromagnetic relay 5 having an electromagnet 6 connected in series with the power supply 10 between the terminals 41 and 42. A normally open contact 7 of the relay 5 is connected in series with a sounding device 9 across the power supply 10. The receiver 4 is also provided with a third terminal 43 and a voltage indicator 11 is connected between the second and third terminals 42 and 43 in accordance with this invention.

As in the case of FIG. 2, only the first detector 5–1 will be described hereinafter since the all detectors have essentially the same circuit configuration. The detector includes a senser portion 21 which is the same as that of FIG. 1 and is connected between the terminals 51 an and 52 there is also connected a series circuit including SCR 22 having a control electrode connected to the voltage signal output terminal of the senser portion 21 and two similarly poled zener diodes 23 and 24. The detector has a third terminal 53 which is connected through a diode 25 to a junction 20 between the both zener diodes 23 and 24. The diode 25 is poled so as to block current flowing from the junction 20 to the terminal 53. An indicating lamp 26 is also connected across the both zener diodes 23 and 24. As shown in the drawing, the third terminals 53 of the all detectors are connected in common to a third conductor 3 extending from the third terminal 43 of the receiver 4. According to a feature of this invention, the zener voltages of the

zener diodes 23 and 24 are previously selected so that the zener voltages of the zener diodes 23 of the all detectors are different from each other but the sum of the zener voltages of the both zener diodes 23 and 25 is constant throughout the detectors.

When one of the detectors is actuated by a fire, the SCR 22 in the detector is driven into conduction and the relay 5 in the receiver 4 is energized as in the case of FIG. 1 to operate the sounding device 9. The characteristic zener voltage of the zener diode 24 is indicated by the voltage indicator 11 and the excited detector can be determined therefrom as in the case of FIG. 1. Contrary to the case of FIG. 1, however, the voltage applied to the relay 5 does not change because the sum of the zener voltages of the zener diodes 23 and 24, which have been previously selected to be constant throughout the detectors, appears between the conductors 1 and 2. Therefore, there is no reduction of reliability due to change of zener voltage. When the detector is excited, the constant sum of zener voltages is also applied to the indicating lamp 26 to flash it. This is very convenient for testing detectors or determining erroneous operation of the detectors. The diode 25 prevents mutual interference of the detectors. More specifically, if the diode 25 is removed, a part of the conduction current may flow through the terminal 52, zener diode 24 and terminal 53 of the other detectors.

FIG. 3 shows another embodiment for maintaining reliability of the system. In the drawing, a plurality of detectors 5–1, 5–2, 5–3, . . . are connected in parallel between a pair of conductors 1 and 2 by terminals 51 and 52 and the conductors 1 and 2 in turn are connected to first and second terminals 41 and 42 of a receiver 4. The receiver 4 includes a relay 5, a sounding device 9 and a power supply 10 which are connected similarly to those in FIGS. 1 and 2, and is also provided with a third terminal 43 connected through a resistor 12 to the positive terminal of the power supply 10 and also through a voltage indicator 11 to the negative terminal thereof.

Each detector includes a senser portion 21 which is similar to that of FIGS. 1 and 2 and connected between the terminals 51 and 52 and a SCR 22 is connected in series with a diode 28 between the same terminals 51 and 52 and driven by the voltage signal output of the senser portion 21. The detector is also provided with a third terminal 53 connected through a zener diode 27 to the anode of the SCR 22 and also connected to a third conductor 3 connected to the third terminal 43 of the receiver 4. The diodes 27 and 28 are poled so that the anode of the SCR 22 is connected to the anode of the diode 27 and to the cathode of the diode 28.

When one of the detectors is actuated by a fire, the conductors 1 and 2 are short-circuited through the SCR 22 which is driven into conduction and the alarm device including the relay 5 and the sounding device 9 are energized as in the case of the foregoing embodiments. In this case, the anode voltage of the SCR 22 drops substantially to the potential of the conductor 1 and a part of the conduction current flows through the resistor 12 and the zener diode 27 to produce a voltage corresponding to the zener voltage of the diode 27 between the terminals 51 and 53. This voltage is indicated by the voltage indicator 11 in the receiver 4 and the actuated detector can be determined from its characteristic zener voltage as in the case of the foregoing embodiments. In this embodiment, the source voltage is substantially applied to the relay 5 whenever the detector is actuated, thereby maintaining reliability of the system. The diode 28 serves the function of preventing mutual interference of the detectors, in a manner similar to the diode 25 of FIG. 2.

As described in the above, according to this invention, the actuated detector can be determined by a system including simpler and less expensive detectors and receiver.

The abovementioned three embodiments have been presented only for purposes of explanation and it is understood that various modifications and changes can be made without departing from the scope of this invention as described in the specification and defined by the appended claims. For example, though the detectors in these embodiments each include an SCR 22, a normally open mechanical switch may be used such as bimetal switch, which is closed when the detector is actuated by a fire.

What is claimed is:

1. A fire alarm system, comprising a plurality of detecting units for sensing a fire and generating an electric signal and a receiving unit for receiving said electric signal and producing an alarm, each of said detecting units having a conduction path including a normally open switch which is closed when a fire is sensed, each of said detecting units including a zener diode connected in conjunction with said conduction path so that at least a part of conduction current of said switch flows through said zener diode, said receiving unit including means for indicating a voltage across said zener diode, and said zener diode having a zener voltage peculiar to each of said detecting units.

2. A fire alarm system according to claim 1 wherein said conduction path includes said zener diode connected in series with said normally open switch and said conduction path of each detecting unit is connected in common across said voltage indicating means.

3. A fire alarm system according to claim 1 wherein said conduction path includes a second zener diode connected in series with said first zener diode and said normally open switch, said first zener diode of each detecting unit being connected in common across said voltage indicating means through a diode included in said detecting unit, and the sum of the zener voltages of said first and second zener diodes is selected to be equal throughout the detecting units.

4. A fire alarm system according to claim 1 wherein said conduction path includes a diode connected in series with said normally open switch, said zener diode being connected to the junction between said diode and said switch and the series connection of said zener diode and said switch of each detecting unit being connected across said voltage indicating means.

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