

[54] **FIRE DETECTOR WITH RED AND BLUE RESPONSIVE PHOTOCELLS AND REGENERATIVE FEEDBACK**

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[58] Field of Search. 340/233, 237 S; 250/83.3 IR; 328/2

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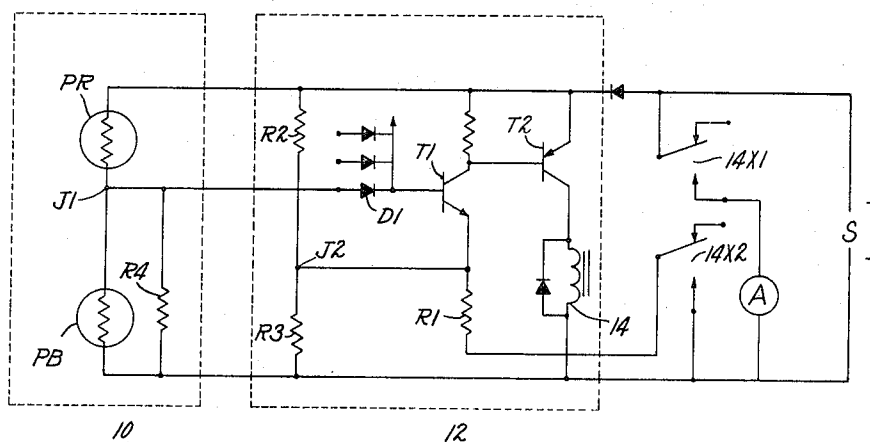
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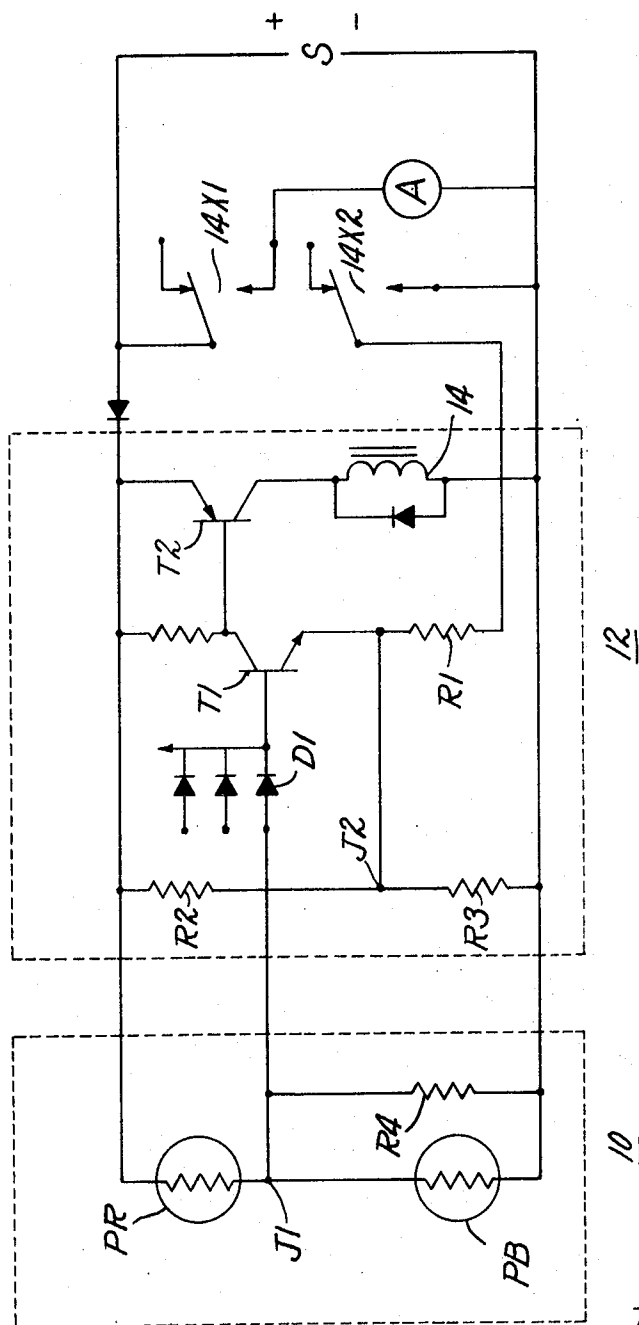
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[57] **ABSTRACT**

A fire detector in which a pair of photo-resistive cells which respond differently to radiation from a fire and a pair of fixed resistors are connected in voltage divider circuits across a common source, with an alarm actuating device connected between the junction of the cells and the junction of the fixed resistors. The alarm actuating device responds to a reversal of relative polarity of said junctions to actuate the alarm. In one embodiment of the invention the portion of the alarm actuation means connected between the junctions is the base-emitter circuit of the first transistor of a transistor amplifier. In a modified form of the invention, on actuation of the alarm, additional resistance is connected into the circuit to shift the drop-out point of the alarm actuator to a desired point.

2 Claims, 1 Drawing Figure





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FIRE DETECTOR WITH RED AND BLUE RESPONSIVE PHOTOCELLS AND REGENERATIVE FEEDBACK

This application is a continuation of application Ser. No. 823,584 filed May 12, 1969, now abandoned.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to optical fire detection apparatus in which the optical detection means comprises a pair of photo-resistive cells which respond differently to radiation from a fire, the cells being connected as a voltage divider, with the change in voltage at the junction of the cells being utilized to actuate an alarm.

2. Description of the Prior Art

Optical fire detection systems of the type utilizing photo-resistive cells connected as a voltage divider customarily utilize the rise in voltage at the junction of the cells as the input to a transistor amplifier, with the output of the amplifier being connected to a relay controlling the operation of an alarm device. As the voltage at the junction between the cells increases, the output of the amplifier increases. When a predetermined voltage at the junction is reached, the output of the amplifier is sufficient to actuate the relay to energize the alarm. Such a system is illustrated in U.S. Pat. No. 3,122,638, issued Feb. 25, 1964. Another form of photo-resistive cell assembly for use in such a system is illustrated in U.S. Pat. No. 3,188,593, issued Although fire detectors of this type have achieved considerable commercial success, one practical difficulty encountered in manufacturing such a system is the fact that the relay used must meet exceptionally high quality standards. The reason for this is the fact that as the radiation in the specified frequency band increases, the voltage at the junction of the detector cells gradually increases, and the current in the relay circuit gradually increases. To insure that the relay armature will pull in at a predetermined level of radiation, a relay is required that has a "pull-in" valve that lies within predetermined narrow limits. In actual commercial construction practice, to achieve consistent performance, it has been found necessary to pay a considerable premium for suitable relays and also necessary to test the actual pull-in current of each individual relay before it is assembled into a detector system.

SUMMARY OF THE INVENTION

This invention disclosed herein relates to a fire detector in which a pair of photo-resistive cells having different response characteristics to radiation from a fire and a pair of fixed resistors are connected in voltage divider circuits across a common source, with an alarm actuating device connected between the junction of the cells and the junction of the fixed resistors. The alarm actuating device responds to a reversal of relative polarity of said junctions to actuate the alarm. In one embodiment of the invention the portion of the alarm actuating means connected between the junctions is the base-emitter circuit of the first stage of a transistor amplifier. In a modified form of the invention, on actuation of the alarm, additional resistance is connected into the circuit to shift the dropout point of the alarm actuator to a desired point.

BRIEF DESCRIPTION OF THE DRAWING

The single FIGURE of the drawing is a schematic diagram of a fire detector embodying the features of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to the drawing, there is illustrated an optical fire detector system comprising a detector portion 10, and amplifier portion 12, for actuating an alarm relay 14 to energize an alarm A when the detector portion 10 receives radiation from a fire, as will be described hereinafter.

The detector portion 10 may be of a type disclosed in either of the above-identified patents and comprises a photo-resistive cell PR primarily responsive to radiation in the red to infra-red band, and a photo-responsive cell PB which is primarily responsive to radiation in the blue band. The cells PR and PB are connected in series through a common junction J1 across a DC source S. The effect of fire radiation on the detector cells is to cause an increase in voltage at the junction J1 in a manner and for a purpose to be described hereinafter.

The amplifier 12 comprises a first stage having a transistor T1 with its collector-emitter circuit connected across the DC source, and the base connected to the junction J1 of the detector cells, and a second stage having a transistor T2 with its collector-emitter circuit connected in series with the coil of the alarm relay 14 across the DC source with the base thereof being connected to the collector of transistor T1.

The relay 14 has a first set of contacts 14 × 1 which, in the de-energized condition of the relay, are open, and which close on energization of the relay coil to complete a circuit to the alarm 16.

The relay 14 has a second set of contacts 14 × 2 which, in the de-energized condition of the relay are open and which close to complete a circuit between the emitter of transistor T1 and the negative pole of the DC source through a resistor R1 for a purpose to appear hereinafter.

To provide a reference voltage to control the base-emitter bias applied to the transistor T1, and to therefor control the conduction in the collector-emitter circuit thereof, a pair of fixed resistors R2 and R3 are connected in series across the DC source through a junction J2, with said junction being connected to the emitter of the transistor T1.

Conduction through the transistor T1, and therefore conduction through transistor T2 and the alarm relay depends on the voltage between the base and emitter of transistor T1. During normal standby operation of the device, when the detector is not exposed to radiation from a fire but is exposed to ambient light such as indirect sunlight, incandescent, or fluorescent light, since the blue component of such light is greater than the infra-red component, the cell PR will have a higher resistance than cell PB. The ratio of the resistance of PR to the resistance of PB is therefore greater than the resistance ratio of R2/R3 and the junction J1 is therefore negative in relation to the junction J2. The base of transistor T1 is therefore negatively biased in relation to the emitter and conduction cannot occur in the

emitter-collector circuit thereof, so that the coil of relay 14 remains unenergized.

However, when the detector is exposed to a fire of sufficient intensity, the infra-red radiation therefrom causes the resistance of cell PR to drop to a value such that the resistance ratio of PR/PB becomes less than the resistance ratio of R2/R3. The junction J1 thereupon becomes positive in relation to the junction J2, and the base of transistor T1 therefore becomes positive in relation to the emitter, allowing conduction to occur in the collector-emitter circuit. Transistor T2 is thereby biased into conduction, energizing the coil of relay 14 and actuating the alarm.

In a specific embodiment of the invention, the resistors R2 and R3 may each have a resistance of 1000 ohms. Under conditions of normal ambient light the cell PR may have a resistance of perhaps 1 million ohms or more, and the cell PB a resistance of perhaps 1/2 million ohms. Junction J1 is therefore negative in relation to junction J2.

However, when infra-red radiation from a fire is received by the photo-cells, the resistance of the cell PR, may drop to 5000 ohms, whereas the resistance of cell PB drops only to 25,000 ohms, so that junction J1 becomes positive in relation to J2 with the result previously described.

Since many fires, in their initial stages, are erratic in their output of infra-red radiation, it has been found desirable to provide means for adjusting the circuit, once there has been energization of the relay 14 so that less infra-red radiation will be required thereafter to hold the relay in the energized condition than was required to initially energize it.

For this purpose, the energization of the relay 14 also closes contacts 14 x 2 which places resistor R1 in parallel with resistor R3 and thereby lowers the voltage at J2. Since the voltage at J1 is unchanged a greater forward bias voltage is therefore applied to the transistor T1. When a momentary decrease of infra-red radiation occurs, the relay 14 will remain energized, so long as sufficient radiation is received by the detector to maintain the voltage at the junction J1 higher than the voltage existing at J2 with the additional resistors R1 in the circuit.

If the detector system is used in conjunction with an extinguishing system, the use of the above described means of lowering the drop-out point of the relay will insure that the alarm will continue to be energized until the fire radiation has dropped to an intensity less than that which initiated the alarm.

Although in the illustrated embodiment, the drop-out point of the relay is changed by reducing the resistance between junction J2 and the negative side of the supply voltage an equivalent effect can be obtained by increasing the resistance between junction J2 and the positive side of the supply voltage.

Since certain other obvious changes may be made in the device without departing from the scope thereof it

is intended that the above descriptions of a specific embodiment of the invention be interpreted in an illustrative and not a limiting sense.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent of the United States is:

1. A fire detector, comprising a transistor amplifier, alarm actuating means, and a power source, said amplifier triggering said alarm actuating means when the input transistor thereof conducts in the collector-emitter path, the emitter of said input transistor being connected to opposite poles of the power source by a pair of resistors to provide a predetermined voltage at the emitter, the base of said input transistor being connected to opposite sides of the power source by a pair of photo-cells, said cells being so associated that they view the same space, one of said cells being responsive by a decrease in resistance to light in the red to infra-red band, the other cell being responsive by a decrease in resistance to light in the blue band, whereby a change from ordinary ambient light to radiation from a fire will cause a change in voltage at said base in relation to the voltage at the emitter, the value of the resistors connected to the emitter being such that during normal standby conditions, a reverse bias is applied to the base, and when the voltage at the base changes due to the change in resistance of the photo-cells due to radiation from a fire, a forward bias is applied to the base to allow conduction in the emitter collector path to trigger said alarm actuating device, and means responsive to energization of the alarm actuating means for changing the value of the resistance between one pole of the power source and the emitter of said input transistor in such a manner as to increase the forward bias on the base, whereby the level of radiation from a fire at which the alarm actuating means is de-energized is less than the level at which it was energized.

2. A fire detector, comprising a pair of photo-cells so associated that they view the same space, one of said cells being responsive by a decrease in resistance to light in the red to infra-red band, the other cell being responsive by a decrease in resistance to light in the blue band, said cells being connected in series across a power source through a first junction, a pair of resistors connected in series across said power source through a second junction, whereby radiation from a fire received by said photo-cells will cause a change in voltage between said junctions, means responsive to said change in voltage to actuate an alarm energizing means, and means responsive to the actuation of said alarm energizing means to further change the voltage between said junctions in a direction such that on decrease of the amount of radiation from a fire, the alarm will continue to be energized at a level of fire radiation less than the level of radiation at which it was energized.

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