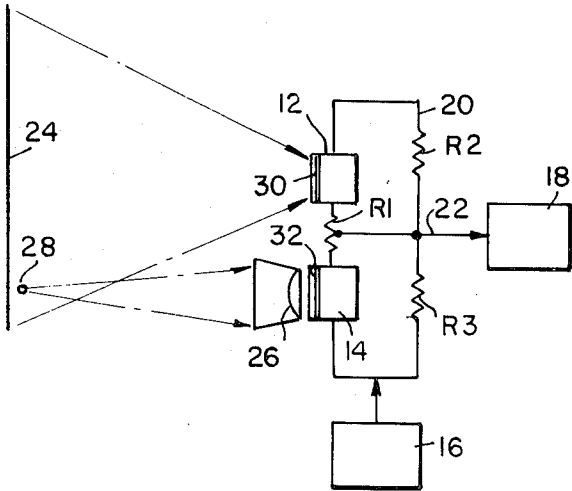


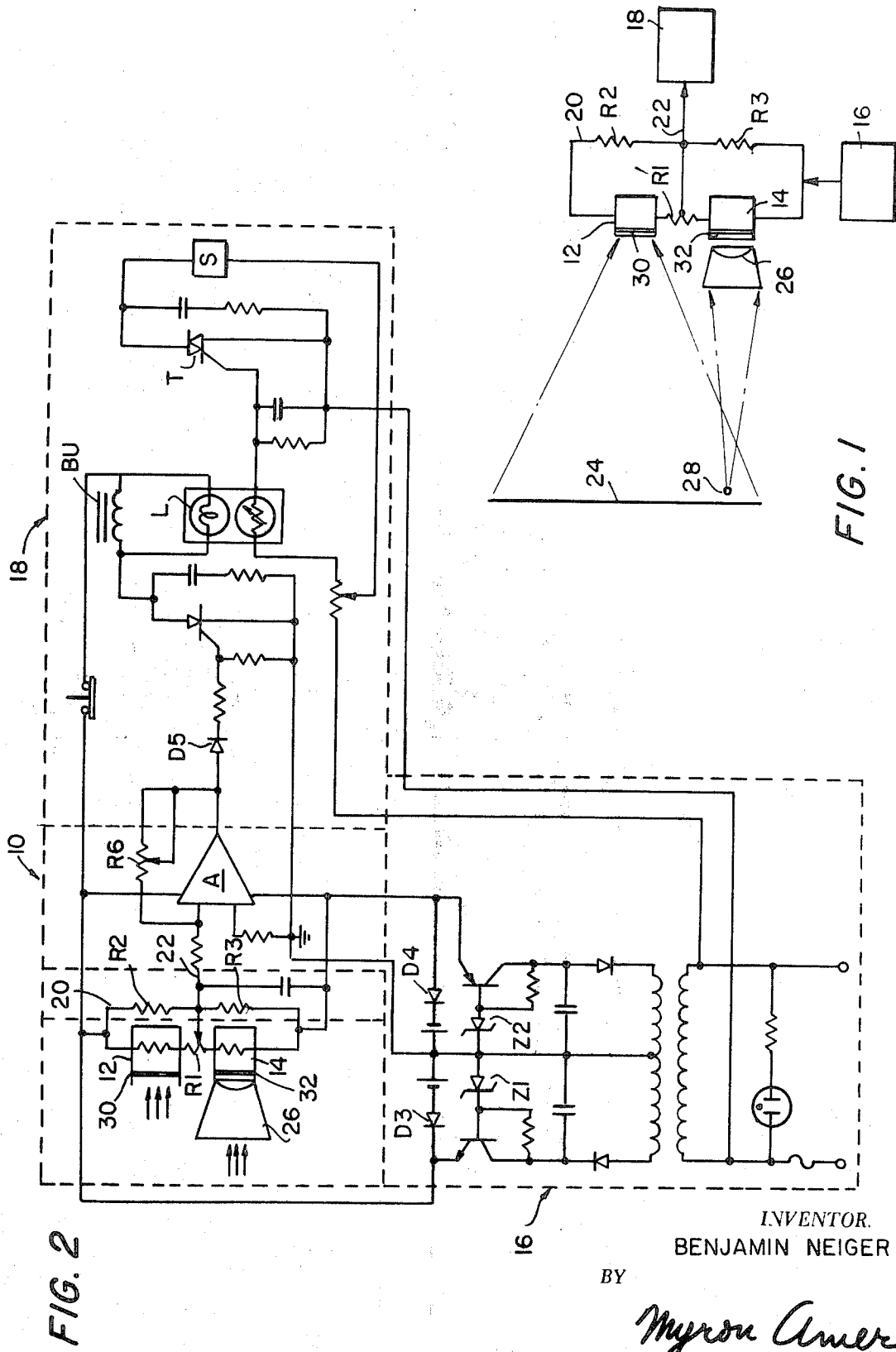
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[54] OPTICAL FLAME DETECTOR
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227 R, 213, 213 D; 250/209, 220 C, 217 F

ABSTRACT: An optical flame detector having a first photocell focused on a general area and another photocell, connected to electronically oppose the first photocell, more particularly focused on a specific point within the general area. Thus, ambient light-level changes which occur in the entire general area produce voltage generation in both photocells which cancel each other out and, quite properly, do not operate the fire alarm. Yet, the occurrence of flame at the specific point activates the one photocell more than the other and, consequently, does cause operation of the fire alarm.





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OPTICAL FLAME DETECTOR

The present invention relates generally to fire alarms, and more particularly to improvements for an optical flame detector.

As generally understood, a typical known flame detector includes a photocell having a specifically assigned area or point of coverage, and is adapted to trigger an alarm in response to the occurrence of flame at the assigned area or point. This prior art photocell arrangement, however, is vulnerable to sounding false alarms because of its inability to distinguish between radiation or light-level increases which should not trigger the fire alarm from flaming which should. For example, an increase in the ambient lighting in a warehouse where the flame detector is installed should not operate the flame detector, but invariably does since the photocell is geared to react to a light-level increase whether it be from flaming or from additional lighting.

Broadly, it is an object to provide an improved flame detector overcoming the foregoing and other shortcomings of the prior art. Specifically, it is an object to provide a photocell-type flame detector capable of distinguishing between ambient light-level changes and flaming at a specific flame-detection point, and of triggering an alarm only in response to the latter.

An optical flame detector demonstrating objects and advantages of the present invention includes two photocells focused by their orientation on an operative area, one of which, however, is further restricted by a lens to a specific flame-detection point in the operative area. The photocells are electrically connected in opposition such that an ambient light-level change which, of course, occurs throughout the operative area effects both equally and results in cancelling voltages. Flaming at the flame-detection point, however, primarily effects only one photocell and results in voltage generation which is readily put to use to trigger a fire alarm.

The above brief description, as well as further objects, features and advantages of the present invention, will be more fully appreciated by reference to the following detailed description of presently preferred, but nonetheless illustrative embodiments in accordance with the present invention, when taken in conjunction with the accompanying drawings, wherein:

FIG. 1 is a simplified circuit diagram of a first embodiment of a flame detector according to the present invention; and

FIG. 2 is similarly a circuit diagram of a flame detector according to the present invention, in which a preferred second embodiment thereof is illustrated in detail.

Reference is first made to the simplified embodiment of a flame detector as illustrated in FIG. 1 and generally designated 10 therein. The essential structural features of the detector 10 in this embodiment, as well as in the embodiment of FIG. 2, consists of a pair of photocells 12 and 14 powered by an appropriate power supply 16 which either can be alternating current supplied over power lines or direct current supplied by batteries. As will be described subsequently herein, the photocells 12, 14 are operatively arranged to operate an appropriate fire alarm 18, which alarm can consist of an optical signal or a sound signal, whichever is preferred. In other words, the specific nature of the power supply 16 or of the fire alarm 18 may vary and is not an essential part of the present invention. What is essential is the use of the photocells 12, 14 and also the additional aspects of the circuit 10 which will now be described in detail and which result in the photocells 12, 14 being capable of detecting the occurrence of a flame at a specific point and thereupon causing operation of the fire alarm 18. In this regard, the occurrence of the flame which, in effect, is an increase in light level cannot be confused with other occurrences which also increase the light level but which should not result in the operation of the fire alarm 18. Such occurrences, for example, would be an increase in the ambient lighting of a warehouse where the flame detector 10 is installed or perhaps merely an increase in sunlight directed upon the flame-detection point. For commercial utility of the

flame detector 10, it is necessary that it be capable of distinguishing between the foregoing light-level changes and that it be sensitive only to that light-level change which is the result of the occurrence of flame at a selected flame-detection point.

To the above end, each embodiment of the flame detector 10 hereof includes the already noted photocells 12, 14, and also an appropriate bridge-type circuit 20 electrically connecting these photocells in opposition to each other such that voltages generated by these photocells which are of substantially the same extent cancel each other out. On the other hand, should there be an overbalance of generated voltage, as for example from the photocell 14, this overbalance of generated voltage will flow through the conductor 22 and, in a well understood manner, be effective in operating the fire alarm 18.

The significance of electrically connecting the photocells 12 and 14 in opposition to each other as it specifically relates to the function of flame detection will now be explained. Photocell 12 is physically arranged so as to sense and react to any light emanating from a prescribed area 24. Photocell 14, on the other hand, is associated with a light-gathering lens 26 which is optically effective to restrict the purview of the photocell 14 to a specific point within the prescribed area 24 which will be understood to be the flame-detection point 28. Specifically, point 28 will be understood to be that point at which the user of the detector 10 feels is most vulnerable to flame and is thus the point that this product is designed to sense for the occurrence of flame. This point, for example, may be a specific location on a boiler or may be a specific location in a warehouse where highly flammable materials are stored. In any event, flame detection point 28, as already noted, is specifically sensed for the occurrence of flame by photocell 14 and is within the operative area 24 which is sensed by the photocell 12.

With the above understanding, let it be assumed that there is a light-level change consisting merely of an increase of the ambient lighting of the warehouse where the flame detector 10 is installed. Such an increase in lighting will naturally occur within the prescribed area 24, and more particularly at the point 28 within this area as well as at other points in this area. As a consequence, this increase in ambient lighting will effect both the photocells 12 and 14 in a similar manner and will produce a generated voltage from both of these photocells which will be substantially of the same extent. Since the photocells 12, 14, as already noted, are connected in opposition to each other, the voltages generated by these cells in response to an increase in ambient lighting will cancel each other out and thus there will be no current flow in the conductor 22 that will result in operation of the fire alarm 18. The foregoing, of course, will also be the result if there is a decrease, rather than an increase, in the ambient lighting.

Assuming, however, that fire starts at the flame-detection point 28, this occurrence of flame will naturally only significantly effect the photocell 14. There thus will be generated in the photocell 14 a voltage which is not similarly generated in the photocell 12, with the result that there is an overbalance of generated voltage which, in turn, will produce current flow in the conductor 22. In any one of numerous ways, this current flow can readily be made to trigger and thereby cause operation of the fire alarm 18.

As a preferred but not necessarily essential technique in restricting or confining the sensitivity of the flame detector 10 to the occurrence of flame at the flame-detection point 28, use is advantageously made of red-transmission light filters 30, 32. Such a filter only passes red wavelength light and since red is the predominant color of flame, the photocells 12, 14 are correspondingly rendered more sensitive to flame.

Reference is now made to the second embodiment of a flame detector according to the present invention in which components similar to these already described are designated by the same reference numeral. Embodiment 10 differs from the previously described embodiment of FIG. 1 only in that the circuit components, particularly those related to the

specific forms of what were previously designated the fire alarm 18 and the power supply 16, are more particularly illustrated in FIG. 2. In this embodiment, the resistors R2 and R3 are compensation resistors. Specifically, resistors R2 and R3 compensate for minimal ambient light conditions for the photocells 12 and 14, whereas resistor R1 compensates for high ambient light-level changes which, in turn, will require triggering of the fire alarm in response to only a slight voltage difference in the event of the occurrence of flame at the previously noted flame-detection point 28.

As illustrated, an overbalance of generated voltage results in current flow to an operational amplifier A. Associated with the operational amplifier A is a resistance R6 which permits adjustment of the operational amplifier and thus adjustment in sensitivity of the complete system. The output of the operational amplifier A is fed through a diode D5 to a fire alarm triggering circuit. The function of the triggering circuit is to activate a buzzer or other alarm device connected in series with it, in the illustrated embodiment, there being a lamp L connected across the buzzer BU which is optically coupled to a photocell in a conventional triac circuit T. Included in the triac circuit T are the usual protection resistance and capacitors preventing damage from excessive inductive loads imposed on the triac.

Turning now to the power supply for the photocells 12, 14, as illustrated in FIG. 2, the same consists of a plus or minus 15-volt supply regulated by the illustrated diodes and transistors Z1, Z2. In the illustrated power supply, there is incorporated a safety feature consisting of two 15-volt batteries decoupled through diodes D3 and D4 which take over the supply of the system when AC power fails. On the other hand, when power is restored, the batteries are automatically decoupled out of the system.

In summary, the essential or inventive feature of the flame detector 10, illustrated in simplified form in FIG. 1 and in detail in FIG. 2, resides in its ability to react only to the occurrence of flame at the flame-detection point 28 and, more important, not to react in response to mere ambient light-level changes. This is in sharp contrast to presently known optical flame detectors which when set to operate in response to the occurrence of flames in an environment characterized by a low ambient light level will invariably cause operation of the fire alarm upon an increase change in this ambient light level. Moreover, where it is attempted to render the prior art flame detector inoperative within a certain range or change in the

ambient light level, this significantly reduces the reaction time of the flame detector as well as its early sensitivity to the occurrence of flame at the flame-detection point, and thus is not an entirely satisfactory solution.

A latitude of modification, change and substitution is intended in the foregoing disclosure and in some instances some features of the invention will be employed without a corresponding use of other features.

What is claimed is:

1. A flame detector operatively arranged to supervise a remote reference area by sounding a fire alarm in response to the presence of flame occurring at a prescribed fire-detection point within said reference area, said flame detector comprising a first photocell focused upon said reference area without any light-blocking object interposed between it and said reference area so as to optically sense light-level changes occurring in said reference area inclusive of said flame-detection point and to generate an alarm-cancelling voltage corresponding thereto, a cooperating arrangement of a lens and a second photocell similarly focused upon said reference area, said lens being optically effective to further restrict the focus of said second photocell only to said flame-detection point within said reference area so as to restrict said second photocell to the sensing of light-level changes occurring only at said flame-detection point and to generate an alarm-operating voltage corresponding thereto, and separate circuits electrically arranged in opposing relation to each other connected between each of said first and second photocells and said fire alarm, whereby a light-level change occurring in said reference area of necessity also occurs at said flame-detection point to thereby produce opposing alarm-operating and alarm-cancelling voltages of the same extent and which cancel each other while a light-level change occurring only at said flame-detection point only produces an alarm-operating voltage which is effective to operate said alarm.

2. An optical flame detector as defined in claim 1 including a red-transmission light filter interposed between said prescribed flame-detection point and each of said photocells effective to limit sensitivity of said photocells to the predominant color of flame.

3. An optical flame detector as defined in claim 2 including an amplifier electrically connected between said first and said second photocells and said fire alarm effective to amplify any overbalance of voltage generated from said first photocell to an extent necessary to operate said fire alarm.

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