

[54] FIRE DETECTOR UTILIZING ULTRAVIOLET AND INFRARED SENSORS

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[58] Field of Search 340/228, 228.2, 227, 224;
250/83.3 H, 83.3 UV, 237 R, 237 P, 237 S;
317/133.5

[56] References Cited

UNITED STATES PATENTS

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[57] ABSTRACT

A fire detector consisting principally of a first radiation detector for detecting radiation in the infrared region of the spectrum and a second detector for detecting radiation in the ultraviolet region of the spectrum, connected to an alarm through a logic circuit. The logic circuit is adapted to set-off the alarm only if the infrared detector detects infrared radiation at a predetermined level in the flicker frequency range of a flame for a predetermined period of time in the absence of ultraviolet radiation at such flicker frequency detected by the ultraviolet detector.

8 Claims, 2 Drawing Figures

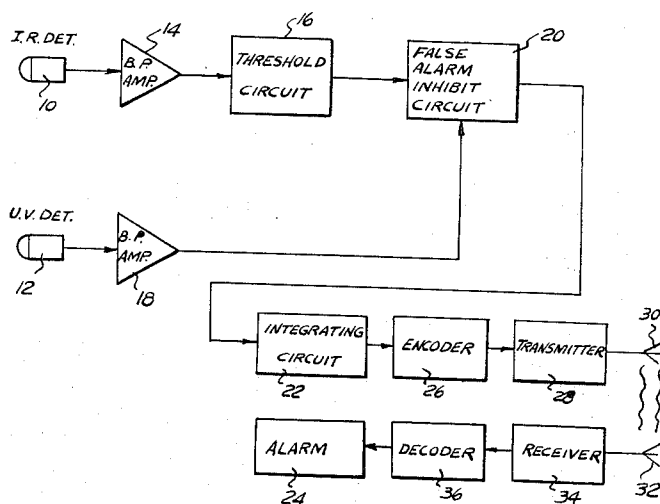


FIG. 1

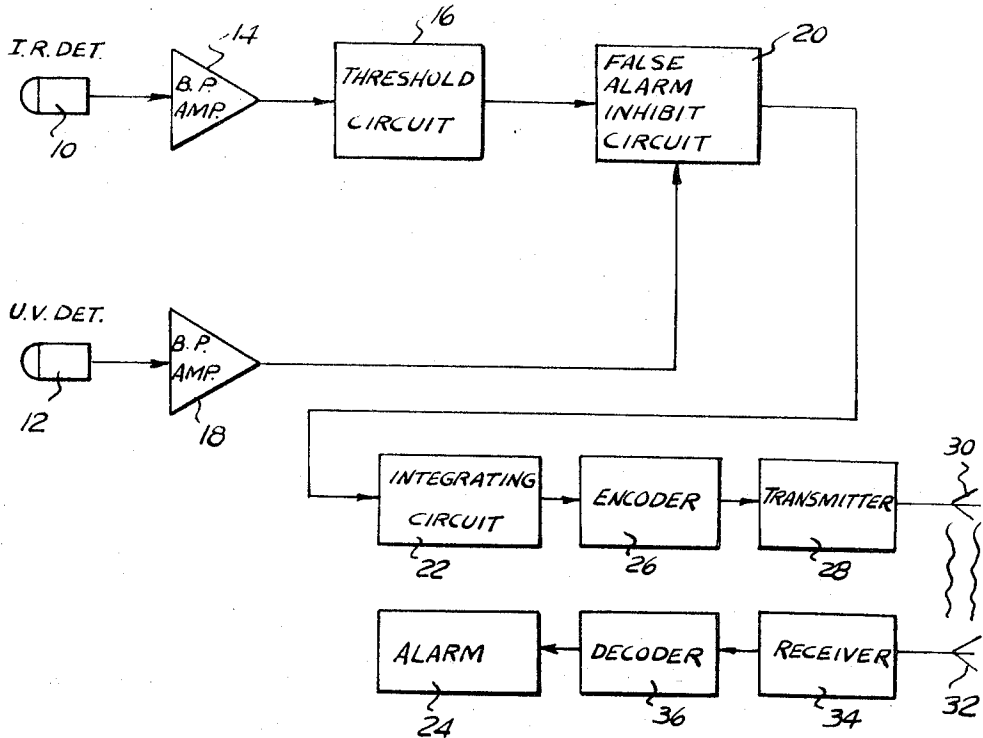
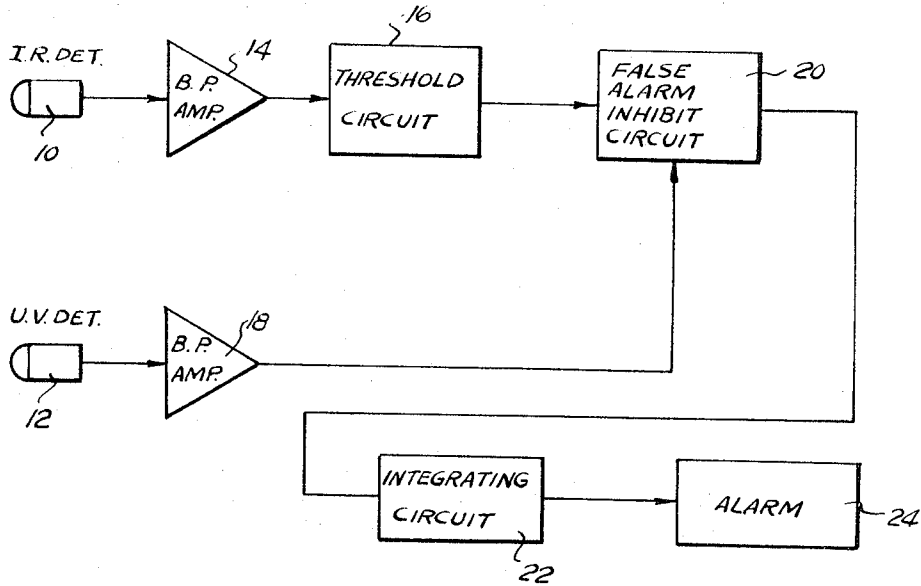


FIG. 2

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FIRE DETECTOR UTILIZING ULTRAVIOLET AND INFRARED SENSORS

BACKGROUND OF THE INVENTION

The present invention belongs to the field of fire detectors and flame sensors, and is particularly adapted to prevent false alarms by using combined optical spectrum discrimination, flicker frequency selection and response to signal of a sufficient level being present for a given period of time.

Prior art fire detectors are generally prone at giving false alarms, or susceptible to suppression from various sources, such as sunlight, ambient lighting, welders, etc. Prior art fire detectors utilize heat increase as an input signal, the presence of smoke, or the existence of the flame detected by appropriate flame sensors.

Fire detectors adapted to detect the presence of a flame belong to several general types. One type includes flame detectors provided with a sensor capable of detecting energy within the visible portion of the optical spectrum. Such detectors must be carefully calibrated and generally shielded from sources of ambient illumination, and, in spite of all precautions, they are obviously rather prone at giving false alarms. Another type includes fire detectors provided with sensors adapted to sense radiation emitted primarily in the infrared region of the spectrum, as is the case of radiation emitted by a flame or an incandescent body, and may be provided with a compensating sensor sensible to the visible region of the spectrum, as disclosed, for example, in U.S. Pat. No. 3,122,638. Other fire detectors are provided with actuating means between the detector and the alarm which are responsive to the flicker fluctuation of a flame, as disclosed in U.S. Pat. Nos. 2,722,677 and 2,762,033. In such fire detectors, the characteristic flicker rate of the flame is used to differentiate fire from other source of radiation. However, they are also subject to false alarms from a source having a flicker rate substantially alike that of a flame.

The present invention permits to overcome the false alarms and the suppression problems present in the prior art fire detectors. This is accomplished by the present invention by using combined optical spectrum discrimination and flame flicker frequency selection. Further discrimination of false alarms is achieved by rejecting low-level signals, and by permitting only signals present for a given period of time to actuate the alarm. Additionally, the present invention provides for an embodiment having a radio link between the fire detection portion of the system and the alarm portion of the system.

The majority of the radiation radiated by flames is in the region of the spectrum from about 0.7 to about 10 microns, the so-called near and far infrared region. There is very little energy emitted in the ultraviolet region, below 0.4 microns. Other radiation sources, such as sunlight, welders, and artificial lighting, have considerable energy radiation in both the ultraviolet and the infrared regions of the spectrum. The fire detector of the invention uses a pair of detectors, one of which is sensitive to the infrared region of the spectrum, and the other which is sensitive to the ultraviolet region of the spectrum. As a flame emits mostly radiation in the infrared region and very little, if any, radiation in the ultraviolet region, a flame is detected only by the infrared detector, and, if a signal appears at the output of both the infrared and the ultraviolet detectors, this is an indication of a false alarm. The present invention provides a logic system whereby the signal at the output of the ultraviolet detector is used to suppress the output signal from the infrared detector such that an overall output signal is present only in the absence of radiation emitted in the ultraviolet region of the spectrum.

However, if a fire appears in an area where ultraviolet radiation is present, as for example in an area illuminated by fluorescent lighting, the presence of a signal at the output of the ultraviolet detector would suppress the alarm signal. To overcome this problem, the flicker characteristic of flames is utilized. Flames typically flicker at frequencies around 10 cycles per second. The outputs from both detectors of the inven-

tion are caused to pass through filters which pass only signals of a frequency centered at about 10 cycles per second. The detectors detect both ultraviolet and infrared radiations with a flicker frequency centered at about 10 cycles per second, but an alarm signal is given only if flickering infrared radiation is present. Additionally, a threshold circuit is provided in the infrared channel of the system, such that only an infrared signal of a predetermined level, at the proper flicker frequency, is capable of actuating the alarm in the absence of an ultraviolet signal at the output of the ultraviolet channel. In this manner, low-level infrared signals from, for example, a match or a cigarette lighter, are not capable of giving an alarm. Additionally, an integrating circuit is included in the system for providing a delay, preventing spurious signals of short duration from setting off the alarm.

SUMMARY OF THE INVENTION

The present invention, therefore, provides a fire detection system adapted to give an alarm only when detecting a flame of a predetermined duration and intensity and within a predetermined flicker frequency range in the absence of ultraviolet radiation within the flicker frequency range. The present invention is thus particularly capable of detecting true fires, and it avoids the inconveniences and disadvantages of prior art fire detectors by providing means adapted to suppress false alarms and to prevent the effect of various sources tending to suppress setting off of an alarm.

BRIEF DESCRIPTION OF THE DRAWINGS

The several objects and main advantages of the invention will become apparent to those skilled in the art when the accompanying description of examples of the best modes contemplated for practicing the invention is read in conjunction with the accompanying drawings, wherein like reference numerals refer to like or equivalent parts, and in which:

FIG. 1 is a block diagram of an example of fire detector in accordance with the present invention; and

FIG. 2 is a block diagram of a modification of the example of the invention of FIG. 1.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIG. 1, an example of a fire detector according to the present invention comprises a first radiation detector 10, particularly sensitive to energy radiation in the infrared region of the spectrum, for example from 1.0 to 2.5 microns in wavelength, and a second energy radiation detector 12, particularly sensitive to energy radiation in the ultraviolet region of the spectrum, below about 0.4 microns in wavelength. The detectors are any conventional photoelectric cells or bolometers selectively sensitive to the appropriate radiation wavelength. For example, the infrared detector 10 may be a lead sulfide photoconductive cell and the ultraviolet detector 12 may be a zinc sulfide photoconductor cell. The output signal from the infrared detector 10 is applied to the input of a band pass amplifier 14, adapted to amplify the signal to a useful value and including a filter portion tuned to a frequency range around 10 cycle per second, for example, such frequency range is preferably from about 5 cycles per second to about 20 cycles per second. In this manner, only signals of an appropriate flame flicker frequency are able to appear at the output of the band pass amplifier 14 for application to the input of a threshold circuit 16. The threshold circuit 16 is adapted to pass only a signal of a predetermined amplitude, or a signal beyond a predetermined threshold level, such that weak signals detected by the infrared detector 10 are unable to pass through the threshold circuit 16, and only signals of at least a predetermined amplitude are passed by the circuit.

The signals appearing at the output of the ultraviolet detector 12 are applied to the input of a band pass amplifier 18, also adapted to pass only signals within a frequency range around 10 cycles per second, for example from about 5 cycles to 20

cycles per second. The amplified signals within the predetermined frequency range appearing at the output of the band pass amplifier 18 are utilized to normally inhibit a false alarm inhibit circuit 20, having an input to which are applied the output signals from the threshold circuit 16. Consequently, there is no output signal at the output of the false alarm inhibit circuit 20 as long as the ultraviolet detector 12 is detecting ultraviolet energy radiation flickering within the predetermined frequency range, but the false alarm inhibit circuit 20 provides an output signal in the event that either the ultraviolet detector 12 is not detecting ultraviolet radiation, or that the ultraviolet radiation detected by the ultraviolet detector 12 is at a frequency outside of the passing band of the band pass amplifier 18. The signal at the output of the false alarm inhibit circuit is applied to an integrating circuit 22. The integrating circuit provides an output signal for setting off an alarm by tripping the alarm providing portion 24 of the system only in the event that the signal at the output of the false alarm inhibit circuit 20 is of at least a predetermined duration. Such duration typically is of the order of 5 to 10 seconds, such that the integrating circuit 22 prevents the setting off of a false alarm in the event that the infrared detector 10 detects infrared energy radiation of too short a duration, although of the proper flickering frequency, for example from stray infrared illumination of the detector, as from a match or cigarette lighter flame.

It will be obvious that the integrating circuit 22 may be disposed between the threshold circuit 16 and the false alarm inhibit circuit 20. Furthermore, it can be seen that the invention provides for an infrared detector and an ultraviolet radiation detector connected to an alarm by way of a logic circuit which sets off an alarm only if infrared radiation within a predetermined flicker frequency range and at least a predetermined level is detected for a predetermined period of time in the absence of detection of ultraviolet energy radiation within the flicker frequency range.

FIG. 2 represents a modification of the fire detection and alarm system of FIG. 1 including generally the same elements, accomplishing the same functions as the circuit of FIG. 1. The arrangement of FIG. 2, however, comprises a radio link between the integrating circuit portion 22 and the alarm portion 24, such radio link comprising an encoder 26, a radio transmitter 28 and a radio wave radiation element or antenna 30. In this manner, the output signal at the output of the logic portion of the circuit, as represented at the output of the integrating circuit 22, is encoded by way of the encoder 26 and transmitted by way of the transmitter 28 provided with the radio wave radiating element 30. The transmitted signal is received by a receiving antenna 32, amplified by way of a conventional radio receiver 34 and decoded by way of a decoder 36 before being applied to the alarm portion 24. By way of the arrangement of FIG. 2, a radio link is provided for setting off an alarm, the alarm portion of the circuit being disposed at an appropriate remote location from the detector and logic portion of the system, such that the system does not require a line connection between the two portions of the system, and that the signal corresponding to the detection of a fire may be transmitted over a long distance. The encoder 26 and decoder 36 may be omitted, if so desired, and are provided only for providing added reliability to the system by preventing a false alarm from being set-off by spurious radio wave signals.

Having thus described the invention by way of examples thereof, given for illustrative purpose only, what is claimed as

new is as follows:

I claim

1. A fire detector comprising a first radiation detection means for providing a first signal in a first channel as a function of radiation detected substantially in the infrared region of the spectrum, first filter means in said first channel for passing said first signal within a predetermined flicker frequency range, said flicker frequency range being about 5 to 20 cycles per second, threshold means in said first channel for providing an output signal as a result of a signal of a predetermined amplitude at the output of said first filter means, second radiation detection means in a second channel for providing a second signal as a function of radiation detected substantially in the ultraviolet region of the spectrum, second filter means in said second channel for passing said second signal within said predetermined flicker frequency range, gating means normally inhibited by the presence of said second signal in said second channel, means for applying said first signal in said first channel to said gating means, integrating means responsive to said first signal of a predetermined duration of at least 5 seconds appearing at the output of said gating means, and alarm means actuated by said integrating means.

2. The fire detector of claim 1, further comprising a radio link between said integrating means and said alarm means.

3. The fire detector of claim 2, further comprising encoder and decoder means in said radio link.

4. A fire detector comprising a first channel consisting of a first radiation detector for converting radiation emitted by a flame substantially in the infrared region of the spectrum to a first electrical signal, band pass first amplifier means for amplifying said first electrical signal within a predetermined flicker frequency range and for rejecting said first electrical signal outside of said frequency range and threshold circuit means for passing said amplified first electrical signal above a predetermined amplitude, and a second channel consisting of a second radiation detector for converting radiation substantially in the ultraviolet region of the spectrum to a second electrical signal and band pass second amplifier means for amplifying said second electrical signal within said predetermined flicker frequency range and for rejecting said second electrical signal outside of said frequency range, said fire detector further comprising inhibit circuit means adapted to pass said first amplified electrical signal in said first channel only in the absence of said second amplified electrical signal in said second channel, integrating circuit means for providing an output signal in the event of an electrical signal of a predetermined duration appearing at the output of said inhibit circuit means, and alarm means actuated by said output signal.

5. The fire detector of claim 4, wherein said first and second band pass amplifier means are tuned to the same frequency range.

6. The fire detector of claim 5, wherein said frequency range is about 5 to 20 cycles per second.

7. The fire detector of claim 4, wherein the duration of said signal at the output of said inhibit circuit means is at least 5 seconds.

8. The fire detector of claim 4, further comprising encoder means at the output of said integrating circuit means for encoding said output signal, radio transmitter means for transmitting said encoded output signal, radio receiver means for receiving said encoded output signal, and decoder means for decoding said output signal, whereby said alarm means is actuated by said decoded output signal.

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