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Burnett

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[54] **FIRE DETECTOR STABILIZER CIRCUIT**

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[52] **U.S. Cl.** .....**340/237 S,** 250/83.6 FT

[51] **Int. Cl.** **G08b 17/10,** H01j 39/28

[58] **Field of Search** .....340/237 S; 250/43.5 D, 44, 83.6 FT

[56] **References Cited**

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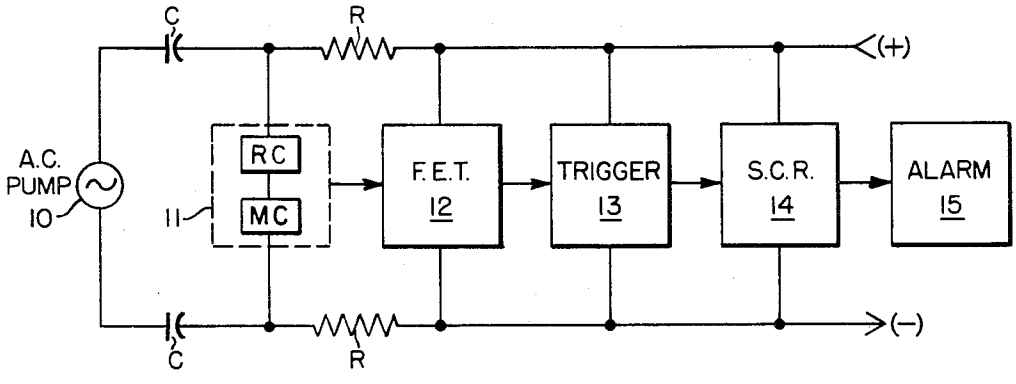
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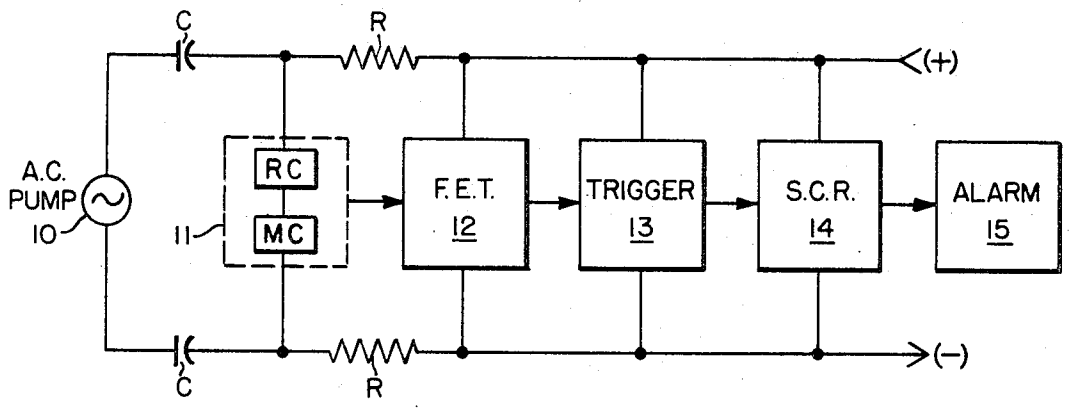
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[57] **ABSTRACT**

A fire detector has been provided including an ionization sensing means which changes the level of an output signal in accordance with the sensing of the presence of smoke particles in the atmosphere. A detecting means including a semi-conductor device selectively responds to the output signal and generates an alarm control signal. The improvement includes a very high frequency pump source coupled across the sensing and detecting means for stabilizing the ionization and to quench areas of intense ionization within the sensing means and the semi-conductor.

9 Claims, 1 Drawing Figure




C
R
(+)
A.C.
PUMP
10
11
RC
MC
F.E.T.
12
TRIGGER
13
S.C.R.
14
ALARM
15
C
R
(−)

FIRE DETECTOR STABILIZER CIRCUIT

BACKGROUND OF INVENTION

The invention relates to smoke detector devices and in particular to apparatus for stabilizing and increasing the sensitivity of such devices.

Ionization sensing devices as used in the present invention requires the imposition of an electric field across electrodes within. Ion particles are emitted by a radioactive source and the electric field facilitates a flow of current through the sensing chamber essential to the operation of such devices. The configuration of the field intensity throughout the chamber may not necessarily be uniform which detracts from the efficient operation of the device as a smoke detector, and as such, careful manipulation of electrode geometry is often required to maximize the effects of aerosols within the chamber.

Another problem arises with respect to the strength of the radio-active source. It is generally required that the source be rather weak in order to avoid the affects of radiation on personnel. A weak source, however, may decrease the efficiency of the detector, and limit its utility to certain applications.

Use of semi-conductors as one of the more recent developments in the fire detector art has added the convenience and economy of low voltage power supplies. These devices because of the nature of semi-conductors are able to produce a signal indicative of a smoke or fire condition without expensive and sometimes cumbersome electronic tube devices. There have arisen, however, problems associated with stability of the semi-conductor devices, some types of which have exhibited erratic behavior in the environments wherein they are utilized. Impurities or flaws in the semi-conductors, in many cases, make reliable detections sometimes very difficult. Without elaborate sensitivity compensation, these devices may be erratic in their behavior and sense anything from an actual fire to a draft in the room or area to be supervised. In addition, fluctuation of ambient conditions may add to the problem of accurate detection.

It is therefore an object of the present invention to provide an arrangement which substantially obviates one or more of the limitations of the described prior art arrangements.

It is another object of the present invention to provide a system which is more stable under varying conditions to which it is subjected.

It is yet another object of the present invention to provide a fire detector system which is stable, sensitive and economically implemented.

SUMMARY OF INVENTION

There has been provided a fire detector including an ionization sensing means for changing the level of an output signal in accordance with sensing the presence of smoke in the atmosphere and a detecting means which includes a semi-conductor device selectively responsive to the output signal for generating an alarm control signal. The improvement comprises means including a very high frequency source coupled across the sensing and detecting means for stabilizing ionization and for quenching areas of intense ionization within the sensing means and the semi-conductor.

For a better understanding of the present invention, together with other and further objects thereof, reference is had to the following description taken in connection with the accompanying drawing, while its scope will be pointed out in the appended claims.

The drawing is a block diagram of the apparatus forming one embodiment of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The apparatus of the present invention includes a smoke sensing device **11** having two ionization type detectors. The general type of detector contemplated for use in this device can be seen in a patent by Abe, U.S. Pat. No. 3,500,368. That device includes two ionization chambers; one substantially open to the atmosphere for detecting ionization products of smoke and the other a reference chamber which is substantially isolated from smoke particles but contains atmosphere for compensating changes in the ambient atmospheric pressure. The chambers shown in the drawing in the present disclosure include a reference chamber RC which establishes a reference potential and is substantially isolated from the combustion products in the atmosphere and a measuring chamber MC connected in series therewith which changes the potential at the junction of the two chambers upon the variations in concentration of the aerosols in the atmosphere. The chambers RC and MC are coupled across an electrical potential and each chamber has disposed therein a relatively weak source of radio-active material for ionizing the atmosphere within each of the chambers, such that under the influence of the potential, a current flows through the chambers. When atmospheric aerosols enter the measuring chamber MC, the current is decreased because the ionized particles produced by the radio-active source combine with the smoke particles thus reducing the total net movement of charge within the measuring chamber MC. Consequently, the potential across electrodes disposed in the measuring chamber MC increases and changes the potential of the junction between the two chambers RC and MC. This potential is coupled directly to an input of field effect transistor **12**. This transistor **12** can have its elements connected as disclosed in the above mentioned Abe U.S. Pat. No. 3,500,368. A field effect transistor was chosen because the input impedance of such a device is extremely high and does not load the series circuit consisting of the chambers RC and MC in sensing means **11**. This is important because the current flowing through the chambers is extremely limited and such loading would adversely affect the operation of the detector. If the potential at the junction between the chambers RC and MC changes by a predetermined amount established by the biasing of the FET **12**, it becomes conductive and produces a signal to trigger a circuit **13**. This circuit **13** acts somewhat as a buffer between the FET **12** and an output control circuit **14** including a silicon controlled rectifier which activates, upon conduction, the alarm **15**.

As previously noted, it is very possible for the field effect transistor **12** to become affected by the ambient temperature and operate erratically. In addition, if the FET **12** is not of the highest quality, ionization of impurities cause a premature avalanche of the device and

therefore improper conduction. Even in the case of a very high quality semi-conductor device, the procedure set forth below has been found to be very useful in improving what has heretofore been rather a satisfactory operation.

Improvement to the system as contemplated by the present invention, is accomplished by imposing a very high A.C. pump frequency across the field effect transistor **12** which has been found to quench the ionization of impurities in the semi-conductor. An A.C. pump **10** is coupled across the sensing means **11**, FET **12** through coupling capacitors C and resistors R. The R-C combinations are tuned to the pump **10** frequency and high quality components are chosen to yield a very high Q or quality factor at the pump frequency. The capacitive effect of the electrodes within the chambers RC and MC and the junction capacitance of the FET **12** is taken into consideration to further precisely tune the coupling circuit to the frequency of the pump **10**. The current generated by the pump **10** is primarily coupled across the chambers RC and MC, while resistors R limit the current to the remainder of the circuit including the FET **12**. The amplitude of the A.C. signal produced by the pump **10** is substantially equal to or slightly higher than the bias placed across the chambers RC and MC by the source potential shown in the drawing as (+) and (−). The imposition of the low level A.C. signal substantially eliminates non-uniform ionization occurring within the chambers RC and MC and FET **12** at the local flaws. The trigger circuit **13** and the SCR circuit **14**, include semi-conductor devices and the presence of the A.C. pump **10** substantially improves their operating characteristics also. However, it is primarily the focus of the invention to increase the sensitivity of the chambers RC and MC and prevent erratic operation of the FET **12** since it is required to detect the low level signal change at the junction of the chambers RC and MC. The ionization characteristics of the chambers RC and MC and the response of FET **12** tend to be more uniform in operation and the latter more sensitive to the changes in the potential at the junction of the two chambers. Thus, the system is more efficient in its initiating the signals for activating the alarm **15**.

The imposition of the relatively high A.C. pump **10** frequency also increases many fold the ionization characteristics of the radio-active source. The sensitivity of the device was noted to increase by at least a factor of 10 by the imposition of a 10 MHz signal, and further as the frequency was increased. It is therefore possible to reduce the radiation level substantially to a nominal value by increasing the frequency of the pump **10**.

There has therefore been provided an improved fire detector which incorporates a very high frequency alternating current pump which quenches intense ionization within the semi-conductor device and provides a stabilizing effect to the semi-conductor as well.

While there has been provided what is at present is the preferred embodiment of the invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the true spirit and scope of the invention, and it is intended in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of the invention.

What is claimed is:

1. A fire detector stabilizer circuit comprising in combination:

a. a smoke sensing device having an ionization detector for changing the output level of a signal in response to the presence of smoke in the atmosphere;

b. detecting means including a semi-conductor device which is selectively responsive to the output level of said smoke sensing device for generating an alarm control signal;

c. a DC potential for inducing a current flow in said smoke sensing device;

d. a very high frequency source including an alternating current pump coupled across said smoke sensing device and said detecting means for quenching non-uniform ionization of said smoke sensing device; and wherein

e. said alternating current pump produces a radio frequency signal at a voltage level substantially equal to, or slightly higher than, that of said DC potential and less than the bias level of said semi-conductor.

2. The apparatus of claim **1** wherein said very high frequency source is coupled to the fire detector, by coupling means tuned to the frequency of the alternating current pump.

3. The apparatus of claim **2** wherein said semi-conductor is a field effect transistor having:

a. a voltage level sensitive gate electrode coupled to the smoke sensing device and;

b. output terminals coupled to the output of said alternating current pump; and wherein

c. said field effect transistor achieves a conductance state in response to a predetermined variation of the voltage level of said gate electrode.

4. The apparatus of claim **3** wherein said smoke sensing device includes: two chambers including electrodes having the ionization potential imposed thereon serially coupled across the alternating current pump and having their junction coupled to the gate of said field effect transistor.

5. The apparatus of claim **2** wherein said coupling means includes: resistive and capacitive impedances for tuning the coupling means and said capacitive impedance further comprises inter-electrode capacitive effects of said chambers and junction capacitive effects of said semi-conductor.

6. The apparatus of claim **5** wherein said chambers comprise: a reference chamber substantially isolated from the smoke for establishing a reference potential; and a measuring chamber open to the atmosphere for producing a change in the potential at the junction of the chamber in accordance with the concentration of smoke in the atmosphere.

7. The apparatus of claim **4** wherein said detector further includes: output circuit means responsive to the conductance state of said field effect transistor for producing the alarm control signal.

8. The apparatus of claim **7** wherein said output circuit includes: a trigger circuit responsive to the conductance state of the field effect transistor for producing an output; and a control rectifier having a gate electrode coupled to the output of said trigger circuit assuming a conductance state upon the occurrence of the trigger output for producing said alarm control signal.

9. The apparatus of claim 8 wherein said trigger means and said control rectifier means include semiconductor devices coupled therein, and said output circuit means is coupled across said alternating current pump output for further stabilizing the response of said semi-conductor devices.

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