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Tipton et al.

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[54] **SYSTEM FOR INDICATING AEROSOLS IN THE ATMOSPHERE**

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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

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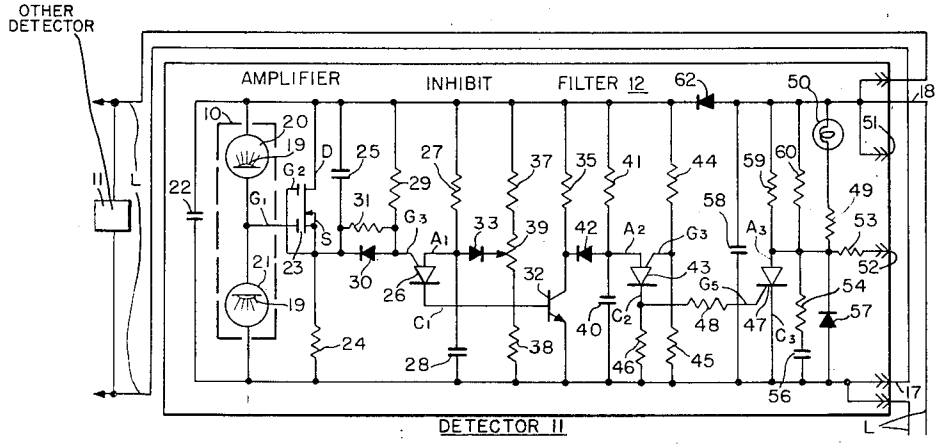
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Attorney—Harold S. Wynn and John P. DeLuca

[57] **ABSTRACT**

A fire detector having an ionization sensing means which changes the level of an output signal in accordance with sensing the presence of smoke in the atmosphere has been provided. A detecting means selectively responsive to the output signal generates an alarm control signal and the improvement includes a filter means for rendering a detecting means operable if uninhibited to generate the alarm signal irrespective of an output signal from the sensing means. Inhibiting means normally operable to inhibit the filter is rendered ineffective in response to the output signal of the sensing means and the inhibiting means therefore checks the operability of the detecting means.

15 Claims, 4 Drawing Figures



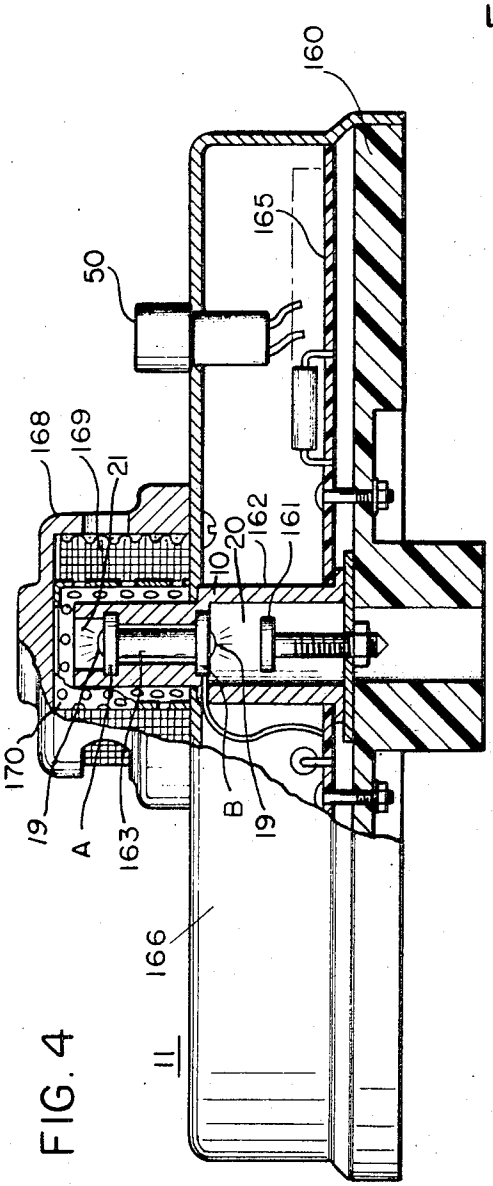


FIG. 4

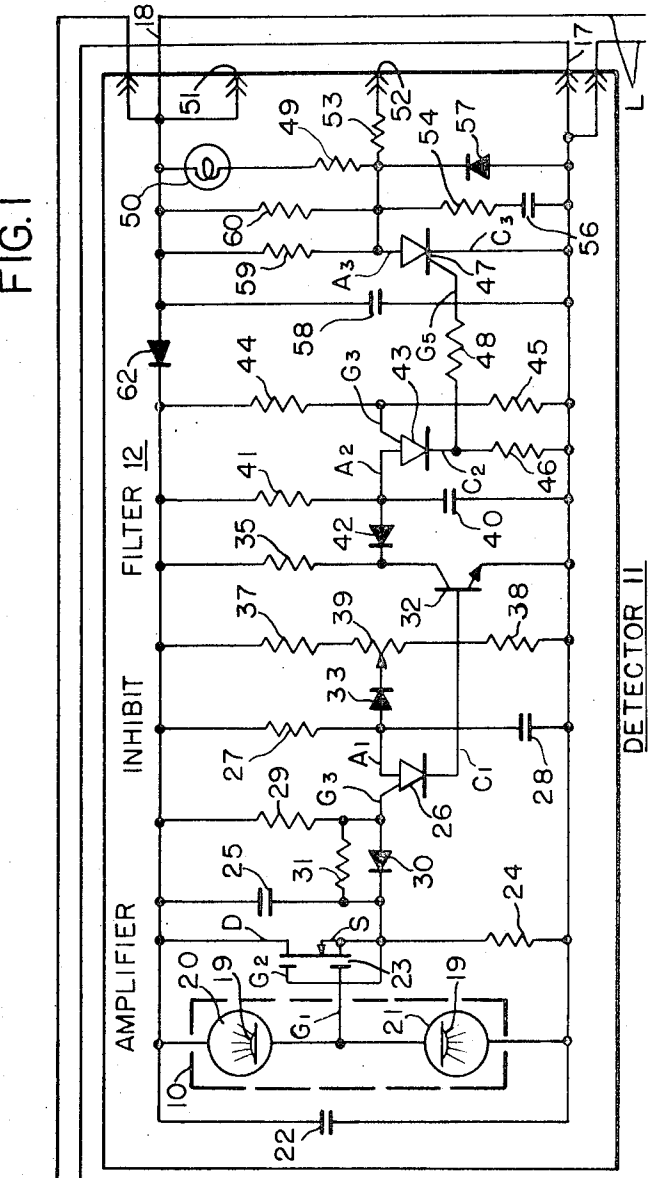


FIG. 1

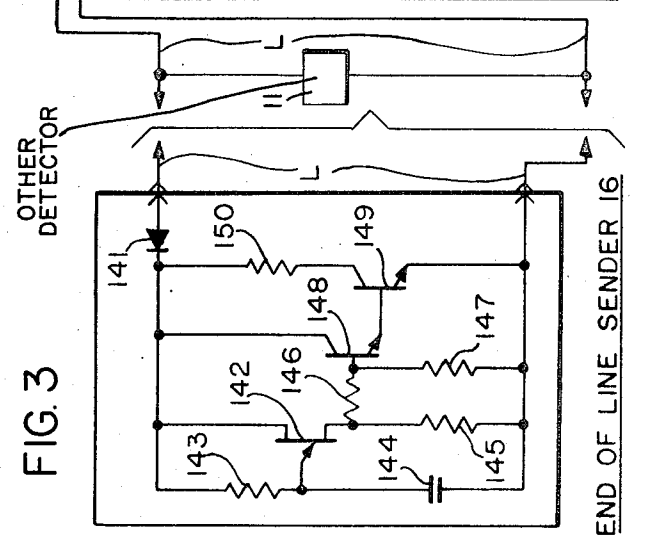


FIG. 3

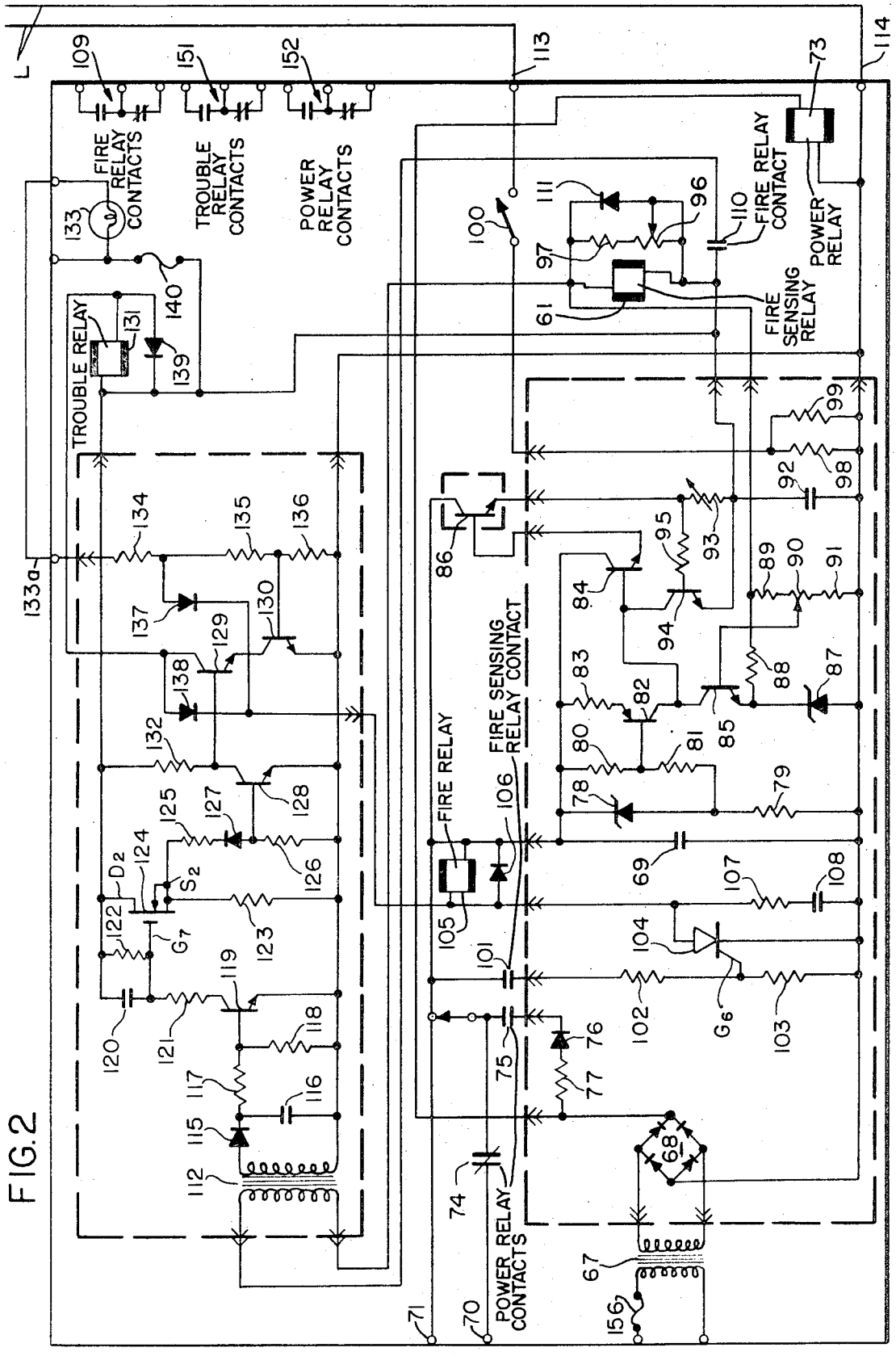

L
109
151
152
113
114
73
FIRE RELAY CONTACTS
TROUBLE RELAY CONTACTS
POWER RELAY CONTACTS
FIRE RELAY CONTACT
POWER RELAY
FIRE SENSING RELAY
TROUBLE RELAY
FIRE RELAY
FIRE SENSING RELAY CONTACT
POWER RELAY CONTACTS
CONTROL UNIT 15

FIG.2

SYSTEM FOR INDICATING AEROSOLS IN THE ATMOSPHERE

BACKGROUND OF INVENTION

This invention relates to a fire detector system and in particular to the system for detecting the presence of combustion products, aerosols in the atmosphere.

Modern fire detection equipment generally utilizes an ionization chamber which uses a radio-active source to ionize the atmosphere within the chamber and a measurement of the variation in voltage across the chamber is indicative of the condition of the atmosphere. If the voltage across the chamber increases, it indicates that the atmosphere for a fixed temperature and pressure has mixed therein atmospheric aerosols or ionized particles which tend to combine with the ionized particles produced by the radio active source and reduce the current through the chamber. Other factors, however, may provide a variation in voltage which would give false indication of a fire condition. A draft, for example, caused by a slamming door might disturb the atmosphere within the chamber such that an alarm is sounded. Variations in atmospheric pressure also effect the characteristic of the chamber. As is well known in the art, two chambers can be used; one open to the atmosphere for receiving or detecting the presence of aerosols and another substantially closed to atmospheric aerosols. The closed chamber is a reference for compensating the system under changes in the atmospheric pressure. The system still may, however, be susceptible to false triggering and noise transients which may be received by the equipment.

Generally it is desirable to connect a plurality of fire detectors in a specific area and link them together to a receiver which would activate the alarm signal. However, noise, loading and supervisory problems have made installing such fire detectors on a system-wide basis with a central indication very difficult and costly.

In order to provide for a truly safety oriented system, supervision of the circuits joining multiple sensing units and individual trouble detection in each of the units is necessary. Trouble may be corrected as soon as it occurs. Discovery should not be delayed by the frequency of periodic checking, but rather continuous monitoring of the fire detection apparatus should be conducted.

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

It is another object of the present invention to provide a simplified fire detection system.

It is yet another object of the present invention to provide a safe fire detection system.

It is still another object of the present invention to provide an economically manufactured installed and maintained fire detection system.

SUMMARY OF INVENTION

There has been provided a fire detection system including ionization sensing means for changing the level of an output signal in accordance with sensing the presence of smoke in the atmosphere. Detecting means selectively responsive to the output signal generates an alarm control signal and the improvement includes filter means for rendering the detecting means operable if uninhibited to generate the alarm signal irrespective of an output signal for the sensing means. Inhibiting means including a voltage level detector is also provided which is normally operable to inhibit the filtering means and it is rendered ineffective when a voltage level governed by the output signal is above or below a predetermined normal voltage range.

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 drawings, while its scope will be pointed out in the appended claims.

FIG. 1 is a schematic diagram of the fire detector including the sensing means, detector circuitry and the improved apparatus of the present invention.

FIG. 2 is a diagram of the control unit which may be remotely located for central monitoring of a number of detectors coupled in parallel.

FIG. 3 is a diagram of the supervisory circuit coupled in parallel to the last unit in the multiple detector system.

FIG. 4 is a drawing showing the structure of the sensing unit.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The combustion products smoke detection system consists essentially of three units; a detector **11**, control unit **15**, and an end-of-line signal sender **16**.

A detector unit **11** produces an output when combustion products are sensed by an ionization chamber **10**.

A control unit **15** supplies regulated, short circuit protected, 16V D.C., to operate from one to 10 detectors connected in parallel. In addition, it indicates a trouble condition if the line continuity is broken, or if the 16V D.C. is lost for any reason. "FIRE" indication condition is provided when a detector **11** output, signals the presence of combustion products.

An end-of-line sender unit **16** furnishes current pulses to a line L which are received by a trouble detection portion of the control unit **15** thus, monitoring continuity.

DETECTOR

The detector **11** circuit operates on a relatively low input voltage in the order of 16V D.C., applied to terminals **17** and **18**. Numerals **20** and **21** indicate ionization chambers of sensing means **10** activated by a radio-active material **19** which emits alpha particles.

Chamber **21** is open to the atmosphere and exposed to combustion particles. Chamber **20** is the reference chamber closed to aerosols which is used to nullify the effects of atmospheric changes. The voltage across the ionization chambers **20** and **21** connected in series is filtered by capacitor **22**.

Particulate products of combustion entering the open sensing chamber **21** hinder the normal ion current flow through the chamber caused by alpha particles from the radio-active material **19**, resulting in a rise of voltage across the chamber **21**. The input stage of the detector **11** circuitry is a dual-gate MOSFET (Metal Oxide Semiconductor Field Effect Transistor) **23**, connected as a source follower. The drain D electrode of FET **23** is connected to the positive potential, the gate electrode G1, is connected to the junction of chambers

20 and 21, the source electrode S is connected to resistor 24, and the remaining electrode G2, is connected to the source. In this connection the source S voltage follows the voltage at gate G1, which is the chamber 21 voltage. It should also be noted that a resistor 24 is selected to provide stable temperature characteristic to the response of FET 23 and is connected between electrode S and negative terminal 17. Capacitor 25 prevents damage to FET 23 should gate G1 suddenly go positive.

The next stage of circuitry functions as a voltage level detector. Transistor 26 is a Programmable Unijunction Transistor (PUT) and with resistor 27 and capacitor 28 forms an oscillator or inhibit means. Resistor 29, rectifier 30, and resistor 24 set a reference voltage level for PUT 26. Capacitor 28 charges through resistor 27 until its voltage exceeds the reference level which is the voltage at the gate electrode G3 of PUT 26 connected to resistors 29, 31 and rectifier 30 by about 0.3V. At this point, conduction begins between the anode A1 and the cathode C1. Capacitor 28 then discharges through the base emitter junction of transistor 32 until its voltage drops to a cut off level at which conduction cannot be maintained. Cut off then restores the anode A1 to cathode C1 blocking of PUT 26 and capacitor 28 may recharge through resistor 27. This charging and discharging of capacitor 28 continues, forming a free running oscillator. A voltage divider formed by resistors 37, 38 and potentiometer 39 is a sensitivity adjustment for the detector. The voltage at the slider of potentiometer 39 sets the maximum voltage that capacitor 28 can charge to. Rectifier 33 permits discharge of capacitor 28 if it exceeds the voltage set at potentiometer 39. If the voltage that capacitor 28 charges to is not greater than the gate voltage by 0.3V, conduction of PUT 26 does not take place, and oscillations cease. This can occur if the gate G3 voltage of PUT 26 is raised high enough as is the case when the sensing chamber 21 voltage rises from the entrance of particulate matter created by combustion. This, therefore, inhibits the filter means 12 described further in the discussion. A fire condition, therefore, causes the oscillations of PUT 26, resistor 27 and capacitor 28 to cease.

Each time capacitor 28 discharges through PUT 26, it biases transistor 32 into conduction. Filter 12 comprises capacitor 40, resistor 41 and transistor 32. When transistor 32 conducts, capacitor 40 which is charged through resistor 41 discharges through rectifier 42. Since transistor 32 conducts periodically, capacitor 40 is discharged periodically. During the non-conduction periods, capacitor 40 recharges through resistor 41. The discharge of capacitor 40 depends on the repetition rate of the pulses gating transistor 32 from capacitor 28, and the charge of capacitor 40 depends on the time constant of resistor-capacitor 41-40 combination. It should be noted that resistor 35 also provides bias voltage for transistor 32. The voltage that appears on capacitor 40 depends on the relation of this repetition rate to the resistor-capacitor 41-40 time constant. The average value of voltage on transistor 32 is in the order of 2V. The resistor-capacitor 41-40 combination in cooperation with transistor 32 therefore filters out signals of less than a predetermined rate.

Transistor 43 is a Programmable Unijunction Transistor (PUT) with resistors 44 and 45 setting the voltage reference level on gate G4. If the pulses which make transistor 32 conduct, stop, capacitor 40 will charge to a higher voltage than the average. When this voltage exceeds the reference set by resistors 44 and 45 by approximately 0.3V, conduction takes place from anode A2 to cathode C2 and capacitor 40 discharges through PUT 43 and resistor 46. The voltage across resistor 46 is coupled to the gate G5 of Silicon Controlled Rectifier SCR 47 through resistor 48 and triggers conduction from its anode A3 to cathode C3. This then effectively grounds resistor 49 and lights a fire indication lamp 50, and also any external light (not shown) that may be connected across terminals 51 and 52. Resistors 49 and 53 are dropping resistors for low voltage lamps such as lamp 50. Resistor 54 and capacitor 56 form a filter network to prevent firing of (SCR) 47 from spurious transients. Rectifier 57 allows the fire indication lamp 50 to light immediately if the line should be connected in reverse polarity. Capacitor 58 is a filter capacitor to filter R.F. transients from the unit. Diode 62 coupled between capacitor 58 and resistor 44 is provided for polarity protection for the semi-conductors if the apparatus of FIG. 1 is inadvertently connected in reverse. Resistors 59 and 60 assure closure of the Fire Sense Relay 61 in the control unit 15 should the fire indication lamp 50 be open circuited.

The control unit 15 contains the voltage regulated supply, fire sensing circuitry, trouble circuitry, power failure sensing and emergency power transfer circuitry.

POWER INPUT

Normal power is supplied to the control unit through a suitable fuse 156 and transformer 67 which is full wave rectified by bridge 68 and filtered by capacitor 69. Emergency battery power is applied to terminal 70 and externally switched, full-wave rectified D.C. power may be applied to terminal 71. Resistor 77 limits the surge current due to the charging of the filter capacitor 69. When AC power is applied, relay 73 is energized thus opening normally closed contacts 74 and closing normally open contacts 75. This opens the battery input and connects the AC power to the control unit. In addition, if A.C. power is lost for any reason, relay 73 deenergizes and closes contacts 152 for producing an A.C. power loss signal. Diode 76 blocks battery voltage from re-energizing relay 76 through resistor 77 if AC power is lost.

VOLTAGE REGULATOR

Zener diode 78 and resistor 79 form a voltage divider. The zener voltage of 78 is about 10V. Resistors 80 and 81 in parallel with zener diode 78 furnish a reference voltage for the base of transistor 82. Since the base voltage is fixed, the drop across resistor 83 is also fixed producing constant emitter current. Neglecting base current the emitter and collector currents are equal and fixed and transistor 82 forms a constant current generator. The collector current of transistor 82 supplies the base of transistor 84 and the collector of transistor 85. Transistors 84 and 86 are Darlington connected current amplifiers. Zener diode 87 and resistor 88 are in series across the output. The junction of zener diode 87 and resistor 88 is at approximately 10V, with

respect to ground, and is a reference for the emitter of transistor **85**. Resistors **89**, **90** and **91** form a voltage divider across the output of transistor **86**. Resistor **90**, which is adjustable, is used to vary the output. The output is varied in the same manner that the output is regulated. If the slider on resistor **90** is made more positive, or the output voltage increases, the base current of transistor **85** is increased, which causes **85** to conduct more. Since the collector current of transistor **82** is constant, the additional current must come from a decrease in base current of transistor **84** and in turn a decrease in the collector current of transistor **86**. This decrease in current is accomplished by an increase in drop across **86**. The output voltage will therefore decrease, since transistor **86** is in series with the supply and load. For decrease in the slider voltage of resistor **90** or a decrease in output voltage, the opposite sequence occurs with a resulting increase in the output voltage. Capacitor **92** is used as a filter capacitor.

OVER-CURRENT PROTECTION

Over-Current Protection is provided to prevent damage due to an accidental short circuit of the output terminals. Output current passes through resistor **93** which is connected to the emitter of transistor **94** and base of transistor **94** through current limit resistor **95**. An increase in output current of transistor **86** increases the drop across resistor **93** and increases the current through transistor **94** until saturation occurs. The increased current draws base current from transistor **84** thus decreasing the drive of transistor **86** and limits its output current.

FIRE SENSING

A parallel combination of relay **61**, resistors **96** and **97** is placed in series with the detectors **11**. When a detector **11** is activated due to the presence of smoke, there is an increase in current due to the added load of the fire indicating lights **50** and the resistors **59** and **60** in the detector **11**. This increase of current actuates the sensing relay **61**. The current drawn per detector ranges from a quiescent current of about 2.5 ma to a fire condition current of 30 ma minimum. The relay **61** is calibrated to close with an increase of 20 ma by closing switch **100** (which connects the resistor **98** and **99** across the supply) and increasing the resistance with resistor **96** until relay **61** pulls in. This step is performed with all the detectors **11** connected. When switch **101** controlled by relay **61** closes, voltage is impressed across resistors **102** and **103** applying voltage to the gate G6 of silicon control rectifier (SCR) **104** causing anode-cathode conduction. This applies voltage across relay **105** energizing it. One set of contacts **109** of relay **105** is available for fire indication, and the other set **110** is used to short out the fire sensing relay, **61** to protect it from over current. Diode **106** prevents inductive voltage spikes when relay **105** deenergizes. Resistor **107** and capacitor **108** limit the rate of rise of voltage applied to SCR **104** to prevent accidental triggering. Diode **111** is a "Stabistor" diode used to bypass the surge currents of the detectors from relay **61**. For a 0.5V pickup voltage of relay **61**, diode **111** conducts less than 1 ma.

TROUBLE CIRCUIT

The trouble circuit detects the pulses placed on the line L connecting all detectors **11** by the "End of Line Sender " **16** unit located at the last detector. The primary of transformer **112** is placed in series with the control unit **15** output terminal **113**. The pulses which appear across the secondary of transformer **112** are rectified by diode **115**, filtered by capacitor **116**, and impressed across resistors **117** and **118**. A portion of this voltage is applied to the base of transistor **119**. Transistor **119** which is non-conducting is turned on by the incoming pulses. When **119** is on, capacitor **120** charges through resistor **121** and when transistor **119** is off, capacitor **120** discharges through resistor **122**. The discharge time constant is chosen to be much longer than the repetition rate of the input pulses from the sender **16**. The average value of the voltage at the junction of resistors **121**, **122** and capacitor **120** which is tied to the gate G7 of field effect transistor FET **124** is about 8–9V. This reduces the gate voltage from the no signal condition. Since the source terminal S2 follows the gate G7 except for a small voltage difference, the source voltage is reduced also. Connected to the source S2 is a series combination of resistors **125**, **126** and a 10V zener diode **127**. The source voltage under these conditions is not sufficient to overcome the zener voltage and cause conduction through this path. The junction between diode **127** and resistor **126** is at a low voltage, so that transistor **128** is cut off with a resulting high voltage on the collector. Transistors **129** and **130** are in series with the "Trouble Relay " **131**. In a normal ready condition, both transistors **129** and **130** will be conducting and **131** will be energized. Rectifier **139** coupled across the coil of relay **131** acts as an electrical surge suppressing device. Transistor **129** will be conducting when transistor **128** is cut off since resistor **132** is supplying base current. Should the pulses fail to be received for any reason, transistor **129** would cut off since transistor **128** would divert its base current. This would cause the "Trouble Relay " **131** to deenergize, indicating trouble. Transistor **130** is maintained conducting by the current through the fire lamp **133**, wire **133*a*** and resistors **134**, **135** and **136**. A portion of this current supplies the base of transistor **130** to maintain it conducting. This supervisory current through the lamp **133** is not sufficient to light it. If the lamp **133** is removed or opens, transistor **130** will cut off and trouble relay **131** will become deenergized. In summary, "-Trouble" will be indicated when relay **131** deenergizes opening normally closed contacts **151** for providing a trouble signal, this occurring from loss of pulses received from the line L, the loss of the lamp **133**, or the loss of the regulated positive voltage for the system.

The diodes **137** and **138** are connected to the anode of SCR **104** which is caused to conduct when a fire signal occurs. This places the diodes **137** and **138** at near ground level as the anode of SCR **104** would then be at a low voltage. The lamp **133** with its protective fuse circuit **140** will then light as almost full supply voltage is across it and resistor **134**, its dropping resistor. Also, "Trouble Relay " **131** will be locked out giving priority to the fire signal.

END-OF-LINE SENDER

The End-of-Line Sender **16** generates pulses and places them on the lines L connecting the detector **11** to the control unit **15**. The unit is connected to the line at the most remote detector. The operation is as follows: diode **141** provides protection against connecting the leads in reverse polarity. Transistor **142** is a "Unijunction Transistor" which, with resistor **143** and capacitor **144** forms an oscillator. The pulses are developed across resistor **145** and the divider formed by resistors **146** and **147**. The pulse voltage across resistor **147** is applied to the base of transistor **148**. The emitter current of **148** supplies enough drive to the base of transistor **149** to saturate it. Thus, almost the full 16V supply is placed across resistor **150**. The supply will be loaded by about 100 ma for the duration of the pulse. The pulse duration is set for about 500 microseconds and it occurs periodically every 500 milliseconds.

FIG. **4** shows a preferred structure of a typical detector **11** having sensing means **10** which is used to sense the presence of aerosols in the atmosphere and produce an output signal indicative of a fire condition. The sensing means includes a base number **160** which has an adjustable reference electrode **161** appropriately coupled or mounted thereto. Cylindrical housing **162** is fitted over the reference electrode **161**. A common electrode **163**, which is a bobbin shaped body of conductor having upper and lower surfaces A and B respectively, is fit into the housing **162**. On each of the surfaces of the cylindrical electrode **163** is deposited a small amount of radio-active material, which in the preferred embodiment, is Americium **241** and is designated by the reference **164**.

The reference chamber **20** is that volume disposed between the reference electrode **161** and the lower surface B of the common electrode **163**. The adjustment of the distance between reference electrode **161** and surface B sets up a reference potential. This is substantially isolated from the atmosphere such that no aerosols enter the chamber **20** and interfere with the current produced by the radio-active source **19**.

The sensing chamber **21** is formed between the upper surface A of the common electrode **163** and sensing electrode **168** mounted above the common electrode **163**. This chamber is substantially opened to the atmosphere and may receive aerosol particles present in the atmospheric medium.

The upper surface A of the common electrode **163** is recessed in the cylindrical housing **162** in order to deflect radiation emitted by the source **19** towards the sensing electrode **168**. The cylindrical housing **162** is composed of teflon material and serves as an absorber of alpha particles which may be emitted at angles away from the sensing electrode **168**. This cylindrical housing **162**, therefore, serves to columnate or direct the radio-active emissions toward the sensing electrode **168**. Another reason for the use of teflon in the construction of the cylindrical **162** is that the teflon has a very high insulative quality and facilitates the use of FET **23** to detect extremely low level changes in ionization potential due to presence of smoke aerosols.

A printed circuit board **165** is mounted about the housing **162** to the base **160** and includes the components of the electronic circuitry shown in FIG. **1**. The field effect transistor **23** is mounted to the board **165** and coupled to the common electrode **163** through a hole in the cylinder **162**.

To the base **160** is mounted a cover **166** for protecting the circuitry and internal components from dust and the like. Warning lamp **50** is coupled to the output of the circuitry on the printed circuit board **165**. The warning lamp **50** is mounted in the cover **166** and gives visual indication of a fire condition. This is convenient for checking where a fire or trouble condition exists in a specific chain of detectors. Over the cover **166** is mounted the sensing electrode **168** and between the electrode **168** and wind shield **170** is a screen **169** used to protect the sensing electrode and to permit the free flow of atmosphere into the sensing chamber **21**.

It can be seen from the drawing that the construction of the sensing unit **10** is simplified and that the reference electrode **161**, sensing electrode **168** and common electrode **163** may be coupled to the input of the detector circuit mounted on the printed circuit board **165** very readily. The chambers **21** and **20** are also designed for ease of manufacture because they are one next to the other rather than one inside of the other as in other detectors in the art. It is apparent from the construction of the chambers in the present invention that assembly time of the unit is greatly reduced and the efficiency of the device is unaffected.

The system shown in the present disclosure therefore provides for accurate sensing of a fire condition as well as warning of a malfunction in any of the units or a break in the transmission line between the central indication unit and any one of the sensing units remotely located. The system is provided with a safety feature for eliminating the condition whereby a false alarm is produced, and the construction of the sensing means has been greatly simplified in order to reduce the cost of manufacture and reduce maintenance cost by making the unit reasonably inexpensive and readily replaceable.

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

What is claimed is:

1. A fire detector including; ionization sensing means for increasing the level of an output signal relative to a normal threshold value in accordance with sensing the presence of smoke in the atmosphere, and detecting means selectively responsive to the output signal for generating an alarm control signal wherein the improvement comprises:

filter means effective if uninhibited for generating the alarm signal; and

inhibiting means including a voltage level detector governed by the output signal, operable to inhibit the filter means only if the output signal is within a normal voltage range,

whereby an alarm signal is generated when the output signal is above the voltage range as when smoke is present in the chamber or when the output signal is below the voltage range as when there is a malfunction in the ionization sensing means.

2. The fire detector of claim 1 wherein said detecting means comprises: a field effect transistor amplifier having its input governed by the output signal and switching means including a plurality of electronic gates energized in accordance with an output of the amplifier for generating said alarm output signal.

3. The fire detector of claim 2 wherein said inhibiting means includes: charging means coupled to a first of said gates, said first gate being responsive to the level of the output of the amplifier and said charging means to periodically trigger said gate upon each accumulation of energy beyond the level of said output of the amplifier.

4. The fire detector of claim 3 wherein said charging means includes a resistor and capacitor combination coupled to said first gate.

5. The fire detector of claim 4 wherein said filter means comprises: timing means responsive to the periodic triggering of said first gate producing a pulse for each occurrence.

6. The fire detector of claim 5 wherein said timing means includes a charging circuit coupled between a second and third of said gates, said charging circuit being discharged through said second gate when said second gate is in a conductance state, said second gate conductance state being governed by said triggering of said first gate; and the third gate being turned on to produce a signal when said charging rate is less than said triggering rate of said first gate.

7. The fire detector of claim 6 wherein said detecting means includes: a fourth of said gates, operative to produce said output alarm signal in response to the conductance state of said third gate.

8. A system as defined in claim 1 further comprising: centrally located control means including line wires coupled to each of a plurality of said fire detectors for indicating said alarm condition.

9. A system as defined in claim 8 wherein said indicating means comprises: current sensitive means responsive to a change in current occasioned by the occurrence of said alarm signal for providing said indication including a relay energized in accordance with said current increase.

10. A system as defined in claim 8 further comprising: an end of line code sender connected across the line wires for terminating a line circuit connecting the detectors to the centrally located control means including:

an oscillator powered by energy applied to the line wires for generating pulses for transmission over the line wires to the centrally located control means, and

centrally located receiver means responsive to said pulses for indicating a trouble condition upon the cessation of pulses.

11. A system as defined in claim 10 wherein said receiver means comprises:

switching means having a conductance state in accordance with said pulsed energy signals,

timing means including a resistor and capacitor charging circuit discharged each time said switching means is in its conductance state, said charging circuit having a discharge time greater than the normal frequency of said pulsed energy; and

means responsive to a charged condition of said charging means for indicating a trouble condition upon the cessation of pulses.

12. The fire detector of claim 1 wherein said ionization sensing means comprises: two ionization chambers coupled serially across a source of low voltage including a reference chamber and a measuring chamber, said reference chamber being substantially isolated from smoke particles establishing a reference potential for said detector and said measuring chamber serially coupled adjacent to said reference chamber for producing a change in the level of said reference potential thereby providing said output signal.

13. The fire detector of claim 1 comprising:

a base member;

a cylindrical tube of insulative material mounted thereto;

a common electrode plate secured coaxially within said tube, said electrode coupled to said detector means;

a reference electrode substantially parallel with said common electrode movably mounted to said base for establishing the reference potential in accordance with the spacing of said common electrode and said reference electrode;

a measuring electrode mounted to said base at the opposite end of said tube in spaced relation with the opposite side of said common electrode, said measuring electrode having openings therein for admitting smoke particles.

14. The fire detector of claim 13 wherein said ionization chamber includes a source of alpha particle emitting material disposed on each side of said common electrode for ionizing the atmosphere with said chambers and producing an ionization current in accordance with a potential imposed across the reference and measuring electrodes.

15. The fire detector of claim 14 wherein said measuring electrode and the associated side of said common electrode are in a spaced relation such that the walls of the tube tend to columnate the alpha particles towards said measuring electrode for uniform ionization of the atmosphere.

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