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ELECTRONIC SMOKE DETECTOR AND FIRE ALARM

Filed Jan. 13, 1964

2 Sheets-Sheet 1

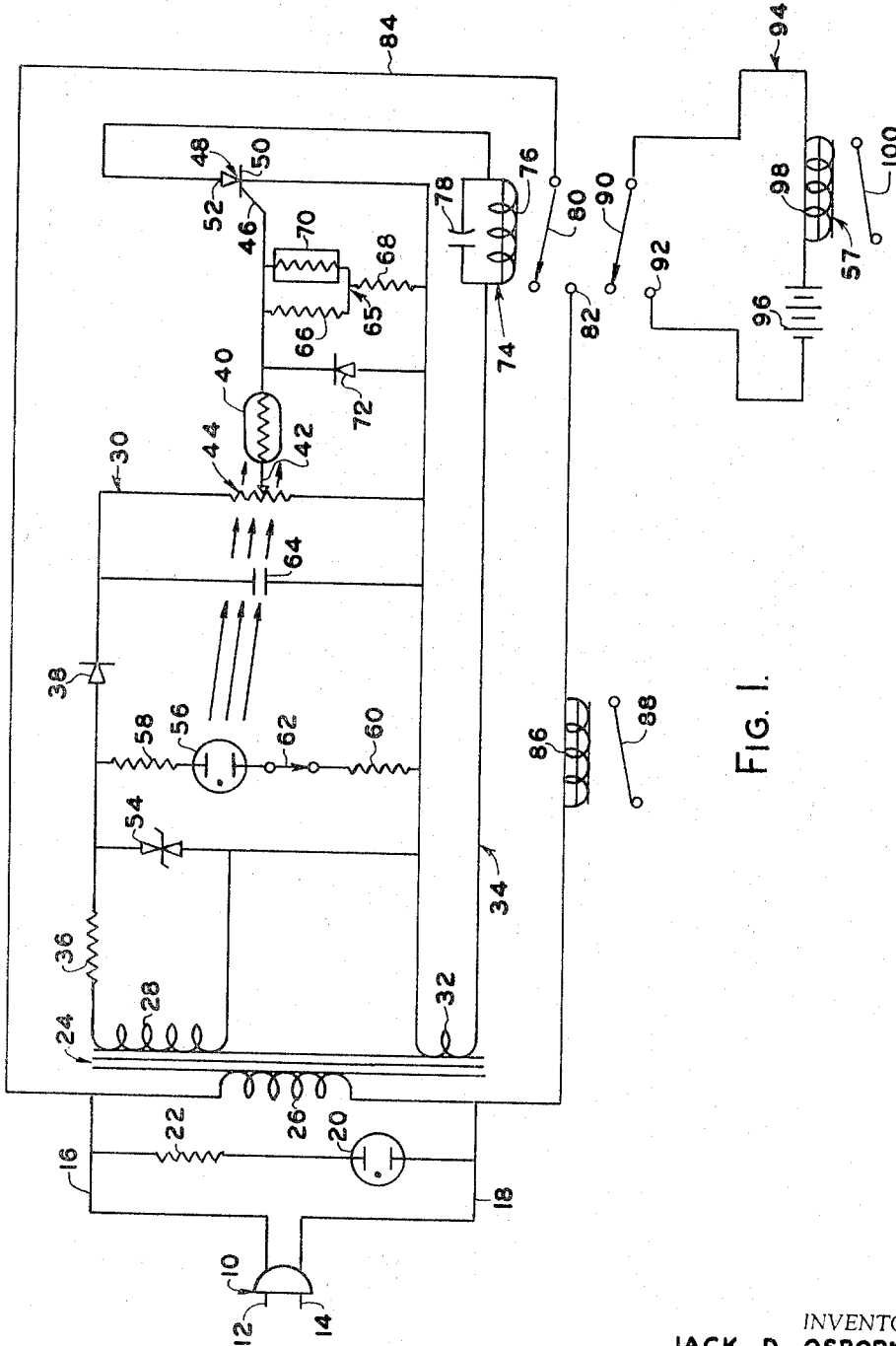


FIG. 1.

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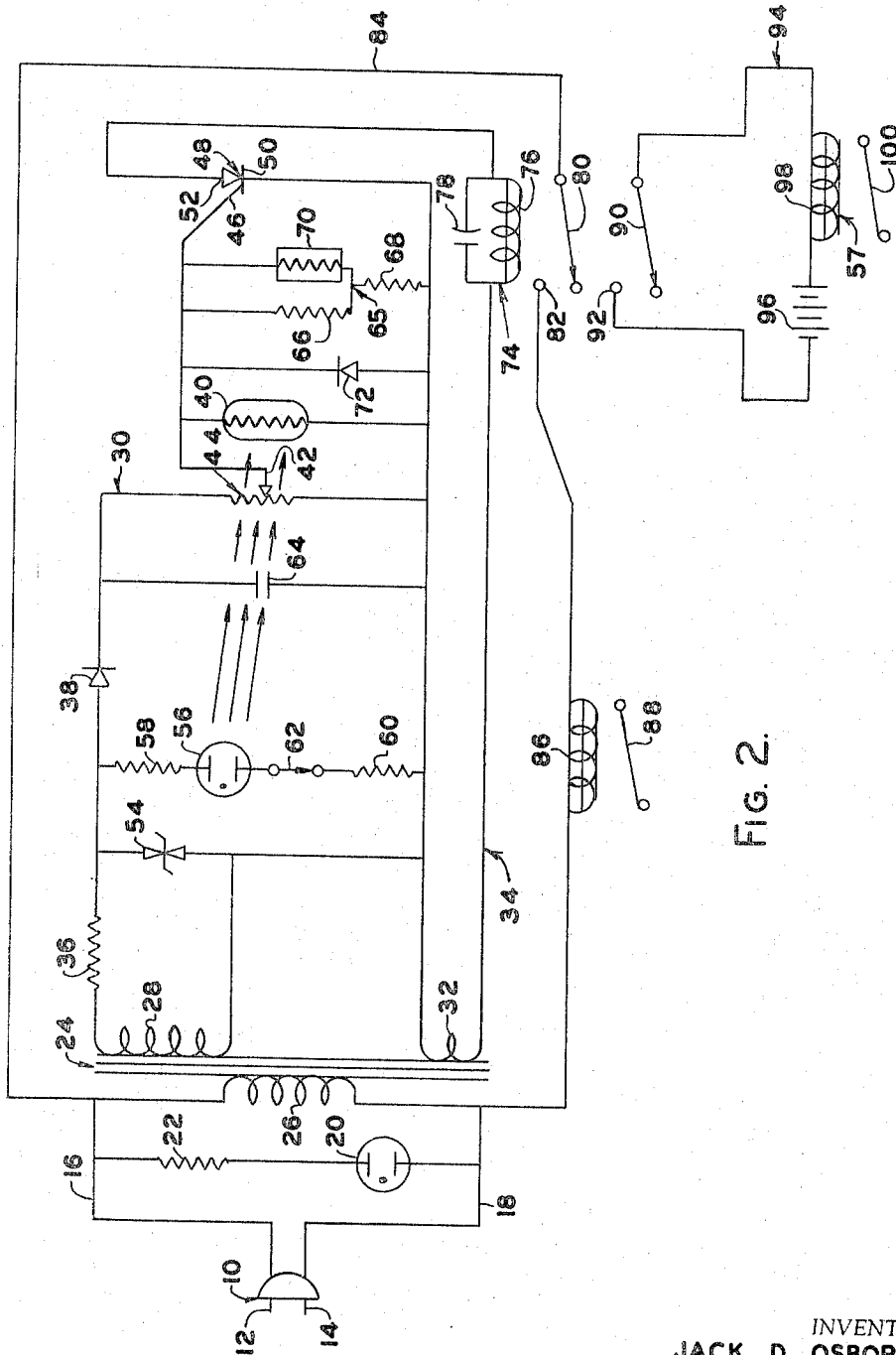


FIG. 2.

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ELECTRONIC SMOKE DETECTOR AND FIRE ALARM

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The present invention relates to fire alarms and particularly to an electronic control circuit for producing an audible alarm in the presence of smoke or fire and more particularly to such a device incorporating a solid state device for its major control function.

Heretofore fire alarms have employed amplifiers that in time become unstable. Such devices incorporating a smoke detecting means required bulky constant voltage transformers thereby adding greatly to the space requirements and cost of such devices. Further, such devices have not been heretofore provided with satisfactory means for indicating whether or not the device is functioning properly and to insure its operation in the event of a power line failure.

The present invention provides a fire and smoke detecting device which is operable to sound an audible alarm upon the presence of either smoke or fire within the vicinity of the device. The use of a solid state device for the major control function of the device greatly increases reliability and substantially decreases space requirements and costs in manufacturing the device. The device is provided with means producing an audible alarm in the event of failure of certain internal components or power line failure.

It is an object then of the present invention to reduce the cost of manufacturing combination smoke detecting and fire alarm devices and to reduce the space requirements of such devices by utilizing a solid state device as the major control function for such devices.

It is another object of the present invention to increase the reliability of combination smoke detecting and fire alarm devices by providing means operable to sound an audible alarm upon failure of certain components of the device and upon power line failure.

It is still another object of the present invention to improve electrically actuated fire alarm devices by providing means electrically isolating the detection portions of the device from power line voltage.

Still further objects and advantages of the present invention readily will occur to one skilled in the art to which the invention pertains upon reference to the following drawings in which like reference characters refer to like parts throughout the several views and in which:

FIG. 1 is a diagrammatic illustration of a preferred embodiment of the present invention, and

FIG. 2 is a diagrammatic illustration of a preferred modification of the present invention.

Description

Now referring to the drawings for a more detailed description of the present invention an input plug 10, designed for insertion into an ordinary A.C. wall receptacle (not shown) is provided with prongs 12 and 14 which are connected to power lines 16 and 18 respectively. A neon lamp 20 and a current limiting resistor 22 are series connected across lines 16 and 18. The lamp 20 is provided to indicate whether or not sufficient line voltage is present across lines 16 and 18 to operate the device.

A transformer generally designated at 24 comprises a primary winding 26 connected across lines 16 and 18, a first secondary winding 28 connected into a control circuit generally indicated at 30 and a second secondary winding 32 connected into an alarm relay circuit generally indicated at 34 as shown.

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The control circuit 30 comprises a dropping resistor 36, a rectifying diode 38, a photoconductive cell 40 having one terminal connected with the adjustable tap 42 of a potentiometer voltage divider 44. The other terminal of the photoconductive cell 40 is connected to the gate 46 of a silicon controlled rectifier 48. The cathode 50 and anode 52 of the silicon controlled rectifier 48 are connected into the alarm relay circuit 34 as shown.

The control circuit 30 further comprises a double anode Zener diode 54 connected across the control circuit 30 between the A.C. side of rectifying diode 38 and the opposite line of the transformer secondary 28. The double anode Zener diode 54 acts as a clipper regulator to provide A.C. voltage level regulation to a neon lamp 56 connected in series with limiting resistors 58 and 60 and normally closed thermostat switch 62 which are also connected across the control circuit 30 as shown.

A capacitor 64 is connected across the control circuit 30 as shown to filter out fluctuations in the pulsating D.C. provided by diode 38.

A temperature compensating series parallel network 65 is connected between the cathode 50 and the input gate 46 of silicon controlled rectifier 48 and comprises resistors 66 and 68 and negative temperature coefficient thermistor 70. A diode 72 is connected across the control circuit 30 shunting the temperature compensating network 65 as shown.

A relay 74 comprises a coil 76 series connected with the transformer secondary 32, the cathode 50 and the anode 52 of the silicon controlled rectifier 48. A capacitor 78 shunts the coil 76. The relay 74 further comprises a first switch armature 80 engageable with a fixed contact 82 to close an alarm circuit generally designated as 84.

The alarm circuit 84 is connected across lines 16 and 18 and further comprises a coil 86 and a clapper armature 88 operable upon coil 86 being energized to strike the side of the box (not shown) of the device to sound an audible alarm.

The relay 74 further comprises a second switch armature 90 engageable with a fixed contact 92 to close an auxiliary alarm circuit generally designated at 94. The auxiliary alarm circuit 94 comprises a battery 96 series connected to a coil 98. An armature clapper 100 is disposed to be actuated upon energization of the coil 98 to strike the side of the box (not shown) of the device to sound an audible alarm.

In standby condition the voltage potential across the potentiometer 44 is impressed through the cell 40 upon the gate 46 to the cathode 50 of the silicon controlled rectifier 48 causing the rectifier 48 to conduct in half cycles between the cathode 50 and the anode 52, resulting in a pulsating D.C. current. This energizes coil 76 to retain the switch armatures 80 and 90 in a position opening alarm circuit 84 and auxiliary alarm circuit 94 respectively.

The Zener diode 54 provides an output to the neon lamp 56 in the form of a clipped sine wave of constant voltage so that neon lamp 56 provides a constant level light source whenever thermostatic switch 62 is closed and regardless of line voltage fluctuations in the control circuit 30.

The photoconductive cell 40 is preferably a cadmium sulfide or cadmium selenide cell and is positioned to receive light energy emitted from neon lamp 56. The resistance of the photoconductive cell 40 is inversely related to the amount of light striking its sensitive portion so that in the presence of smoke or other particles of a predetermined concentration intermediate the lamp 56 and the cell 40 the resistance of the cell 40 will increase a sufficient amount to result in a decrease in voltage potential between the gate 46 and the cathode 50 of the silicon controlled rectifier 48. This decrease in voltage potential will cause

the silicon controlled rectifier 48 no longer to conduct, thus de-energizing the relay coil 76. The switch armatures 80 and 90 are spring loaded so that with the relay coil 76 de-energized the alarm circuit 84 and the auxiliary alarm circuit 94 are energized to produce simultaneous audible alarms.

The thermostat switch 62 as heretofore explained is normally closed and could be either bimetallic or an expansive alloy operable to open upon being heated to a predetermined temperature. In the event of a fire, the switch 62 would open, de-energizing the lamp 56 and thereby decreasing the light energy received by the photoconductive cell 40 and energizing the alarm circuit 84 and auxiliary alarm circuit 94 as heretofore explained.

It is apparent that although it has been preferred to describe the control circuit 30 of the present invention as including a silicon controlled rectifier 48 with the proper connections and biases, a NPN or PNP transistor could be used as well. In addition, a binistor, a trigistor or a transwitch could be used in place of the silicon controlled rectifier 48 without departing from the intended scope of the present invention.

It is to be noted that the circuitry of the present invention provides an important measure of safety by providing a means of sounding an audible alarm in the event of component and/or power failure. In the event that any of the components of the control circuit 30 open so that they do not conduct the alarm will sound since the relay coil 76 will be de-energized to energize the alarm circuit 84 and auxiliary alarm circuit 94 as heretofore described. If the primary winding 26 of the transformer 24 or the relay coil 76 itself should malfunction and not conduct, again the relay coil 76 would be de-energized and alarm circuits 84 and 94 would be energized.

In the event the resistors 60 and 66, thermistor 70, capacitor 64, diode 72, potentiometer 44, lamp 56, Zener diode 54 or secondary winding 28 short circuit, the effect would be a reduction in voltage at the gate 46 with respect to the cathode 50 of the silicon controlled rectifier 48 causing the relay coil 76 to de-energize to sound the alarms. If the secondary winding 32, primary winding 26, relay coil 76 or capacitor 78 should short circuit, the coil 76 will be de-energized to actuate the alarm.

In the event of power failure, the relay coil 76 would be de-energized to energize the auxiliary alarm circuit 94 and actuate the battery energized coil 98 and clapper 100.

FIG. 2 illustrates a preferred modification in which the photoconductive cell 40 shunts the gate 46—cathode 50 of the silicon controlled rectifier 48. Light striking the cell 40 from the lamp 56 then in this modification would reduce the resistance through the cell 40 and shunt out sufficient voltage through the gate 46 and cathode 50 of the rectifier 48 to cause non-conduction of the rectifier 48 through the anode 52—cathode 50 circuit. Thus, the relay coil 76 in this modification would normally de-energize and the switch armatures 80 and 90 would be spring loaded to normally be in a position disengaging from fixed contacts 82 and 92 respectively to de-energize alarm circuit 84 and auxiliary alarm circuit 94 respectively.

In this embodiment, if the light intensity received by the cell 40 is reduced either by the presence of smoke or upon opening of the switch 62 as explained above, the resistance through the cell 40 would increase to increase the gate voltage to the silicon controlled rectifier 48 sufficient to energize the relay coil 76. Energizing the coil 76 in this modification would close switch armatures 80 and 90 to energize the alarm circuits 84 and 94 respectively to sound the alarms.

It is apparent that a combination fire and smoke alarm device has been provided in which reliability has been greatly increased and in which space and cost requirements have been minimized.

Although I have described but two embodiments of the present invention, it is apparent that many changes and modifications can be made without departing from the

spirit of the invention as expressed by the scope of the appended claims.

I claim:

1. An alarm system adapted for connection to a source of electrical power comprising
 - (a) An alarm circuit adapted for connection to said source of electrical power and including switching means and means producing an alarm upon closing of said switching means,
 - (b) an alarm relay circuit including an inductor and operable to close said switching means upon de-energizing of said inductor,
 - (c) a control circuit including a solid state switch device series connected with said inductor and operable to energize and de-energize said inductor in response to changes in the voltage impressed upon the input side of said switch device,
 - (d) said control circuit further comprising a gaseous incandescent lamp and means regulating the voltage to said lamp to produce a substantially constant light source from said lamp, a photoconductive cell adjacent said lamp to receive light energy emitted therefrom and being series connected to the input side of said solid state switch device whereby variations in the light intensity received by said photoconductive cell caused by particles intermediate said lamp and said cell will produce a variation in the voltage impressed upon the input side of said solid state switch device, and a normally closed thermostat switch series connected with said switch and being operable to open upon being heated to a predetermined temperature.
2. The system as defined in claim 1 and in which said voltage regulating means comprises a double anode Zener diode.
3. The system as defined in claim 1 and including
 - (a) an auxiliary alarm circuit adapted for connection to a second source of electrical power and including a switching means and means producing an alarm upon closing of said switching means, and
 - (b) said last mentioned switching means being operably connected to said inductor to be actuated to a closed position upon de-energization of said inductor.
4. The system as defined in claim 1 and in which said solid state switch device comprises a silicon controlled rectifier having an anode-cathode circuit connected with said inductor and a gate connected with said photoconductive cell.
5. An alarm system adapted for connection to a source of electrical power and comprising:
 - (a) an alarm circuit adapted for connection with said source of electrical power including switching means and means producing an alarm upon actuation of said switching means;
 - (b) control means adapted for connection with said source of electrical power for actuating said switching means and comprising a solid state switching device operably connected to said switching means to actuate said switching means upon a predetermined change in the voltage on the input side of said solid state switching device; and
 - (c) temperature responsive means connected to the input side of said solid state switching device and being operable to vary the voltage impressed thereon in response to changes in the temperature in the proximity of said alarm system;
 - (d) wherein said temperature responsive means comprises:
 - (1) a gaseous incandescent lamp and means regulating the voltage to said lamp to produce a substantially constant light source from said lamp;
 - (2) a photoconductive cell adjacent said lamp to receive light energy emitted therefrom and being electrically connected to the input side of said solid state switching device; and

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(3) a thermostat switch operable to de-energize said lamp upon said switch being heated to a predetermined temperature.

6. An alarm system adapted for connection to a source of electrical power comprising:

(a) an alarm circuit adapted for connection to said source of electrical power and including switching means and means for producing an alarm upon closing of said switching means;

(b) an alarm relay circuit including an inductor and operable to close said switching means upon de-energization of said inductor;

(c) a control circuit including a solid state switch device series connected with said inductor and operable to energize and de-energize said inductor in response to changes in the voltage impressed upon the input of said solid state switch device;

(d) said control circuit further comprising temperature responsive means electrically connected to the input of said solid state switch device and operable to change the voltage impressed thereon in response to changes in the temperature in the proximity of said temperature responsive means; and

(e) wherein said temperature responsive means comprises:

(1) a gaseous incandescent lamp and means regulating the voltage to said lamp to produce a substantially constant light source from said lamp;

(2) a photoconductive cell adjacent said lamp to receive light energy emitted therefrom and being electrically connected to the input of said solid state switch device; and

(3) a thermostat switch operable to de-energize said lamp upon said thermostat switch being heated to a predetermined temperature.

7. The alarm system as defined in claim 5 and in which said control means further comprises

(a) a source of substantially constant light intensity,

(b) means adjacent said source and being operable to vary the voltage impressed upon the input side of said solid state switching device in response to changes in the light intensity intermediate said source and said last mentioned means.

8. The system as defined in claim 5 and including

(a) an auxiliary alarm circuit including a switching means operably connected to said solid state switching device and means producing an alarm upon actuation of said last mentioned switching means, and

(b) said second mentioned alarm producing means including a second source of electrical power for energizing said auxiliary alarm circuit.

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9. The alarm system as defined in claim 5 and in which said control means further comprises

(a) a source of substantially constant light intensity.

(b) means adjacent said source and being operable to vary the voltage impressed upon the input side of said solid state switching device in response to changes in the light intensity intermediate said source and said last mentioned means

(c) a light intensity responsive means connected to the input side of said solid state switching device and being operable to vary the voltage impressed thereon in response to changes in the light intensity in the proximity of said light intensity responsive means.

10. The system as defined in claim 7 and in which said light intensity responsive means comprises

(a) a gaseous incandescent lamp and means regulating the voltage to said lamp to produce a substantially constant light source from said lamp, and

(b) a photoconductive cell adjacent said lamp to receive light energy emitted therefrom and being electrically connected to the input side of said solid state switching device whereby variations in the light intensity received by said photoconductive cell caused by particles intermediate said lamp and said cell will produce a variation in the voltage impressed upon the input side of said solid state switching device.

11. The system as defined in claim 6 and in which said control circuit further comprises a light intensity responsive means electrically connected to the input side of said switch device and operable to change the voltage impressed thereon in response to changes in the light intensity in the proximity of said light intensity responsive means.

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