MULTI-PURPOSE ALARM SYSTEM
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The present invention relates to alarm systems, particularly to electronic control circuits to be used singly or in multiples for producing an audible alarm in the presence of an elevated temperature, smoke or from the actuation of burglar alarm switches and more particularly to such a system incorporating a solid state device for its major control function.

Hereof, fire alarm systems have employed holding relay or amplifiers that in time become unstable and smoke detectors where used required bulky constant voltage transformers which added greatly to the space requirements and costs of such systems.

Further, previous fire alarm systems have utilized normally open thermostatic switches operable to sound the alarm upon the switches being warped to an open position. Such switches need not be enclosed to insure proper operation as the two mating surfaces of the contacts keep the required contact surface clean. The build up of dust or dirt will not materially affect the proper function of the thermostats and response time will be considerably faster than the enclosed normally open thermostats.

Such a system also has the advantage that normally closed thermostatic heat sensors may be arranged in a series circuit containing a plurality of individual thermostats and any one of them opening will break the circuit and cause the alarm to go off. The series connected thermostats or switches also permit the use of other normally closed switches or conductive paths to be used as a burglar alarm system.

In a system having thermostats placed at different points, it has been found that a fixed temperature setting thermostat is not entirely satisfactory at each of the necessary points because of the wide range of ambient temperature which may occur at some of these points due to seasonal changes and for other reasons. If for instance a fixed temperature setting thermostat were positioned within the attic of a home or the garage, the thermostat would be slow to respond in winter and could produce a false alarm especially in the attic or the like during a hot day in the summer. In winter the attic or garage might be as low as a minus 10 or 15 degrees and a fire would have to raise the ambient temperature to approximately 120 degrees before the thermostat would operate. To prevent this, a higher setting thermostat might be used but this would further aggravate the condition of slow response in winter.

The present invention further provides an alarm system which is provided with means operable to sense a sudden rise in temperature and to produce an audible alarm when the rate of rise exceeds a predetermined setting and regardless of the ambient temperature. In the event that the rise is very slow, a fixed temperature thermostat acts the alarm.

The present invention further provides an alarm system which utilizes a separate power source to energize the alarm circuit so that the system is not dependent on power line voltage. Further, the means are provided to sound an alarm in the event of power line failure.

It is an object then of the present invention to improve alarm systems by providing an electronic control circuit for systems having a plurality of series connected normally closed temperature sensing switches and means operable to sound an alarm upon any one of said switches being heated to an open position.

It is another object of the present invention to improve multi-purpose alarm systems by providing circuitry for such a system having an alarm producing circuit and means energizing said circuit in the presence of smoke or fire and upon the disconnection of said means as by unauthorized entry or the like.

It is another object of the present invention to improve multi-purpose alarm systems by providing such a system which will serve as a fire alarm, a smoke detector, a burglar alarm and which will also warn of power line failure.

It is still another object of the present invention to improve fire alarm systems by providing normally closed fixed setting thermostat switches actuating an audible alarm upon any of said switches being heated to a predetermined temperature and means sensing the rate of temperature increase and operable to produce an alarm upon the rate of temperature increase exceeding a predetermined value.

It is yet another object of the present invention to reduce the cost of providing a reliable multi-purpose alarm system by providing such a system utilizing rechargeable batteries as a power source and a battery charger connected with the batteries.

Many other advantages and objects of the present invention will be readily apparent 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 view of a typical alarm system employing the present invention.
FIG. 2 is a diagrammatic view of a preferred embodiment of the fire alarm portion of the present invention.
FIG. 3 is a diagrammatic view similar to FIG. 2 but illustrating the rate of temperature increase sensing means of the present invention.
FIG. 4 is a diagrammatic view of another preferred embodiment of the present invention.
FIG. 5 is a diagrammatic view of a preferred battery charging means of the present invention, and
FIG. 6 is a diagrammatic view similar to FIG. 1 but illustrating another preferred embodiment of the present invention.

Description

Referring now to the drawings for a more detailed description of the present invention, FIG. 1 illustrates a typical multi-purpose alarm system embodying the present invention, as comprising a fixed thermostat fire alarm system 10, a rate of rise fire alarm system 12, and a smoke detector and power failure indicating system 14 all connected in parallel. Each of the systems 10, 12 and 14 are respectively provided with a plurality of series connected normally closed thermostat switches 16. Series connected with the thermostat switches are a smoke detector 18, a rate of rise detector 20, and a power failure detector 22.

With the thermostat switches 16 a predetermined point at any desired point normally closed switches 18 of the type ordinarily used in burglar alarm systems may be provided. A circuit 20 series connected with the thermostat switches 16 and
switches 18 may be provided at any desired point and comprises a conductive pattern provided in a substrata such as glass 22 so that if the glass 22 is broken, the circuit 20 is opened to sound an alarm as will be more clearly explained below.

Now referring to FIG. 2, a pair of fixed thermostat fire alarm systems 10 are illustrated as being parallel connected. The system 10 comprises an alarm circuit and a control circuit. The alarm circuit comprises a battery 24, preferably a three volt unit (two 1.5 volt units connected series), having a positive terminal 26 and a negative terminal 28. The alarm circuit further comprises an electromagnetic interrupting type coil 30 and the anode 32 and cathode 34 of a silicon controlled rectifier 36 connected in series across the terminals 26 and 28 of the battery 24. An armature clapper 38 is disposed within the magnetic field of the coil 30 so that upon energization of the coil 30 an interrupted buzzer alarm is sounded.

The control circuit comprises a limiting resistor 40, the gate 42 and the cathode 34 of the silicon controlled rectifier 36 series connected between the center tap 44 and the negative terminal 28 of the battery 24. A normally closed normally open thermostat switch 16 shunts the gate 42-cathode 34 circuit of the silicon controlled rectifier 36. Although it has been preferred to illustrate only one switch 16 in FIG. 2, it is apparent that a plurality of series connected switches 16 as well as normally closed switches 18 and circuits 20 can be provided as illustrated in FIG. 1.

In the standby condition with the thermostat switches 16, switches 18 and circuits 20 all closed, the gate 42-cathode 34 circuit of the silicon controlled rectifier 36 is shunted and the rectifier 36 will be non-conductive with reference to the anode 32-cathode 34 circuit. This in effect provides an open switch in the alarm circuit and the coil 38 will remain de-energized.

In the event of fire or a sufficient rise in the temperature one or more of the thermostat switches 16, preferably being of a bimetal construction, will warp open and remove the shunt from the gate 42-cathode 34 circuit of the silicon controlled rectifier 36. With the shunt removed from the gate 42-cathode 34 circuit, the voltage therethrough will increase sufficiently to produce conduction through the anode 32-cathode 34 circuit of the silicon controlled rectifier 36, thus energizing the coil 30 to sound an audible alarm.

Any number of normally closed thermostat switches 16, burglary detection switches 18 or conductive paths 20 may be connected in series to provide a combination fire alarm and burglary alarm. Also, any number of fire alarm systems 10 may be connected in parallel across like points 46 and 48 as shown in FIG. 2 with the result that all systems 10 so connected would respond with an audible alarm should any one of the switches 16, 18 or paths 20 be opened or broken.

Now referring to FIG. 3 for a more detailed description of the rate of rise fire alarm system 12 of the present invention, it is therein illustrated as comprising an alarm circuit and a control circuit. The alarm circuit comprises a battery 50, again preferably a three volt unit, having a positive terminal 52 and a negative terminal 54. The alarm circuit further comprises an electromagnetic interrupting type coil 56 and the anode 58 and cathode 60 of a silicon controlled rectifier 62 connected in series across the alarm system terminals 52 and 54 of the battery 50. An armature clapper 64 is disposed within the magnetic field of the coil 56 so that upon energization of the coil 56 an interrupted buzzer alarm is sounded.

The control circuit comprises a thermostir 66, a variable resistor 68, and the gate 70 and cathode 60 of the silicon controlled rectifier 62 connected between the center tap 72 and the negative terminal 54 of the battery 50. A series connected thermostat 74 and thermostat switch 16 shunt the variable resistor 68 and the gate 70-cathode 60 circuit of the silicon controlled rectifier 62. Again although it has been preferred in FIG. 3, it is apparent that a plurality of series connected switches 16 and normally closed switch 18 can be provided as illustrated in FIG. 1. Also if desired, circuits 20, described and illustrated with reference to the fire alarm system 10, can also be connected in series with the switches 16 and 18.

The thermostors 66 and 74 are preferably of the negative temperature coefficient type having like resistances at a given temperature and like temperature response curves. Thermostat 66 is preferably mounted outside of the box 76 of the system 12 as illustrated diagrammatically in FIG. 1, and the thermostat 74 is mounted inside the box 76 again as shown diagrammatically in FIG. 1. Thermostat 66 is preferably thermally insulated from the box 76 so that it will rapidly respond to a change in ambient temperature. Thermostat 74 is also preferably thermally insulated with respect to the outside of the box 76 and the thermostat 66 so that it will respond very slowly to temperature changes outside of the box 76.

In the standby condition with the switches 16, switches 18 and circuits 20 if provided all closed and with the variable resistor 68 properly adjusted, the voltage impressed across the gate 70-cathode 60 circuit of the silicon controlled rectifier 62 is too low for conduction of the rectifier 62 between the anode 58 and cathode 60 so that the coil 56 is de-energized.

In the event of a sudden rise in temperature outside of the box 76, the thermostat 66 will respond accordingly with a corresponding decrease in resistance. Thermostat 74 disposed within the box 76 and thermally insulated therefrom will not respond immediately to the temperature increase outside the box 76. The resistance differential of the thermostats 66 and 74 will increase the voltage impressed upon the gate 70 and the silicon controlled rectifier 62 will conduct between the anode 58 and cathode 60 to energize the coil 56 and sound an audible alarm.

In the event of a slow rise in temperature of the air surrounding the box 76, the resistances of thermostats 66 and 74 will decrease by a like amount. Thus the voltage impressed upon the gate 70 will remain substantially constant and the silicon controlled rectifier 62 will not fire. In the event that the temperature even though rising slowly reaches a predetermined setting, one or more of the switches 16 will be warped open and the coil 56 will be energized to sound an alarm substantially as described with reference to FIG. 2.

Any number of normally closed switches 16, burglary detection switches 18 or conductive paths 20 may be connected in series to provide a combination rate of rise fixed temperature setting fire alarm and burglary alarm. Also, any number of fire alarm systems 12 may be connected in parallel across terminals 78 and 80 or any number systems 12 can be connected in parallel with the systems 10 in any desired combination as illustrated in FIG. 1 by connecting points 46 and 48 of the systems 10 to terminals 78 and 80 respectively of the systems 12 also illustrated in FIG. 1.

Now referring to FIG. 4 for a more detailed description of the smoke detector and power failure indicating system 14 of the present invention, it is therein illustrated as comprising a constant light producing portion 82 and an alarm producing portion 84. The smoke detector producing portion 82 comprises an input line plug generally designated at 84 and adapted for insertion into an ordinary A.C. wall receptacle (not shown). The plug 84 is provided with prongs 86 and 88 respectively connected to power lines 90 and 92. A limiting resistor 94 is provided in series connected between power line 90 and a limiting resistor 96 and a neon lamp 98 are series connected across lines 90 and 92. A double anode zener diode 100 connected across lines 90 and 92 provides voltage regulation for the neon lamp 98. It is apparent that the double anode zener diode...
The diode 144 rectifies the A.C. voltage at the secondary winding 142 and provides a pulsating D.C. current to the output terminals 148 and 150. The resistor 146 is a current limiting resistor for providing a trickle charge to terminals 148 and 150. By connecting the terminals 148 and 150 to the appropriate leads for parallel connection to any one of the systems 10, 12 or 14 whether these systems are used individually or in combination, the battery charger illustrated in FIG. 5 will keep all of the batteries of the various systems charged.

It is apparent that with appropriate modifications the limiting resistor 146 could be replaced by a variable resistor without departing from the present invention. It is also apparent that the battery charger illustrated in FIG. 5 could be used to replace the batteries of the systems 10, 12 and 14. By connecting the terminals 148 and 150 to either the terminals 46 and 48 of the system 10, the terminals 78 and 80 of the system 12, or the terminals 126 and 128 of the system 14 the batteries of the system could be eliminated.

While it has been preferred to describe the various systems of the present invention as utilizing silicon controlled rectifiers as the control means, it is apparent that other solid state devices can be used in the systems as well. To illustrate this FIG. 6 discloses diagrammatically a fixed temperature element bias circuit of the system 210 similar to the alarm system 10 but utilizing an NPN type transistor 236 in place of the silicon controlled rectifier. The other components of the circuit are the same as those in the system 10 and the system 210 functions substantially similar to the system 10.

With all of the switches 16 closed, the voltage potential across the base 242-emitter 234 circuit of the transistor 236 is sufficiently low to produce non-conduction across the collector 232-emitter 234 circuit and thus retain the coil 30 non-energized. With any one of the switches 16, 18 or paths 20 open, the shunt is removed from the base 242 and the transistor 236 will conduct with respect to the collector 232-emitter 234 circuit to energize the coil 30 and sound the alarm.

It is apparent that a PNP type transistor could be used in place of the NPN type transistor 236 if the proper battery polarity is observed. Also any type of transistor, including a field effect transistor, or a solid state device which is part of a substrate to form a miniature or microcircuit could be used in any of the described systems with low base or gate current and low leakage between the anode and cathode or emitter and collector being the only critical parameters for the battery operated alarms. Any of the other components shown could also be part of a substrate to form a miniature or microcircuit without departing from the spirit of the invention.

It is also apparent that although several modifications of the present invention have been described, many other changes and modifications can be made without departing from the spirit of the invention as expressed by the appended claims.

We claim:
1. An alarm system comprising:
(a) a plurality of parallel connected alarm circuits each one of which comprises:
   (1) a source of electrical direct current power,
   (2) alarm producing means in series with normally off solid state switching means across said source of direct current power, said solid state switching means including a control element and a controlled junction just mentioned, said control element being a non-conductive state as a result of a bias applied to the control element of said solid state switching means,
   (3) control means including a plurality of normally low impedance elements in series in the control element circuit to bias said control element means so as to normally hold said controlled junction in a non-conductive state,
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(4) whereby said switching means is turned on when the impedance of any one of said impedance elements in said control means increases above a predetermined value;

(b) said alarm circuits being connected in parallel so that when any one of said solid state switching means controlled junction is turned to a conductive state it causes all the alarm producing means to be activated.

2. The alarm system of claim 1 wherein said low impedance elements comprise at least one normally closed heat responsive switch adapted to open at a predetermined temperature.

3. The alarm system of claim 1 wherein said low impedance elements comprise a plurality of series connected heat responsive elements each adapted to have an impedance increasing with increasing temperatures.

4. The alarm system of claim 1 wherein at least one of said low impedance elements comprises a light responsive means normally exposed to light energy and adapted to increase in impedance in response to a decrease in the light energy impinging thereupon.

5. The alarm system of claim 1 wherein at least one of said low impedance elements is a heat responsive resistor adapted to increase in impedance in response to an increase in temperature.

6. The alarm system of claim 5 wherein said low impedance element comprises a first heat responsive resistor in contact with the ambient and a second heat responsive resistor substantially thermally insulated from the ambient, said first and second heat responsive resistors forming a bridge network adapted to normally bias said solid state switching means control element so as to hold the controlled junction thereof to a non-conductive state and to turn said switching means controlled junction to a conductive state when the resistance of any one of said heat responsive resistors decreases below a predetermined value.

7. The alarm system of claim 1 wherein at least one of said low impedance elements comprises a breakable conductive path.

8. The alarm system of claim 4 wherein the light energy impinging upon said light responsive means is produced by a light bulb placed across an ordinary alternating current power line, whereby in the event of loss of normal alternating current power, said alarm producing means are turned on.

9. The alarm system of claim 1 wherein said solid state switching means is a silicon controlled rectifier having its anode-cathode circuit in series with said source of direct current electrical power and said alarm producing means and its gate-cathode circuit normally biasing said anode-cathode circuit in a non-conductive state, a circuit shunting said gate-cathode circuit including said low impedance element, whereby when the impedance of said low impedance element is increased beyond a predetermined value said gate-cathode circuit is no longer shunted and said anode-cathode circuit is turned on.

10. The alarm system of claim 1 wherein said solid state switching means is a transistor with its collector-emitter circuit in series with said source of direct current electrical power and said alarm producing means and its base-emitter circuit normally biasing said collector-emitter circuit in a non-conductive state, a circuit shunting said base-emitter circuit including said low impedance element, whereby when the impedance of said low impedance element is increased beyond a predetermined value, said base-emitter circuit is no longer shunted and said collector-emitter circuit is turned on.

11. The alarm system of claim 10 wherein said source of electrical direct current power is a rechargeable battery normally maintained fully charged by a battery charger connected to a source of normal a.c. power, whereby said alarm system is prevented from becoming disabled as a result of loss of normal a.c. power.

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