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Lawton

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[54] **ANNUNCIATOR CIRCUIT**

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[52] **U.S. Cl.**..... **340/213 R,** 340/213.1, 340/415, 340/248 R

[51] **Int. Cl.** **G08b 23/00**

[58] **Field of Search**..... 340/213 R, 252 R, 256, 340/248 R, 255, 415, 213.1; 317/9 D, 36 TD; 200/167

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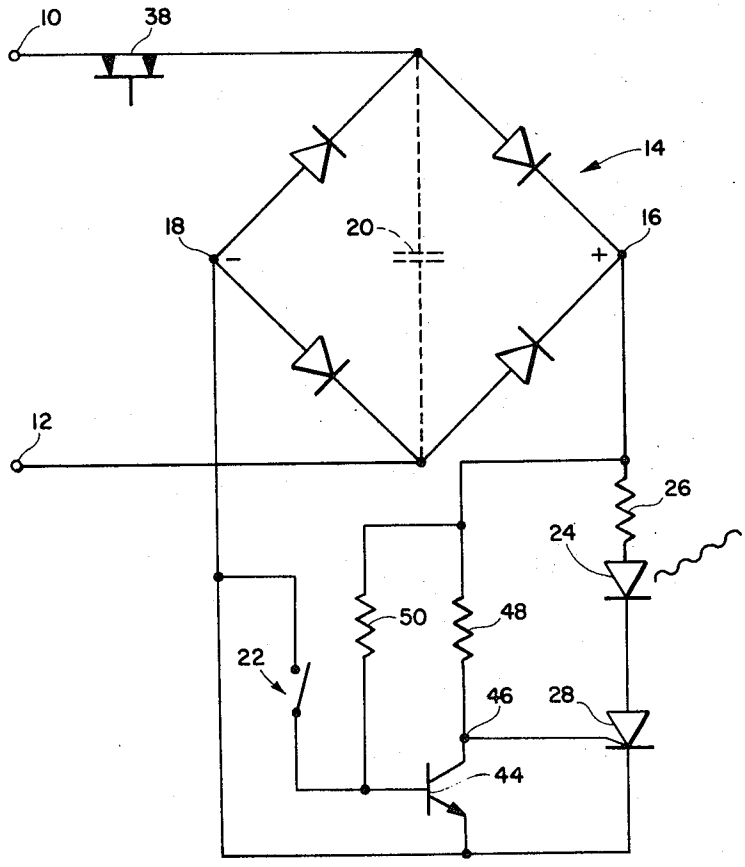
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Assistant Examiner—Richard P. Lange

[57] **ABSTRACT**

An annunciation circuit is provided for an alarm signalling device, which annunciator causes a continuous indication of operation of the alarm signalling device after such operation. The indication is usually from a solid state light emitting device which is triggered from an SCR. The gate or driving circuit for the SCR is in series with a switch within the alarm signalling device, and is arranged to trigger the SCR only after the switch has operated. The SCR is in series with the solid state light emitting device and latches so that the light emitting device is maintained "on" until such time as power is temporarily removed from the circuit. A plurality of alarm signalling device may be powered from a single source and may operate a single alarm; and a simple visual inspection either of the annunciator board or of the devices themselves will show which device operated because the light or other annunciation will remain on until the SCR latch circuit is disconnected from its power source.

3 Claims, 2 Drawing Figures



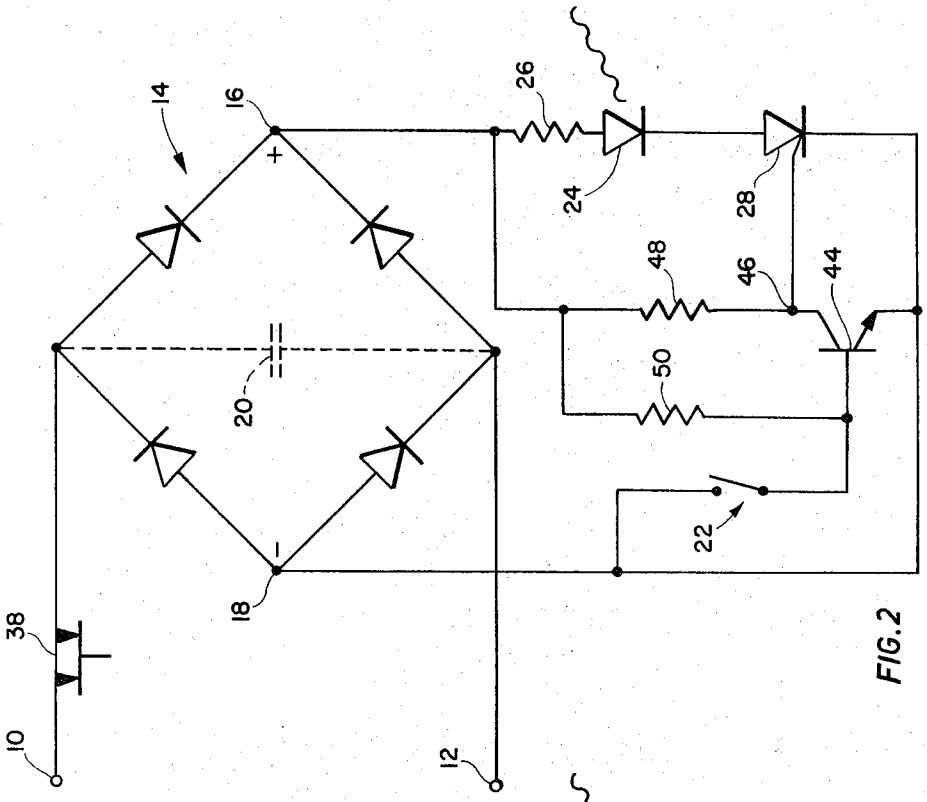

14
16
+
26
24
28
48
46
44
20
50
22
18
38
10
12

FIG.2

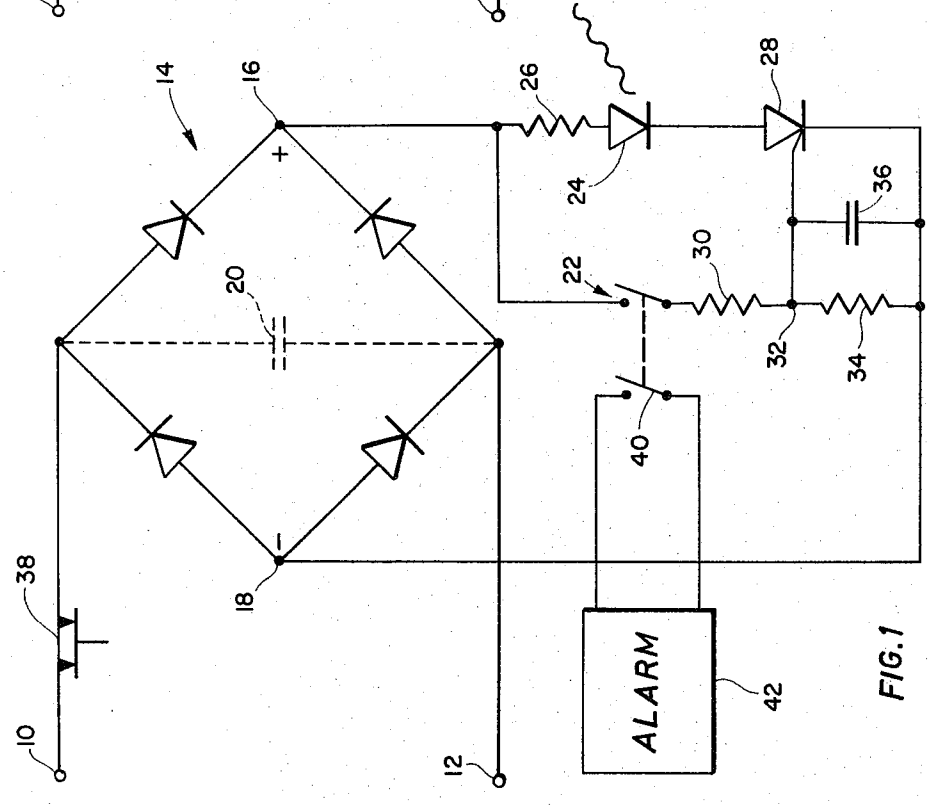

14
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34
40
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38
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ALARM
42

FIG.1

ANNUNCIATOR CIRCUIT

FIELD OF THE INVENTION

This invention relates to alarm signalling devices; and particularly to annunciator or indicating circuits therefor which provide a continuous indication of the operation of an alarm signalling device. The circuits provided by this invention are particularly useful in such alarm signalling devices as rate-of-rise of temperature and/or maximum or minimum temperature sensing devices; and the invention may equally be useful in other such devices as over speed sensors, flow sensors, etc.

BACKGROUND OF THE INVENTION

As noted, this invention is particularly useful in such installations of alarm signalling devices as thermal devices which may signal a rate-of-rise of temperature in excess of a predetermined rate, or a temperature in excess of a predetermined temperature, etc. Such devices are very often found in large industrial or public buildings. Very often an installation of a plurality of thermal detectors of the sort usually found in such buildings may include a number [up to a dozen or more]of like devices which are connected to a single alarm circuit. For example, all of the devices on a floor or a group of floors of a building, or in a particular area of a building, may be connected to a single alarm circuit. Operation of any one of the devices causes an alarm signal to be given, at such receiving stations as central watch stations, police or fire department headquarters etc. Likewise, a plurality of other types of sensors or alarm signalling devices may be used in buildings, industrial processes, etc., where several devices may be connected to a single alarm circuit. In all such circumstances, however, whan an alarm is given — especially in response to a transitory alarm condition, or as a result of a temporary fault — it is usually not possible to determine which one of the alarm signalling devices has caused the alarm signal to be activated. Thus, an individual inspection of each alarm signalling device may be required to determine which device cause the alarm signal.

In such installations as thermal detector installations where a plurality of like temperature and rate-of-rise devices which may, in fact, be the same devices each having the ability to trip or cause an alarm under either or both of two pre-set alarm conditions, there may be intermittent operation of one of the devices which may be false — in which case, the device is faulty — or which may be as a result of transitory temperature rise or maximum temperature conditions in excess of the permitted limits, but which may last for a period of only a few seconds. Nevertheless, an alarm signal would have been caused; and in such circumstances it may be very helpful to know which of the devices has operated. If the device itself is faulty or set to operate at limits which are too low, it may be very difficult to discover such device. It is therefore desireable than an annunciation or indication be given — either at an annunciator board or at the device itself — whenever the device operates to cause an alarm signal; and that such annunciation or indication continue to remain operating until the cause for the alarm signal can be determined. It is then helpful and useful to provide means whereby the annunciation or indication can be terminated, and the device placed back into its normal operating — i.e., non-indicating — condition together with the other devices on the same alarm circuit. Power for operation of the device may be derived from the alarm circuit, or independently, as discussed hereafter.

During the installation, it is helpful to be able to test the operation of an alarm signalling device; and to check the continuity of the alarm circuit. Likewise, it is helpful in two-wire alarm circuits to make each power utilization device to be polarity insensitive: i.e., so that each device, especially a solid state circuit, which may operate no matter which direction the impressed voltage across such device may be. Indeed, it may be contemplated that in certain conditions, alarm signalling devices may be desired to have annunciators associated therewith which would operate with an AC voltage impressed across them rather the the usual DC voltage. It should be noted that most such alarm signalling circuits operate at a low DC voltage, which is easier to handle than a high voltage, and which can assure better quality power than low voltage AC which might be subject to waveform or other distortion. In any event, it may happen that a technician, when installing a plurality of alarm signalling devices in a two-wire alarm circuit, might accidentally reverse the polarity of connection of one device relative to another.

It is desirable to provide an annunciator or indicator circuit which has the smallest possible physical volume, so that it may be installed easily in the base or container of an alarm signalling device, and which provides circuit reliability and assurance of operation over a long period of time. Thus, the present invention is particularly related to annunciator circuits for alarm signalling devices where the annunciator comprises a light emitting semi-conductor device — usually, a light emitting diode — in series with a gating and latching device. The gating and latching device which is usually employed in such circuits is a synchronous switch operable from a gate circuit which in turn is fired from a control circuit. The most common of such device is a silicon controlled rectifier (SCR). An SCR is also a device which latches; i.e., once the SCR closes so that it becomes conductive, it will not re-open until power if removed from the cathode-anode circuit of the SCR. This is especially important in such circumstances as those discussed above, where an alarm signalling device may have intermittent operation which causes the opening or closing of a single-pole switch. After such a switching operation, an SCR which is fired or turned on in response to a control circuit which in turn is responsive to the switching operation within the alarm signalling device, then provides a latching function to assure the continuing indication of the fact that a switching operation has taken place.

Several different control circuits which control the gate of an SCR are contemplated by this invention. They include a voltage dropping network to provide sufficient gating and latching voltage for an SCR, in series with a circuit having a time delay (for DC operation, a parallel RC circuit) so as to avoid inadvertent operation due to external field conditions such as transient voltages, radio frequency interference, etc., and a transistor circuit which is operative to gate the SCR to its latched condition only after the occurrence of a switching operation within the alarm signalling device.

BRIEF SUMMARY OF THE INVENTION

It is an object of this invention to provide an annunciator circuit for an alarm signalling device, which may

be installed either within the device or at a remote annunciator board, and which provides a continuous indication of the fact that the alarm signalling device with which the annunciator is associated has caused an alarm signal to be given by its own operation.

Another object of this invention is to provide a low-priced, solid state annunciator for use with an alarm signalling device, where the annunciator circuitry is physically quite small.

Yet another object of this invention is to provide an annunciator device that gives a continuing like indication of the fact that a switching operation has taken place in an alarm signalling device, where such indication is continued until power to the annunciator circuit is at least temporarily interrupted.

A still further object of this invention is to provide a low power utilizing annunciator device for use with alarm signalling devices, as spoken of above.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other features and objects of the present invention are more fully described hereafter in association with the accompanying drawings, in which:

FIG. 1 is a circuit of a preferred embodiment of an annunciator device in accordance with this invention and FIG. 2 is a circuit of an alternative preferred embodiment of an annunciator device in accordance with this invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

As noted above, an alarm signalling device such as a thermal device which causes an alarm signal to be actuated either upon the sensing by the device of a rate-of-change of temperature faster than a predetermined rate, or upon the sensing of a temperature higher (or lower) than a predetermined temperature, may be connected to an alarm circuit together with a plurality of like devices. Each of those devices is therefore a switching device, and an alarm condition causes a change of the switch condition of at least a single pole of a switch within the device. In the usual installations, the switches within alarm sensing devices are normally open switches, so that when the devices are monitoring but not in alarm status, there is little or no current or power consumption. Normally closed switches may, however, by used to provide an indication at a power source of the continuing operation of the circuit in monitoring or standby condition.

FIG. 1 shows a circuit in accordance with this invention, having input terminals **10** and **12** which are connected to the input terminals of a diode bridge indicated generally at **14.** The output terminals of the diode bridge **14** are indicated at **16** and **18,** being the positive and negative output terminals of the diode bridge, respectively. Obviously, the power source to which terminals **10** and **12** may be connected can comprise an alarm circuit where the alarm signalling device includes only a single-pole single-throw switch, as discussed hereafter. The circuit to which terminals **10** and **12** are connected may have an AC or a DC voltage across it, and either of terminals **10** or **12** may be connected to the positive side or the negative side of such circuit when it is DC. In any event, the output terminals of the diode bridge **14** provide a polarized DC; so that the entire circuit is insensitive to polarity of the power source at terminals **10** and **12.** For purposes of this discussion, however, the power source for the circuit to be discussed hereafter may be considered to be the positive and negative terminal **16** and **18,** respectively of the diode bridge **14.**

Likewise, a capacitor **20** may be connected between input terminals **10** and **12,** for extreme noise suppression of noise on the input power lines if necessary.

A switch **22** is shown in FIG. **1,** with one side thereof connected to the power source — in this case, terminal **16** of diode bridge **14.** As noted, switch **22** may be a single-pole single-throw switch, leaving aside any consideration of another pole of the switch which is discussed hereafter with respect to an alternative embodiment of the circuit of FIG. **1.** Switch **22** is the switch within the alarm signalling device whose switching operation causes an alarm signal to be activated. However, as noted above, the operation of the switch **22** may be transitory, as a result of alarm conditions which occur for only a very short period of time, faulty operation of the alarm signalling device per se, or for other reasons. Thus, the circuit of FIG. **1** is provided to cause an annunciation or indication of a switching operation of the switch **22,** unless that switching operation is for a very short time which is less than the time constant of an RC circuit to be discussed hereafter; and even though the switch **22** may restore to its standby condition, the annunciation will continue.

The annunciator which is most commonly used is a light emitting diode **24**; although other lamp means or annunciator means such as relays, etc., may be used. In series with the light emitting diode **24** is a resistor **26** whose function is to limit the operating current to the light emitting diode **24** upon activation of the annunciator operation of the circuit. An SCR **28** is also in series with the light emitting diode **24**; and the cathode side of the SCR may be connected to the negative side **18** of the diode bridge **14.**

A resistor **30** is in series with the switch **22,** and the side of resistor **30** which is remote from the switch **22** — i.e., junction **32** — is connected to the gate of SCR **28.** A further resistor **34** is connected in series with resistor **30** from junction **32** to terminal **18** of diode bridge **14**; so that resistors **30** and **34** may form a voltage divider string. A capacitor **36** is arranged in parallel with resistor **34** to form an RC circuit, whose time constant is determined by the values of the capacitor and resistor within the circuit.

The operation of the circuit as it has been described so far, is as follows. If switch **22** closes, capacitor **36** begins to charge, and if the switch **22** remains closed for a longer time than the time constant of the RC circuit **34, 36** so that capacitor **36** becomes fully charged, the voltage at junction **32** between resistors **30** and **34** become such as to fire SCR **28** to make it conductive. The values of resistors **30** and **34** are chosen having regard to the usual operating circuit voltage, the firing voltage required for SCR **28,** etc. When SCR **28** fires and becomes conductive, current flows through current limiting resistor **26** and the light emitting diode **24.** Thus, the light emitting diode causes an annunciation or indication of the fact that a switching operation of switch **22** has occurred. As noted previously, the light emitting diode **24** may be replaced with other current operated devices such as relays, small lamps, etc., whose operation and indication would continue only so long as current continued to flow through such indicating devices. If, at any time after the SCR **28** has fired, switch **22**

opens once again, there will be no effect on the circuit because the SCR would remain latched — i.e., conducting — and the light emitting diode **24** would continue to be operative. Obviously, the only way that the annunciator or indicator can become non-operative is to at least temporarily remove the circuit from the power source. This may conveniently be achieved by opening a normally closed switch such as switch **38.**

If the switch **22** is ganged as one pole of a single-throw switch having more than one pole, such as to switch **40** in FIG. **1,** the operation of the circuit remains essentially as discussed above, except as follows. Either switch pole **22** or switch pole **40** may be the switch within the alarm signalling device whose operation is predicated on the existence of an alarm condition. The other of the poles of the switch is ganged so that, in this case, a two-pole single-throw switch is achieved. Switch **40** may be connected to an alarm circuit **42,** whose nature is not relevant to this invention. In any event, it is now seen that the power source for the alarm circuit is independent from the power source for the annunciator circuit including the light emitting diode **24,** SCR **28** and the control circuitry therefor. Operation of the annunciator circuit is therefore independent of any fault condition — e.g., an open circuit — which may occur in the alarm circuit. Similarly, operation of the detector and annunciator circuitry may be proven, and continuity at least of the annunciator circuitry proven, without causing an alarm signal to be given such as at a central control receiving station, by suitable manipulation at the device itself.

An alternative embodiment of an apparatus according to this invention is illustrated in FIG. **2,** where like numerals indicate like circuit elements. In the circuit of FIG. **2,** the collector of a transistor **44** is connected at junction **46** to the gate of SCR **28.** Also connected to junction **46** is a resistor **48.** Resistor **48** and a resistor **50** are each connected to terminal **16** of the diode bridge **14,** and the other side of resistor **50** is connected to the base of transistor **44.** Switch **22** is also connected, in this instance to the base of the transistor **44,** and to terminal **18** of the diode bridge **14.**

In the same manner as discussed above, the switch **22** may be one pole of a multiple-pole single-throw switch.

In the circuit of FIG. **2,** where switch **22** is a normally open switch, the transistor **44** is maintained in its conducting state by the voltage across it, as seen at its base from resistor **50.** The voltage at junction **46,** and thus at the gate of SCR **28,** is such that the SCR remains open and nonconductive. However, when switch **22** closes, even temporarily, it causes a base to emitter short circuit on transistor **44,** thereby turning transistor **44** off so that it become non-conductive. The voltage at junction **46** therefore tends to go upwards to the voltage at terminal **16,** or at least until the firing voltage of SCR **28** is reached whereupon the SCR fires and latches. The voltage at junction **46** thereafter collapses.

If switch **22** in FIG. **2** is opened after it has been closed and SCR **28** has fired, the SCR remains latched in the same manner as discussed above, and the light emitting diode **24** or other such annunciator device as may be used continues to indicate the fact that the switch **22** has at least momentarily been closed. Restoration of the circuit of FIG. **2** to its standby — i.e., non-indicating — status is, once again, accomplished by such means as temporarily opening switch **38.** The circuit of FIG. **2** is such that when the annunciator is in its non-indicating status, a certain but very low power consumption will occur because of the conducting status of transistor **44.** If switch **22** is replaced with one which is normally closed, the operation of the circuit of FIG. **2** can be duplicated by suitably reconnecting the transistor **44.**

It will be noted that the SCR **28** — or other synchronous switch which may be fired by operation of the control circuit, and which latches — is operable only upon the operation of a suitable control circuit which is, itself, active so as to control the firing of the SCR only after a switching operation of the switch within the alarm signalling device. Thus, switch **22** causes a control circuit which includes resistor **30** and a parallel circuit **34, 36** to fire the SCR **28** in the circuit of FIG. **1;** whereas in the circuit of FIG. **2,** a switching operation by switch **22** causes transistor **44** to turn off, thereby raising the voltage at the gate of SCR **28,** and causing the SCR to fire. In both circuits, once the SCR **28** has fired, the light emitting diode **24** — which acts essentially as a short circuit when it is conducting — remains on, because of the latching operation of the SCR, until such time as power is removed at least from that portion of the circuit which includes the light emitting diode and the SCR in series.

Various alternative embodiments, and additions thereto by way of complementary or electrically isolated power circuits, have been discussed. Various types of control circuitry which causes the SCR to fire only after a switching operation of the switch within the alarm signalling device which causes an alarm signal to be generated, have been discussed, as well as various alternatives of current operation annunciator devices. It has been noted that the circuits of this invention can operate without regard to the polarity of the power source to which the circuits may be connected; and it has been noted that especially with the use of all solid state components, power consumption and physical size — as well as costs — can be kept at a minimum.

Various other amendments, alterations or substitutions may be made to the circuits taught herein, without departing from the spirit and scope of the appended claims.

What I claim is

1. In an alarm signalling device having at least a single-pole single-throw switch whose operation is determined by a change of ambient conditions being monitored by said device, and where said switch is connected in series with one side of a source of electrical power; the improvement comprising annunciator means associated with said alarm signalling device and connected to said power source to provide a continuous annunciation after a switching operation of said switch in response to a change of the conditions being monitored until such time as said annunciator means is at least temporarily disconnected from said power source, including;

annunciator means operable from said power source and in series with gate means; said gate means being operable only upon operation of a control circuit therefor; said control circuit being active to control said gate means only after a switching operation of said switch;

said gate means including latch means connected to said power source to maintain said gate means closed and said annunciator means operative even after a further switching operation of said switch,

until said latch means is disconnected from said power source; said gate and latch means being an SCR, and said annunciator means being a light emitting diode;

said control circuit for said gate means from having a transistor whose base is connected series with said switch; resistor means connected to bias the base of said transistor so that said transistor is conductive when said switch is in its normal switching condition; and further resistor means connected at one end both to said transistor and to the gate of said SCR, so that after a switching operation of said switch said transistor become non-conductive and said SCR is fired by the voltage then impressed on the gate thereof.

2. The circuit of claim **1** where said power source is the output terminals of a diode bridge.

3. The circuit of claim **1** where said detector device has at least a two-pole single-throw switch whose operation is determined and controlled at only one pole thereof, and where the second pole of said switch is connected to an alarm circuit.

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