

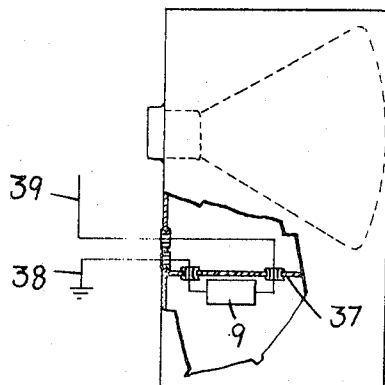
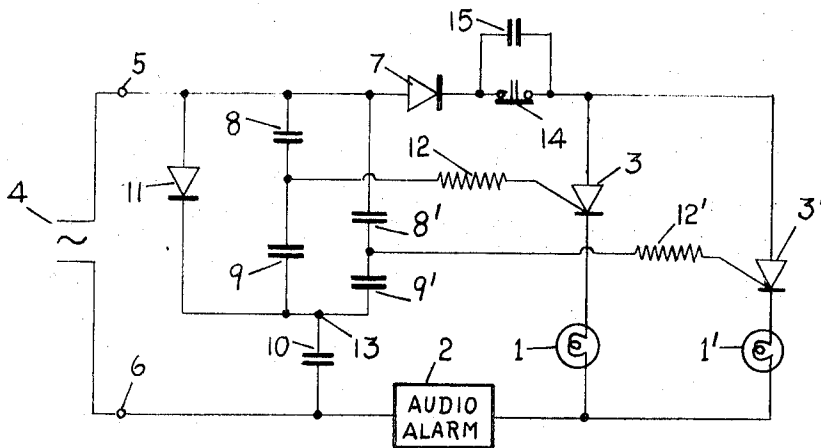
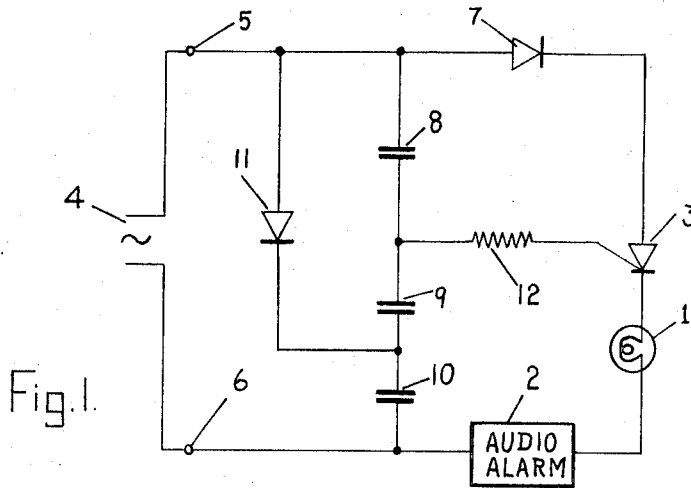
Jan. 5, 1971

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THEFT ALARM SYSTEM UTILIZING A BRIDGE HAVING A
CAPACITIVE VOLTAGE DIVIDER

3,553,674

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2 Sheets-Sheet 1



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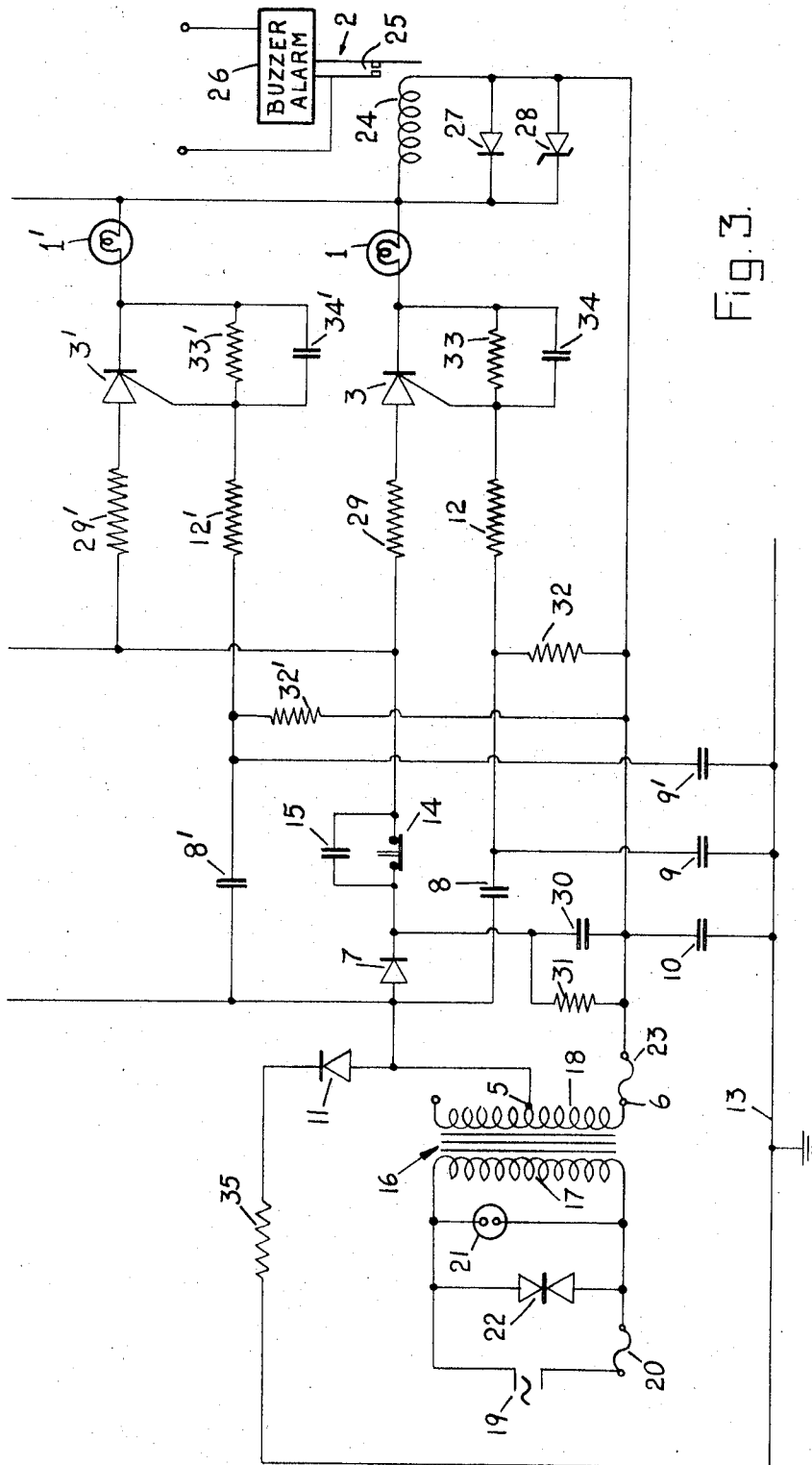


Fig. 3.

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THEFT ALARM SYSTEM UTILIZING A BRIDGE HAVING A CAPACITIVE VOLTAGE DIVIDER

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13 Claims

ABSTRACT OF THE DISCLOSURE

An alarm system for indicating an alarm condition at any of a number of remote points, comprises a plurality of alarm circuits each including a solid-state switching device which is triggered by a control current applied to its control electrode in accordance with an alarm condition. Each control electrode is connected to a respective capacitor chain including a capacitor located at the respective remote point; any tampering with the said capacitor will affect the chain so that the control electrode receives either direct current or alternating current to trigger the switching device.

BACKGROUND OF THE INVENTION

This invention relates to an alarm system for indicating an alarm condition at a remote point, or at any one of a number of remote points. The alarm system is of the kind including an electrically operable alarm device connected in circuit with an electrical impedance situated at the remote point, the alarm device being adapted to be operated by changes in the circuit caused by changes in the impedance.

An alarm system in accordance with the invention is especially suitable for use as a theft alarm system for indicating the removal of objects, such as television sets in hotel rooms, from the remote points, or for indicating the unauthorised opening of doors or windows; when the alarm system is so used, the impedances located at the remote points are physically connected to the objects, or the doors or windows, so as to be open-circuited when the objects are removed, or the doors or windows are opened. The invention is also applicable to other systems for monitoring conditions, for example temperature, humidity, at remote points whereby to provide an indication when an abnormal condition, or alarm condition, arises.

It is well known that the simpler forms of burglar alarm system, for example, can be rendered ineffective by a skillful burglar by short-circuiting the sensing impedance or otherwise modifying the circuit of the alarm device so that the circuit becomes insensitive to removal of the sensing impedance; this is usually possible because the sensing impedance, being situated at the remote point, is accessible to the burglar. Numerous alarm circuits of various degrees of complication have been proposed to overcome this defect of the simpler systems.

It is an object of the present invention to provide an alarm system which does not have the above-mentioned defect, and which provides a ready indication at a central monitoring station or control panel of an alarm condition at a remote point, or at any of a number of remote points.

SUMMARY OF THE INVENTION

An alarm system in accordance with the invention essentially comprises an electronic switching device connected in series with an alarm device for controlling the supply of electric current thereto from an electrical supply, and a chain of three impedances connected across the supply, the midpoint (i.e. the point of connection)

of the first and second impedances being connected to one supply terminal and the midpoint of the second and third impedances being connected to a control electrode of the switching device. The second impedance, which is connected electrically between the first and third impedances, serves as the "sensing" impedance and is located at the remote point at which an alarm condition might arise.

Under normal conditions, the switching device is held "OFF" because no control current is applied to its control electrode, the current being bypassed by the second and third impedances of the impedance chain. If the second impedance is open-circuited, for example by removal of a protected object or forcing of a door or window, the impedance chain no longer acts as a bypass and the switching device is switched "ON" to operate the alarm device. On the other hand, if an attempt is made to circumvent the alarm system by placing a short circuit or impedance across the second impedance, then a control current is applied to the control electrode from the supply, thus switching the switching device "ON" and operating the alarm.

Preferably the electronic switching device is a silicon controlled rectifier. Such a device will be triggered and held "ON" even if the current applied to its control electrode, or gating electrode, is of very short duration.

In an alarm system for monitoring conditions at a number of remote points, a separate alarm circuit is provided for each such point, the alarm circuits being connected in parallel and connected to the supply through a common return path. A corresponding number of impedance chains are also connected across the supply, but the "third" impedances of the chains may be represented by a single, common impedance.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will now be described, by way of example, with reference to the accompanying drawings in which:

FIG. 1 is a simplified, schematic circuit diagram of an alarm system, illustrating the manner of operation of the circuit with respect to a single alarm device;

FIG. 2 is a diagram similar to FIG. 1, but showing a plurality of alarm circuits for indicating conditions at a plurality of remote points;

FIG. 3 is a circuit diagram of a preferred embodiment of the invention; and

FIG. 4 shows a sensing capacitor physically connected to an object to be protected.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The basic alarm system shown in FIG. 1 comprises an electrically operable alarm device, consisting of a visual indicator, such as a lamp 1, and an audio alarm 2, and an electronic switching device 3 connected in series with the alarm device for controlling the supply of electric current thereto. The electronic switching device 3 is of the kind having a control electrode for controlling the operation of the device in accordance with an applied control current, and is represented in the drawings by a silicon controlled rectifier. The alarm device is supplied from an alternating current supply 4 having first and second supply terminals 5, 6, to which the alarm device 1, 2 and series-connected switching device 3 are connected by way of a half-wave rectifier 7. A chain of first, second and third impedances represented by three series-connected capacitors 8, 9, 10 is connected between the supply terminals 5 and 6. The capacitor 9 is the "sensing" impedance of the system and is located at the remote point to be protected; all the other components of the system are located at a suitable central control point. A rectifier 11 is connected between the first supply terminal 5 and the midpoint of the

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capacitors 9 and 10, and a limited resistor 12 is connected between the midpoint of the capacitors 8 and 9 and the control electrode of the device 3, to provide an impedance path therebetween.

In operation of this system, the silicon controlled rectifier 3 is held "OFF" until a control current is applied to its control electrode, and until that time the alarm device remains quiescent. Under normal conditions alternating current from the supply finds a low impedance path through the chain of capacitors 8, 9, 10, and so the control electrode is bypassed. Moreover, the unidirectional voltage obtained by the rectifier 11 is blocked by the capacitor 9.

If the capacitor 9 at the remote point is open-circuited, by removal of an object to which it is physically connected, or by unauthorised entry through a door or window, then the capacitor chain is broken and no longer provides an alternating current path which bypasses the control electrode of the device 3. The latter will therefore be triggered by a positive half cycle of the alternating current, and the alarm device will be operated.

On the other hand, if an attempt is made to render the system ineffective by placing a short circuit or other direct current path across the capacitor 9, then direct current will be applied directly to the control electrode from the rectifier 11, and the switching device will be triggered.

Similarly if a capacitor is placed in shunt with the capacitor 9, prior to disconnection of the latter, the new capacitor being of sufficiently high capacitance to be an effective substitute, then the charging current of the new capacitor will be sufficient to trigger the silicon controlled rectifier.

The circuit of FIG. 2 is essentially the same as the circuit of FIG. 1, and corresponding parts are denoted by the same reference numerals. However, the circuit is intended for use in the case where a plurality of remote points (in this case two) are to be monitored. Sensing capacitors 9, 9' are located at the respective remote points, and these are connected between capacitors 8 and 10, and 8' and 10 respectively. The capacitor chain of FIG. 1 is thus replaced by a plurality of circuit elements connected in parallel between the supply terminal 5 and a common point 13, each circuit element consisting of the first and second series-connected impedances or capacitors 8, 9 and 8', 9', the common point 13 being connected to the second supply terminal 6 through a third impedance or capacitor 10.

Associated with the circuit elements, 8, 9 and 8', 9' are respective alarm circuits each formed by a silicon controlled rectifier 3 or 3' and a visual alarm indicator 1 or 1', the alarm circuits being connected in parallel with one another and in series with a common audio alarm device 2. Analogously with the circuit of FIG. 1, a rectifier 11 is connected between the supply terminal 5 and the common point 13, and the midpoints of the circuit elements 8, 9 and 8', 9' are connected via limiting resistances 12, 12' to the control electrodes of respective silicon controlled rectifiers 13, 13'. It will be seen that if an alarm condition arises at any one of the remote points, by open-circuiting or bypassing a capacitor 9 or 9', then a control current of appropriate polarity will be applied to the control electrode of a respective device 3, 3', thus firing the device and lighting the appropriate indicator 1, 1'. At the same time the audio alarm 2 will be energised by the flow of current, which can only be stopped by resetting the operated alarm circuit, after removal of the alarm condition. This is achieved by opening a normally closed resetting switch 14 in series with the alarm circuits. A capacitor 15 is connected across the switch to prevent the triggering of other alarm circuits when the switch is reclosed.

FIG. 3 is a circuit diagram of a practical embodiment of the invention, the circuit being essentially the same as

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that of FIG. 2 but showing additional details of the preferred embodiment.

Referring to FIG. 3, the electrical supply means comprises a step-down transformer 16 having a primary winding 17 and a secondary winding 18. The primary winding 17 is connected across a 117 volt mains supply 19, and the secondary winding 18 is connected between supply terminals 5 and 6 to provide a 12 volt alternating current supply. The primary circuit of the transformer 16 includes a fuse 20, and a power indicator 21 and a thyrector 22 for suppressing transients in the mains supply, are connected in parallel across the primary winding. A fuse 23 is provided in the secondary circuit of the transformer 16.

As in the circuit of FIG. 2, the sensing capacitors 9, 9' are located at the respective remote points, and these are connected between capacitors 8 and 10, and 8' and 10, respectively. The capacitors 8 and 9, and 8' and 9', thus form a plurality of circuit elements connected in parallel between the supply terminal 5 and a common point 13, each circuit element being formed by the pair of series connected capacitors. The capacitor 10 is connected between the common point 13 and the second supply terminal 6. Associated with the circuit elements 8, 9, and 8', 9', are respective alarm circuits, each formed by a silicon controlled rectifier 3 or 3' and a visual alarm indicator 1 or 1', the alarm circuits being connected in parallel with one another and in series with a common audio alarm device 2. The device 2 consists of a relay coil 24 having a pair of normally open contacts 25 for closing the energising circuit of a buzzer 26. A diode 27 is connected across the relay coil 24 to bypass any counter E.M.F. across the relay coil when the contacts 25 open. A Zener diode 28 is also connected in parallel with the relay coil to maintain a constant voltage drop across the coil so to prevent lack of brilliance of the indicators 1, 1', if more than one alarm circuit is operated. The parallel connected alarm circuits are connected in circuit with the alternating current supply terminals 5, 6, through a rectifier 7, and a normally closed resetting switch 14 across which a capacitor 15 is connected. Each silicon controlled rectifier 3, 3', is connected in series with a limiting resistor 29, 29'. A smoothing circuit formed by a capacitor 30 and resistor 31 is connected between the output of the rectifier 7 and the supply terminal 6. It will also be noted that the midpoints of the circuit elements 8, 9 and 8', 9', are connected to the supply terminal 6 by way of a resistor 32, 32'. A biasing circuit formed by a gate resistor 33 and capacitor 34 is connected between the control electrode of each silicon controlled rectifier 3 and its anode. In the circuit of FIG. 3, the common point 13 is represented by an earthed conductor, to which the supply terminal 5 is connected by way of the rectifier 11 and a limiting resistor 35. The resistor 35 in combination with capacitor 10 provides a slow voltage rise time which prevents unwanted firing of the silicon controlled rectifiers when the alarm system is connected to the mains supply.

As previously mentioned, all the components of this system, except the sensing capacitors 9, 9', are located at a central control station at which the visual indicators can be observed, and the audio alarm heard. The sensing capacitors 9 and 9' are located at the remote points. A particular application of the system is to a supervisory system for detecting the unauthorized removal of objects such as television sets from hotel rooms. In such a case, the individual sensing capacitors are physically connected to the respective television sets and are connected to the remainder of the circuit located at the central control station by means of conducting leads which are passed through existing conduits. FIG. 4 illustrates one method of physically connecting a sensing capacitor 9 to a television set 36. The capacitor 9 is mounted in the chassis 37 of the set, and a pair of leads 38, 39, are brought out through existing small holes 40 in the rear wall 41 of the set. It is

important that the sensing capacitor should be mounted in such a way that it cannot be physically removed from the set without interrupting its circuit. The lead 38 is connected to earth, and hence to the common point 13, and the lead or call wire 39 is connected to one side of the capacitor 9.

Suitable values for the components of the circuit shown in FIG. 3 are given in the following table.

TABLE I

Reference No.	Resistors	Value, ohms	
12 (12')	-----	1000	
29 (29')	-----	150	
31	-----	470	
32	-----	47000	15
33 (33')	-----	1000	
35	-----	330	
	Capacitors		
		Mfd.	20
8 (8')	-----	.22	
9 (9')	-----	10	
10	-----	1000	
15	-----	100	
34 (34')	-----	1	25
	Miscellaneous		
3 (3')	-----	SCR 2N5061	
1 (1')	-----	Lamp 10ESB	

What I claim as my invention is:

1. An alarm system for providing an indication of abnormal conditions at a remote point, comprising:

- (a) an electrically operable alarm device;
- (b) electrical supply means providing first and second supply terminals;
- (c) means connecting the alarm device to the first and second supply terminals;
- (d) an electronic switching device connected in series with the alarm device for controlling the supply of electric current thereto;
- (e) the electronic switching device having a control electrode for controlling the operation of the switching device in accordance with an applied control current;
- (f) a chain of first, second and third impedances connected electrically in series between the first and second supply terminals, the second impedance being located at the remote point and being connected electrically between the first and third impedances;
- (g) first circuit means connecting the first supply terminal to the midpoint of the second and third impedances; and
- (h) second circuit means connecting the midpoint of the first and second impedances to the control electrode of the switching device, the system being so arranged and constructed that:
 - (i) in normal conditions control current to the control electrode is bypassed by the second and third impedances;
 - (ii) if the second impedance is open-circuited, the control current is not bypassed and the switching device is fired so as to operate the alarm device;
 - (iii) if the second impedance is shunted, control current is applied to the control electrode, from said first supply terminal, via said first circuit means, whereby the switching device is fired so as to operate the alarm device.

2. An alarm system according to claim 1, wherein the switching device is a solid-state latching device, and wherein a normally closed resetting switch is connected in series with the latching device.

3. An alarm system according to claim 2, wherein the electrical supply means comprises a transformer having a secondary winding connected to the first and second

supply terminals and a primary winding for connection to an alternating current, mains supply, and means connected across the primary winding for suppressing transient voltages on the mains supply.

4. An alarm system for providing an indication of abnormal conditions at a remote point, comprising:

- (a) an electrically operable alarm device;
- (b) electrical supply means providing first and second alternating current supply terminals;
- (c) first rectifying means connecting the alarm device in current with said alternating current supply terminals;
- (d) a solid-state electronic switching device in series with the alarm device and first rectifying means for controlling the supply of electric current to the alarm device;
- (e) the electronic switching device having a control electrode for controlling the operation of the switching device in accordance with an applied control current of appropriate polarity;
- (f) a chain of first, second and third impedances connected electrically in series between the first and second alternating current supply terminals, the second impedance being located at the remote point and being connected electrically between the first and third impedances;
- (g) second rectifying means connected between the first supply terminal and the midpoint of the second and third impedances; and
- (h) circuit means connected between the midpoint of the first and second impedances, and said control electrode, the system being so arranged and constructed that:
 - (i) in normal conditions control current to the control electrode is bypassed by the second and third impedances;
 - (ii) if the second impedance is open-circuited, the control current is not bypassed and the switching device is fired so as to operate the alarm device;
 - (iii) if the second impedance is shunted, control current of the appropriate polarity is applied to the control electrode, from the supply means, via the second rectifying means, whereby the switching device is fired so as to operate the alarm device.

5. An alarm system according to claim 4, wherein the solid-state switching device is a silicon controlled rectifier.

6. An alarm system according to claim 5, wherein said first, second and third impedances are a chain of capacitors.

7. An alarm system according to claim 5, wherein the electrical supply means comprises a transformer having a secondary winding connected to the first and second supply terminals and a primary winding for connection to an alternating current, mains supply, and means connected across the primary winding for suppressing transient voltages.

8. An alarm system according to claim 6, including a normally closed resetting switch in series with the silicon controlled rectifier, and a capacitor connected across the resetting switch to prevent triggering of the silicon controlled rectifier when the switch is actuated.

9. An alarm system for indicating abnormal conditions at a plurality of remote points, comprising:

- (a) a plurality of alarm circuits;
- (b) each alarm circuit comprising an electrically operable alarm indicator and a solid-state electronic switching device connected in series with the alarm indicator for controlling the supply of electric current thereto;
- (c) each electronic switching device having a control electrode for controlling the operation of the switching device in accordance with an applied control current of appropriate polarity;

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- (d) said alarm circuits being connected in parallel with one another;
- (e) electrical supply means providing first and second alternating current supply terminals;
- (f) first rectifying means connecting the parallel-connected alarm circuits in circuit with the alternating current supply terminals;
- (g) a plurality of circuit elements connected in parallel between the first alternating current supply terminal and a common point, each circuit element consisting of first and second series-connected impedances, said second impedances being located at said remote points, respectively, and being connected electrically between the first impedances and the common point;
- (h) a circuit element comprising a third impedance connected between the common point and the second alternating current supply terminal;
- (i) second rectifying means connected between the first alternating current supply terminal and said common point; and
- (j) a plurality of circuit means connected respectively between the midpoints of said first and second impedances and the control electrodes of the electronic switching devices, the system being so arranged and constructed that:
 - (i) in normal conditions control current to each of the control electrodes is bypassed by a respective said second impedance and third impedance in series therewith;
 - (ii) if any one of the second impedances is open-circuited, the control current to the respective control electrode is not bypassed and the switching device is fired so as to operate the respective alarm indicator;
 - (iii) if any one of the second impedances is shunted, control current is applied to the respective

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control electrode, from said first supply terminal, via said second rectifying means and a respective one of said circuit means, whereby the respective switching device is fired so as to operate an alarm indicator.

10. An alarm system according to claim 9, wherein the first and second impedances of said parallel-connected circuit elements, and said third impedance, are capacitors.

11. An alarm system according to claim 9, wherein the alarm indicators are visual indicators, and said alarm circuits are connected in series with a common audio alarm device and a common, normally closed, resetting switch for the solid-state electronic switching devices.

12. An alarm system according to claim 9, wherein the electrical supply means comprises a transformer having a secondary winding connected to the first and second supply terminals and a primary winding for connection to an alternating current, mains supply, and means connected across the primary winding for suppressing transient voltages on the mains supply.

13. An alarm system according to claim 9, for indicating physical removal of objects situated at the remote points, wherein the second impedances located at the remote points are physically connected to the objects.

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