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(54) Security alarm

(57) A security alarm is described for protecting mains powered electrical devices. A relay coil is energised by the mains power supply voltage and when this is removed a relay is tripped to initiate further action by the security alarm. The security alarm then detects the impedance/resistance ( $R_{mps}$ ) between the mains power supply terminals. If this impedance/resistance is indicative of the device having been disconnected from the mains power supply rather than merely a mains power failure, then an alarm signal is generated by an alarm siren.

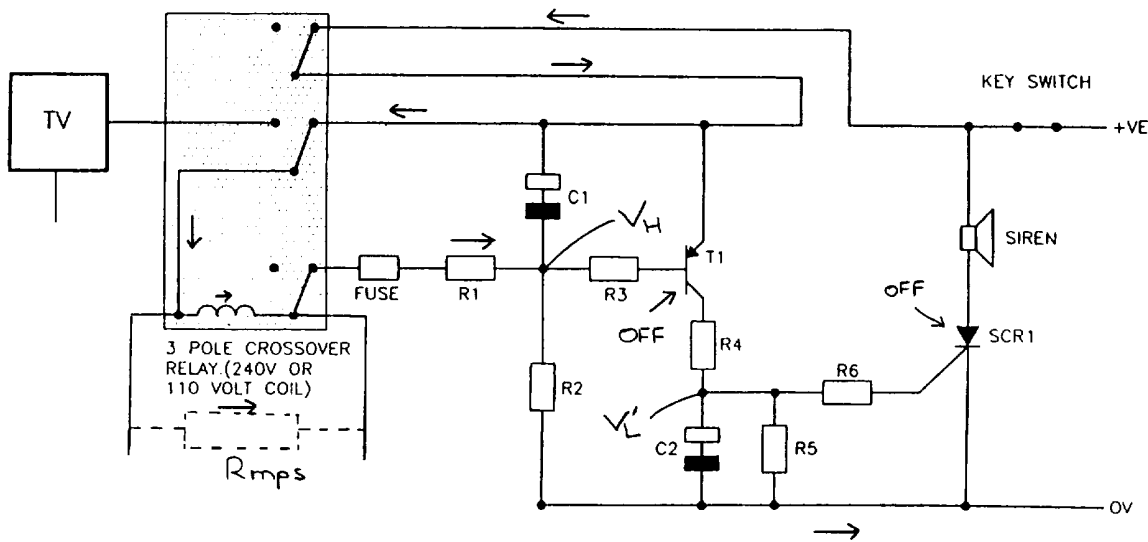


Fig. 2

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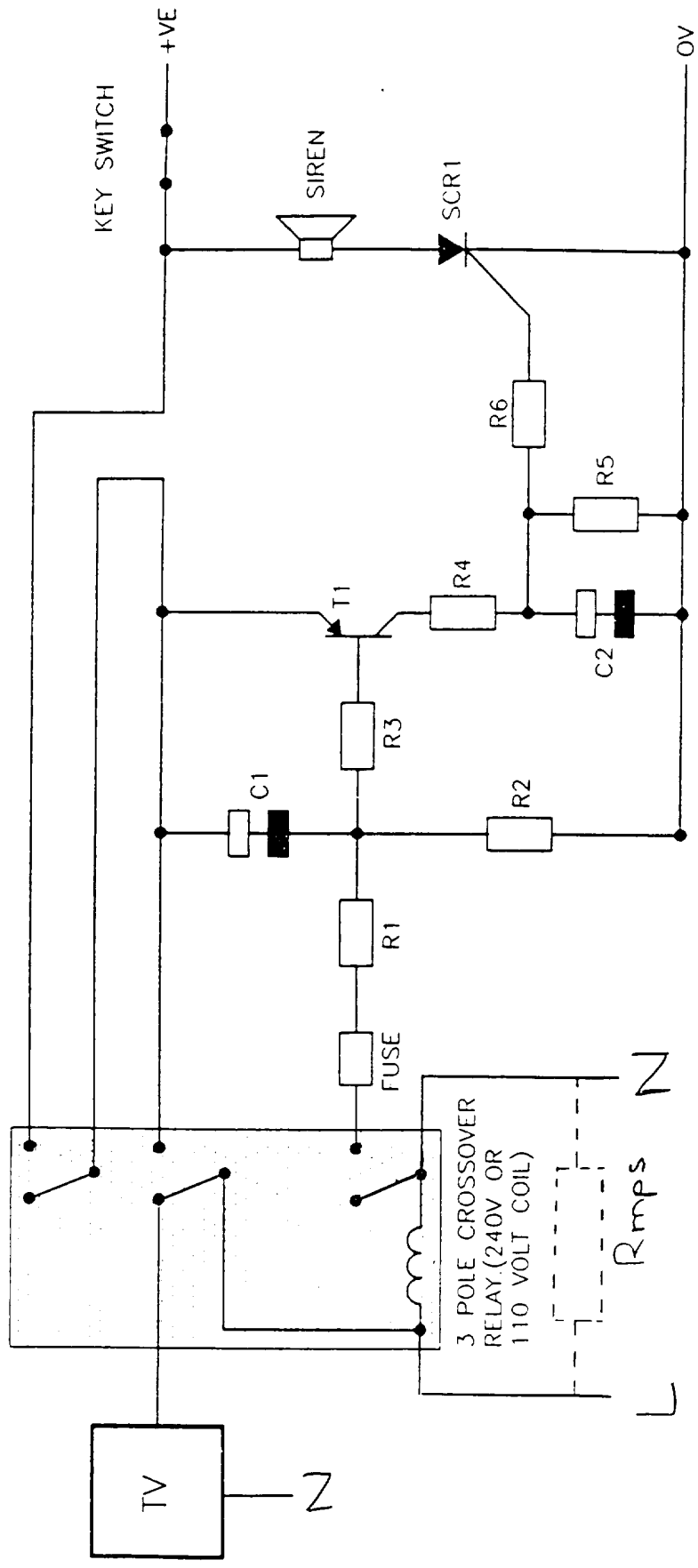


Fig 1

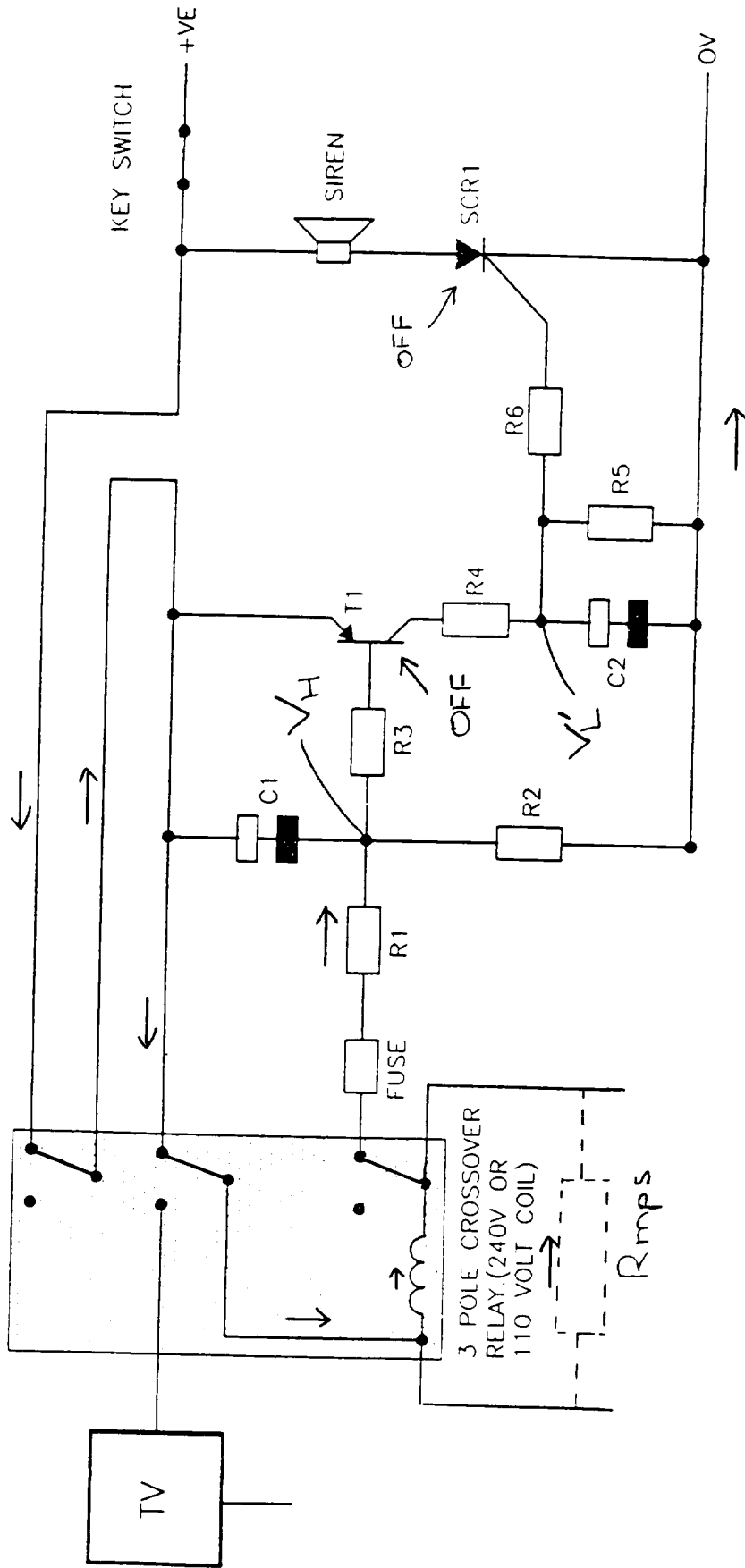


Fig. 2

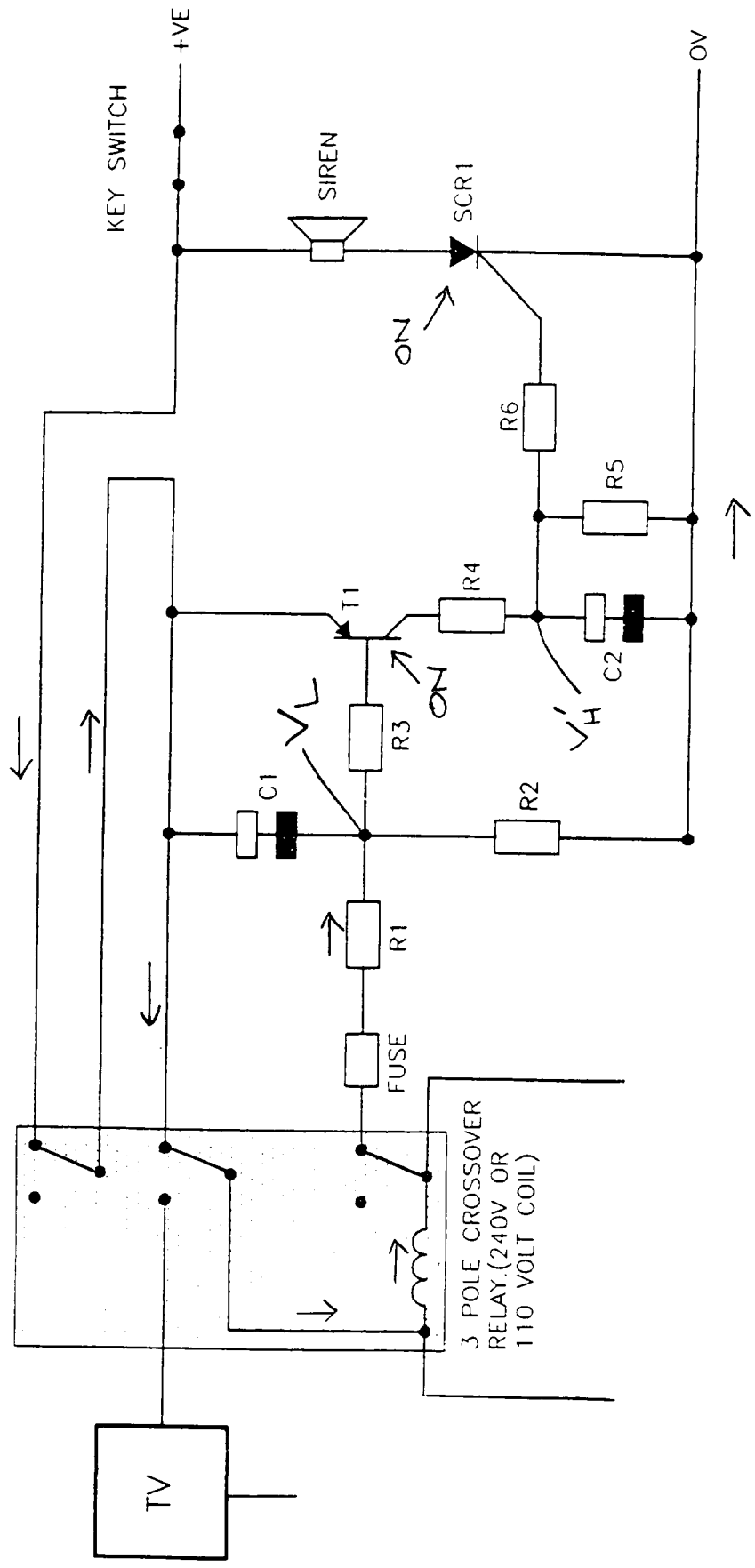


Fig: 3

SECURITY ALARM

The present invention relates to the field of security alarms. More particularly, the present invention relates to security alarms for  
5 mains powered electrical apparatus.

British Published Patent Application GB-A-2 151 057 discloses an alarm device that is activated when the mains supply to a transformer is removed; if a thief attempts to steal an apparatus, then they must remove it from its main power supply so triggering the alarm.

10 United States Patent US-A-4,237,450 discloses an appliance theft alarm in which removal of the mains supply voltage switches a relay and triggers an alarm. Again, this device serves to deter theft since removal of the device from the mains power supply triggers the alarm.

A problem with the above-described alarm devices is that they are  
15 prone to giving false alarm signals when the mains power supply fails due to a power cut. Such power cuts occur not infrequently due to severe electrical storms or electrical distribution equipment malfunctions. With the above-described devices, a power cut removes the main supply voltage and an alarm signal is triggered. This is  
20 particularly disadvantageous in the circumstances of a power failure when the lighting, ventilation and many other systems will also fail. In such circumstances, the effect of such false alarms is particularly disadvantageous.

According to the present invention there is provided a security  
25 alarm for protecting electrical apparatus which, in use, is connected to a mains power supply via mains power terminals, said alarm comprising:

impedance sensing means for sensing electrical impedance between  
said mains power terminals to detect disconnection of said electrical  
30 apparatus from said mains power supply; and

an alarm signal generator activated when said impedance sensing means senses an impedance between said mains power terminals indicative of disconnection of said mains power supply.

The invention recognises that removal of the mains supply voltage  
35 is not in itself indicative of disconnection of the electrical apparatus from the mains power supply. Having recognised this problem, the invention provides the solution of instead sensing the impedance

(may be considered as a simple resistance) between the mains supply terminals to provide an indication of whether the device has been disconnected from the mains power supply. Whilst not absolutely certain to avoid false alarms, sensing the impedance in this way avoids  
5 the occurrence of a significant number of false alarm whilst ensuring that an alarm signal is generated when the electrical apparatus is disconnected from the mains power supply by a thief.

The impedance sensing means may continuously sense the impedance between the power supply terminals. However, preferred embodiments of  
10 the invention comprise voltage sensing means responsive to removal of a mains supply voltage at said mains power terminals to trigger operation of said impedance sensing means.

Providing a voltage sensing means that first detects removal of the mains supply voltage before activation of the impedance sensing  
15 means avoids continuous exposure of the impedance sensing means to a potentially damaging mains supply voltage whilst ensuring that the impedance sensing means is activated in situations where disconnection of the electrical apparatus from the mains power supply may have taken place.

An advantageously robust and inexpensive embodiment of said  
20 voltage sensing means comprises a relay having a relay coil energised by said mains power supply such that removal of said mains supply voltage causes said relay to switch.

It will be appreciated that the alarm signal generated could take  
25 a number of forms. Sophisticated devices could include a radio transmitter or the like to activate a remote alarm. However, an advantageously simple device is one in which the alarm signal generator comprises an alarm siren. This is particularly the case when the alarm siren is built into the security alarm.

With such an arrangement, when a thief disconnects an electrical  
30 apparatus from its power supply prior to attempting to remove it, an alarm siren sounds that may frighten the thief and cause him to flee. It will be appreciated that sensing the disconnection from the mains power supply is advantageous over sensing movement of the device (such  
35 as with a vibration sensor) since the thief is less likely to have picked up the electrical apparatus at this stage and so will be less likely to drop and damage the electrical apparatus in panic at the

sound of the alarm siren.

A simple, inexpensive and robust implementation of the impedance sensing means that resists attempts to stop the alarm signal once it has been triggered is one in which said impedance sensing means  
5 triggers switching on of a thyristor to activate said alarm signal generator, said thyristor serving to maintain activation of said alarm signal generator if said mains power supply is reconnected.

In order that the alarm signal may be generated for a sufficiently long time, power supplies for the security alarm such as  
10 a large capacitor charged from the mains supply voltage are not sufficient, and it is preferred that said impedance sensing means and said alarm signal generator are battery powered.

In order that an authorised person may set up the system and initially connect the electrical apparatus to the mains power supply,  
15 and disconnect it when they wish, preferred embodiments of the invention comprise a key switch that serves to enable and disable said impedance sensing means.

It will be appreciated that the security alarm may be a discreet unit attached to the back of an electrical apparatus to be protected.  
20 However, the presence of the security alarm concealed, and so its psychological impact upon a thief when triggered is improved, when said security alarm is disposed within a housing of said electrical apparatus.

An embodiment of the invention will now be described, by way of  
25 example only, with reference to the accompanying drawings, in which:

Figure 1 shows a security alarm for an electrical apparatus during normal operation of the electrical apparatus;

Figure 2 shows the security alarm during a mains supply failure;  
and

30 Figure 3 shows the security alarm when the mains power supply has been disconnected.

Figure 1 shows an electrical apparatus, in this case a television receiver TV, connected to the live L and neutral N mains power supply terminals of a mains power supply. The connection to the live power  
35 supply terminal is via a three pole crossover relay. When the mains power supply voltage is present between the mains power supply terminals L, N, a relay coil of the relay is energised and the contacts

within the relay are biased into the position shown in Figure 1. In this position, the circuitry of the alarm that performs the impedance sensing function is disconnected from the mains supply and its battery power supply and accordingly is both protected and disabled.

5         A key switch is provided between the battery power supply and the rest of the alarm circuit. This key switch is illustrated as closed, but when open serves to disable the alarm even when it has been triggered. In this way, an authorised user may use the key switch to terminate a false alarm.

10         A property of mains power supply systems is that a finite relatively low resistance (impedance) is present between the live L and the neutral N power supply terminals. This is schematically illustrated in Figure 1 by a mains power supply resistance  $R_{mps}$ . This mains power supply resistance can be thought of as the resistance of  
15         the circuit elements forming the cables back to the local electricity sub-station, the transformer coils within the sub-station and other elements within the mains power supply system upstream of the consumer.

Figure 2 illustrates the situation where a mains power failure occurs, but the security alarm has not been disconnected from the mains  
20         power supply. In this case, the mains power supply resistance  $R_{mps}$  is still in place.

When the mains power supply fails, the mains supply voltage reduces to zero and the current through the relay coil falls to zero. The relay coil serves as a voltage sensing means and in the absence of  
25         a voltage the contacts of the relay spring back to the position illustrated in Figure 2. In this case, a current now flows from the battery of the security alarm through the mains power supply resistance, the resistor R1, the resistor R2 and back to the battery. Since the mains power supply resistance  $R_{mps}$  is relatively low, the  
30         potential at the point between resistor R1 and resistor R2 is relatively high  $V_H$  and the transistor T1 remains switched off. With the transistor T1 switched off, the potential between the resistor R4 and the resistor R5 remains relatively low  $V'_L$  and the thyristor SCR1 is switched off. With the thyristor SCR1 switched off, no current flows  
35         through the siren and an alarm signal is not generated.

It will be appreciated that the relay coil serves as a voltage



sensing means and the transistor T1 with its associated resistor network serves as an impedance sensing means to determine the presence of the mains power supply resistance  $R_{mps}$ .

5 Figure 3 illustrates operation of the alarm siren when the mains power supply is disconnected. In this case, the mains power supply resistance  $R_{mps}$  is no longer present and an open circuit high resistance exists between the mains power supply terminals. As in Figure 2, the relay coil is de-energised and the contacts switch position allowing a current to flow from the battery through the resistor network. In this case, since the relay coil resistance is relatively high compared to the mains power supply resistance, the potential at the point between the resistor R1 and the resistor R2 is lowered to a value  $V_L$ . This lower potential  $V_L$  serves to switch on the transistor T1. Switching on the transistor T1 increases the potential 10  $V'_H$  between the resistor R4 and the resistor R5 so triggering the thyristor SCR1 to switch on. Once the thyristor SCR1 is switched on, it remains on even if its triggering potential  $V'_H$  is removed. The current through the thyristor SCR1 causes the alarm siren to generate an audible signal.

20 As previously mentioned, the security alarm illustrated in Figures 1, 2 and 3, including the siren, the battery and the relay, is shaped and sized so as to be able to be fitted within the housing of the electrical apparatus which it is protecting. The key switch is accessible through the housing of the electrical apparatus to enable 25 the security alarm to be disabled and false alarms to be switched off.

CLAIMS

1. A security alarm for protecting electrical apparatus which, in use, is connected to a mains power supply via mains power terminals, said alarm comprising:

impedance sensing means for sensing electrical impedance between said mains power terminals to detect disconnection of said electrical apparatus from said mains power supply; and

an alarm signal generator activated when said impedance sensing means senses an impedance between said mains power terminals indicative of disconnection of said mains power supply.

2. A security alarm as claimed in claim 1, comprising voltage sensing means responsive to removal of a mains supply voltage at said mains power terminals to trigger operation of said impedance sensing means.

3. A security alarm as claimed in claim 2, wherein said voltage sensing means comprises a relay having a relay coil energised by said mains power supply such that removal of said mains supply voltage causes said relay to switch.

4. A security alarm as claimed in claim 3, wherein said electrical apparatus is connected to said mains power supply via said relay.

5. A security alarm as claimed in any one of the preceding claims, wherein, said alarm signal generator comprises an alarm siren.

6. A security alarm as claimed in claim 5, wherein said alarm siren is built in to said security alarm.

7. A security alarm as claimed in any one of the preceding claims, wherein said impedance sensing means triggers switching on of a thyristor to activate said alarm signal generator, said thyristor serving to maintain activation of said alarm signal generator if said mains power supply is reconnected.

8. A security alarm as claimed in any one of the preceding claims, wherein said impedance sensing means and said alarm signal generator are battery powered.

5 9. A security alarm as claimed in any one of the preceding claims, wherein a key switch serves to enable and disable said impedance sensing means.

10 10. A security alarm as claimed in any one of the preceding claims, wherein said security alarm is disposed within a housing of said electrical apparatus.

11. A security alarm substantially as hereinbefore described with reference to the accompanying drawings.

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**Patents Act 1977**  
**Examiner's report to the Comptroller under Section 17**  
**(The Search report)**

Application number  
 GB 9421952.4

**Relevant Technical Fields**

- (i) UK Cl (Ed.N)      G4N - NCSE
- (ii) Int Cl (Ed.6)    G08B - 13/22, 13/14

Search Examiner  
 P S DERRY

Date of completion of Search  
 10 JANUARY 1995

**Databases (see below)**

- (i) UK Patent Office collections of GB, EP, WO and US patent specifications.
- (ii) ONLINE: WPI

Documents considered relevant following a search in respect of Claims :-  
 1 TO 10

**Categories of documents**

- X:** Document indicating lack of novelty or of inventive step.
- Y:** Document indicating lack of inventive step if combined with one or more other documents of the same category.
- A:** Document indicating technological background and/or state of the art.
- P:** Document published on or after the declared priority date but before the filing date of the present application.
- E:** Patent document published on or after, but with priority date earlier than, the filing date of the present application.
- &:** Member of the same patent family; corresponding document.

Category	Identity of document and relevant passages	Relevant to claim(s)
X	GB 2215106 A      (DYNAMIC) see Claim 11	1, 5, 6, 7, 9
X	US 4736195      (McMURTY) see Abstract	1, 8, 10
X	US 4658242      (ZEDER) see Claims 1 and 2	1, 8
X	US 3289194      (KING)	1 to 4, 8, 10

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