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POWER LINE SENSING APPLIANCE THEFT ALARM

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Fig. 1

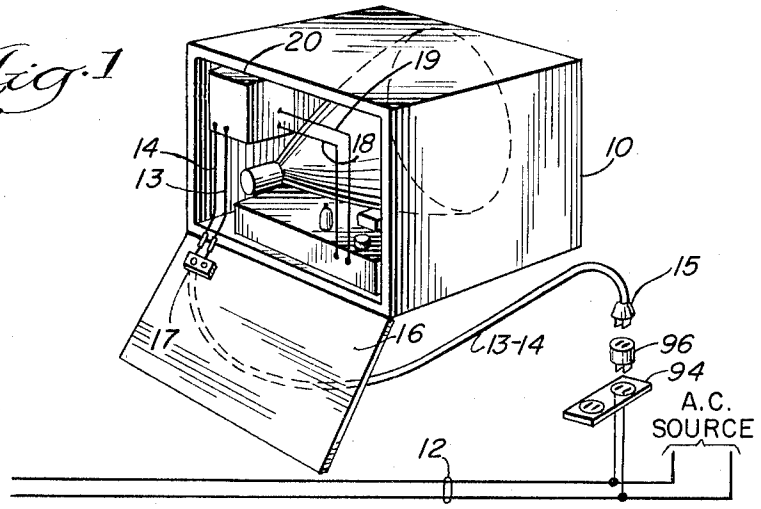


Fig. 2

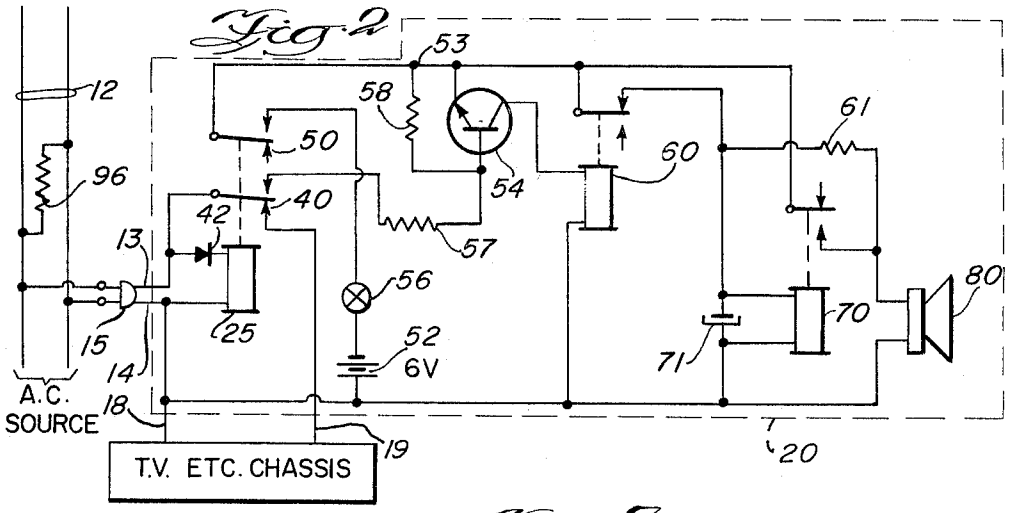


Fig. 3

LINE 12	PLUG 15	A.C. RELAY CONTACTS 40	A.C. RELAY CONTACTS 50	D.C. RELAY 60	D.C. RELAY 70	HORN 80
LIVE	IN	CLOSED	CLOSED	CLOSED	OPEN	DEAD
LIVE	OUT	OPEN	OPEN	CLOSED	CLOSED	SOUND
DEAD	IN	OPEN	OPEN	OPEN	OPEN	DEAD
DEAD	OUT	OPEN	OPEN	CLOSED	CLOSED	SOUND

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POWER LINE SENSING APPLIANCE THEFT ALARM

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This invention relates to alarm systems and, more particularly, to a burglar alarm system for giving an unequivocal warning of disturbance by an intruder of an electrically powered equipment of the type adapted for energization by a conventionally available, alternating current supply line.

This is a continuation-in-part of my copending application Serial No. 215,172, filed August 6, 1962, and entitled similarly. In our advancing society, much of the advance of this society is characterized by the availability of readily portable, electrically powered equipments to the individual members of the society, television sets, air conditioners and the like. Most conveniently, such equipments are powered from an alternating current power source provided in all premises suitable for occupancy by members of the society.

Attendant upon this need for portable, electrically powered equipments, is a concurrent need for protecting such often expensive equipments against burglary by unscrupulous and often clever thieves. Such thieves, in anticipation of burglar alarms, often are equipped with tools to effect disablement of customary alarms by interrupting the orderly processing of an alarm generating signal therein.

Typically, suitable cutting of cables or pulling of power supply plugs has been available to thieves of by-gone times to silence an embarrassing alarm. As an alternative, insertion of appropriate jumper leads has been available to a thief for silencing an embarrassing alarm while he pursued his unlawful purpose.

In accordance with the present invention, it is a principal object to provide a burglar alarm which is of a small size consistent with installation in the casing of a normally sized, electrically powered equipment.

It is a further object of the invention to provide a burglar alarm which is disposed within an equipment to be protected for continual, theft announcing signalling so long as the protected equipment remains in the hands of the thief.

It is a still further object of the invention to provide an alarm arrangement for portable electric equipments in which provision is made for disabling alarm signal arrangements so long as the normal power supplying connections are made to a portable electric equipment protected by apparatus in accordance with the invention.

The invention will be more clear and further objects, features and advantages thereof will become apparent from a consideration of the following brief description of an illustrative embodiment of the invention shown in the drawings and from a consideration of the appended claims.

In the drawings:

FIG. 1 is an isometric drawing of a partially opened, substantially conventional portable television set protected by alarm apparatus in accordance with the invention;

FIG. 2 is a schematic diagram of alarm apparatus in accordance with the invention; and

FIG. 3 is a block diagram arrangement delineating several to be expected conditions of apparatus in accordance with the invention.

The invention comprises generally a relatively high impedance conduction element, a resistor, for connection across a conventional A.C. power line for supplying a portable equipment protected in accordance with the invention. From this power line so adapted for cooperation with alarm apparatus of the invention, normal power connection is made to conventional input terminals associated with the protected equipment.

Thence, alarm arrangements in accordance with the invention are interposed in the path of alternating current supply to conventional operating components of the protected equipment. These so interposed arrangements include an alternating current relay having two sets of contacts operable responsive to proper supply of alternating current. The first set of contacts, normally open, are connected in a circuit, including a battery, for providing power to an alarm generator through an alarm signal processing channel. The other set of relay contacts, normally closed, are connected for supplying operating power to the protected equipment. The signal processing channel includes a signal amplifying and translating transistor element, and a transistor control feedback path. This path extends through the noted other set of contacts, normally open, of the aforementioned alternating current relay to the power line and, by way of the aforementioned high impedance resistor, conduction element, to the base electrode of the processing channel transistor to disable this transistor in the normally open contact condition. This provision allows for no generating of an alarm signal upon simple power failure in the supply lines for equipment protected in accordance with the invention.

For the usual condition of normal power line energization, the invention provides that this last mentioned set of contacts is opened but that a complete transistor disabling circuit is provided through the high impedance resistor connected across the power supply line. Clearly, this high impedance provides disabling circuit continuity but limits wasteful drain on the normally energized power line.

Through these last mentioned relay contacts, in an alarm position, the battery provided supplies energizing power to the alarm processing channel by way of a manually operable switch disposed in a physically secure position. In arrangements in accordance with the invention, this switch may be a key operated switch at some unobvious location such as a container for apparatus in accordance with the invention. Thence, appropriate switching arrangements are provided for conveying this battery supplied power to an alarm signaling indicator included in arrangements in accordance with the invention for providing conspicuous indication of protected equipment removal by unauthorized personnel.

Referring now more particularly to the drawings, in FIG. 1 there is shown a typical, electrically powered, portable equipment, a television set **10**, protected by apparatus in accordance with the invention including the processing circuits of the invention securely housed in the container **20**.

Internal leads **13**, **14** are provided within the housing for equipment **10** for receiving A.C. power by way of conventional, female plug **17** mounted on the back cover **16**. This plug is energized, in turn, by conductors **13**, **14** associated with male plug **15**. This plug is associated, in turn, with receptacle **94**. This receptacle is connected for being energized from A.C. power leads **12** connected to a conventional source of power. This source is indicated but not shown nor designated numerically. Neatly, the receptacle **94** is provided with an appropriate adapter **96** which, in well known fashion, provides a relatively high impedance conductive path across the two leads. This adapter **96** simply comprises a high impedance resistor connected across familiar male plugs and includes conventional receptacles respectively connected to these plugs. Thus, the adapter **96** electrically provides a resistor across power line **96**. Conveniently, it is installed remotely of the protected equipment at any con-

venient wall plug simply to avoid giving any warning to a potential thief. Alternatively this adapter may be made flush with receptacle 94 to avoid removal by the thief simultaneously with removal of plug 15. As will be seen hereafter, such simultaneous removal of an impedance across lines 13, 14 enables defeat of an alarm in accordance with the invention.

We turn next to the schematic diagram of FIG. 2. In this schematic diagram the two conductor power lead 12, as in FIG. 1, is shown connected for energizing receptacle 94, and, therethrough, plug 15 with associated leads 13, 14. The adapter 96 is represented in this schematic drawing simply by a similarly numbered resistor 96 across the power leads. The leads 13, 14, as shown, enter the housing 20, indicated by dashed lines, for energizing contained operating circuits for alarm apparatus in accordance with the invention. The two leads 13, 14 are connected, as shown by way of a rectifying diode 42, this diode being poled to oppose conduction from battery 52, discussed hereafter, to an operating winding of a double, A.C. relay 25 having first and second contact sets 40, 50. Such relays are readily available and well known in the art, being advertised, for example, in the 1960 Catalog of Allied Radio Corporation, 100 North Western Avenue, Chicago, Illinois, at page 211. Typically, such relays are designed to give effective armature switch response to an A.C. current at a preassigned level. Such relays do not respond to a direct current below a level consistent with the current carrying capacity of the operating winding. Such a characteristic may readily be imparted to a relay operating winding, as is well known in the art, by suitably adjusting the inductance of this winding in relation with an associated capacitor.

Applicant subscribes to no particular theory of operation for the A.C. relay 25 beyond observing the fact that apparatus constructed, actually employed an A.C. relay which was provided with switch armatures responsive only to A.C. current flow therethrough. It is surmised that these necessary A.C. components existing in energizing leads connected to the operating winding. It is well known in the art that in rectification of an applied, sinusoidal A.C. wave, such as by rectifier 42, pulses are derived which themselves have substantial A.C. components.

Assuming a normal condition, operating power is supplied from leads 12 by way of receptacle 94, adapter 96, plug 15, leads 13, 14 and one switch 40 of A.C. relay 25, positioned as shown, to leads 18, 19. Thence, this power flows to the representative protected equipment, the television chassis illustrated. At the same time this A.C. power is supplied through rectifier 42, it serves also to hold contact set 50 in the open condition illustrated. Thus, alarm energizing battery 52 provides no current through key operated, security switch 56. This switch is normally maintained in a closed condition but is operable by a key holder for disconnecting the battery 52 from energizing further alarm channels.

Now in the alarm condition, that is, in the condition that plug 15 is pulled from receptacle 94 by a potential thief, the current from battery 52 is supplied through the shifted relay contacts 50 (shifted from the position shown by failure of A.C. current in leads 13, 14). From this relay switch 50, current flows through lead 53 to energize the switch contacts of relays 60, 70. These relay contacts normally are positioned as shown.

Note now that in this condition, the relay switch contacts 40 are shifted for failure of energizing A.C. power from lead pair 12. Absent resistor 96, this absence resulting from removal of plug 15, no circuit connection is made to the base electrode of transistor 54. Thus, current flows through lead 53 from battery 52 to energize, but not to operate switch contacts of relay 60 positioned as shown. No current flows from the collector electrode of transistor 54. In this relay 60 switch position, current passes by way of lead 53 to charge capacitor 71 connected in parallel with an operating winding of relay 70.

Upon charging of capacitor 71, simply a delay capacitor, current flows from lead 53, to energize the switch contacts of a relay 70. These contacts, positioned as shown, normally provide an open termination for battery potential on lead 53. Shifted, however, upon charging of capacitor 71, these contacts provide energizing battery potential from lead 53 to an electric alarm horn 80 through which connection is made to a positive terminal of battery 52. This horn has a low, nominal impedance, for example, an impedance of 5 ohms.

In the operated condition, the switch of relay 70, is connected also by way of relatively large resistor 61, say a resistor of 100 ohms, to capacitor 71 and, through the unoperated switch contacts of relay 60, to the battery 52 energized lead 53. Simple voltage divider action between large resistor 61 and low resistance horn 80 insures that a small charging current is fed back to the delay capacitor 71 so long as the horn 80 is sounded. The disparity in size of the large resistor 61 and the impedance of horn 80 insures that this feed back current is minor.

Thus, initially, current supplied to lead 53 from the switch of relay 50 passes directly to the normally open switch of relay 70. At the same time, from lead 53, this current is passed by way of unoperated relay switch 60 through relatively, large resistor 61 so that only a negligible trickle of operating current is supplied to the low impedance horn 80. As capacitor 71 is charged, however, relay 70 shifts switch position and alarm connection is made directly from lead 53 to the electrically powered alarm device, horn 80.

In summary then, shift of relay switches 40, 50 follows immediately on opening of plug 15. This directs current from battery 52 to be amplified in transistor 54 if, but only if, a complete transistor base current path is provided by resistor 96 toward opening the switch of relay 60. Absent this opening, current passes through switch 60 and resistor 61 to energize horn 80 below an operating level, because of resistor 61 and to charge capacitor 71.

Thereafter, as capacitor 71 is sufficiently charged, relay switch 70 shifts to supply horn energizing current directly from lead 53 and, by way of resistor 61, to maintain capacitor 71 charged and relay switch 70 operated. Now, the condition of relay switch 60 is immaterial. The sounding of horn 80 is self-sustaining. Wherever a thief may take equipment protected by the invention, he takes the noisy alarm horn 80 too.

In the event that this alarm is initiated by mistake, an authorized key holder may quiet an individual equipment by opening the key switch 56 to interrupt horn power supply from battery 52.

Should the power fail on lead pair 12, a not uncommon mischance, relay switches 40 and 50 will shift positions as discussed above but no alarm indication from horn 80 will result. Insead, the base electrode of N-P-N transistor 54 is connected by way of resistor 57, lead 13, power line bridiging resistor 96, and lead 14 to the positive terminal of battery 52. These several resistors are chosen of such values in connection with the base-emitter resistor 58 that the transistor 54 is biased ON so long as conductive connection, as by resistor 96, is made across leads 13, 14. At the same time, resistor 96 is chosen of a sufficiently high value that negligible power drain is made across power lead pair 12. Thus, upon simple power failure in leads 12 collector current from transistor 54 operates relay 60 to an open condition and no power is available for operating switch 70. Notice, the aforementioned back biasing of transistor 54 is ineffective for silencing the alarm 80, once sounding has been initiated, as a result of feed back through resistor 61.

In the diagram of FIG. 3 there are shown the cooperative relations of the principal elements of apparatus in accordance with the invention.

In the first line of this diagram we observe the conditions of those elements in a normal condition. The relays **40**, **50** are energized and positioned as shown so no battery power is available to the lead **53**, or, consequently, to horn **80**.

In the condition represented by line **2**, power is available on lead pair **12** but the plug **15** has been removed from its receptacle, presumptively by a thief. The A.C. relays contacts, **40**, **50** are deenergized and shifted from the normal condition illustrated by FIG. 2. Thus, alarm battery power is supplied to horn **80** through lead **53** and switch **70** after a moment during which the capacitor **71** is fully charged—near instantaneously, to be sure—to operate relay **70**. During this interval horn **80** energized to be sure but below an operating level is through resistor **61**.

Next, in the third alarm apparatus condition illustrated in FIG. 3 the line **12** is dead, a power failure, but the protected apparatus is not disturbed. Plug **15** remains in place, relays **40** and **50** are shifted but feedback from the base electrode of transistor **54** through line bridging resistor **96** permits passage of transistor amplified current to the operating winding of relay **60**. Accordingly, no power is supplied to horn **80**. Hence, with conduction by transistor **54**, no sound is heard from horn **80** to warn of power line failure.

Finally in a fourth condition, the power line **12** again fails but a thief disturbs the protected apparatus. No connection exists across line **13**, **14** by removal of plug **15**. Relays **40**, **50** continue open to provide battery power to line **53** and forward bias to transistor **54**. Relay **60** shifts from transistor **54** collector current flow to charge capacitor **71**. Relay **70** shifts and battery power is supplied directly to sound horn **80** and to maintain capacitor **71** charged through resistor **61**.

In this fashion the alarm apparatus provides a binary programming arrangement to outwit the would be thief. The logic elements are supply (1) line **12**, (2) plug **15**, (3) relay **40**, (4) relay **50**, (5) relay **60** and (6) relay **70**. The six designated logic elements (1)–(6) are so arranged that disturbance of (1) alone will not lead to positive output response from (6) the alarm controlling relay. Similarly, disturbance of logic element (2) will give a positive output from the alarm signalling horn **80**. But this output is negated by the disabling feed back path from transistor **54** absent disturbance of logic elements (2).

The invention has been described with respect to a single illustrative embodiment. It will be clear to one skilled in the art the numerous variations on this illustrative embodiment without departing from the spirit and the scope of the invention.

What is sought to be secured by Letters Patent of the United States is set forth in the appended claims:

1. Alarm apparatus for installation within the housing of an equipment adapted to be powered from a pair of leads energized by an alternating current source which comprises, high resistor means for connection across said pair of leads, an electric lead pair for connection from said pair of leads to said apparatus, first and second relay switches, an operating winding responsive to applied alternating currents of operating said switches from a first condition to a second condition, a common lead, a battery for energizing said common lead by way of said second switch in a first condition, an electrically operated alarm horn, connecting means for energizing said alarm device from said common lead, said connecting means comprising relay operated switch means having an operating winding and being operable to interrupt energizing current flow to said alarm device upon current flow through said last named operating winding, a transistor having first and second conduction electrodes connected in circuit from said last named common lead to said operating winding and having a control base electrode connected in circuit with said conduction electrodes by way of said first switch in a first condition and by way of said resistor means, whereby power supply from said battery to said alarm device is interrupted by transistor current flow through said operating winding thus to preclude energizing said alarm device by failure of power in said pair of leads.

2. Apparatus as set forth in claim **1** and in combination therewith a next relay having an operating winding connected in circuit with said common lead by way of said connecting means, said next relay having an operating winding on a parallel connected storage capacitor, said next relay being operable to connect said common lead in operative circuit with said alarm device upon charging of said capacitor to a threshold level.

3. Alarm apparatus for disposition in the housing of an electrical equipment requiring power from a first pair of leads energized from a source of alternating current power which comprises, a second lead pair for electrically connecting said first lead pair to said equipment in said housing, an alarm device for rendering an alarm, a battery having first and second direct current voltage terminals, a common lead for conducting energizing current between said first terminal of said battery and said alarm device, means connecting the first terminal of said battery to one lead of said second lead pair, first and second switch means responsive to the presence of a normal alternating current voltage on said second lead pair for interrupting a first normally closed connection between said common lead and said first terminal of said battery for completing a normally open connection between said second lead pair and said electrical equipment for supplying alternating current thereto, and for interrupting a second, normally closed circuit connected between a second lead of said second lead pair and a D.C. responsive operating means for a third switch means, means connecting the second terminal of said battery to said D.C. responsive operating means, a resistor for connection across said first lead pair, and a third switch means for interrupting, when operated, the normally closed circuit through said common lead to inhibit said alarm device, said D.C. responsive third switch operating means responsive to a D.C. connection through the battery, first leads of said first and second lead pairs, said resistor, said second leads of each of said first and second lead pairs, and said second closed circuit for operating said third switch means.

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