US005561417A

United States Patent [19]

Rothbaum et al.

[11] **Patent Number: 5,561,417**

[45] **Date of Patent: Oct. 1, 1996**

[54] **SECURITY DEVICE FOR MERCHANDISE AND THE LIKE**

[75] Inventors: **Arthur H. Rothbaum**, Northport; **Richard S. Goldblatt**, Kings Park, both of N.Y.

[73] Assignee: **Protex International Corp.**, Bohemia, N.Y.

[21] Appl. No.: **174,389**

[22] Filed: **Dec. 28, 1993**

[51] **Int. Cl.**[6] **G08B 13/14**

[52] **U.S. Cl.** **340/568**; 340/687

[58] **Field of Search** 340/568, 687

[56] **References Cited**

U.S. PATENT DOCUMENTS

3,127,597	3/1964	Lewin et al.	340/568
3,253,270	5/1966	Downer	340/568
3,596,265	7/1971	Garland	340/568
4,293,852	10/1981	Rogers	340/568
4,620,182	10/1986	Keifer	340/687
4,746,909	5/1988	Israel et al.	340/568
5,066,942	11/1991	Matsuo	340/568
5,153,567	10/1992	Chimento	340/691
5,172,098	12/1992	Leyden et al.	340/568
5,345,220	9/1994	Wachsman	340/568

FOREIGN PATENT DOCUMENTS

1730092	3/1992	Australia .

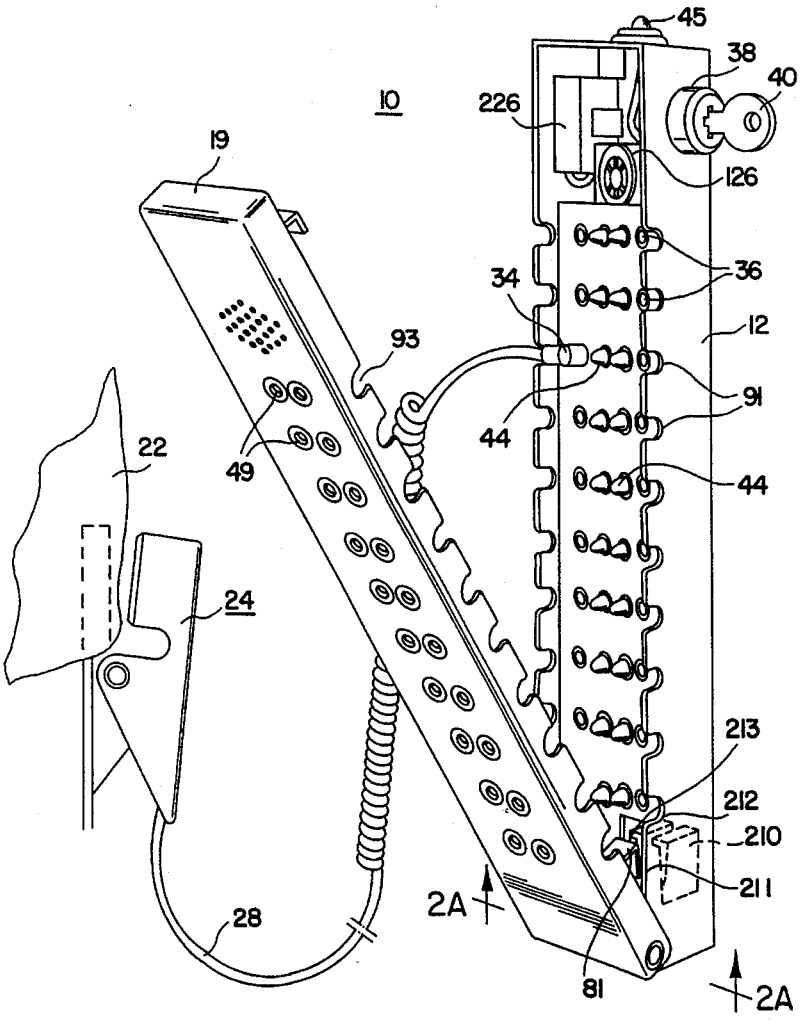
Primary Examiner—Glen Swann

Attorney, Agent, or Firm—Eugene E. Renz, Jr.

[57] **ABSTRACT**

An electronic security system for monitoring merchandise sounds an alarm when a change in the state of the sensors or the electrical connections is detected. The system eliminates the need for shunt plugs and other extraneous components in favor of a self-contained solid state electronic circuit. The security system includes a lid which deactivates the alarm when the lid is open. When the lid is closed, the alarm is activated and physical tampering with the electrical connections.

13 Claims, 5 Drawing Sheets



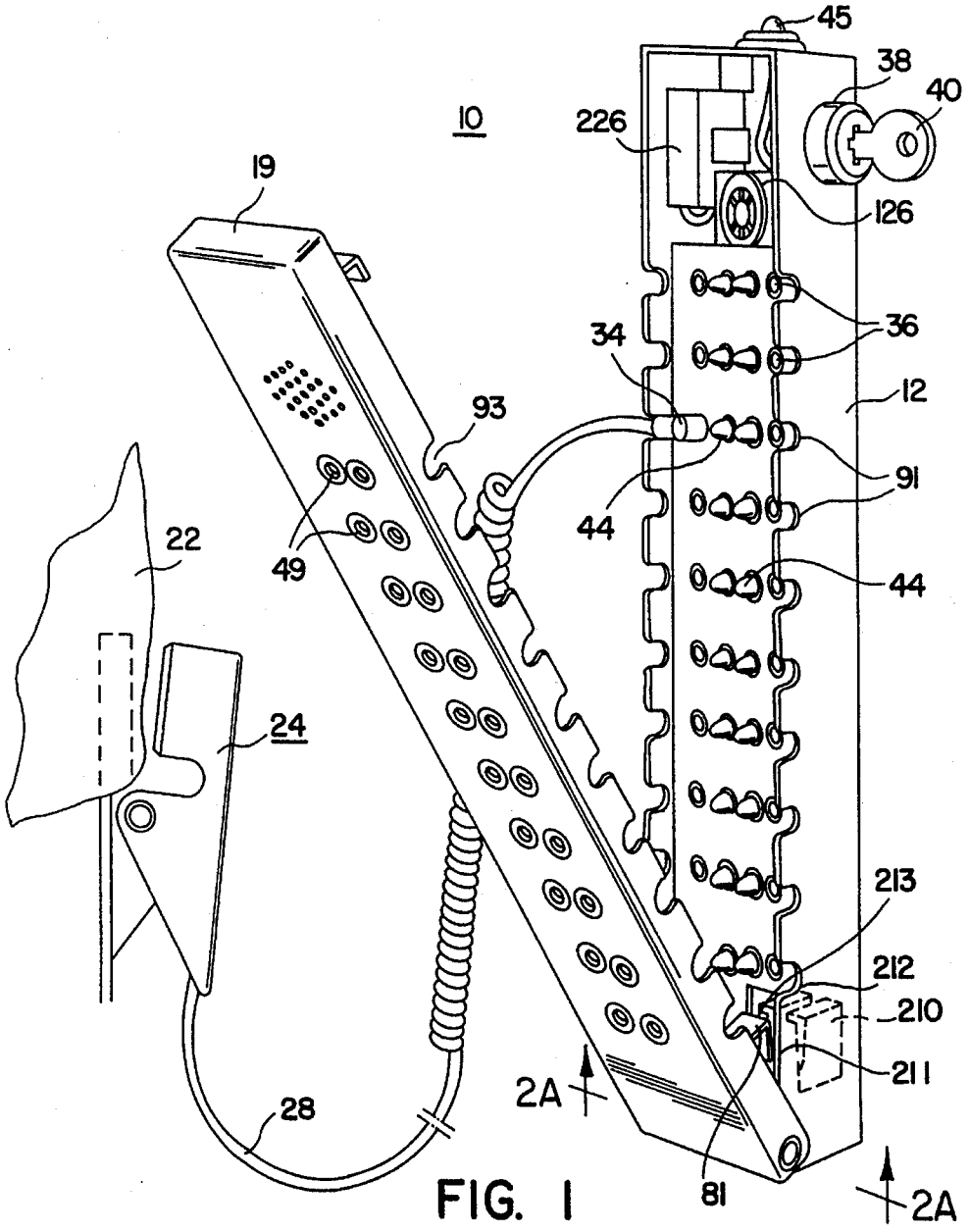


FIG. 1

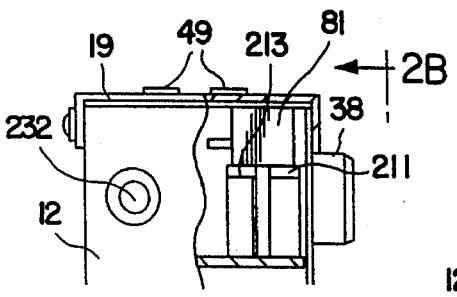


FIG. 2A

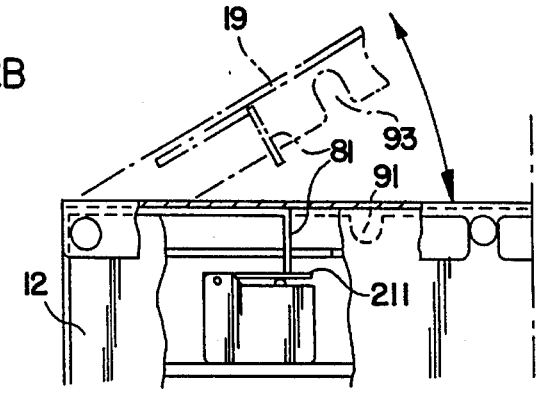


FIG. 2B

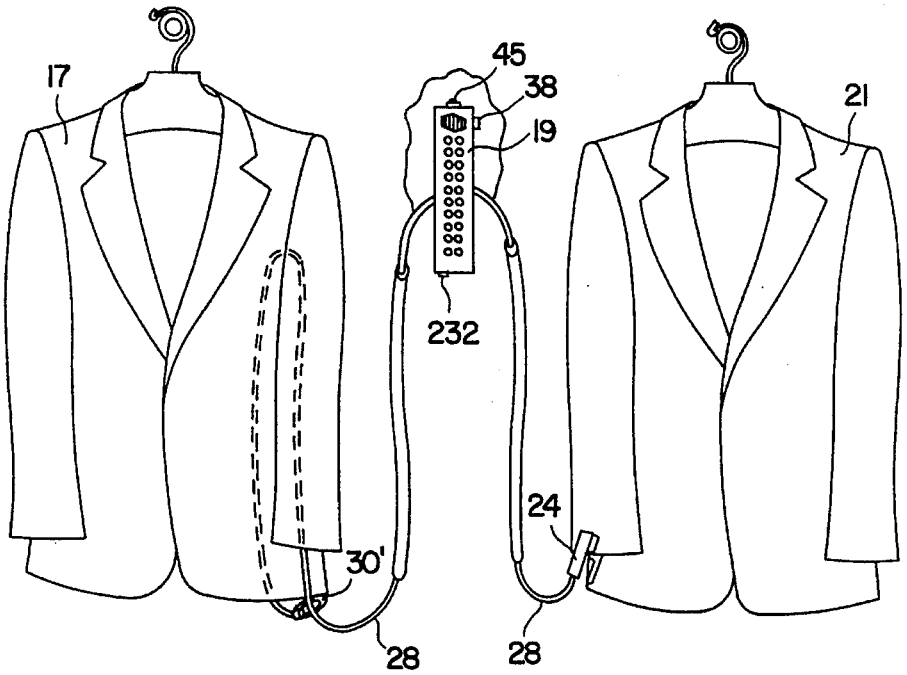


FIG. 3

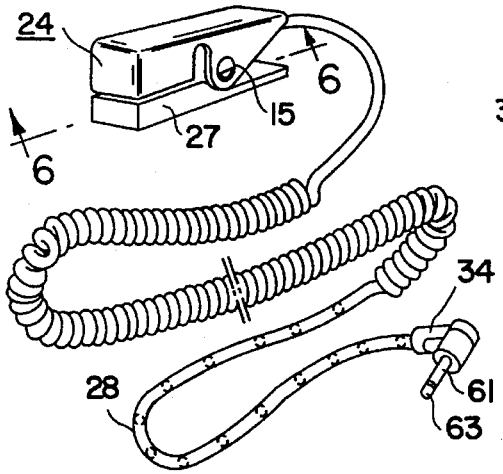


FIG. 4A

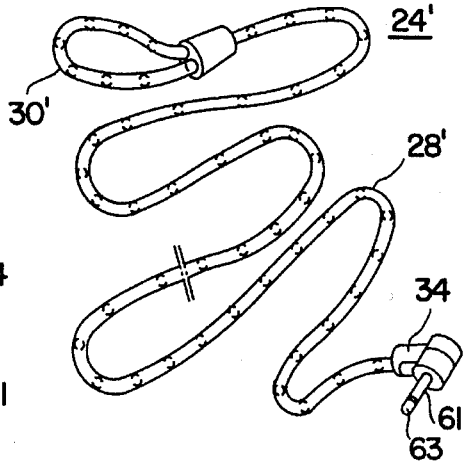


FIG. 4B

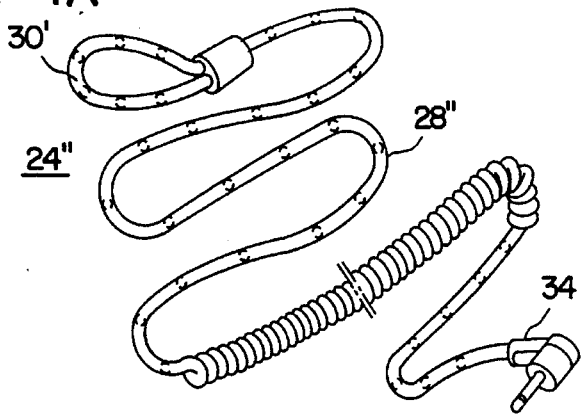


FIG. 4C

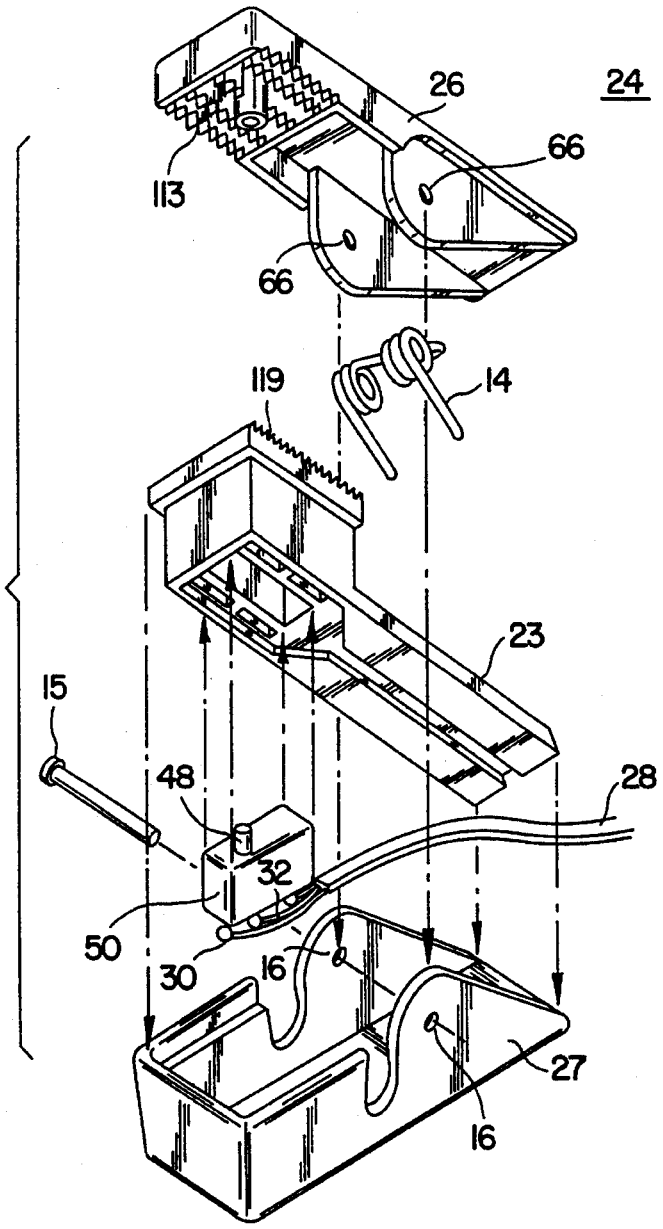

24
26
66
113
66
119
14
23
15
48
28
32
50
30
16
27
16

FIG. 5

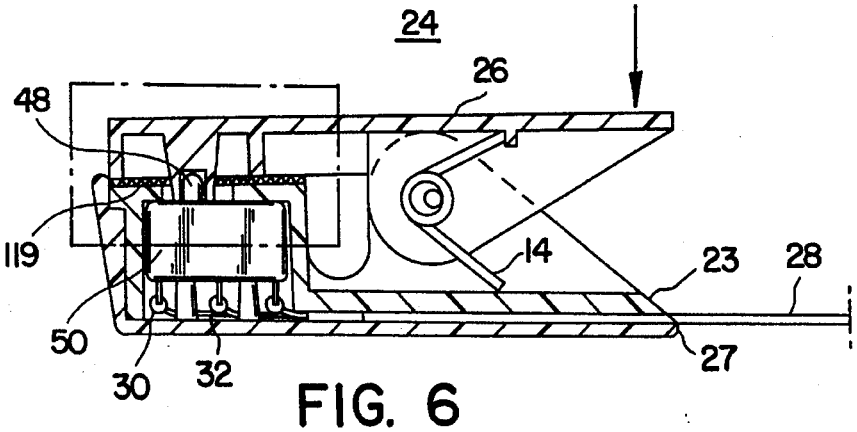

24
26
48
119
14
23
28
50
30
32
27

FIG. 6

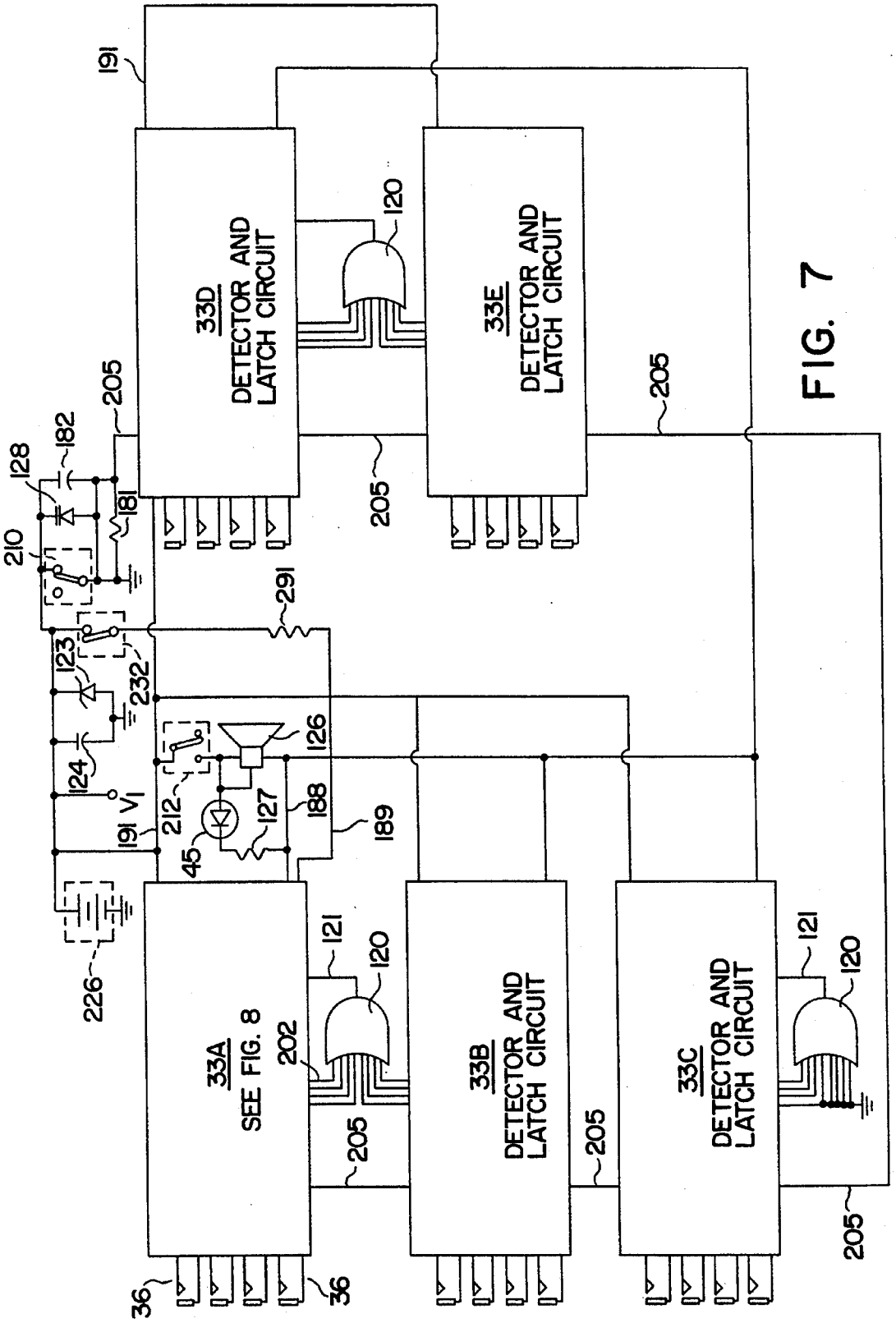

191
33D DETECTOR AND LATCH CIRCUIT
120
33E DETECTOR AND LATCH CIRCUIT
205
205
205
182
128
181
210
291
123
232
126
124
212
127
188
189
191 V1
45
226
33A SEE FIG. 8
202
121
120
33B DETECTOR AND LATCH CIRCUIT
33C DETECTOR AND LATCH CIRCUIT
121
120
205
205
205
36
36

FIG. 7

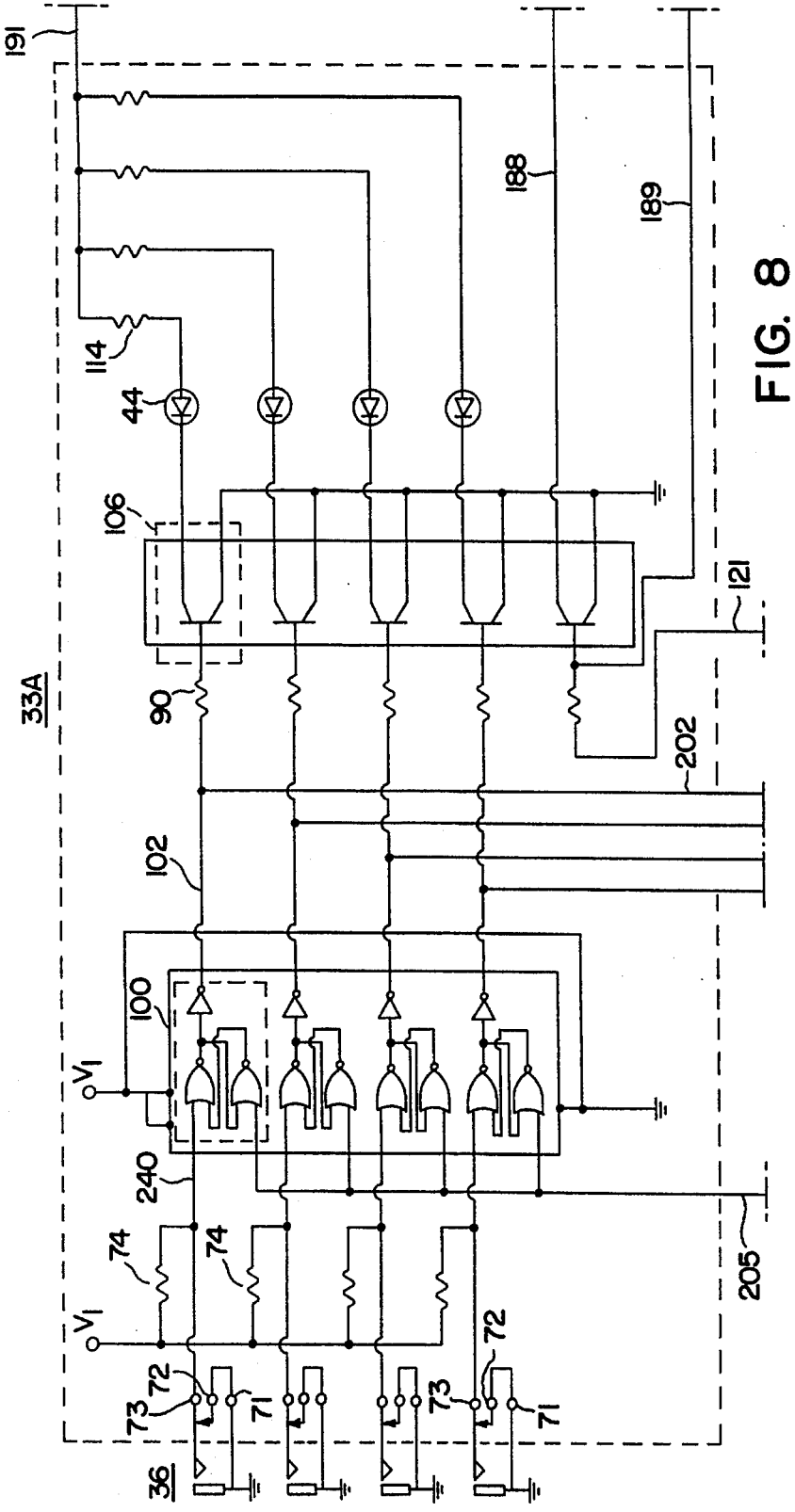

191
188
189
114
44
106
121
33A
90
202
102
100
V1
240
74
74
205
V1
72
72
73
71
73
71
36

FIG. 8

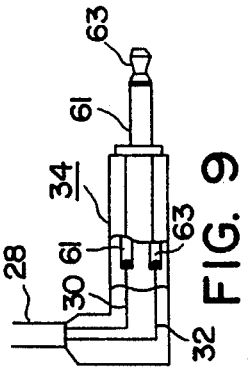

63
61
34
63
28
61
30
32

FIG. 9

SECURITY DEVICE FOR MERCHANDISE AND THE LIKE

FIELD OF THE INVENTION

The present invention generally relates to security systems, and more specifically to electronic security systems used in retail stores, offices, hotels and other establishments to prevent the theft of merchandise.

BACKGROUND OF THE INVENTION

Various types of security systems to protect retail goods on display in a store are known throughout the trade. The basic components of the system include a sensor which is attached to each item of merchandise intended to be protected, a switch within the sensor which generates an alarm signal, splitter boxes or similar modular connecting units for receiving signals from the sensors, and an alarm box which is connected to the splitter boxes through various conducting cables and which houses an alarm.

Merchandise security systems can be broadly classified into two groups, closed loop and open loop systems. In a closed loop security system, current constantly flows from the alarm box to the sensor. The sensor switch is in a normally open state, i.e., a non-conducting state. Depressing the actuator of the switch would place the switch in a closed state, i.e., a conducting state. The sensor is attached to the article in such a manner that the actuator of the switch is depressed, placing the switch in its closed state, i.e. the contacts of the switch make or are electrically connected. After a sensor is attached to each item of merchandise, the alarm circuit is armed or set, usually with a key switch. When armed, the alarm box circuitry sends out a continuous current through the splitter boxes and sensor switches; the current then returns to the alarm box circuitry. A complete electrical circuit is formed when the switch is closed as a result of its attachment to an item of merchandise. As long as no cables are cut and the actuator remains depressed, a complete electrical circuit is made and the security system remains in its armed state.

During an unauthorized removal of the sensor, the actuator is distended, which opens the switch contacts and which breaks the closed loop circuit. Similarly, if a cable is cut the continuous current to the sensor is interrupted. The alarm box circuitry detects that the current has been interrupted and an alarm will sound. The alarm notifies store personnel that there has been a security breach.

A typical closed loop alarm system is disclosed in U.S. Pat. No. 4,746,909 (the '909 patent), issued May 24, 1988. The '909 patent discloses an electronic security system including a single control box, series connected modular sensor units, and conductive loop sensors attached to the modular monitoring units. A closed loop circuit is formed through the conductive loop sensors. The unauthorized removal of an item of merchandise will break or disconnect the conductive loop. This closed loop circuit will be broken; this disruption will be detected by the monitoring circuit which activates the alarm. A time-out circuit within the control box is used to determine the period of time in which the alarm is activated.

U.S. Pat. No. 3,253,270 discloses a battery-powered alarm in which separate long leads are connected to each of the goods to be protected. A first battery is used to power a detection circuit and a second battery is used to power an alarm circuit. A resistor is included with each sensor. The

resistance of each sensor resistor must be substantially identical to the resistance of an internal circuit resistor. During a security breach, the current in the line will change, thus affecting the calibration of a meter in the detection circuit. When the needle of the meter is deflected far enough, an alarm is sounded.

The '270 patent also discloses a box to house the alarm circuitry. The box includes a lid which can be locked to the box. The lid is locked after the meter is adjusted to prevent tampering with the alarm system.

Another example of a closed loop system is U.S. Pat. No. 5,172,098, issued Dec. 18, 1992. The '098 patent discloses sensor switches on each sensor. During a security breach, the switch opens, breaking the closed loop. Detection circuitry determines that a security breach has occurred and turns on an audio and visual alarm.

The assignee of the '098 patent has developed several other closed loop security systems which operate in a manner similar to the '098 patent. For example, their Kord Kontrol® strip alarm system is another closed loop system. The Kord Kontrol® strip alarm is powered by two nine volt batteries with an AC adapter option. A switch within each sensor activates the alarm horn.

The assignee of the present application also has developed closed loop security systems. For example, the Electronic Merchant Guard (EMG-32) can be used with mechanical cables or electronic cables. The mechanical cables physically secure merchandise to a stationary box; the electronic cables carry a small DC voltage to electronic sensors which electrically secure merchandise. When merchandise is electrically secured, an alarm is sounded upon the detection of a security breach. The Electronic Merchant Guard houses the electronic circuitry in the same stationary box to which the mechanical cables are secured. A cover on the stationary box prevents tampering of the circuitry and locks the mechanical cables to the stationary box.

The assignee of the present application also manufactures SECURTRON (ES-24) which is a closed loop security system. The SECURTRON is easily adaptable to any fixture or wall system. Sensor clips or electronic cables are attached to the items or goods to be protected. The alarm circuitry is electronically connected to the sensor clips forming a closed loop circuit. When the cable is cut or is improperly removed, or when the security clip is removed without authorization, an alarm is activated.

A drawback of all closed loop security systems is that current must constantly flow. Accordingly, power must be supplied to the conductive loop or to the sensor switch at all times. Usually, the most feasible way to do this is to provide power via an AC/DC adapter. This presents a problem during power outages. Also, many stores turn off all power to the retail floor space at night or when the store is closed.

Battery backups have been designed to supply the necessary current; however, the current draw on the batteries is often too great to supply current for extended periods of time. This leaves the merchandise unprotected from unscrupulous security guards and support personnel (janitors, stock boys, etc.). In addition, batteries would need to be checked and replaced on a regular basis, increasing the maintenance of the security system. Recently, the situation has become more acute with the use of light emitting diodes (LEDs) on the splitter boxes and on the sensors. The LEDs add to the current drain making a battery back-up system an even less viable option.

Another drawback of many closed loop security systems is that they require jumpers or shunt plugs on the splitter box

connections which are not connected to merchandise. The shunt plugs form an electrical connection to prevent the alarm from sounding when the system is armed. Shunt plugs increase the cost of the system and are also a source of misconnections if improperly installed. Further, shunt plugs must constantly be installed and removed as the items of merchandise are sold or as stock is replaced. Accordingly, the shunt plugs increase the amount of time store personnel must spend attending to the security system. In addition, if the required shunt plugs are lost or not installed properly the security system is inoperable since the alarm will sound continuously.

An open loop security system operates in a similar fashion to a closed loop system. However, the sensor switch would be normally closed, i.e. when the actuator is distended. When the sensor is properly attached to the merchandise, the actuator is depressed, opening the switch; this prevents current from flowing. If there is a tampering of the sensor switch, the actuator distends, the switch contacts close and current flows through the sensor switch. A continuous circuit is made when the sensor switch closes, activating the alarm.

In an open loop security system, the alarm does not sound unless a circuit is completed. Normally, the only way to complete the circuit is to remove the sensor from the article. Therefore, an open loop security system may be circumvented by cutting the sensor cable or removing the sensor cable plug from its jack. In this manner, the article may be stolen without the alarm sounding. Since open loop systems are easier to circumvent, they are not as popular as closed loop systems.

An open loop security system is disclosed in U.S. Pat. No. 4,620,182. This device includes a special cable which is designed to short out its internal wires if the cable is cut. When this cable is cut or damaged, a complete circuit is made thereby activating the alarm.

In many of the closed loop and open loop systems merchandise can be added while the security system is armed; either no alarm or only a short alarm will be activated. Continual short bursts from an alarm horn may annoy customers. In addition, many of these systems may be susceptible to circumvention since a foreign object may be connected to the security system to override the alarm.

The use of alarm modules or splitter boxes in security systems increases the maintenance of the security system. Extra connections are required to incorporate these splitter boxes; these extra connections are a weak link that can be attacked by a thief. In addition, many security systems require jumpers on all unused connections. Further, splitter boxes are unsightly to look at, and are a source of misconnections and false alarms.

SUMMARY OF THE INVENTION

It is an object of the instant invention to provide an improved security system to protect merchandise and the like.

The instant invention is a closed loop security system. An alarm horn will sound and various LEDs will light upon the detection of a security breach. It is designed to conserve energy by lighting the necessary LEDs only during a security breach. In addition, the system is activated or deactivated by movement of the lid.

The present invention is a fully integrated security device and system to protect articles of merchandise within a retail store. The alarm and detection circuitry, the connections to the sensors, and the power supply are all located in one housing. Accordingly, the security system is an integrated or completely self-contained unit. The instant security device and system includes a plurality of electronic sensors which are attached to the items to be protected. Item cords or cables connect the sensors directly to the alarm circuit. The preferred connection means is to have plugs on the ends of the item cords. Mating jacks, located on the housing, ensure the proper electrical contact between the plugs and the detector circuit. Separate alarm modules or splitter boxes are not required.

The alarm circuit is housed in a single unit or strip and is usually remotely located from the protected items of merchandise. However, the system is completely self-contained and can be located almost anywhere, including directly attached to various display racks.

The present security system is powered by a battery contained within the housing and is designed to conserve energy. This eliminates a potential security problem since there is no AC/DC adapter nor is there a connection from the AC/DC adapter to the alarm circuitry. Further, a power outage in the retail store will not affect the operation of the security system.

A LED is associated with each sensor circuit and is located on the housing next to its respective item cord jack. The LED indicates a secure or non-alarm state by displaying a first color. In order to conserve the greatest amount of energy, the first color of the LED may be "off", indicating that the system is armed.

An alarm indicator light is on the housing at a location that is easily visible. The alarm indicator light turns on when the system is armed and a security breach is detected. The alarm indicator light may be an LED and is preferably large enough to catch the attention of store personnel from a distance. In order to make the indicating light even more noticeable, components can be chosen and designed to turn the indicator light on and off repeatedly, i.e. blinking, upon the detection of a security breach.

The present invention also includes a specially designed lid or cover. During normal operations, i.e. in its armed mode, the lid is mechanically locked to the housing. The lid contains holes so that all of the housing LEDs are visible. The lid also has holes to allow the item cords to pass through. When the lid is closed, it blocks access to the plugs and jacks, preventing an accidental or an unauthorized removal of the plugs from the jacks.

The lid is also designed to change the state of a switch or switches. The primary function of these switches is to control the circuitry of the security system and to place the security system in its proper mode.

When the lid is open, a switch or switches are actuated placing the security system in its SET-UP mode. The horn and the indicator light will be deactivated; the sensors can be properly affixed to the items of merchandise to be protected without the distraction of having the horn or indicator light being on.

When the lid is closed, the lid changes the state of the switches and the security system is on or ARMED. The horn and indicator light are activated but remain off; they will both turn on upon the detection of a security breach.

Upon the unauthorized removal of the sensor, the cutting of the item cable, or upon a similar security breach (i.e. the breaking of the closed circuit), the alarm will sound, the housing LED will change from its first color to a second or alarm color (e.g., off to on), and the indicator light will blink. After a security breach, the store personnel will be alerted to the particular security system which has been breached by

the blinking LED and by the audio alarm. This feature is especially useful when there are many security systems within close proximity. The store personnel can determine the general location of the breach by approaching the direction of the horn sound and the blinking light. After locating the security system in which the breach took place, the store personnel scans the LEDs on the housing. The store personnel can immediately see which sensor was tampered with since the associated housing LED will be on.

The security personnel can deactivate the horn by unlocking and opening the lid. As the lid opens, the switches are activated, turning the horn and the indicating light off; however, the circuitry design allows the housing LED to remain lit.

The present security system is designed to physically and electronically protect the connections of the sensor to the housing. Store personnel cannot connect merchandise to the instant security system unless the key to the lid is obtained from authorized personnel. In addition, the present security system's SET-UP mode cannot be overriden unless the key is obtained.

LEDs may also be placed within the sensor housing to provide a visual warning to a potential thief that the item of merchandise is protected by a security system. However, sensor LEDs will add an additional current drain on the battery.

BRIEF DESCRIPTION OF THE DRAWINGS

Other objects and advantages of the present invention will become apparent from the following detailed description, when taken in conjunction with the accompanying drawings, wherein:

FIG. **1** is a perspective view illustrating the various components comprising the electronic security system, shown in accordance with this invention.

FIG. **2A** is a slightly enlarged bottom plan view taken along line **2A—2A** of FIG. **1**, with the hinged lid in a closed position and a portion of the housing shown in section to more easily view the plunger engaging the activating switches in unison.

FIG. **2B** is a fragmentary side elevational view taken along line **2B—2B** of FIG. **2A**, with a portion of the housing shown in section to more easily view the plunger engaging the activating switches, and including a fragment of the lid in dashed line in an intermediate opened position.

FIG. **3** is an elevational view illustrating two of the sensors (an electronic cable and a security clip) used to protect articles of clothing in accordance with the present invention.

FIGS. **4A–4C** illustrate three types of sensors that may be utilized with the instant invention.

FIG. **5** is an exploded isometric view showing all of the component parts of the electronic security clip sensor prior to assembly.

FIG. **6** is an enlarged sectional elevational view of an electronic security clip sensor taken along line **6—6** of FIG. **4A**.

FIG. **7** is a partial schematic diagram of the security system according to the present invention.

FIG. **8** is an enlarged schematic diagram of the detection and latch circuitry contained within the blocks of FIG. **7**.

FIG. **9** is an enlarged sectional view of a plug used in connection with the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

The security system of the present invention is an advanced electronic cabling system which is adapted for use in protecting merchandise displayed in a retail store. The system can protect almost any item with the proper sensor, however it is particularly suited to protect soft goods, e.g. clothing. Referring now to the drawings, a security system, according to the instant invention, includes at least one sensor, e.g. an electronic cable or an electronic security clip, along with an alarm circuit; one such security system being designated in its entirety by reference numeral **10**.

The security system circuitry will detect a security breach by turning on a housing LED to indicate exactly which circuit has been broken (i.e., a sensor has been tampered with, or a cord or cable has been cut), and activating an alarm (visual, audio or both) to attract the attention of the store personnel. The system circuitry will also "remember" when a sensor circuit has been opened such that an alarm condition cannot be reset by reconnecting the sensor.

Referring to FIG. **1**, a security system **10** in accordance with the present invention is shown. The number of jacks corresponds roughly to the number of items of merchandise that can be protected. One skilled in the art could replicate the circuitry to make a security system to protect any number of items.

The preferred embodiment envisions the security system having twenty jacks **36**, as illustrated. A housing **12** contains virtually all of the circuitry. This self-contained or integrated approach eliminates the need for splitter boxes. Also, the system is designed to run on a battery **226** located within the housing **12**. Accordingly, the number of false alarms and misconnections are reduced since no external connection to an AC/DC adapter is required.

Typically, battery **226** is a single nine volt battery. Battery **226** provides all of the power needed for the security system. All references to the V_1 supply voltage means the voltage supplied by battery **226**.

It should be noted that one skilled in the art could readily adapt the present security system for use with an AC/DC adapter. The AC/DC adapter can be hard-wired to the security system, or a plug/jack connection could be utilized. When using an AC/DC adapter, a power indicator light may be used to indicate that DC power is being properly supplied by the AC/DC adapter.

Store personnel decide which articles of merchandise **22** are to be protected. In the preferred embodiment, up to twenty items **22** of merchandise may be selected for protection; this corresponds to a one-to-one relationship with the number of jacks **36** located on the housing **12**. However, variations are readily designed.

It should be noted that the system is still operable when less than all jacks **36** are used. Further, if there are less than twenty items **22** to be protected, jumpers or shunt plugs are not required to be inserted into the unused jacks **36**.

The location of housing **12** is determined by a variety of factors, including the location of the items **22** of merchandise to be protected and the length of an item cord **28**. Other factors which may be considered are the convenience of store personnel, a desire to keep the housing **12** visible from a distance, and for aesthetic purposes. Although the housing **12** is shown in a vertical orientation, it may be mounted horizontally or in any other orientation without affecting the operation of the security system.

The present security system **10**, may be used to protect hard goods (TVs, VCRs, computers, telephones, etc.) How-

ever, it is particularly adapted to be used in protecting soft goods, including coats, suits, skirts, dresses, and other articles of clothing. The sensor used in conjunction with this security system depends on the type of merchandise to be protected.

For purposes of illustration, the security clip **24**, as seen in FIGS. **1**, **3**, **4A**, **5** and **6**, will be used to describe the operation of the security system. However, one skilled in the art would readily understand that this security system **10** will work with any sensor that has a two-state or binary component (on/off); for example conductive loops (see FIGS. **3**, **4B** and **4C**), specially adapted computer plugs and RCA-type plugs, and other sensors which can be easily designed to work with the instant invention.

In FIG. **4B**, an example of a closed circuit electrically conductive loop **24'** is illustrated. Item cord **28'** is straight and contains two wires. The loop portion **30'** connects the ends of the two wires contained by item cord **28'**. Current flows from the detection circuit, through one wire of item cord **28'**, through loop **30'** and back to the detection circuit through the second wire of item cord **28'** forming a closed loop circuit. Loop portion **30'** will physically break upon the application of excessive pressure, which electrically breaks the closed loop circuit, thereby activating the alarm.

The closed circuit electrically conductive loop **24"** of FIG. **4C** operates in a similar manner to the conductive loop **24'** except that item cord **28"** is coiled. Identically numbered components are interchangeable between the various sensors. For example, right angle plug **34** can be used with a security clip **24** or either closed circuit conductive loop **24'** or **24"**. Similarly, loop **30'** is identical on both electrically conductive loops **24'** and **24"**.

Referring to FIG. **5**, the individual elements of the clip device **24** are shown in an exploded view prior to assembly. The clip device **24** generally includes a lower jaw **23**, a clip base **27**, and an upper jaw **26**. Lower jaw **23** is secured to clip base **27**. Spring **14** is held in place by shaft **15**. Holes **66** of upper jaw **26** and holes **16** of clip base **27** are designed to hold shaft **15**, so that the jaw **26** pivots with respect to clip base **27**. The spring **14** biases the jaws in a closed position.

Security clip **24** is connected to the item of merchandise **22**. The clip **24** is attached by applying pressure on upper jaw member **26** in the direction of clip base **27** as shown by the large arrow in FIG. **6**. This raises the upper jaw **26** and exposes actuator **48** of switch **50**.

An item of merchandise is inserted between the open jaws **26**, **23** of the clip **24**. Pressure on upper jaw member **26** is released and the jaw faces **113** and **119** of upper jaw member **26** and lower jaw member **23**, respectively, frictionally engage the item **22**.

The item of clothing is held in place by pressure supplied by spring **14**. Teeth or a non-slip material on either, or both, jaw faces **113** or **119** may also be used to more thoroughly secure the item **22**. The bias provided by spring **14** along with the slip resistant surfaces of jaw faces **113**, **119** prevent the accidental displacement of the item **22** from the jaws.

The switch **50** is connected to the system circuitry via wires **30** and **32** of item cord **28**. Item cord **28** is of sufficient length to connect the clip **24** to the system circuitry located within housing **12**. In the preferred embodiment, item cord **28** is coiled to allow for a longer length while minimizing entanglement.

Any connection means can be used to electrically connect the wires **30** and **32** of clip **24** to the security system circuitry. In the preferred embodiment, a two-contact plug **34** is used as shown in FIGS. **4A–4C** and FIG. **9**. Contact or terminal **61** is located at the base of plug **34** and contact **63** is located at the tip of plug **34**. Plugs **34** are illustrated as having a right angle design, however any style plug may be used including straight plugs.

A mating jack **36** is mounted in the housing **12**. The clip plugs **34** and the corresponding mating jack **36** are off-the-shelf items. Plug **34** is inserted into jack **36** to make the appropriate electrical connections. When plug **34** is fully inserted into jack **36**, terminals **61** and **63** physically and conductively touch terminals **71** and **73** FIG. **8**, respectively, of jack **36**.

Cover or lid **19** serves two main purposes. First, cover **19** includes a plunger **81**. When cover **19** opens and closes, plunger **81** activates switches **210** and **212** (see FIGS. **1**, **2A**, **2B** and **7**). Second, cover **19** is mechanically locked into place, preventing physical access to jacks **36** and any plugs **34** inserted into jacks **36**. Accordingly, this prevents tampering with unused jacks **36**, and the accidental or unauthorized removal of plugs **34** from jacks **36**.

The state of the security system **10** depends on the position of cover **19**. When cover **19** is opened or separated from the housing **12**, the security system **10** is in its SET-UP mode. The security system **10** is activated or placed in its ARMED mode by the closure of cover **19**.

The security system is "on" or in its ARMED mode when plunger **81** simultaneously engages the flexible metal bars **211** and **213** located on the tops of switches **210** and **212** respectively. Switches **210** and **212** are single-pole double-throw switches. Metal bars **211** and **213** contact the actuators of switches **210** and **212**. The metal bars **211** and **213** provide a larger surface area for plunger **81** to engage the actuators of switches **210** and **212**. When plunger **81** engages metal bars **211** and **213**, the actuators of switches **210** and **212** are in turn depressed.

When lid **19** is closed, the security system **10** is ARMED and mechanical key lock **38** may be turned with key **40** to physically lock lid **19** to housing **12**. If lid **19** is unlocked and opened, the actuators of switches **210** and **213** lift metal bars **211** and **213** and switches **210** and **213** change state.

The basic circuit operation will now be addressed. A single alarm circuit will be described, however one skilled in the art would understand that the circuit can be readily replicated to form a custom security system to protect any number of items of merchandise. In the preferred embodiment, the present security system is designed to have twenty jacks **36** on the housing **12**. Each jack **36** is associated with its own separate closed loop circuit.

Referring to FIG. **6**, clip **24** is shown in cross section. A single-pole single-throw switch **50** is the principle alarm signal generation means and is secured to the interior of the clip base **27**. Actuator **48** of switch **50** is biased in a distended position above the plane of face **119**, and switch **50** is normally open. When clip device **24** is properly attached to an article **22** of clothing FIG. **1**, item **22** contacts actuator **48**, keeping actuator **48** depressed below the plane of face **119**; sensor switch **50** is closed forming a closed loop circuit.

The pressure supplied by spring **14** keeps item **22** in place. Various clip arrangements may be designed to secure an article of clothing. The article **22** of clothing is protected since it depresses the actuator **48**, closing the contacts of switch **50**.

When the actuator **48** of switch **50** is depressed, closing switch **50**, electrical contact is made between wires **30** and **32**. When switch **50** is closed, current flows from the system circuitry through plug **34**, wire **30**, switch **50**, and wire **32** back to the system circuitry.

If there is a security breach, for example when there is an unauthorized removal of the clip **24** from a jacket **21** FIG. **3**, the actuator **48** distends above the jaw face **119** opening switch **50**. This interrupts the current flow between wires **30** and **32**. The system circuitry detects this interruption and an alarm is sounded. A thief cannot override the alarm by placing a foreign object between jaws **113** and **119**, even if the foreign object again depresses actuator **48**. The present security system **10** is designed to keep the alarm on until authorized personnel deactivate the alarm.

Other sensors may be used with the present security system having an operation similar to clip **24**. For example, the electronic security cable **24"** as shown in FIGS. **3** and **4C** has a two-state operation. During normal operation, current flows from the alarm circuitry through conductive loop **30'** back to the alarm circuitry. An unauthorized removal of an article of clothing **17** would require the breaking of loop **30'** or the cutting of cable **28**. This causes an open circuit which is detected by the security system and an alarm is again generated.

With respect to FIG. **7**, a partial schematic block diagram of the security system **10** is shown. Jacks **36** are separated into five groups of four. A single plug **34** may be inserted into each jack **36**. However, twenty plugs **34** are not needed for the security system to operate. A single closed loop system is formed when only one plug **34** is inserted into jack **36**.

Detector and latch circuits **33A**, **33B**, **33C**, **33D** and **33E** are shown in FIG. **7**. The operation of each detector circuit **33A–E** is substantially identical.

The schematic diagram of detector circuit **33A** is shown in FIG. **8**. Jack **36** having terminals **71**, **72**, **73** is shown. Jack **36** is a three-conductor normally closed jack. Terminal **72** makes with terminal **73** when there is no plug **34** inserted into jack **36**. However, when plug **34** is inserted into jack **36**, the electrical connection between terminals **72** and **73** is broken.

The plugs and jacks operate in the normal fashion, i.e. when plug **34** is fully inserted into jack **36**, conductor **61** makes electrical contact with conductor **71**, and conductor **63** makes electrical contact with conductor **73**.

Terminal **71** is grounded. Terminal **72** is shorted to terminal **71**. Conductor **73** is connected to resistor **74**, typically at 6.2 megohm resistor; the other end of resistor **74** is connected to the supply voltage V_1. Supply voltage V_1 is nominally nine volts DC.

Connector **73** is also connected to the input **240** of latch **100**. Latch **100** is a cross-coupled NOR set/reset latch. Various set/reset latches can be used; for example CD4043B is a common integrated circuit chip **115** which contains four set/reset latches **100**. Chip **115** is connected in a normal manner including connections to the supply voltage and ground.

When the voltage appearing at the set input **240** of latch **100** is less than ⅓ of the V_1 supply voltage (a non-alarm condition) the output of the latch **100** will be low. When the voltage appearing at the set input **240** of latch **100** is greater than ⅔ of the V_1 supply voltage (a security breach), the output **102** of the latch **100** will go high and remains high.

Under normal operation in the ON or ARMED mode, current flows from the V_1 supply voltage through resistor **74**, terminal **73**, to terminal **72**, to terminal **71** and to ground when no plug **34** is inserted into jack **36**. This keeps set input **240** of latch **100** low. This feature eliminates the need for shunt plugs.

If plug **34** is inserted into jack **36** the internal connection between terminals **72** and **73** is broken. When there is not an alarm condition, the set input **240** of the latch **100** remains low, since a closed loop circuit through switch **50** is formed, and resistor **74** sources a current of approximately 1.5 microamps through the switch **50**. The voltage level at the set input **240** of latch **100** will be approximately ground since current flows from V_1 through resistor **74**, to terminal **73**, to terminal **63**, through wire **30**, through switch **50**, through wire **32**, to terminal **61**, to conductor **71** to ground. Accordingly, latch **100** will remain in the reset state. The voltage at the output **102** of the latch **100** will be low (ground); therefore, the corresponding housing LED **44**, the alarm horn **126** and the indicator light **45** will all remain off.

If the jacket **21** is removed from the clip **24** (see FIG. **3**), the actuator **48** distends and the switch **50** within the clip **24** will open circuit, thereby breaking the connection between wires **30** and **32**. The voltage at the input **240** of the latch **100** will be pulled up approximately to the V_1 supply voltage (nine volts DC), through resistor **74**. The latch **100** will be set and the output **102** of the latch **100** will go high. Similar results occur when item cord **28** is cut, since the detector circuit will again detect an open circuit, and input **240** will again be pulled high to the V_1 supply voltage.

The latch **100** ensures that the removal and reinsertion of plug **34**, or the removal and reapplication of clip **24**, will not reset the alarm circuitry. Accordingly, once a breach of security condition is detected, the alarm horn **126** will sound, and housing LED **44** and indicator light **45** will both illumiinate until an authorized person resets the security system (i.e., by unlocking lock **38** and raising lid **19**).

The output **102** of the latch **100** is connected to resistor **90** and the other end of resistor **90** is connected to the base of transistor **106**. Resistor **90** is typically a twenty kilohm resistor and limits the current flowing into transistor **106**. Transistor **106** is a NPN transistor, for example part of a CA3083 integrated circuit transistor array.

The collector of transistor **106** is connected to the cathode of housing LED **44**. The anode of LED **44** is connected to resistor **114**. Resistor **114** is typically a one kilohm resistor. The other end of the resistor **114** is connected to the V_1 supply voltage via line **191**. The emitter of transistor **106** is connected to ground.

When the output **102** of latch **100** goes high (i.e., during a security breach), transistor **106** is turned on. Current flows from the V_1 supply voltage through resistor **114**, LED **44**, transistor **106** to ground; this has the effect of turning LED **44** on.

The output **102** of latch **100** is also connected to an eight-input OR gate **120** as shown in FIG. **7** via line **202**. OR gate **120** may be integrated circuit chip CD4078. The output **121** of OR gate **120** drives transistor **122** through resistor **127**. Transistor **122** is a NPN transistor and can be part of the IC array **107**. Resistor **127** is nominally a five kilohm resistor.

The emitter of transistor **122** is connected to ground while the collector is connected to the negative side of horn **126** via lead line. When all items **22** are secure (i.e. a non-alarm condition), all eight inputs of OR gate **120** are low. The output of OR gate **120** will also be low, keeping transistor **122** off, which in turn keeps horn **126** and indicator light **45** off.

During a security breach, the output **102** of latch **100** goes high. Since the input **202** of OR gate **120** is connected to output **102**, the output **121** of the OR gate **120** goes high which turns on transistor **122**; this in turn causes the horn **126** to sound and indicator light **45** to flash or blink.

The power for this circuit is supplied by a nine volt battery **226**. A zener diode **123** and a capacitor **124** are wired in

parallel across the battery terminals. The capacitor **124** filters any transients appearing on the V_1 supply line, while the zener diode **123** is used to limit the voltage to the integrated circuits due to an inadvertent high voltage. Diode **123** is typically a fifteen volt zener diode while capacitor **124** is nominally a 4.7 microfarad capacitor.

A power on and reset circuit is included. This circuit consists of diode **128**, capacitor **182** and resistor **181**. In the preferred embodiment, diode **128** is a 1N914 diode, capacitor **182** is a one microfarad capacitor, and resistor **181** is ten kilohms. This circuit is connected to the reset input **205** of latch **100**. When lid **19** is opened, closing switch **210**, a rising voltage is coupled to the reset input **205** of latch **100** through capacitor **182**. The capacitor **182** and resistor **181** act as a differentiator providing a positive going voltage pulse to the latches **100**. As long as the set input **240** is low and switch **210** is closed, the voltage pulse to reset input **205** will reset the output **202** of latch **100** (i.e. output **102** will be low). If an item **22** was removed from the jaws of clip **24**, or if item cable **28** was cut, set input **240** will be high preventing the particular latch **100** from being reset. This keeps the corresponding housing LED **44** lit. The diode ensures that the capacitor **182** is quickly discharged when the battery **226** is removed from the circuit.

Battery test switch **232**, as shown in FIGS. **1** and **7**, is provided in order to check the condition of the battery **226**. Switch **232** is normally open. Closing switch **232** connects the battery **226** to a resistor **291**; the other end of resistor **291** is connected to the base of transistor **122** via line **189**. Resistor **291** is nominally a five kilohm resistor. When switch **232** closes, current is supplied to the base of transistor **122**, turning the transistor on. This in turn sounds the alarm horn **126** and turns on the indicator light **45**.

The set-up of the alarm system by store personnel will now be described. Key **40** is used to open lock **38**. Lid **19** is opened, actuator **81** rises off of flexible metal bars **211** and **213**, distending the actuators of switches **210** and **212**. (See FIGS. **1**, **2A** and **2B**.) Switch **210** is a normally closed switch while switch **212** is a normally open switch. The security system **10** is now in its SET-UP mode. Since switch **212** is open, horn **126** and indicating light **45** are deactivated. Since switch **210** is closed, current flows from battery **226** resetting all twenty latches **100** via reset input **205**.

Store personnel will choose the appropriate sensors and connect it to the items **22** to be protected. In this example, clips **24** is attached to the desired items **22**. Since lid **19** is open, wire **28** can be threaded through semi-circular cut-out **91** of the housing **12**. Plug **34** is then inserted into jack **36**.

In the set-up mode, if the clip **24** is not properly attached to the item **22** or if there is an open circuit (e.g., a misconnection between plug **34** and jack **36**), the housing LED **44** which corresponds to jack **36** will light. The store personnel must check plug **34** and jack **36** or ensure that item **22** depresses actuator **48** of switch **50**. When the connection is properly made, the housing LED **44** will turn off. In the SET-UP mode, the horn **126** and indicator light **45** can not turn on since switch **212** is open.

When all of the desired items **22** are attached and their respective plugs **34** are inserted into jacks **36**, lid **19** is closed. Plunger **81** of lid **19** depresses the flexible metal bars **211**, **213** and the actuators of switches **210** and **212** are depressed. Switch **210** is now open; switch **212** is now closed which makes horn **126** and indicator light **45** operable. The security system is now in its ARMED state. Further, when lid **19** is closed, semi-circular cut-out **93** forms a securing clamp with semi-circular cut-out **91** to prevent the removal of plug **34** from jack **36**.

If there is a security breach, the proper housing LED **44** lights, indicator light **45** begins to blink or flash and horn **126** sounds. The purpose of indicating light **45** is to alert store personnel from a distance. This is especially useful when there are several security systems **10** located near each other. It may be difficult to find the system **10** in which a security breach is detected if there is only an audio alarm.

The indicator light **45** is usually a large LED and can be seen from a distance. In the preferred embodiments, the LED can flash to enhance its ability to draw the attention of store personnel. Store personnel can go directly to the security circuit in which the breach has taken place. The housing LED **44** which corresponds to the clip **24** or cord **28** in which the security breach took place, will also light. Upon visual inspection, the store personnel can pinpoint the exact location of the security breach by noting which housing LED **44** is lit. If the security breach is the removal of clip **24**, the reapplication of the clip **24** onto another item **22** or a foreign object, will not deactivate the alarm since latch **100** has been set. Latch **100** can only be reset by opening lid **19**.

In reference to FIGS. **1** and **2B**, after a security breach, the store personnel can turn the alarm horn **126** off by opening lock **38** and raising lid **19**. When the lid **19** is open, horn **126** and indicator light **45** are deactivated since switch **212** will open. However, the housing LED **44** which corresponds to the security breach will stay lit, if switch **50** remains open or cable **28** was cut. When the lid **19** is open, the insertion of item **22** into clip **24**, i.e., the closing of switch **50**, will turn the housing LED **44** off.

The lid **19** also prevents tampering since it restricts access to the jacks **36**. Accordingly, foreign objects cannot be inserted into jacks **36**. When lid **19** is closed, plug **34** cannot be removed from jack **36**. This prevents the accidental removal of plug **34** from jack **36** since lid **19** holds the plug **34** securely in place. Similarly, it prevents the unauthorized removal of plug **34** from jack **36**, thwarting the attempts of a potential thief. However, view ports **49** allow the visual inspection of housing LEDS **44**.

While the invention has been particularly shown and described with reference to a preferred embodiment thereof, it is to be understood by those skilled in the art that various changes in form and details may be made therein without departing from the spirit and scope of the invention.

What is claimed is:

1. A security device for merchandise and the like comprising:

a. a sensor circuit attached to each item of merchandise to be protected, the sensor circuit including:
   i. an alarm signal generation means having at least a secure state and an alarm state; and
   ii. electrical conductors connected to the alarm signal generation means at one end and having conducting means at the other, for communicating the state of the sensor; and
   iii. a lid that places the alarm means in a set-up mode when open and places the alarm means in an armed mode when closed, whereby in the set-up mode when a security breach is detected, the housing LEDs indicate an improper connection and the audio alarm means is deactivated, and when in the armed mode, the audio alarm means is able to sound upon the detection of the security breach means,

b. connection means for connecting to the conducting means;

c. security means for insuring that the conducting means keeps continual electrical contact with the connection means;

d. detection means connected to the connection means for determining the state of the alarm signal generation means and the integrity of the electrical conductors; and

e. an alarm connected to the detection means and which is activated upon the detection of the alarm state.

2. The device of claim **1** comprising housing LED corresponding to each cable or sensor, connected to the detection means, for indicating the secure state and the alarm state of each sensor.

3. The device of claim **1** wherein the alarm signal generation means comprises a switch.

4. The device of claim **1** wherein the alarm signal generation means comprises a conductive sensor loop designed to pass through a portion of the item of merchandise to be secured, and having a slip loop at one end in which the connecting end can pass through, whereby the unauthorized removal of the item requires disconnection of the slip loop generating the alarm signal.

5. The device of claim **1** wherein the conducting means is a plug and the connection means is a jack for receiving the plug.

6. The device of claim **5** wherein the jack is a normally closed jack thereby providing the proper connections when no plug is inserted into the jack.

7. The device of claim **1** further comprising a flashing indicating light operatively connected to the detection means for alerting store personnel of a security breach.

8. A security device for merchandise and the like comprising:

a. a sensor circuit attached to each item of merchandise to be protected, the sensor circuit including:

i. an alarm signal generation means having at least a secure state and an alarm state; and

ii. electrical conductors connected to the alarm signal generation means at one end and having conducting means on the other end, for communicating the state of the sensor;

b. an alarm means for sounding an alarm upon the detection of a security breach, the alarm means including:

i. detection means connected to the conducting means for determining the state of the alarm signal generation means and the integrity of the electrical conductor;

ii. an audio alarm means that sounds upon the detection of a security breach;

iii. a visual alarm means located next to every connection to the conducting means that lights when the security breach occurs in that respective sensor circuit; and

iv. a lid that places the alarm means in a set-up mode when open and places the alarm means in an armed mode when closed, whereby in the set-up mode when a security breach is detected, the housing LEDs indicate an improper connection and the audio alarm means is deactivated, and when in the armed mode, the audio alarm means is able to sound upon the detection of the security breach.

9. The device of claim **8** wherein the sensor circuit is an electronic clip.

10. The device of claim **8** wherein the sensor circuit is an electronic cable loop.

11. The device of claim **8** wherein the lid prevents tampering with the conducting means.

12. The device of claim **8** further comprising a latch circuit connected to the detection means which prevents an unauthorized resetting of the audio alarm means and the video alarm means once the security breach has been detected.

13. The device of claim **12** further comprising a switch means activated upon the opening of the lid; and a reset circuit which resets the latch circuit.

* * * * *