United States Patent

Lee

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[54] **SECURITY SYSTEM FOR INDICATING FIRE, INTRUSION OR THE LIKE**

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[58] **Field of Search**...340/409, 420, 226, 227.1, 221, 340/273, 274, 253, 256, 213.1

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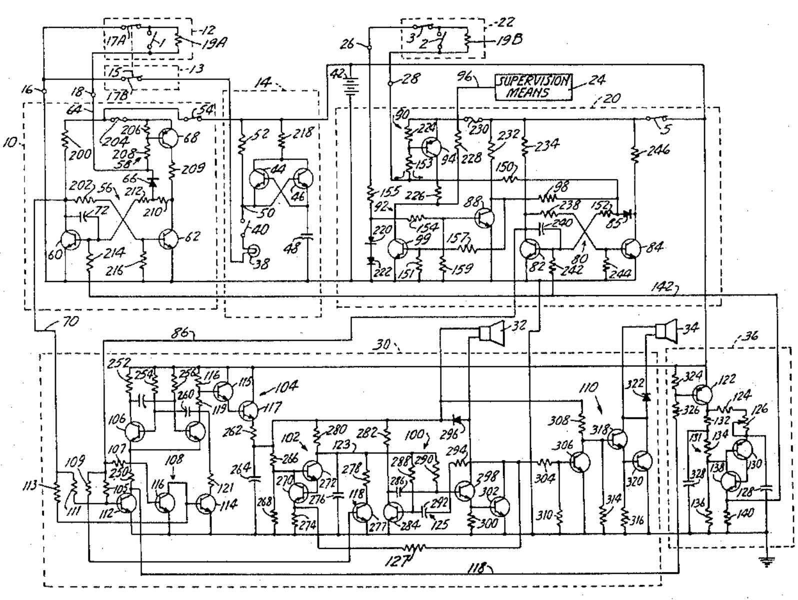
[57] **ABSTRACT**

A fire-intrusion system of the type including at least one electrically continuous closed-loop for detecting the presence of an intruder and at least one electrically continuous closed-loop for detecting a fire wherein breaches in security indicative of fire and intrusion are sensed by a change in potential at a point in their respective loops. Potential sensing circuits are provided which are responsive to a changed or abnormal potential to indicate a fire, intrusion or inoperative circuit condition.

13 Claims, 1 Drawing Figure



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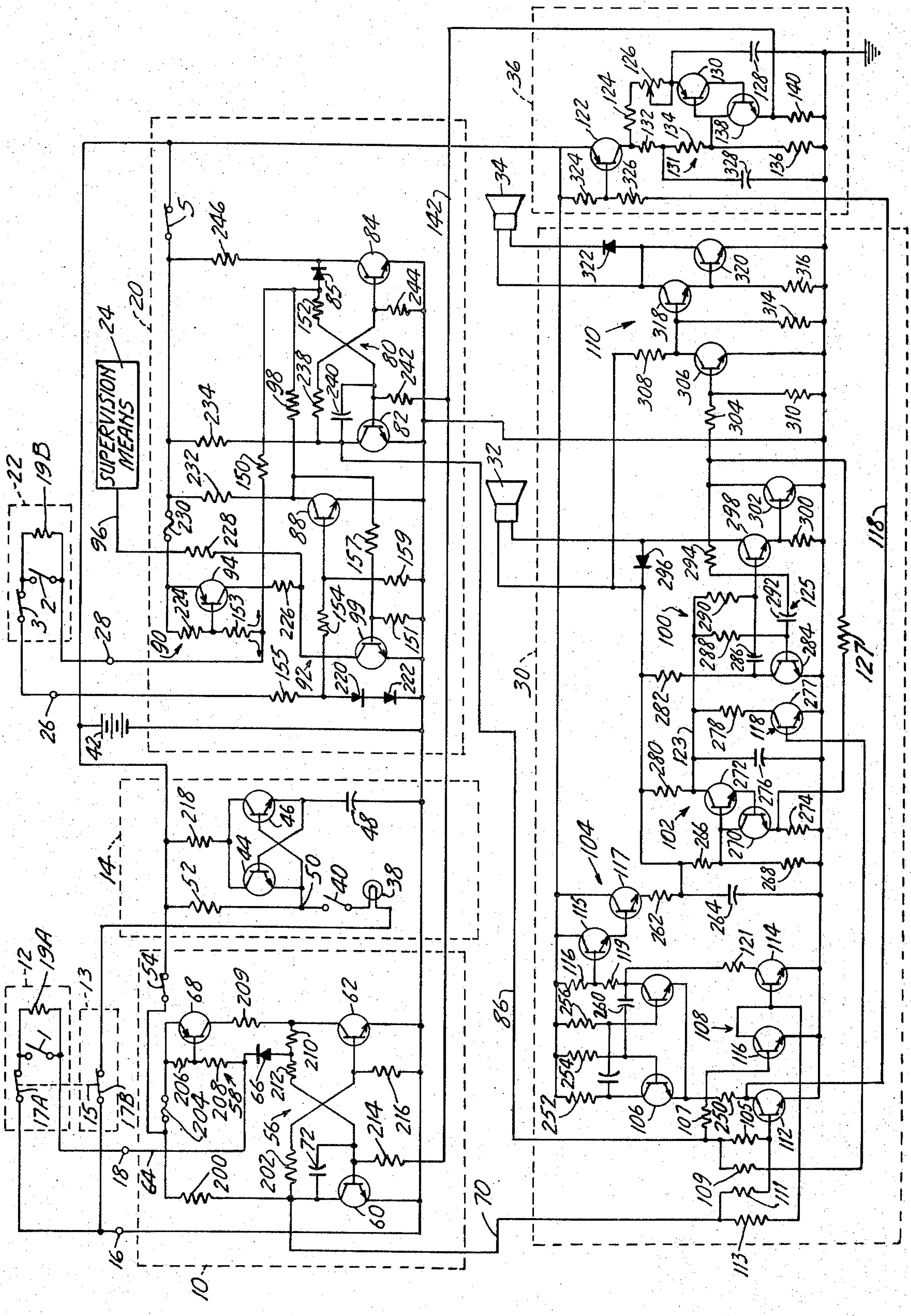

SECURITY SYSTEM FOR INDICATING FIRE, INTRUSION OR THE LIKE

CROSS REFERENCES

This application is a continuation-in-part of our pending application, Security System For Indicating Fire, Intrusion Or The Like, U.S. Ser. No. 839,007 Filed July 3, 1969, now abandoned.

FIELD OF THE INVENTION

Generally, the invention relates to electronic security systems and, more specifically, it relates to electronic devices responsive to detecting an abnormal potential in a normally closed security loop to indicate the nature of the condition causing the abnormal potential.

BACKGROUND OF THE INVENTION

A great need exists for protecting residences and businesses from unauthorized entry and from fires. Many devices for use in such security or fire-intrusion systems are commercially available. For example, electrically conductive tape to be applied to windows, and various tamper-proof locks and other means for indicating opening of a door are available. Also, fire detection devices such as smoke sensors and temperature sensors such as bi-metallic strips are well known. Such devices are commonly connected to form an electrically continuous circuit, commonly referred to as a normally closed or closed-loop circuit. Such systems also include means for sensing an abnormal potential in the closed-loop (most commonly a potential corresponding to either a short or open circuit condition) and for providing an indication corresponding to the nature of the abnormal potential. Serious deficiencies of prior art sensing means include excessive power consumption, unreliability, and cost. The sensing means of many prior art systems employed relays. They draw relatively high operating currents, are considerably more expensive than solid state switches and generally are less reliable than solid state devices. Other systems which employed solid state circuitry proved unreliable because they were overly sensitive; for one thing, they generated an alarm, a false alarm, in response to spurious or noise signals.

Further, a problem of some prior systems, partly because of their large power consumption, is that they were connected to receive their operating energy from the ordinary house wiring and could thus be rendered inoperative by cutting this connection.

BRIEF SUMMARY OF THE INVENTION

In one embodiment, the invention comprises an electronic security system for sensing breaches in security within a closed-loop circuit, such breaches being recognized as an open or short circuit condition between two portions of the closed-loop circuit. The system includes a bistable multivibrator means having a first normal state representing that said closed-loop circuit is neither open or short circuited, and a second alarm state representing that said circuit is either open or short circuited. The multivibrator comprises first and second cross-coupled transistors wherein the first transistor is in the conducting state when the multivibrator is in the first normal state. The system also includes a unidirectional conducting device and a

switching transistor both of which are connected between the closed-loop circuit and the multivibrator to sense said open or short circuit conditions and to cause the multivibrator to change states in response thereto. The unidirectional conducting device is connected between a point on the closed-loop circuit and the base of the first transistor such that the unidirectional conducting device is in a nonconducting state when the potential with respect to ground at that point on the circuit is at a normal level. The switching transistor has a base coupled to a potential divider in series with the closed-loop circuit, and collector and emitter leads coupled in series between a source of potential and the base of the first transistor such that the normal potential at the point on the closed-loop causes the switching transistor to conduct to provide current to the base of the first transistor. In operation the unidirectional conducting device switches to a conducting state to divert current from the base of the first transistor in response to the closed-loop becoming short circuited and the switching transistor switches to a nonconducting state to block the current flow to the base of the first transistor in response to the closed-loop becoming open circuited. The multivibrator means is thus caused to switch to the second state to produce an alarm signal whenever the base current flow of the first transistor is diverted or blocked.

In another embodiment of the invention the device detects breaches in security in the closed-loop circuit corresponding to open and short circuit conditions and also other abnormally high and low potentials. This embodiment is particularly suited for use with the closed-loop of a fire alarm system. Two portions of the closed-loop are normally maintained at two different potentials with respect to ground. A condition indicative of a fire is signaled by shorting the two closed-loop portions together. It is usually required in such fire alarm systems, for all malfunctions causing other abnormal potentials within the closed-loop, that a positive indication different than that provided by the fire alarm signal be provided whenever such malfunctions occur within the system. The device includes a bistable multivibrator means similar to the bistable means of the afore-mentioned embodiment. The bistable multivibrator means in this embodiment is coupled directly to one portion of the closed-loop and is used to directly detect a short condition of one portion of the closed-loop to another portion, which short circuit condition is indicative of a fire condition. The multivibrator means are adapted to provide an output alarm signal representative of the second or alarm state.

This embodiment further provides first and second bistable switching means coupled to the closed-loop circuit for sensing malfunctions. The first bistable switching means has a first normal level in which the first bistable means remains so long as the closed-loop circuit is closed, and switches to a second level in response to sensing an open-loop condition to produce a system malfunction signal. The second bistable switching means has a first normal mode in which it remains so long as the closed-loop circuit is closed and switches to a second mode in response to the closed-loop circuit becoming shorted to ground to produce the system malfunction signal. The first and second bistable switching means are coupled to the bistable multivibrator means to prevent production of the output alarm signal when either the second level or second mode are present.

In another embodiment of the invention, a limited current drain device coupled to the closed-loop circuit provides a momentary indication of a closed circuit condition existing in the closed-loop circuit. This device includes switch means having first and second normally closed switches mechanically coupled together, wherein the first switch is connected in series in the closed-loop circuit while the second switch is connected in series with an energy source, a current limiting resistor, a normally open switch means and a light indicating means. The device further includes a capacitor and a switching circuit. The switching circuit is connected across the current limiting resistor and to the capacitor, connects the capacitor to the energy source when the normally open switching means is open, to charge the capacitor, and connects the capacitor to the current limiting resistor when the normally open switch means is closed, thereby allowing a discharge path for the capacitor through the light indicating means. This provides a momentary indication of the position of the switch means and therefore an indication of a closed circuit condition existing in the closed-loop circuit.

A still further embodiment of the invention provides an electronic security system for indicating breaches in security within at least one closed-loop circuit wherein alarm signals produced by different alarm signal producing means are coupled to indicating means. The indicating means include source switch means responsive to a given alarm signal and characteristic security breach signal producing means, in turn coupled to the source switch means, for producing a particular characteristic breach indication depending upon the source of the alarm signal present.

DESCRIPTION OF PREFERRED EMBODIMENTS

Having thus generally described exemplary embodiments of the abnormal potential sensors of the present invention, a preferred embodiment of the present invention will be described in greater detail with reference to the accompanying drawing.

The FIGURE is a combination block diagram and schematic wiring diagram illustrating a security system including three exemplary embodiments of abnormal potential sensing circuits and associated indicating means.

The particular circuits shown are specifically intended for use with a security system for a residence. The system is shown to include a perimeter alarm circuit **10**, a perimeter protection loop **12**, a perimeter check loop **13**, and a perimeter check circuit **14**. The perimeter protection loop **12** may include motion detector devices (such as those described in U.S. Pat. No. RE.27,067; and co-pending U.S. application, Ser. No. 191,917, both of which are assigned to the same assignee as the present invention), contact switches for use on doors and windows, door locks, pressure mats, invisible ray devices and window locks. When all such devices in a loop such as perimeter protection loop **12** and perimeter alarm circuit **10** are in their normal condition, that is, with the doors and windows locked, and with the motion detectors operating but not detecting a moving object, they form a continuous closed-loop circuit comprising first and second portions providing first and second potentials with respect to ground at terminals **16** and **18** respectively. Terminal **16** it should be noted is at ground potential. A resistor **19** is connected between terminals **16** and **18** to provide the desired potential difference between terminals **16** and **18**. Perimeter check circuit **14** provides means for momentarily checking for an open circuit in the perimeter protection loop **12** so that one may be sure that all of the system sensors are in their proper non-alarm condition prior to activating the system. For purposes of illustration only one sensor **15** which includes the normally closed switch **17A** is shown used in the perimeter protection loop **12**. Because security systems often operate from a self-contained energy source, such as a wet or dry cell battery, it is desirable that such a checking circuit, when activated, provide only an insignificant current drain from the energy source. Otherwise, one intending to compromise the system need only hold the switch of such a circuit in an activated position until the energy source is depleted to a point insufficient to operate the remainder of the system.

Also included in the system are a fire alarm circuit **20** and its associated fire protection loop **22** and a supervision means **24**. Fire protection loop **22**, like the perimeter protection loop **12**, is a normally electrically continuous circuit having at least two portions at different potentials with respect to ground, one potential provided at terminal **26** and another potential provided at terminal **28**. Resistor **19B** is connected between terminals **26** and **28** to provide the potential difference between terminals **26** and **28**. The sensors employed within the fire protection loop **22** are well known in the art. For purposes of illustration only one sensor having a normally open switch **2** which is connected in parallel with resistor **19B** is shown. Switch **2** closes in response to a fire condition. They may be devices such as smoke sensors, heat detecting devices, or devices which sense for both heat and smoke. One example of such a smoke and heat detecting device is a Pyrotector D-C Smoke and Heat Detector, Pyrotector Model No. 30–286. Fire alarm circuit **20**, in addition to providing an indication that a sensor of loop **22** has detected a condition indicative of a fire, must also provide a positive indication of any other abnormal potential in the closed-loop. Supervision means **24** provides such an indication.

The system also includes a siren generator shown generally as **30**, a speaker **32** and a horn **34**, both coupled to the siren generator **30**. The siren generator **30** responds to a signal from the perimeter alarm circuit **10** to produce a warbling tone from the speaker **32** and horn **34** and responds to a signal from the fire alarm circuit **20** to produce an intermittent tone of a single frequency. A reset timer **36** is provided for resetting the perimeter alarm circuit **10** and fire alarm circuit **20** to their respective normal state a predetermined time after switching into their alarm state, provided an alarm condition no longer exists.

The operation of the system will now be described beginning with the perimeter check circuit **14**. The perimeter check circuit **14** includes a resistor **52**, a lamp **38**, a normally open manually operated switch **40**, and the perimeter check loop **13**, all of which are connected in series between the system's energy source **42**, which for the illustrated embodiment may be a 12-volt battery, and ground. The sensor **15** for the perimeter protection loop **12**, includes the normally closed switch **17A**, connected in series in the perimeter protection loop **12**, and another normally closed switch **17B** connected in series in the perimeter check loop **13**. Switch **17B** is shown linked to switch **17A** and can therefore be used in check loop **13** to check the position of sensing switch **17A**. Resistor **52** limits the current drawn from said energy source upon closure of switch **40** to an insignificant level. With switch **40** open, and with no charge stored in capacitor **48**, the voltage at node **50** will cause transistor **46** to conduct, thereby passing current to charge capacitor **48**. Capacitor **48** charges rapidly until transistor **46** is turned off, while transistor **44** remains off due to the lack of a potential difference across the transistor. Transistor **44** has its base connected to the emitter of transistor **46**, its collector connected to the collector of transistor **46**, and its emitter connected to node **50** and the base of transistor **46**. Upon closure of switch **40**, and assuming that switch **17B** is closed, the emitter of transistor **44** is grounded while the base is forward biased by the charge on capacitor **48**, the effect of which is to cause transistor **44** to conduct, resulting in a relatively high current flow through transistor **44**, closed switch **40**, thence through the lamp **38** and switch **17B** to ground. This energizes the lamp **38**, provided the sensor **15** of perimeter protection loop **12** is in its normally closed condition so that switch **17B** of sensor **15** is closed, and provides an indication that the perimeter protection loop is in a normal operating condition. The relatively large current is applied only so long as the charge on capacitor **48** is sufficient to forward bias transistor **44**. As the charge on capacitor **48** is dissipated, transistor **44** ceases to conduct. The current through lamp **38** is then limited by resistor **52** to a very low value, on the order of 60 microamps for so long as switch **40** is closed. When switch **40** is released, capacitor **48** rapidly recharges so that another check may be immediately made, if desired. If during such a check the sensor **15** of perimeter check loop **13** is not in its normal operating condition so that switch **17** is open, lamp **38** will not be energized and the nonoperating sensor thus detected.

Operation of the perimeter alarm circuit **10** begins upon closure of switch **54**. The perimeter alarm circuit **10** is shown to comprise a bistable multivibrator shown generally as **56** and a voltage potential sensing means shown generally as **58**. Upon closure of switch **54**, multivibrator **56** is set to its normal state, i.e., with cross-coupled transistors **60** and **62** conducting and nonconducting respectively.

A damping capacitor **72** is provided between the collector and base of normally conducting transistor **60** to prevent multivibrator **56** from changing from a normal state to an alarm state in response to noise or otherwise spurious signals.

Voltage potential sensing means **58** is coupled by lead **64** to terminal **18** of the perimeter protection loop **12**, which terminal is at about 6 volts. The potential of the other portion of the loop **12**, which may be sensed at terminal **16**, is normally at about ground potential or zero volts. Under normal conditions, a diode **66** and transistor **68** of the voltage potential sensing means **58** are non-conducting and conducting respectively. Diode **66** is connected between lead **64** and the multivibrator **56**. Should the voltage at terminal **18** rise to about the voltage of energy source **42**, as would happen should the perimeter protection loop **12** become open circuited, the voltage at the base of transistor **68** will then be the same as the voltage at its emitter, and the transistor **68** will be turned off. With transistor **68** turned off, the current to the base of transistor **60** is cut off and multivibrator **56** is switched from its normal state to an alarm state, i.e., with transistor **62** conducting and transistor **60** nonconducting. When multivibrator **56** switches to its alarm state, a signal is provided on lead **70** to siren generator **30**. The perimeter protection loop **12** may also utilize a number of sensors each of which have normally open switches, connected in parallel with resistor **19A**. Thus, a sensor which includes a normally open switch is shown connected in parallel with resistor **19A**. When such a sensor responds to an alarm condition the switch **1** closes to connect terminal **16** directly to terminal **18**. Assuming switch **17A** is closed, as would occur when the security in the perimeter protection loop is breached, the current normally flowing to the base of the transistor **60** is diverted through diode **66** to ground. With the base current thus diverted, transistor **60** turns off to switch the multivibrator **56** into its alarm state, thereby also providing a signal on lead **30**.

The fire alarm circuit **20** includes a bistable multivibrator circuit **80** much like multivibrator **56** of the perimeter alarm circuit **10**, and control switch **5** similar to switch **54** of perimeter alarm circuit **10** which must be closed to have circuit **20** operate. Bistable multivibrator **80** has a pair of cross-coupled transistors **82** and **84** which normally are in a conducting and nonconducting state, respectively. The base of the normally conducting transistor **82** is coupled through resistors **150** and **152** to a point on the fire protection loop **22**, specifically to terminal **28**. With the fire protection loop **22** in its normal state, current flows through the loop **22** to ground and also to the base of transistor **82** to maintain it in a conducting state. When switch **2** closes in response to a fire condition the current in loop **22** increases substantially to reduce the potential at terminal **28**. This reduces the base current to transistor **82** to a level sufficient to turn the transistor **82** off, thus switching multivibrator **80** to a second or alarm state, wherein transistor **84** conducts, due to the increase in potential at the collector of transistor **82**. When transistor **84** conducts, a diode **85** which connects with the collector of transistor **84** and to terminal **28** via resistor **150** conducts to inhibit the current from flowing to the base of transistor **82** thereby holding multivibrator **80** in its alarm state. In its second or alarm state, fire alarm circuit **20** provides an output signal on lead **86** to the siren generator **30**.

It is a requirement of fire alarm circuits in general that, whenever the voltage potential in a fire protection loop changes to some abnormal level other than that indicative of a fire condition, that an indication be provided to indicate the the circuit is not operating properly. Moreover, when such an abnormal condition exists, the circuit is not to provide its normal alarm condition. Fire protection loop **22** therefore includes means for sensing three types of conditions. These three conditions are fire, open circuits, and short circuits to ground which could exist anywhere in the loop 22. Accordingly, multivibrator 80 is provided with an additional transistor 88, the base of which is coupled through resistor 154 to the low potential side of the fire protection loop 22, while the collector of transistor 88 is coupled through resistors 98 and 152 to the multivibrator transistor 82 in a manner to provide current to the base of transistor 82 whenever an open circuit or like condition in the fire protection loop 22 interrupts the normal supply of current to the base of transistor 88.

The fire alarm circuit 20 is also provided with a high potential sensor designated generally as 90 and a low potential sensor designated generally as 92. As shown, the high potential sensor 90 includes a PNP transistor 94 having its base coupled through a resistor 153 to terminal 28. Accordingly, should terminal 28 suddenly rise to an abnormally high potential with respect to ground, e.g., the voltage of the energy source 42, the corresponding voltage increase at the base of transistor 94 will cause the transistor to lose its bias current thereby turning the transistor 94 off. Such a rise to an abnormally high potential could, for example, be caused by a short circuit from terminal 28 to the energy source 42 or by an open circuit in the loop 22. When transistor 94 turns off, an output signal is provided on lead 96 to the supervision means 24 in the form of cessation of the current normally flowing through transistor 94 to the means 24.

The low potential sensor 92 includes NPN transistor 88 and NPN transistor 99 together with associated coupling resistors 151, 157 and 159. Transistor 88 has its base coupled through resistors 154 and 155 to terminal 26, to normally provide a bias current maintaining transistor 88 in a conducting state. Should the fire loop 22 potential drop to an abnormally low potential, such as if terminal 26 was shorted to ground, the base current to transistor 88 is removed, causing the transistor 88 to turn off. When transistor 88 turns off, the potential at the collector of transistor 88 rises to cause current to flow through resistor 98 to multivibrator 80 to maintain it in its normal state, as previously described. The increased potential at the collector of transistor 88 is also coupled to the base of NPN transistor 99 through resistor 157 to cause the transistor 99 to conduct. This produces a signal on lead 96 to the supervision means 24 in the form of cessation of the current normally flowing to the supervision means 24 from the transistor 94, such current being diverted to ground through transistor 99 rather than to the supervision means 24. The supervision means 24 provides only an indication of whether or not there is an open circuit, a short circuit to ground, or a short circuit to the energy supply source 42 in the fire protection loop 22. The supervision means 24 may be monitored by maintenance supervisors, a change in current supplied to the means 24 being interpreted as an indication of a malfunction in the loop. On the other hand, a short circuit across the line, i.e., between terminals 26 and 28, as is provided by closure of sensor switch 2, produces an alarm signal at the collector of transistor 82 which is indicative of an actual fire condition.

The siren generator 30 is shown to comprise a tone generator 100, saw tooth generator 102, a source switch 104, a free running multivibrator 106, a series of input gates 108 and circuits 110 for driving the horn 34. The bases of transistors 112 and 114 of the input gates 108 are coupled by resistors 111 and 113 to lead 70 respectively. Breach of security in the perimeter protection loop 12 causes an output signal to be present on lead 70 which switches transistors 112 and 114 to a conducting state. Transistor 114, when conducting, continuously provides biasing current to the base of PNP transistor 115 of source switch 104 via resistors 116, 119 and 121. Consequently, transistor 115 turns on, which in turn causes NPN transistor 117 to conduct, thereby providing a source of current on lead 120 for enabling saw tooth generator 102, tone generator 100, and horn driving circuits 110. When the saw tooth generator 102 is thus enabled, a ramp signal is generated on lead 123, which in turn is coupled to the tone generator 100. Tone generator 100 is shown to comprise a free running multivibrator 125, the frequency of which varies according to the amplitude of the ramp signal on lead 123. The effect of the output of saw tooth generator 102 thus varying the frequency of tone generator 100, is to produce a warbling tone from speaker 32 and horn 34.

In the fire alarm mode of operation, a signal from fire alarm circuit 20 on lead 86 is coupled to the bases of transistors 112, 116 and 118 via resistors 105, 107 and 109. This causes the transistors 112, 116 and 118 to conduct. Transistor 114 remains cut off. With transistor 114 cut off and transistor 112 conducting, the free running multivibrator 106 is enabled, thereby intermittently supplying bias current to transistor 115 only when transistor 120 of the free running multivibrator is conducting. The effect of this intermittent bias current is to cause the source switch 104 to turn on and off, thus providing an intermittent current on lead 120, which in turn only allows intermittent operation of tone generator 100 and horn driving circuits 110. Saw tooth generator 102 is continuously disabled by the conduction of transistor 118 to stop the warbling effect of tone generator 100. With the source switch 104 turning on and off, and the tone generator 100 oscillating at a fixed frequency during the on periods of switch 104, siren generator 30 provides an on-off tone to the speaker 32 and horn 34.

Reset timer 36 is also enabled in response to a signal on either lead 70 or 86. As shown, the collector of transistor 112 is coupled via lead 118 to the base of transistor 122 in the reset timer. When transistor 112 turns on, transistor 122 does likewise, thus permitting current flow through resistors 124 and 126 to store a charge in capacitor 128. When the charge on capacitor 128 exceeds the voltage at the base of transistor 130, (determined by a voltage divider comprising resistors 132, 134 and 136), the transistor 130 conducts. This in turn forward biases emitter follower transistor 138. Current then flows through transistor 138 and its emitter resistor 140 to produce a positive pulse on lead 142, which lead is shown to be coupled to the bases of the normally conducting transistors of multivibrators 80 and 56. If the condition which caused one of the multivibrators to change states, i.e., the conditions which turned on transistor 110, no longer exists, the multivibrator will be switched back to its normal state.

In the embodiment depicted in the drawing, the following component values are preferred.

RESISTORS

19A	33K	153	10K	244	33K
19B	33K	154	10K	246	33K
52	220K	155	1K	250	6.8K
98	100K	157	100K	252	6.8K
105	220K	159	33K	254	100K
107	220K	200	33K	256	100K
109	220K	202	220K	262	56Ω
111	220K	206	10K	266	6.8K
113	220K	208	33K	268	10K
116	2.2K	209	33K	274	100Ω
119	6.8K	210	100K	278	1.2K
121	6.8K	212	47K	280	2.2K
124	220K	214	33K	282	1K
126	470K Pot.	216	33K	288	6.8K
127	470Ω	218	22Ω	290	15K
132	15K	224	10K	294	1K
134	15K	226	33K	300	10K
136	33K	228	33K	304	15K
140	100Ω	232	33K	308	2.2K
150	100K	237	33K	310	3.9K
151	33K	238	100K	314	2.2K
152	33K	242	33K	316	1K
				324	33K
				326	220K

TRANSISTORS

44, 46, 60, 62, 82, 84, 88, 99, 112, 114, 116, 120, 138, 251, 270, 277, 284, 306	2N3394
68, 94, 115, 122, 130, 272	2N5354
117, 298, 302, 318	2N3414
320	2N4921

CAPACITORS

48	125μf	264	320μf
72	.22μf	276	125μf
128	1000μf	286	0.05μf
240	.22μf	292	0.05μf
256	10μf	328	10μf
260	10μf		

DIODES

66, 85, 220, 222, 296	1N914
322	1N4001
204, 330 Fuse ½ amp	

What is claimed is:

1. An electronic security system for detecting a breach in security within a closed-loop circuit having a plurality of sensors which may short or open said closed-loop in response to said breach wherein the improvement comprises an electronic device responsive to said sensors for producing an alarm signal when one of said sensors is opened or shorted, said electronic device comprising:

a. a bistable multivibrator means connected in said closed-loop having a first normal state representing that said closed-loop circuit is neither open nor short circuited and a second state representing that said circuit is either short or open circuited, said multivibrator means adapted to provide as said alarm signal an output signal representative of said second state and including first and second cross-coupled transistors, said first transistor being in a conducting state during said multivibrator first normal state;

b. a source of potential;

c. a unidirectional conducting device connected between a point on said closed-loop circuit and to the base of said first transistor, said unidirectional conducting device being in a non-conducting state when the potential with respect to ground of said point on said circuit is at a normal level;

d. potential dividing means connected between said source of potential and said point; and

e. a switching transistor having a base coupled to said potential dividing means and having collector and emitter leads coupled in series between said source of potential and the base of said first transistor, the normal potential at said point causing said switching transistor to conduct to provide current to the base of said first transistor;

said unidirectional conducting device switching to a conducting state to divert current from the base of said first transistor in response to said closed-loop becoming short circuited and said switching transistor switching to a nonconducting state to block current flow to the base of said first transistor in response to said closed-loop becoming open circuited, said multivibrator means switching to said second state to produce said alarm signal whenever the base current flow of said first transistor is diverted or blocked.

2. An electronic security system for detecting breach in security within a closed-loop circuit having at least one sensor which may short said closed-loop in response to a said breach comprising:

a bistable multivibrator means coupled to said closed-loop circuit and having a first normal state representing that said circuit is not short circuited and a second state representing that said circuit is short circuited, said multivibrator means adapted to provide an output alarm signal representative of said second state;

a first bistable switching means coupled to said closed-loop circuit having a first normal level in which said first bistable switching means remains so long as said closed-loop circuit is closed, and switching to a second level in response to sensing an open-loop, and producing a system malfunction signal when switched to said second level; and

a second bistable switching means coupled to said closed-loop circuit having a first normal mode in which said second bistable switching means remains so long as said closed-loop circuit remains closed, and said second bistable means switching to a second mode in response to said closed-loop circuit shorting to ground and producing said system malfunction signal when switched to said second mode; and wherein said first and second bistable switching means are coupled to said bistable multivibrator means for preventing production of said output alarm signal when either a second level or second mode is produced.

3. An electronic security system according to claim 2 further comprising:

supervision means coupled to said first and second switching means and responsive to the presence of said system malfunction signal therefrom to produce sensible indications for supervisory and maintenance personnel that said system is malfunctioning.

4. An electronic device for detecting abnormal conditions in a closed-loop circuit, which circuit comprises a first portion normally at a substantially uniform first potential and a second portion normally at a substantially uniform second potential different from said first potential and other than zero, comprising:

a. first means for sensing a change in potential at a point on said first portion of the loop produced when said first and second portions become substantially short circuited, for switching from a normal state to an alarm state in response to said change and for providing an alarm signal when switched to said alarm state;

b. second means for sensing a change in potential at a point on said first portion of the loop produced when the potential at said point rises above that of said substantially uniform first potential, and for providing an output signal in response to said sensed change in potential; and

c. third means for sensing a change in potential at a point on said second portion of the loop portion produced when said potential becomes approximately zero, and for providing an output signal in response to said sensed change in potential.

5. An electronic device according to claim 4, wherein said third means is further coupled to said first means to prevent said first means from switching to said alarm state when said third means switches to said second state and produces said output signal.

6. An electronic device according to claim 4, further comprising an inhibiting means coupled to said first means for holding said first means in said alarm state until a reset signal causes said first means to switch back to said normal state.

7. An electronic device according to claim 4, wherein said first means comprises

a bistable multivibrator having a pair of cross-coupled transistors, including a first transistor normally residing in a conducting state and having a base lead coupled to a point on said first closed-loop portion, the normal potential at said point providing current flow through said base lead to maintain said first transistor in a conducting state but the potential at said point, when at the same potential as the potential of said second portion, switching said first transistor to the nonconducting state.

8. An electronic device according to claim 7, wherein said third means comprises a switching transistor having its collector and emitter leads connected in series with a current source, having its collector lead also connected to said first multivibrator transistor base lead, and having its base lead connected to a point on said second portion of said closed loop, the normal potential of said second portion maintaining said switching transistor in a conducting state and an abnormally low potential at said second portion causing said switching transistor to switch to a nonconducting state, to divert current normally flowing through said switching transistor to said base lead of said first multivibrator transistor to prevent said multivibrator transistor from switching to a nonconducting state.

9. An electrical device according to claim 4, wherein said second means comprises a switching transistor having its collector and emitter leads connected in series with a current source and having its base lead coupled to said point in said first portion of said closed-loop circuit so as to be in a normally conducting state but turning off in response to an increase in potential at said point to provide an output signal.

10. A limited current drain device coupled to a closed-loop circuit for providing a momentary indication indicative of a closed circuit condition existing in said closed-loop circuit comprising:

a. energy source means;

b. switch means having first and second normally closed switches mechanically coupled to operate together as a unit, said first switch connected in series to said closed-loop circuit;

c. a series circuit connected to said energy source including a current limiting resistor having one end connected to said energy source, a normally open switch means, a light indicating means and said second normally closed switch, the current flow from said energy source means through said series circuit when completed by closure of said normally opened switch means causing a limited current drain on said energy source;

d. a capacitor;

e. a switching circuit means connected across said current limiting resistor and to said capacitor, said switching circuit means connecting said capacitor to said energy source when said normally open switching means is open to charge said capacitor, said switching circuit means connecting said capacitor to said other end of said current limiting resistor when said normally open switch means is operated to the closed position and said second normally closed switch is closed, to provide a discharge path for said capacitor, said light indicating means providing a momentary indication in response to current flow produced by said discharge of said capacitor, said momentary indication being indicative of the position of said switch means and therefore indicative of a closed circuit condition existing in said closed-loop circuit.

11. A limited current drain device according to claim 10 wherein said switching circuit means comprises a first transistor having emitter and collector leads connected across said current limiting resistor, having a base lead connected to said capacitor and having a conduction state controlled by said capacitor, and a second transistor having its emitter and collector leads connected in series between said energy source and said capacitor and having its base coupled to the emitter of said first transistor; said second transistor conducting to rapidly charge said capacitor when said normally open switch means is in its open state and said capacitor when charged causing said first transistor to momentarily conduct to pass current from said capacitor to said lamp when said normally open switch means is closed and said second normally closed switch is closed.

12. An electronic security system for indicating breaches in security within at least one closed-loop circuit comprising:

a. sensing means for sensing breaches in security in said at least one closed-loop circuit;

b. at least one alarm signal producing means coupled to said sensing means for producing an alarm signal and response to said sensing; and

c. indicating means coupled to said at least one alarm signal producing means for producing a characteristic security breach indication in response to a said alarm signal, wherein said indicating means comprises:

1. source switch means responsive to a said alarm signal;

2. characteristic security breach signal producing means connected to said source switch means for activating said signal producing means when said alarm signal is present said signal producing means comprising:

saw tooth generator means for generating a saw tooth voltage signal;

tone generating means coupled to said saw tooth generator for producing an output, the frequency of which varies in response to the amplitude of said saw tooth voltage signal; and

sound generating means coupled to said tone generating means for producing as a said characteristic security breach indication a warbling tone in response to said varying frequency output.

13. An electronic security system according to claim **12** wherein each of said at least one closed-loop circuit has associated therewith at least one sensing means and wherein the sensing means associated with each closed-loop circuit is coupled to a separate alarm signal producing means, wherein a first of said alarm signal producing means is capable of producing a first alarm signal, and a second of said alarm signal producing means is capable of producing a second alarm signal; and wherein said source switch means further comprises means responsive to said second alarm signal to deactivate said tone generator, and wherein said characteristic signal producing means further comprises a free running multivibrator means for producing a series of pulses, which multivibrator is capable of being activated by said switching means in response to said second alarm signal, and wherein said multivibrator is coupled to said tone generator such that said series of pulses is transformed into a series of intermittent burst of signals having a characteristic frequency within each burst to produce an intermittent tone in said sound generating means as said characteristic security breach indication when said second alarm signal is present.

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