United States Patent [19]

Minasy

[11] **3,868,669**

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[54] **REDUCTION OF FALSE ALARMS IN ELECTRONIC THEFT DETECTION SYSTEMS**

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[73] Assignee: **Knogo Corporation,** Westbury, N.Y.

[22] Filed: **Apr. 13, 1973**

[21] Appl. No.: **351,019**

[52] **U.S. Cl.** .... **340/280,** 340/258 C

[51] **Int. Cl.** **G08b 13/18**

[58] **Field of Search** .... 340/258 C, 280, 258 A; 343/5 PD, 6.8 R; 325/478, 35

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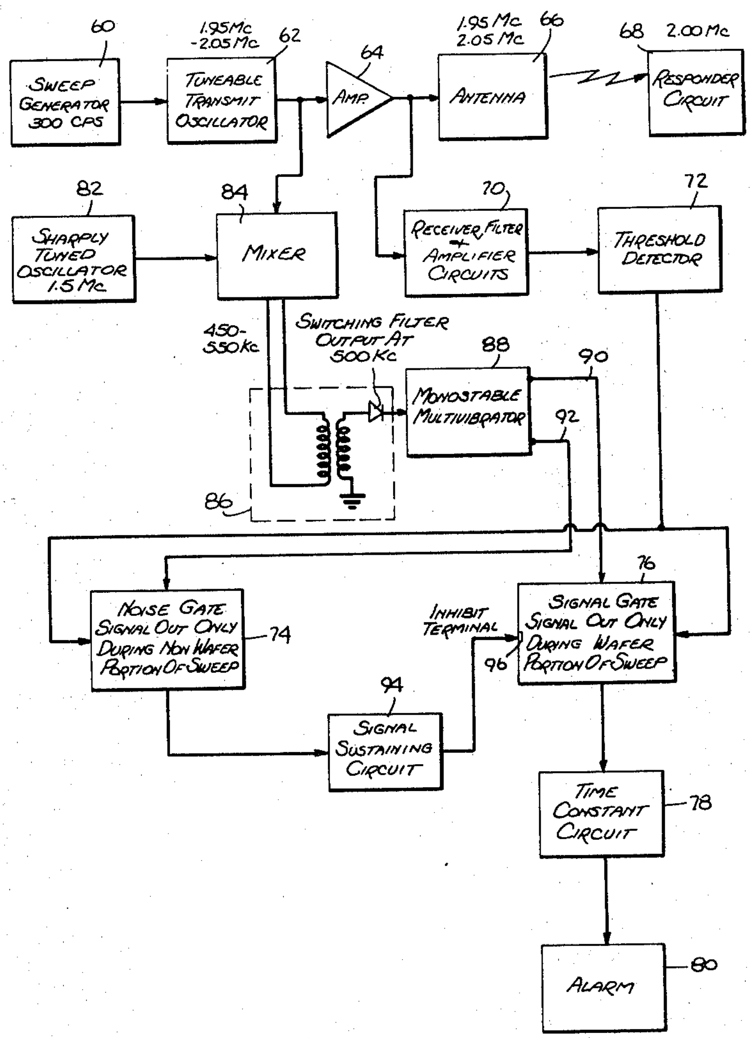
Primary Examiner—Glen R. Swann, III
Attorney, Agent, or Firm—Fitzpatrick, Cella, Harper & Scinto

[57] **ABSTRACT**

Electronic theft detection systems are disclosed which have a particular frequency within which protected articles cause electronic response. False alarms are reduced by detecting similar electronic responses outside the frequency range and temporarily deactivating the system when such responses are detected. In a swept frequency system deactivation signals are produced during the portion of the frequency sweep outside the particular frequency and the deactivation remains during the remaining portion of the frequency sweep past the particular frequency.

11 Claims, 4 Drawing Figures



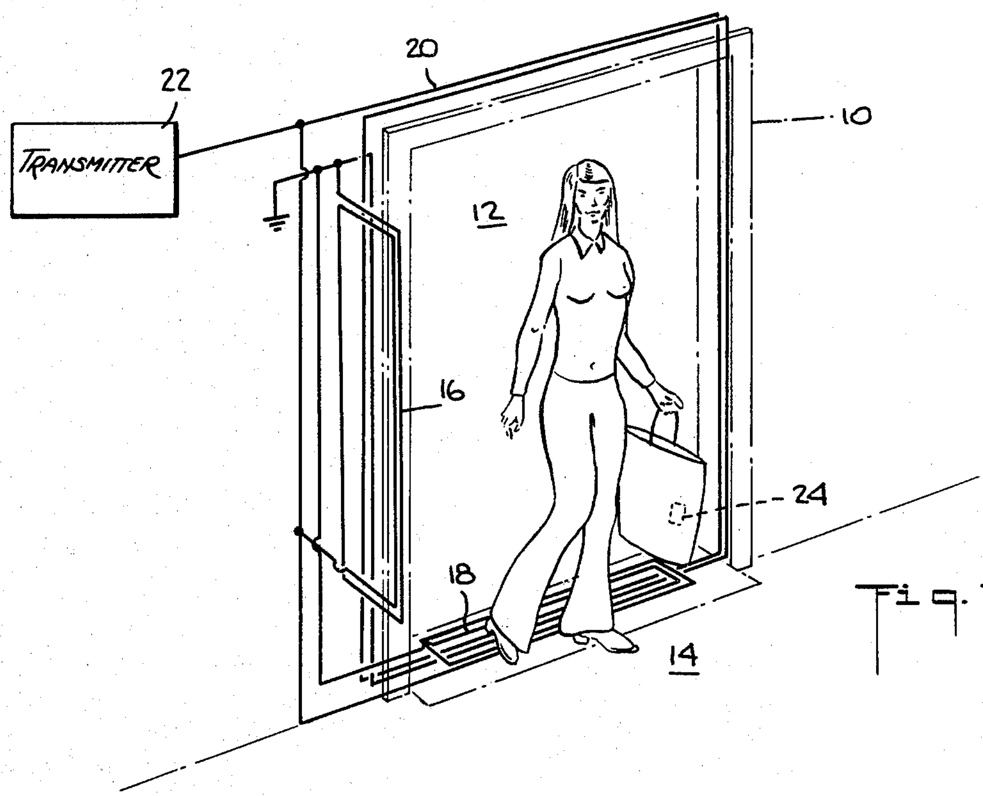
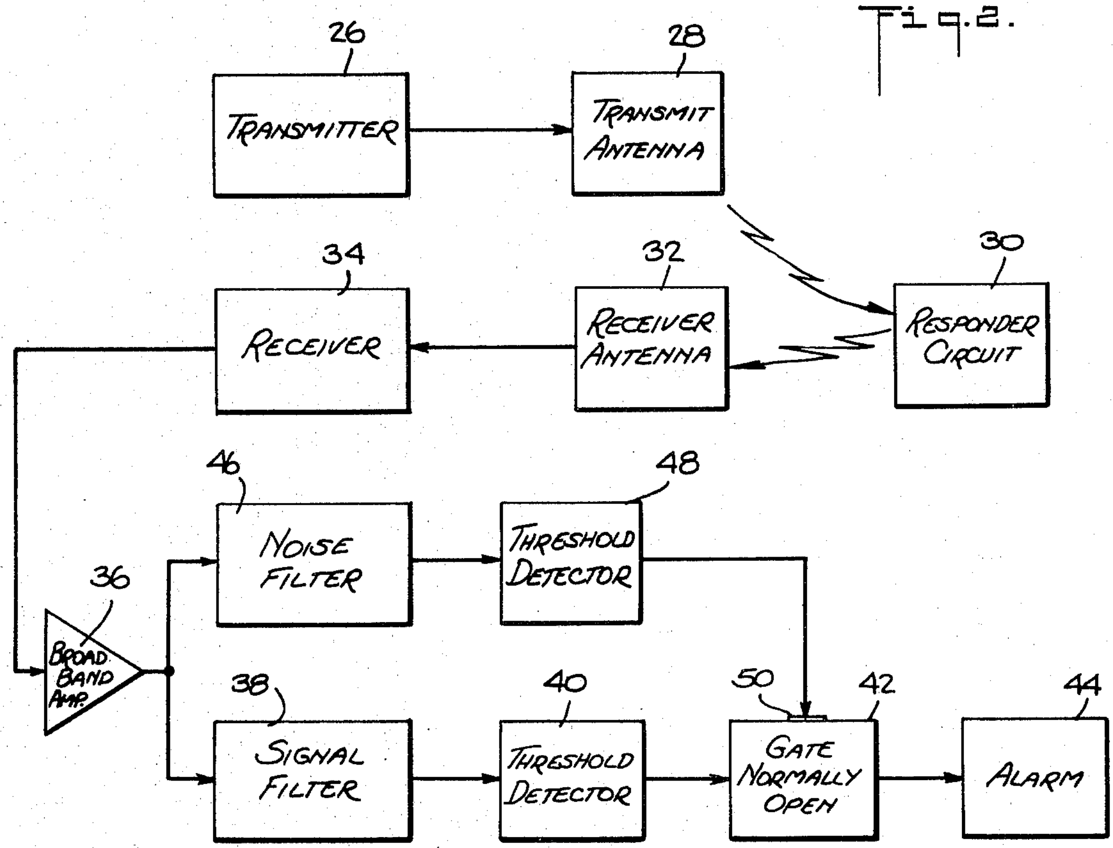

22
TRANSMITTER
20
10
12
16
24
18
14

Fig. 1.

Fig. 2.


26
TRANSMITTER
28
TRANSMIT ANTENNA
30
RESPONDER CIRCUIT
32
RECEIVER ANTENNA
34
RECEIVER
36
BROAD BAND AMP.
46
NOISE FILTER
48
THRESHOLD DETECTOR
38
SIGNAL FILTER
40
THRESHOLD DETECTOR
50
42
GATE NORMALLY OPEN
44
ALARM

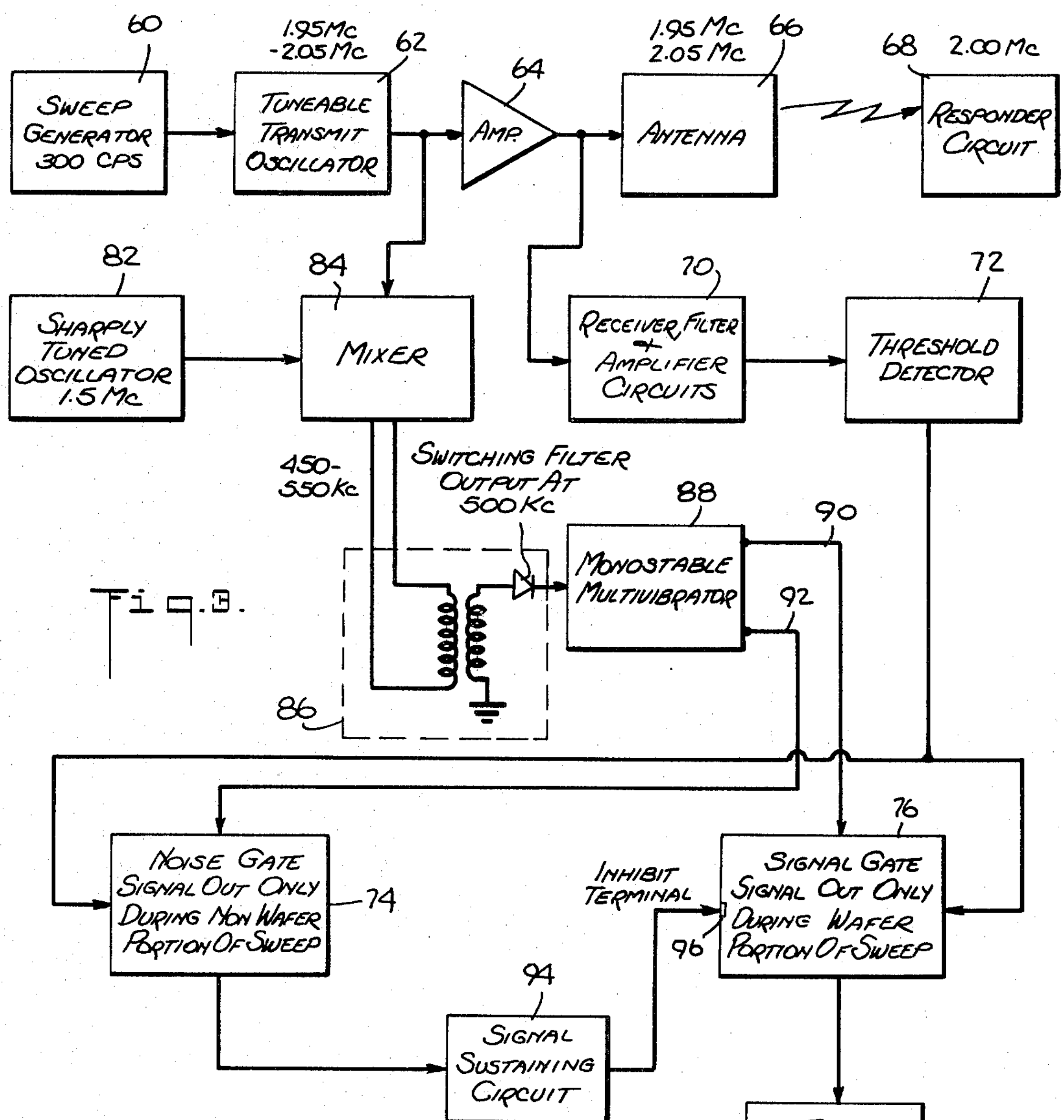
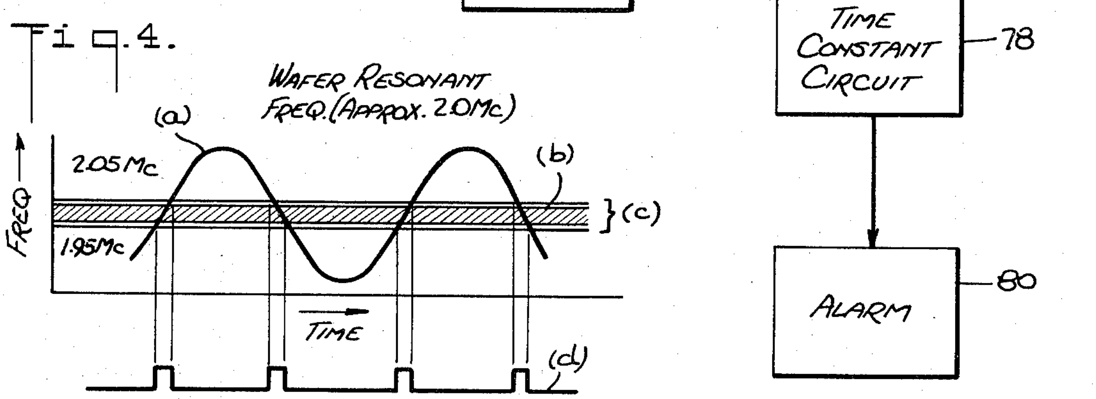

60
1.95Mc
-2.05Mc
62
64
1.95Mc
2.05Mc
66
68
2.00Mc
SWEEP GENERATOR 300 CPS
TUNEABLE TRANSMIT OSCILLATOR
AMP.
ANTENNA
RESPONDER CIRCUIT
82
84
70
72
SHARPLY TUNED OSCILLATOR 1.5Mc
MIXER
RECEIVER, FILTER + AMPLIFIER CIRCUITS
THRESHOLD DETECTOR
450-550Kc
SWITCHING FILTER OUTPUT AT 500Kc
88
90
MONOSTABLE MULTIVIBRATOR
92
86
76
NOISE GATE SIGNAL OUT ONLY DURING NON WAFER PORTION OF SWEEP
74
INHIBIT TERMINAL
96
SIGNAL GATE SIGNAL OUT ONLY DURING WAFER PORTION OF SWEEP
94
SIGNAL SUSTAINING CIRCUIT
TIME CONSTANT CIRCUIT
78
ALARM
80

Fig. 3.

Fig. 4.


WAFER RESONANT FREQ. (APPROX. 2.0Mc)
(a)
2.05Mc
1.95Mc
FREQ
(b)
(c)
TIME
(d)

REDUCTION OF FALSE ALARMS IN ELECTRONIC THEFT DETECTION SYSTEMS

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to the control of theft detection systems and more particularly it concerns arrangements for reducing the occurrence of false alarms from such systems due to extraneous and sporadic electrical effects, such as may result from the operation of electrical machinery near the system.

2. Description of the Prior Art

The present invention is especially suitable for use in conjunction with electronic theft detection systems of the type described in U.S. Pat. Nos. 3,493,955 and 3,500,373. In both systems, each of the articles to be protected from theft has a electronic responder circuit attached to it. This circuit may be concealed in a wafer like element which may also serve as a price label or the like for the protected article. The articles are maintained in an enclosure having limited egress and checkpoints are set up at each egress. A transmitter is provided at the checkpoint to transmit an interrogation signal and receiver means are provided to note any response produced by the interaction of a wafer responder circuit with the transmitted signal field in the vicinity of the checkpoint. In the case of the systems described in U.S. Pat. No. 3,493,955, the wafer responder circuits respond to the transmitted interrogation signal, which is at a first frequency, to produce a response signal at a second frequency. The receiver means are tuned to detect this second frequency.

In the case of the system described in U.S. Pat. No. 3,500,373, the wafer responder circuits are resonant circuits tuned to resonate at the transmitted interrogation frequency. When these wafer responder circuits are brought into the transmitted interrogation signal field they absorb some of the transmitted energy. The receiver means monitors the transmitted signal, which changes in amplitude due to this absorbtion. In order to maximize sensitivity the transmitter of this system produces an output frequency which sweeps cyclically over a given range which includes the resonant frequency of the wafer responder circuits. This causes a series of responses in the form of impulses which occur at a repetition rate corresponding to the frequency sweep rate.

While in both of the above described systems the wafer circuit serves to produce a unique electrical response to the interrogation signal, the possibility exists that similar responses may be produced by nearby electrical equipment such as switches, motors, relays etc., or by other extraneous or sporadic electrical effects; and in such case a false alarm signal may result.

In another U.S. Pat., No. 3,696,379, there is described one means for counteracting the effects of nearly electrical equipment and extraneous or sporadic electrical effects. According to this patent, a separate receiving system is provided near, but not at, the checkpoint. This receiving system, because of its location, will not respond to the effects of wafer responder circuits passing through the checkpoint. However, it does respond to the signals of nearby electrical machinery, etc., which might produce false alarms. Whenever such signals are detected by the separate receiving system, it operates to deactivate the main receiving system so that the false alarm cannot be produced.

SUMMARY OF THE INVENTION

The present invention provides an alternative way to reduce the occurrence of false alarm signals. According to the present invention a separate receiving means is provided; but instead of being responsive to the same frequency signals as the main receiving system but at a different location, the separate receiving system of the present invention responds to different frequency signals at the same location as the main receiving system.

According to one embodiment of the present invention the separate receiving means comprises a receiving channel tuned to respond to electrical effects which occur only within a frequency range which does not include the response signal frequencies. Should those effects exceed a predetermined magnitude, the separate receiving channel produces an output which is utilized to deactivate the alarm.

According to a further embodiment of the invention, the transmitter and the wafer responder circuits are arranged so that the wafer responder circuit produces a series of spaced responses. A gating system is set up in a manner which on one hand permits the main receiving system to function only at the times the spaced responses would occur and which on the other hand permits the separate receiving system to function during the intervening times. Should the output of the main receiving system exceed a predetermined level, it will activate an alarm. However, should the output of the separate receiving system exceed a predetermined amount it will override the effect of the first receiving system and deactivate the alarm.

In the preferred embodiment of the invention a transmitting system is arranged to transmit an interrogation signal at a frequency which is swept back and forth at a given rate and over a range which includes a predetermined wafer responder circuit response frequency. The wafer responder circuits on the protected articles resonate at the response frequency and change the impedance in the vicinity of the transmitting system during the times that the transmitted frequency sweeps past the response frequency. Thus when a wafer responder circuit passes through a check-point in the transmitter antenna field, it causes a series of responses to be produced at a repetition rate corresponding to the transmitter frequency sweep rate. In order to protect the system from possible false alarms a frequency selective switch is provided. This frequency selective switch is arranged to direct the receiver response into a first or a second channel referred to respectively as a noise channel and a signal channel. The frequency selective switch is tuned to span the wafer responder circuit resonant frequency range and is arranged to open the signal channel when the transmitter frequency passes through that range. Whenever the response level exceeds a predetermined threshold in the signal channel an alarm is activated. The filter switch also opens the noise channel during the remaining portions of each transmitter frequency sweep. Whenever the signal level in the noise channel exceeds a given threshold a deactivation signal is produced which deactivates the alarm for a given length of time.

There has thus been outlined rather broadly the more important features of the invention in order that the detailed description thereof that follows may be better understood, and in order that the present contribution to the art may be better appreciated. There are, of course, additional features of the invention that will be described hereinafter and which will form the subject of the claims appended hereto. Those skilled in the art will appreciate that the conception upon which this disclosure is based may readily be utilized as a basis for the designing of other structures and methods for carrying out the several purposes of the invention. It is important, therefore, that the claims be regarded as including such equivalent constructions and methods as do not depart from the spirit and scope of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

Specific embodiments of the invention have been chosen for purposes of illustration and description, and are shown in the accompanying drawings forming a part of the specification, wherein:

FIG. 1 is a fragmentary perspective view illustrating a checkpoint for article theft detection in which the present invention is embodies;

FIG. 2 is a block diagram of a theft detection system including a false alarm prevention arrangement according to one embodiment of the present invention;

FIG. 3 is a block diagram of another theft detection system also including a false alarm prevention arrangement according to a further embodiment of the invention; and

FIG. 4 is a time, frequency and amplitude plot useful in understanding the operation of the embodiment of FIG. 3.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In FIG. 1 there is shown a doorway **10** separating an enclosure **12** from an exterior region **14**. The doorway **10** constitutes one of a limited number of egress passageways from the enclosure **12**; and accordingly it serves as a checkpoint for ascertaining any unauthorized removal of articles from the enclosure. The doorway **10** is provided with several antenna windings **16**, 18 and **20** arranged such that when the windings are energized from a transmitter **22**, they establish electromagnetic fields in the region of the doorway **10**. These electromagnetic fields serve as a monitoring means since any object passing through the doorway **10** must also pass through the electromagnetic field. All articles to be protected are provided with a wafer **24** (shown in dotted outline) which encapsulates an electronic responder circuit. When the wafer is brought through the doorway **10**, its circuit reacts with the electromagnetic field. This response is detected by a receiving system (not shown) which activates an alarm. If an article has been purchased special means may be employed for removal or deactivation of the wafer circuit so that it may pass through the electromagnetic field without causing an alarm actuating disturbance.

FIG. 2 illustrates in block diagram form, the application of the present invention to a rebroadcaster type electronic theft detection system such as that shown and described in U.S. Pat. No. 3,493,955. As can be seen in FIG. 2, there is provided a transmitter **26** which energizes a transmitter antenna **28** so that the transmitter antenna continuously emits an electromagnetic field at a monitoring frequency of, for example, 27.2 megahertz (MHZ). The transmitter antenna **28** may comprise one or more of the windings **16**, **18** and **20** (FIG. **1**) so that the electromagnetic field fills the region of the doorway **10**. A responder circuit **30**, which may be encapsulated in the wafer **24** of FIG. **1**, is configured to respond to the 27.2 MHZ field and to emit a response signal at a frequency of between 5.1 and 5.9 MHZ, for example.

The responder circuit output signals are intercepted by a receiver antenna **32**; and they are detected and amplified in a receiver **34**. The receiver antenna **34** may also comprise a winding at the doorway **10** (FIG. **1**). The output of the receiver **34** passes through a broad band amplifier **36**; and from there the detected signals pass along two channels. The first channel includes a signal filter **38** which is relatively sharply tuned to the output frequency of the responder circuit **30**. The output of the signal filter **38** passes to a threshold detector **40** which, upon receipt of a signal of a predetermined magnitude, generates an alarm actuation signal. The alarm actuation signal from the threshold detector passes through a normally open gate circuit **42** to actuate an alarm **44**. The alarm **44** may be any audio or visual type indicator means well known in the art.

The second channel of the receiver system includes a noise filter **46** which is tuned to pass signals whose frequency components do not lie within the selected signal range, i.e., between 5.1 and 5.9 MHZ. The output of the noise filter is applied to a threshold detector **38**. The threshold detector is set to respond to a predetermined noise level and, upon the occurrence of such noise level, to apply a signal to an inhibit terminal **50** of the normally open gate circuit **42**.

In operation of the system of FIG. **2**, articles to be protected are provided with wafers **24** (FIG. **1**) which contain responder circuits **30** capable of emitting an electromagnetic signal of between 5.1 and 5.9 MHZ when energized by an electromagnetic field at 27.2 MHZ. Thus, whenever a protected article containing an operative responder circuit **30** passes through the doorway **10** (FIG. **1**) and through the field of the transmitter antenna **28**, it responds to the continuously transmitted electromagnetic field in the doorway and in turn energizes the receiver antenna **32**. Signals from the receiver antenna **32** are detected by the receiver **34** and are passed through the broad band amplifier **36**, the filter **38**, the threshold detector **40**, and the normally open gate circuit **42**, to activate the alarm **34**.

Should there occur any sporadic or extraneous electrical disturbances capable of causing premature or improper actuation of the alarm **44**, such disturbances would, according to the present invention, be detected and utilized in a novel way to protect against any premature or improper alarm actuation. The present invention is based in part on the discovery that sporadic and extraneous electrical disturbances occur over a rather broad frequency band substantially greater than the selected response signal frequency. Thus, in the present case, while sporadic electrical disturbances may produce electromagnetic fields in the vicinity of the doorway **10**, within the 5.1 to 5.9 MHZ response frequency range, those same disturbances will also produce other electromagnetic fulls at frequencies both above and below the response frequency range. These other electromagnetic fields are detected by the receiver **34**; and while the receiver signals they produce do not pass through the signal filter **38**, they do pass through the noise filter **46**. These signals pass through the threshold detector **48** and appear at the inhibit terminal of the gate circuit **42.** This closes the gate circuit **42** and prevents the sporadic electrical disturbance induced signals in the signal channel from passing through the channel to activate the alarm **44.** When the electrical disturbance ceases, the signals in the noise channel terminate, and the inhibit terminal **50** of the gate circuit **42** is deactivated, thus allowing the gate circuit to revert to its normally open condition. Thus, any responder circuit induced signals which are not accompanied by signals outside the selected response frequency range may then pass through the signal channel and through the gate **42** to activate the alarm **44.** The noise filter **46** must, of course, also be tuned to prevent passage of signals at the transmitted frequency in order to prevent continuous indications of false alarm from energy received directly from the transmitter.

FIG. **3** shows in block diagram form, a modified version of the present invention as applied to an electronic theft detection system of the type shown and described in U.S. Pat. No. 3,500,373. As shown in FIG. **3,** the theft detection system includes sweep generator **60** capable of producing a repetitive output sweep, for example a sine wave voltage whose amplitude varies at a frequency of 300 cycles per second. The sweep generator output is applied to a tunable transmitter oscillator **62** which, in response to the signals from the sweep generator **60,** produces an output frequency which shifts, for example, from 1.95 to 2.05 MHZ at a 300 cycle per second rate. This varying frequency output is applied to a transmitter amplifier **64** where it is amplified and then applied to a transmitter antenna **66.** This transmitter antenna may comprise one or more of the windings **16, 18** and **20** arranged in the doorway **10** of FIG. **1.** The antenna **66** produces an electromagnetic field in the vicinity of the doorway **10** which varies in frequency between 1.95 and 2.05 MHZ at a 300 cycle per second rate. A responder **68,** which may be encapsulated within the wafer **24** of FIG. **1,** comprises a resonant circuit, such as shown in the aforementioned U.S. Pat. No. 3,500,373. This circuit is tuned to resonante at some fixed frequency between 1,95 and 2.05 MHZ. More specifically, in the present embodiment, the responder circuit is tuned to resonate at 2.00 MHZ.

A receiver **70** is connected to a point between the transmitter amplifier **64** and the antenna **66.** The output of the receiver **70** is applied to a threshold detector **72,** and its output in turn is connected in parallel to a noise gate circuit **74** and to a signal gate circuit **76.** The output of the signal gate circuit **76** is connected through a time constant circuit **78** to an alarm **80.**

The circuit of FIG. **3,** as thus far described, operates to detect the presence of the responder circuit **68** in the field of the antenna **66,** i.e., in the vicinity of the doorway **10** (FIG. **1**), in the manner described in aforementioned U.S. Pat. No. 3,500,373. Thus, the vicinity of the doorway is filled with a high frequency electromagnetic field whose frequency is swept continuously at a 300 cycle per second rate back and forth over a frequency range which includes the resonant frequency of the responder circuit **68.** This frequency sweep is illustrated by a curve (*a*) in FIG. **4.** The resonant frequency of the responder circuits **68,** which is indicated by a cross hatched strip (*b*), is chosen to be near the middle of the frequency range. The width of the strip (*b*) depends upon the Q of the resonant circuits **68,** that is, upon the sharpness with which they can be tuned.

Each time the antenna field frequency sweeps across the resonant frequency of a resonant circuit **68** which is in its field, i.e., which is present in the doorway **10** of FIG. **1,** the impedance presented to the antenna **66** decreases and a greater amount of energy flows out the antenna. Because of this, the amount of transmitter energy presented to the receiver **70** decreases. This phenomenon is experienced twice during each cycle of transmitter frequency sweep, i.e., at 600 times per second. The receiver circuits are designed, as described in U.S. Pat. No. 3,500,373, to respond to the occurrence of energy decreases incident on the receiver at 600 times per second, and to supply a signal to the threshold detector **72** when this occurs. Signals from the threshold detector **72** pass through the signal gate circuit **76,** the time constant circuit **78** and activate the alarm **80.**

The remainder of the system of FIG. **3** is designed to disable the actuation of the alarm **80** whenever spurious electromagnetic or electrical disturbances occur, which otherwise might be interpreted by the receiver **70** and the threshold detector **72** as a responder circuit **68** passing through the field of the antenna **66.** The disabling portion of the system of FIG. **3** includes a sharply tuned oscillator **82** which is tuned to a frequency of 1.5 MHZ. The output of this oscillator is applied to a mixer **84** along with output signals from the tunable transmitter oscillator **62.** These signals, when mixed in the mixer **84,** produce an output signal which varies between 450 and 550 KHZ (kilohertz) at a 300 cycles per second rate. The mixer output is applied to a switching filter **86.** The switching filter is tuned to pass signals whose frequency corresponds to transmitter frequencies over a band which is slightly greater than and which envelopes the frequency to which the responder circuits **68** are tuned. The range of transmitter frequencies which cause the switching filter **86** to produce outputs is indicated at (*c*) in FIG. **4,** the output of the switching filter **86** is applied to a monostable multivibrator **88.**

The monostable multivibrator **88** has a signal gate actuation output terminal **90** and a noise gate actuation output terminal **92** which are alternately energized. Normally, the noise gate actuation output terminal **92** of the monostable multivibrator **88** is energized. However, whenever the output of the mixer **84** reaches a frequency approaching a frequency corresponding to that of the responder circuit **68,** the switching filter **86** produces an output causing the monostable multivibrator **88** to deenergize the noise gate actuation terminal **92** and to energize the signal gate actuation terminal **90.** Since the switching filter **86** is tuned to have an equivalent band pass range (*c*) which is slightly greater than the responder circuit response frequency range (*b*), the switching filter **86** will operate to trigger the monostable multivibrator whenever the antenna frequency approaches the responder circuit resonant frequency in both directions of the antenna frequency sweep, irrespective of whether the antenna frequency is increasing or decreasing. The monostable multivibrator **88** reverts back to its normal state, i.e., with the noise gate actuation output terminal **92** energized and the signal gate actuation output terminal **90** deenergized, after a predetermined length of time following each output from the switching filter **86.** This predetermined length of time is slightly longer than the length of time required for the antenna frequency sweep to sweep across the resonant frequency of the responder circuit **68**. That is, the monostable multivibrator **88** remains energized over a period of time which straddles the period during which the antenna frequency sweeps across the resonant frequency of the responder circuits **68**. This energization of the monostable multivibrator **88** is illustrated by a curve (*d*) in FIG. **4**.

It will be noted from FIG. **4** that the monostable multivibrator **88** is switched to its non-stable state at different transmitter frequencies depending upon whether the transmitter frequency is increasing or decreasing. This is made possible by the tuning of the switch filter **86**. This tuning is broader than that of the responder circuits **68**; and it produces a switching signal at the multivibrator **88** just before the antenna frequency reaches the resonant frequency of the responder circuits **68**.

The signal gate actuation output terminal **90** of the monostable multivibrator **88** is connected to the signal gate circuit **76** while the noise gate actuation output terminal **92** is connected to the noise gate circuit **74**. Whenever the noise gate circuit **74** or the signal gate circuit **76** receives a signal from a corresponding one of the gate actuation output terminals **90** or **92**, that gate circuit is opened to allow passage of signals from the threshold detector **72**. The output from the noise gate circuit **74** is connected through a signal sustaining circuit **94** to an inhibit terminal **96** of the signal gate circuit **76**. The signal sustaining circuit **94** is constructed to cause outputs from the noise gate circuit **74** to remain on the inhibit terminal **96** of the signal gate circuit **76** for a predetermined length of time (e.g., 0.1 seconds), which is substantially in excess of the frequency sweep period of the transmitter. This allows time for any spurious interference to terminate before the system reverts to normal operation.

The operation of the system of FIG. **3** will now be described. The tunable transmitter oscillator **62** energizes the antenna **66** so that an electromagnetic field is emitted from the antenna **66** into the vicinity of the doorway **10** (FIG. **1**). The frequency of this electromagnetic field is continuously varied by the action of the sweep generator **60** so that the antenna field undergoes successive frequency sweeps between 1.95 and 2.05 MHZ at a 300 cycles per second rate. Whenever a responder circuit **68** passes through the doorway **10** (FIG. **1**) and encounters the field of the antenna **66**, the responder circuit will resonate each time the frequency of the antenna field passes through 2.00 MHZ. Since this happens twice during each frequency sweep, a resonant response is generated at the rate of 600 responses per second. As indicated previously, the nature of these resonant responses is such that they produce a decrease in antenna output impedance and a corresponding reduction of energy applied to the receiver **70**. These decreases in energy are detected by the receiver **70**; and its filter configuration is such as to select those energy decreases which occur at the 600 responses per second rate. When this occurs, the receiver **70** produces an output which is applied to the threshold detector **72** and its output in turn is applied to the noise gate circuit and the signal gate circuit **74** and **76** respectively. In the event that the output from the receiver **70** occurs while the anetnna **66** is emitting a frequency within the range (*c*) of FIG. **4**, i.e., corresponding substantially to the resonant range (*b*) of the responder circuits **68**; then the switching filter **86** will have caused the monostable multivibrator **88** to energize its signal gate actuation output terminal **90** to open the signal gate circuit **76** and allow the output from the threshold detector **72** to pass through the time constant circuit **78** to energize the alarm **80** for predetermined length of time.

On the other hand, if the receiver **70** causes an output to pass through the threshold detector **72**, when the antenna **66** is transmitting outside the range (*c*) of FIG. **4**, then the switching filter **80** will not have caused the monostable multivibrator **88** to energize its signal gate actuation output terminal **90**. Instead, the noise gate actuation output terminal **92** of the monstable multivibrator **88** remains energized. Accordingly, the signal gate **76** remains closed; and the receiver output, which passes through the threshold detector **72**, is stopped at the signal gate circuit **76** and does not actuate the alarm **80**. Thus, even though a resonant circuit may be present in the antenna field, it will not cause a false alarm if it produces any resonant response outside the preselected resonant frequency range of the responder circuits **68**.

The system of FIG. **3** provides additional protection in that it uses information obtained during the portion of the frequency sweep outside the preselected responder circuit resonant frequency range to control its operation when the transmitter frequency subsequently reaches the preselected resonant frequency of the responder circuits. Thus, should responses be detected outside the responder circuit resonant frequency range, the system will, for a predetermined length of time, prevent any alarm actuation even from subsequent responses which do occur within the resonant frequency range. This protects against false alarms from objects which pass through the antenna field and which have an assortment of electrical characteristics producing resonant responses in several frequency ranges including the resonant range of the responder circuits **68**.

The manner in which this subsequent alarm deactivation occurs can be seen in FIGS. **3** and **4**. Should any output from the threshold detector **72** occur during the time that the antenna frequency is outside the range (*c*), the detector output will pass through the noise gate circuit **74**. This is because the normal energization of the noise gate actuation output terminal **92** maintains the noise gate circuit **74** in an open condition. As a result of this, the noise gate circuit **74** applies a signal through the signal sustaining circuit **94** to the inhibit terminal **96** of the signal gate circuit **76**. Accordingly, as the antenna frequency continues to sweep and ultimately passes through the response ranges (*b*) and (*c*) the resulting switching of the monostable multivibrator **88** which opens the signal gate circuit **76** is rendered ineffective because of the continued presence of an inhibit signal at the inhibit terminals **96** of the gate circuit **76**. This maintains the signal gate circuit **76** is closed for a predetermined length of time (e.g., 0.1 seconds), which is well is excess of the transmitter frequency sweep period. In most instances the sporadic electrical disturbance will have terminated. On the other hand, if the sporadic electrical disturbance should continue, the noise gate circuit **74** will be allowed to produce an inhibit signal gate circuit **76** on the next subsequent transmitter sweep.

It will be appreciated from the foregoing that the present invention provides protection from false alarms based upon active detection in frequency ranges outside the frequency range of the various responder devices.

Having thus described the invention with particular reference to the preferred forms thereof, it will be obvious to those skilled in the art to which the invention pertains, after understanding the invention, that various changes and modifications may be made therein without departing from the spirit and scope of the invention, as defined by the claims appended hereto.

What is claimed is:

1. A method for reducing the occurrence of false alarms in an electronic theft detection system of the type wherein an interrogation signal is varied in frequency and wherein predetermined changes in the electromagnetic field in the vicinity of a checkpoint are produced by the passage therethrough of protected articles carrying special electronic circuits whenever said interrogation signal passes through a given frequency range, and wherein an alarm indication is produced in response to said predetermined changes, said method comprising the steps of monitoring the interrogation signal frequency and preventing alarm indications when said interrogation signal frequency is outside said given range.

2. A method for reducing the occurrence of false alarms in an electronic theft detection system of the type wherein an interrogation signal is varied in frequency and wherein predetermined changes in the electromagnetic field in the vicinity of a checkpoint are produced by the passage therethrough of protected articles carrying special electronic circuits whenever said interrogation signal passes through a given frequency range, and wherein an alarm indication is produced in response to said predetermined changes, said method comprising the steps of monitoring for similar changes in the electromagnetic field in the vicinity of said checkpoint which occur while said interrogation signal is outside said given range and preventing alarm indications in response to detection of said similar changes when said interrogation signal subsequently passes through said given range.

3. A system for detecting the unauthorized passage of articles through a checkpoint, said system comprising a transmitter operative to transmit an interrogation signal which varies in frequency, responder circuits mounted on articles whose unauthorized passage is to be detected, said responder circuits being operative to produce a predetermined change in the electromagnetic field conditions in the vicinity of said checkpoint in response to the incidence on said circuits of said interrogation signal within a given frequency range, receiver means operative in response to said predetermined change to produce an alarm actuating signal, alarm means responsive to said actuating signal to produce an alarm indication and means operative to prevent alarm actuation while said interrogation signal is outside said given frequency range.

4. A system according to claim **3** wherein said responder circuits include energy absorbing resonant circuits and wherein said receiver means is connected to respond to energy level changes in the vicinity of said checkpoint caused by the absorption of power in a responder circuit passing through the checkpoint.

5. A system according to claim **3** wherein said means operative to prevent alarm actuation comprises a gate circuit associated with said receiver and arranged in the path of said alarm actuating signal, a frequency sensitive switch connected to receive transmitted interrogation signals and to produce switching signals to open said gate circuit when said interrogation signals are within said given frequency range and to close said gate circuit where said interrogation signals are outside said given frequency range.

6. A system for detecting the unauthorized passage of articles through a checkpoint, said system comprising a transmitter operative to transmit an interrogation signal which varies in frequency, responder circuits mounted on articles whose unauthorized passage is to be detected, said responder circuits being operative to produce a predetermined change in the electromagnetic field conditions in the vicinity of said checkpoint in response to the incidence on said circuits of said interrogation signal within a given frequency range, receiver means operative in response to said predetermined change to produce an alarm actuating signal, alarm means responsive to said actuating signal to produce an alarm indication and means associated with said receiver means for producing alarm inhibit signals in response to said predetermined change which occurs while said interrogation signal is outside said given frequency range and means responsive to the occurance of said alarm inhibit signals for inhibiting alarm indications when said interrogation signal subsequently passes through said given frequency range.

7. A system according to claim **6** wherein said responder circuits include energy absorbing resonant circuits and wherein said receiver means is connected to respond to energy level changes in the vicinity of said checkpoint caused by the absorption of power in a responder circuit passing through the checkpoint.

8. A system according to claim **6** wherein said means associated with said receiver means comprises first and second gate circuits each connected to receive signals from said receiver means, one of said gate circuits being connected to permit signals passing therethrough to produce an alarm indication, the other gate circuit being connected to permit signals passing therethrough to override any opening of said one gate circuit for a predetermined length of time and a frequency sensitive switch connected to receive transmitted interrogation signals and to produce switching signals to open said one gate when said interrogation signals are within said given frequency range and to open said other gate when said interrogation signals are outside said given frequency range.

9. A system according to claim **8** wherein said frequency sensitive switch includes a multivibrator having two output terminals which are alternately energized and which are connected, respectively, to control terminals of said first and second gate circuits.

10. A system according to claim **8** wherein a signal sustaining circuit is connected to the output of said other gate circuit.

11. A system according to claim **10** wherein said transmitter is operative to vary the frequency of said interrogation signal cyclically at a given rate and wherein said signal sustaining circuit has a duration in excess of the cyclic period of frequency variation of said interrogation signal.

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