METHOD AND APPARATUS FOR DETECTING THE THEFT OF ARTICLES

Inventors: Roger L. Hall, Franconia; Edward S. Wainright, Nashua, both of N.H.; Kenneth Clarkson, Tonasket, Wash.

Assignee: North American Systems Corp., Londonderry, N.H.; by said Hall and Wainright

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ABSTRACT

The theft of articles or goods maintained in a vending place such as a department store having at least one exit passageway is prevented by affixing thereto a preferably small detection element comprising a receiver of first predetermined frequency, a transmitter of second predetermined frequency, and power supply means coupled from said receiver and capable of disabling said transmitter. At the authorized checkout area of the store there is disposed a relatively high power transmitter of first predetermined frequency capable of preferably permanently disabling the power supply means and in turn said transmitter of second predetermined frequency of the detection element. In one preferred embodiment the power supply means includes a rectifier circuit which is destroyed (burned out and thus opened) when the detection element comes within predetermined proximity to the high power transmitter at the checkout area. At the exit there is disposed a transmitter of first predetermined frequency and a receiver of second predetermined frequency which only detects a signal when the power supply means has not been disabled at the authorized checkout area whereby an alarm signal is generated.

6 Claims, 7 Drawing Figures
METHOD AND APPARATUS FOR DETECTING THE THEFT OF ARTICLES

FIELD OF THE INVENTION

The present invention relates in general to an apparatus or system and associated method of detecting the theft of articles from a vending place such as a department store. More particularly, the present invention is directed to the type of system that employs an electronic detection element preferably of small integrated-circuit size affixed to the article or goods.

BACKGROUND OF THE INVENTION

Many different means have been devised for preventing or deterring the theft of articles or goods from a store or other vending place. Some of these means include mirrors, security police, cameras, television with video recording and gentian violet marking. None of these means are completely effective, and once the thief has been able to conceal the item these above devices cannot detect the passage of the item through the exitway of the store.

The problem of stolen merchandise is further complicated by the possible legal rights of the individual against false accusations. Thus, persons in authority at the store are hesitant to accuse any potential thief, in the absence of effective detection means, for fear of the possibility of a suit for defamation of character being filed. Also, any false accusations may have a deleterious outcome regarding the good-will of the store.

Accordingly, it is important that the detection means accurately identify, preferably at the exitway of the store, articles that have not passed through the check-out counter and been paid for. In the past there have been both electrical and mechanical devices designed. Generally, however, these devices are too costly, too dangerous, or too unreliable. One technique, for example, shown in U.S. Pat. No. 3,582,931 uses a radioactive material affixed to the article. The problem with this technique is that the articles carrying the material may be adversely affected by the presence of any radioactive material. Another technique is to use a sensitive reed switch (see U.S. Pat. No. 3,577,136) which is responsive to a magnet disposed at the exitway. This type of device has, inter alia, the disadvantage that it can be too easily falsely triggered. Still another prior art device is of the resonant frequency type (see U.S. Pat. Nos. 3,493,955 and 3,500,373) wherein a resonant circuit is affixed to the article and a receiver/transmitter combination is used to monitor changes in the ambient energy level due to the presence of the resonant circuit. This device also is susceptible to false triggering because the frequency sensitivity of the energy level monitoring equipment is quite low and metal objects can cause false triggering.

OBJECTS OF THE INVENTION

Accordingly, it is an important object of the present invention to provide an improved apparatus or system and associated method for detecting the theft or articles or goods from a vending place such as a department store. The apparatus of the present invention is of the electromagnetic wave detection type.

Another object of the present invention is to provide a system for preventing article thefts that is both safe and effective in operation. With the apparatus of the present invention there is no exposure to harmful radiation.

A further object of the present invention is to provide an apparatus for monitoring the unauthorized passage of articles past a predetermined checkpoint preferably adjacent an exitway of the store wherein there is no need for additional security personnel wherein the apparatus is readily concealable from the view of the ordinary purchaser.

Still another object of the present invention is to provide a system for preventing article thefts that effectively distinguishes between the authorized and unauthorized passage of articles past a given checkpoint thereby alleviating the false alarm problem.

An additional object of the present invention is to provide a detection element that readily impregnates or adheres to various articles whether constructed of paper, cloth, wood, plastic, etc. that is very small in size, and may be easily disabled by even non-skilled workers.

SUMMARY OF THE INVENTION

To accomplish the foregoing and other objects of the invention, there is provided a system for detecting the unauthorized removal of articles from an enclosure such as a department store having a checkout area and a passageway through which the articles are generally moved from the enclosure. The system comprises a transmitter of a first frequency and a receiver of a second frequency both being disposed at the exit passageway. The receiver of second frequency is not responsive to a signal of first frequency. A means is also provided for establishing an alarm condition when the receiver at the passageway receives a signal of second frequency.

A relatively small detection element is attached to the article and comprises a receiver of first frequency, a transmitter of second frequency and means responsive to a signal, of a level less than a predetermined threshold level, from said receiver of a first frequency for providing power to the transmitter of a signal of second frequency.

If the article is properly taken from the enclosure it passes through a checkout area where there is located a high power transmitter of a first frequency for establishing a signal of a level greater than the predetermined threshold level from the receiver of the detection element to thereby disable the power providing means, interrupting power to the transmitter of the detection element. Thereafter, when the detection element passes through the exit passageway the receiver of second frequency disposed at the exit passageway does not receive a signal because of the permanently disabled power providing means and therefore no alarm condition is established. Alternatively, if the article does not pass as it should through the checkout counter area and is not subjected to the high power transmitter disposed thereat, the means for providing power to the transmitter of the detection element is not inhibited and thus as the article passes through the exit passageway the receiver disposed at the passageway will receive a signal of a second frequency and thus there will be an alarm condition established.

In accordance with another aspect of the present invention the transmitter of a second frequency which forms part of the detection element has a modulation means associated therewith. Each of the modulation
means is different for each type of article being protected. By using a first frequency transmitter and second frequency receiver just before the checkout area, it is possible to keep track of all articles passing to the checkout area for purposes of inventory control. For this purpose it is also necessary to have some type of accumulator for distinguishing each article and providing a cumulative count of each article sold.

BRIEF DESCRIPTION OF THE DRAWINGS

Numerous other objects, features and advantages of the invention should now become apparent upon a reading of the following detailed description taken in conjunction with the accompanying drawings in which:

FIG. 1 is a schematic diagram showing the different areas of the store and the components of the present invention associated therewith;

FIG. 2A shows a block diagram of the detection element of the present invention;

FIG. 2B shows a block diagram of the means provided at the checkout area of the store;

FIG. 2C is a block diagram of the means provided at the exitway area of the store;

FIG. 3 is a circuit diagram of a preferred embodiment of the detection element shown in FIG. 2A;

FIG. 4 shows a block diagram of an alternate embodiment for the detection element; and

FIG. 5 is a block diagram of the inventory monitoring means of the present invention used in conjunction with the detection element of FIG. 4.

DETAILED DESCRIPTION

FIG. 1 shows the three basic areas of a store that are of interest in discussing the concepts of the present invention. Various articles are disposed in storage or display area 10 in any known manner and preferably each article A has a detection element affixed thereto. FIG. 2A which is discussed in more detail hereinafter shows a block diagram of one detection element of this invention. If the article is being properly purchased it passes from area 10 to checkout area 12 where there is usually disposed a checkout counter 14 and associated cash register 16 or the like. The high power transmitter of the present invention is disposed at the checkout area 12 for disabling the detection element and permitting passage of the article through the exitway area 14 without providing an alarm. This high power transmitter may be disposed beneath the recess 18 provided in counter-top 20 of checkout counter 14. A pair of doors 21 is shown in FIG. 1 for providing access to the outside of store or enclosure 22.

If the article A has not passed through the checkout area 12 and has not been subjected to the high power transmitter thereat, when the article does pass through the doors 21 means are provided adjacent thereto as discussed with reference to FIG. 2C for providing an alarm.

Referring now to FIG. 2A there is shown a block diagram of the detection element 24 which is affixed to article A in an appropriate manner. This detection element 24 is preferably constructed by integrated circuit technology and may be no larger than 0.025 sq. in. The detection element 24 includes an input antenna 26 which couples to receiver R1. Receiver R1 is preferably a fixed frequency receiver of frequency F1 which may be on the order of 460 megacycles. The detection element 24 also includes a transmitter T2 (and associated antenna 27), and a power supply 30 coupled from receiver R1 for delivering power to both receiver R1 and transmitter T2 when an input signal of frequency F1 is received on antenna 26. Transmitter T2 may be of conventional design. Power supply 30 which is discussed later with reference to FIG. 3 preferably includes a rectifier that is preselected so that if a power greater than a predetermined threshold is received by receiver R1 the rectifier of the power supply 30 is burned out (opened) and thus when any future signal is received by receiver R1 the power supply 30 blocks power to transmitter T2 and prevents any transmission of its associated frequency F2. Frequency F2 may be on the order of 430 megacycles.

FIG. 2B shows the checkout area 12 and the transmitter 32 which is a high power transmitter capable of generating sufficient energy when the article is passed over the transmitter to cause the rectifier of power supply 30 to be opened.

In FIG. 2C there is shown the exitway area 14 including a transmitter T1 (with associated antenna 28) of first frequency F1 and a receiver R2 (with associated antenna 29) of second frequency F2 having an alarm 34 associated therewith for generating an alarm signal when a signal of frequency F2 is received by receiver R2. If the article has been appropriately passed through checkout area 12 and passes as shown in FIG. 2C between transmitter T1 and receiver R2 the signal from transmitter T1 is blocked because the rectifier of power supply 30 has prevented transmission of any F2 frequency, and thus receiver R2 does not trigger alarm 34.

Referring now to FIG. 3, there is shown a circuit diagram for one embodiment of the detection element 24 shown in a block diagram in FIG. 2A. The detection element 24 comprises a receiver R1, a transmitter T2, and power supply 30. The receiver R1 includes a tank circuit comprising of capacitor C1 and an inductor L1. Similarly, transmitter T2 includes a tank circuit comprised of capacitor C2 and inductor L2. The inductors of these tank circuits function as the antennas of each tank circuit.

The power supply means 30 comprises transistor Q1, diode D1, capacitors C3 and C4 and resistor R. The collector of transistor Q1 couples to transmitter T2 and the emitter of transistor Q1 couples by way of a diode D1 to receiver R1. Capacitor C3 also couples from the emitter of transistor Q1 to both receiver R1 and transmitter T2. Resistor R and capacitor C4 are coupled, in parallel, from the base of transistor Q1 to transmitter T2. Resistor R establishes the proper bias for the base of transistor Q1 and capacitor C4 is an AC bypass capacitor. It is the diode D1 that is destroyed when receiver R1 receives a signal of strength greater than a predetermined threshold level. This level is a function of the type diode selected. When diode D1 is burned out transistor Q1 can no longer supply power to either receiver R1 or transmitter T2.

Because the receiving and transmitting antennas (inductors L1 and L2, respectively) are much smaller than a half wave, an optimum impedance match has been calculated at the terminals of the antenna, of approximately 73 ohms. By choosing a five microfarad capacitor for capacitor C1 and assuming a resonant frequency of 460 MHZ for receiver R1, an inductance of approximately 6,000 μH henries can be calculated for inductor L1. A loop of wire whose radius is 1/20 inch and whose thickness is 4 x 10⁻⁶ inch can be used for inductor L.
Using the same value of capacitance for capacitor C2, the inductance in the transmitter can be calculated to be approximately 5,800 μH, making the transmitter T2 a resonant frequency on the order of 430 MHz.

Thus, when the receiver R1 is receiving a signal of frequency F1, diode D1 rectifies the output from the tank circuit of receiver R1 and transistor Q1 provides power by way of capacitor C3 to both receiver R1 and transmitter T2. A feedback line 36 couples from transmitter T2 to capacitor C4 for providing regenerative feedback to the power supply means 30. When the circuit shown in FIG. 3 is passed adjacent the transmitter 32 shown in FIG. 2, the power from the transmitter 32 which is received by receiver R1 is sufficient to burn out diode D1, thereby inhibiting the power supply means 30 and the transmitter T2 shown in FIG. 3. When the article is subsequently passed through the exitway area 14 shown in FIG. 2C the transmitter T2 is not capable of sending any signal to receiver R2 at the exitway area and thus no alarm condition is generated. If the circuit of FIG. 3 is not subjected to the high power transmitter 32 the diode D1 is not burned out and thus transmitter T2 is capable of generating a signal received by receiver R2 at the exitway area 14 for generating an alarm condition by means of alarm 34.

Referring now to FIG. 4 there is shown a block diagram of another embodiment of a detection element of 24. The block diagram of FIG. 4 is similar to the previous block diagram of FIG. 2A with the addition of a modulator 40 which receives an input from power supply 30 and has an output connected to transmitter T2. Modulator 40 may be of conventional design. When receiver R1 receives a signal of frequency F1, power supply 30 provides power to receiver R1, transmitter T2 and modulator 40, and the output signal from the antenna associated with transmitter T2 is a modulated frequency signal. A known type of amplitude modulation can be provided by modulator 40. With the use of the detection element of FIG. 4 the exitway detection circuitry may be similar to that shown in FIG. 2C with the addition of a modulator associated with receiver R2.

FIG. 5 shows a block diagram of an inventory monitoring means which may be disposed before or after the checkout area 12 (see FIG. 1). The inventory monitoring means may be used in conjunction with the high power transmitter 32 at the checkout area 12. The purpose of this inventory control means is to provide a running total of the number of total articles of each type that have been passed through the checkout area 12. By determining the total amount sold the total inventory on hand can be easily calculated.

The block diagram of FIG. 5 is similar to the one shown in FIG. 2C and comprises a transmitter T1, a receiver R2, a demodulator 42, and an accumulator 44. As the article A passes between the transmitter T1 and receiver R2, a modulated signal from transmitter T2 of the detection element shown in FIG. 4 is coupled to receiver R2. The demodulator 42 demodulates this signal, thereby in effect identifying the particular article being sold, and an accumulator 44 provides a total of the particular article that has been sold over a part predetermined time period. The demodulator 42 and accumulator 44 may both be of conventional design and would include various electronic components. Accumulator 44 may even be a general purpose digital computer. Also, the apparatus shown in FIG. 5 may replace the detection circuitry of FIG. 2C in one particular system.

In accordance with another aspect of this invention the transmitter T1 may have a modulator associated therewith (see FIG. 2C), in which case receiver R1 would have a demodulator associated therewith for enabling operation of power supply 30 (see FIG. 2A).

Having described some embodiments of the present invention, it should now become obvious that there are numerous other embodiments and modifications thereof all of which should fall within the spirit and scope of the present invention as defined by the appended claims.

What is claimed is:

1. A system for detecting the unauthorized removal of articles from an enclosure having a checkout area and a passageway through which said articles may be moved, said system comprising:
   a transmitter of a signal of first signal characteristic disposed at said passageway;
   a receiver of a signal of second signal characteristic disposed at said passageway and being non-responsive to a signal of first signal characteristic, means for establishing an alarm condition when said receiver receives a signal of second signal characteristic, a detection signal attached to the article and comprising a receiver of a signal of first signal characteristic, a transmitter of a signal of second signal characteristic, and means responsive to a signal, of a level less than a predetermined threshold level, from said receiver of a signal of first signal characteristic for providing power to said transmitter of a signal of second signal characteristic, and means for biasing the transistor including a resistor coupled to the input electrode of the transistor, a diode coupling from the output electrode of the transistor to one of the tank circuits and capacity means coupling from the output electrode of the transistor to both tank circuits, each said tank circuit including an inductor defining part of the tank circuit and forming an antenna means for transmitting or receiving signals.

2. The system of claim 1 comprising a demodulator associated with said receiver of a signal of second signal characteristic.

3. The system of claim 2 comprising means positioned adjacent the checkout area for registering a total
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count of each article passing through the checkout area.

4. The system of claim 3 wherein said means for registering includes an accumulator means.

5. The system of claim 1 wherein the anode of said diode couples to the output electrode and the cathode of said diode connects to the receiver tank circuit.

6. The system of claim 1 wherein said detection element comprises a modulator coupling to said transmitter of a signal of second signal characteristic and means for coupling power to said modulator from said power providing means of said detection element.

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