

COMMONWEALTH of AUSTRALIA
PATENTS ACT 1952

APPLICATION FOR A STANDARD PATENT

LODGED AT SUB-OFFICE
- 9 FEB 1988
Melbourne

Xx
We

KNOGO CORPORATION,
of 350 Wireless Boulevard,
Hauppauge,
New York 117788,
UNITED STATES OF AMERICA

605832

hereby apply for the grant of a Standard Patent for an invention entitled:
"DETECTION OF UNAUTHORIZED REMOVAL OF THEFT
DETECTION TARGET DEVICES"

which is described in the accompanying ~~provisional~~ ~~xxx~~ complete specification.

Details of basic application(s):—

<u>Number</u>	<u>Convention Country</u>	<u>Date</u>
013,120	UNITED STATES OF AMERICA	10th February 1987

REVISION ACCEPTED AND AMENDED

RECEIVED 31 - 10 - 90

The address for service is care of DAVIES & COLLISON, Patent Attorneys, of 1 Little Collins Street, Melbourne, in the State of Victoria, Commonwealth of Australia.

Dated this 9th day of February 19 88

H. W. Rimington

To: THE COMMISSIONER OF PATENTS

.....
(a member of the firm of DAVIES & COLLISON for and on behalf of the Applicant).

COMMONWEALTH OF AUSTRALIA
 PATENTS ACT 1952
 DECLARATION IN SUPPORT OF CONVENTION OR
 NON-CONVENTION APPLICATION FOR A PATENT

Insert title of invention

In support of the Application made for a patent for an invention
 entitled: DETECTION OF UNAUTHORIZED REMOVAL OF THEFT
 DETECTION TARGET DEVICES

Insert full name(s) and address(es)
 of declarant(s) being the appli-
 can. (s) or person(s) authorized to
 sign on behalf of an applicant
 company

I Arthur John Minasy
~~XX~~ of KNOGO CORPORATION
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Cross out whichever of paragraphs
 1(a) or 1(b) does not apply
 1(a) relates to application made
 by individual(s)
 1(b) relates to application made
 by company, insert name of
 applicant company

do solemnly and sincerely declare as follows:
 1 (a) ~~XXX~~ ~~XXXXXXXXXXXXXXXXXXXXXXXXXXXX~~
 or (b) I am authorized by KNOGO CORPORATION,

Cross out whichever of paragraphs
 2(a) or 2(b) does not apply

the applicant for the patent to make this declaration on ^{its} ~~XXX~~ behalf.

2(a) relates to application made
 by inventor(s)
 2(b) relates to application made
 by company(s) or person(s) who
 are not inventor(s), insert full
 name(s) and address(es) of inven-
 tors

2 (a) ~~XXX~~ ~~XXXXXXXXXXXXXXXXXXXXXXXXXXXX~~
 or (b) ARTHUR JOHN MINASY, a citizen of the United
 States of America, residing at 15 Hunting Hill Road,
 Woodbury, New York 11797, United States of America;
 and MICHAEL NELSON COOPER, a citizen of the United
 States of America, residing at 410 Daub Avenue,
 Hewlett, New York 11557, United States of America.

State in which applicant(s)
 derive title from inventor(s)

~~XX~~ are the actual inventor(s) of the invention and the facts upon which the applicant.....
~~XX~~ is entitled to make the application are as follows :-

The said actual inventors have assigned their rights
 in respect to the invention to the applicant, by
 virtue of an assignment executed on 6th February, 1987.

Cross out paragraphs 3 and 4
 for non-convention applications.
 For convention applications,
 insert basic country(s) followed
 by date(s) and basic applicant(s).

3 The basic application..... as defined by Section 141 of the Act ^{was} ~~was~~ made
 in United States of America ^{on} ~~on~~ the 10th February 1987 SN 13, 120
 by ARTHUR JOHN MINASY and MICHAEL NELSON COOPER
 in on the
 by
 in on the
 by

Insert place and date of signature

4 The basic application referred to in paragraph 3 of this Declaration ^{was} ~~was~~
 the first application made in a Convention country in respect of the invention the subject
 of the application
 Declared at Hauppauge NY this 15 day of Feb 1990

Signature of declarant(s) (no
 attestation requir d)

Arthur John Minasy
 ARTHUR JOHN MINASY, President
 KNOGO CORPORATION

Note Initial all alterations

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DETECTION OF UNAUTHORIZED REMOVAL OF THEFT DETECTION TARGET
DEVICES

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(56) Prior Art Documents
EP 205225
US 3713133
US 3911534

(57) Claim

1. An electronic article surveillance system for protecting merchandise from theft from a store having a private room located within a protected area of the store, said system comprising a first monitor arranged to respond to a first characteristic electromagnetic disturbance in an exit path from the protected area of the store, a second monitor which is responsive to a second characteristic electromagnetic disturbance within the private room to produce an alarm, and a security tag which is constructed to be fastened to an article of merchandise, said security tag being removable from said article of merchandise only with a special tool, said security tag being constructed to produce the first characteristic electromagnetic disturbance when it is fastened to an article of merchandise and to produce the second characteristic electromagnetic disturbance when it is removed from the article of merchandise, said security tag containing at least one electromagnetically responsive element responsive to electromagnetic waves to produce said first and second characteristic electromagnetic disturbances, and said

first monitor also being responsive to said second characteristic electromagnetic disturbance to produce an alarm, said system being characterised in that said security tag has associated therewith an element which is held adjacent said electromagnetically responsive element when said security tag is fastened to an article of merchandise and is removed from said electromagnetically responsive element when said security tag is removed from the article of merchandise, said element interacting with said electromagnetically responsive element when held adjacent thereto to cause said electromagnetically responsive element to produce said second characteristic electromagnetic disturbance, said system being further characterised in that said security tag contains a target which includes said electromagnetically responsive element and which produces said first and second characteristic electromagnetic disturbances in response to interrogation signals and in that said first and second monitors each include means for producing said interrogation signals, said target being a resonant circuit and said security tag being constructed such that said target has a first resonant frequency when said security tag is fastened to an article of merchandise and a second resonant frequency when said security tag is removed from the article of merchandise, and said electromagnetically responsive element comprising a coil of said resonant circuit.

COMMONWEALTH OF AUSTRALIA

PATENTS ACT 1952

COMPLETE SPECIFICATION

(Original)

FOR OFFICE USE

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Class Int. Class

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Complete Specification Lodged:
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This document contains the amendments made under Section 49 and is correct for printing.

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Complete specification for the invention entitled:

"DETECTION OF UNAUTHORIZED REMOVAL OF THEFT
DETECTION TARGET DEVICES"

The following statement is a full description of this invention,
including the best method of performing it known to us :-

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BACKGROUND OF THE INVENTION

Field of the Invention

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This invention relates to electronic article surveillance systems and more particularly it concerns arrangements for detecting unauthorized removal of surveillance system security tags from articles of protected merchandise.

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Description of the Prior Art

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Electronic article surveillance systems for protecting articles of merchandise from theft are well known. In all of these systems the articles of merchandise to be protected have a security tag containing a "target" element attached to them and when the article is carried from a protected area, such as a store, an antenna at the exit from the protected area senses the target element and sounds an alarm. When the article of merchandise is purchased, the store clerk either deactivates the target

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or removes the security tag so that the merchandise can be taken from the protected area without activating the alarm.

Systems have been proposed which utilize so called
"active" targets which contain their own power and give
off distinctive electromagnetic signals or disturbances
which are detected when they are carried past sensing
5 antennas at the store exit. U.S. Patent No. 2,474,271
describes one such system.

Most systems however, use "passive" targets or responders
which respond to electromagnetic radiation supplied from
10 an interrogation antenna at the store exit and produce
distinctive electromagnetic disturbances which are then
detected. U.S. Patents No. 3,493,955, No. 2,774,060, No.
3,500,373, No. 4,321,586 and No. 4,623,877 and U.S.
15 Patent No. 4,642,613 describe such responder systems.

It is important that the target not be deactivatable or
removable from the merchandise except by special means
controlled by the store clerk. Various deactivation and
20 removal arrangements have been proposed and utilized.
U.S. Patent No. 3,810,147 proposes to provide a fusible
link in a resonant circuit target which, when subjected to
radiation at the appropriate power and frequency, would
melt the link and change the distinctive resonant
25 characteristics of the target so that it cannot be
detected.

U.S. Patents No. 3,747,086, No. 3,820,103 and No.
3,820,104 describe the provision of high coercivity
30 magnetic elements mounted on a soft magnetic strip target
so that, when the elements are magnetized they prevent the
soft magnetic strip from producing characteristic
harmonics of an interrogation field.

U.S. Patents No. 3,858,280, No. 3,911,534, No. 4,531,264
and No. 4,590,461 describe specially detachable locking
arrangements for security tags which allow them to be
removed from the merchandise only with a special tool
controlled by the store clerk. The electromagnetic
characteristics of the targets contained in these tags is
not altered and they may be reused, after removal, to
protect other articles of merchandise. These security
tags are generally in the form of plastic wafers and are
fastened to the merchandise by means of a tack-like
fastening element whose shank passes through the
merchandise and enters into a locking mechanism on the
tag. The locking mechanism can be released by a special
tool, e.g. a special magnet, controlled by the store clerk.

A problem has arisen in connection with removable security
tags in electronic article surveillance systems. Although
the locking mechanism can be released legitimately only
with a special tool, it may be possible, by continued
working with a large and powerful tool, for example,
pruning shears or a heavy duty cable cutter, eventually to
destroy the locking mechanism and then remove the security
tag. Although it would not be possible to use such tools
in the public areas of a store without arousing suspicion,
it is possible to use them without detection in the
privacy of a dressing room or a rest room in the store.
Thus a thief can bring merchandise into the store dressing
room and, without detection, work with a large tool for as
long as necessary to destroy the security tag locking
mechanism and then remove the tag and target from the
merchandise. The protection of merchandise in private
areas such as in dressing rooms and rest rooms has been a
difficult problem because a certain degree of privacy must
be accorded to store patrons in those areas.

SUMMARY OF THE INVENTION

The present invention seeks to overcome the problems of the prior art and provide novel arrangements to enable the detection of unauthorised removal of security tags from merchandise in private areas of a store without affecting the privacy that must be maintained in such areas.

According to one aspect of the invention there is provided an electronic article surveillance system for protecting merchandise from theft from a store having a private room located within a protected area of the store, said system comprising a first monitor arranged to respond to a first characteristic electromagnetic disturbance in an exit path from the protected area of the store, a second monitor which is responsive to a second characteristic electromagnetic disturbance within the private room to produce an alarm, and a security tag which is constructed to be fastened to an article of merchandise, said security tag being removable from said article of merchandise only with a special tool, said security tag being constructed to produce the first characteristic electromagnetic disturbance when it is fastened to an article of merchandise and to produce the second characteristic electromagnetic disturbance when it is removed from the article of merchandise, said security tag containing at least one electromagnetically responsive element responsive to electromagnetic waves to produce said first and second characteristic electromagnetic disturbances, and said first monitor also being responsive to said second characteristic electromagnetic disturbance to produce an alarm, said system being characterised in that said security tag has associated therewith an element which is held adjacent said electromagnetically responsive element when said security tag is fastened to an article of merchandise and is removed from said electromagnetically responsive element when said security tag is removed from the article of merchandise, said element interacting with said electromagnetically responsive element when held adjacent thereto to cause said electromagnetically responsive element to produce said second characteristic electromagnetic disturbance, said system being further characterised in that said



security tag contains a target which includes said electromagnetically responsive element and which produces said first and second characteristic electromagnetic disturbances in response to interrogation signals and in that said first and second monitors each include means for producing said interrogation signals, said target
5 being a resonant circuit and said security tag being constructed such that said target has a first resonant frequency when said security tag is fastened to an article of merchandise and a second resonant frequency when said security tag is removed from the article of merchandise, and said electromagnetically responsive element comprising a coil of said resonant circuit.

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According to a second aspect of the invention there is provided an electronic article surveillance system for protecting merchandise from theft from a store having a private room located within a protected area of the store, said system comprising a first monitor arranged to respond to a first distinctive
15 electromagnetic disturbance in an exit path from the protected area of the store, a second monitor which is responsive to a second distinctive electromagnetic disturbance with the private room to produce an alarm, and a security tag which is constructed to be fastened to an article of merchandise, said security tag being removable from said article of merchandise only with a special tool, said security
20 tag containing a target which is constructed to produce the first distinctive electromagnetic disturbance when it is fastened to an article of merchandise and to produce the second distinctive electromagnetic disturbance when it is removed from the article of merchandise, said target including at least one electromagnetically responsive element which produces said first and second
25 distinctive electromagnetic disturbances, said system being characterised in that said security tag includes an element which, when positioned adjacent said electromagnetically responsive element changes its electrical characteristics so that it produces said first distinctive electromagnetic disturbance, and said element is held in position adjacent said electromagnetically responsive element when said
30 security tag is fastened to an article of merchandise and is released from said security tag when said security tag is separated from said article of merchandise,



said system being further characterised in that said target produces said first and second distinctive electromagnetic disturbances in response to interrogation signals and in that said first and second monitors each include means for producing said interrogation signals, said target being a resonant circuit of which said

- 5 electromagnetically responsive element comprises a coil and said security tag being constructed such that said target has a first resonant frequency when said security tag is fastened to an article of merchandise and a second resonant frequency when said security tag is removed from the article of merchandise.

- 10 There is further provided a security tag for use in an electronic article surveillance system, said tag comprising a casing, a fastener for securing the casing to an article of merchandise, said fastener being realisable only by a special tool to allow separation of the casing from the article of merchandise, a target mounted in the casing, said target including at least one electromagnetically responsive element
- 15 responsive to electromagnetic waves to produce first and second distinctive electromagnetic disturbances, said security tag being arranged such that said target produces said first distinctive electromagnetic disturbance when the fastener secures the casing to the article of merchandise and said second distinctive electromagnetic disturbance when the casing is separated from the article of merchandise, said
- 20 security tag being characterised in that it includes an element which, when positioned adjacent said electromagnetically responsive element, changes the target's electrical characteristics so that it produces said first distinctive electromagnetic disturbance, and in that said element is held in position adjacent said electromagnetically responsive element when said fastener holds said casing to
- 25 an article of merchandise but separates from said electromagnetically responsive element when said casing is separated from said article of merchandise, said target being a resonant electrical circuit and said electromagnetically responsive element being a coil of said resonant electrical circuit.



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Fig. 1 is a diagrammatic plan view of a protected area of store, including private rooms, in which the present invention is used;

Fig. 2 is a diagrammatic illustration and block diagram of a monitoring
5 arrangement at an exit of the protected area of Fig. 1;

Fig. 3 is a circuit diagram of a target which is detected by the monitoring arrangement of Fig. 2;

10 Fig. 4 is a diagrammatic illustration and block diagram of a monitoring arrangement at a private room of Fig. 1;



Fig. 5 is a perspective view showing a security tag according to the present invention fastened to an article of merchandise;

5 Fig. 6 is an exploded view showing the security tag of Fig. 5 removed from the article of merchandise;

Fig. 7 is an enlarged cross sectional view taken along line 7-7 of Fig. 5;

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Fig. 8 is a waveform and a timing diagram for showing the detection of targets, according to a preferred embodiment the present invention, at a store exit and at a dressing room;

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Figs. 9 and 10 are waveforms and timing diagrams for showing the detection of targets according to an alternative form of the present invention; and

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Fig. 11 is a view similar to Fig. 7 but showing an alternate security tag according to the present invention.

DETAILED DESCRIPTION OF
THE PREFERRED EMBODIMENTS

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Fig. 1 shows, in plan view, the interior of a retail store. The store has outer walls 10 and an entrance and exit way 12. Articles of merchandise 14 are hung on racks 16 inside the store so that they can be examined by store customers 18.

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There are also provided inside the store, private rooms such as dressing rooms 20 and rest rooms 22 for the use of store customers. Customers may bring articles of merchandise 14 into these private rooms and try them on so that they can decide whether to purchase them.

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Special security tags 24 are fastened to the articles of merchandise 14. These security tags contain targets which protect the merchandise from theft. A store exit monitor 26 is arranged at the exit way 12 of the store; and if an article of merchandise 14 with an attached security tag 24 is carried through the exit way 12 past the monitor 26, the monitor will detect the security tag target and actuate an alarm. When, on the other hand, a customer makes a legitimate purchase, the customer takes the merchandise 14 to a counter 28 where a store clerk 30 removes the security tag 24 using a special tool 32. The customer may then take the merchandise through the exit way 12 without activating the alarm.

The security tags 24 can be quite securely fastened to the merchandise 14 so as to prevent unauthorized removal and yet can be quickly removed by the store clerk using the special tool 32. Nevertheless, by use of a large tool such as pruning shears or heavy cable cutters, it may be possible, after a time, to destroy the locking mechanism on the security tag and remove it from the merchandise. Any such activity would be readily noticed if it were attempted in the public area of the store. However, if a shoplifter takes the merchandise into one of the dressing rooms 20 or rest rooms 22, the shoplifter is assured of privacy and may work on the fastener of the security tag for as long as necessary to destroy it without being noticed. The shoplifter may then leave the security tag in the private room and take the merchandise out through the exit way 12 without being detected by the monitor 26.

The arrangements of the present invention serve to protect against such unauthorized security tag removal. As shown in Fig. 1, dressing room and rest room monitors 34 are

provided in each of the dressing rooms 20 and rest rooms 22. These monitors are similar in construction to the store exit monitor 26; however, they respond to a somewhat different electromagnetic disturbance than the store exit
5 monitors. Thus when articles of merchandise 14 having security tags 24 attached to them are taken into a dressing room or rest room in order to try on the merchandise the monitor 34 will not produce an alarm. However, according to the present invention, the security
10 tags 24 are of special construction and, when removed from the articles of merchandise 14, they produce a different electromagnetic disturbance that is detected by the dressing room and rest room monitor 34. Accordingly, whenever a security tag is removed from an article of
15 merchandise in one of the dressing rooms 20 or rest rooms 22, the monitor therein will immediately produce an alarm.

The present invention in its broadest aspects is not limited to any particular type of monitoring system, security tag or target; however, for purposes of
20 illustration there is described herein a preferred arrangement with a swept frequency security system and plastic wafer security tags containing resonant circuit targets. Fig. 2 shows, in schematic and block diagram
25 form, a swept radio frequency store exit monitor 26 located at the exit way 12 of the store. This monitor may have the same construction as described in United States Patent No. 4,321,586 and that description is fully
30 incorporated herein by reference.

As shown in Fig. 2 there is provided on opposite sides of the exit way 12 a transmitting antenna 36 and a receiving antenna 38. Any store customer who leaves the store must walk between these two antennas; and the articles of
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merchandise which the customer carries pass through electromagnetic fields generated in the vicinity of these antennas.

5 The transmitting antenna is energized by the output of an amplifier 40 which in turn receives a continuous swept radio frequency signal from a swept frequency oscillator 42. The oscillator in turn is driven by a sweep generator 44. The sweep generator produces a 220 hertz signal which
10 causes the swept frequency oscillator to vary its output frequency between 1920 and 2,220 kilohertz at a 220 hertz rate. This swept radio frequency signal is converted by the transmitting antenna 36 to a swept radio frequency electromagnetic field in the exit way 12.

15 It will be understood that the frequencies and sweep rates described herein are given only by way of example and are not critical to the invention.

20 Turning now to Fig. 3, it will be seen that the target contained in the security tag 24 comprises a spiral coil 46 and a capacitor 48 connected in a loop to form a resonant electrical circuit. The coil and capacitor are tuned so that their resonant frequency is within the
25 frequency sweep range of the transmitter circuit i.e. between 1,920 and 2,220 kilohertz. Consequently twice during each sweep cycle, the transmitted frequency is the same as the resonant frequency of the target circuit. When the security tag 24 is in the exit way 12 its target
30 circuit is driven into resonance each time the transmitted frequency passes the resonance frequency of the target circuit. This results is a series of distinctive electromagnetic disturbances which are received by the receiving antenna 38 and detected by the receiving
35 circuits connected to that antenna.

As shown in Fig. 2, the receiving antenna 38 is connected to input filters and detector 50 which remove the radio frequency components from the received signals. The remaining signal components are then passed through signal processing circuits 52 which examine the components for the distinctive characteristics that are produced by a true resonant circuit having the same Q as the target circuits.

10 The output of the signal processing circuits 52 is supplied to a pulse generator 54. The pulse generator produces a pulse each time the transmitter frequency sweeps past the resonance frequency of a target circuit in the exit way 12. The pulse generator output is applied simultaneously to a signal gate 56 and a noise gate 58. These gates are opened alternatively by signals from a signal/noise gate generator 60. This gate generator in turn is connected to the receiver input circuits 50 and receives the sweep portion of the received signal.

20 The gate generator 60 is set to open the signal gate 56 during those portions of the frequency sweep cycle which bracket the resonant frequency of the target circuits and to open the noise gate 58 during the remaining portions of the frequency sweep cycle.

25 The outputs of the signal and noise gates 56 and 58 are applied, respectively, to associated low pass filters or accumulators 62 and 64 which accumulate pulses from the pulse generator 54. The outputs of the low pass filters 30 62 and 64 are compared in a comparator 66. When the number of pulses which pass through the open signal gate 56 becomes large in comparison to the number of pulses which pass through the open noise gate 58, the voltage comparator 66 supplies a signal to actuate an alarm 68.

Fig. 4 shows a dressing room 20 fitted out with a dressing room monitor 34. The dressing room 20 typically is a small compartment having just enough space for one individual to change clothes. The dressing room monitor includes a transmitting antenna 36' and a receiving antenna 38' mounted in opposite walls 11 of the dressing room. The electrical components of the dressing room monitor 34 are essentially the same as those of the store exit monitor 26 and accordingly the same reference numbers primed are used in Fig. 4 to represent components which are counterparts of components in the store exit monitor 26 of Fig. 2. The dressing room monitor 34 operates in the same manner as the store exit monitor 36 except that the swept frequency oscillator 42' is set to sweep through a range of frequencies that is somewhat lower than the range of frequencies produced by the swept frequency oscillator 42 of the store exit monitor. In this example, the oscillator 42' is swept between 1,820 and 2,120 kilohertz. In addition, the gate generator 60' of the dressing room monitor 34 is set to open the signal gate 56' only during the transmission of a narrow range of transmitted frequencies near the center of the sweep range (i.e. 1,970 kilohertz) during each transmitter frequency sweep cycle. This narrow range of transmitter frequencies does not include the resonant frequency of the target circuits when their respective target devices are attached to article of merchandise. However, if a security tag 24 according to the invention is removed from an article of merchandise, the resonant frequency of its target circuit becomes shifted to that region of the transmitted frequency sweep which occurs while the signal gate 56' is opened. As a result detected pulses caused by the target circuit pass through the signal gate and activate the alarm 68'.

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The construction of the security tag 24 and the manner in which the resonant frequency of its target circuit becomes shifted when the tag is detached from an article of merchandise is illustrated in Figs. 5-7. The basic construction of the security tag 24 is the same as described in United States Patent No. 4,590,461 and the description in that patent is incorporated herein by reference. As shown in Fig. 7, the target device 24 has a molded plastic casing 70 which is fastened by means of a tack-like fastener element 72 to a sheet shaped portion of the merchandise 14, e.g. the hem or sleeve of a garment. This arrangement allows the garment to be tried on in a dressing room, yet the presence of the casing 70 leaves no doubt that the garment is electrically protected and will cause an alarm to sound if it is carried through the store exit way 12 with the security tag 24 attached to it. The coil 46 is held in place in a spiral slot 74 in the lower half of the casing 70; and the capacitor 48 is located in a compartment 76 formed in the casing.

The casing 70 is also formed with a lock housing 78 which accommodates a releasable locking mechanism 80. The locking mechanism 80 securely grips the shank of the fastener element 72 when it enters the casing 70 from the lower side after passing through the merchandise 14. When the fastener element 72 is held in place by the locking mechanism, the casing 70 is securely held to the merchandise 14 and, under normal conditions, it cannot be removed from the merchandise. However, when a powerful magnetic force is applied with the special tool 32 at the counter 28 (Fig. 1), the lock housing 74 the locking mechanism is released and the fastener element may easily be removed to allow separation of the security tag 24 from the merchandise.

Under some conditions, however, a person may, by working long enough on the lock housing 74, eventually destroy the housing and the locking mechanism and thereby remove the security tag 24 from the merchandise. Usually this is attempted in a dressing room or a rest room where there is a measure of privacy. This invention permits the detection of such removal without otherwise violating the privacy of the dressing room or rest room, by providing arrangements which change the characteristic electromagnetic disturbance produced by the target circuit when it is removed from the merchandise. In the illustrated embodiment the resonant frequency of the target circuit is shifted when it is removed from the merchandise.

As shown in the exploded view of Fig. 6, a copper ring 82 is interposed between the merchandise 14 and the casing 70 of the security tag 24. The shank of the fastener element 72 passes through the center of the copper ring 82. When the security tag 24 is fastened to the merchandise 14 the copper ring 82 is held tightly between the casing 70 and the merchandise as shown in Figs. 5 and 7.

When the copper ring 82 is in the position shown in Figs. 5 and 7 adjacent, or in close proximity, to the coil 46 and the capacitor 48, the copper ring interacts electrically with the coil and capacitor and shifts their resonant frequency upwardly. Thus, in the illustrated embodiment, where the coil 46 and capacitor 48 by themselves have a resonant frequency of 1,970 kilohertz, when the copper ring 82 is positioned close to the coil and capacitor their resonant frequency becomes 2,070 kilohertz. The amount of frequency shift depends on the dimensions of the ring 82.

It has been found that a frequency shift of 100 kilohertz can be obtained with a copper ring having an outer diameter of 1.25 inches (3.175 cm) an inner diameter of 1.187 inches (3.015 cm) and a thickness of 0.125 inches (0.317 cm).

In the preferred embodiment, the store exit monitor 26 operates to detect security tags 24 taken through the store exit way 12 whether or not those tags are attached to articles of merchandise. The dressing room monitors 34, on the other hand, operate to detect only security tags which are removed from merchandise within the dressing rooms 20 or the rest rooms 22. This permits store patrons to take merchandise with the security tags attached into these rooms to try on the merchandise without causing an alarm to be actuated.

The timing diagrams of Figs. 8, 9 and 10 illustrate the manner in which the store exit and dressing room monitors 26 and 34 operate to selectively detect attached or removed security tags. As shown in Figs. 8 and 9, the center frequency of the store exit swept frequency oscillator 42 is set at the resonant frequency of the target circuit of the attached security tags 24 with the copper ring 82 in place (i.e. 2,070 kilohertz). The frequency sweep is from 1,920 to 2,220 kilohertz, which also includes the resonant frequency of the target circuit of the detached security tags 24 with the copper ring 82 removed (i.e. 1,970 kilohertz). In this case the timing of the signal gate 56 is set so that the gate is "on" while the interrogation frequency, i.e. the output of the swept frequency oscillator 42 passes both through 2,070 kilohertz and 1,970 kilohertz. Thus should either an attached or a detached security tag 24 be carried through the exit way

12, the pulses produced when the interrogation frequency sweeps past the resonant frequency of the tag's target circuit will occur while the signal gate is "on". These pulses will pass through to the voltage comparator 66 and cause an alarm to be actuated.

As shown in Fig. 10, the center frequency of the dressing room monitors is set at the resonant frequency of the detached security tag 24, with the copper ring 82 removed (i.e. 1,970 kilohertz). The frequency sweep is from 1,820 to 2,120 kilohertz. This also includes the resonant frequency of the target circuit of the attached security tags 24 with the copper ring 82 in place (i.e. - 2,070 kilohertz). However, in this case, the timing of the signal gate 56' is such that this gate "on" only while the interrogation frequency, i.e. the output of the swept frequency oscillator 42' passes through 1,970 kilohertz. The signal gate 56' is "of" and the noise gate 58' is "on", at the times when the interrogation frequency passes through the resonant frequency of the target circuits of the attached security tags, i.e. 2,070 kilohertz. Consequently when a garment with a security tag attached is brought into a dressing room 20 or a rest room 22 the pulses produced by the tag's resonant circuit will occur only while the signal gate 56' is "of" and its noise gate 58' is "on" and the alarm will not be actuated.

If however, the security tag 24 is removed from the garment while in the dressing room or rest room, the copper ring 82 will fall away from the resonant circuit and the resonant frequency of the circuit will shift downwardly to 1,970 kilohertz. As a result, the pulses generated by the resonant circuit will occur while the signal gate 5' is "on" and this will actuate the alarm 68'. Alternatively, as shown in Fig. 8, the dressing room signal gates 56' may be set to be "on" when the sweep frequency is at 1,970 kilohertz and "off" when the sweep frequency is at 2,070 kilohertz and the dressing room noise gates 58' may be set to be "on" when the sweep frequency is at 2,070 kilohertz and "off" when the sweep frequency is at 1,920 kilohertz, thus permitting the store exit and dressing room monitors to have the same sweep frequency.

Fig.11 shows an alternative arrangement for controlling the resonant frequency of the target circuit so that it shifts to a lower frequency when the security tag is detached from the merchandise. In Fig.11 a security tag 24' is shown which is similar in construction to the security tag 24 of Fig. 7. The basic construction of the security tag 24' is the same as shown U.S. Patent No. 4,187,509.

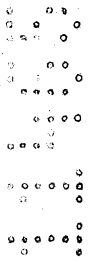
As can be seen, the outer configuration of the security tag 24' is somewhat modified from that of the security tag 24. However the security tag 24' has all the same basic elements of the security tag 24 and those elements which have counterparts in Fig. 7 are given the same reference numerals with a prime.

In the arrangement of Fig. 11, the fastener 72' is provided with an enlarged molded plastic head 86 in which the copper ring 82' is cemented. Thus when the shank of the fastener 72' is passed through the merchandise 14 and locked into the locking mechanism 80' of the security tag, the copper ring 82' is held in proper positional relationship to the coil 46' and capacitor 48' of the target resonant circuit to shift its frequency upward. If the locking mechanism 80' or the fastener 72' are destroyed so as to remove the fastener from the wafer housing 70', the copper ring 82' will become separated from the resonant circuit and the resonant frequency of the circuit will decrease. Thus, the removed target will be detected in the same manner as in the embodiment of Figs. 5-7.

It will be appreciated from the foregoing that the present invention provides a novel electronic article surveillance

system and security tag construction which enables the detection of unauthorized removal of security tags from articles of merchandise in dressing rooms and rest rooms without otherwise affecting the privacy of persons using those rooms.

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THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. An electronic article surveillance system for protecting merchandise from theft from a store having a private room located within a protected area of the store, said system comprising a first monitor arranged to respond to a first
5 characteristic electromagnetic disturbance in an exit path from the protected area of the store, a second monitor which is responsive to a second characteristic electromagnetic disturbance within the private room to produce an alarm, and a security tag which is constructed to be fastened to an article of merchandise, said
10 security tag being removable from said article of merchandise only with a special tool, said security tag being constructed to produce the first characteristic electromagnetic disturbance when it is fastened to an article of merchandise and to produce the second characteristic electromagnetic disturbance when it is removed from the article of merchandise, said security tag containing at least one
15 electromagnetically responsive element responsive to electromagnetic waves to produce said first and second characteristic electromagnetic disturbances, and said first monitor also being responsive to said second characteristic electromagnetic disturbance to produce an alarm, said system being characterised in that said security tag has associated therewith an element which is held adjacent said
20 electromagnetically responsive element when said security tag is fastened to an article of merchandise and is removed from said electromagnetically responsive element when said security tag is removed from the article of merchandise, said element interacting with said electromagnetically responsive element when held adjacent thereto to cause said electromagnetically responsive element to produce
25 said second characteristic electromagnetic disturbance, said system being further characterised in that said security tag contains a target which includes said electromagnetically responsive element and which produces said first and second characteristic electromagnetic disturbances in response to interrogation signals and in that said first and second monitors each include means for producing said
30 interrogation signals, said target being a resonant circuit and said security tag being constructed such that said target has a first resonant frequency when said security



tag is fastened to an article of merchandise and a second resonant frequency when said security tag is removed from the article of merchandise, and said electromagnetically responsive element comprising a coil of said resonant circuit.

5 2. An electronic article surveillance system according to claim 1 further characterised in that said first and second monitors produce swept frequency interrogation signals which sweep repetitively through a range of frequencies including said first and second resonant frequencies, said first monitor is responsive to electromagnetic disturbances produced by a resonant circuit which is resonant at
10 said first resonant frequency and said second monitor is responsive only to electromagnetic disturbances produced by a resonant circuit which is resonant at said second resonant frequency.

3. An electronic article surveillance system according to claim 2 wherein said
15 first and second monitors include respectively, first and second signal gates through which signals produced upon detection of said first and second electromagnetic disturbances must pass to actuate an alarm, further characterised in that said first monitor further includes first signal gate operating means to cause said first signal gate to pass signals which occur during the times that its interrogation signal is
20 being swept through said first resonant frequency and in that said second monitor further includes second signal gate operating means to cause said second signal gate to pass signals which occur during the times that its interrogation signal is being swept through said second resonant frequency.

25 4. An electronic article surveillance system according to claim 3 further characterised in that said first signal gate operating means also causes said first signal gate to pass signals which occur during the times that its interrogation signal is being swept through said second resonant frequency.

30 5. An electronic article surveillance system for protecting merchandise from theft from a store having a private room located within a protected area of the



store, said system comprising a first monitor arranged to respond to a first distinctive electromagnetic disturbance in an exit path from the protected area of the store, a second monitor which is responsive to a second distinctive electromagnetic disturbance within the private room to produce an alarm, and a security tag which is constructed to be fastened to an article of merchandise, said security tag being removable from said article of merchandise only with a special tool, said security tag containing a target which is constructed to produce the first distinctive electromagnetic disturbance when it is fastened to an article of merchandise and to produce the second distinctive electromagnetic disturbance when it is removed from the article of merchandise, said target including at least one electromagnetically responsive element which produces said first and second distinctive electromagnetic disturbances, said system being characterised in that said security tag includes an element which, when positioned adjacent said electromagnetically responsive element changes its electrical characteristics so that it produces said first distinctive electromagnetic disturbance, and said element is held in position adjacent said electromagnetically responsive element when said security tag is fastened to an article of merchandise and is released from said security tag when said security tag is separated from said article of merchandise, said system being further characterised in that said target produces said first and second distinctive electromagnetic disturbances in response to interrogation signals and in that said first and second monitors each include means for producing said interrogation signals, said target being a resonant circuit of which said electromagnetically responsive element comprises a coil and said security tag being constructed such that said target has a first resonant frequency when said security tag is fastened to an article of merchandise and a second resonant frequency when said security tag is removed from the article of merchandise.

6. An electronic article surveillance system according to claim 5 further characterised in that said security tag comprises a casing which contains said target and a tack-like fastener having a shank which projects through an article of merchandise and is held inside said casing by a locking mechanism therein.

7. An electronic article surveillance system according to claim 6 further characterised in that said element is in the form of a ring and is held in place between said article of merchandise and said casing with the shank of said fastener passing through said ring.

5

8. An electronic article surveillance system according to claim 6 further characterised in that said element is in the shape of a ring and is embedded in the head of said tack-like fastener.

10 9. An electronic article surveillance system according to claim 7 or 8 further characterised in that said target is a resonant electrical circuit whose frequency is shifted by said ring when said ring is positioned adjacent said casing.

10. An electronic article surveillance system according to claim 5 further
15 characterised in that said first and second monitors produce swept frequency interrogation signals which sweep repetitively through a range of frequencies including said first and second resonant frequencies, said first monitor is responsive to electromagnetic disturbances produced by a resonant circuit which is resonant at said first resonant frequency and said second monitor is responsive only to
20 electromagnetic disturbances produced by a resonant circuit which is resonant at said second resonant frequency.

11. An electronic article surveillance system according to claim 10 further
25 characterised in that said first monitor is also responsive to electromagnetic disturbances produced by a resonant circuit which is resonant at said second resonant frequency.

12. An electronic article surveillance system according to claim 10 further
30 characterised in that said first and second monitors include respectively, first and second signal gates through which signals produced upon detection of said first and second electromagnetic disturbances must pass to actuate an alarm, in that said first



monitor further includes first signal gate operating means to cause said first signal gate to pass signals which occur during the times that its interrogation signal is being swept through said first resonant frequency and in that said second monitor further includes second signal gate operating means to cause said second signal gate to pass signals which occur during the times that its interrogation is being swept through said second resonant frequency.

13. An electronic article surveillance system according to claim 12 further characterised in that said first signal gate operating means also causes said first signal gate to pass signals which occur during the times that its interrogation signal is being swept through said second resonant frequency.

14. A security tag for use in an electronic article surveillance system, said tag comprising a casing, a fastener for securing the casing to an article of merchandise, said fastener being releasable only by a special tool to allow separation of the casing from the article of merchandise, a target mounted in the casing, said target including at least one electromagnetically responsive element responsive to electromagnetic waves to produce first and second distinctive electromagnetic disturbances, said security tag being arranged such that said target produces said first distinctive electromagnetic disturbance when the fastener secures the casing to the article of merchandise and said second distinctive electromagnetic disturbance when the casing is separated from the article of merchandise, said security tag being characterised in that it includes an element which, when positioned adjacent said electromagnetically responsive element, changes the target's electrical characteristics so that it produces said first distinctive electromagnetic disturbance, and in that said element is held in position adjacent said electromagnetically responsive element when said fastener holds said casing to an article of merchandise but separates from said electromagnetically responsive element when said casing is separated from said article of merchandise, said target being a resonant electrical circuit and said electromagnetically responsive element being a coil of said resonant electrical circuit.



15. A security tag according to claim 14 further characterised in that said target is constructed to produce said first and second distinctive electromagnetic disturbances at first and second frequencies respectively.

5 16. A security tag according to claim 14 further characterised in that said target is constructed to produce said first and second electromagnetic disturbances in response to interrogation signals.

10 17. A security tag according to claim 16 further characterised in that said element is held against said casing by said fastener.

18. A security tag according to claim 17 further characterised in that said fastener is a tack-like device having a shank which passes through an article of merchandise and is held inside said casing by a lock assembly therein.

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19. A security tag according to claim 18 further characterised in that said element is in the shape of a ring and in that the shank of said fastener passes through the center of said ring.

20 20. A security tag according to claim 19 further characterised in that said element is fixed in the head of said fastener.

21. A security tag according to claim 14 further characterised in that said target is arranged to have a first resonant frequency when said fastener secures the casing to the article of merchandise and to have a second resonant frequency when said casing is separated from the merchandise.

22. A security tag according to claim 21 further characterised in that said element is held adjacent said casing when said fastener holds said casing against an article of merchandise.

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23. A security tag according to claim 22 further characterised in that said element is an electrically conductive ring.

24. A security tag according to claim 23 further characterised in that said fastener is a tack-like device having a shank which passes through said article of merchandise and said ring and into a locking mechanism in said casing.

25. A security tag according to claim 24 further characterised in that said ring is mounted in the head of said fastener.

10

26. An electronic article surveillance system substantially as hereinbefore described with reference to the drawings.

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27. A security tag substantially as hereinbefore described with reference to the drawings.

DATED this 26th day of October, 1990.

20 KNOGO CORPORATION
By its Patent Attorneys
DAVIES & COLLISON

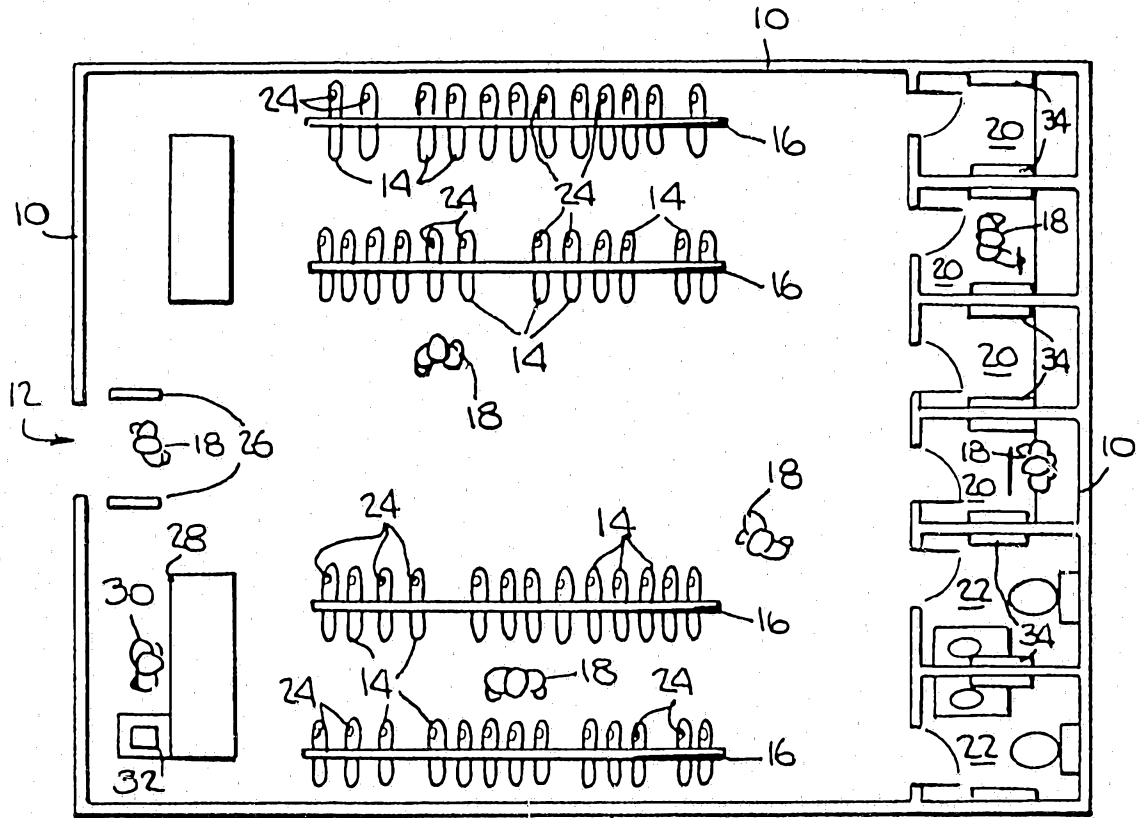


Fig. 1.

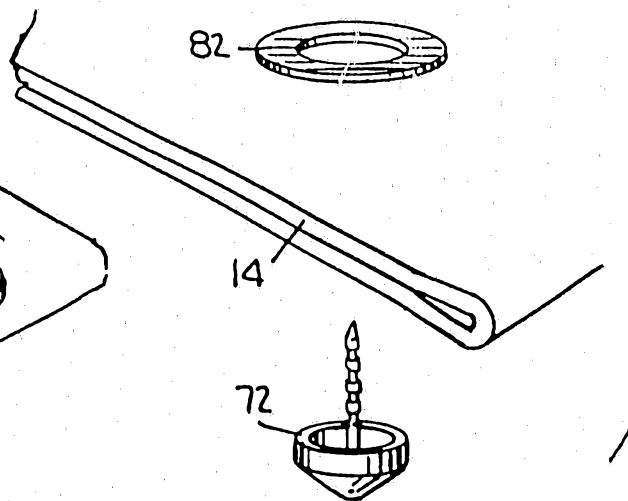
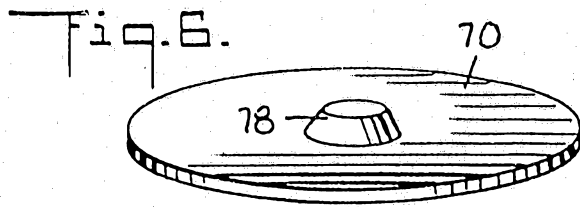
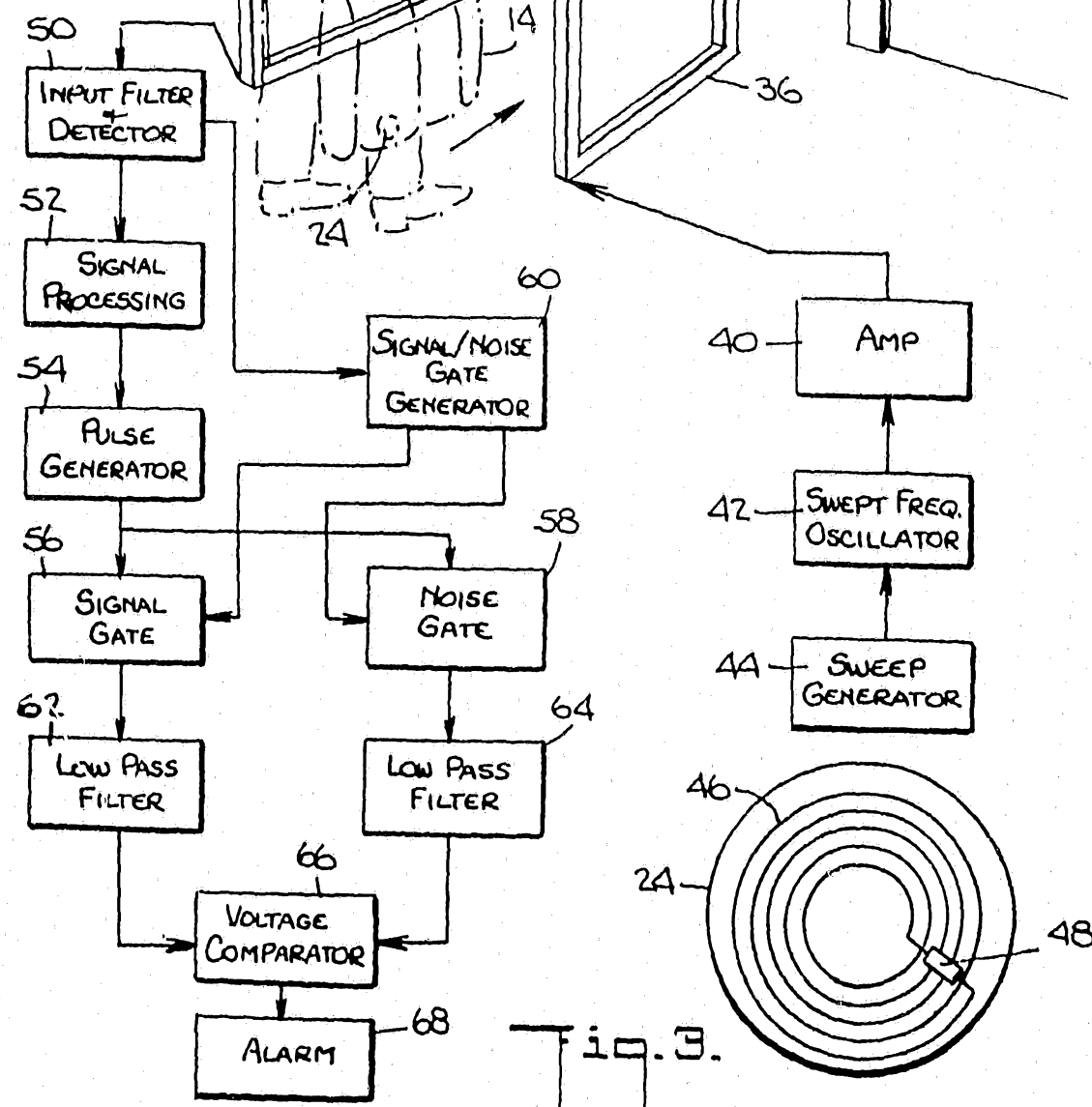
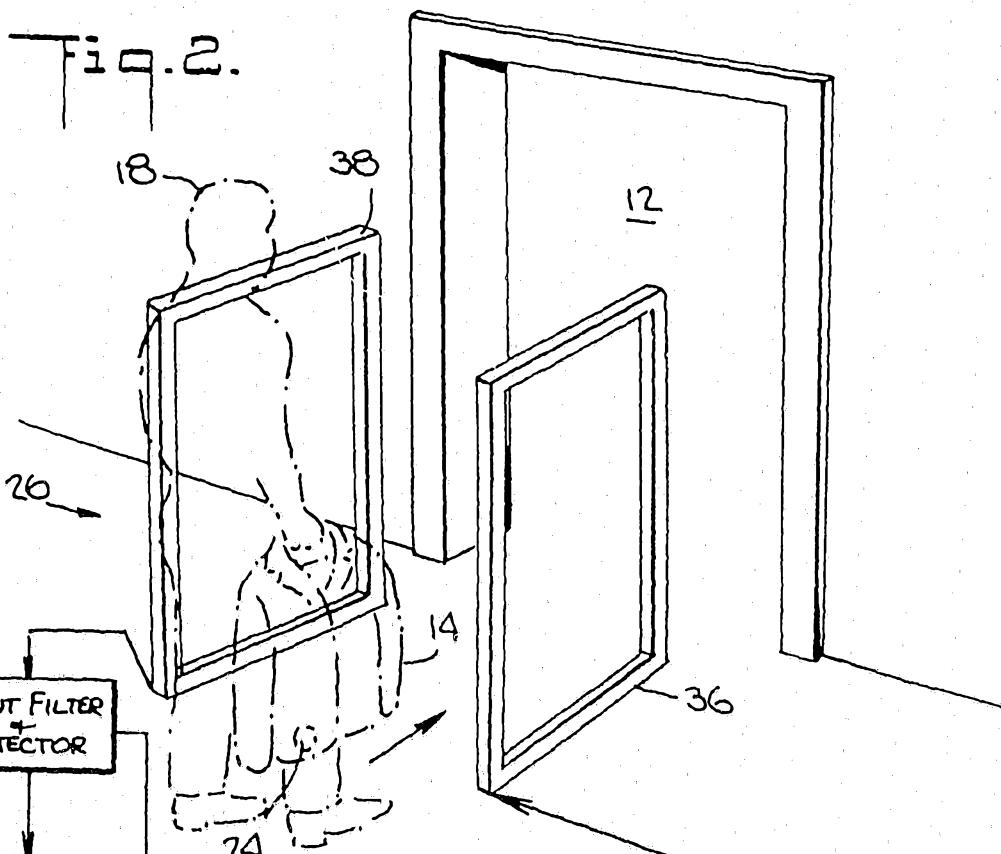


Fig. 5.



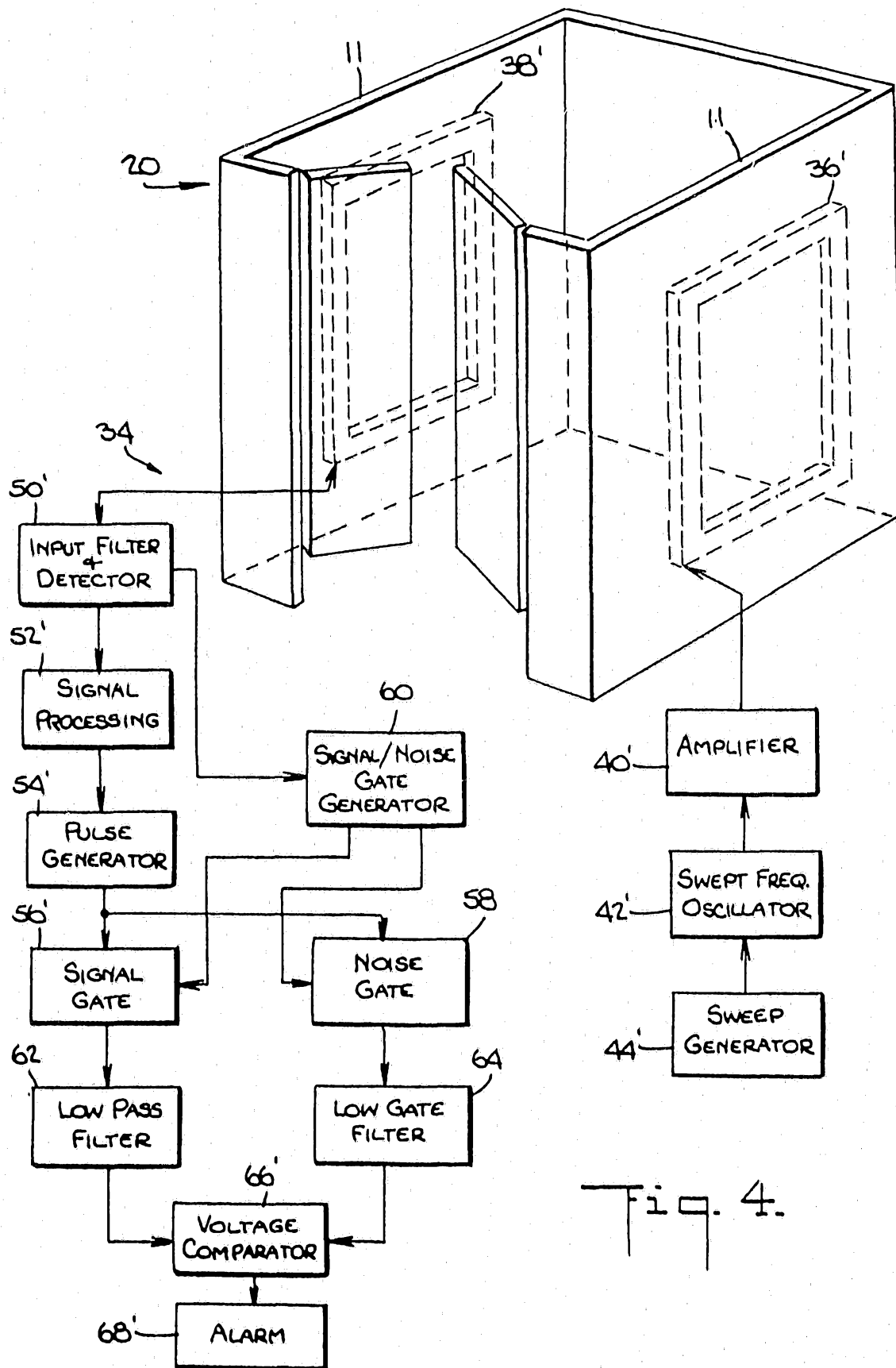


Fig. 4.

Fig. 7.

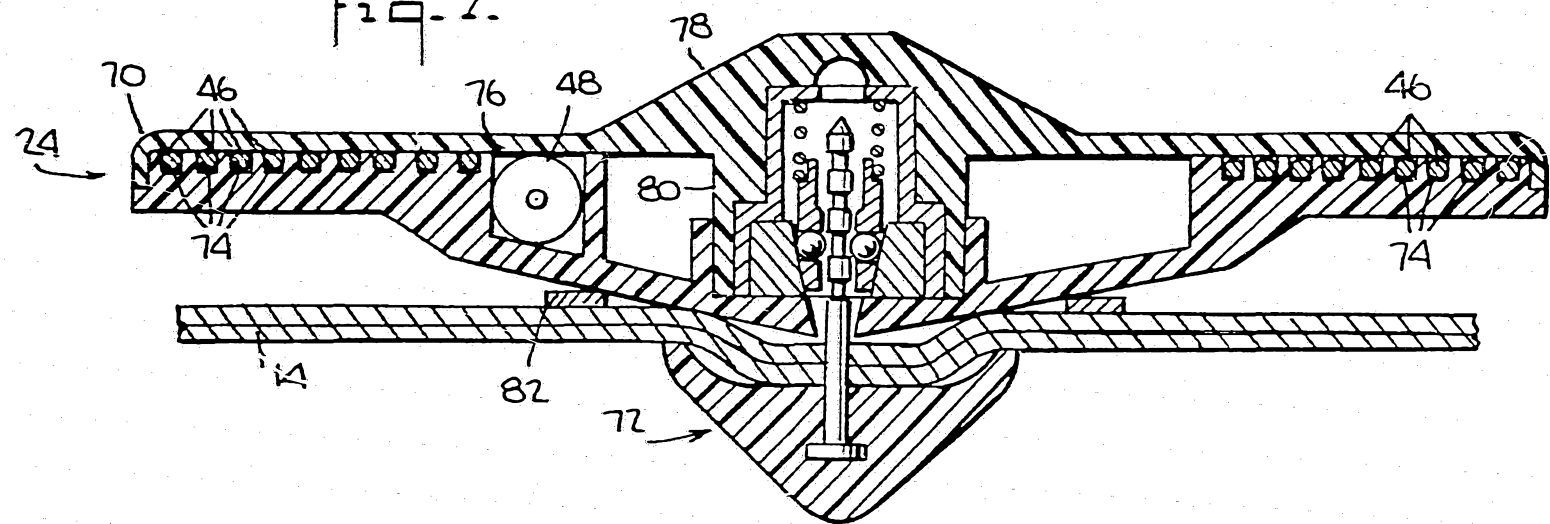


Fig. 11.

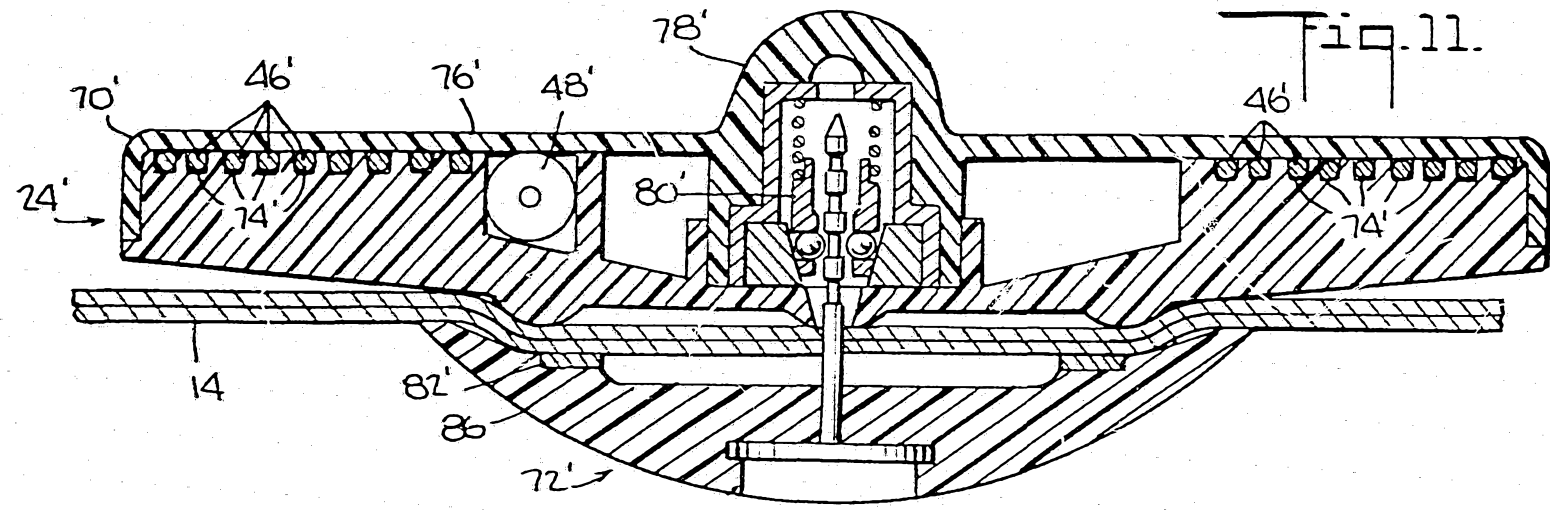


Fig. 8.

