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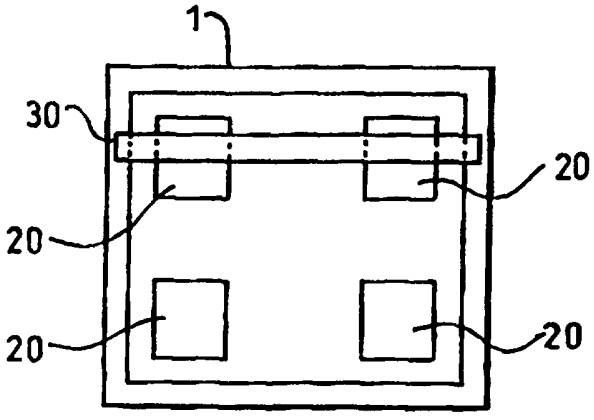
(54) Title: EVENT DETECTION DEVICE WITH REDUCED BLIND ZONE

(57) Abstract

An event detection device which comprises a microwave transmitter and a microwave receiver, the transmitter emitting microwave radiation at a defined frequency and the receiver measuring the Doppler shift in reflected radiation, the device being provided with antenna pattern shaping means whereby the coverage of the device is enhanced.



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EVENT DETECTION DEVICE WITH REDUCED BLIND ZONE

Field of the Invention

This invention relates to event detection devices and more particularly to an event detection device having an enhanced coverage.

Background Art

Event detection devices, for example, intrusion monitoring devices, are well known in the art. Typically they are used to detect unauthorised entry or intrusion in to a protected space.

Commercially available intrusion monitoring devices can be either of the passive or active variety. Passive intrusion monitoring devices can, for example, comprise a sensor which detects infra red radiation propagated by warm blooded animals. Typically such passive devices comprise a thermal detection device, consisting of one or more thermal detectors adapted to detect infra red radiation incident thereon, and an optical system for directing incident radiation from a plurality of angular fields of view towards the thermal detection device. Such optical systems may consist of lenses, particularly Fresnel lenses and/or reflecting surfaces such as mirrors. Normally such devices are activated when a

source of infra red radiation passes from one angular sector to the next. Typical prior art intrusion monitoring devices are illustrated in US patents nos 3703718 and 3958118, and in UK patent no GB1335410. The entire disclosures of these patents are incorporated herein by reference for all purposes.

Active intrusion monitoring devices are also known which comprise a transmitter and a receiver, the transmitter emitting radiation at a defined frequency and the receiver measuring the Doppler shift in any reflected radiation. Such active devices can, for example, operate at microwave frequencies, using a microwave radiation detection device to detect the reflected radiation.

In each case, an electrical circuit is provided to process the electrical output signal of the detection device and to compare that signal with a pre-set threshold signal.

Microwave intrusion detection devices can be used alone, or as a combined technology event detection device. Examples of such combined devices including specifically a combination of a photo electric sensor and a microwave sensor are described in US patents nos 3725888, 4401976, 4710750, 4833450, 4660024, 5216410, in EP-A-0337964, EP-A-0255812, EP-A-0259015 and in

WO95/28692. The entire disclosures of all these patents are incorporated herein by reference for all purposes.

In a typical combined technology event detection device, the outputs of two independent sensing means, responding to different physical stimuli, are supplied to an AND gate, and if both sensing means register an event within a specified period of time, then an alarm is triggered. In this manner, the incidence of false alarms occurring when only a single sensor means is used can be greatly reduced.

A problem with single or combined technology event detection devices incorporating microwave radiation detection devices is that of so called "blind zones". The antenna pattern of a microwave motion detector is required to fill a volume of space into which any encroachment by an intruder would result in an alarm condition. Planar antennas, for example, printed antennas such as microstrip antennas, tend to have blind zones at angles close to the plane of the antenna in which coverage is often inadequate. Aperture antennas, for example, horn antennas and open-ended waveguides, can also have this deficiency. Wire antennas can also exhibit nulls in the antenna pattern in certain directions. The system may thus be unable to detect an intruder in certain regions, in particular creeping below

the detector, or approaching from below with the aim of masking the detector.

The problem can be illustrated by reference to Figure 1 of the accompanying Drawings, which shows in side elevation a typical radiated antenna pattern 2 from a wall-mounted microwave radiation detection device 1. Such devices are normally mounted high up on a wall 3 in order to be relatively inaccessible, and to give the widest possible area of coverage. It will be observed, however, that the space immediately below the detection device is a blind zone 4 in which the level of microwave radiation is very low and within which an event, such as the presence of an intruder, can remain undetected.

It will be appreciated that the problem of "blind zones" is present in any single or combined technology event detection device in which a microwave radiation detection device is used. This is because even in combined technology event detection devices, it is necessary for both of the sensors to register an event before an alarm signal is triggered.

Summary of the Invention

The present invention provides an event detection device incorporating a microwave radiation detection

device in which the microwave radiation pattern is shaped to provide enhanced coverage.

In a first aspect the present invention provides an event detection device which comprises a microwave transmitter and a microwave receiver, the transmitter emitting microwave radiation at a defined frequency and the receiver measuring the Doppler shift in reflected radiation, the device being provided with antenna pattern shaping means whereby the coverage of the device is enhanced.

The event detection device of the present invention is preferably a combined technology event detection device, and more particularly a combined event detection device comprising a Doppler shift microwave sensor and a passive infra red sensor. Examples of such devices are those sold by Pyronix Limited under the trade mark EQUINOX. More than two sensing means may be used where necessary or desired, provided that at least one of the sensing means is a Doppler shift microwave sensor.

The antenna pattern shaping means can take a variety of forms. In its simplest, and most preferred form, the antenna pattern shaping means can comprise a radiation blocking means which is situated in the near field of the antenna and which causes the radiation pattern to be distorted or defocused, by altering the aperture

amplitude and/or phase distributions. The blocking means can, for example, comprise a strip or patch of material, which can be, for example, a conducting material such as copper or other metallic materials, and/or a microwave absorbing material and/or any other material which disturbs the electromagnetic fields. The strip or patch can be positioned in front of the antenna, changing the effective aperture. The blocking means is preferably disposed in an offset position with respect to the aperture, such that the radiation pattern is distorted and spread, increasing coverage in the desired direction(s).

It has been found that by a suitable selection of size and type of material for the blocking means the total coverage of the radiation field can remain substantially unaffected whilst the coverage of the blind zone beneath the detection device can be substantially enhanced.

The blocking means can be of any suitable size, shape and thickness, although rectangular patches or strips of relatively thin material such as foil are usually preferred.

In a further embodiment, the antenna pattern shaping means can comprise a parasitic antenna which is disposed in the radiated field of the antenna. The parasitic

antenna can be formed from a suitable electrically conductive, metallic material and can be positioned such that the field radiated by the parasitic antenna combines with the field radiated by the main antenna to give the required shaping of the main field and enhance the desired coverage thereof.

Where the antenna pattern shaping means comprises a blocking means or a parasitic antenna, it can be very convenient to arrange for the strip or patch comprising the blocking means, or the parasitic antenna, to be disposed on a surface of the case or cover of the device in the appropriate location relative to the main antenna. The strip or patch blocking means can, for example, be disposed on an inner or outer surface of the case, for example, using a suitable adhesive.

It will be appreciated that more than one blocking means or parasitic antenna could be used if desired or necessary to obtain the required radiation pattern.

In a further embodiment, the antenna may comprise a plurality of microwave radiation emitting elements disposed in an phased array, and the pattern shaping means may comprise means for feeding signals to a plurality of the elements in the appropriate amplitude and phase relationships. Typically, in an array, the

radiating elements will be arranged in a square, rectangular, or triangular pattern.

By applying an appropriate amplitude and phase weighting to the radiating elements it may be possible to shape the resultant microwave field and enhance the coverage in desired areas. This could be achieved, for example, by varying the path length of the feed line to each element, and by using a different line width to one or more of the elements.

In a still further embodiment, reflectors may be used to re-direct a portion of the radiated energy into the blind zone.

Whilst parasitic antennas, phased arrays and reflectors can be used, these can be impractical in some circumstances due to size and cost restraints, and a simple blocking means is usually preferred.

The event detection device of the invention can also comprise a fault monitoring system in accordance with International patent application no. WO95/28693, or an anti-masking system in accordance with UK patent application no. GB9526004.8, the entire disclosures of which are incorporated herein by reference for all purposes.

Description of Drawings

An embodiment of an event detection device according to the invention will now be more particularly described, by way of example only, with reference to the accompanying
Drawings in which:

Figures 2(a) and (b) show respectively, in diagrammatic form, a microwave antenna and blocking means for an event detection device according to the invention; and

Figure 3 illustrates graphically the radiation pattern of the antenna of Figure 1, demonstrating the enhanced coverage obtained using a blocking means in accordance with the invention.

Referring firstly to Figure 2, the antenna 10 has microstrip radiating elements 20 arranged in a square configuration. The antenna aperture is 50mm by 50mm. A strip of copper foil 30 is disposed in front of the antenna aperture so that it blocks an upper portion of the emitted radiation. The copper strip has a length of 45mm, a width of 4mm, and a thickness of 0.1mm. The strip is arranged at a distance of 4mm from the surface of the radiating elements 20.

The effect of the blocking strip 30 is illustrated in Figure 3 which is a plot of the antenna radiation pattern. As can be seen from the plot, the presence of the blocking strip provides enhanced microwave amplitude at low incident angles, thereby effectively reducing the blind zone beneath the transmitter. The very small decrease in amplitude in the main beam of the antenna is insignificant compared to the improvement in low angle coverage.

The reader's attention is directed to all papers and documents which are filed concurrently with or previous to this specification in connection with this application and which are open to public inspection with this specification, and the contents of all such papers and documents are incorporated herein by reference.

All of the features disclosed in this specification (including any accompanying claims, abstract and drawings), and/or all of the steps of any method or process so disclosed, may be combined in any combination, except combinations where at least some of such features and/or steps are mutually exclusive.

Each feature disclosed in this specification (including any accompanying claims, abstract and drawings), may be replaced by alternative features

serving the same, equivalent or similar purpose, unless expressly stated otherwise. Thus, unless expressly stated otherwise, each feature disclosed is one example only of a generic series of equivalent or similar features.

The invention is not restricted to the details of the foregoing embodiments. The invention extends to any novel one, or any novel combination, of the features disclosed in this specification (including any accompanying claims, abstract and drawings), or to any novel one, or any novel combination, of the steps of any method or process so disclosed.

CLAIMS

1. An event detection device which comprises a microwave transmitter and a microwave receiver, the transmitter emitting microwave radiation at a defined frequency and the receiver measuring the Doppler shift in reflected radiation, the device being provided with microwave radiation pattern shaping means whereby the coverage of the device is enhanced.

2. A device according to Claim 1, which comprises a combined technology event detection device.

3. A device according to Claim 1 or 2, which comprises, in combination, a Doppler shift microwave sensor and a passive infra-red sensor.

4. A device according to any of the preceding Claims, in which the antenna pattern shaping means comprises a radiation blocking means which is situated in the near field of the antenna.

5. A device according to Claim 4, which comprises a strip or patch of a conducting material and/or a microwave absorbing material, and/or a material which disturbs the electromagnetic fields.

6. A device according to Claim 5, in which the strip or patch comprises copper foil.

7. A device according to any of Claims 4 to 6, in which the blocking means is disposed in an off-set position with respect to the centre of the aperture of the antenna, such that the radiation pattern is distorted, increasing coverage in a desired direction.

8. A device according to any of Claims 1 to 3, which comprises a main antenna, and in which the antenna radiation pattern shaping means comprises a parasitic antenna which is disposed in the electromagnetic field emitted by the main antenna.

9. A device according to Claim 8, wherein the parasitic antenna is formed from an electrically conductive, metallic material and positioned such that the field radiated by the parasitic antenna combines with the field radiated by the main antenna to give the required shaping of the overall radiation pattern to enhance the desired coverage thereof.

10. A device according to any of Claims 4 to 9, wherein the blocking means, or the parasitic antenna, is disposed on a surface of the case or cover of the

device in an appropriate location relative to the main antenna.

11. A device according to Claim 10, in which the strip or patch blocking means is disposed on an inner surface of the case or cover.

12. A device according to any of Claims 1 to 3, wherein the antenna comprises a plurality of microwave radiation emitting elements disposed in a phased array, and the microwave pattern shaping means comprises means for feeding signals to a plurality of the elements in an appropriate amplitude and phase weighting.

13. A device according to Claim 12, in which the means for feeding signals to a plurality of the elements comprises feed lines of varying lengths and widths.

14. A device according to any of Claims 1 to 3, which comprises one or more reflectors which re-direct a portion of the radiated energy from the transmitter into a desired area.

15. An event detection device substantially as hereinbefore described with reference to and as illustrated in the accompanying Drawings.

16. An event detection device substantially as hereinbefore described.

17. A method of enhancing the coverage of an event detection device which comprises a microwave transmitter and a microwave receiver, the transmitter emitting microwave radiation at a defined frequency and the receiver measuring the Doppler shift in reflected radiation, the method comprising disposing a radiation blocking means in the path of the radiation emitted from the transmitter to alter the aperture amplitude and/or phase distribution thereof.

18. A method according to Claim 18, wherein the blocking means is disposed such that the amplitude of the microwave radiation at low incident angles is increased.

19. A method according to Claim 18 or 19 substantially as hereinbefore described.

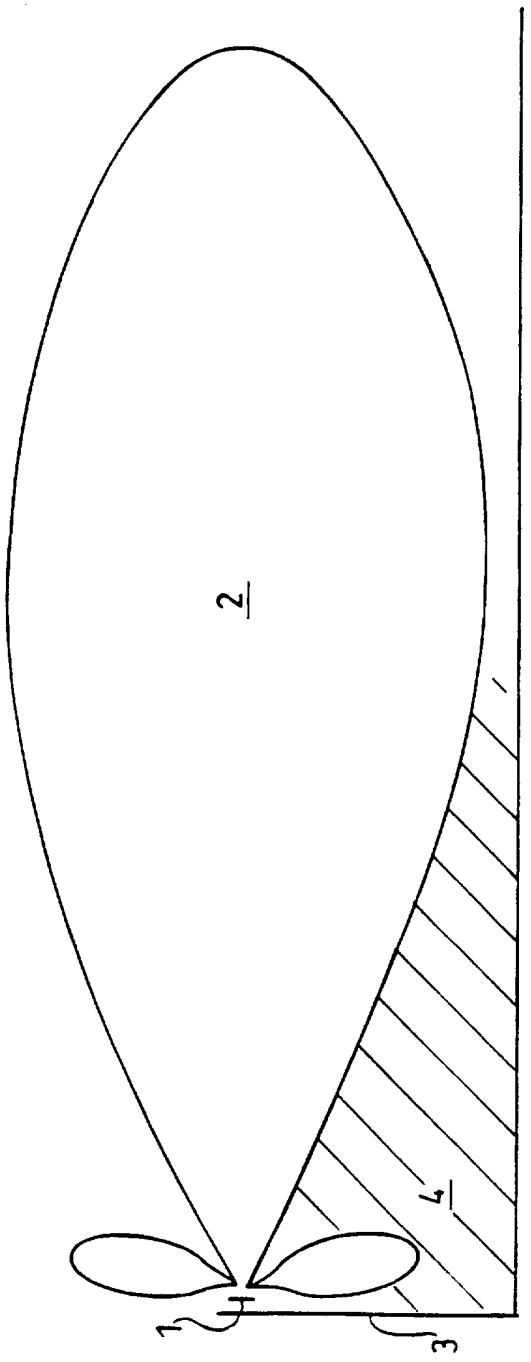


Fig.1.

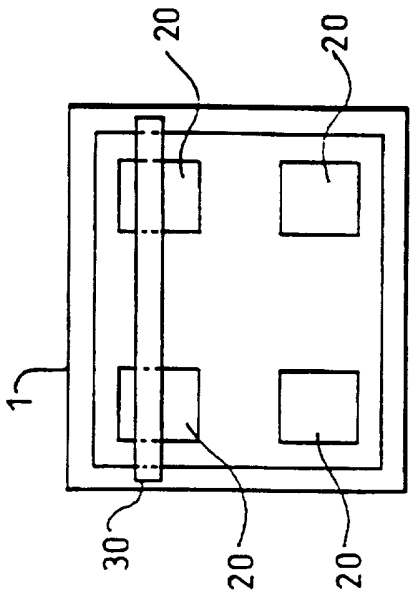
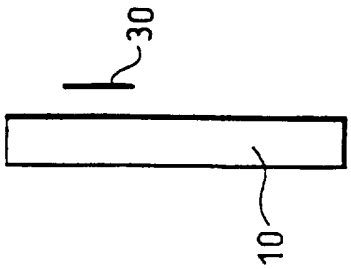


Fig.2.



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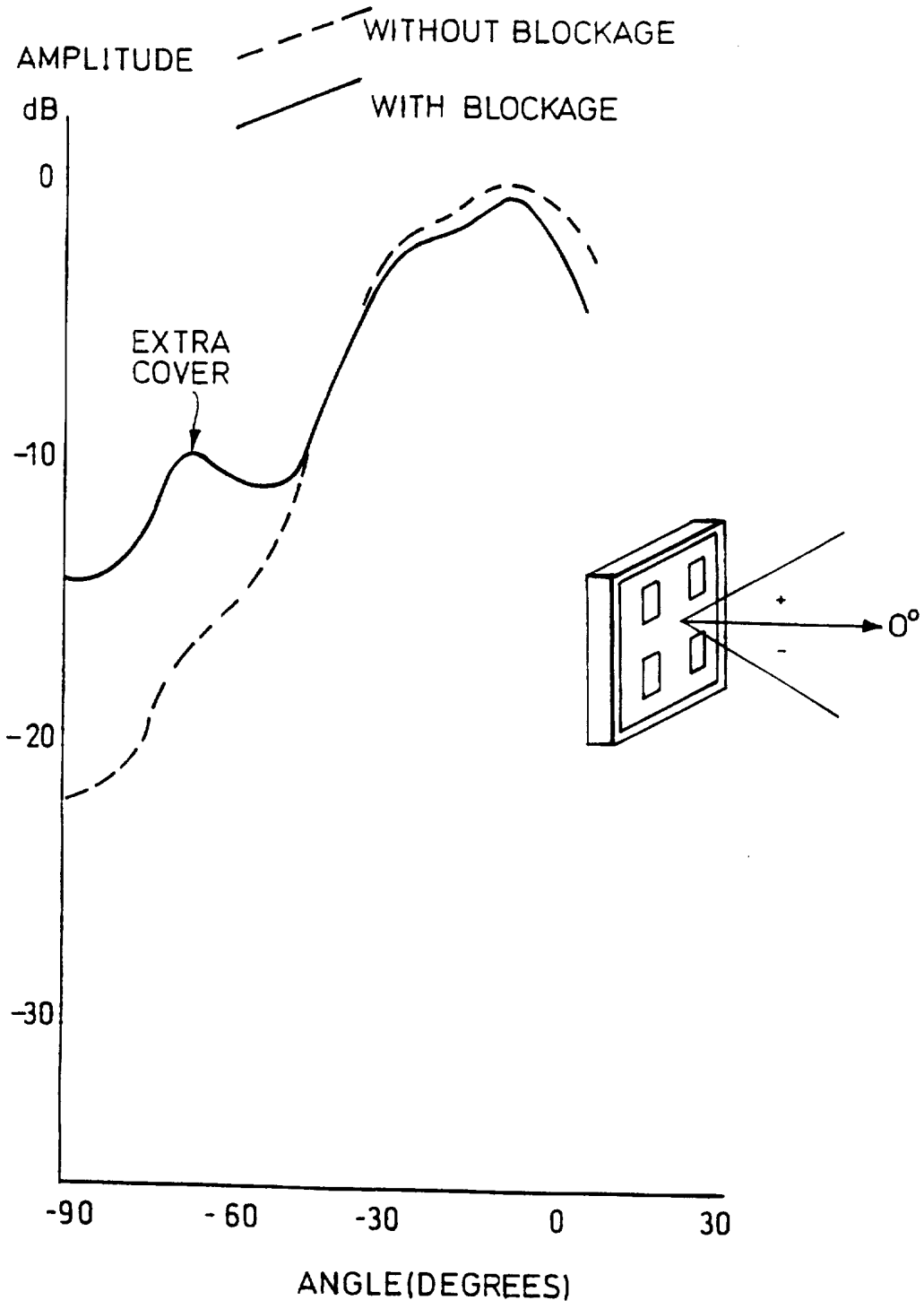

Fig.3.

INTERNATIONAL SEARCH REPORT

International Application No
PCT/GB 97/01264

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 G01S13/56 H01Q15/02 G01S13/86 H01Q19/06

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 G01S H01Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 337 964 A (ELKRON SPA) 18 October 1989 cited in the application see column 1, line 46 - column 3, line 17; figures 1-4	15,16,19
Y		1-9, 12-14, 17,18

Y	DE 43 13 395 A (HIRSCHMANN RICHARD GMBH CO) 10 November 1994 see column 1, line 30-38 see column 2, line 37-52 see claims 3,13,15; figures 1,3	1-9,12, 13

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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Y	EP 0 376 701 A (HARADA IND CO LTD) 4 July 1990 see column 2, line 28 - column 4, line 39; figures 1-5	14,17,18
A	US 3 911 443 A (KORTA LAWRENCE B ET AL) 7 October 1975 see column 2, line 20-34 see column 7, line 60 - column 8, line 58; figures 12-14	6
A	EP 0 055 420 A (NISSAN MOTOR) 7 July 1982 see page 3, line 15-25 see page 4, line 17 - page 6, line 10; figures 1-5	4,5,9, 14,17,18

Form PCT/ISA/210 (continuation of second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Information on patent family members

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		US 5245349 A	14-09-93
US 3911443 A	07-10-75	NONE	
EP 0055420 A	07-07-82	NONE	