(12) UK Patent Application (19) GB (11) 2 372 363 (13) A

(43) Date of A Publication 21.08.2002

(21) Application No 0029333.2

(22) Date of Filing 01.12.2000

(71) Applicant(s)
Peter Gwynne
Islington Boatyard, Church Hill, PENRYN, Cornwall, TR10 8AT, United Kingdom

(72) Inventor(s)
Peter Gwynne

(74) Agent and/or Address for Service
Peter Gwynne
Islington Boatyard, Church Hill, PENRYN, Cornwall, TR10 8AT, United Kingdom

(51) INT CL[7]
G08B 13/14

(52) UK CL (Edition T)
G4N NPPXA2 N2A2

(56) Documents Cited
GB 2230164 A **GB 2040524 A**
DE 004344890 A **DE 002529034 A**

(58) Field of Search
UK CL (Edition T) **G4N NAT1 NCSE NPPXA2**
INT CL[7] **G08B 13/12 13/14**
ONLINE: WPI, EPODOC, JAPIO

(54) Abstract Title
Security device having a capacitive sensor

(57) Security device for detecting an attempt to remove or tamper with a protected object comprising a capacitive sensor 103, a means for producing a repetitive signal which is a function of the capacitance of the sensor, and a means for generating an alarm signal when frequency of the repetitive signal changes by a predetermined amount as a result of a change in the capacitance of the capacitive sensor resulting from an attempt to interfere with the protected object. The capacitive sensor may be a cable adapted to form part of a loop alarm.

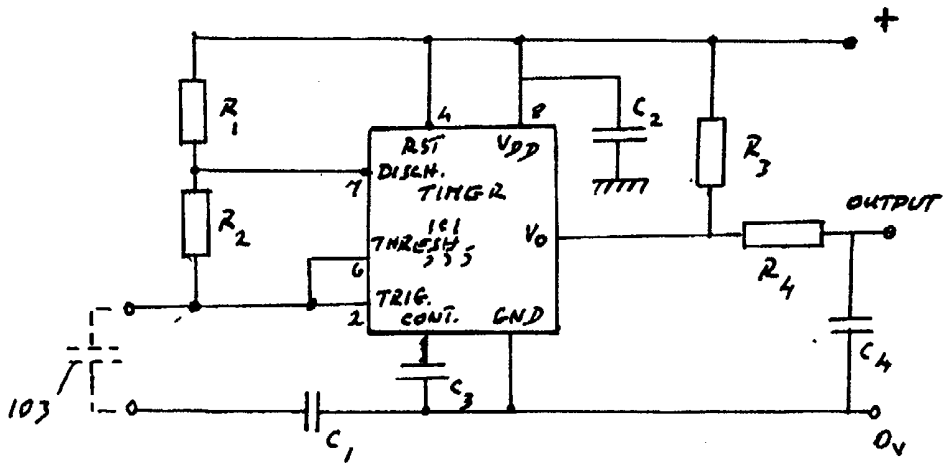

Fig 2

GB 2 372 363 A

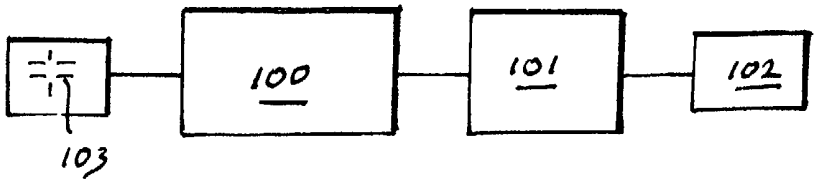
100
101
102
103

Fig 1

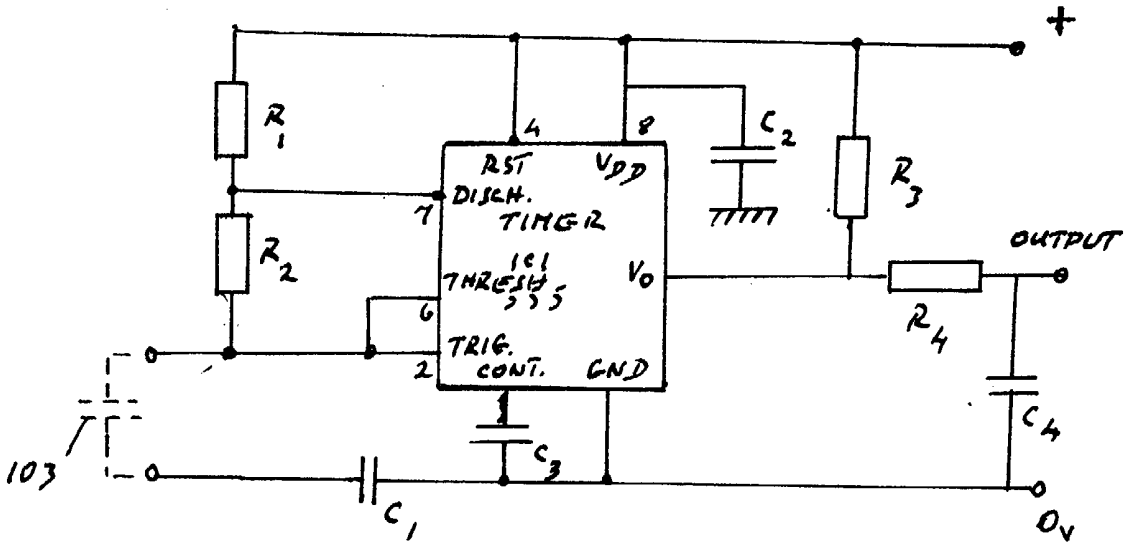
+
R1
R2
4
8
RST
VDD
DISCH.
7
TIMER
IC1
THRESH
555
6
TRIG.
CONT.
2
GND
1
C2
R3
OUTPUT
Vo
R4
C4
C3
C1
103
0V

Fig 2

2372363

SECURITY DEVICE

The present invention relates to security devices and more specifically to those known as loop alarms.

Loop alarms consist of a cable in which there is at least one electrical conductor. Usually one end of the cable is connected to an energising/alarm unit. If the cable is cut or disengaged from the energising/alarm unit so that the flow of current through the cable is interrupted, then the alarm is triggered. Examples of such, and other loop alarms are disclosed in specifications GB 1,393,125; GB 1, 369,399; US 5,689,237; US 3,989,641 and US 3,596,265.

Specification GB 1,393,125 is concerned with protecting the connection points of simple loop alarm which is operated by the interruption of an electric current upon severance of the cable.

Specification GB 1,369,399 discloses a twin-conductor loop alarm in which cutting or an attempted bridging of the conductors de-stabilises an alarm control circuit.

Specification US 5,689,237 discloses a security tag which includes a twin-conductor loop with a resistive element and monitors the resistance of the loop.

Specification US 3,898,641 discloses a system for protecting a mooring rope in which the mooring rope includes a pair of conductors and connections to both a vessel and a mooring bollard to form an electrical circuit. Removal of

the mooring rope from the vessel or the bollard, or cutting of the mooring rope triggers an alarm.

Specification US 3,596,265 discloses an anti-shoplifting loop alarm system which includes at least one twin-conductor cable which has an eye at one end through which the cable is passed after being passed through a suitable hole forming part of an object to be protected and plugged into an alarm unit. Cutting of the cable triggers the alarm circuit.

A disadvantage of loop alarms which rely on the interruption, or establishment of a current path to indicate tampering with the loop alarm cable is that, in the first case, a by-pass can be established before cutting the loop alarm beyond the position of the by-pass and in the second case care can be taken to ensure that no current return path is established when the loop alarm cable is cut.

It is an object of the present invention to provide an improved electrically actuated security device, and in particular, to provide an improved loop alarm security device.

According to the present invention in one aspect, there is provided a security device, comprising a capacitive sensor adapted to be positioned in close proximity, or attached to, an object to be protected, means for producing a repetitive signal the repetition frequency of which is a function of the capacitance of the capacitive sensor and means for producing an alarm signal when the frequency of the repetitive signal changes by more than a pre-determined amount as a result of a change in the capacitance of the capacitive sensor as a result of an attempt to interfere with the protected object.

The term repetitive signal is intended to encompass both digital and wave signals.

The means for producing the repetitive signal may comprise a clock circuit of which the capacitive sensor forms a part and which produces a train of output pulses the repetition frequency of which is a function of the capacitance of the capacitive sensor.

Preferably, the means for producing an alarm signal is adapted to measure the rate of change of the frequency of the repetitive signal and produce the alarm signal only when the rate of change of the frequency of the repetitive signal exceeds a threshold value. Thus the security device is rendered insensitive to long-term drifts in the frequency of the repetitive signal which might arise from environmental effects.

A preferred form of capacitive sensor is a cable adapted to form part of a loop alarm and including two electrically isolated parallel conductors, each of which acts as a plate of a capacitor.

According to the invention in a second aspect, there is provided a method of detecting an attempt to remove or tamper with a protected object including the operations of positioning in the vicinity of, or attaching to, an object to be protected a capacitive sensor and detecting changes in the capacitance of the capacitive sensor as a result of an attempt to remove or interfere with the protected object.

Preferably, the changes in the capacitance of the capacitive sensor are detected by measuring changes in the frequency of a repetitive signal generated by an electrical circuit of which the capacitive sensor forms part.

The invention will now be described by way of example, with reference to the accompanying diagrams in which:-

Figure 1 is a schematic circuit diagram of a security device embodying the invention, and

Figure 2 shows the repetitive signal generator of Figure 1 in more detail.

Referring to the drawings, a security device embodying the invention consists of a signal generator 100 the output frequency of which is a function of its input capacitance. The signal generator 100 is connected to a micro-processor 101 which measures the rate of change of changes in the output frequency from the signal generator 100. Should this exceed a pre-determined value, the circuit 101 produces an alarm signal which is applied to an alarm 102.

The input capacitance of the pulse generator 100 is provided, at least in part, by a capacitive sensor, indicated by a dotted capacitor 103.

In practice, a preferred capacitive sensor is a length of cable adapted to be looped through or around an object to be protected by the security device and which contains two parallel electrically isolated conductors which act as the plates of the capacitor 103.

Referring to Figure 2, the signal generator 100 consists of an integrated circuit timer of the generic type known as 555 or, similar device/s, with ancillary components connected as shown. The capacitive sensor 103 provides the timing capacitor for the timing circuit and the resistors R_1 and

R_2 provide the resistive components. R_3 is the load resistor for the timing circuit. The resistor R_4 and the capacitor C_4 provide an anti-aliaising filter for the micro-processor 101.

The output signal frequency from the signal generator is given the equation:

$$f = 1.44/(R_1 + R_2)\, C_x \text{ , where}$$
$$C_x = C_1 . C_{sens.} / C_1 + C_1 + C_{sens.}$$

The frequency of the output signal from the signal generator changes if the electrical characteristics of the sensor cable are changed in any way. Thus, if the conductors in the sensor cable are bridged, causing a short circuit, there will be a significant change in the frequency of the output signal from the signal generator 100 to a value dictated by the value of the capacitor C_1 . If the sensor cable is cut without the occurrence of bridging of the conductors in the sensor cable, then the frequency of the output signal from the signal generator 100 will increase to a large value determined by stray capacitance. If the non-earthy conductor of the capacitive cable is exposed during an attempt to bridge a section of the sensor cable to enable it to be cut (as can be done with a conventional loop alarm cable) then a significant change will occur in the frequency of the output signal from the signal generator 100. A figure of 10% is typical in dry conditions. This figure increases greatly if there is good electrical contact between the person seeking to interfere with the sensor cable and the ground, for example, if he should be wearing damp shoes.

On the other hand, normal mechanical disturbance of the sensor cable due to factors such as wind, or in marine use, wave effects, will have negligible effects on the frequency of the output signal from the signal generator 100.

CLAIMS

1. A security device comprising a capacitive sensor adapted to be positioned in close proximity, or attached to, an objet to be protected, means for producing a repetitive signal, the repetition frequency of which is a function of the capacitance of the capacitive sensor and means for producing an alarm signal when the frequency of the repetitive signal changes by more than a pre-determined amount as a resultant of a change in the capacitance of the capacitive sensor as a result of an attempt to interface with the protected object.

2. A security device according to Claim 1 wherein the means for producing an alarm signal is adapted to measure the rate of change of the frequency of the repetitive signal and to produce the alarm signal only when the rate of change of the repetition frequency of the repetitive signal exceeds a threshold valve.

3. A security device according to Claim 1 wherein the means for producing a repetitive signal is adapted to produce a signal in the form of a train of regular pulses.

4. A security device according to Claim 3 wherein the means for producing the repetitive signal comprises a clock circuit of which the capacitive sensor forms a part and which produces a train of output pulses the repetition frequency of which is a function of the capacitance of the capacitive sensor.

5. A security device according to any preceding claim wherein the capacitive sensor comprises a length of cable adapted to form part of a loop alarm and including two electrically isolated parallel conductors each of which acts as a plate of a capacitor.

6. A security device according to Claim 5 wherein the cable is of co-axial form.

7. A method of detecting an attempt to remove or tamper with a protected object including the operations of positioning in the vicinity of, or attaching to, an object to be protected a capacitive sensor, detecting changes in the capacitance of the capacitive sensor as a result of an attempt to remove or interfere with the protected object and generating an alarm signal when the frequency of the repetitive signal changes by more than a pre-determined amount.

8. A security device substantially as hereinbefore described and with reference to the accompanying drawings.

9. A method of detecting an attempt to remove or tamper with a protected object substantially as hereinbefore described and with reference to the accompanying drawings.

INVESTOR IN PEOPLE

Application No: GB 0029333.2 **Examiner:** Richard Kerslake
Claims searched: 1-9 **Date of search:** 14 June 2002

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.T): G4N (NAT1, NCSE, NPPXA2)

Int Cl (Ed.7): G08B 13/12, 13/14

Other: Online: WPI, EPODOC, JAPIO

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	GB 2230164 A	(MARCONI ELECTRONIC) Page 2 line 30 - Page 3 line 25, Page 4 lines 3 - 34	1,3,4,7
X	GB 2040524 A	(LAWRENCE SECURITY) Page 1 line 43 - Page 2 line 4, Page 2 lines 25 - 42, Page 3 lines 26 - 40	1,2,5,6,7
X	DE 4344890 A	(BEER) Abstract	1 & 7 at least
X	DE 2529034 A	(RODE) Abstract	1 & 7 at least

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.