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(56) Documents Cited:
GB 2356077 A **GB 2343042 A**
GB 2276747 A **US 5748083 A**
US 5406256 A **US 4952908 A**
US 3728675 A

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INT CL[7] **B60R, B62H, E04H, G08B**
Other: **Online: WPI, EPODOC, PAJ.**

(54) Abstract Title: **Detecting movement of a surface**

(57) The movement of a surface is detected by a movement sensor comprising a mercury switch (32, figure 1c). When movement is detected a transmitter sends a movement signal a remote receiver 3. The system can be used to detect movement of a swimming pool cover 20 where a remote user is alerted to cover movement (e.g. due to person in water) by transmission of the movement signal to a remote receiver 3(e.g. attached to the user's belt). The system can be used to detect movement of other surfaces such as a vehicle 3, a door (figure 9) etc. (e.g. to alert the owner of theft). The receiver may alert the user if the transmitter power is low or is the receiver is out of range.

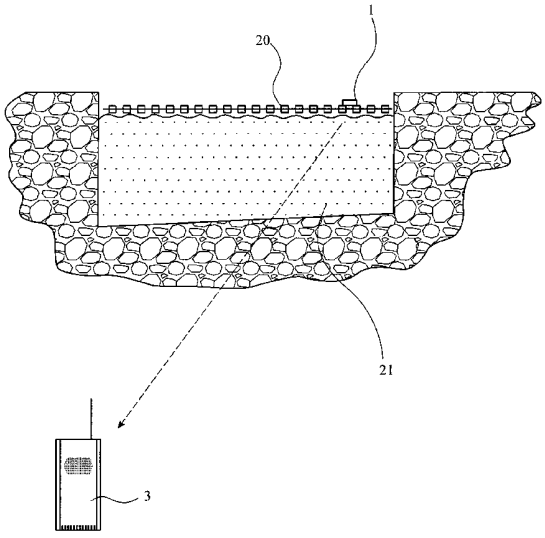

Fig. 1(a)

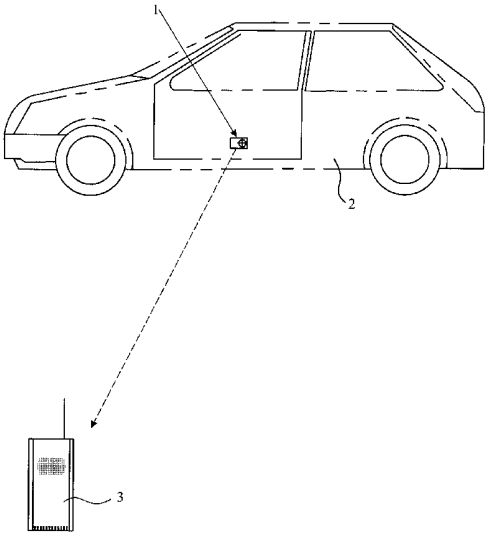

Fig. 3(a)

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At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

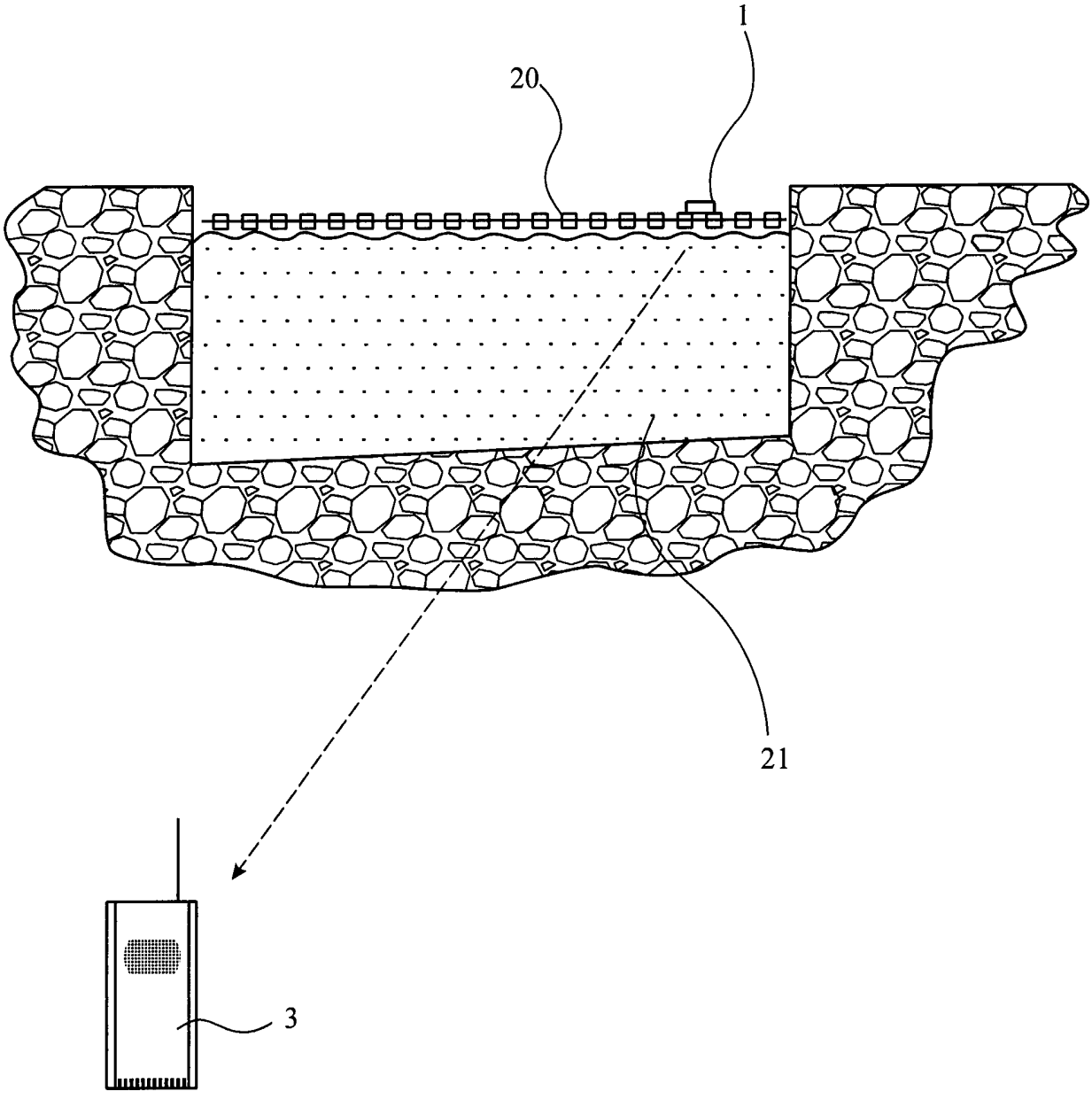


Fig. 1(a)

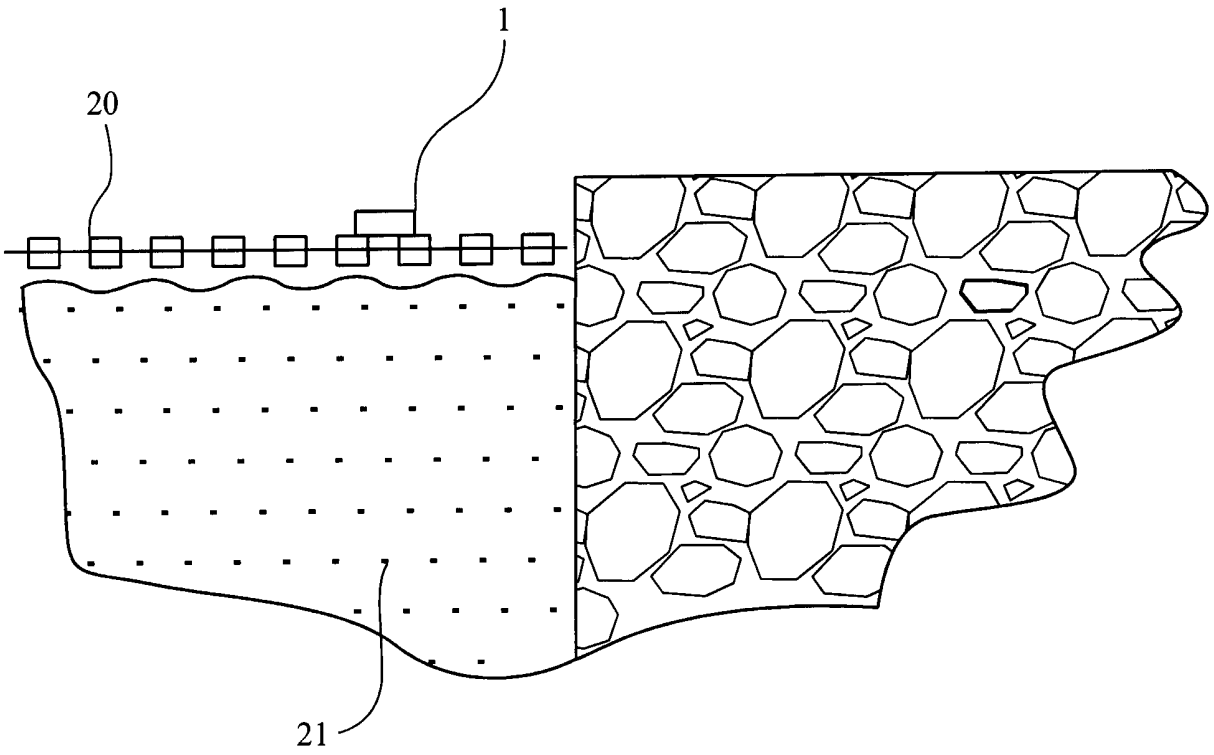


Fig. 1(b)

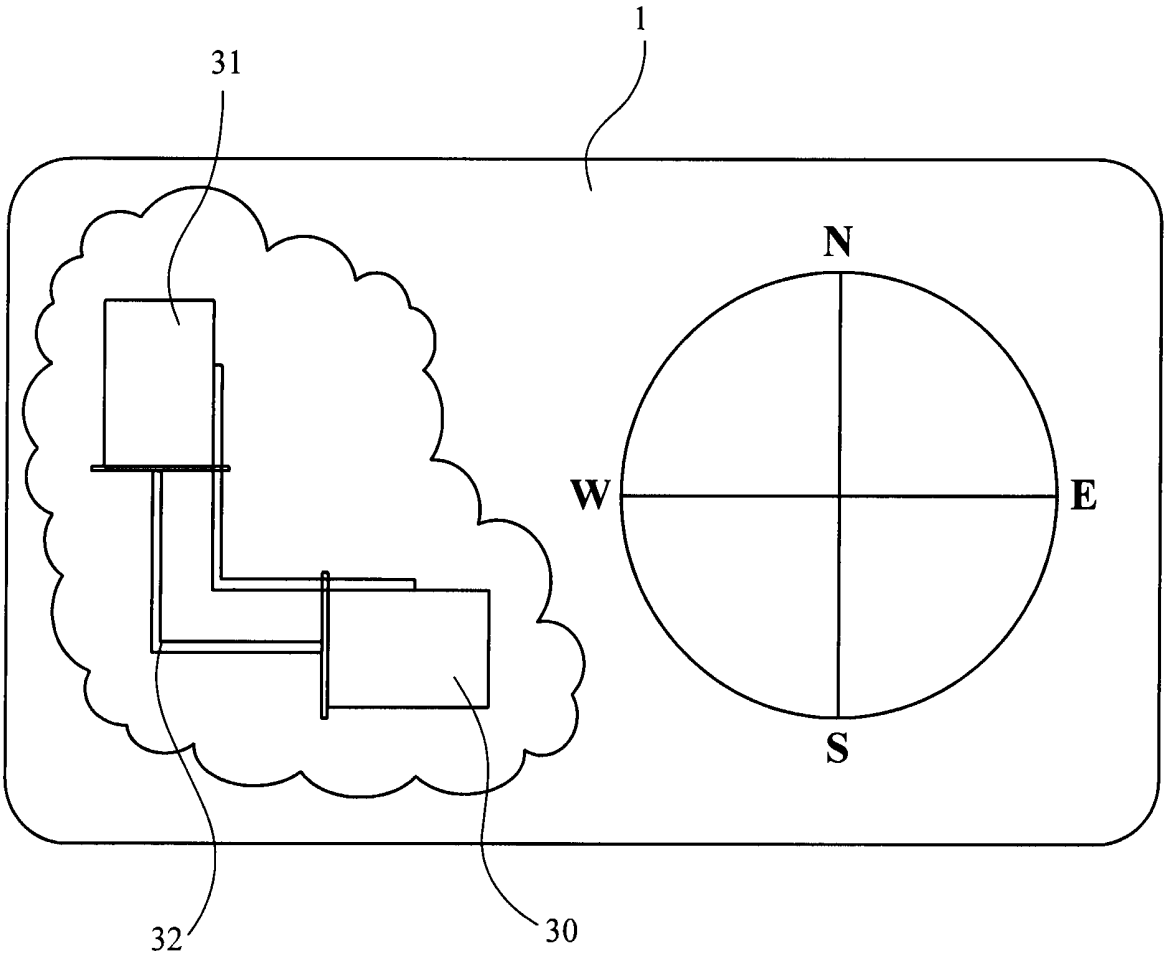
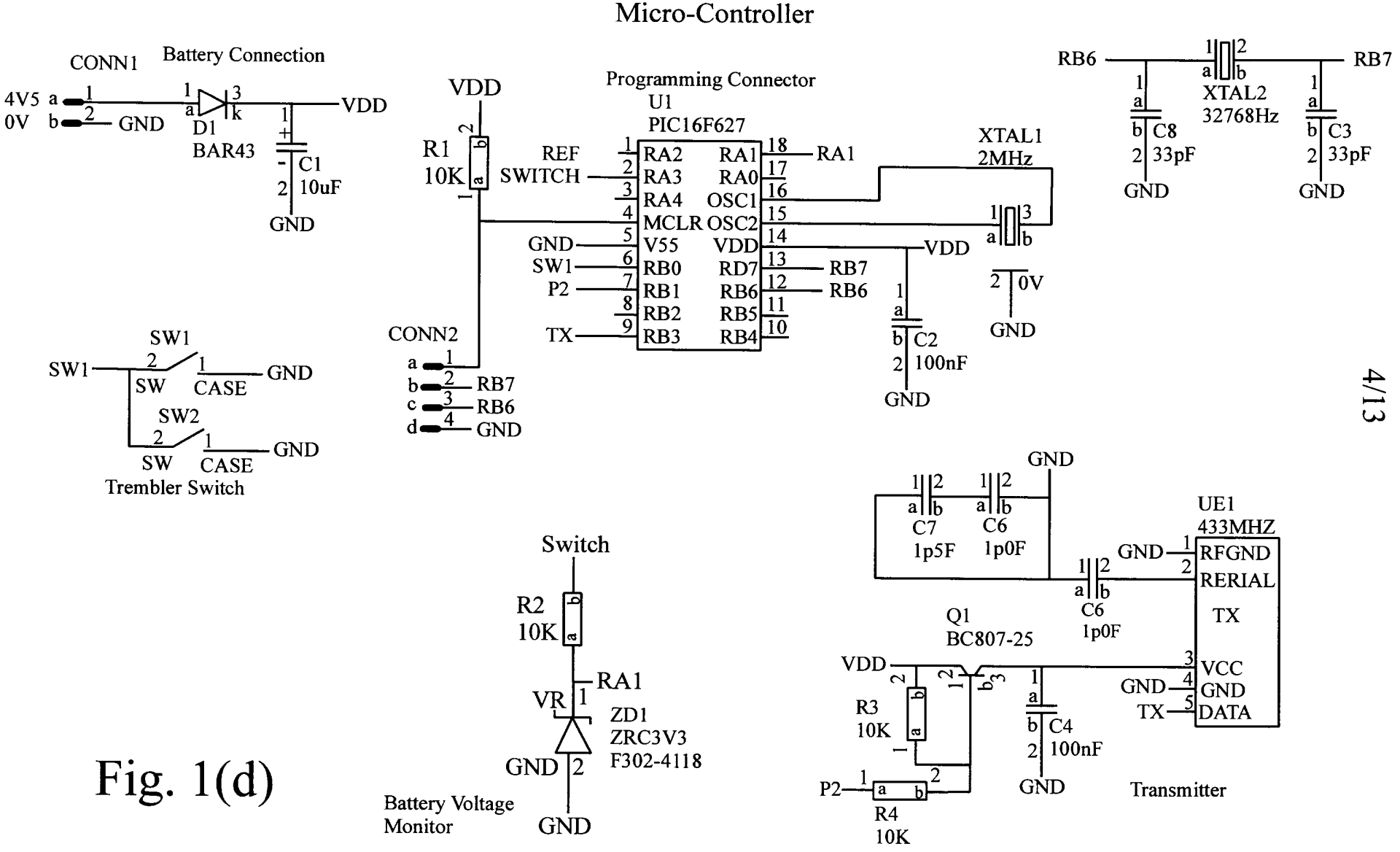


Fig. 1(c)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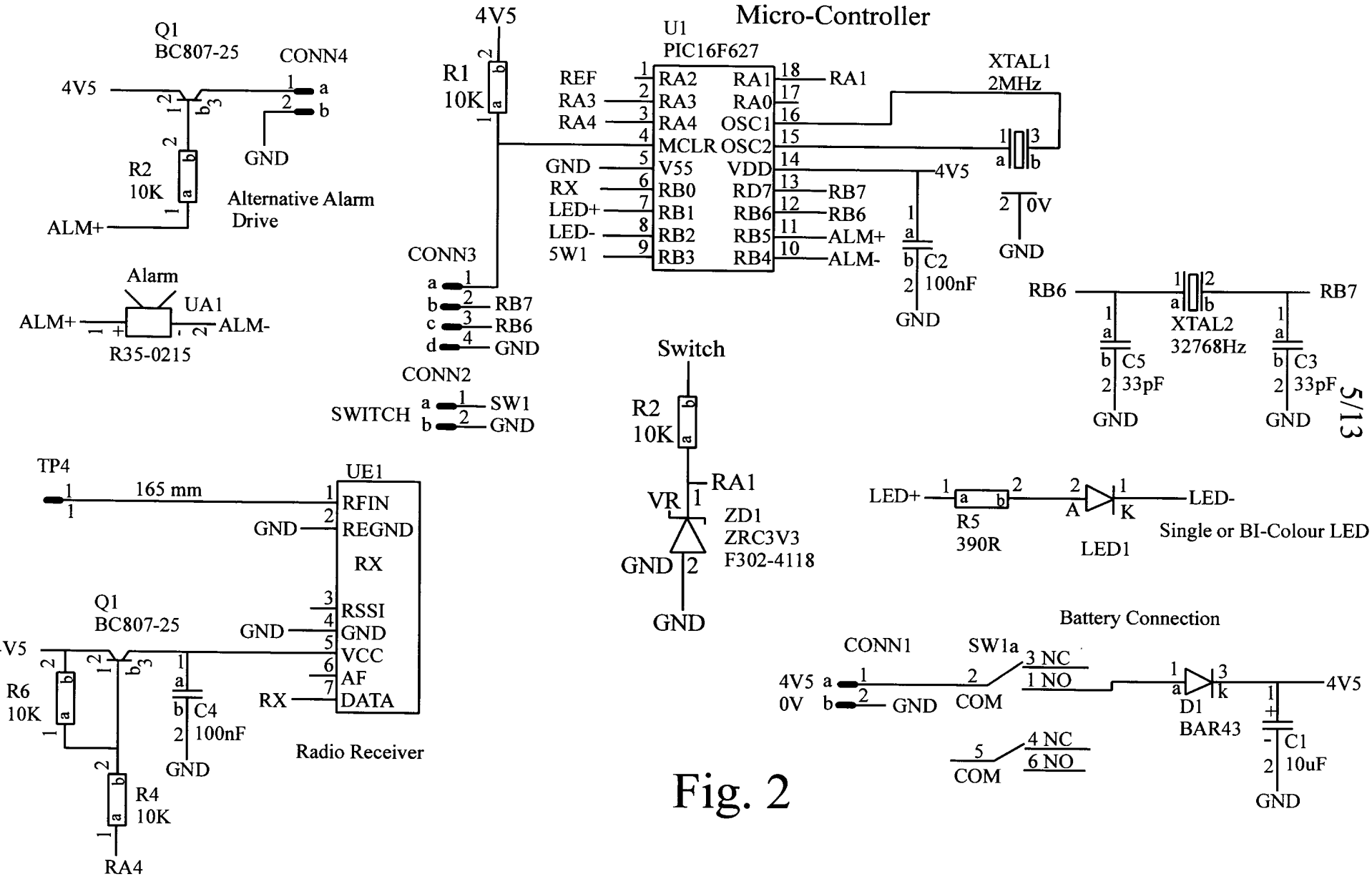
CONN1
Battery Connection
4V5
0V
GND
D1
BAR43
C1
10uF
VDD
Programming Connector
U1
PIC16F627
R1
10K
REF
SWITCH
GND
SW1
P2
TX
RA2
RA3
RA4
MCLR
V55
RB0
RB1
RB2
RB3
RA1
RA0
OSC1
OSC2
VDD
RD7
RB6
RB5
RB4
RB7
RB6
CONN2
RB7
RB6
GND
XTAL1
2MHz
C2
100nF
0V
RB6
RB7
XTAL2
32768Hz
C8
33pF
C3
33pF
SW1
SW2
SW
CASE
Trembler Switch
Switch
R2
10K
RA1
VR
ZD1
ZRC3V3
F302-4118
Battery Voltage
Monitor
C7
1p5F
C6
1p0F
UE1
433MHZ
RFGND
RERIAL
TX
VCC
GND
DATA
Q1
BC807-25
R3
10K
C4
100nF
P2
R4
10K
Transmitter

Fig. 1(d)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PIC16F627
Q1
BC807-25
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R2
10K
GND
ALM+
Alternative Alarm
Drive
Alarm
UA1
ALM+
ALM-
R35-0215
4V5
R1
10K
CONN3
RB7
RB6
GND
CONN2
SWITCH
SW1
GND
REF
RA3
RA4
GND
RX
LED+
LED-
5W1
RA2
RA3
RA4
MCLR
V55
RB0
RB1
RB2
RB3
RA1
RA0
OSC1
OSC2
VDD
RD7
RB7
RB6
RB5
RB4
RA1
ALM+
ALM-
XTAL1
2MHz
0V
GND
4V5
C2
100nF
GND
RB6
RB7
XTAL2
32768Hz
C5
33pF
GND
C3
33pF
GND
5/13
Switch
R2
10K
RA1
VR
ZD1
ZRC3V3
F302-4118
GND
GND
LED+
R5
390R
A
K
LED-
LED1
Single or BI-Colour LED
TP4
165 mm
UE1
RFIN
GND
REGND
RX
RSSI
GND
VCC
AF
DATA
RX
Q1
BC807-25
4V5
R6
10K
C4
100nF
GND
Radio Receiver
R4
10K
RA4
Battery Connection
CONN1
4V5
0V
GND
SW1a
COM
3 NC
1 NO
4 NC
6 NO
COM
D1
BAR43
4V5
C1
10uF
GND

Fig. 2

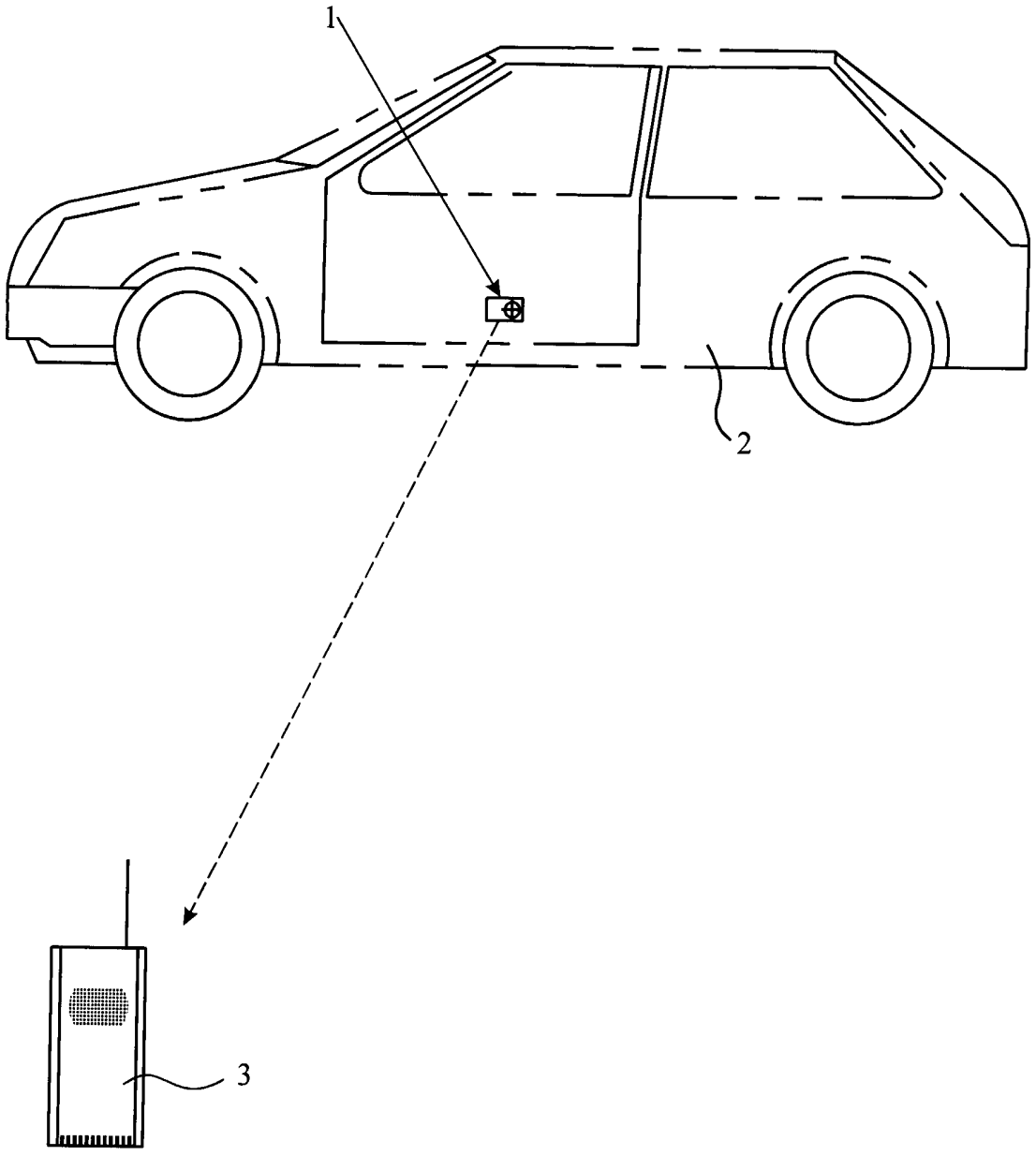

Fig. 3(a)

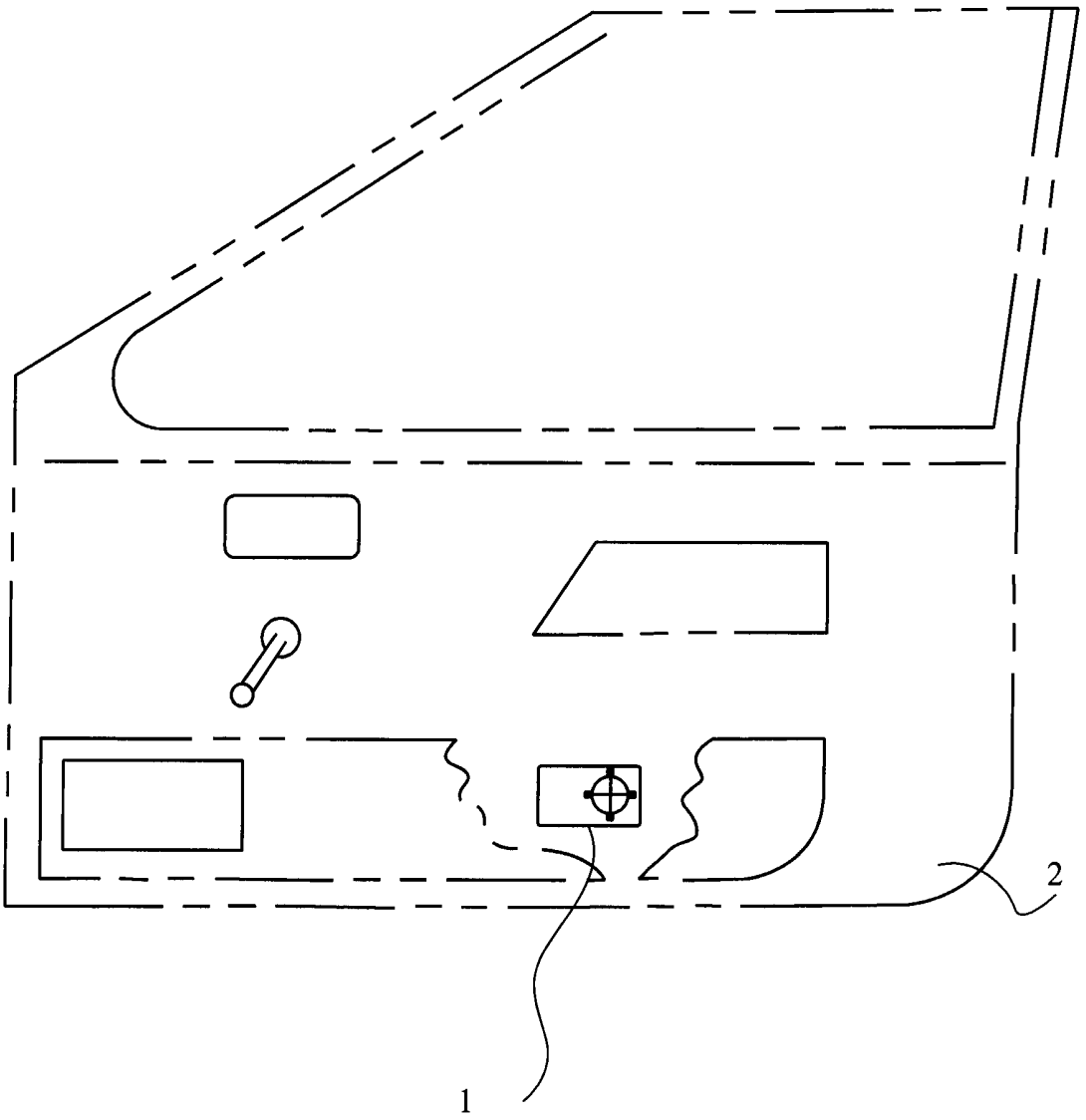

Fig. 3(b)

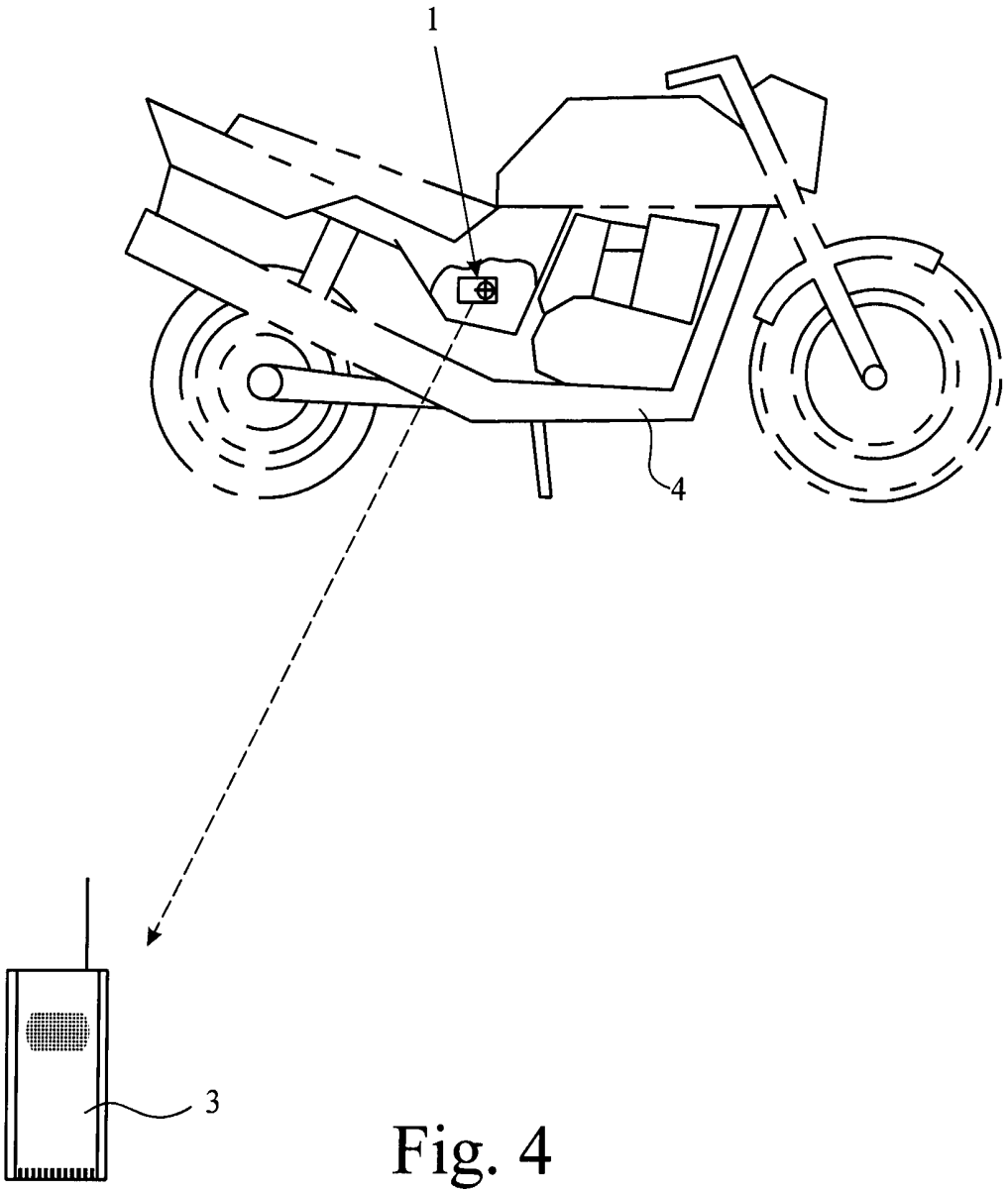

Fig. 4

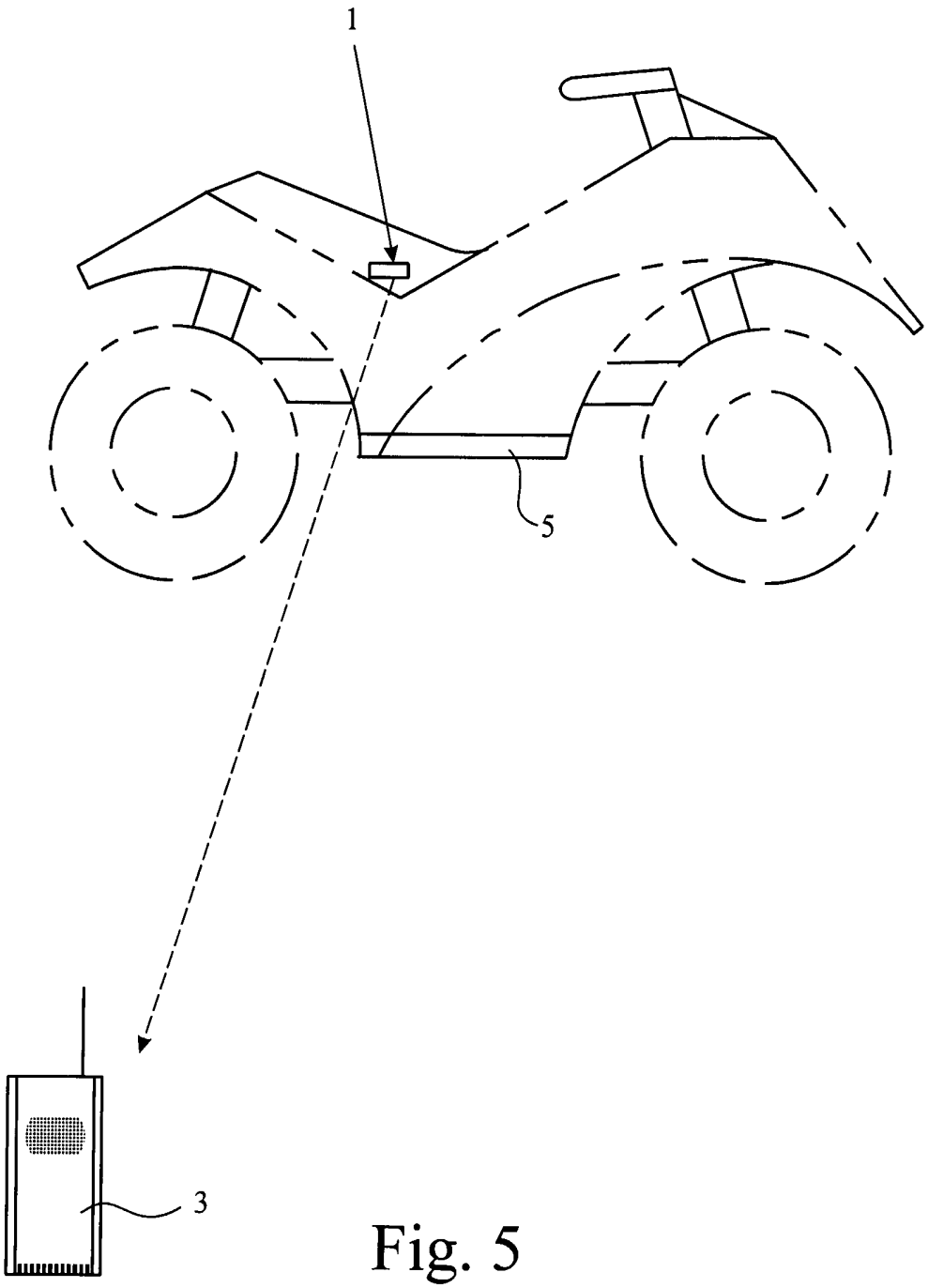

Fig. 5

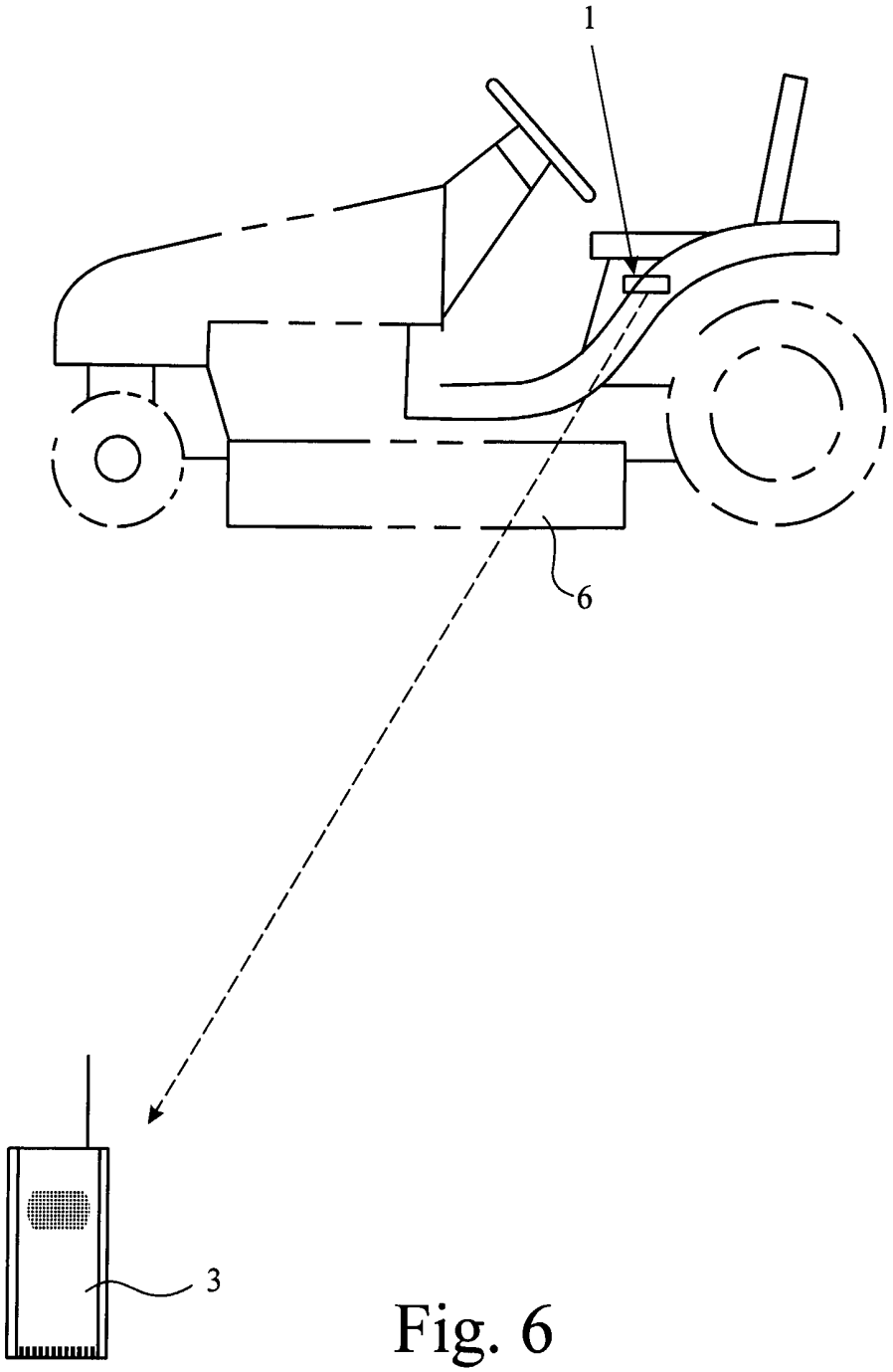

Fig. 6

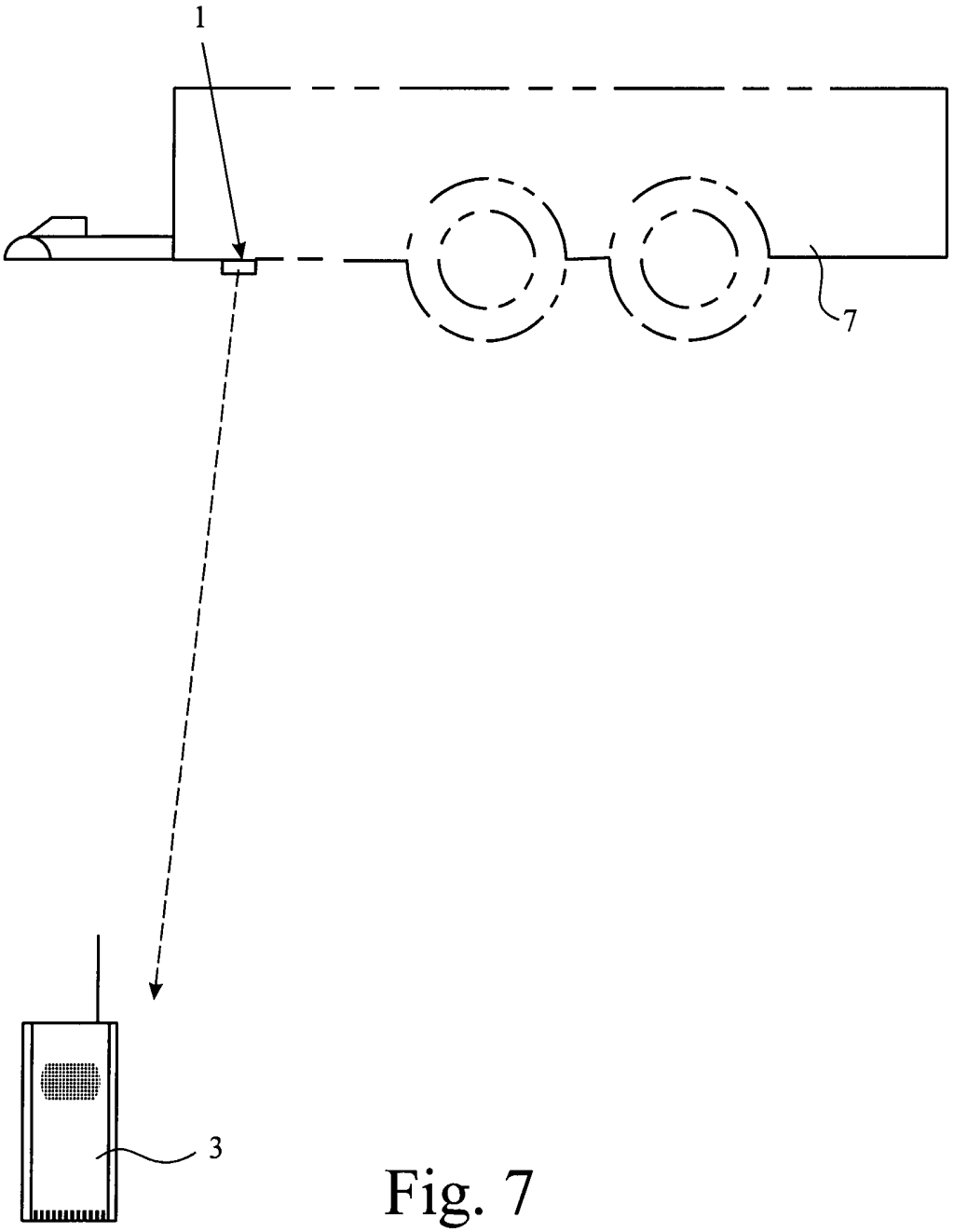

Fig. 7

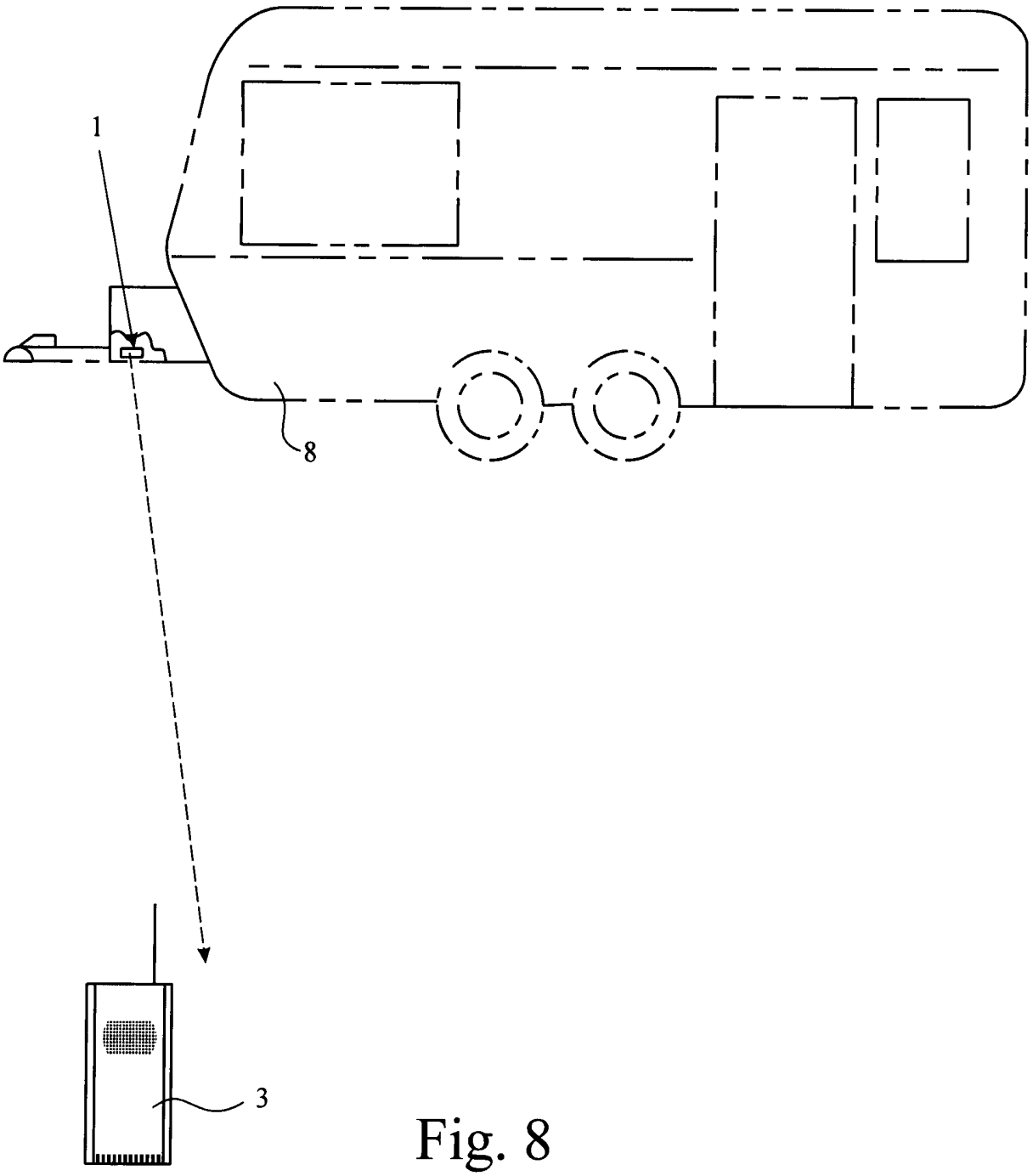

Fig. 8

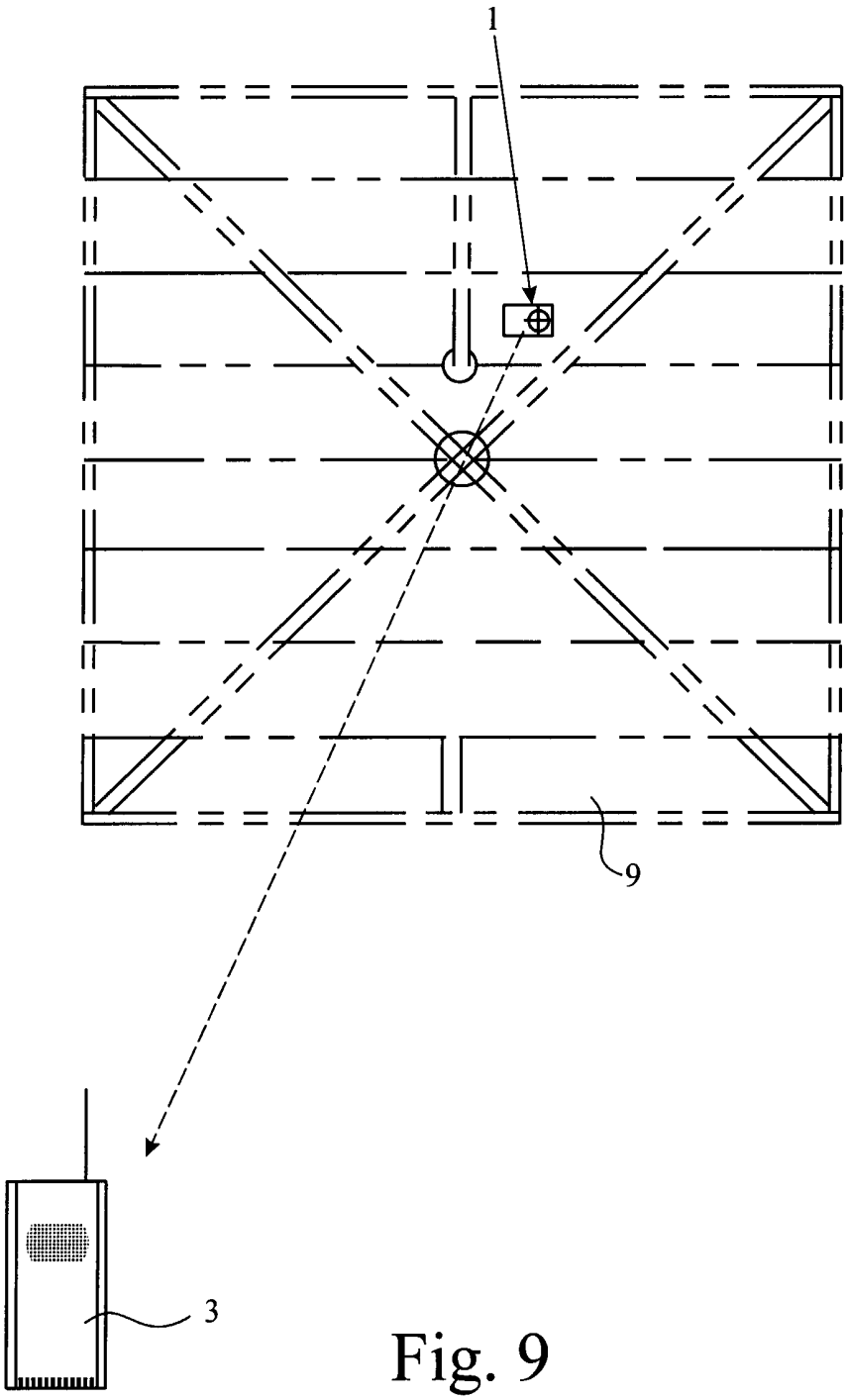

Fig. 9

"A System"

Introduction

This invention relates to a system for detecting movement of a surface. In particular it relates to a system for detecting movement of a surface of a swimming pool cover.

It is common to cover a swimming pool with a cover when the swimming pool is not in use. For example, a winter debris cover could be used to prevent leaves and the like from falling into a swimming pool, or a heat retention cover could be used to minimise heat loss from the water in a swimming pool.

Accidents involving an unsupervised child falling into a swimming pool occur frequently. Such accidents can have potentially fatal consequences.

This invention is therefore aimed at improving safety in relation to swimming pools.

Statements of Invention

According to the invention there is provided a system for detecting movement of a surface, the system comprising:-

a sensor to detect movement of a surface;

the sensor comprising at least one mercury switch;

a transmitter to transmit a movement signal responsive to movement being detected; and

a receiver to receive the movement signal.

Because the receiver may be kept close to a user, the system according to the invention enables the user to be alerted relatively quickly to the movement of the surface. This may occur, for example, if an unsupervised child has fallen into a swimming pool and in the process has caused movement in a surface of a swimming pool cover. In particular, it is not necessary for the swimming pool to be visible or audible to the user. The system according to the invention enables the user to be alerted to the accident.

It has been found that the mercury switch sensor results in fewer false alarms being caused than other forms of sensor. In addition the mercury switch sensor is not sensitive to the positioning of the contacts. The rate of detection can thus be controlled by the orientation of the contacts.

In one embodiment of the invention the mercury switch comprises at least two contacts movable relative to one another between an open configuration and a closed configuration to detect movement of a surface. Preferably the mercury switch comprises fluid mercury in which the contacts float.

In one case the sensor is configured to periodically detect movement.

Preferably the receiver is located remotely from the transmitter. The receiver may be movable relative to the transmitter. Ideally the receiver is portable. The portable receiver may be carried by the user at all times, for example by conveniently clipping the receiving onto a belt of the user. The user will therefore be alerted to the movement of the surface regardless of the location of the user.

In a preferred embodiment the receiver comprises means to activate and/or deactivate the system. Because the receiver comprises the activation/deactivation means, this ensures the system is tamper-proof. For example, a child playing at a poolside

cannot inadvertently deactivate the system. Only the user via the receiver can deactivate the system. In this manner the safety aspect of the system is enhanced.

The movement signal may be a radio frequency (RF) signal.

In another embodiment of the invention the system comprises means to alert a user responsive to the receiver receiving the movement signal. Preferably the transmitter is configured to periodically transmit a range signal. Ideally the receiver is configured to periodically receive a range signal. The system may comprise means to alert a user responsive to the receiver receiving no range signal for a predetermined period of time. Most preferably the system comprises means to alert a user responsive to a power level of the transmitter and/or of the receiver being below a predetermined value.

In one case the means to alert comprises means to emit energy. The means to emit energy may comprise means to emit audible sound. The means to emit energy may comprise means to emit visible light.

In one embodiment the means to alert a user and the receiver are housed within a housing. In another embodiment the sensor and the transmitter are housed within a housing.

The invention provides a system for detecting movement of a surface of a vehicle. In another case the invention provides a system for detecting movement of a surface of a door. Further the invention provides a system for detecting movement of a surface of a swimming pool cover.

The system according to the invention is a simple, compact invention. In particular, no time or effort is required to install the system for use.

Brief Description of the Drawings

The invention will be more clearly understood from the following description of some embodiments thereof, given by way of example only, with reference to the accompanying drawings, in which:-

Fig. 1(a) is a cross-sectional, side view of a system according to the invention for detecting movement of a surface of a swimming pool cover;

Fig. 1(b) is an enlarged, cross-sectional, side view of the system of Fig. 1(a);

Fig. 1(c) is a schematic, plan view of a sensor of the system of Fig. 1(a);

Fig. 1(d) is a circuit layout of a transmitter of the system of Fig. 1(a);

Fig. 2 is a circuit layout of a receiver of the system of Fig. 1(a);

Fig. 3(a) is a schematic illustration of a system according to the invention for detecting movement of a surface of a vehicle;

Fig. 3(b) is an enlarged, schematic illustration of a sensor of the system of Fig. 3(a);

Figs. 4 to 8 are schematic illustrations of other systems according to the invention for detecting movement of a vehicle; and

Fig. 9 is a schematic illustration of a system according to the invention for detecting movement of a surface of a door.

Detailed Description

Referring to Figs. 1(a) to 2, there is illustrated a system according to the invention for detecting movement of a surface, such as a surface of a swimming pool cover 20. The system comprises a first housing unit 1 and a second housing unit 3.

The first housing unit 1 houses a sensor to detect movement of the swimming pool cover surface, and a radio frequency (RF) transmitter to transmit a RF movement signal to the second housing unit 3 in response to movement of the swimming pool cover surface being detected.

In this case the sensor comprises a mercury switch 32. As illustrated in Fig. 1(c), the mercury switch 32 comprises two contacts 30, 31 located at 90° to one another floating horizontally in fluid mercury. The contacts 30, 31 are movable relative to one another between an open configuration and a closed configuration (Fig. 1(c)) to detect movement of the surface of the swimming pool cover 20.

The transmitter has a range, in this case, of approximately 250m.

The first housing unit 1 is waterproof to prevent water ingress affecting the performance of the sensor and/or the RF transmitter.

The second housing unit 3 houses a RF receiver to receive the RF movement signal from the first housing unit 1, and means to alert a user in response to the receiver receiving the RF movement signal. In this case, the means to alert is provided by means to emit energy in the form of an audible sound. The sound emitter may be configured to emit sound at, for example, 90 dB for 1 minute when movement of the swimming pool cover 20 is detected.

The housing units 1, 3 are movable relative to one another, with the second housing unit 3 preferably being portable. Thus the two housing units 1, 3 may be located remotely from one another.

Means to activate/deactivate the system is provided at the second housing unit 3.

Fig. 1(d) illustrates the circuit layout of the transmitter. Power is provided by three AA type batteries giving a nominal 4.5 volts DC. The circuit includes a diode (D1) to prevent damage to components if the batteries are incorrectly fitted. C1, C2 and C4 are noise reduction capacitors. Conn2 is the in-circuit programming connector, and R1 is a pull-up resistor to hold the MCLR line high when the processor is running normally. XTAL1 is the main clock oscillator for the processor (U1). XTAL2 and C3 and C8 form a low-speed oscillator which is used by the processor to provide accurate timing when it is in sleep mode. ZD1 and R2 form a voltage reference which is used as a comparison with the battery voltage to give a low-battery indication.

The processor (U1) monitors the trembler switch(es) (SW1) and each time it sees a movement it increments an internal counter. The processor goes to sleep for about five seconds. The actual time is related to the serial number so that multiple units in the same area do not continuously transmit at the same time. When the processor wakes up it sends a message which consists of the serial number and the number in the movement counter.

To preserve power the transmitter is powered down when not in use, this is done using Q1, R3 and R4. C5, C6 and C7 form part of the printed circuit aerial.

Fig. 2 illustrates the circuit layout of the receiver. Power is provided by three AA type batteries giving a nominal 4.5 volts DC. The circuit includes an on/off switch SW1 and a diode (D1) to prevent damage to components if the batteries are incorrectly fitted. C1, C2 and C4 are all noise reduction capacitors. CONN3 is the

in-circuit programming connector, and R1 is a pull-up resistor to hold the MCLR line high when the processor is running normally. XTAL1 is the main clock oscillator for the processor (U1). XTAL2 and C3 and C5 form a low-speed oscillator which is used by the processor to provide accurate timing when it is in sleep mode. ZD1 and R3 form a voltage reference which is used as a comparison with the battery voltage to give a low-battery indication. LED1 and R5 are a two-colour indicator for operator information.

The alarm is driven by R2 and Q2 to provide the extra current needed for the sounder. The radio receiver module (UE1) is powered down using R4, R5 and Q1 to reduce current consumption when not in use.

To preserve power the processor remains in a sleep mode most of the time. It wakes up at approximately 5 second intervals. The actual time is related to the serial number. It wakes up just before it expects to receive its next message. If it receives a message with an increased number of movements then it will sound the alarm. If it does not receive a message then it remains awake for just over 10 seconds and if no message is received in that time it sounds the alarm. This would indicate that the transmitter had failed, or that it had been moved out of range.

By spending most of the time in sleep mode, the power usage of the processor is minimised.

When either unit shows a battery-low condition the visible indicator will change state. Thus the user is automatically informed of the need to renew the batteries.

In use, a swimming pool cover 20 is located on the water surface of a swimming pool 21 which is not in use. The first housing unit 1 is then located resting on a surface of the swimming pool cover 20. The second housing unit 3 may be located at any suitable location, for example, within a house adjacent to the swimming pool 21.

Alternatively the second housing unit 3 may be carried by a user, for example, in a pocket or clipped to a belt of the user.

Next the system is activated by the user at the second housing unit 3. The system is thus ready to detect any movement of the surface of the swimming pool cover 20.

In the event of movement of the surface of the swimming pool cover 20 occurring, for example, if an unsupervised child fell into the pool 21 and in the process caused movement of the surface of the swimming pool cover 20, this movement causes the contacts 30, 31 to float in the fluid mercury towards one another from the open configuration to the closed configuration. When the contacts 30, 31 meet, an electrical circuit is temporarily formed and in this manner the mercury switch sensor 32 detects the movement. Responsive to this movement being detected, the RF transmitter transmits the RF movement signal to the RF receiver, and responsive to this RF movement signal being received by the RF receiver, an audible sound is emitted from the second housing unit to alert the user that the surface of the swimming pool cover has been moved. The user can then take immediate action to ensure the safety of the child.

After a predetermined period of sound emission, in this case 60 seconds, the second housing unit 3 ceases emission of the audible sound, and the system automatically re-sets. If any further movement of the surface of the swimming pool cover 20 occurs, the mercury switch sensor 32 will detect this movement and the second housing unit 3 will emit an audible sound.

Figs. 3(a) and 3(b) illustrate another system for detecting movement of a surface according to the invention, which is similar to the system described previously with reference to Figs. 1(a) to 2, and similar elements in Figs. 3(a) and 3(b) are assigned the same reference numerals. In this case the first housing unit 1 is mounted to a vehicle, such as a motor car 2, and the second housing unit 3 is located remotely from the motor car 2.

In this manner the system may be used to detect movement of a surface of the motor car 2. In the event of an unauthorised person attempting to move or steal the motor car 2, the system will alert the user even if the motor car 2 is not visible or audible to the user.

The first housing unit 1 may be concealed within the motor car 2. Thus a potential thief would be unaware of the presence of the security system.

Referring to Figs. 4 to 8 there are illustrated other systems for detecting movement of a surface according to the invention, which are similar to the system described previously with reference to Fig. 3, and similar elements in Figs. 4 to 8 are assigned the same reference numerals.

It will be appreciated that these systems may be used to alert a user in the event of an unauthorised person attempting to move or steal a motorbike 4 (Fig. 4), or a quad bike/ATV 5 (Fig. 5), or a lawn tractor 6 (Fig. 6), or a trailer 7 (Fig. 7), or a caravan 8 (Fig. 8).

Fig. 9 illustrates a further system for detecting movement of a surface according to the invention, which is similar to the system described previously with reference to Fig. 3, and similar elements in Fig. 9 are assigned the same reference numerals.

In this case the first housing unit 1 is mounted to a door, such as a garage door 9, and the second housing unit 3 is located remotely from the garage door 9. In this manner the system may be used to detect movement of a surface of the garage door 9. In the event of the garage door 9 being opened or attempted to open, the system will alert the user, even if the garage door 9 is not visible or audible to the user.

It will be appreciated that the means to alert may be provided in any suitable form, such as by means to emit energy in the form of visible light.

The invention is not limited to the embodiments hereinbefore described, with reference to the accompanying drawings, which may be varied in construction and detail.

Claims

1. A system for detecting movement of a surface, the system comprising:-

a sensor to detect movement of a surface;

the sensor comprising at least one mercury switch;

a transmitter to transmit a movement signal responsive to movement being detected; and

a receiver to receive the movement signal.

2. A system as claimed in claim 1 wherein the mercury switch comprises at least two contacts movable relative to one another between an open configuration and a closed configuration to detect movement of a surface.

3. A system as claimed in claim 2 wherein the mercury switch comprises fluid mercury in which the contacts float.

4. A system as claimed in any of claims 1 to 3 wherein the sensor is configured to periodically detect movement.

5. A system as claimed in any of claims 1 to 4 wherein the receiver is located remotely from the transmitter.

6. A system as claimed in any of claims 1 to 5 wherein the receiver is movable relative to the transmitter.

7. A system as claimed in claim 6 wherein the receiver is portable.

8. A system as claimed in any of claims 1 to 7 wherein the receiver comprises means to activate and/or deactivate the system.

9. A system as claimed in any of claims 1 to 8 wherein the movement signal is a radio frequency (RF) signal.

10. A system as claimed in any of claims 1 to 9 wherein the system comprises means to alert a user responsive to the receiver receiving the movement signal.

11. A system as claimed in any of claims 1 to 10 wherein the transmitter is configured to periodically transmit a range signal.

12. A system as claimed in any of claims 1 to 11 wherein the receiver is configured to periodically receive a range signal.

13. A system as claimed in claim 11 or 12 wherein the system comprises means to alert a user responsive to the receiver receiving no range signal for a predetermined period of time.

14. A system as claimed in any of claims 1 to 13 wherein the system comprises means to alert a user responsive to a power level of the transmitter and/or of the receiver being below a predetermined value.

15. A system as claimed in any of claims 10 to 14 wherein the means to alert comprises means to emit energy.

16. A system as claimed in claim 15 wherein the means to emit energy comprises means to emit audible sound.

17. A system as claimed in claim 15 or 16 wherein the means to emit energy comprises means to emit visible light.

18. A system as claimed in any of claims 10 to 17 wherein the means to alert a user and the receiver are housed within a housing.

19. A system as claimed in any of claims 1 to 18 wherein the sensor and the transmitter are housed within a housing.

20. A system for detecting movement of a surface of a vehicle as claimed in any of claims 1 to 19.

21. A system for detecting movement of a surface of a door as claimed in any of claims 1 to 19.

22. A system for detecting movement of a surface of a swimming pool cover as claimed in any of claims 1 to 19.

23. A system for detecting movement of a surface substantially as hereinbefore described with reference to the accompanying drawings.

Application No: GB0315914.2 **Examiner:** Eleanor Hogan

Claims searched: 1-23 **Date of search:** 8 September 2004

Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular relevance
X	1- 6, 8, 9, 10-19 & 20.	GB 2276747 A (STEPHENS) see abstract, page 1 para. 4 and figs.
X	1- 6, 8, 9, 10-19 & 20.	US 5406256 A (LEDEL et al) see abstract, cols. 2-4 and figs.
X	1-7, 9-16, 19 & 20.	US 3728675 A (HORN et al) see abstract, col. 3 lines 19-25, col. 5 lines 6-16 and fig. 6.
X	1-6, 8-16 & 18-20.	US 4952908 A (SANNER) see abstract, col. 3 and figs.
X	1-6 & 9-19.	US 5748083 A (RIETKERK) see abstract and figs. 1A & 1B.
X	1-5, 9-17, 19 & 21.	GB 2356077 A (BRIGGS) see abstract, page 10 lines 16-27 and page 16 lines 20-22.
A	-	GB 2343042 A (EVERETT)

Categories:

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.

Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC^{W} :

G4N

Worldwide search of patent documents classified in the following areas of the IPC[07]

B60R; B62H; E04H; G08B

The following online and other databases have been used in the preparation of this search report

WPI, EPODOC, PAJ.