APPARATUS AND METHODS FOR PROTECTING VALUABLES

Cross Reference to Related Application

[0001] This application claims priority from US application No. 60/___,___ filed on 24 January, 2003, which is hereby incorporated by reference herein.

Technical Field

[0002] The invention relates to apparatus and methods for detecting when an object is disturbed and generating an alarm in response thereto. The invention has general application to protecting valuables. Some embodiments of the invention are applied to protect laptop computers or other portable electronic devices.

Background

[0003] The theft or loss of valuable belongings is a problem, especially for those who need to leave or use such valuable belongings in public areas. Valuables may be stolen or tampered with if left unattended even for short periods. A person's valuables can be exposed to risk by common events such as when the person goes to the washroom, takes time away from the office for lunch or coffee, travels by car, bus, train or airplane, or checks into a hotel. Items from purses, briefcases, luggage, wallets, cellular phones, Personal Digital Assistants (PDAs), digital cameras, music players, Liquid Crystal Displays (LCDs), LCD projectors, and laptop computers are just some of the small, but valuable, items that thieves are targeting today.

[0004] The theft of a laptop computer can be particularly costly because laptop computers often store information that is confidential and/or very difficult to recreate. More and more laptop computers are used each year as mobile computing replaces conventional desktop computers. Over 100 million laptops are in use worldwide and laptop sales have been continuously increasing. In 2002 alone, notebook computer sales increased by 11% while more portable computers such as PC tablets were introduced to the market. Correspondingly, theft of laptop computers has also been increasing year by year. Last year, more than 640,000 laptops were stolen, resulting in a $60 billion loss in both hardware and stored software and data. Roughly 65% percent of the total thefts occurred on the road and in airports while 29% took place at the office.

[0005] Guarding against the theft of portable valuables, and particularly portable computers and other electronic devices is a major issue that has yet to be appropriately addressed. Current anti-theft solutions and theft deterrent systems range from passive devices, such as tethers which can be used to lock a computer to a desk or table, to more complex separation detectors, 2-way signaling devices, and motion alarms.

[0006] Motion alarms can be triggered by an authorized user of the device if the user forgets to disarm the motion alarm before moving the valuable.

[0007] 2-way signaling devices extend the capability of monitoring a valuable further by allowing a user to screen signals and get feedback from the valuable. However, these devices are often complex and are undesirably hard to use.

[0008] Scholder, US Patent 5,578,991 discloses a security system for a portable personal computer. The security system includes a sensor which detects when the computer is moved away from an object, such as the surface of a table on which the computer is sitting. The sensor is connected to trigger an alarm.

[0009] Andrews US patent 5,757,271 discloses a security system for a portable computer. A security device detects whether or not a second electronic device is nearby. In response to a detection that the second electronic device is not nearby a signal is generated indicating that a security violation has occurred. In one embodiment, wireless signals having an effective range equal to the selected proximity are transmitted from the second electronic device to the first electronic device. The security device determines that the first electronic device is not within the selected proximity of the second electronic device in response to a failure to receive the wireless signals.

[0010] D'Angelo , et al. US patent 5,963,131 discloses a motion sensitive theft detector system for portable articles featuring two way communication between the theft detector unit installed in or affixed to a portable article and a control unit carried by the owner. The theft detector communicates alerts to the control unit allowing the user to screen for

false alarms and to trigger an alarm at the portable article when warranted.

[0011] D'Angelo , et al. US patent 6,133,830 discloses a motion sensitive theft detector system for portable articles featuring two way communication between the theft detector unit installed in or affixed to the portable article and the control unit carried by the owner. The theft detector communicates alerts to the control unit allowing the user to screen for false alarms and to trigger an alarm at the portable article when warranted.

[0012] There remains a need for practical cost effective theft-deterrent devices and methods.

Summary of the Invention

[0013]

[0014] Further aspects of the invention and features of specific embodiments of the invention are described below.

Brief Description of the Drawings

[0015] In drawings which illustrate non-limiting embodiments of the invention,

Figure 1 is a block diagram of apparatus according to a basic embodiment of the invention;

Figure 1A is a block diagram of apparatus more fully featured than the apparatus of Figure 1;

Figure 2 is a flowchart illustrating a process performed at a base unit of one embodiment of the invention;

Figure 3 is a flowchart illustrating a process performed at a remote unit cooperating with a base unit operating under the process of Figure 2;

Figure 4 is a schematic illustration showing a base unit having a cable lock;

Figure 5 is a flow chart illustrating a process for turning on a base unit in some embodiments of the invention; and,

Figure 6 is a flow chart illustrating a process for turning on a remote unit and turning off both a remote unit and a corresponding base unit in some embodiments of the invention.

Description

[0016] Throughout the following description, specific details are set forth in order to provide a more thorough understanding of the invention. However, the invention may be practiced without these particulars. In other instances, well known elements have not been shown or described in detail to avoid unnecessarily obscuring the invention. Accordingly, the specification and drawings are to be regarded in an illustrative, rather than a restrictive, sense.

[0017] The invention will be described with reference to example systems and methods for alerting a person when an item in their charge is tampered with and/or moved. Apparatus **10** according to a general embodiment of the invention is shown in Figure 1. A valuable item, **12**

for example, a portable computer, is equipped with one or more sensors **13**. Sensors **13** detect disturbance (e.g. movement or tampering) of item **12**. In some embodiments of the invention, sensor **13** comprises one or more tilt sensors, accelerometers, touch sensors, optical sensors or the like.

[0018] An alarm **14** is coupled to receive signal(s) from sensor **13**. The alarm is triggered when sensor **13** generates a disturbance signal which indicates that item **12** is being disturbed (e.g. tampered with and/or moved). The alarm is inhibited when a wireless signal from a remote unit **15** indicates that the remote unit is near to item **12**. In the embodiment of Figure 1, an alarm inhibition mechanism **16** receives a wireless signal from remote unit **15**. As long as the wireless signal indicates that remote unit **15** is nearby (for example, as long as the signal is stronger than a threshold value) alarm inhibition mechanism **16** inhibits alarm **14**. Alarm inhibition mechanism **16** may comprise, for example, an electronic circuit; a software process being executed by a data processor; or some combination thereof.

[0019] In some embodiments of the invention, apparatus **10** includes a transmitter **17** that transmits a notification signal to a receiver **18** in remote unit **15** when alarm **14** is triggered. In such embodiments, receiver **18** may be connected to trigger an alarm indicator **19** when the notification signal is detected. Alarm indicator **19** may comprise an audible, visual or tactile warning device, for example.

[0020] Apparatus **10** can be used simply. A user can keep remote unit **15** on his or her person. While the user remains near item **12**, alarm inhibition mechanism responds to the proximity of remote unit **15** and inhibits the operation of alarm **14**. The user can move and use item **12** without raising an alarm. If the user leaves the vicinity of item **12**, alarm inhibition mechanism **16** ceases to inhibit the operation of alarm **14**. While the user remains away from the immediate vicinity of item **12**, any disturbance detected by sensors **13** will trigger alarm **14**. If apparatus **10** includes a mechanism for transmitting a notification signal to remote unit **15** then alarm indicator **19** warns the user that an alarm has been triggered, even if the user is not in the immediate vicinity of item **12**.

[0021] An advantage of this embodiment of the invention is that the operation of apparatus **10** is simple for the user. The user does not need to manually arm and disarm apparatus **10** to switch alarm **14** between its enabled and disabled modes.

[0022] The components of apparatus **10** that are collocated with item **12** may be integrated with item **12** or may be combined in a base unit which can be attached to item **12**.

[0023] Figure 1A shows a system **20** according to a more fully featured embodiment of the invention. System **20** includes a base unit **21** and a remote unit **22**. Remote unit **22** may be carried by a user. Base unit **21** may be affixed to a valuable to be protected.

[0024] Base unit **21** includes a control circuit, which may conveniently comprise a microcontroller **24**. Microcontroller **24**, may comprise a suitable microcontroller chipset that allows for software programs to be stored and executed. In the alternative, the control circuit could comprise logic circuits which are configured specifically to provide one or more of the functions described herein. Such logic circuits could be provided on an application specific integrated circuit (ASIC), a field programmable gate array (FPGA) or by way of discrete components, for example.

[0025] In the embodiment of Figure 1A, microcontroller **24** includes a clock, a central processing unit (CPU), random access memory (RAM), and read only memory (ROM) which may be on one or more chips. Base unit **21** also includes a motion sensor circuit **25**, an alarm circuit **23**, an ON control **26**, and a two-way wireless communication mechanism.

[0026] In the illustrated embodiment, the communication mechanism comprises an RF transceiver which includes a transmitter **28** and a receiver **27**. The transmitter **27** and receiver **28**, can be provided conveniently by the transmitter and receiver portions of a commercially available RF transceiver. These components could also be made up of discrete components. Any suitable communication protocol may be used for signalling between base unit **21** and remote unit **22**. In some embodiments, digital data is exchanged between base unit **21** and remote unit **22**. In some embodiments data is communicated by sending a low power RF signal that includes preamble data bits that allow other

receivers to lock onto the frequency of transmission of transmitter **28**, an identifier comprising a sequence of bits unique to one remote unit **22**, and instruction bits which remote unit **22** can process.

[0027] Motion sensor circuit **25** includes one or more sensors. The sensors may include one or more:

- tilt switches;
- vibration sensors;
- accelerometers;
- proximity detectors;
- capacitive sensors;
- mechanical switches located to change state when the base unit is lifted away from a surface on which it is sitting;
- light detectors; and/or
- other sensors or combinations of sensors capable of generating an output signal indicative that base unit **21** is being moved, tampered with of otherwise disturbed.

[0028] An disturbance signal from motion sensor circuit **25** is provided to microcontroller **24**. Any suitable mechanism may be used to provide the disturbance signal to microcontroller **24**. For example, sensor circuit **25** could be configured to:

- set a flag, for example by writing a value to a data register;
- trigger an interrupt sequence in the microcontroller **24**;
- set a control line to a current or voltage level indicative of an alarm condition;
- or the like.

[0029] Siren circuit **23**, includes any suitable audible and/or visual alarm generator together with any necessary driving circuits.

[0030] ON control **26**, may comprise a pushbutton or other input mechanism coupled to a circuit which causes base unit **21** to power up.

[0031] Remote unit **22** includes a control circuit. The same general design options available for the control circuit of base **21** are also available for the control circuit of remote unit **15**. In the illustrated remote unit **22** a microcontroller **33** provides control functions.

[0032] Remote unit **22** also includes a notification circuit **34**, an ON/OFF control **31**, a DISARM control **32**, and a two-way wireless communication mechanism compatible with the wireless communication mechanism of base unit **21**. In the illustrated embodiment, the communication mechanism of remote unit **22** comprises a transmitter **30** capable of broadcasting a wireless signal which can be received by receiver **27** of base unit **21** and a receiver **29** capable of receiving signals broadcast by transmitter **28** of base unit **21**.

[0033] The signals exchanged by the wireless communication mechanism are preferably encoded. The use of encoded signals allows several systems **20** to operate in the same vicinity even if the wireless communication mechanisms of the systems operate at the same frequencies. Encoding and decoding of signals exchanged between remote unit **22** and base unit **21** may be performed by microcontrollers

24 and **33** or, in the alternative, by separate encoder / decoder systems. Microcontrollers **24** and **33** may be configured to ignore signals that are not encoded in the manner associated with the corresponding unit **21** or **22**.

[0034] Notification circuit **34** comprises a device for alerting a user carrying remote unit **22**. Remote unit **22** may include a sound-emitting device such as a speaker or buzzer, a light emitting device, a tactile device, such as a vibrator, and any circuitry necessary to drive the device.

[0035] ON/OFF control **31** and DISARM control **32** each comprise a suitable input mechanism, such as a pushbutton, which can be activated by a user.

[0036] When system **20** is off, it can be turned on by actuating ON control **26** on base unit **21** and actuating ON/OFF control on remote unit **22**. It is noteworthy that, in the illustrated embodiment, there is no control on base unit **21** for turning system **20** off. System **20** can be turned off by actuating ON/OFF control **26** of remote unit **15**. This makes it difficult for a malicious individual to interfere with the proper operation of system **20** by turning off base unit **21**.

[0037] System **20** may include a soft switch mechanism which controls switching both remote unit **22** and the base unit **21** between their active modes and standby modes. The soft switch mechanism may use both software and hardware circuitry to accomplish its task. Figures 5

and 6 illustrate methods performed by an example embodiment of such a soft switch mechanism at the base unit and remote unit respectively. As shown in Figure 5, activating ON control **26** moves process **80** from block **81** to block **82**. Block **82** causes power to be supplied to microcontroller **24** and other circuits of base unit **21**. After process **80** has left block **81**, activating the ON control **26** additional times has no effect. Process **80** then waits to receive an off signal **83** from remote unit **22**. When an OFF signal (encoded in the expected manner) is received by way of receiver **27**, process **80** moves to block **84** which causes power to microcontroller **24** and other circuits of base unit **21** to be being turned off. Base unit **21** can be turned off only by way of remote unit **22** .

[0038] Figure 6 illustrates a process **90** which is invoked when remote unit **22** is off and ON/OFF control **31** is actuated by a user in block **91**. Operation of ON/OFF control **31** causes power to be supplied to microcontroller **33** and other circuits of remote unit **22** in block **92**. Process **90** then moves to block **93** where it remains until the user operates ON/OFF control **31** again. Preferably, block **93** requires the user to keep ON/OFF control **31** actuated for at least a short while. This reduces the likelihood that the user could accidentally turn system **20** off.

[0039] When block **93** detects that ON/OFF control **31** has been actuated for a sufficient time, process **90** moves to block **94**. The exact time for which ON/OFF control **31** must be actuated is not critical. The time is chosen to be longer than any anticipated accidental actuations of ON/OFF control **31**. In block **94**, process **90** sends an OFF signal to base unit **21** by way of transmitter **30** (assuming that base unit **21** is on and

process **80** is on block **83** the OFF signal causes base unit **21** to turn off). Process **90** then completes at **95** by turning the power off to remote unit **22**.

[0040] When system **20** is operating, programs running on microcontrollers **24** and **33** cause signals to be exchanged periodically between base unit **21** and remote unit **22**. From the signals received at base unit **21**, microcontroller **24** can determine when remote unit **22** is nearby. The signals sent by base unit **21** to remote unit **22** may include signals which indicate that sensor system **25** has detected disturbance. The signals sent by remote unit **22** to base unit **21** may include OFF signals, and/or other control signals.

[0041] During normal operation, each of remote unit **22** and base unit **21** expect to periodically receive a coded signal from the other every so often.

[0042] Figure 2 illustrates a flowchart for an operating process **40** performed by microcontroller **24** of base unit **21** in one embodiment of the invention. Process **40** commences at block **41** when microcontroller **24** is either powered up or woken up from a low-power idle mode. Once microcontroller **24** is activated, process **40** proceeds to step **42** where receiver **27** is set to receive mode for a short period of time. While receiver **27** is in receive mode, microcontroller **24** processes any received bits and checks to see if a valid signal from the corresponding remote unit **22** has been received. If such a signal is received then block **43** uses the signal to determine whether or not remote unit **22** is nearby.

[0043] Block **43** may include generating a request signal at transmitter **28** which, when received by remote unit **22** causes remote unit **22** to automatically transmit a ranging signal. The ranging signal may be used by base unit **21** to determine whether or not remote unit **22** is nearby as described above.

[0044] Various methods can be used to determine whether remote unit **22** is nearby. These include:

- Sending a low power ranging signal from remote unit **22** to base unit **21**. If the low power signal is successfully received then block **43** concludes that remote unit **22** is nearby. If the low power signal is not received then block **43** concludes that remote unit **22** is not nearby. The power of the low-power signal sent by remote unit **22** and/or the sensitivity of receiver **27** may be set to adjust the maximum distance at which the low-power signal can be received by base unit **21**. The low power ranging signal may have the same or a different power level than other signals exchanged between base unit **21** and remote unit **22**.
- At base unit **21** measuring the strength of a signal originating from remote unit **22** and comparing the measured signal strength to a threshold value. Since signal strength falls off with distance, the remote unit **22** can be considered to be nearby if the signal strength exceeds the threshold value. Any or all of the threshold value, the strength of the transmitted signal, and an attenuation of the received signal prior to measuring the signal strength may be

varied to adjust the maximum distance at which the received signal strength can exceed the threshold.

[0045] If block **43** determines that the remote unit is nearby then process **40** proceeds to sleep **44**. In the alternative, if process **40** does not determine that the remote unit **22** is nearby then process **40** proceeds to block **45**. In block **45**, base unit **21** sends a reminder signal to remote unit **22** the reminder signal is sent by way of transmitter **28**. When remote unit **22** receives the reminder signal, microcontroller **33** causes a reminder action to be generated at remote unit **22**. The reminder action may comprise generating a tone or other audible signal, flashing or blinking an indicator light, vibrating slightly or the like. The reminder action reminds the person carrying remote unit **22** that the base unit **21** and associated valuable have been left behind. This feature enables the user to be notified with a subtle beep or visual queue once they are separated from their valuable, in case they simply forgot to bring it with them.

[0046] Process **40** now proceeds to block **47**. In block **47** microcontroller commences monitoring the output of sensor system **25** for signals indicative that base unit **21** has been moved or tampered with. If no motion or tampering is detected, process **40** goes back to sleep in block **44**.

[0047] If motion or tampering is detected in block **47**, base unit **21** sends a notification signal by way of transmitter **28**. The notification signal is received by remote unit **22** if remote unit **22** is not too far away.

When remote unit **22** receives the notification signal, remote unit **22** generates a notification action distinct from the reminder action. The notification action may comprise an audio, visual or tactile signal or a combination thereof.

[0048] Base unit **21** also initiates a timer (block **49**) in response to detecting the motion or tampering. The timer provides the person who has remote unit **22** with an opportunity to disarm base unit **21** before alarm **23** sounds, and thereby avoid an undesired alarm from being issued by base unit **21**. Process **40** then places base unit **21** in receive mode (block **50**) and loops around blocks **51** and **52** until the timer expires or a DISARM signal is received from remote unit **22**. If block **51** detects a DISARM signal before the timer expires then process **40** proceeds to sleep **44**. If block **52** determines that the timer has expired then process **40** proceeds to block **53** which activates siren **23**.

[0049] After turning on siren **23**, process **40** causes receiver **27** to listen for a DISARM signal from remote unit **22** in block **55**. When the DISARM signal is received then base unit **21** turns siren **23** off at block **56**. After turning the siren off, microcontroller **24** and transceiver (**27** and **28**) enter sleep mode once again at **44**.

[0050] Process **40** operates on base unit **21** which operates in conjunction with remote unit **22**. A software program executing on microcontroller **33** may coordinate the operation of remote unit **22**. A process **60** that may be followed by such a program is illustrated in Figure Figure 3. Process **60** commences at block **61** where

microcontroller **33** is either powered up or woken up from a low power idle mode.

[0051] Process **60** then proceeds to block **62** wherein it controls transmitter **30** to transmit a RF signal at low power and then proceed immediately to place receiver **29** into receive mode at block **63**. If, during this receive mode, receiver **29** detects a reminder signal from base unit **21,** as indicated by block **64** then process **60** proceeds to block **65** which generates the reminder action (e.g. a short indicator from notification circuit **34**). Process **60** then proceeds to block **66** which causes microcontroller **33** to go to sleep **66**.

[0052] If block **67** determines that a notification signal has been received (i.e a signal indicating that movement or tampering have been detected at base unit **21** then process **60** proceeds to block **68**. At block **68**, the notification action is performed (e.g. notification circuit **34** is turned fully on).

[0053] After the notification action has been initiated, process **60** checks in block **69** to see if the user has actuated DISARM control **32**. If so, then a DISARM signal is sent by way of transmitter **30** at block **70**. The notification action is discontinued at block **71**. If block **69** does not detect that the user has actuated DISARM control **32** then process **60** remains at block **69**.

[0054] Base unit **12** may be associated with a valuable item to be protected in any of various ways. For example, in various embodiments:

- Base unit **21** includes a lock which allows it to be physically attached to devices like laptops, liquid crystal display monitors, and projectors. The lock may engage a security slot (one example being a Kensington slot), a PC card interface of a computer, a PC Universal Serial Bus port of a computer, a floppy disk drive of a computer or the like.
- Base unit **21** is integrated into a valuable item to be protected - for example as part of a motherboard of a laptop computer. or
- Base unit **21** is affixed to a valuable item to be protected with a fastening means such as screws, bolts, rivets, an adhesive, or the like.

Figure 4 shows a base unit **21** having a locking mechanism **19** according to one embodiment of the invention. Locking mechanism **19** may comprise a cable lock and may be adapted to lockingly engage a security slot of the type sometimes provided on laptops, LCDs, and LCD projectors and the like.

[0055] Base unit **21** and remote unit **22** may each have an internal power supply **129**, typically a battery. In many applications of the invention it is desirable to make base unit **21** and remote unit **22** lightweight for easy portability. In such cases power management is important because there is a limit to the capacity of lightweight batteries. Power consumption can be minimized, by having microcontrollers **24** and **33** spending significant proportions of the time in sleep modes.

[0056] There are a wide range of suitable mechanisms for causing a microcontroller to wake up periodically from a low power (or “sleep”)

mode to perform a necessary process and then return to the low power mode. For example:

- A software timer may operate while the processor is in sleep mode. The software timer may interrupt the microcontroller (**24**, **33**) when it is time to wake up.
- A separate timer, such as a digital logic counter coupled to a system clock may be connected to pass an elapsed time signal to the microcontroller or to another part of the circuit. For example, a microcontroller might set the timer to expire after a certain period of time. Upon the time period ending the timer could cause a flag to be set or send a signal to some circuitry indicating that time has expired.

[0057] By operating microcontrollers and/or other circuits at full power only some of the time, overall power consumption can be significantly reduced. In some cases, power can be on less than half of the time, and in another case it can be on for only a quarter of the time, and in yet another case can be on for less than an eighth of the time, and so on.

[0058] Power can further be conserved by operating transceivers of the base unit and remote unit to exchange information according to a protocol that minimizes the amount of time that the transceivers are operating and especially minimizes transmitting operations.

[0059] Certain implementations of the invention comprise computer processors which execute software instructions which cause the

processors to perform a method of the invention. For example, one or more processors in a base unit may implement the methods of Figure 2 by executing software instructions in a program memory accessible to the processors. The invention may also be provided in the form of a program product. The program product may comprise any medium which carries a set of computer-readable signals comprising instructions which, when executed by a computer processor, cause the data processor to execute a method of the invention. Program products according to the invention may be in any of a wide variety of forms. The program product may comprise, for example, physical media such as magnetic data storage media including floppy diskettes, hard disk drives, optical data storage media including CD ROMs, DVDs, electronic data storage media including ROMs, PROMS, EPROMS, flash RAM, or the like or transmission-type media such as digital or analog communication links.

[0060] Where a component (e.g. a software module, processor, assembly, device, circuit, etc.) is referred to above, unless otherwise indicated, reference to that component (including a reference to a "means") should be interpreted as including as equivalents of that component any component which performs the function of the described component (i.e., that is functionally equivalent), including components which are not structurally equivalent to the disclosed structure which performs the function in the illustrated exemplary embodiments of the invention.

[0061] As will be apparent to those skilled in the art in the light of the foregoing disclosure, many alterations and modifications are possible

in the practice of this invention without departing from the spirit or scope thereof. For example:

- Alarm inhibition circuit **16** could inhibit triggering of alarm **14** or, in the alternative, could inhibit the effect of alarm **14**, for example, by silencing audible warnings and/or disabling visual alarm displays provided by alarm **14**.
- In addition to sounding an alarm upon a possible theft attempt, base unit **21** could be configured to activate or protect the valuable further by locking down peripherals of a laptop, encrypting data, connecting to a global positioning system in order to track the valuable or the like.
- The invention is not limited to use in protecting inanimate valuable items. The methods and components described herein may also be used for monitoring pets or children. For example, a base unit **21** could be incorporated into a bracelet to be worn by a child or a collar to be worn by a pet.
- The signals exchanged between a base unit and a remote unit do not need to be radiofrequency signals. Other types of wireless signals, such as ultrasonic signals could be used in the alternative.
- It is not mandatory that the same type of signals used to carry information (e.g. OFF signals, DISARM signals, REMINDER signals, NOTIFICATION signals) be used to determine when remote unit **22** is near to base unit **21**. For example, an ultrasonic signal could be used for ranging while radiofrequency signals are used to carry information receivers in the base and/or remote units may include receivers for different signal types.

- Signals used to carry information between a base unit and remote unit may have different strengths, frequencies, formats etc. from signals used to determine when the corresponding remote unit is nearby to a base unit. In some embodiments low strength ranging signals are used for determining whether the remote unit is nearby to the base unit and some or all of the information carrying signals have significantly greater ranges than the ranging signals.
- Ranging signals could also be used to carry information between a base unit and a remote unit or vice versa.
- In some of the embodiments described above, a low strength ranging signal is sent from the remote unit to the base unit. The base unit knows that the remote unit is nearby if it receives the low strength ranging signal. The invention could also be practised by sending a low strength ranging signal from the base unit to the corresponding remote unit. The remote unit could be configured to generate a reply signal upon detecting the low strength ranging signal. In such embodiments the base unit would know that the remote unit is nearby if it receives reply signals in response to its low strength ranging signals.
- ON/OFF control **31** may be replaced with separate ON and OFF controls.
- The frequencies of signals used by a system do not need to be fixed. The system may have the capability to vary the operating frequency to prevent interference from other products working in the same RF band or signal frequency.

Accordingly, the scope of the invention is to be construed in accordance with the substance defined by the following claims.

WHAT IS CLAIMED IS:

1. A valuables monitoring system comprising:

a disturbance detection mechanism comprising one or more sensors configured to generate a disturbance signal upon disturbance of an item being monitored;

an alarm connected to be triggered by the disturbance signal;

a receiver configured to receive a wireless signal from a remote unit;

an alarm inhibition mechanism connected to selectively inhibit operation of the alarm, the alarm inhibition mechanism including a mechanism responsive to signals from the remote unit received at the receiver to automatically inhibit the alarm if the received signals indicate that the remote unit is nearby.

2. A valuables monitoring system according to claim 1 wherein the disturbance detection mechanism, alarm, receiver and alarm inhibition mechanism are packaged in a base unit and the system comprises a lock for attaching the base unit to the item being monitored.

3. A valuables monitoring system according to claim 2 comprising a connector for attaching the base unit to a security slot of the item.

4. A valuables monitoring system according to claim 2 wherein the item comprises a computer and the base unit comprises an

interface for coupling the base unit to a PC card interface of the computer.

5. A valuables monitoring system according to claim 2 wherein the item comprises a computer and the base unit comprises an interface for coupling the base unit to a universal serial bus port of the computer.

6. A valuables monitoring system according to claim 1 wherein the disturbance detection mechanism, alarm, receiver and alarm inhibition mechanism are integrated within the item being monitored.

7. A valuables monitoring system according to claim 1 comprising a timer connected to delay the application of the disturbance signal to the alarm by a delay period.

8. A valuables monitoring system according to claim 7 wherein the base unit is configured to detect DISABLE signals originating at the remote unit and to disable the alarm upon receipt of a DISABLE signal.

9. A valuables monitoring system according to claim 1 wherein the base unit comprises a transmitter and is configured to transmit a notification signal upon occurrence of the disturbance signal.

10. A valuables monitoring system according to claim 4 wherein the base unit is configured to detect OFF signals originating at the remote unit and to turn itself off upon receipt of an OFF signal.

11. A valuables monitoring system according to claim 1 wherein the receiver comprises a radiofrequency receiver.

12. A valuables monitoring system according to claim 1 comprising a mechanism for comparing a strength of the wireless signal to a threshold, wherein the alarm inhibition mechanism is configured to inhibit the alarm while the strength of the wireless signal exceeds the threshold.

13. A valuables monitoring system according to claim 1 comprising a transmitter and a mechanism responsive to the receiver for causing the transmitter to send periodic REMINDER signals if received signals do not indicate that the remote unit is nearby.

14. A valuables monitoring system according to claim 1 wherein the alarm inhibition mechanism comprises a microcontroller interfaced to the disturbance detection mechanism, alarm and receiver.

15. A valuables monitoring system according to claim 2, wherein the base unit lacks an external control for turning off the base unit.

16. A valuables monitoring system according to claim 2 wherein the wireless signal is encoded in a manner associated with the remote

unit and the base unit includes a decoder configured to decode and pass wireless signals encoded in the manner associated with the remote unit.

17. A method for monitoring an item, the method comprising:

providing a base unit attached to the item and a remote unit;

detecting a proximity of the remote unit to the base unit and inhibiting an alarm if the remote unit is determined to be nearby the base unit;

detecting a disturbance of the base unit and, in response to the disturbance triggering the alarm unless the alarm is inhibited.

18. A method according to claim 17 comprising waiting for an interval after detecting the disturbance before triggering the alarm.

19. A method according to claim 18 comprising sending a notification signal from the base unit to the remote unit upon detecting the disturbance.

20. A method according to claim 19 comprising, at the remote unit, receiving the notification signal and performing a notification action detectable by a person carrying the remote unit in response to the notification signal.

21. A method according to claim 20 comprising, at the remote unit, receiving a control input and, in response to the control input

transmitting a DISABLE signal, and, at the base unit, receiving the DISABLE signal and deactivating the alarm in response thereto.

22. A method according to claim 17 comprising periodically transmitting a REMINDER signal from the base unit if the remote unit is determined to be not nearby to the base unit.

23. A method according to claim 22 comprising, at the remote unit, receiving the REMINDER signal and performing a reminder action detectable by a person carrying the remote unit in response to the REMINDER signal.

24. A method according to claim 17 wherein detecting the proximity of the remote unit comprises measuring at the base unit a strength of a ranging signal transmitted by the remote unit.

25. A method according to claim 24 comprising adjusting a strength of the ranging signal to vary a size of a region within which the remote unit is determined to be nearby to the base unit.

26. A method according to claim 17 wherein detecting the proximity of the remote unit comprises detecting at the base unit a ranging signal transmitted by the remote unit.

27. A method according to claim 26 comprising transmitting the ranging signal automatically upon receipt at the remote unit of a request signal from the base unit.

28. A method according to claim 26 wherein the request signal has a range greater than a range of the ranging signal.

29. A method according to claim 26 comprising adjusting a strength of the ranging signal to vary a size of a region within which the remote unit is determined to be nearby to the base unit.

30. A method according to claim 17 wherein detecting the proximity of the remote unit comprises transmitting a ranging signal from the base unit and, in response to detection of the ranging signal at the remote unit, automatically transmitting a reply signal.

Abstract of the Disclosure

A wireless valuables monitoring device, with proximity sensing and automatic arming and disarming features two way communication between the base unit affixed to the valuable and the remote unit carried by the owner. The base unit continuously monitors the position of the remote unit relative to itself to determine when the owner has left the immediate vicinity of the valuable. The base unit alerts the owner upon disturbance of the protected valuable and allows the user to screen for false alarms and be notified of an occurring theft attempt. A soft power switch enables the base unit to be powered off by the unique remote unit to which it belongs.

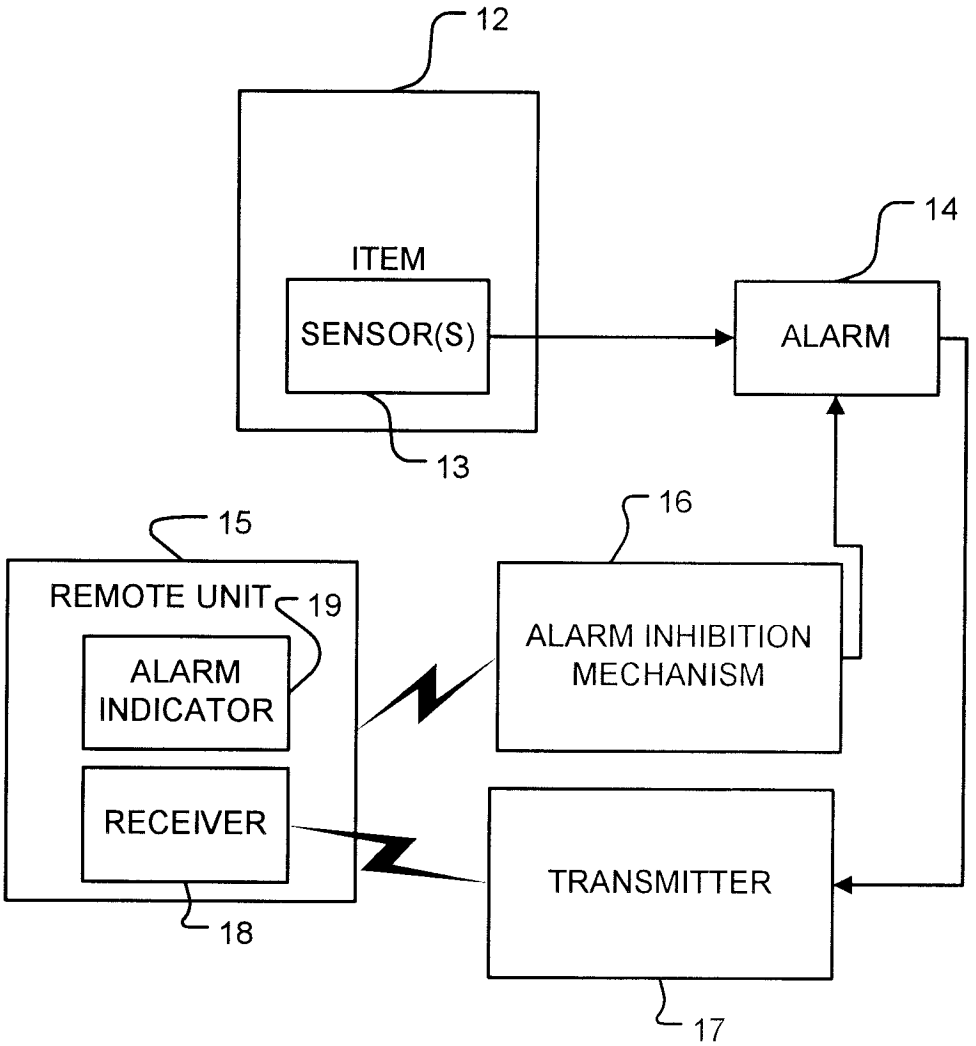
12
ITEM
SENSOR(S)
13
14
ALARM
15
REMOTE UNIT
19
ALARM
INDICATOR
RECEIVER
18
16
ALARM INHIBITION
MECHANISM
TRANSMITTER
17

FIGURE 1

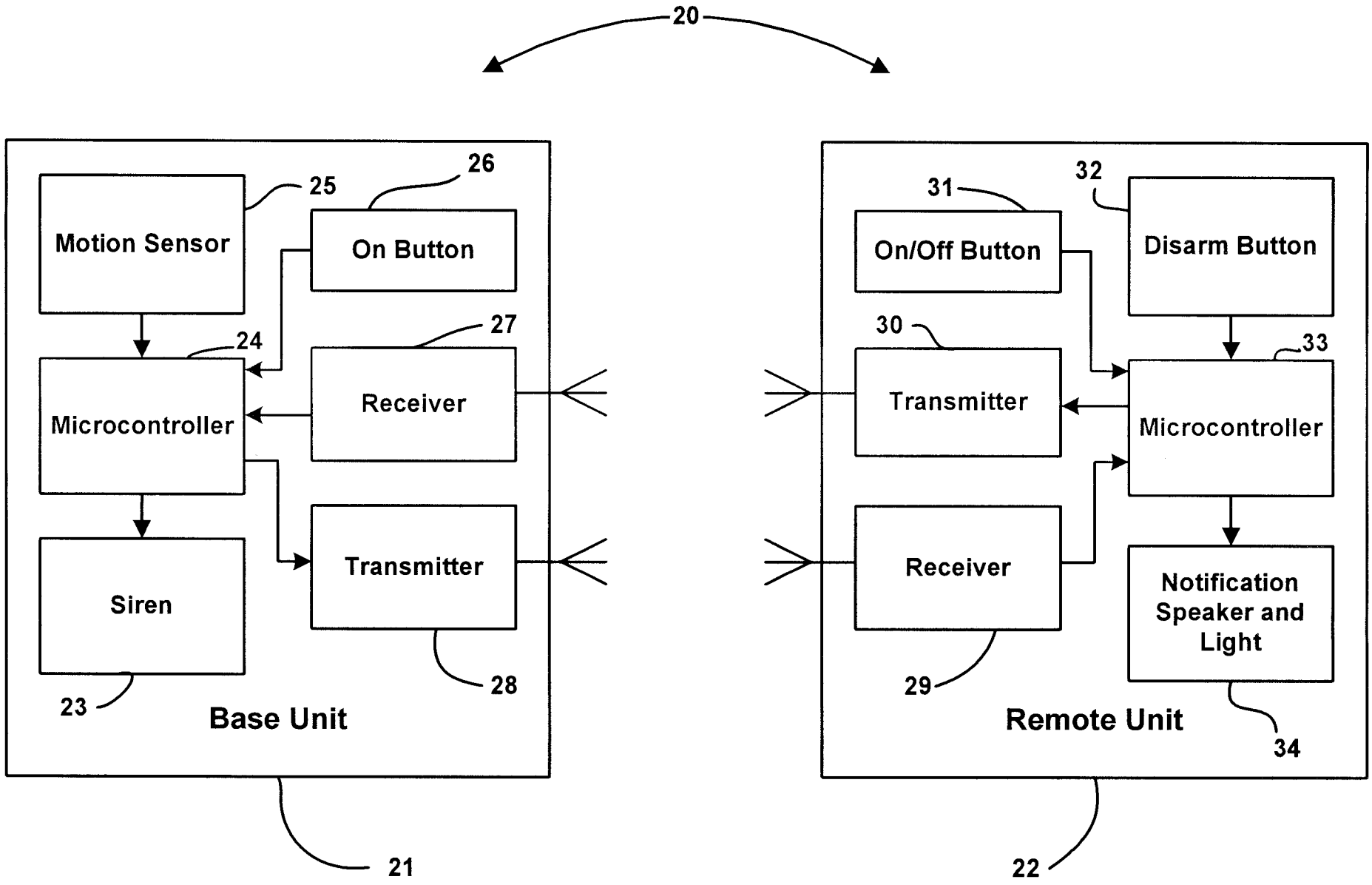
20
Motion Sensor
25
26
On Button
24
27
Microcontroller
Receiver
Siren
Transmitter
23
28
Base Unit
21
31
32
On/Off Button
Disarm Button
30
33
Transmitter
Microcontroller
Receiver
Notification Speaker and Light
29
Remote Unit
34
22

FIGURE 1A

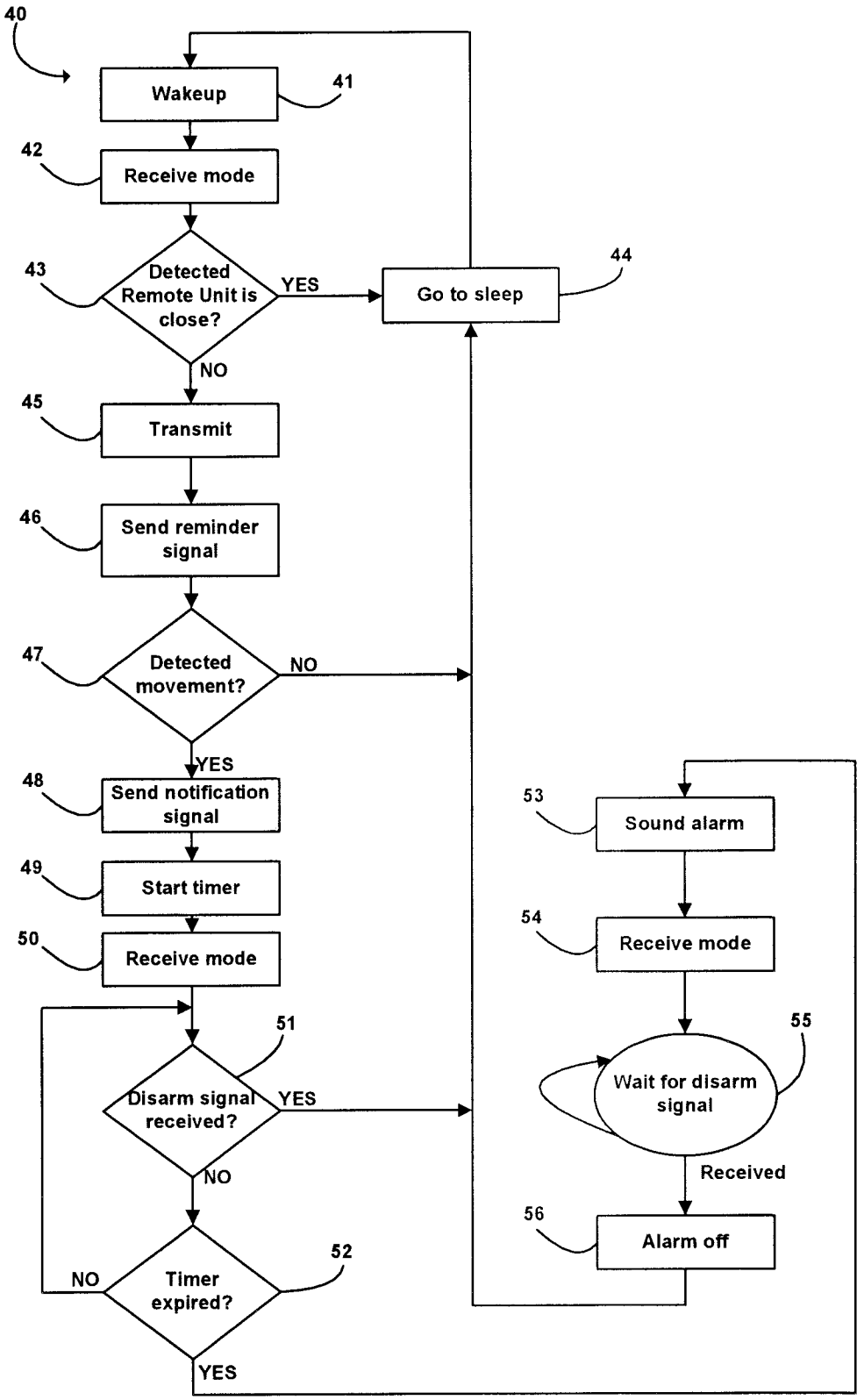
40
Wakeup
41
42
Receive mode
43
Detected Remote Unit is close?
YES
Go to sleep
44
NO
45
Transmit
46
Send reminder signal
47
Detected movement?
NO
YES
48
Send notification signal
49
Start timer
50
Receive mode
51
Disarm signal received?
YES
NO
NO
Timer expired?
52
YES
53
Sound alarm
54
Receive mode
55
Wait for disarm signal
Received
56
Alarm off

FIG. 2

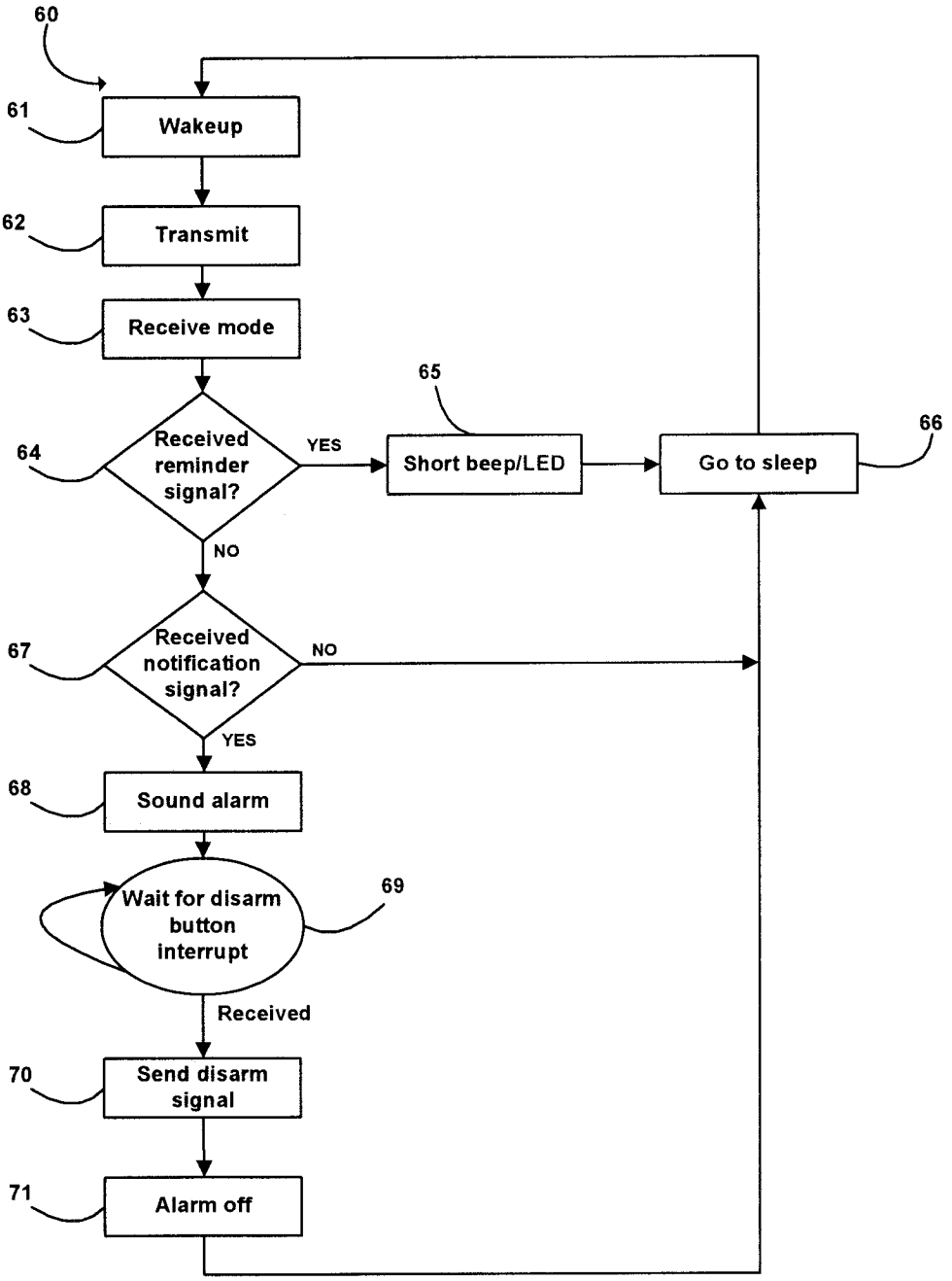
60
61
Wakeup
62
Transmit
63
Receive mode
64
Received reminder signal?
YES
65
Short beep/LED
66
Go to sleep
NO
67
Received notification signal?
NO
YES
68
Sound alarm
69
Wait for disarm button interrupt
Received
70
Send disarm signal
71
Alarm off

FIG. 3

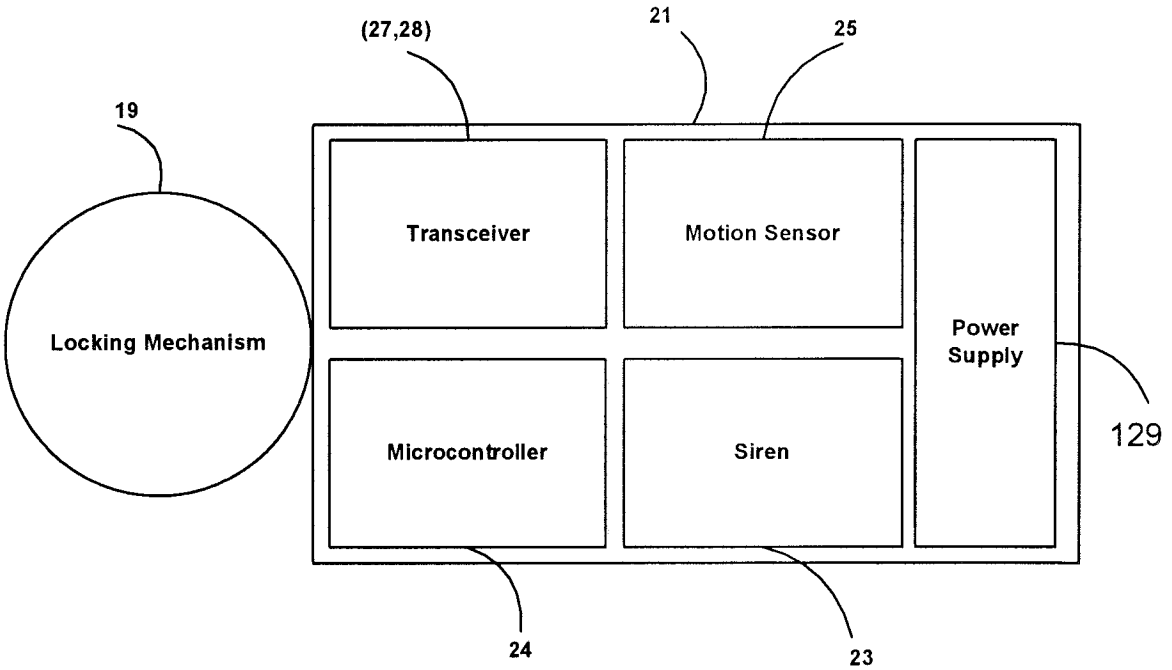
(27,28)
21
25
19
Transceiver
Motion Sensor
Power Supply
Locking Mechanism
129
Microcontroller
Siren
24
23

FIG. 4

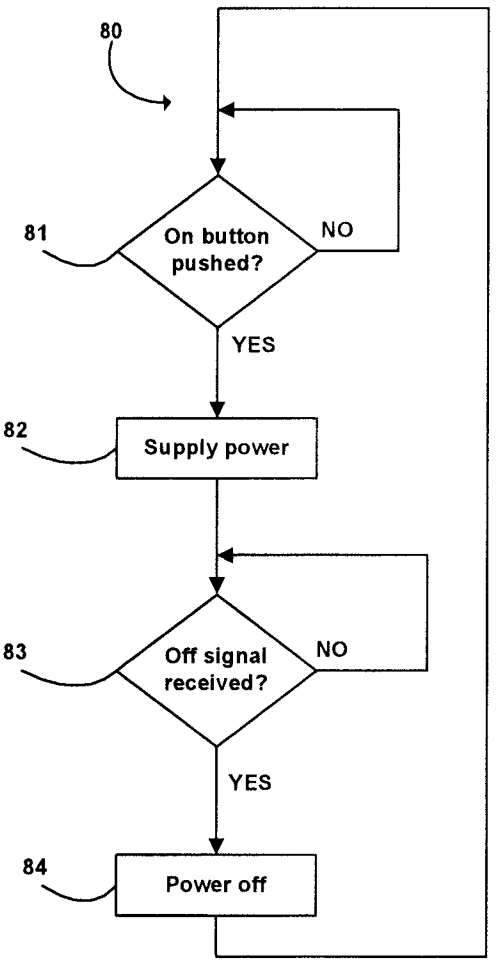
80
81
On button pushed?
NO
YES
82
Supply power
83
Off signal received?
NO
YES
84
Power off

FIG. 5

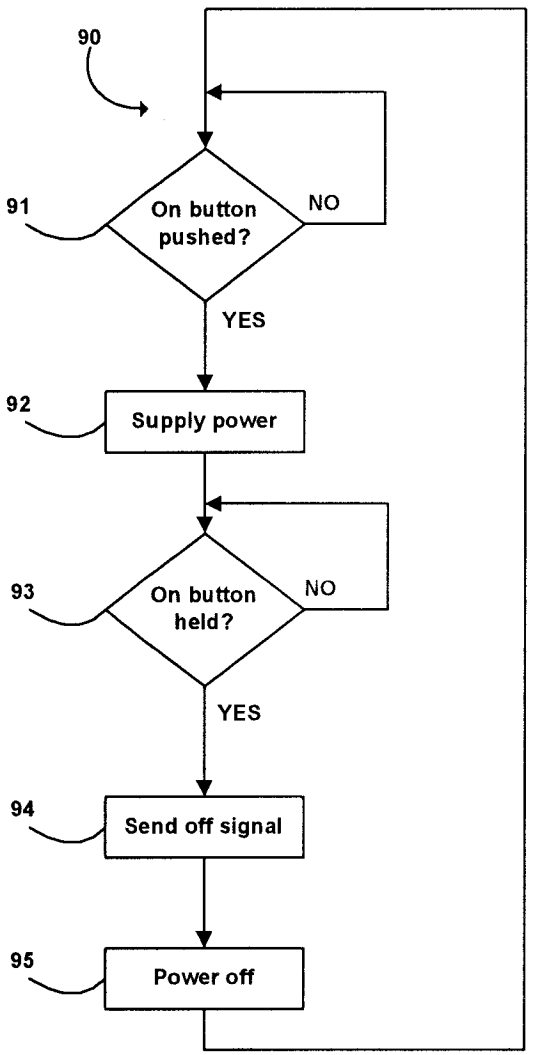
90
91
On button pushed?
NO
YES
92
Supply power
93
On button held?
NO
YES
94
Send off signal
95
Power off

FIG. 6