US 20040019258A1

(19) United States

(12) Patent Application Publication (10) Pub. No.: US 2004/0019258 A1

Kavounas et al. (43) Pub. Date: Jan. 29, 2004

(54) DETECTING REMOVAL OF A MEDICAL DEVICE FROM A STATION

(76) Inventors: **Gregory T. Kavounas**, Kirkland, WA (US); **Randy L. Merry**, Woodinville, WA (US); **Shawn R. Bertagnole**, Lake Stevens, WA (US)

Correspondence Address:
SHUMAKER & SIEFFERT, P. A.
8425 SEASONS PARKWAY
SUITE 105
ST. PAUL, MN 55125 (US)

(21) Appl. No.: **10/357,301**

(22) Filed: **Jan. 31, 2003**

Related U.S. Application Data

(60) Provisional application No. 60/394,981, filed on Jul. 9, 2002.

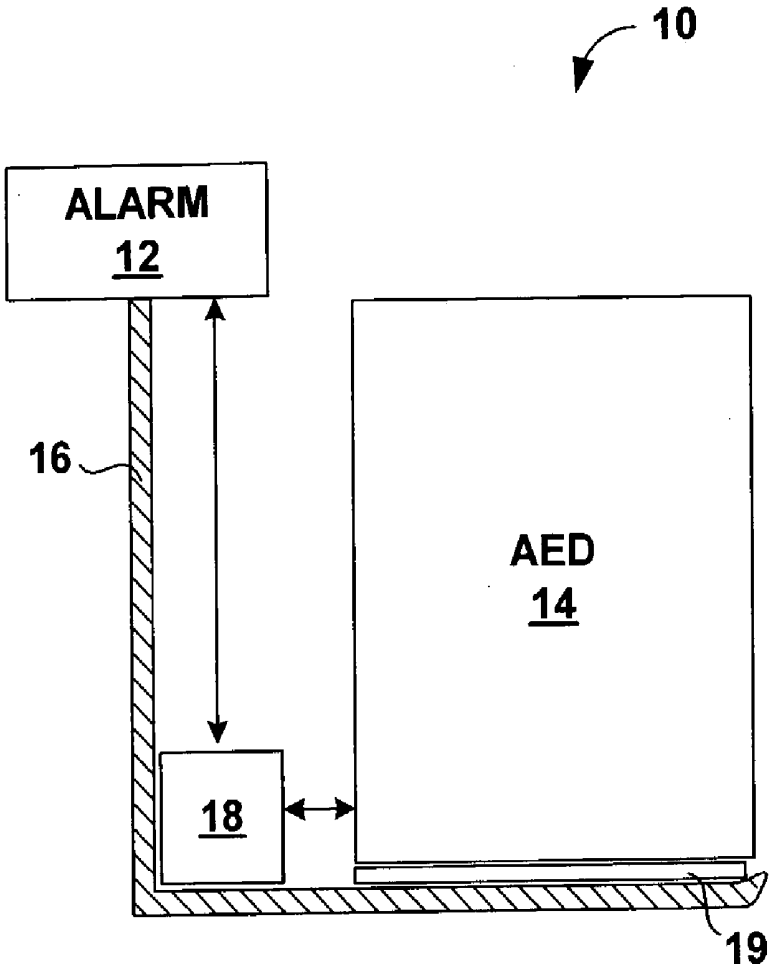
Publication Classification

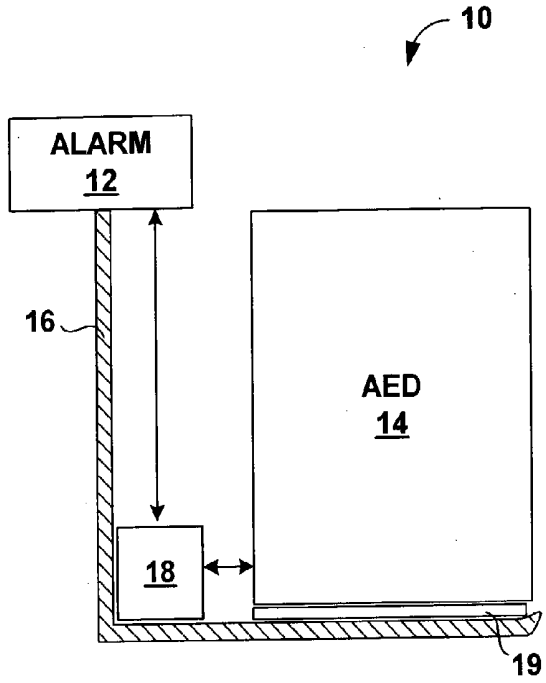
(51) **Int. Cl.**[7] **A61B 5/00**

(52) **U.S. Cl.** **600/300**; 600/594

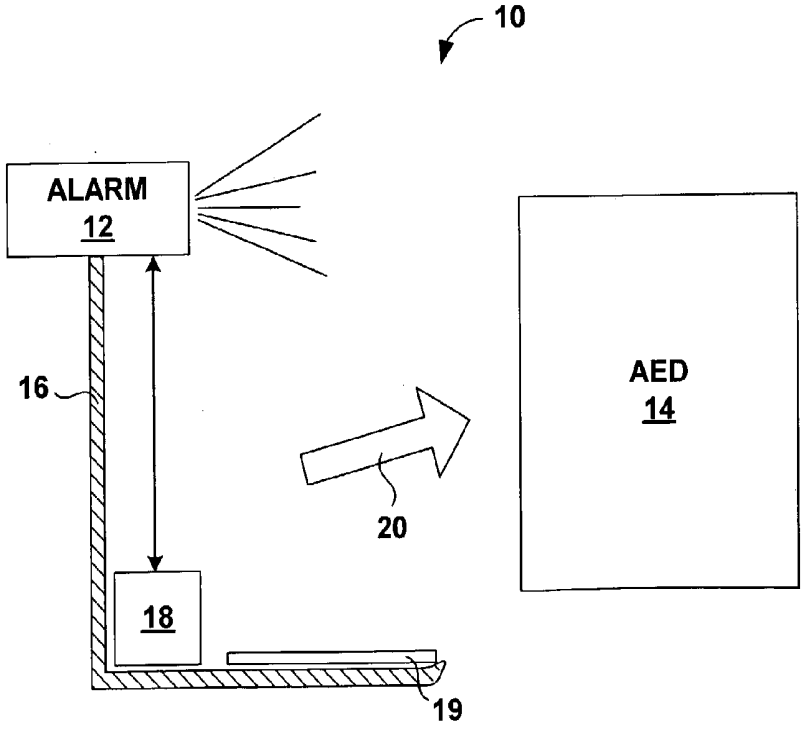
(57) **ABSTRACT**

Techniques are described for detecting removal of a medical device from a station and activating an alarm in response to the detected removal. More specifically, the station includes a detector that detects removal of the medical device and causes the alarm to activate upon detecting the removal. For example, the station may include an optical detector that receives an optical signal from a light transmitter on the medical device. When the optical detector does not receive a signal from the medical device, the optical detector sends a signal to activate the alarm. The optical detector may, for example, not receive an optical signal when the medical device is too far from the optical detector or oriented in an improper direction. The sensitivity of the detector may further be calibrated to allow different detection ranges to be defined for the station.





(A)



(B)

FIG. 1

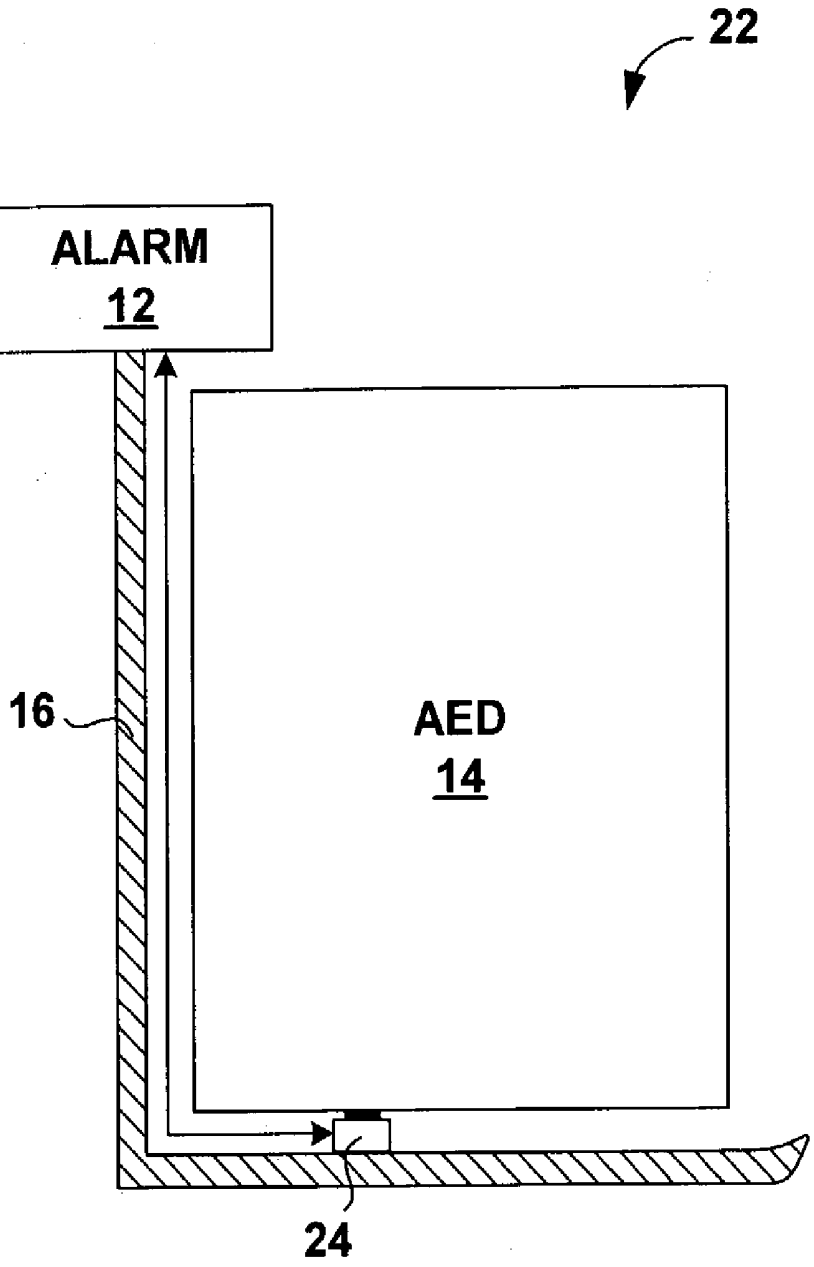


FIG. 2

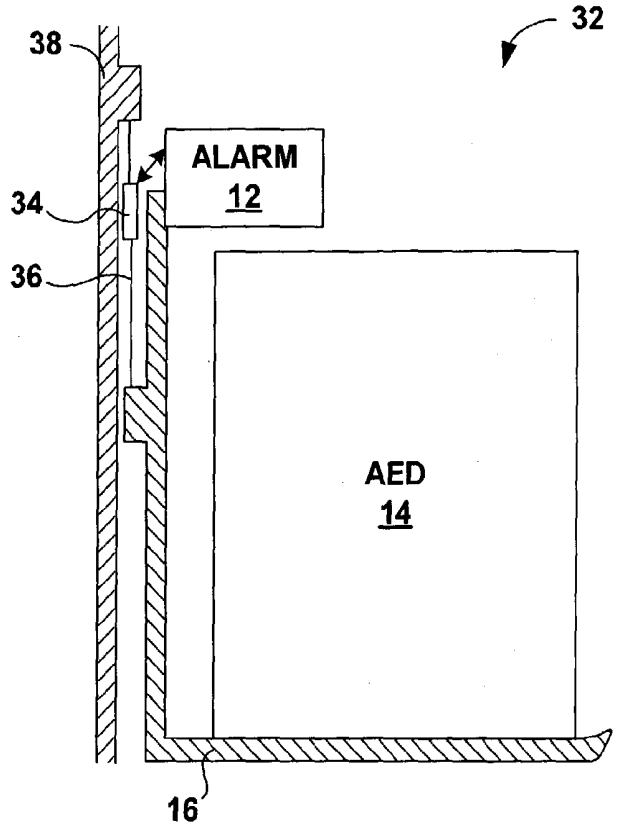


FIG. 3

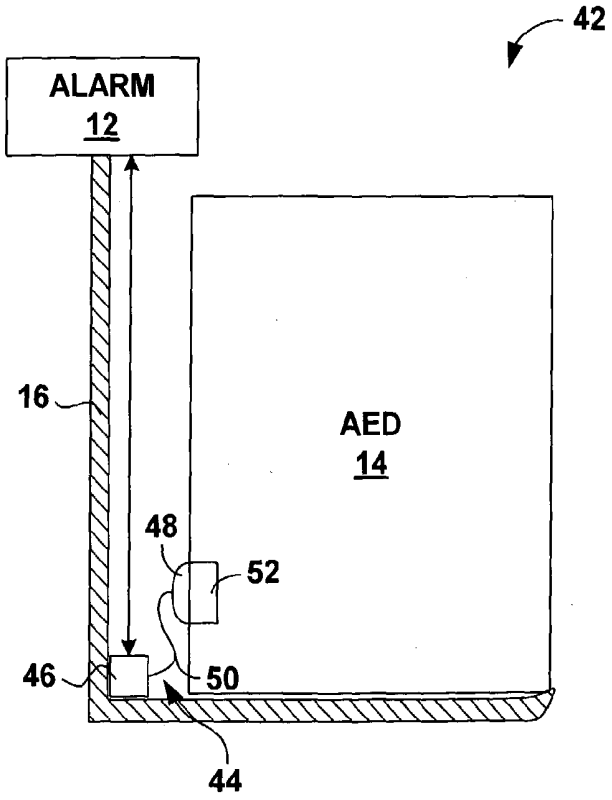


FIG. 4

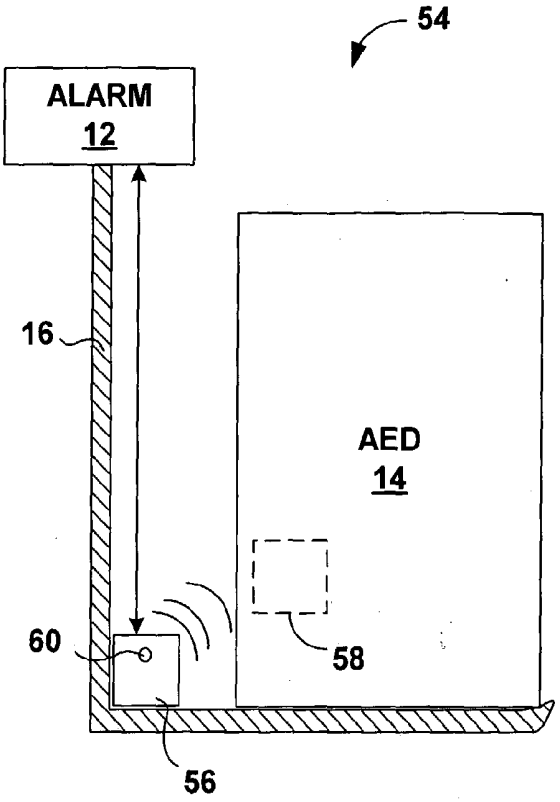


FIG. 5

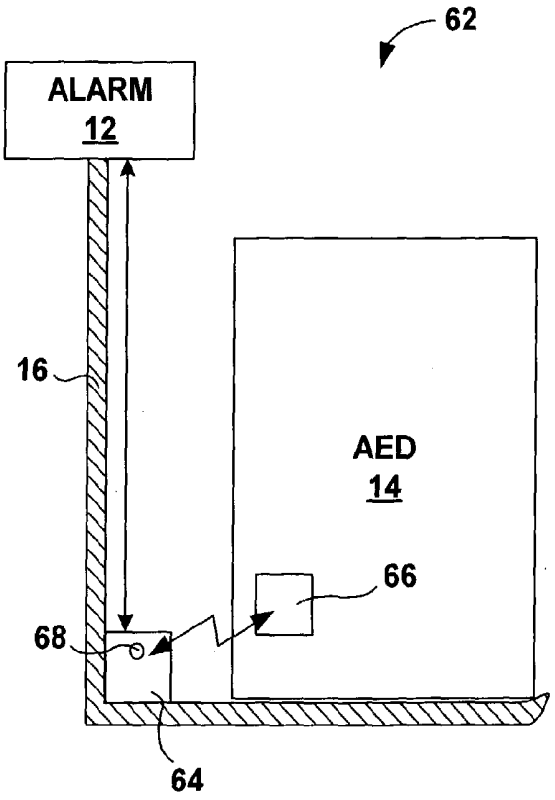


FIG. 6

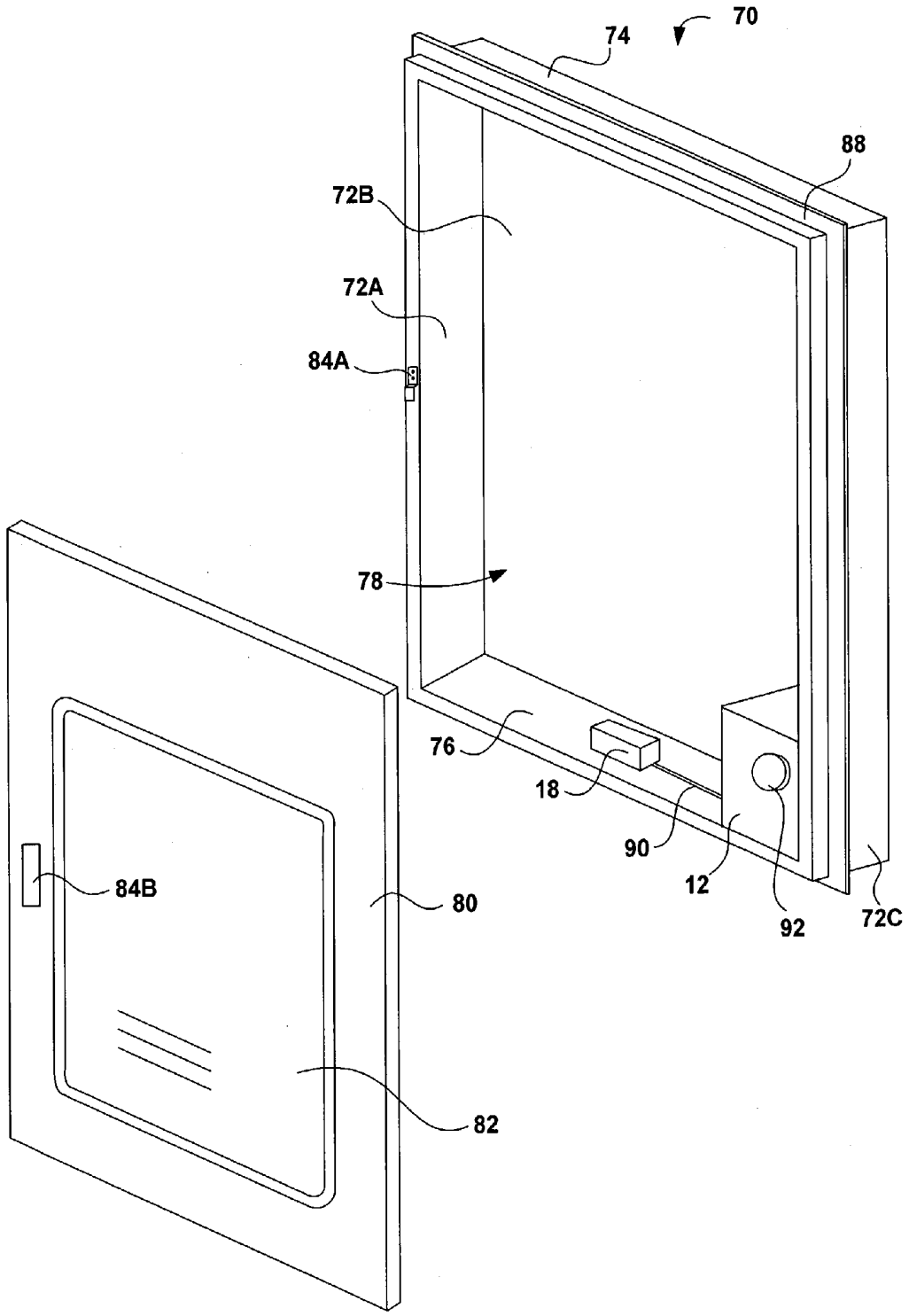


FIG. 7

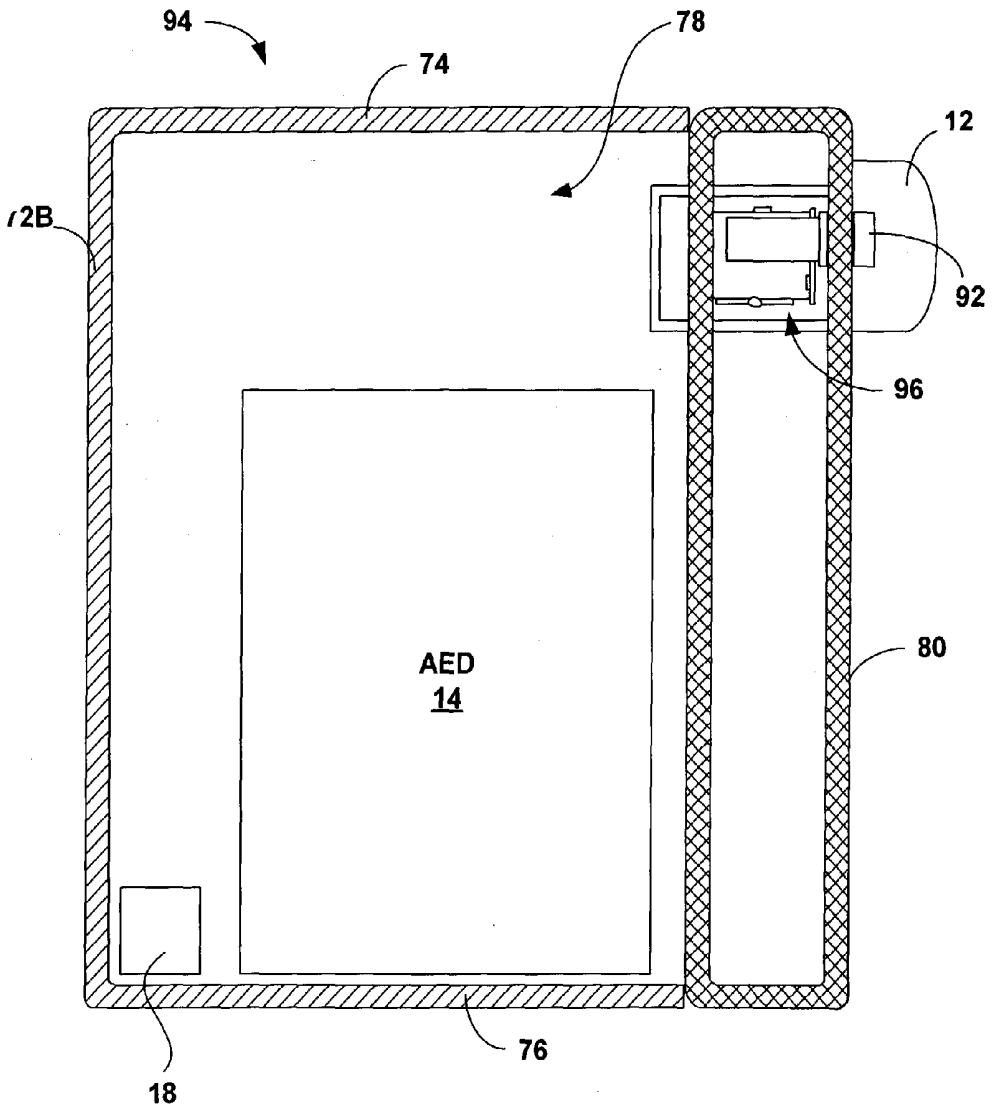


FIG. 8

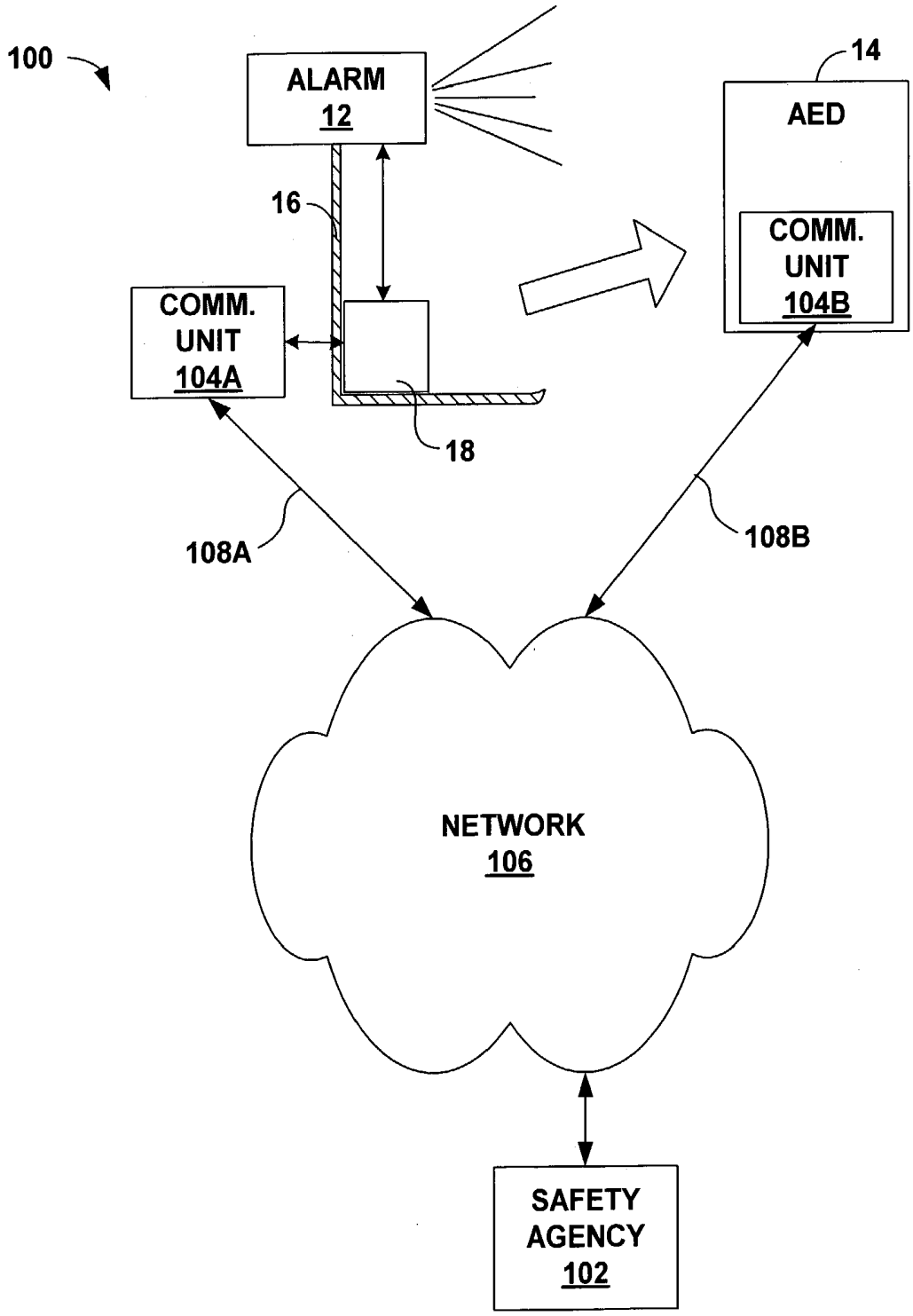

100
ALARM
12
16
14
AED
COMM.
UNIT
104B
COMM.
UNIT
104A
18
108A
108B
NETWORK
106
SAFETY
AGENCY
102

FIG. 9

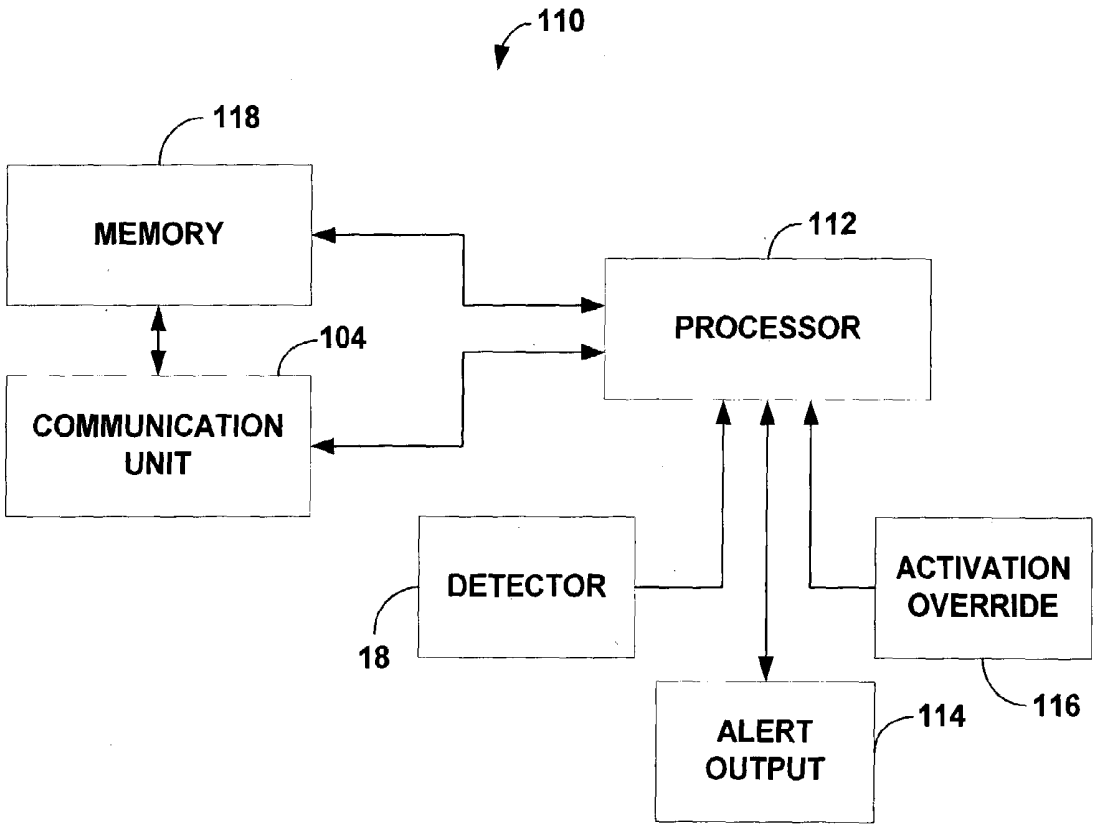

110
118
MEMORY
112
PROCESSOR
104
COMMUNICATION UNIT
DETECTOR
18
ACTIVATION OVERRIDE
116
ALERT OUTPUT
114

FIG. 10

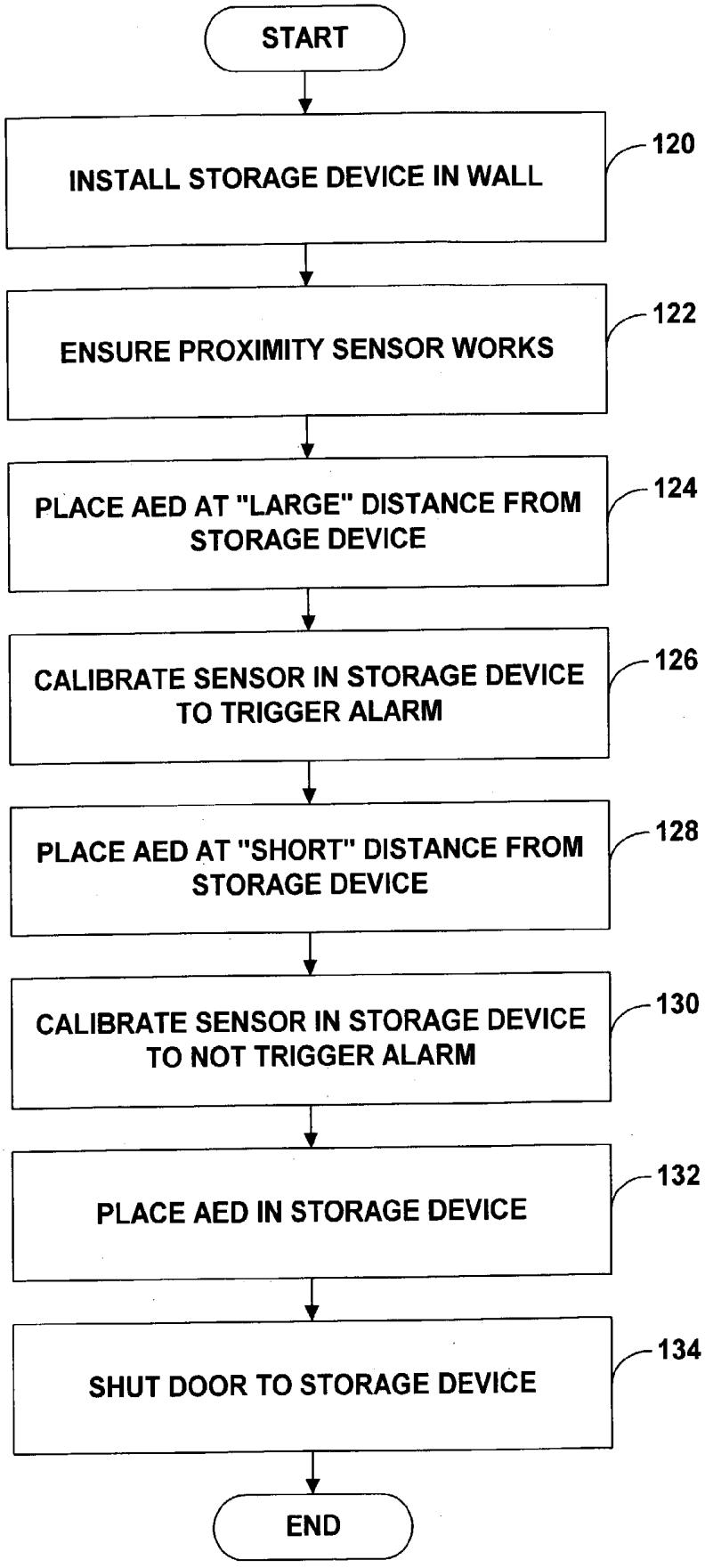

START
INSTALL STORAGE DEVICE IN WALL
120
ENSURE PROXIMITY SENSOR WORKS
122
PLACE AED AT "LARGE" DISTANCE FROM STORAGE DEVICE
124
CALIBRATE SENSOR IN STORAGE DEVICE TO TRIGGER ALARM
126
PLACE AED AT "SHORT" DISTANCE FROM STORAGE DEVICE
128
CALIBRATE SENSOR IN STORAGE DEVICE TO NOT TRIGGER ALARM
130
PLACE AED IN STORAGE DEVICE
132
SHUT DOOR TO STORAGE DEVICE
134
END

FIG. 11

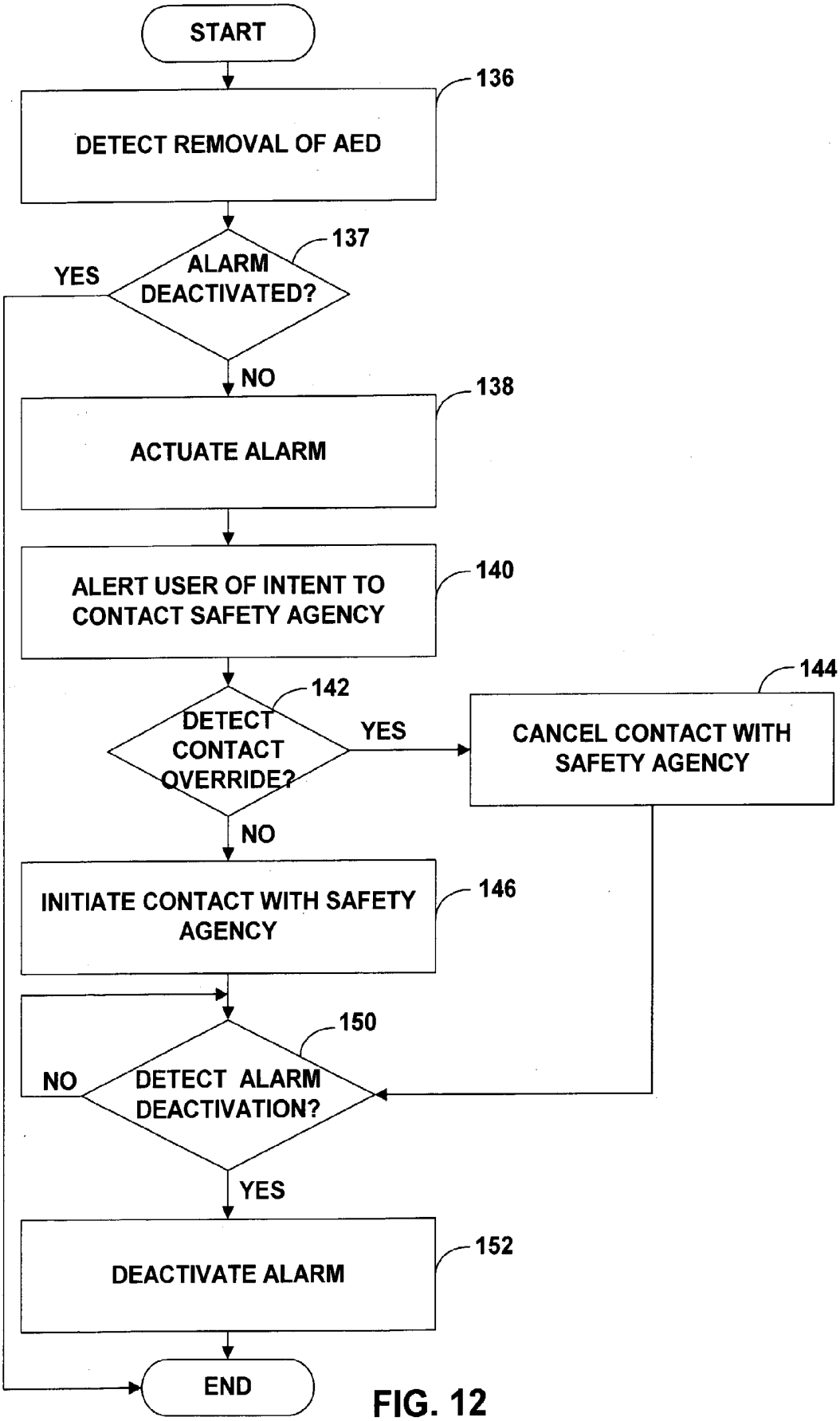

START
136
DETECT REMOVAL OF AED
137
ALARM DEACTIVATED?
YES
NO
138
ACTUATE ALARM
140
ALERT USER OF INTENT TO CONTACT SAFETY AGENCY
142
DETECT CONTACT OVERRIDE?
YES
144
CANCEL CONTACT WITH SAFETY AGENCY
NO
146
INITIATE CONTACT WITH SAFETY AGENCY
150
DETECT ALARM DEACTIVATION?
NO
YES
152
DEACTIVATE ALARM
END

FIG. 12

DETECTING REMOVAL OF A MEDICAL DEVICE FROM A STATION

[0001] This application claims priority from U.S. Provisional Application Serial No. 60/394,981, filed Jul. 9, 2002, the entire content of which is incorporated herein by reference.

TECHNICAL FIELD

[0002] The invention relates to medical devices, and more particularly, to detecting removal of a medical device from a station.

BACKGROUND

[0003] Cardiac arrest is a life-threatening medical condition that may be treated with external defibrillation. External defibrillation includes applying electrodes to a chest of a patient and delivering an electric shock to the patient to depolarize a heart of the patient and restore normal sinus rhythm. The chances that the heart of the patient can be successfully defibrillated increase significantly if a defibrillation pulse is applied quickly.

[0004] In some cases, the patient's need is urgent and the patient cannot wait for trained personnel, such as paramedics, emergency medical technicians, or others trained in defibrillation techniques, to arrive. In recognition of the need for prompt treatment and the advantages of early defibrillation, automated external defibrillators (AEDs) are becoming more commonplace, and are available in venues such as airports, health clubs and auditoriums.

[0005] Within the venues described above, an AED may be housed within a storage unit. The storage unit may protect the AED from the surrounding environment. For example, the storage unit may protect the AED from being disturbed by passersby. Further, the storage unit may protect the AED from theft and tampering. The storage unit, for example, may have a lock that must be unlocked before opening the storage unit. The storage unit may further include an alarm that is activated upon opening of a door of the storage unit. However, if a portion of the door of the storage unit is designed for breaking, such as a storage unit for a fire extinguisher, the door will remain shut and the alarm will not sound upon removing the AED. Further, the alarm may falsely sound during routine maintenance, for instance, during a routine test of the AED.

SUMMARY

[0006] In general, the invention is directed to techniques for detecting removal of a medical device from a station and activating an alarm in response to the detected removal. More specifically, a station may include a detector that detects removal of a medical device from the station. Upon detecting removal of the medical device, the detector causes the alarm to activate in order to provide notification an emergency situation or unauthorized removal of the medical device.

[0007] The notification may take the form of an audible or visible alarm for notification of people in the vicinity of the station. For example, the alarm, when activated, may sound a buzzer, a siren or any other audible alarm. Further, the activated alarm may emit a strobe light or other visible alarm. The alarm may be deactivated after a defined period of time or via an alarm deactivation. The alarm deactivation may be used to deactivate and reset a sounding alarm or deactivate the alarm before it sounds. The alarm deactivation may, for example, be used to deactivate the alarm in order to perform routine maintenance to the medical device.

[0008] Alternatively, the notification may involve activation of a remote alarm or communication with a remote safety agency. For example, the station may directly contact a safety agency, such as an alarm monitoring service or an emergency services agency, in response to the removal of the medical device from the station. For instance, the station may send an advisory message to the safety agency alerting the safety agency to the emergency situation currently in progress. The advisory may include location information as well as any other pertinent information.

[0009] In one embodiment, the invention provides a system comprising a station to support an emergency medical device, a detector to detect removal of the medical device from the station, and an alarm that is activated in response to the detected removal of the medical device.

[0010] In another embodiment, the invention provides a method comprising detecting removal of an emergency medical device from a station that supports the emergency medical device and activating an alarm responsive to the removal of the medical device from the station.

[0011] In another embodiment, the invention provides a system comprising means for supporting a medical device, means for detecting removal of the medical device from the station, and means for alerting people in the vicinity that the medical device has been removed.

[0012] The invention can provide a number of advantages. In general, the invention provides techniques for early and accurate detection of removal of a medical device from a station. The techniques of the invention may be used to detect removal of the medical device from a storage unit without needing the storage unit to have a door, which further needs to be opened for detection. Further, routine maintenance may be performed without falsely activating the alarm. For example, depending on the detector used, the medical device may be moved within a detection range without sounding the alarm. In this manner, routine maintenance such as battery replacement or calibration, may be performed without activating the alarm.

[0013] The techniques of the invention allow the detector to be calibrated, for example, during installation. The ability to calibrate the detector allows different detection ranges to be defined for the station. For example, a sensitivity of the detector may be calibrated in order to increase the distance by which the medical device may be moved before removal is detected.

[0014] The details of one or more embodiments of the invention are set forth in the accompanying drawings and the description below. Other features, objects, and advantages of the invention will be apparent from the description and drawings, and from the claims.

BRIEF DESCRIPTION OF DRAWINGS

[0015] **FIG. 1** is a block diagram illustrating a system in which an alarm is activated in response to detecting removal of a medical device from a station according to the present invention.

[0016] **FIG. 2** is a block diagram illustrating an automated external defibrillator (AED) removal detection system in which a switch detects removal of an AED from a station and activates an alarm in response to the removal of the AED.

[0017] **FIG. 3** is a block diagram illustrating another AED removal detection system in which a suspended switch is used to detect removal of an AED from a station.

[0018] **FIG. 4** is a block diagram illustrating another AED removal detection system that uses a receptacle plug sensor to detect removal of an AED from a station.

[0019] **FIG. 5** is a block diagram illustrating another AED removal detection system that uses an optical detector to detect removal of an AED from a station.

[0020] **FIG. 6** is a block diagram illustrating another AED removal detection system that uses a wireless receiver to detect removal of an AED from a station.

[0021] **FIG. 7** is a block diagram of an exemplary storage unit that activates an alarm upon detecting removal of a medical device.

[0022] **FIG. 8** is a block diagram illustrating a side view of another exemplary storage unit.

[0023] **FIG. 9** is a block diagram illustrating a system that provides direct communication with a safety agency as well as activation of an alarm in response to detecting removal of a medical device from a station.

[0024] **FIG. 10** is a block diagram illustrating an exemplary embodiment of communications circuitry within a station for automatic initiation of direct contact between station and a safety agency.

[0025] **FIG. 11** is a flow diagram illustrating installation of a station and calibration of a detector within the station for detecting removal of a medical device from the station.

[0026] **FIG. 12** is a block diagram illustrating operation of a removal detection system upon detecting removal of a medical device from a station.

DETAILED DESCRIPTION

[0027] **FIG. 1** is a block diagram illustrating a system **10** in which an alarm **12** is activated in response to detecting removal of a medical device, such as an automated external defibrillator (AED) **14**, from a station **16**. More specifically, a detector **18** detects removal of AED **14** from station **16** and causes alarm **12** to activate upon detecting the removal of AED **14** from station **16**.

[0028] **FIG. 1A** illustrates AED **14** in a "mounted" state. The term "mounted" state refers to a state in which AED **14** is within, on, or otherwise supported by station **16**. The term "mounted" may further refer to AED **14** being in close proximity to station **16**. For example, AED **14** may be in the mounted state when AED **14** is within a detectable range of a detector associated with station **16**. **FIG. 1B** illustrates AED **14** being removed according to arrow **20** to an unmounted or removed state.

[0029] In the example of **FIG. 1A, a** lower portion of station **16** supports AED **14**. More specifically, AED **14** rests on station **16** much like a shelf. Station **16** may further include a non-skid surface **19** that prevents AED **14** from inadvertently sliding off of station **16**. Nonskid surface **19** may, for example, be formed by applying a patch of coarse material to the surface of station **16**. Alternatively, station **16** may support AED **14** via a hook, a mount, or other supporting means. Further, in some cases, station **16** may be a storage unit such as a wallbox or cabinet that encloses AED **14** and protects it from the surrounding environment. In either case, station **16** may be mounted on a wall, recessed within a wall, or be free standing.

[0030] Station **16** includes a detector **18** to detect whether AED **14** remains in a mounted state or is removed from station **16**. Detector **18** may be implemented via various proximity sensors, such as a mechanical switch that is activated upon removal of AED **14** from the station **16**, a capacitive sensor that senses a change in capacitance upon removal of AED **14** from the station **16**, an optical emitter-detector circuit, a wireless sensor that detects removal of AED **14** from station **16** when the wireless sensor no longer receives a signal, an optical sensor that detects removal of AED **14** from station **16** when the optical sensor no longer receives an optical signal, and a receptacle plug sensor that detects removal of AED **14** from station **16** when the receptacle plug is unplugged.

[0031] Upon detector **18** detecting removal of AED **14** from station **16**, detector **18** causes alarm **12** to activate. Alarm **12** may, for example, be coupled to detector **18** via a wireless connection or a wired connection. Alarm **12** may be a visual alarm such as a strobe light, an audible alarm such as a siren or a buzzer, or a combination of visual and audible alarms. **FIG. 1B** illustrates the activation of alarm **12** in response to removal of AED **14**, indicated by arrow **20**.

[0032] AED **14** may, for example, be out of a detectable range of a wireless sensor forming part of detector **18**. Although in the example of **FIG. 1**, alarm **12** and detector **18** reside within station **16**, alarm **12** and detector **18** may reside within AED **14**. In this manner, detector **18** may detect, for example, the presence of station **16**. Upon removal of AED **14** from station **16**, the alarm within AED **14** activates to alert people in the vicinity of the station **16** of an emergency situation or unauthorized removal of AED **14**.

[0033] Further, station **16** may be configured to contact a safety agency upon removal of AED **14**. Contacting a safety agency upon removal of AED **14** from station **16** may involve, for example, sending an advisory from station **16** to the safety agency using a telecommunication link. Alternatively, AED **14** may include a communication interface to send the advisory the safety agency. The safety agency may be, for example, an emergency services agency operating an Emergency Medical System such as 9-1-1 in the United States, or a security monitoring agency.

[0034] FIGS. **2-7** illustrate a variety of AED removal detection systems that actuate an alarm in response to removal of AED **14** from station **16**. **FIG. 2** is a block diagram illustrating an AED removal detection system **22** in which a switch **24** detects removal of an AED **14** from a station **16**. AED **14** may rest on switch **24** and the weight of AED **14** may serve to depress an actuator associated with switch **24**. Removing AED **14** from station **16** activates switch **24** by no longer depressing switch **24** and, in turn, causing alarm **12** to activate.

[0035] As shown in the example of **FIG. 2**, switch **24** resides on a bottom portion of station **16**. In this manner,

AED **14** may rest on top of switch **24**. Alternatively, switch **24** may reside on a back plane of station **16**. In this configuration, AED **14** may rest on the bottom portion of station **16** and lean against the back plane of station **16**, depressing switch **24**. Switch **24** may be a micro switch, a pin switch, a plate switch, or any other mechanical or electrical switch.

[**0036**] Switch **24** may be coupled to alarm **12** either via a wired connection or a wireless connection. Upon removal of AED **14**, switch **24** opens or closes, depending on the normal state of the switch, and sends a signal to alarm **12** in response to switch movement. Alarm **12** activates in response to the signal from switch **24** to alert people within a close vicinity of an emergency situation or unauthorized removal of AED **14**. Further, station **16** may contact a safety agency upon removal of AED **14**, as discussed above.

[**0037**] **FIG. 3** is a block diagram illustrating an AED removal detection system **32** in which a suspended switch **34** detects removal of an AED **14** from a station **16**. Removing AED **14** from station **16** activates switch **34**, in turn causing alarm **12** to activate.

[**0038**] As shown in the example of **FIG. 3**, station **16** suspends from a wall **38**. More particularly, a suspension support **36** and suspended switch **34** interconnect a protruding portion of wall **38** to station **16**. Station **16** may also include a protruding portion to which an end of suspension support **36** connects. In this manner, the protruding sections of wall **38** and station **16** may connect to opposite ends of suspension support **36**. Alternatively, suspension support **36** may connect to other parts of station **16**. For example, suspension support **36** may connect to a top portion of station **16**.

[**0039**] Wall **38** may further include a track (not shown) that guides station **16** to prevent swaying or other unnecessary side-to-side movement of station **16**. For example, the protruding portion of station **16** may insert into the track to prevent unwanted side-to-side movement.

[**0040**] Suspension support **36** may include a cable, a wire or the like that has a tensile strength large enough to hold the weight of station **16** and AED **14**. Suspended switch **34** activates when the weight of station **16** and AED **14** changes. More particularly, upon removal of AED **14** from station **16**, suspended switch **34** detects a change in weight and activates in response to the change in weight. For example, suspended switch **34** may activate when the supported weight falls below a threshold weight. Suspended switch **34** sends a signal to alarm **12**, in turn activating alarm **12** to notify people in the vicinity of an emergency situation in progress or unauthorized removal of AED **14**. As with system **22** of **FIG. 2**, station **16** may further contact a safety agency upon removal of AED **14**.

[**0041**] **FIG. 4** is a block diagram illustrating an AED removal detection system **42** in which a receptacle plug detector **44** detects removal of an AED **14** from a station **16**. Receptacle plug detector **44** includes a sensor **46**, a plug **48**, and a cord **50**. Plug **48** inserts into a port **52** of AED **14**. Alarm **12** activates upon removal of plug **48** from port **52**.

[**0042**] More specifically, as AED **14** is removed from station **16**, cord **50** extends until cord **50** reaches a maximum length. Upon reaching the maximum length and being pulled further, plug **48** ejects from port **52**. Sensor **46** detects ejection of plug **48** and sends a signal to activate alarm **12**. Sensor **46** may detect ejection of the plug via failure to receive an electrical signal across terminals in the plug that were electrically coupled by terminals in the port. For example, while plug **48** is inserted in port **52** sensor **44** receives an electrical signal from AED **14**. Removal of AED **14** causes sensor **44** to no longer receive the electrical signal. In response to the loss of the electrical signal, sensor **44** issues a signal to activate alarm **12**.

[**0043**] Although in the example of **FIG. 4** the receptacle plug detector **44** is attached to station **16**, receptacle plug detector **44** may be attached to AED **14**. In this manner, sensor **46**, plug **48**, and cord **50** extend from AED **14** and couple to a port within station **16**.

[**0044**] **FIG. 5** is a block diagram illustrating an AED removal detection system **54** in which an optical detector **56** detects removal of an AED **14** from a station **16**. Removing AED **14** from station **16** activates optical detector **56**, in turn causing alarm **12** to activate.

[**0045**] Station **16** includes an optical detector **56** that receives an optical signal from AED **14**. The optical signal serves as assurance that AED **14** is in the present state. AED **14** may include a light transmitter **58** that emits an optical signal to optical detector **56**. The optical signal may be in the visible portion, the infrared (IR) portion, or other portions of the light spectrum. The optical signal transmitted by light transmitter **58** may further be characteristic of the respective AED **14** that emits the signal. The optical signal transmitted by light transmitter **58** may include, for example, a serial number of AED **14** or other information associated AED **14**.

[**0046**] When optical detector **56** does not receive a signal from AED **14**, optical detector **56** sends a signal to activate alarm **12**. Optical detector **56** may, for example, not receive an optical signal when AED **14** is too far from optical detector **56** or oriented in an improper direction. In these cases, optical detector **56** fails to receive an expected optical signal.

[**0047**] Optical detector **56** may further include a control **60** to adjust the sensitivity of optical detector **56**. Optical detector **56** may be adjusted to increase or decrease the strength of the optical signal that optical detector **56** must receive in order to consider AED **14** to be in the present state. In this manner, optical detector **56** may be calibrated to sense AED **14** at different distances. Calibrating optical detector **56** may adjust the detection range of station **12**. Calibration using control **60** may occur, for example, during installation of station **16**.

[**0048**] However, AED **14** may not transmit an optical signal. Instead, station **16** may include a transceiver. The transceiver may emit a querying optical signal to AED **14** and wait for a signal to be returned. A surface of AED **14** may, for example, be optically passive and reflect the optical signal back to the transceiver. The surface of AED **14** may be specially designed to have good reflection characteristics.

[**0049**] **FIG. 6** is a block diagram illustrating an AED removal detection system **62** in which a wireless receiver **64** detects removal of an AED **14** from a station **16**. Removing AED **14** from station **16** activates wireless receiver **64**, in turn causing alarm **12** to activate.

[**0050**] System **62** operates in the same manner as system **54** of **FIG. 5**. Specifically, station **16** includes a wireless

receiver **54** that receives a wireless signal from a wireless transmitter **66** in AED **14**. The wireless signal transmitted by wireless transmitter **66** may be in the radio frequency (RF) portion, microwave portion, or other portions of the light spectrum.

[**0051**] When wireless detector **64** does not receive a signal, i.e., AED **14** is out of range or oriented improperly, wireless detector **64** sends a signal to activate alarm **12**. Wireless detector **64** may further include a knob **66** to adjust the sensitivity of wireless detector **64**. Wireless detector **64** may be adjusted to increase or decrease the strength of the wireless signal that wireless detector **64** must receive in order to consider AED **14** to be in the present state. In this manner, wireless detector **64** may be calibrated to sense AED **14** at different distances.

[**0052**] Alternatively, AED **14** may not transmit a wireless signal. Instead, station **16** may include a transceiver that emits a querying wireless signal to AED **14** and waits for a signal to be returned. AED **14** may include a passive element that retransmits or reflects the querying wireless signal back to the transceiver of station **16**.

[**0053**] **FIG. 7** is a block diagram of an exemplary storage unit **70** that activates an alarm **12** upon detecting removal of a medical device, such as AED **14** of **FIG. 1**. Storage unit **70** comprises a plurality of wall sections **72**A-**72**C ("72"), a top section **74**, and a bottom section **76** that define an interior compartment **78** of sufficient size to house a medical device. Storage unit **70** may further include a door section **80** to enclose the medical device to protect the medical device from the surrounding environment. Door section **80** may include a translucent section **82** to allow visibility into interior compartment **78**. In this manner, the contents of storage unit **70** may be visible to an outside observer when door section **80** is closed. Translucent section **82** may be constructed of a translucent material such as a synthetic plastic, glass, or the like. Storage unit **70**, including wall sections **72**, top section **74**, bottom section **76**, and door section **80** (not including translucent section **82**), may be made from steel or other rigid, lightweight material.

[**0054**] Storage unit **70** includes locking mechanisms **84**A-**84**B ("84") to secure door section **80** in a closed position. Locking mechanism **84**A is mounted on a wall section **72** of storage unit **70** and locking mechanism **84**B is mounted on door section **80**. When door section **80** is closed, locking mechanism **84**B receives locking mechanism **84**A and secures door section **80** in the closed position. In order to open door **80**, locking mechanism **84**B may be pushed upward and door **80** may be pulled open.

[**0055**] Storage unit **70** is typically mounted onto a surface of a wall. Storage unit **70** may, for example, be mounted on a wall in venues such as airports, health clubs and auditoriums. In one embodiment of the invention, storage unit **70** may include a retaining flange **88** that extends around storage unit **70** to allow storage unit **70** to be at least partially recessed into the wall. Recessing storage unit **70** into the wall helps to minimize the amount of space required to accommodate storage unit **70**. However, in venues where the walls are made of concrete or brick, storage unit **70** may protrude from the wall. Alternatively, storage unit **70** may attach to a base to allow the storage unit **70** to be free standing.

[**0056**] Storage unit **70** further includes a detector **18** that detects the presence of the medical device. Detector **18** is coupled to an alarm **12** via a wire **90**. Alternatively, detector **18** may be coupled to alarm **12** via a wireless coupling or other coupling means. Upon detecting removal of the medical device from storage unit **70**, a signal is sent via wire **90** to activate alarm **12**. Alarm **12** is activated to alert people in the vicinity of an emergency situation in progress or unauthorized removal of the medical device. Detector **18** may activate alarm **12** whether door section **80** of storage unit **70** is opened or remains closed. Alarm **12** may, for example, still activate when translucent section **82** is broken to remove the medical device stored in storage unit **70**.

[**0057**] An alarm deactivation **92** may be connected in circuit to alarm **12**. Alarm deactivation **92** may reset the alarm system of storage unit **70** after activation. Alarm deactivation **92** may further totally deactivate alarm **12**. Alarm **12** may, for example, be totally deactivated in order to perform routine maintenance to the medical device stored in storage unit **70**. Alarm deactivation **92** may include a button, a switch, a dial or other input medium. Alarm deactivation **92** may, for example, be a controlled by a key switch. In this manner, only authorized personnel may deactivate alarm **12**. Alternatively, alarm deactivation **92** may be an alarm deactivation timer. The deactivation timer may be initiated when alarm **12** is activated. Upon expiration of the deactivation timer, alarm **12** is deactivated and reset.

[**0058**] Detector **18** may be implemented via various proximity sensors including a mechanical switch, a capacitive sensor, an emitter-detector circuit, a wireless detector, an optical detector, a receptacle plug sensor, or similar proximity sensor. Alarm **12** may be a visual alarm such as a strobe light, an audible alarm such as a siren or a buzzer, or a combination visual and audible alarm. Although alarm **12** of **FIG. 7** is illustrated within storage unit **70**, alarm **12** may reside on an outside portion of storage unit **70**, on a wall to which storage unit **70** is mounted, or the like. For example, alarm **12** may reside on door section **80** of storage unit **70**.

[**0059**] The medical device stored in storage unit **70** may be supported by bottom section **76**. However, the medical device may be stored within storage unit **70** via any storage configuration. For example, the medical device may be suspended from top portion **74** of storage unit **70**, similar to system **32** of **FIG. 3**. Further, storage unit may include a mount to support the medical device. The mount may include, for example, a bracket connected to wall **72**B of storage unit **70** that supports the medical device.

[**0060**] **FIG. 8** is a block diagram illustrating a side view of another exemplary storage unit **95**. In the example of **FIG. 8**, an AED **14** rests within storage unit **95** and, more particularly, within interior compartment **78**. As described above, interior compartment **78** is formed via walls **72** (of which wall **72**B is shown), top section **74**, bottom section **76**, and door **80**. Interior compartment **78** may be formed to fit a small or large AED. Further interior compartment may be designed to hold AED **14** along with additional items. For instance, interior compartment **78** may further hold a first aid kit and any other medical or non-medical items.

[**0061**] A detector **18** detects when AED **14** is removed from storage unit **78**. Detector **18** causes alarm **12** to sound in response to removal of AED **14**. In the example illustrated in **FIG. 8**, alarm **12** resides on the outside of door **80**. As described above, however, alarm **12** may reside anywhere within or on storage unit **95**. Alarm deactivation **92** also

resides on the outside of door **80**. Alarm deactivation **92** is connected to alarm **12** via circuit **96**. Circuit **96** allows alarm **12** to be deactivated and reset after sounding in response to removal of AED **14**.

[**0062**] **FIG. 9** is a block diagram illustrating a system **100** that provides direct communication with a safety agency **102** as well as activation of an alarm **12** in response to detecting removal of a medical device, such as AED **14**. Direct communication between AED **14** and safety agency **102** may be initiated automatically upon removing AED **14** from station **16**, prompting early notification and arrival of emergency personnel. Safety agency **102** may be, for example, an Emergency Medical System such as 9-1-1 in the United States, or a security monitoring agency.

[**0063**] As shown in **FIG. 9**, direct communication with safety agency **102** may be initiated by station **16** or by AED **14** via communication units **104**A and **104**B ("104"), respectively. Communication units **104** are coupled to a network **106** via links **108**A and **108**B ("108"), respectively. More than one link **108** may couple communication units **104** to network **106** in order to provide alternative communication paths between safety agency **14** and station **16** or AED **14**. Communication units **104** may include a network card, a wireless local area network (WLAN) card, a mobile phone, an infrared (IR) card, a modem, or any combination thereof. Communication units **104** may instead couple station **16** or AED **14** and a communication device that is already coupled to network **18**. For example, communication unit **104**A may electrically couple station **16** to a mobile phone via a connector that connects to the mobile phone and station **16**.

[**0064**] Network **106** may be a combination of network architectures, including a public switched telephone network (PSTN), an integrated services digital network (ISDN), an Internet protocol (IP) network, a local area network (LAN), a wide area network (WAN), a wireless communications network, or an asynchronous transfer mode (ATM) network. Links **108** may be wireless links, wired links, optical links or the like.

[**0065**] Detector **18** of station **16** detects removal of AED **14** from station **16**. Upon detecting removal of AED **14** from station **16**, detector **18** causes alarm **12** to activate in order to notify people in the vicinity of an emergency situation in progress or an unauthorized removal of AED **14**. Station **16** may further contact safety agency **102** in response to the detected removal. For example, station **16** may send an advisory to safety agency **102** via communication unit **104**A and network **106**. In this manner, station **16** initiates direct communication between station **16** and safety agency **102**. The communication may serve to request that emergency personnel be dispatched to the scene of the emergency. To that end, the communication may include location information, as well as other pertinent information.

[**0066**] Direct communication between station **16** and safety agency **102** may advantageously reduce the amount of time before delivery of early advanced care to the patient. Although described in terms of direct communication between station **16** and safety agency **102**, system **100** may provide direct communication between the removed medical device (in this example AED **14**) and safety agency **102**. For example, upon detecting removal of AED **14** from station **16**, AED **14** may sound an alarm located within AED **14** and initiate direct contact with safety agency **102** via communication unit **104**B.

[**0067**] **FIG. 10** is a block diagram illustrating an exemplary embodiment of communications circuitry **110** within station **16** for automatic initiation of direct contact between station **16** and a safety agency **102**. As shown in **FIG. 10**, communications circuitry **110** includes a detector **18** that detects removal of AED **14** from station **16**. For example, detector **18** may be an optical receiver that detects when AED **14** is removed from station **16** when an optical signal is no longer received.

[**0068**] Detector **18** causes alarm **12** to activate upon detecting removal of AED **14**. More specifically, detector **18** may communicate to a processor **112** that removal of AED **14** was detected. Processor **112** conveys to an operator removing AED **14** from station **16**, via an alert output **114** of the intent to contact safety agency **102**. For example, processor **64** may convey to the operator that an advisory will be sent to safety agency **102**. Alert output **114** may be a speaker, a display, or a combination thereof. Processor **112** may wait for a defined time interval after the alert to the operator before contacting safety agency **102**.

[**0069**] The operator may choose to cancel the contact within the defined time interval via an activation override **116**. The operator may choose to cancel the contact with safety agency **14**, for example, when the event detected is a non-emergency situation. For example, an AED **14** may be removed from station **16** for routine maintenance, in which case there is no need to send an advisory to safety agency **102**. Activation override **116** may, for example, be a button, switch, dial or other input medium that, when actuated by the operator, cancels the advisory. Alternatively, activation override **116** may take the form of an audible command from the operator.

[**0070**] When the operator does not cancel the contact within the defined time interval, processor **112** may access a memory **118** to generate an advisory. Memory **118** may include location information, such as a recorded message indicating the location of AED **14**. Further, memory **118** may contain contact information of a prescribing physician, a serial number of the AED **14**, and other pertinent information. Processor **112** may, for example, generate an advisory from a subset of the information stored in memory **118**, and send the advisory to safety agency **102** via a communication unit **104**.

[**0071**] **FIG. 11** is a flow diagram illustrating installation of station **16** and initialization of a detector **18** within station **16** for detecting removal of the medical device from station **16**. Initially, station **16** is installed in a venue (**120**). Station **16** may, for example, be installed on a wall within the venue. Alternatively, station **16** may be coupled to a base and be free standing. In the case in which station **12** comprises a storage unit, such as storage unit **70**, station **12** may be installed partially within the wall of the venue. The venue may include airports, health clubs, auditoriums and the like.

[**0072**] Next, detector **18** of station **16** is checked to ensure proper operation (**122**). Detector **18** may be checked, for example, by powering-up a relevant detection circuit. The medical device to be stored within/on station **16** is placed at a distance away from station **16** that it is desired for alarm **12** to activate (**124**). For example, for a wireless detector that uses radio frequency (RF) communication, the distance from station **16** that may activate alarm **12** may be 10-20 feet.

Detector **18** is calibrated to trigger alarm **12** at the current distance (**126**). Calibration of detector **18** may, for example, include adjusting a sensitivity knob, such as knob **60** of **FIG. 5**.

[**0073**] The medical device is moved to a distance closer to station **16** and detector **18** is calibrated to not activate alarm **12** (**128**, **130**). The closer distance, for example, may be only a few feet. Alternatively, the medical device may be placed within or on station **16** when the medical device is moved closer. However, if this is not the case, the medical device is then placed within or on station **16** after calibration of detector **18** (**132**).

[**0074**] If station **16** is a storage unit **70**, a door section **80** of station **16** is closed (**134**). At this point installation and initialization are complete. Station **16** is now able to detect when the medical device is removed from station **16**, e.g., when the medical device is removed outside of the sensing range.

[**0075**] **FIG. 12** is a block diagram illustrating operation of station **16** upon detecting removal of AED **14** from station **16**. Initially, detector **18** detects removal of AED **14** from station **16** (**136**). For example, an optical detector may no longer receive an optical signal from AED **14** when AED **14** is moved beyond a detection range. Station **16** next determines whether alarm **12** is deactivated (**137**). When alarm **12** is deactivated, alarm **12** does not sound upon removal of AED **14** from station **16**. Further, station **16** does not initiate contact between station **16** and safety agency **102**. Alarm **12** may be deactivated, for example, when authorized personnel are performing routing maintenance to the medical device.

[**0076**] When alarm **12** is not deactivated, alarm **12** is sounded (**138**). A signal may be sent to actuate alarm **12** in response to detecting removal of AED **14**. Alarm **12** may, for example, sound a buzzer or a siren as well as initiate a strobe light. Further, station **16** alerts the operator that removed AED **14** of the intent to contact safety agency **102** (**140**). The alert to the operator may be displayed on a display or may be prompted via a speaker located on station **16**. The alert may indicate, for example, that an advisory will be sent to safety agency **102** in a defined amount of time unless the operator indicates otherwise. Station **16** may monitor for an override command to be input by the operator during the defined amount of time (**142**). In locations where automatic direct communication with the safety agency is not permitted by law, an override button, switch, dial, or other input medium may be present to allow the operator input an override command to cancel the advisory. When station **16** detects an override command from the operator, station **16** cancels the advisory to safety agency **102** (**144**).

[**0077**] When station **16** does not detect an override command from the operator, station **16** initiates communication with safety agency **102** (**146**). Processor **112** may, for example, retrieve information stored in memory **118**, such as location information **66**, contact information of a prescribing physician, and a serial number of the medical device and generate the advisory with a subset of the information. Station **16** may send the advisory to safety agency **102** via communication unit **104**A. Alternatively, a voice channel may be opened between station **16** and safety agency **102**.

[**0078**] Alarm **12** determines whether an alarm deactivation has occurred and deactivates alarm **12** upon receiving the alarm deactivation (**150**, **152**). The alarm deactivation may include actuation of an alarm deactivation button, turning of a deactivation switch, or the like. For example, a person may use a key to turn the deactivation switch to deactivate alarm **12**. The key deactivation switch allows deactivation of alarm **12** by authorized personnel only. Alternatively, alarm deactivation may occur upon expiration of an alarm deactivation timer.

[**0079**] As mentioned above, a medical device supported by the station **16** may instead provide the removal detection techniques provided by station **16**. For example, AED **14** may detect removal by sensing the presence of station **16** and activate an alarm within or on AED **14** in response to the detected removal. Further, AED **14** may initiate direct contact with safety agency **102**.

[**0080**] Various embodiments of the invention have been described. These embodiments are illustrative of the practice of the invention. Various modifications may be made without departing from the scope of the claims. The techniques of the invention may be applied to other medical devices that may be housed within a storage unit or otherwise supported by a station. These and other embodiments are within the scope of the following claims.

1. A system comprising:

a station to support a medical device;

a detector to detect removal of the medical device from the station; and

an alarm that is activated in response to the detected removal of the medical device.

2. The system of claim 1, in which the alarm includes an audible alarm.

3. The system of claim 2, in which the audible alarm includes one of a siren and a buzzer.

4. The system of claim 1, in which the alarm includes a visual alarm.

5. The system of claim 4, in which the visual alarm includes a strobe light.

6. The system of claim 1, in which the detector includes a proximity sensor.

7. The system of claim 6, in which the proximity sensor includes a mechanical switch that is actuated upon removal of the medical device from the station.

8. The system of claim 7, in which the mechanical switch includes a micro switch on a bottom portion of the station.

9. The system of claim 7, in which the mechanical switch includes one of a pin switch and a plate switch.

10. The system of claim 7, in which the mechanical switch includes a suspended mechanical switch.

11. The system of claim 6, in which the proximity sensor includes a capacitive sensor that senses a change in capacitance upon removal of the medical device from the station.

12. The system of claim 6, in which the proximity sensor includes a wireless sensor.

13. The system of claim 12, in which the detector detects removal of the medical device from the station when the wireless sensor no longer receives a signal from the medical device.

14. The system of claim 6, in which the proximity sensor includes an optical sensor.

15. The system of claim 14, in which the detector detects removal of the medical device from the station when the optical sensor no longer receives an optical signal from the medical device.

16. The system of claim 6, in which the proximity sensor includes a receptacle plug coupled to a wire.

17. The system of claim 16, in which the detector detects removal of the medical device from the station when the receptacle plug is unplugged from the medical device.

18. The system of claim 16, in which the receptacle plug is coupled to the station and the wire is coupled to the medical device.

19. The system of claim 6, in which the proximity sensor includes an emitter-detector circuit.

20. The system of claim 1, in which the station includes an storage unit comprising a plurality of wall sections, a top section, a bottom section, and a door section, in which the wall sections, the top section, the bottom section, and the door section define an interior compartment to house the medical device.

21. The system of claim 20, in which the station includes a mount within the interior compartment.

22. The system of claim 1, further comprising a deactivation switch to deactivate the alarm.

23. The system of claim 22, in which the deactivation switch is responsive to a timer and deactivates the alarm when the timer exceeds a threshold time.

24. The system of claim 22, in which the deactivation switch is responsive to a key.

25. The system of claim 1, further comprising a communication unit to contact a safety agency in response to detecting removal of the medical device from the station.

26. The system of claim 25, in which the communication unit sends an advisory to the safety agency in response to detecting removal of the medical device from the station.

27. The system of claim 26, in which the advisory includes at least one of location information, contact information of a prescribing physician, and a serial number of the medical device.

28. The system of claim 25, in which the communication unit is located within the medical device.

29. The system of claim 25, in which the communication unit is coupled to the station.

30. The system of claim 25, in which the communication unit includes at least one of a mobile phone, a wireless local area network (WLAN) card, a infrared (IR) card, a network card, and a modem.

31. The system of claim 1, in which the medical device is an automated external defibrillator (AED)

32. A method comprising:

detecting removal of a medical device from a station that supports the medical device; and

activating an alarm in responsive to the detected removal of the medical device from the station.

33. The method of claim 32, further comprising deactivating the alarm.

34. The method of claim 33, in which deactivating the alarm includes deactivating the alarm after a defined time interval.

35. The method of claim 34, in which deactivating the alarm includes deactivating the alarm permanently.

36. The method of claim 34, in which deactivating the alarm includes deactivating the alarm via one of a switch, a button, a key, and a dial.

37. The method of claim 32, further comprising contacting a safety agency in response to the detected removal.

38. The method of claim 37, in which contacting the safety agency includes sending an advisory to the safety agency.

39. The method of claim 38, in which the advisory is sent from the medical device.

40. The method of claim 38, in which the advisory is sent from the station.

41. The method of claim 38, in which the advisory includes at least one of location information, contact information of a prescribing physician, and a serial number of the medical device.

42. The method of claim 38, in which the advisory includes a recorded message.

43. The method of claim 32, in which the station includes a storage unit to house the medical device and the storage unit is opened to access the medical device.

44. The method of claim 32, in which the medical device includes an automated external defibrillator (AED).

45. A system comprising:

a station to support a medical device;

means for detecting removal of the medical device from the station; and

means for alerting people in the vicinity that the medical device has been removed.

46. The system of claim 45, further comprising means for deactivating the alerting means.

47. The system of claim 45, further comprising means for contacting a safety agency in response to detecting removal of the medical device.

48. The system of claim 45, in which the station includes a storage unit.

49. The system of claim 45, in which the detecting means include a proximity sensor.

50. The system of claim 45, in which the alerting means include an alarm.

* * * * *

专利名称(译)	检测从工作站移除医疗设备		
公开(公告)号	US20040019258A1	公开(公告)日	2004-01-29
申请号	US10/357301	申请日	2003-01-31
[标]申请(专利权)人(译)	KAVOUNAS GREGORY t MERRY RANDY大号 BERTAGNOLE SHAWN - [R		
申请(专利权)人(译)	KAVOUNAS GREGORY T. MERRY RANDY L. BERTAGNOLE SHAWN R.		
当前申请(专利权)人(译)	KAVOUNAS GREGORY T. MERRY RANDY L. BERTAGNOLE SHAWN R.		
[标]发明人	KAVOUNAS GREGORY T MERRY RANDY L BERTAGNOLE SHAWN R		
发明人	KAVOUNAS, GREGORY T. MERRY, RANDY L. BERTAGNOLE, SHAWN R.		
IPC分类号	A61N1/39 G08B13/14 A61B5/00		
CPC分类号	G08B13/1481 A61N1/39 A61N1/3904		
优先权	60/394981 2002-07-09 US		
外部链接	Espacenet USPTO		

摘要(译)

描述了用于检测从站中移除医疗设备并响应于检测到的移除而激活警报的技术。更具体地，该站包括检测器，该检测器检测医疗设备的移除并且在检测到移除时使警报激活。例如，该站可以包括光学检测器，该光学检测器从医疗设备上的光发射器接收光学信号。当光学检测器没有从医疗设备接收到信号时，光学检测器发送信号以激活警报。例如，当医疗设备离光学检测器太远或者在不正确的方向上取向时，光学检测器可以不接收光学信号。可以进一步校准检测器的灵敏度以允许为站定义不同的检测范围。