



US009198590B2

(12) **United States Patent**  
**Balda et al.**

(10) **Patent No.:** **US 9,198,590 B2**  
(45) **Date of Patent:** **Dec. 1, 2015**

(54) **CARDIAC EVENT MONITORING SYSTEM**

(2013.01); *A61B 2560/0209* (2013.01); *A61B 2560/0468* (2013.01); *A61B* (2013.01)

(71) Applicant: **MEDICOMP, INC.**, Melbourne, FL (US)

(58) **Field of Classification Search**

CPC ..... *A61B 5/0408-5/04087*; *A61B 5/0404*; *A61B 5/6826*

(72) Inventors: **Daniel Balda**, Indian Harbour Beach, FL (US); **Robert Michael Thomas**, Melbourne, FL (US); **Monte Marek**, Palm Bay, FL (US); **Tary Mann**, Satellite Beach, FL (US); **Anthony Balda**, Satellite Beach, FL (US)

USPC ..... 600/509  
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

(73) Assignee: **Medicomp, Inc.**, Melbourne, FL (US)

3,556,084 A 1/1971 Budde  
4,583,553 A 4/1986 Shah  
5,027,824 A 7/1991 Dougherty et al.

(\* ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(Continued)

FOREIGN PATENT DOCUMENTS

(21) Appl. No.: **14/197,826**

WO WO 85-05547 12/1985

(22) Filed: **Mar. 5, 2014**

OTHER PUBLICATIONS

(65) **Prior Publication Data**

US 2014/0187898 A1 Jul. 3, 2014

Patient Instructions WristRecorder™ Plus, LifeWatch, (www.lifewatchinc.com), Feb. 2004, 8 pages.

(Continued)

**Related U.S. Application Data**

(63) Continuation of application No. 11/550,759, filed on Oct. 18, 2006, now Pat. No. 8,983,583.

*Primary Examiner* — Michael Kahelin

(74) *Attorney, Agent, or Firm* — Mark R. Malek; Kelly G. Swartz; Wideman Malek, PL

(51) **Int. Cl.**

*A61B 5/0408* (2006.01)  
*A61B 5/024* (2006.01)  
*A61B 5/0404* (2006.01)  
*A61B 5/0432* (2006.01)  
*A61B 5/0428* (2006.01)  
*A61B 5/00* (2006.01)

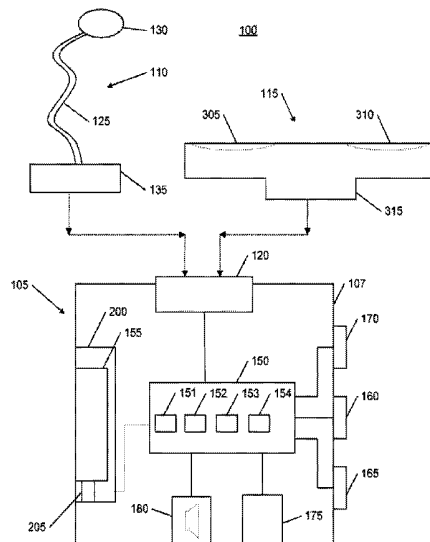
(57) **ABSTRACT**

A cardiac event monitoring system includes a base unit including a base connector, a wearable electrode system, and a plug-in adapter. The wearable electrode system includes a cable, an electrode at one end of the cable, and a cable connector at the other end of the cable. The cable connector is configured to plug into the base connector. The plug-in adapter includes electrodes and an adapter connector that is configured to plug into the base connector.

(52) **U.S. Cl.**

CPC ..... *A61B 5/0408* (2013.01); *A61B 5/02438* (2013.01); *A61B 5/0404* (2013.01); *A61B 5/0432* (2013.01); *A61B 5/0428* (2013.01); *A61B 5/04325* (2013.01); *A61B 5/6826*

**24 Claims, 6 Drawing Sheets**



(56)

**References Cited**

U.S. PATENT DOCUMENTS

5,285,783	A	2/1994	Secker	
5,316,008	A	5/1994	Suga et al.	
6,032,060	A	2/2000	Carim et al.	
6,366,871	B1 *	4/2002	Geva .....	340/539.12
6,783,492	B2	8/2004	Dominguez et al.	
6,871,089	B2	3/2005	Korzinov et al.	
7,222,054	B2	5/2007	Geva	
7,610,085	B2 *	10/2009	Allgeyer .....	600/513
2008/0097231	A1	4/2008	Balda et al.	

OTHER PUBLICATIONS

Patient Instructions Micro ER, Life Watch, ([www.lifewatchinc.com](http://www.lifewatchinc.com)), prior to Oct. 18, 2006, 8 pages.

PCT International Search Report (Application No. PCT/US2007/081668) filed Oct. 17, 2007, mailed Apr. 7, 2008 (3 pages).

PCT Written Opinion (Application No. PCT/US2007/081668) filed Oct. 17, 2007, mailed Apr. 7, 2008 (7 pages).

ReadMyHeart V2.0, DailyCare BioMedical Inc., Taiwan, ([www.debiomed.com](http://www.debiomed.com)), 2005, 45 pages.

HeartOne™, Pocketsize Transtelephonic ECG Event Recorder, HeartOne Aerotel Medical Systems, (<http://www.aerotel.com/HeartOne.asp?id=65>), prior to Oct. 18, 2006, 1 page.

Handheld ECG, ReadMyHeart, DailyCare Biomedical Inc., Taiwan, ([www.debiomed.com](http://www.debiomed.com)), prior to Oct. 18, 2006, 2 pages.

CardioPAL™ . . . Medicomp's Event Monitoring Solution, Medicomp, ([www.medicompine.com](http://www.medicompine.com)), (1998), 2 pages.

\* cited by examiner

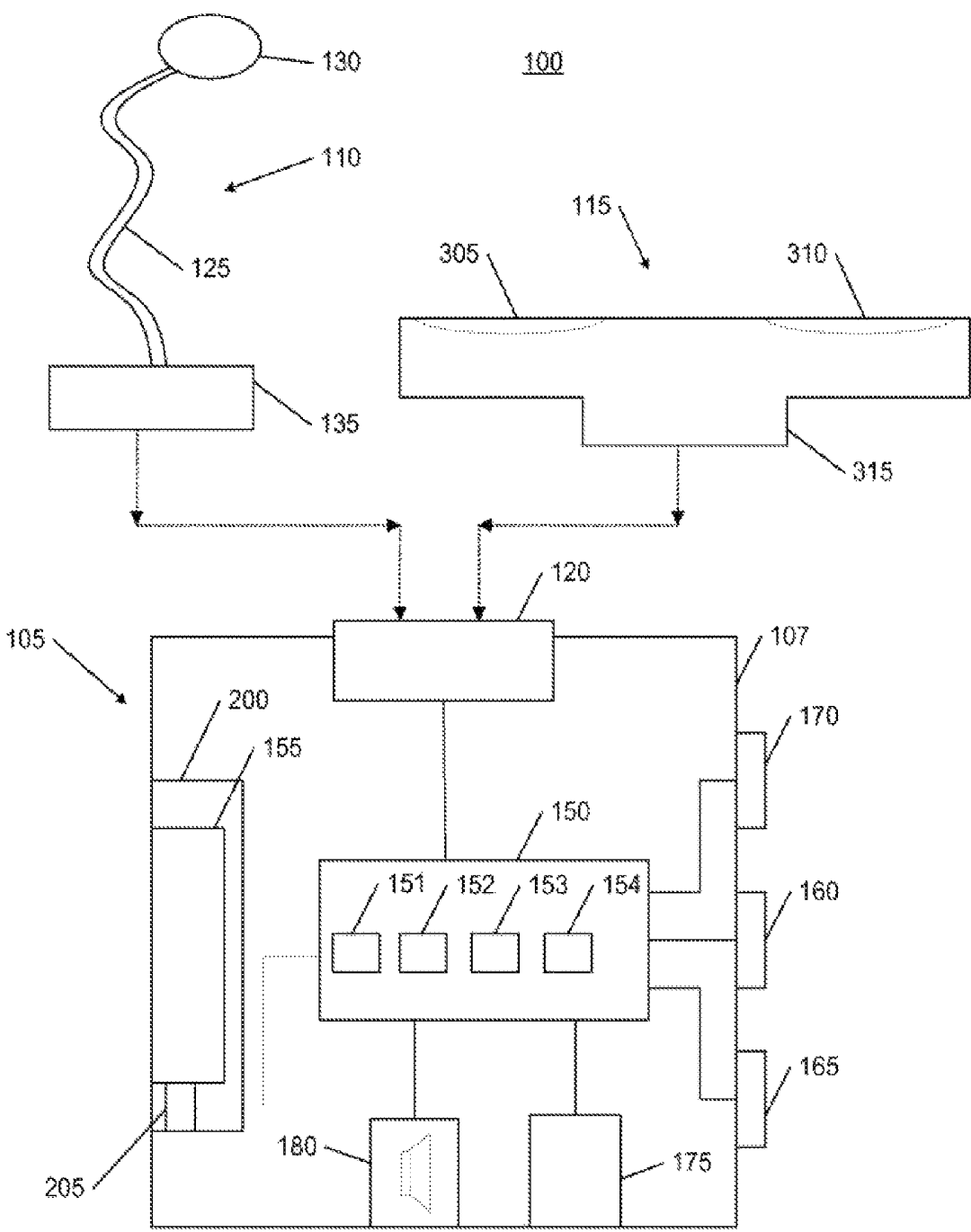


Fig. 1

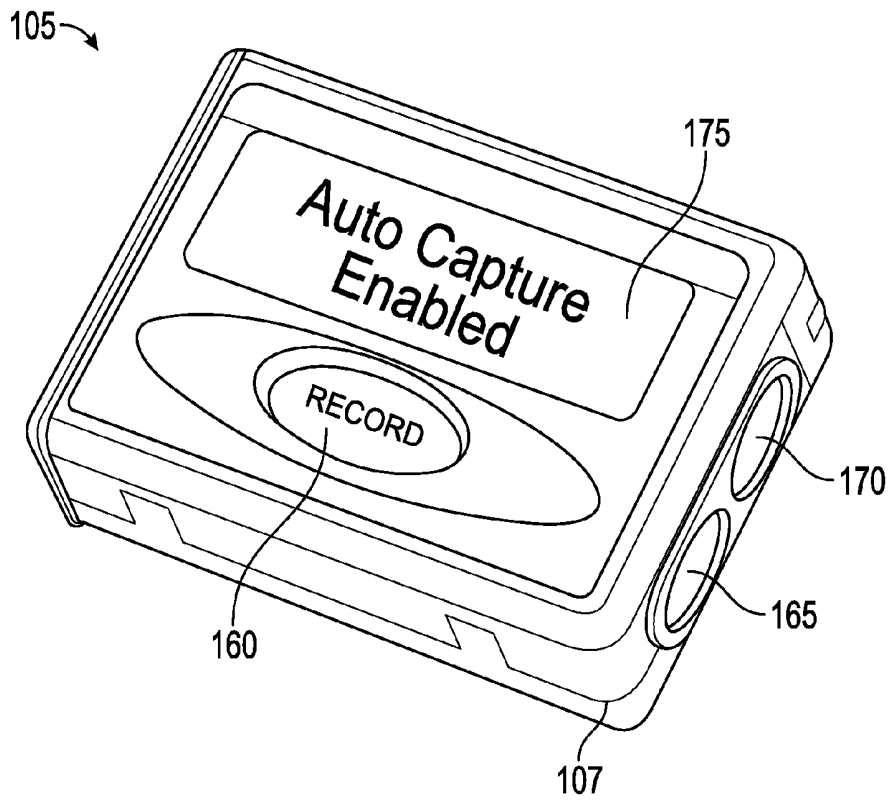


FIG. 2A

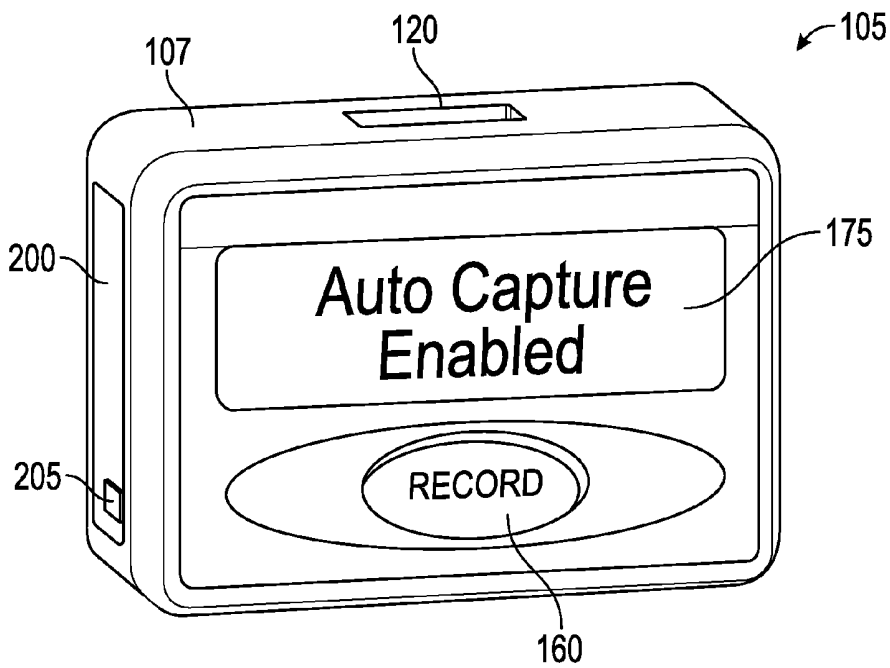
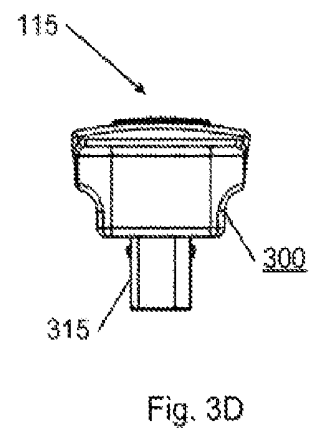
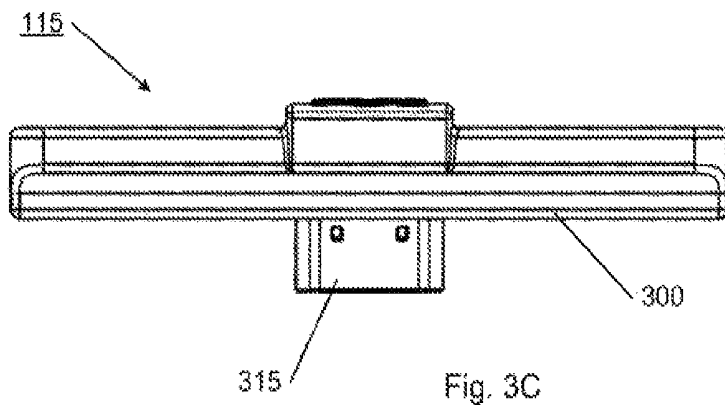
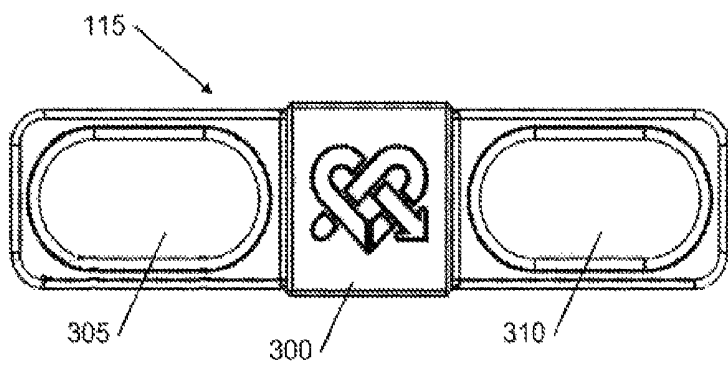
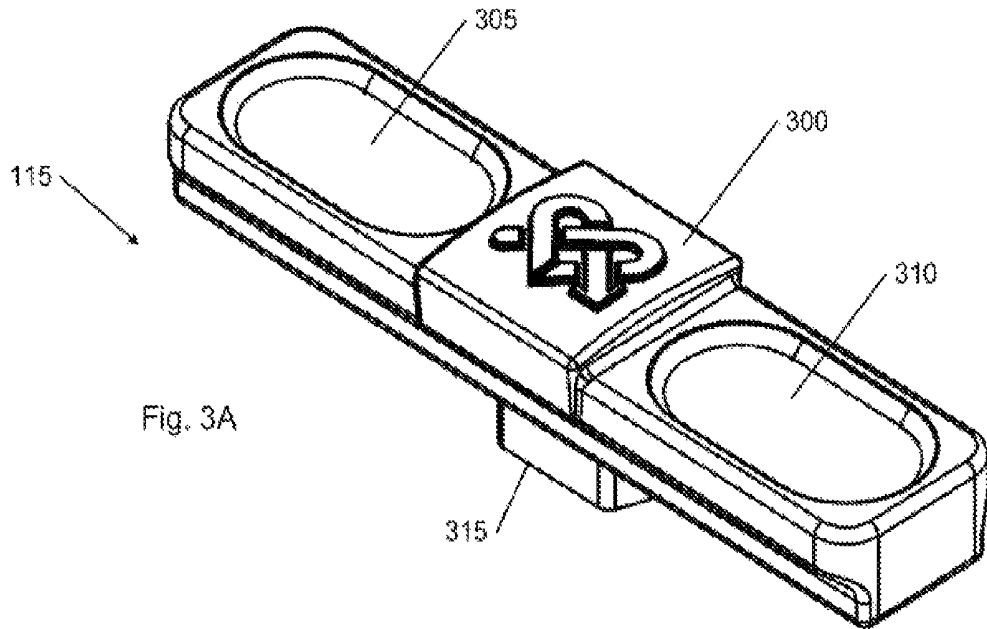


FIG. 2B



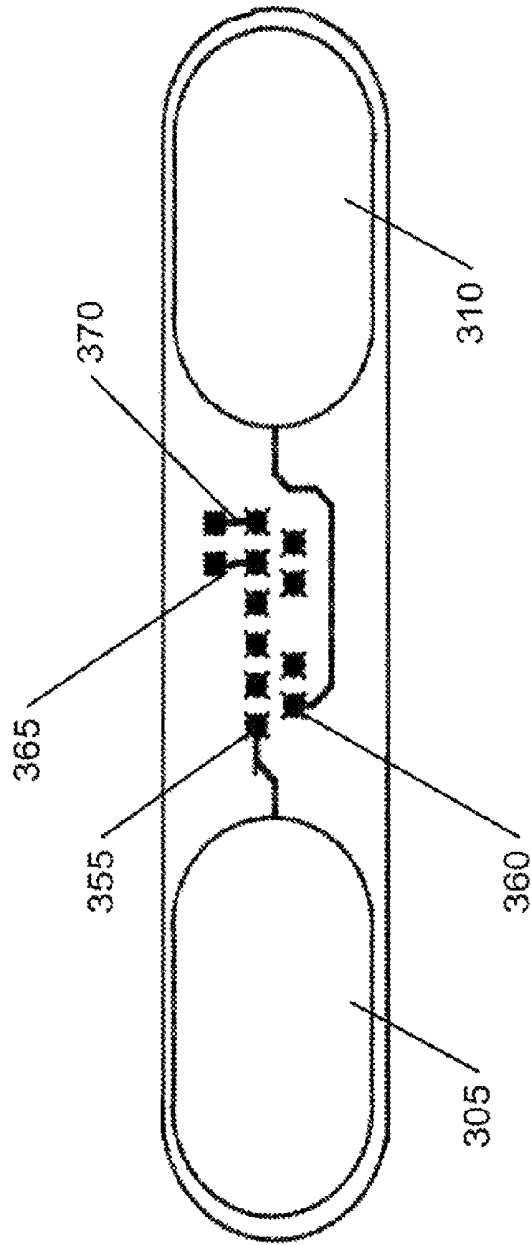


Fig. 3E

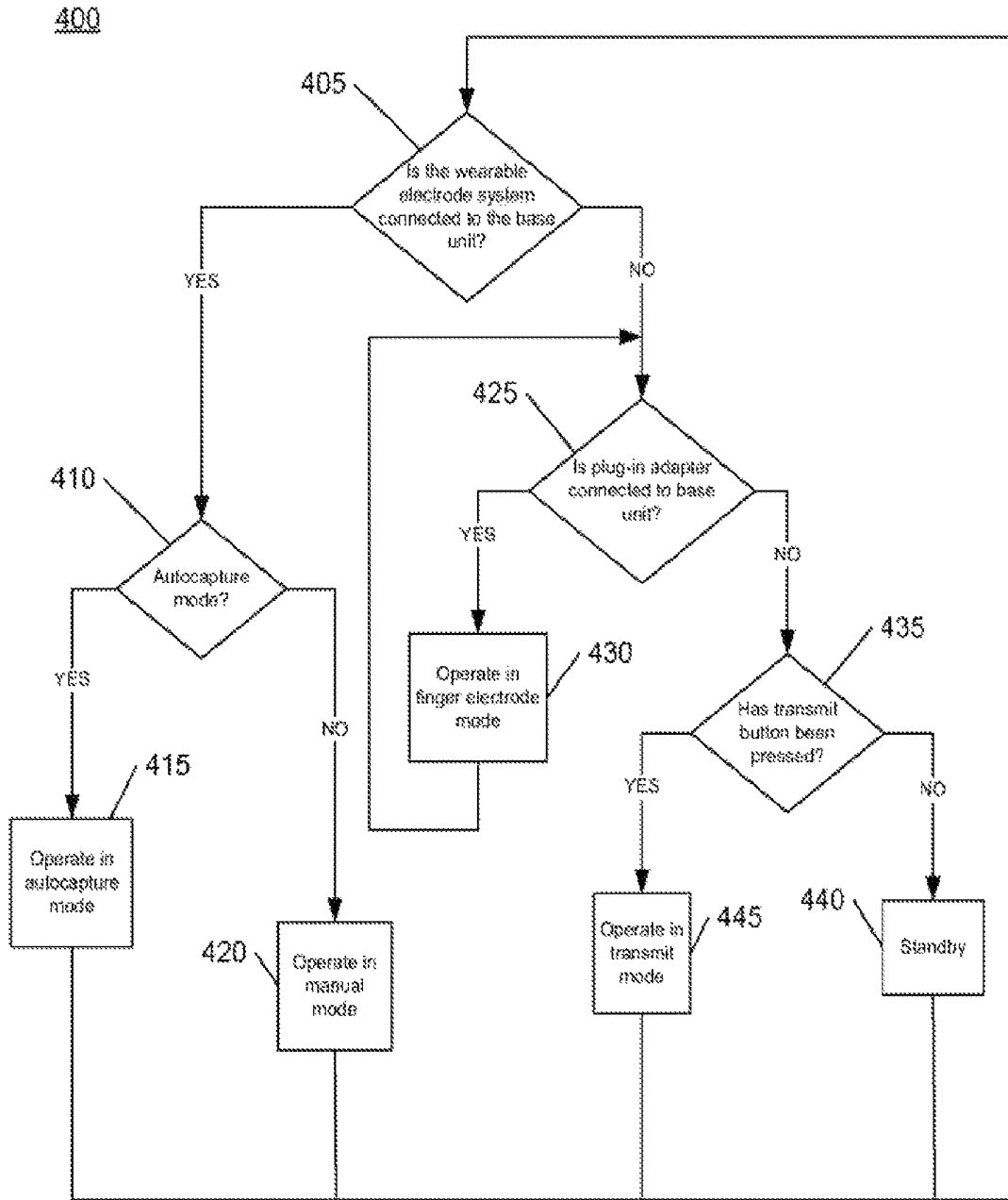


Fig. 4

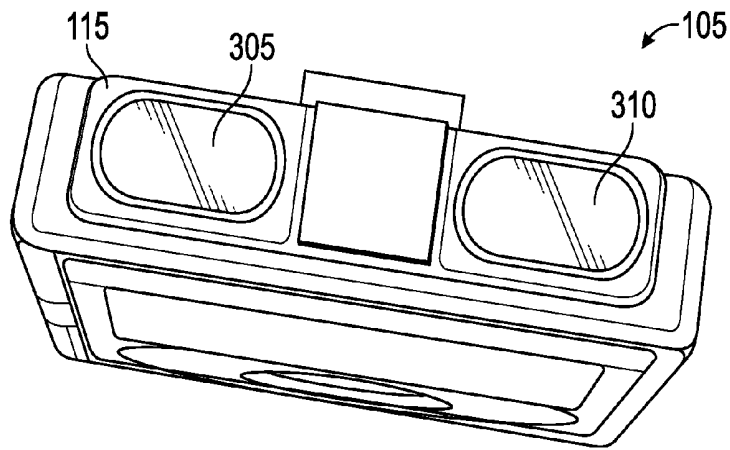


FIG. 5

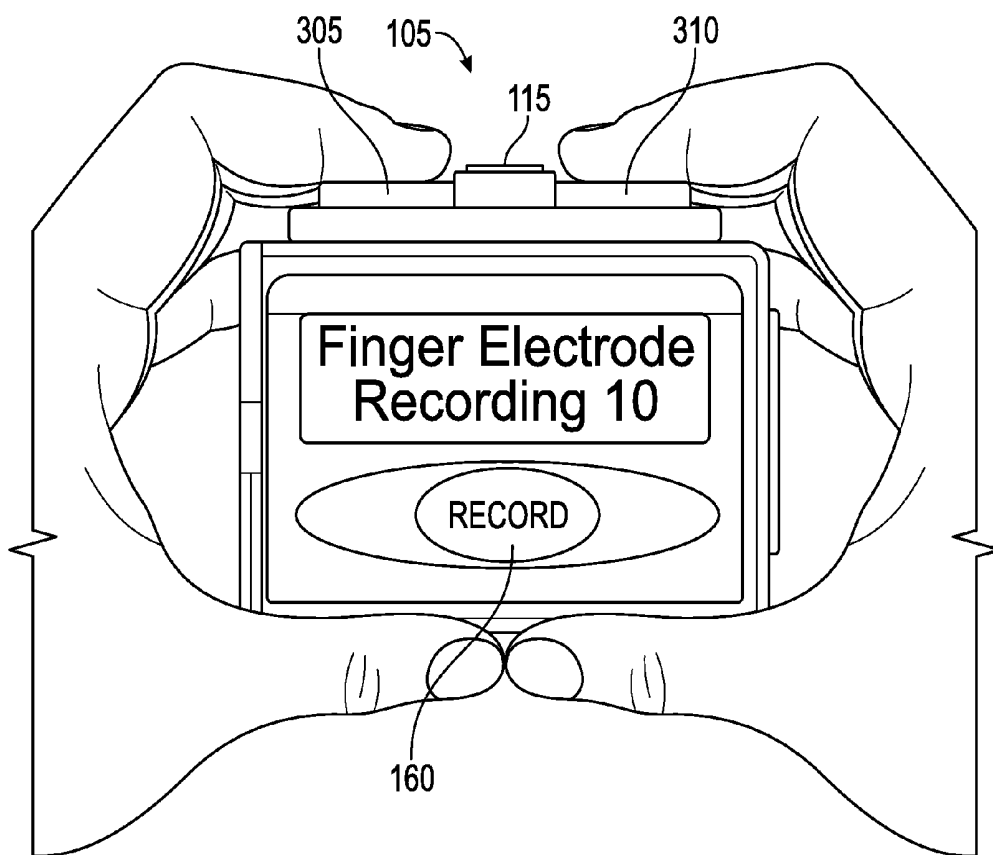


FIG. 6

**CARDIAC EVENT MONITORING SYSTEM**

## RELATED APPLICATIONS

This application is a continuation and claims the benefit under 35 U.S.C. §120 of U.S. patent application Ser. No. 11/550,759, now U.S. Pat. No. 8,983,583 titled Cardiac Event Monitoring System filed by the inventor of the present application on Oct. 18, 2006, the entire contents of which are incorporated herein by reference.

## FIELD OF THE INVENTION

This description relates to a cardiac event monitoring system.

## BACKGROUND

Cardiac event monitoring is a procedure that is conducted on patients who report symptoms that may be cardiac in origin, and that occur infrequently, such as, for example, three times or less in one week. The term "event monitoring" is used because traditionally the test relied on the occurrence of symptoms, or "events." When symptoms occur, the patient activates an event monitor to record her electrocardiogram (ECG). The patient carries the event monitor during the testing period, which can last for several days or up to, for example, 30 days.

## SUMMARY OF THE INVENTION

In one general aspect, a cardiac event monitoring system includes a base unit including a base connector, a wearable electrode system, and a plug-in adapter. The wearable electrode system includes a cable, an electrode at one end of the cable, and a cable connector at the other end of the cable. The cable connector is configured to plug into the base connector. The plug-in adapter includes electrodes and an adapter connector that is configured to plug into the base connector.

Implementations can include one or more of the following features. For example, the plug-in adapter can include two electrodes. The electrodes of the plug-in adapter can be each sized to receive a finger. The electrode of the wearable electrode system can be configured to be attached to a patient's skin. The electrodes of the plug-in adapter and the wearable electrode system can detect electrical signals from a patient's heart when coupled to the patient's skin.

The base unit can include a controller. The controller can be configured to operate in an auto capture mode, in manual mode, or in finger electrode mode. The base unit can include a speaker for transmitting data recorded from the plug-in adapter or the wearable electrode system. The base unit can include memory for storing data recorded from the plug-in adapter or the wearable electrode system. The base unit can include a display, and/or one or more input devices.

In another general aspect, a cardiac event monitoring system includes a base unit and a plug-in adapter. The base unit includes a base connector configured to receive a cable connector of a wearable electrode system. The plug-in adapter includes electrodes and an adapter connector configured to plug into the base connector of the base unit.

Implementations can include one or more of the following features. For example, the base unit can include a controller that is configured to operate in an auto capture mode.

Each of the electrodes can be sized to receive a finger. The electrodes of the plug-in adapter can detect electrical signals from a patient's heart when coupled to the patient's skin.

The base unit can include a speaker for transmitting data recorded from the plug-in adapter or the wearable electrode system. The base unit can include memory for storing data recorded from the plug-in adapter or the wearable electrode system.

In another general aspect, a method of monitoring cardiac events includes determining whether a wearable electrode system is connected to a base unit of a monitoring system, and if the wearable electrode system is connected to the base unit, operating the base unit to receive electrical signals from an electrode of the wearable electrode system. The method also includes determining whether a plug-in adapter is connected to the base unit if the wearable electrode system is not connected to the base unit, and operating the base unit to receive electrical signals from electrodes of the plug-in adapter if the plug-in adapter is connected to the base unit.

Implementations can include one or more of the following features. For example, the method can also include transmitting the electrical signals to a monitoring center if it is determined that the patient requested that the electrical signals be transmitted.

Operating the base unit to receive electrical signals from the electrode of the wearable electrode system can include monitoring the patient's electrical signals and recording the electrical signals if it is determined that the electrical signals are abnormal. Operating the base unit to receive electrical signals from the electrode of the plug-in adapter can include receiving an electrical signal from the electrode of the plug-in adapter when the patient puts a finger on at least one of the electrodes.

The method can include storing in memory electrical signals received from the plug-in adapter or the wearable electrode system for a predetermined time or until a patient transmits the electrical signals. The method can include displaying instructions to a patient on the base unit. The method can include receiving instructions from a patient from one or more input devices on the base unit.

In a further general aspect, a method of monitoring cardiac events includes providing a plug-in adapter that includes electrodes and an adapter connector that is configured to plug into a base connector of a base unit. The base connector is configured to receive a cable connector of a wearable electrode system that includes a cable, an electrode at one end of the cable, and the cable connector at the other end of the cable.

In another general aspect, a plug-in adapter includes a housing, two finger electrodes on one side of the housing, and an adapter connector on another side of the housing. The adapter connector is configured to plug into a connector of a base unit of a cardiac event monitor.

The cardiac event monitoring system provides a system that enables a patient to use a standard event monitor that uses wearable electrodes but also provides a patient with the option to use finger electrodes if the patient is uncomfortable with or does not want to use the wearable electrodes. The plug-in adapter is designed to be compatible with the base unit that is already designed to connect with the wearable electrode system. Therefore, the standard base unit does not need to be redesigned for use with the finger electrodes. It can be used for either the wearable electrodes or the finger electrodes, providing more options to the patient in a complete package.

Other features will be apparent from the description, the drawings, and the claims.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a block diagram of a cardiac event monitoring system;

FIGS. 2A and 2B are perspective views of a base unit of the cardiac event monitoring system of FIG. 1;

FIG. 3A is a perspective view of a plug-in adapter of the cardiac event monitoring system of FIG. 1;

FIGS. 3B-3D are top, front, and side plan views of the plug-in adapter of FIG. 3A;

FIG. 3E is an electrical diagram of the plug-in adapter of FIG. 3A;

FIG. 4 is a flow chart of a procedure describing operation of the cardiac event monitoring system of FIG. 1;

FIG. 5 is a perspective view showing the cardiac event monitoring system of FIG. 1 with the plug-in adapter of FIG. 3A connected to the base unit of FIGS. 2A and 2B; and

FIG. 6 is a perspective view showing a patient using the cardiac event monitoring system of FIG. 1 with the plug-in adapter of FIG. 3A connected to the base unit of FIGS. 2A and 2B.

Like reference symbols in the various drawings indicate like elements.

### DETAILED DESCRIPTION OF THE INVENTION

Cardiac event monitoring is used to evaluate a patient who experiences transient, infrequent symptoms of various forms of heart disease. Symptoms such as shortness of breath, dizziness, and palpitations are some of the common patient complaints. These symptoms may be caused by disturbances in the electrical signals that control the heart muscle contractions. The disturbances can be random, spontaneous, or emotion- or stress-induced.

Referring to FIG. 1, a cardiac event monitoring system 100 includes a base unit 105, a wearable electrode system 110, and a plug-in adapter 115. The base unit 105 includes a base connector 120 and a body 107 that houses the electrical components and includes a user interface, as discussed further below.

The wearable electrode system 110 includes a cable 125, at least two electrodes 130 at one end of the cable 125, and a cable connector 135 at the other end of the cable 125. The cable connector 135 is configured to plug into the base connector 120. Each electrode 130 is designed with a conducting member on a flat patch that contacts the patient's skin. In some cases, the flat patch of each electrode 130 is coated with a gel that improves electrical conduction between the patient's skin and the electrode surface. The patch can include an adhesive that sticks to the patient's skin. The electrodes 130 are usually placed along the patient's chest, at appropriate locations for producing the best ECG signal.

Referring also to FIGS. 2A and 2B, the base unit 105 is pager-sized, and is either handheld or patient-worn. The base unit 105 includes the body 107 that houses components that control operation of the system 100. Thus, the base unit 105 includes a controller 150 within the body 107, and various input and output devices coupled to the controller 150 through the body 107. The controller 150 receives power from a power source 155 that may be provided by batteries that are placed within a compartment 200 on a side of the body 107. The body 107 and the battery compartment 200 can be made of a suitable non-conductive lightweight material, such as a rigid plastic.

The controller 150 includes a processor 151, memory 152, a clock 153, and a counter 154 to process signals from the wearable electrode system 110 and/or the plug-in adapter 115, receive input from a patient or a service technician using the system 100, and transmit recorded data to a monitoring center, as provided by a health professional, a clinic, or a hospital. The input devices on the base unit 105 include a

symptom record button 160, a yes/transmit button 165, and a no button 170. The yes/transmit button 165 can be used in one of two ways: it can be used as a response button to answer "yes" when queried by the controller 150, or it can be used to indicate to the controller 150 to transmit the ECG. The no button 170 can be used in one of two ways: it can be used as a response button to answer "no" when queried by the controller 150, it can be used to indicate to the controller 150 to cancel a transmission of an ECG.

The output devices on the base unit 105 include a display 175 such as a liquid crystal display (LCD) that provides an interface with the patient and/or a technician, and a speaker 180 for transmitting data regarding the recording.

The system 100 is designed to record, store, and transmit ambulatory ECG signals received from the wearable electrode system 110 or the plug-in adapter 115. The system 100 can be worn for days or weeks, as it is intended for use by patients who are experiencing symptoms that are transient and infrequent in nature. The base unit 105 can be worn outside the patient's clothing if there is any chance that moisture (for example, sweat) might come in contact with the base unit 105. The base unit 105 can be worn under outer wear, such as raincoats or jackets, for protection during wet or cold conditions.

A patient would normally operate the base unit 105 and the wearable electrode system 110 as a single unit to capture ECG data. However, some patients who want the features of the base unit 105 and the wearable electrode system 110 may also want the option of finger electrode capture, which is less irritating to the patient than using the wearable electrodes 130, which have to be placed on the patient's skin to obtain data. Thus, the plug-in adapter 115 is designed to couple with the base unit 105 when the wearable electrode system 110 is disconnected or detached from the base unit 105.

Referring to FIGS. 3A-3D, the plug-in adapter 115 includes a housing 300 having finger electrodes 305, 310 on one side of the housing 300 and an adapter connector 315 protruding from another side of the housing 300. The electrodes 305, 310 are positioned such that, when the adapter 115 is attached to the base unit 105, a patient may easily place the surface of a finger on each of the electrodes 305, 310 while holding the base unit 105. The fingers used by the patient may be any of the five terminating members of the patient's hand. The adapter connector 315 is configured to plug into the base connector 120 and the connections within the connector 315 are the same as those of the connector 135 of the wearable electrode system 110 to enable both the adapter 115 and the wearable electrode system 110 to be used with the base unit 105. The housing 300 is made of a lightweight non-conductive material such as a rigid plastic. The adapter 115 is generally sized to be smaller than the base unit 105 but large enough to accommodate the fingers at the electrodes 305, 310. The adapter 115 can be rectangular in shape, as shown in the drawings.

Referring also to FIG. 3E, the adapter 115 includes electrical connections 355, 360 from the electrodes 305, 310 to the adapter connector 315. The electrical connections 355, 360 connect to the controller 150 of the base unit 105 in the same fashion as the electrical connections within the wearable electrode system 110. Additionally, the adapter 115 includes a unique identifier that enables the base unit 105 to identify the adapter 115 when it is connected to the base unit 105. For example, the unique identifier can be formed from an internal resistance formed by resistors 365, 370 having a value unique to the adapter 115.

Referring also to FIG. 4, a procedure 400 is performed by the cardiac event monitoring system 100 for monitoring car-

diac events of a patient. In general the base unit **105** turns off after a period of inactivity to conserve energy of the power source **155**. The base unit **105** can be set up so that the patient can turn on the base unit **105** by pressing any button on the base unit **105**. Initially, the controller **150** determines whether the wearable electrode system **110** is connected to the base unit **105** (step **405**). For example, the wearable electrode system **110** could be equipped with an internal resistance that is unique to the wearable electrode system **110**, and the base unit **105** could detect the resistance when the wearable electrode system **110** is connected to the base unit **105**. If the wearable electrode system **110** is connected to the base unit **105**, then the controller **150** determines if the patient had set up the base unit **105** to operate in auto capture mode by, for example, selecting auto capture mode during a set up operation (step **410**). If the patient had pre-selected the auto capture mode (step **410**), then the controller **150** operates in the auto capture mode (step **415**), a mode in which the controller **150** determines when to record the ECG, without the input from the patient.

During the auto capture mode (step **415**), the patient carries the small, battery-powered system **100** on their person for the duration of the testing period. The electrodes **130** are attached to the patient's body, such as, for example, the patient's chest, using the associated adhesive patches, and the electrodes **130** detect the electrical signals from the patient's heart. The controller **150** continuously analyzes the signals from the electrodes **130** to detect an abnormality in the electrical signal of the heart. If the controller **150** detects an abnormality, the controller **150** records and stores the event data according to pre-defined protocols. Moreover, any memory **152** that is devoted to the auto capture mode can be dynamically managed and overwritten, as needed, for new activity. Moreover, the controller **150** can send a signal to the speaker **180** indicating to the patient that data has been recorded and that the patient should transmit that data to a monitoring center. The controller **150** operates in auto capture mode (step **415**) until it receives an indication that the wearable electrode system **110** is disconnected from the base unit **105** (step **405**) or unless the patient had set up the base unit **105** to operate in manual mode (step **410**).

If the controller **150** determines that the wearable electrode system **110** is connected to the base unit **105** (step **405**) and the patient set up the base unit **105** to operate in manual mode (step **410**), then the controller **150** operates in a manual mode (step **420**). As with the auto capture mode, the patient carries the battery-powered system **100** on their person for the duration of the testing period in the manual mode. The electrodes **130** are attached to the patient's body and the electrodes **130** detect the electrical signals from the patient's heart. When a symptom occurs, the patient triggers the controller **150** in the base unit **105** to record the ECG by pressing the symptom record button **160**. The display **175** shows a countdown message while the recording takes place. The controller **150** operates in manual mode (step **420**) until it receives an indication that the wearable electrode system **110** is disconnected from the base unit **105** (step **405**) or unless the patient sets up the base unit **105** to operate in auto capture mode (step **410**).

If the controller **150** determines that the wearable electrode system **110** is not connected to the base unit **105** (step **405**), then the controller **150** determines whether the plug-in adapter **115** is connected to the base unit **105** (step **425**). For example, the plug-in adapter **115** could be equipped with the resistors **365**, **370** having a resistance that is unique to the plug-in adapter, and the base unit **105** could detect the resistance when the plug-in adapter **115** is connected to the base unit **105**. If the plug-in adapter **115** is connected to the base

unit **105**, as shown in FIG. **5**, then the controller **150** operates in the finger electrode mode (step **430**). During the finger electrode mode (step **430**), the base unit **105** shuts off or operates in a standby mode, and the controller **150** can maintain the display **175** on standby to conserve power in the power source **155** until the patient takes an action to initiate a data recording.

When the patient experiences a symptom, he presses the symptom record button **160** and watches the display **175**, as shown in FIG. **6**. The controller **150** determines that the button **160** has been pressed and enters a countdown mode, sending signals to the display **175** to display a "countdown to record" message that instructs the patient to place the fingers on the electrodes **305**, **310** such that the electrodes **305**, **310** make contact with the fingers. After the controller **150** has completed counting down, the countdown mode ends, and the controller **150** causes the display **175** to display an indication that the base unit **105** is recording data. For example, the display **175** can display the message "Finger Electrode Recording XX", where XX is the number of seconds that were specified as a measurement duration during setup of the base unit **105**. For example, as shown in FIG. **6**, the display message is "Finger Electrode recording 10." The controller **150** counts down to zero from the XX value, and, upon reaching zero, the controller **150** enters a transmit prompt mode. The controller **150** can send a signal to the display **175** to display a message requesting that the patient transmit the recorded signal, as discussed below. The controller **150** operates in finger electrode mode (step **430**) until it receives an indication that the plug-in adapter **115** is disconnected from the base unit **105** (step **425**).

After the recording is complete, the patient disconnects either the wearable electrode system **110** or the plug-in adapter **115** from the base unit **105**. Therefore, the controller **150** determines that the wearable electrode system **110** is not connected to the base unit **105** (step **405**) and the plug-in adapter **115** is not connected to the base unit **105** (step **425**). The controller **150** then determines if the yes/transmit button **165** has been pressed (step **435**). In this implementation, the base unit **105** is configured to only transmit if both the wearable electrode system **110** and the plug-in adapter **115** are disconnected from the base unit **105**. If the yes/transmit button **165** has not been pressed (step **435**), then the controller **150** causes the base unit **105** to enter into standby mode to conserve energy (step **440**).

If the controller **150** determines that the yes/transmit button **165** has been pressed (step **435**), then the controller **150** operates in transmit mode (step **445**). During transmit mode, the patient transmits the ECG data to a monitoring center using a telephone or some other suitable device. To transmit the ECG data, the patient calls the monitoring center, and follows the directions given by the monitoring center. Next, the patient places the base unit **105** on a flat surface near the telephone and places the mouthpiece of the phone behind the base unit **105**. The patient presses the yes/transmit button **165**, which indicates to the controller **150** to send a signal to the speaker **180** to start transmission of the ECG data. During transmission, the speaker **180** emits a series of tones that indicate the ECG data. If needed, in some circumstances, the patient can re-transmit ECG data.

The monitoring center staff reviews the tracings and, when necessary, notifies the patient's physician immediately. A report is generated and forwarded to the physician. In the implementation shown in FIG. **4**, the patient removes the cable connector **135** of the wearable electrode system **110** and the plug-in adapter **115** from the base unit **105** prior to transmission.

Other implementations are within the scope of the following claims. For example, in other implementations, the base unit **105** could be configured to be able to transmit when either the wearable electrode system **110** or the plug-in adapter **115** is connected from the base unit **105**. Thus, in this implementation, the patient is not required to remove the wearable electrode system **110** or the plug-in adapter **115** from the base unit **105** prior to transmitting the data. The patient may merely be required to press the transmit button **165** in order to initiate the transmit mode.

The base unit **105** can be any size suitable for permitting a patient to carry the base unit **105** on the patient's body without undue hardship.

Alternatively, the patient can wait to transmit the ECG data, which can be stored within the memory **152** of the controller **150**, for a period of time after the data is recorded.

The plug-in adapter **115** can be formed from other suitable shapes, or can be ergonomically designed. For example, the adapter **115** can have a flat base that faces the base unit **105** when plugged into the base unit **105** and have a triangularly-shaped outer surface with two angled surfaces such that the electrodes **305**, **310** are formed along the angled surfaces. As another example, the adapter **115** can have a flat base that faces the base unit **105** when plugged into the base unit **105** and have a concave or convex outer surface on which the electrodes **305**, **310** are formed. The outer surface can be polygonal, with each side including an electrode. Although the plug-in adapter **115** is suitable for making contact between the patient's fingers and the electrodes **305**, **310**, the plug-in adapter **115**, and, in particular, the electrodes **305**, **310**, can be contacted to any body part of the patient. For example, the electrodes **305**, **310** can be contacted to the chest, the legs, or the arms of the patient. Moreover, the electrodes **305**, **310** may be designed with different shapes or sizes.

The power source **155** may be turned off and on by a switch **205** (FIGS. **1** and **2B**) accessible on the compartment **200** and connected to the power source **155** and the controller **150**.

That which is claimed is:

1. A cardiac event monitoring system comprising:
  - a base unit including a base connector and a controller;
  - a wearable electrode system including a cable, an electrode at one end of the cable, and a cable connector at the other end of the cable, the cable connector being configured to plug into and to disconnect from the base connector; and
  - a plug-in adapter that includes first and second electrodes configured to detect a signal from a heart of patient when the first electrode is contacted by a first finger of the patient and the second electrode is contacted by a second finger of the patient, and an adapter connector that is configured to plug into and to disconnect from the base connector;
 wherein the plug-in adapter is coupleable to the base unit when the wearable electrode system is disconnected from the base unit;
  - wherein the controller is configured to selectively operate the base unit to receive electrical signals from the heart of the patient upon detection of one of a normal operation connection and an optional operation connection;
  - wherein the normal operation connection is defined as a connection of the cable connector of the wearable electrode system to the base connector of the base unit; and
  - wherein the optional operation connection is defined as a connection of the adapter connector of the plug-in adapter to the base connector of the base unit.
2. The cardiac event monitoring system according to claim 1 wherein the plug-in adapter comprises two electrodes.

3. The cardiac event monitoring system according to claim 1 wherein the electrodes of the plug-in adapter are each sized to receive a finger of the patient.

4. The cardiac event monitoring system according to claim 1 wherein the electrode of the wearable electrode system is configured to be attached to a body part of the patient.

5. The cardiac event monitoring system according to claim 1 wherein the controller is further configured to operate in an auto capture mode.

6. The cardiac event monitoring system according to claim 1 wherein the electrodes of the plug-in adapter and the wearable electrode system detect the electrical signals when coupled to a body part of the patient.

7. The cardiac event monitoring system according to claim 1 wherein the base unit comprises a speaker for transmitting data recorded from the plug-in adapter or the wearable electrode system.

8. The cardiac event monitoring system according to claim 1 wherein the base unit comprises memory for storing data recorded from the plug-in adapter or the wearable electrode system.

9. The cardiac event monitoring system according to claim 1 wherein the base unit comprises a display.

10. The cardiac event monitoring system according to claim 1 wherein the base unit comprises one or more input devices.

11. The cardiac event monitoring system according to claim 1 wherein the controller is further configured to operate in a manual mode.

12. A cardiac event monitoring system comprising:

a base unit including a base connector configured to receive a cable connector of a wearable electrode system; and

a plug-in adapter that includes first and second electrodes configured to detect a signal from a heart of a patient when the first electrode is contacted by a first finger of the patient and the second electrode is contacted by a second finger of the patient, and an adapter connector configured to plug into and to disconnect from the base connector of the base unit;

wherein the plug-in adapter is coupleable to the base unit when the wearable electrode system is disconnected from the base unit; and

wherein the base unit is configured to selectively receive electrical signals from the heart of the patient through one of a normal operation connection defined as electrical coupling of the cable connector of the wearable electrode system to the base connector of the base unit, and an optional operation connection defined as electrical coupling of the adapter connector of the plug-in adapter to the base connector of the base unit.

13. The cardiac event monitoring system according to claim 12 wherein the base unit comprises a controller that is configured to operate in an auto capture mode.

14. The cardiac event monitoring system according to claim 12 wherein each of the electrodes is sized to receive a finger of the patient.

15. The cardiac event monitoring system according to claim 12 wherein the electrodes of the plug-in adapter detects the electrical signals when coupled to a body part of the patient.

16. The cardiac event monitoring system according to claim 12 wherein the base unit comprises a speaker for transmitting data recorded from the plug-in adapter or the wearable electrode system.

9

17. The cardiac event monitoring system according to claim 12 wherein the base unit comprises memory for storing data recorded from the plug-in adapter or the wearable electrode system.

18. A method of monitoring cardiac events generated as electrical signals from a heart of a patient, the method comprising:

providing a plug-in adapter that includes first and second electrodes configured to detect a signal from a heart of a patient when the first electrode is contacted by a first finger of the patient and the second electrode is contacted by a second finger of the patient and an adapter connector that is configured to connect to and to disconnect from a base connector of a base unit, wherein the base connector is configured to connect to and to disconnect from a cable connector of a wearable electrode system that includes a cable, an electrode at one end of the cable, and the cable connector at the other end of the cable;

determining whether the cable connector of the wearable electrode system is connected to the base connector of the base unit;

wherein if the cable connector of the wearable electrode system is connected to the base connector of the base unit, operating the base unit to receive the electrical signals from the electrode of the wearable electrode system;

wherein if the cable connector of the wearable electrode system is not connected to the base connector of the base

10

unit, determining whether the adapter connector of the plug-in adapter is connected to the base connector of the base unit; and

wherein if the adapter connector of the plug-in adapter is connected to the base connector of the base unit and at least one of the electrodes of the plug-in adapter is contacted by a finger of the patient, operating the base unit to receive the electrical signals from the electrodes of the plug-in adapter.

19. The method according to claim 18 further comprising transmitting the electrical signals to a monitoring center.

20. The method according to claim 18 wherein operating the base unit to receive the electrical signals from the electrode of the wearable electrode system includes monitoring the electrical signals and recording the electrical signals.

21. The method according to claim 18 wherein operating the base unit to receive the electrical signals from the electrode of the plug-in adapter includes receiving the electrical signal from the electrode of the plug-in adapter when a body part of the patient makes contact with the electrodes.

22. The method according to claim 18 further comprising storing in a memory included in the base unit the electrical signals received from the plug-in adapter or from the wearable electrode system for a predetermined time or until the electrical signals are transmitted.

23. The method according to claim 18 further comprising displaying instructions to the patient on the base unit.

24. The method according to claim 18 further comprising receiving instructions from the patient from one or more input devices on the base unit.

\* \* \* \* \*

专利名称(译)	心脏事件监测系统		
公开(公告)号	<a href="#">US9198590</a>	公开(公告)日	2015-12-01
申请号	US14/197826	申请日	2014-03-05
[标]申请(专利权)人(译)	MEDICOMP		
申请(专利权)人(译)	MEDICOMP INC.		
当前申请(专利权)人(译)	MEDICOMP INC.		
[标]发明人	BALDA DANIEL THOMAS ROBERT MICHAEL MAREK MONTE MANN TARY BALDA ANTHONY		
发明人	BALDA, DANIEL THOMAS, ROBERT MICHAEL MAREK, MONTE MANN, TARY BALDA, ANTHONY		
IPC分类号	A61B5/0408 A61B5/0432 A61B5/024 A61B5/0404 A61B5/0428 A61B5/00		
CPC分类号	A61B5/0408 A61B5/02438 A61B5/0404 A61B5/0432 A61B2562/226 A61B5/04325 A61B5/6826 A61B2560/0209 A61B2560/0468 A61B5/0428 A61B2018/00178		
其他公开文献	US20140187898A1		
外部链接	<a href="#">Espacenet</a> <a href="#">USPTO</a>		

摘要(译)

心脏事件监测系统包括基座单元，基座单元包括基座连接器，可穿戴电极系统和插入式适配器。可穿戴电极系统包括电缆，电缆一端的电极和电缆另一端的电缆连接器。电缆连接器配置为插入基座连接器。插入式适配器包括电极和适配器连接器，适配器连接器配置为插入基座连接器。

