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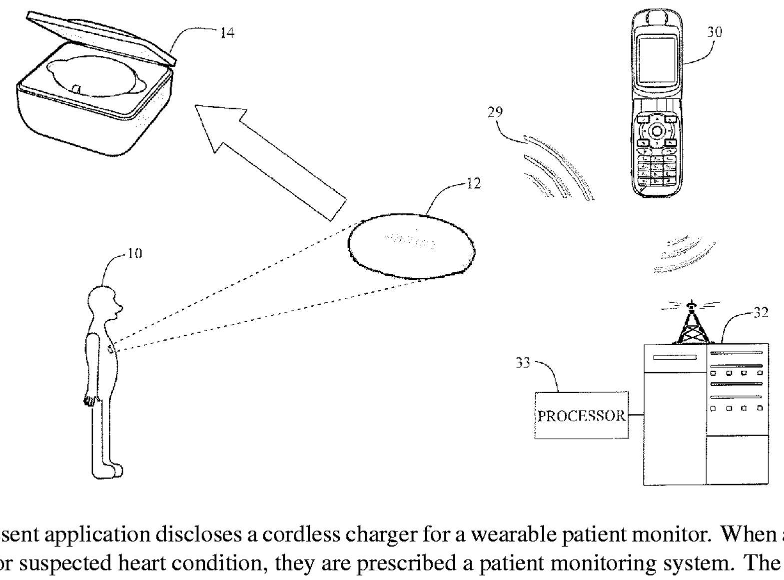
(54) Title: CORDLESS CHARGER FOR A WEARABLE PATIENT MONITOR



(57) Abstract: The present application discloses a cordless charger for a wearable patient monitor. When a patient (10) is diagnosed with a heart condition, or suspected heart condition, they are prescribed a patient monitoring system. The system includes monitors (12) that the patient (10) wears to collect the data of interest. Each day, the patient swaps the monitor (12) he or she is wearing with a fully charged monitor (12) from a cordless charger (14). In this manner, a fresh monitor (12) is always available for monitoring the patient (10). The cordless charger (14) includes a battery (50) that powers the processes of the charger and recharges batteries (34) of the monitors (12). Data from the monitors can be either offloaded to the charger memory (70), or transmitted to a remote database (32) via the patient's Bluetooth enabled cellular phone (30) or other like device.

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CORDLESS CHARGER FOR A WEARABLE PATIENT MONITOR

DESCRIPTION

The present application relates to use in the diagnostic arts. It finds particular application in wireless heart monitors that are intended to be used by a patient for a limited period of time, e.g. a month. However, it also finds application in wireless monitors for different purposes and for different usage durations.

People can experience cardiac arrhythmias or syncopal events at unpredictable intervals. These events can be difficult to catch and monitor at a physician's office due to their infrequent nature.

Also, there is a trend toward releasing hospital patients earlier after surgery or a medical event, such as a heart attack. It would be advantageous to monitor the cardiac function for a limited duration after release.

Typically, patients in need of short term monitoring are equipped with monitors designed for long term use. The monitors may require frequent, e.g. daily, battery replacement or charging. Others have larger batteries to extend the time between charging or replacement. Because batteries are heavy, devices with larger batteries are less comfortable to wear.

While rechargeable batteries are convenient, they require a battery charger. Changing the monitor often involves changing a patch or other body mounting, which is adhered to the patient's chest. Hence, the monitors are typically changed and recharged in the bathroom, where the charger is plugged in. This, disadvantageously, introduces another device with a power cable and plug into the bathroom. There is often little space to put these devices and limited outlets, both of which may already be allocated to power toothbrushes, hair dryers, curling irons, shavers, or the like. In addition to limited space and limited outlets, sometimes outlets are not available, or have different power outputs, making them useless without a converter. This may happen, for example, when traveling to jurisdictions where outlets have higher or lower wall plug voltage standards.

The present application provides a new and improved patient monitoring system which overcomes the above-referenced problems and others.

In accordance with one aspect, a patient monitoring system is disclosed. At least one wearable patient monitor monitors an aspect of a patient's physiology. The monitor has a rechargeable power source. A cordless charger charges the power source. A data transfer system transfers data from the monitor to a processor or memory at a remote location.

In accordance with another aspect, a method of patient monitoring is disclosed. At least one aspect of a patient's physiology is monitored with a first wearable patient monitor with its own rechargeable power source. Data is transferred from the first monitor to a processor or database. The first monitor is exchanged with a second monitor so that the first monitor can recharge in a cordless charging unit.

In accordance with another aspect, a patient monitoring system is disclosed. A first means for monitoring monitors at least one aspect of a patient's physiology. The means for monitoring includes a data storage means. A data transfer means transfers data from the monitoring means to a data storage means. A second means for monitoring also monitors the aspect of the patient's physiology, and a means for cordlessly recharging recharges the monitoring means.

One advantage resides in increased convenience for the patient.

Another advantage resides in the safety of low voltages.

Another advantage resides in simplified portability of the charger.

Another advantage resides in ease of travel among jurisdictions with different electrical power standards

Still further advantages of the present invention will be appreciated to those of ordinary skill in the art upon reading and understand the following detailed description.

The invention may take form in various components and arrangements of components, and in various steps and arrangements of steps. The drawings are only for purposes of illustrating the preferred embodiments and are not to be construed as limiting the invention.

FIGURE 1 is an illustration of interaction aspects of a wearable monitor;

FIGURE 2 is a diagrammatic illustration of internal components of an exemplary monitor;

FIGURE 3 shows a monitor docked in a cordless charger;

FIGURE 4 depicts a cordless charger with two docking bays; and

FIGURE 5 is a block diagram of the cordless charger.

With reference to FIGURE 1, a patient **10** who either has or is suspected of having a heart or other condition wears a patient monitor **12**. The monitor **12** can monitor any physiological condition that is measurable non-invasively. While the monitor **12** in the preferred embodiment measures cardiac activity, a monitor **12** that monitors any of a broad range of conditions are contemplated. In order to detect cardiac signals, the monitor is worn in close proximity to the specific anatomy being monitored. Typically, a doctor prescribes the use of the monitor **12**. The patient **10** is supplied with two of the monitors **12**, a cordless charger **14**, and a supply of skin surface patches. The patient is instructed on preparation of the skin area, applying the patch to the skin area, and how to attach the monitor **12** to the patch so it can start monitoring the physiological process at interest. Typically the patches are replaced every three to seven days. Each time the patient prepares and applies the patch in substantially the same manner. Preferably, the monitor itself **12** is exchanged daily, and the first is charged while the second is monitoring, and vice versa.

With reference to FIGURE 2, the monitor includes a sensing array **20**, which senses the physiological process that is to be monitored. The sensing array can include an accelerometer, electrical leads, an acoustic pickup, pressure sensor, or the like The raw data gathered by the sensing array **20** is processed by an on-board processor **22**. The processor **22** filters useful information from stray noise, artifacts, background, normal physiological conditions, and other uninteresting information. Since the monitor **12** monitors continuously, vast amounts of information are generated. The processor **22** compares the gathered data to parameters that are pre-programmed into a data parameter or rules memory **24**. If, after the comparison is made, the data is determined to be medically significant, it is stored in a collected data memory **26**. Otherwise, the data is discarded. Useful data is sent to a data transfer system. Preferably, the data transfer system includes a Bluetooth™ transmitter **28**, although other low power transmission protocol are contemplated. With reference again to FIGURE 1, the transmitter **28** transmits a short range signal **29** to the patient's Bluetooth enabled cellular telephone **30**. It is to be understood that any equivalent to a cellular phone is also contemplated. This includes, but is not limited to PDAs, Pocket PCs, Tablet PCs, laptop computers, RIM BlackBerries, Motorola Q-phones, and other like devices capable of wireless communication. The cell phone **30** then communicates the information collected by the monitor **12** over a cell phone network **31** to a database **32** such as in a computer at the physician's office, hospital, or the like. The database **32** does not have to be resident on a computer, but can be accessible from other devices. Additionally, the information can go to pre-selected third parties as well, such as researchers, statisticians, referring physicians, family members, or the like. Once the data is available, the clinician then can, at any time, review the information collected by the monitors **12** in order to better diagnose and treat the patient **10**. In this embodiment, the monitor **12** could transfer the data at a variety of times. For example, the monitor **12** might transmit when the memory **26** is nearly filled to capacity, or it may be set to transmit at regular intervals or at certain times of the day (such as when it is docked in the charger **14**).

Another aspect of the monitor's **12** transmission comes in conjunction with emergency situations. If the monitor **12** detects upon comparing detected data with the data or rules in the data parameter memory **24** that a critical situation is present, the monitor **12** triggers the patient's cell phone **30** to contact the appropriate emergency service. Preferably the message would contain the type of situation that the monitor is currently detecting, so the paramedics could be better prepared. Alternately, if detected data differs from normal for the monitored patient, crosses into a pre-selected zone, or is otherwise determined to be significant, the monitored data is sent via the cell phone **30** to the database **32**. A processor **33** in conjunction with the database alerts the clinician that data that should be analyzed promptly has been received.

With reference again to FIGURE 2, the components **20, 22, 24, 26,** and **28** are powered by a battery **34**. The monitor battery **34** is preferably a rechargeable lithium-ion cell that has a useful run time that exceeds 24 hours, within a margin of safety. A battery **34** that can operate the monitor **12** for 48 hours or more is preferable. That way, the patient can swap monitors **12** once a day, placing the one that came off the patch into the charger **14** and replacing it with the fully charged monitor **12** that just came out of the charger. For the application described, the battery **34** can be relatively small, e.g., having a capacity of approximately 150 mA hours. This value balances the time needed to perform the task (plus an extra margin of safety) and the size and weight of the battery. Ideally, the battery is as small and as light as possible while still providing adequate power.

The monitor **12** includes contacts **36**, which engage matching contacts (not shown) in the charger **14**. for receiving a charge when inserted into the charger **14**. In the preferred embodiment, the battery **34** in the monitor **12** can receive a full charge (empty to full) promptly, e.g. in approximately three hours. That way, should one of the two monitors fail, the patient will only be without the monitor while it is charging, which will be a relatively short period of time.

In another embodiment, with reference to FIGURE 3, the data transfer system does not include a cellular phone. In this embodiment, cordless charger **14** includes a short range signal receiver **38** and a memory **70**. The monitor **12** transmits its data to the charging station where it is stored. Alternately, the data can be downloaded from the monitor to the charging station memory via contacts **36** each time the monitor is charged. The charging station stores the data so it can later be downloaded when the patient turns the monitors **12** and charging station **14** back into the physician. Alternately, the charging station **14** includes a cellular communication circuit **39**, and takes the place of the cellular phone **30** of the previous embodiment. In another embodiment, the charger **14** could be adapted to charge the cell phone **30** as well.

In another embodiment, where a patient is supplied with a home monitoring system in addition to the monitors **12**, the monitors **12** can transmit data to a temporary storage in the home monitoring system. The home monitoring system then relays the information to off site storage or processing, such as the database **32**.

Turning now to FIGURE 4, a dual-bay cordless charger **40** is shown. The charger **40** includes a housing **42** with two bays **44a**, **44b**. The second bay **44b** facilitates storage of the second monitor. One or both of the bays **44a, 44b** have the appropriate contacts for charging the monitor **12** and receiving information therefrom. An electrically inactive bay may just accommodate the second monitor, when it is not in use. This facilitates keeping paired monitors together between patients. Of course, it is possible that both bays of the charger **40** could be active to charge and transfer information. Additionally, the second bay can also be used for cleaning or sanitizing the monitor **12**. For example, the patient can be supplied with a liquid sterilant for the second bay **44b** for sanitizing the monitor while not in use. The housing may also include automatic sanitation facilities such as a sterilant or disinfectant injector, heater, timer, or the like.

Now with attention to FIGURE 5, a block diagram of the charger **14** is depicted. First and foremost, the charger **14** includes a battery **50** of its own for recharging the batteries **34** of the monitors **12** and for powering its own functions. In one embodiment, the battery **50** is compatible and interchangeable with the patient's cell phone **30**, or other wireless device. The charger **14** includes a processor **52** that controls the various sub-processes that occur in the course of the charger's **14** normal operation. The battery **50** itself is rechargeable. In the preferred embodiment, the patient **10** does not have to worry about charging the battery **50** of the charger **14**. The battery **50** is charged at a service station and is fully charged when the patient **10** takes possession of it. If a patient is monitored for more than the life of a charge of battery **50**, e.g. a month, the charger **14** is replaced on the patient's monthly visit. Preferably, the battery **50** is a lithium ion cell and can be either permanent or removable. If the battery **50** is removable, it could be charged independently of the rest of the charger **14**, so that the charger **14** could be field ready with another battery without having to wait for the battery **50** to recharge. Alternately, the battery **50** can be non-rechargeable, removable standard batteries. This would enable (and perhaps require) the patient to replace them. In yet another embodiment, it is contemplated that the charger **14** can be disposable. In the illustrated embodiment, however, a charger **54** receives DC current from an external power supply to charge the battery **50**. One or more battery management sub-processors **56** regulates the charging of the battery **50**.

A monitor recharging sub-processor **58** oversees the charging of the batteries **34**. The battery charge sub-processor **56** works in conjunction with the recharging sub-processor **58** to adjust charging to achieve optimum efficiency. Specifically, the recharging sub-processors balance preserving a life of battery **50** and promptness of charging battery **34**. In the preferred embodiment, the battery **50** receives a charge that is sufficient to enable it to charge the batteries **34** of the monitors **12** for about a month, that is, about 30 times. It is also desired to give the battery **50** plenty of extra charges should they be needed, and to account for untraceable losses. The battery **50** is able to charge the monitor batteries **34** about sixty times in the preferred embodiment. In the preferred embodiment, the battery **50** is rated at 4800 mA hours fully charged. Voltage regulators **60** and a current monitor **62** report to the monitor recharging sub-processor **58**.

When the battery **50** has 4800 mA hours and the battery **34** has 150 mA hours, the maximum number of full charges is about 4800/150 ≈ 32. However, since the battery **34** is typically charged when it is only a third to a half discharged, the number of charges is two to three times this amount. On the other hand, the charging requires a voltage differential between the two batteries. As the battery **50** starts approaching its low voltage limit, the charging rate may be slowed. To optimize the number of recharges and minimize inefficiencies, the voltage difference is reduced when the battery **34** is most drained. As the battery **34** approaches full charge, the charging voltage is increased. When the monitor is fully charged, as sensed by the monitor recharging sub-processor **58**, the processor **52** directs a power switch **64** to cut power and stop charging the monitor **12**. A monitor detection sensor **66** reports to the processor **52** when the presence of the monitor **12** is detected, so it can determine when to discontinue charging should the monitor **12** be removed prematurely.

The charger **14** also includes a monitor testing sub-processor **68** that runs a diagnostic routine each time a monitor **12** is inserted into the charger **14**. This way, the charger **14** detects any malfunctions in the monitors **12**. In an embodiment where the charger **14** has no communication capabilities of its own, it a malfunction message is sent to the monitor **12** to report its defect (via Bluetooth through the patient's cell phone **30**) to the database **32**.

Some embodiments include storage on the charger **14**. An SD card or flash memory **70** is connected to the processor **52**. These embodiments communicate with the monitor via either USB or serial ports. In a USB embodiment, a signal multiplexor **72** and USB port **73** receive communications from the monitor **12** and rout them to a USB hub **74**. The data is processed and stored in the memory **70**. In the serial communication embodiment, the processor processes signals from a serial port **76** and stores them in the memory **70**. Later, the data can be off-loaded by either removing the SD or flash card **70** or via a USB port **78** which connects with the database **32** either directly or over a remote communication medium such as telephone lines, the internet, a cell phone, or the like .

The charger **14** in some embodiments has a user interface **80**. The user interface **80** allows the user to offload data (i.e. over a USB connection) or to program monitors (e.g. setting threshold values, emergency conditions, rules, etc.) over the serial **76** or USB **73** connection.

The invention has been described with reference to the preferred embodiments. Modifications and alterations may occur to others upon reading and understanding the preceding detailed description. It is intended that the invention be constructed as including all such modifications and alterations insofar as they come within the scope of the appended claims or the equivalents thereof.

CLAIMS

Having thus described the preferred embodiments, the invention is now claimed to be:

1. A patient monitoring system comprising:

at least one wearable patient monitor **(12)** for monitoring at least one aspect of a patient's physiology, the monitor including a rechargeable power source **(34)**;

a cordless charger **(14)** for recharging the rechargeable power source **(34)** of the monitor **(12)**;

a data transfer system for transferring data from the monitor **(12)** to a processor or memory **(32)** at a remote site.

2. The patient monitoring system as set forth in claim 1, further including:

a memory **(70)** disposed in the cordless charger **(14)**.

3. The patient monitoring system as set forth in claim 1, wherein the monitor **(12)** first transmits data to a temporary storage, which then relays the data to the processor or memory **(32)**.

4. The patient monitoring system as set forth in claim 1, wherein the monitor rechargeable power supply **(34)** includes a battery **(34)** sized to power the monitor **(12)** for at least 24 hours and a charger battery **(50)** is sized to recharge the monitor battery **(34)** at least thirty times.

5. The patient monitoring system as set forth in claim 4, wherein the cordless charger battery **(50)** is rechargeable.

6. The patient monitoring system as set forth in claim 4, wherein the charger battery **(50)** is removable and replaceable.

7. The patient monitoring system as set forth in claim 1, wherein the cordless charger battery **(50)** includes a battery that is interchangeable with the battery of a cellular phone.

8. The patient monitoring system as set forth in claim 1, wherein the monitor **(12)** further includes:

a sensor assembly **(20)** for sensing the physiology aspect; and

a short range transmitter **(28)** for transmitting sensed physiological data, the sensor assembly **(20)** and the short range transmitter **(28)** being powered by the rechargeable power supply **(34)**.

9. The patient monitoring system as set forth in claim 8, wherein the monitor **(12)** further includes:

a memory **(26)** for storing the sensed physiological data and a processor **(22)** for at least one of (a) determining which sensed physiological data should be transmitted by the short range transmitter **(28)** and (b) controlling the short range transmitter **(28)** to transmit the physiological data stored in the memory **(26)** at intervals, the memory **(26)** and the processor **(22)** being powered by the rechargeable power supply.

10. The patient monitoring system as set forth in claim 8, further including:

a wireless communication capable device **(30)** that in turn transmits it to a remote database **(32)**.

11. The patient monitoring system as set forth in claim 1, further including:

a sensor assembly **(20)** for sensing the physiology aspect;

a memory **(26)** for storing the sensed physiological data, wherein the physiological data is subsequently transferred to a charger memory **(70)** and stored.

12. The patient monitoring system as set forth in claim 11, wherein the data from the charger memory **(70)** is downloaded to a database **(32)** at a remote site.

13. The patient monitoring system as set forth in claim 11, wherein the data from the charger memory **(70)** is transmitted from the charger **(14)** to a database **(32)** at a remote site.

14. The patient monitoring system as set forth in claim 1, wherein the cordless charger **(14)** includes at least two docking bays **(44a, 44b)**, at least one of the docking bays **(44a, 44b)** being functional.

15. A method of patient monitoring comprising:

monitoring at least one aspect of a patient's physiology with a first wearable, patient monitor **(12)** with a rechargeable power supply source **(34)**;

transferring data from the first monitor **(12)** to a processor or database **(32)** at a remote site;

providing a second wearable rechargeable patient monitor **(12)** for exchange with the first monitor **(12)** and monitoring the at least one aspect of the patient's physiology with the second wearable patient monitor **(12)**; and,

providing a charging unit **(14)** for recharging the first wearable rechargeable patient monitor **(12)**.

16. The method as set forth in claim 15, wherein the at least one aspect of the patient's physiology includes cardiac activity.

17. The method as set forth in claim 15, wherein the transferring includes wirelessly transmitting the data to a device **(30)** capable of wireless communication and from the wireless communication device **(30)** to the processor or database **(32)** at the remote site.

18. The method as set forth in claim 15, further including:

at least one of replacing and recharging a battery **(50)** of the cordless charging unit **(14)**.

19. The method as set forth in claim 18 further including:

sizing the power supply source **(34)** so that it can power the monitor **(12)** for at least 24 hours; and

sizing the battery **(50)** so that it can charge the power supply source **(34)** at least thirty times.

20. The method as set forth in claim 15, further including:

exchanging the second patient monitor **(12)** with the first patient monitor **(12)** and monitoring again with the first patient monitor **(12)** while recharging the second patient monitor **(12)**.

21. The method as set forth in claim 15, further including:

sensing the physiology aspect with a sensor **(20)**;

storing the sensed physiological data in a memory **(26)**;

processing the sensed physiological data with a processor **(22)** to determine what portions of the physiological data are useful and what portions are negligible;

transmitting the useful sensed physiological data with a transmitter **(28)**; and

powering the sensor **(20)**, the memory **(26)**, the processor **(22)**, and the transmitter **(28)** with the rechargeable power supply **(34)**.

22. The method as set forth in claim 15, wherein the step of transferring includes:

transferring the data to a memory **(70)** on the cordless charging unit **(14)**; and

storing the data in the memory **(70)** of the cordless charging unit **(14)**.

23. An apparatus for performing the method of claim 15.

24. A patient monitoring system comprising:

a first means for monitoring **(12)** at least one aspect of a patient's physiology;

a means for storing data **(26)** within the means for monitoring **(12)**;

a means for transferring data **(28)** from the means for monitoring **(12)** to a remote means for data storage **(32, 70)**;

a second means for monitoring **(12)** at least one aspect of the patient's physiology; and,

a means for cordlessly recharging **(14)** the first and second means for monitoring **(12)**.

25. A charging device **(14)** comprising:

a cordless housing **(42)** that includes at least one active docking bay **(44a)** in which a rechargeable medical device **(12)** is received and charged.

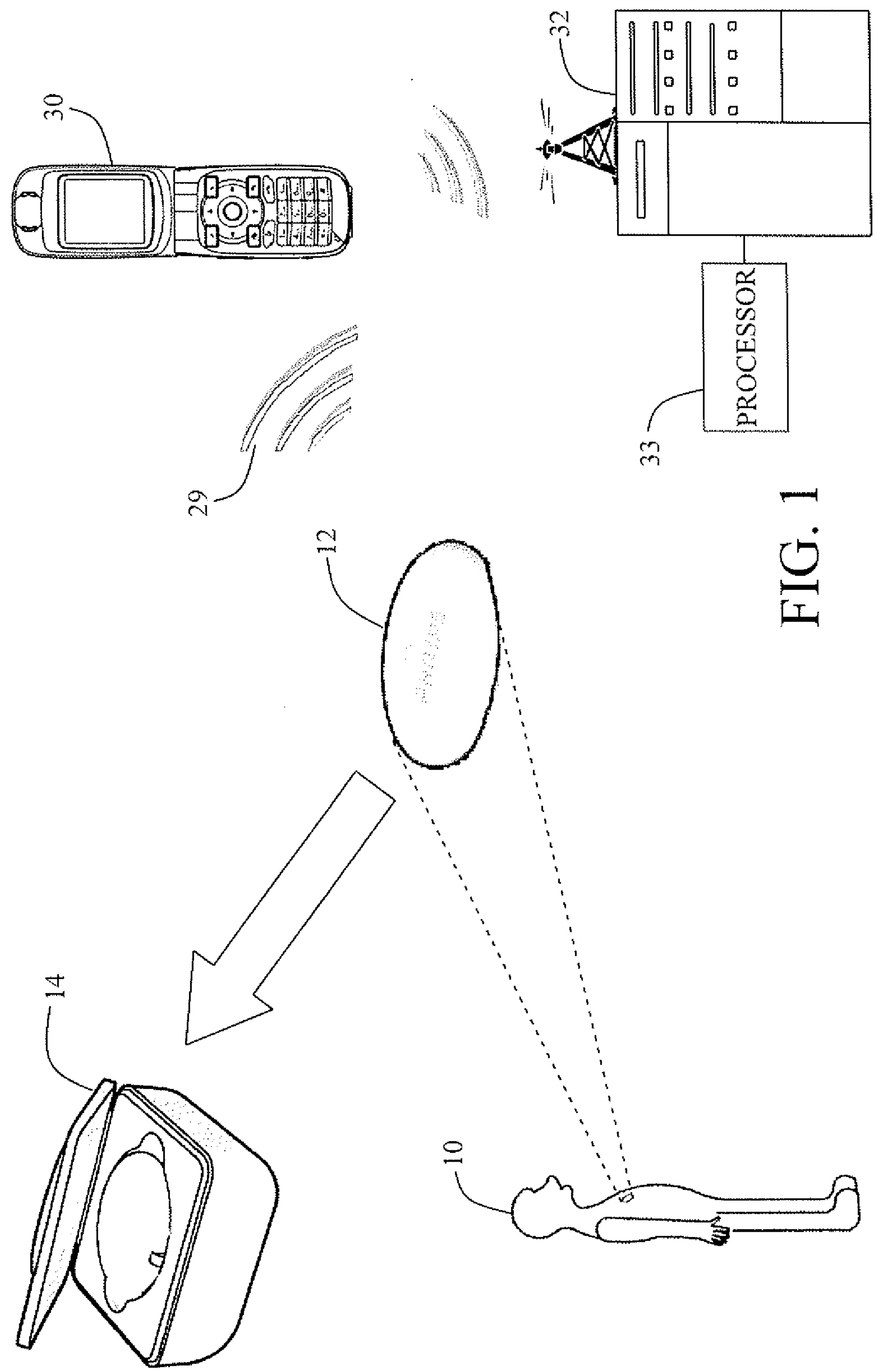

FIG. 1

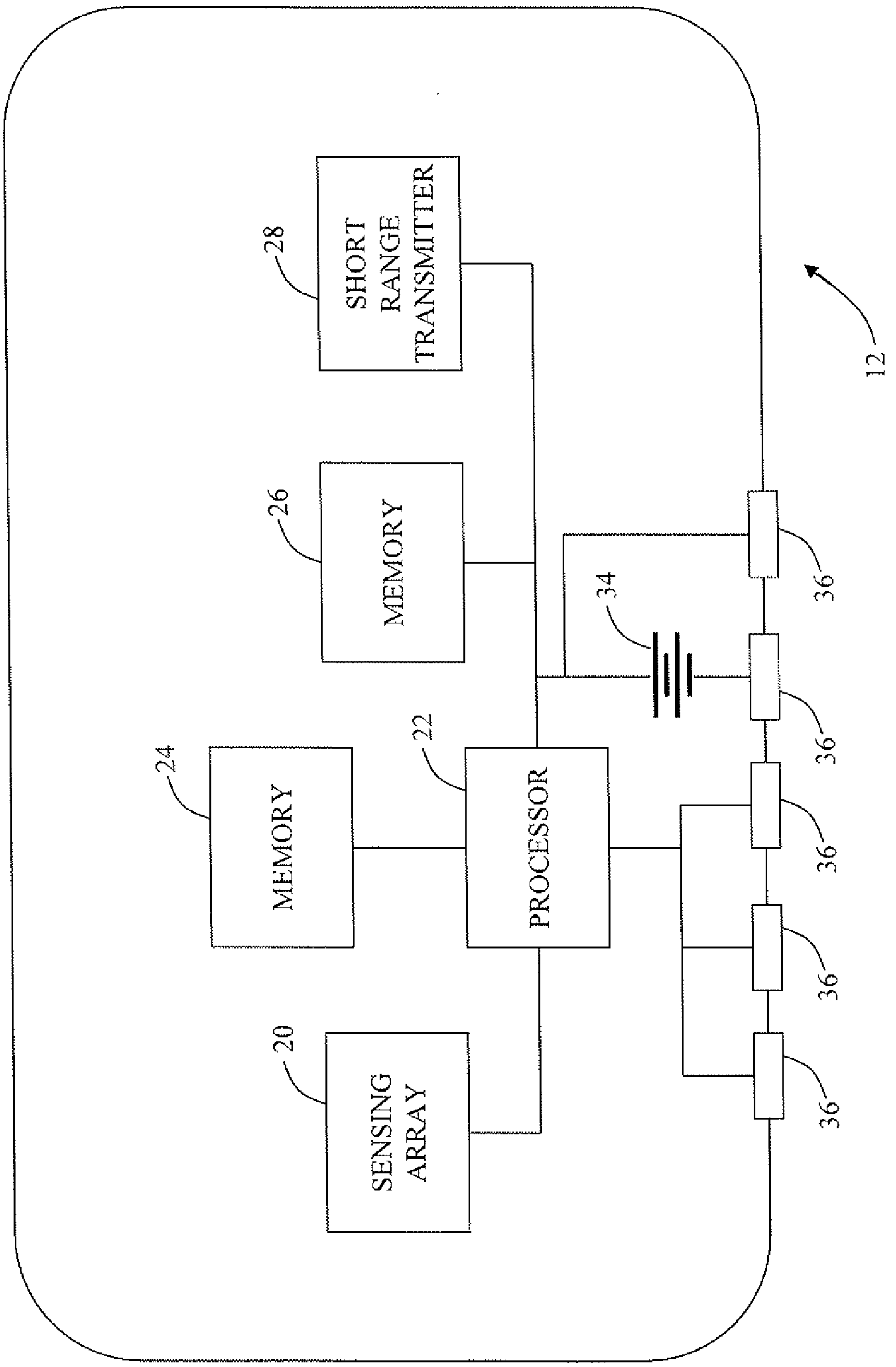
SHORT RANGE TRANSMITTER
28
MEMORY
26
MEMORY
24
PROCESSOR
22
SENSING ARRAY
20
34
36
36
36
36
36
12

FIG. 2

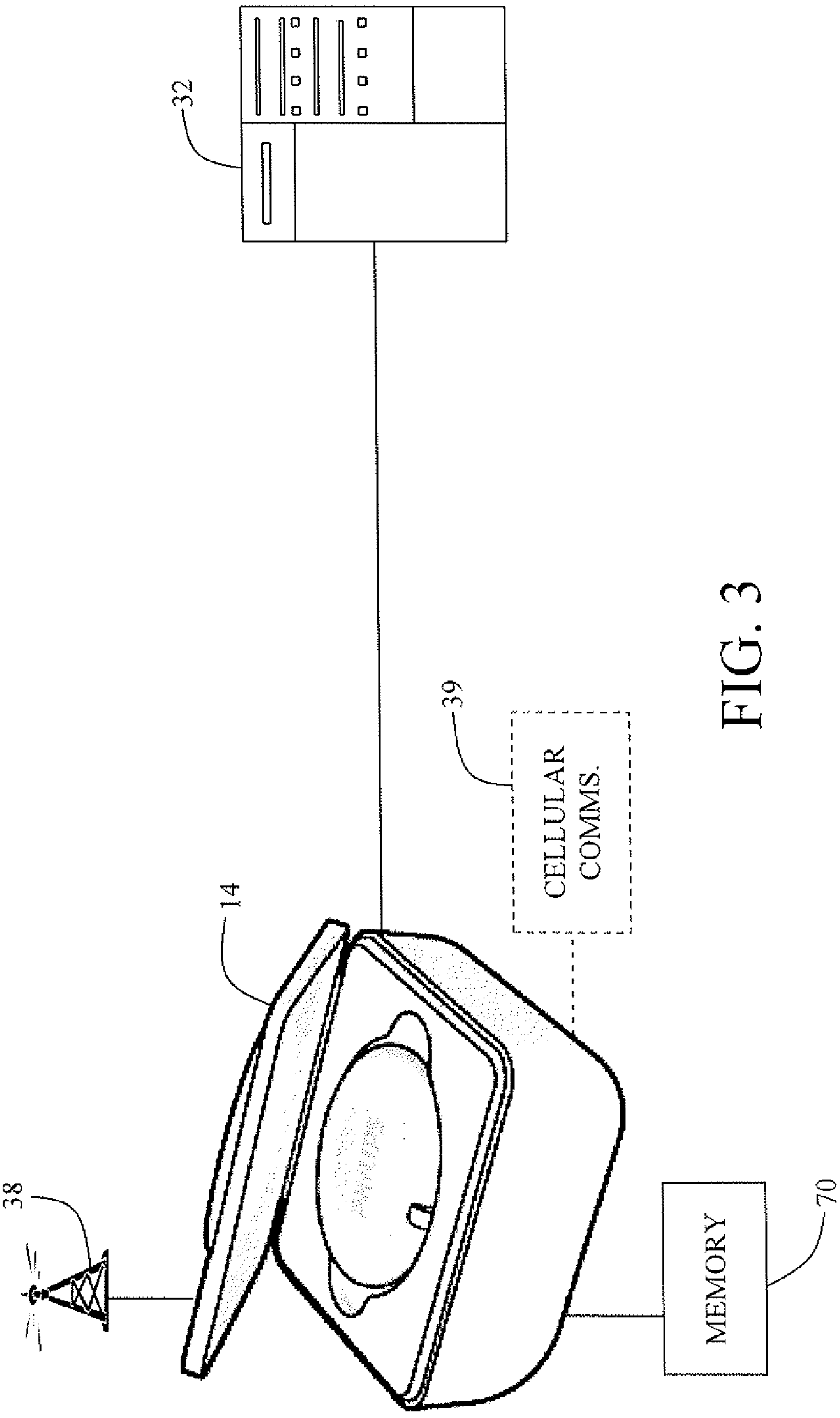

FIG. 3

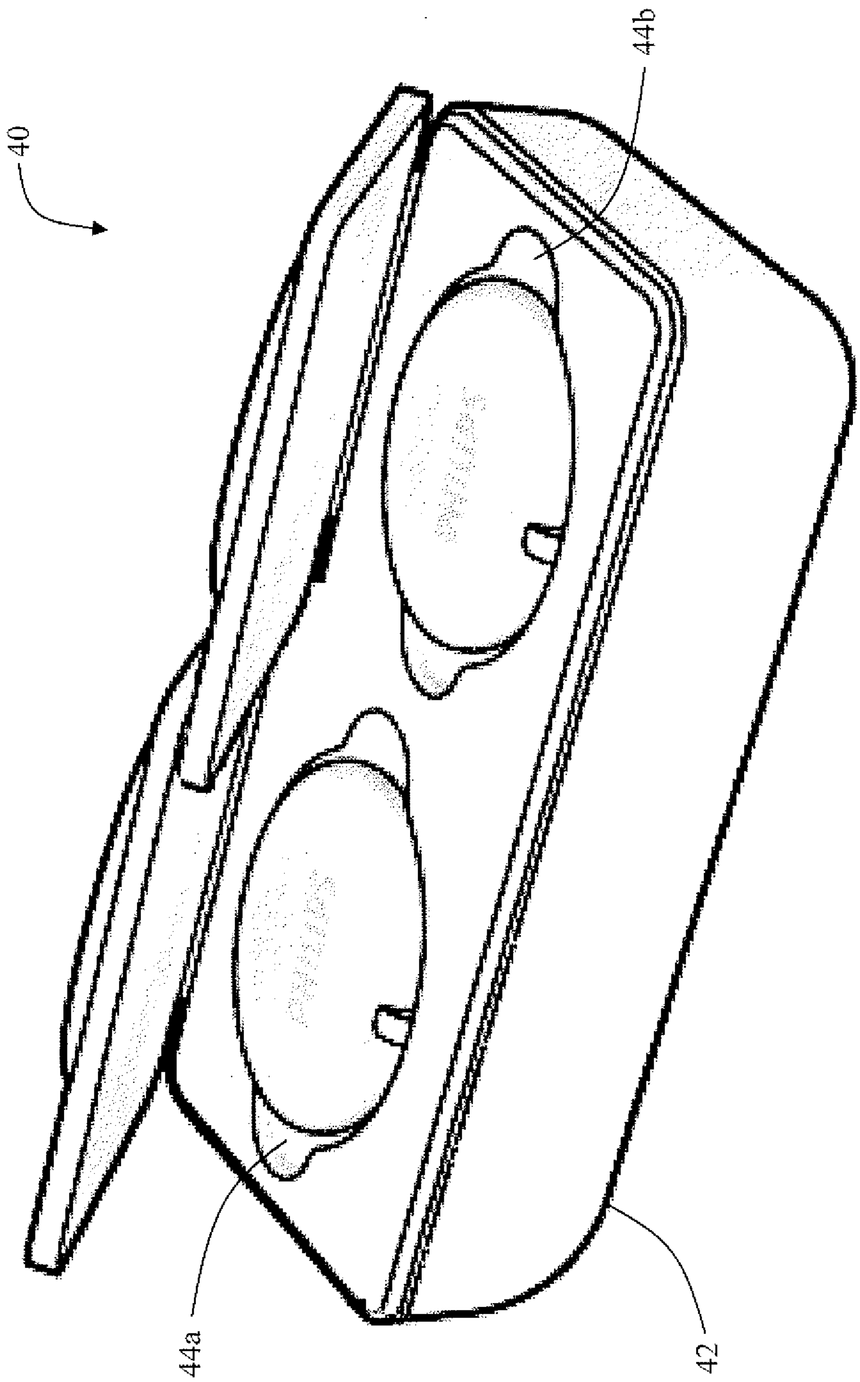

FIG. 4

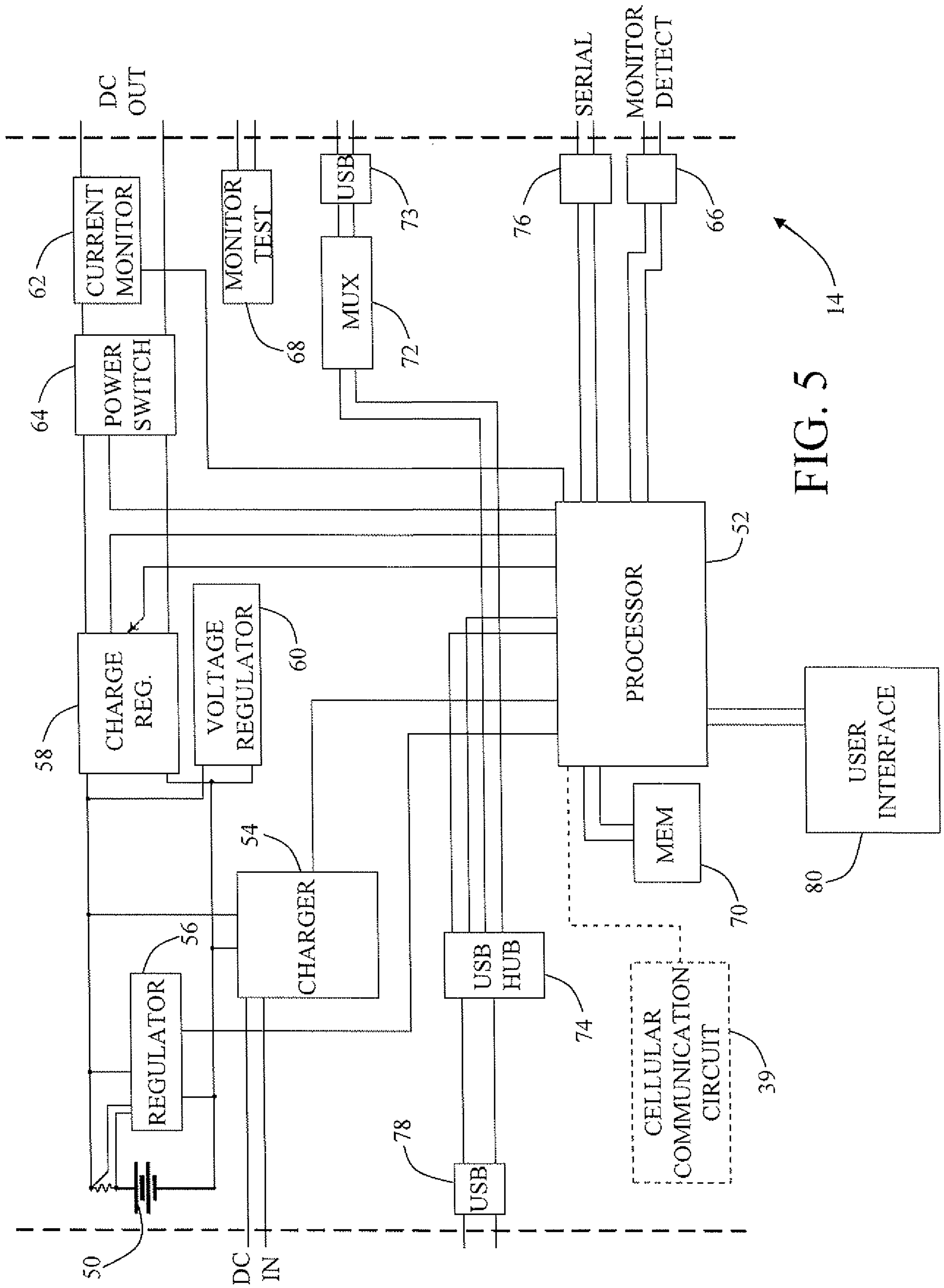
DC OUT
SERIAL
MONITOR DETECT
CURRENT MONITOR
MONITOR TEST
USB
MUX
POWER SWITCH
PROCESSOR
CHARGE REG.
VOLTAGE REGULATOR
CHARGER
REGULATOR
USB HUB
MEM
USER INTERFACE
CELLULAR COMMUNICATION CIRCUIT
USB
DC IN
62
64
58
60
54
56
50
68
72
73
76
66
14
52
70
80
74
78
39

FIG. 5

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2007/067850

A. CLASSIFICATION OF SUBJECT MATTER
INV. A61B5/00 A61B5/024 H02J7/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
A61B H02J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	WO 99/59465 A (TELECOM MEDICAL INC [US]; FEIERBACH GARY [US]; NIKOLIC SERJAN D [US]) 25 November 1999 (1999-11-25) the whole document	1-3, 7-18, 20-25 4-6,19
Y	US 2005/288559 A1 (FELISS NORBERT [US] ET AL FELISS NORBERT [US] ET AL) 29 December 2005 (2005-12-29) paragraph [0091]	4-6,19
X	US 5 228 449 A (CHRIST ATHANASIOS G [US] ET AL) 20 July 1993 (1993-07-20) the whole document	1,14,15, 20,23,24
X	EP 0 940 903 A (POLAR ELECTRO OY [FI]) 8 September 1999 (1999-09-08) the whole document	1,5

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[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
16 October 2007	26/10/2007

Name and mailing address of the ISA/	Authorized officer
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INTERNATIONAL SEARCH REPORT

International application No
PCT/US2007/067850

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
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专利名称(译)	用于可穿戴式病人监护仪的无绳充电器		
公开(公告)号	EP2028998A1	公开(公告)日	2009-03-04
申请号	EP2007761622	申请日	2007-05-01
[标]申请(专利权)人(译)	皇家飞利浦电子股份有限公司		
申请(专利权)人(译)	皇家飞利浦电子N.V.		
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优先权	60/803164 2006-05-25 US		
其他公开文献	EP2028998B1		
外部链接	Espacenet		

摘要(译)

本申请公开了一种用于可穿戴患者监视器的无绳充电器。当患者（10）被诊断出患有心脏病或疑似心脏病时，他们被开处方患者监测系统。该系统包括患者（10）佩戴以收集感兴趣的数据的监视器（12）。每天，患者用无绳充电器（14）交换他或她佩戴的监视器（12）和充满电的监视器（12）。以这种方式，新的监视器（12）总是可用于监视患者（10）。无绳充电器（14）包括电池（50），其为充电器的过程供电并为监视器（12）的电池（34）充电。来自监视器的数据可以被卸载到充电器存储器（70），或者经由患者的蓝牙蜂窝电话（30）或其他类似设备发送到远程数据库（32）。