IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent of:	Albert et al.		
U.S. Patent No.:	10,342,444	Attorney Docket No.:	50095-0087IP1
Issue Date:	July 9, 2019		
Appl. Serial No.:	15/923,699		
Filing Date:	March 16, 2018		
Title:	MOBILE ECG SENSOR APPARATUS		

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PETITION FOR *INTER PARTES* REVIEW OF UNITED STATES PATENT NO. 10,342,444 PURSUANT TO 35 U.S.C. §§ 311–319, 37 C.F.R. § 42

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APPLE-1003	Declaration of Dr. Richard Fletcher
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Petitioner ("Apple") petitions for *Inter Partes* Review of claims 1-15 ("Challenged Claims") of U.S. Patent No. 10,342,444 ("'444 patent").

I. REQUIREMENTS

A. Grounds for Standing

Apple certifies that the '444 patent is available for IPR. This petition is being filed more than nine months after the date the '444 patent was granted. The '444 patent has not been asserted against Apple. Apple is not barred or estopped from requesting this review of the Challenged Claims.

B. Challenge and Relief Requested

Apple requests IPR and cancellation of the Challenged Claims on the grounds below.

Ground	Claims	Basis
1	1-4, 6, 8-12, and 14	§103: Libbus in view of Faarbaek
2	12, 14	§103: Libbus in view of Batkin
3	5, 13	§103: Libbus in view of Faarbaek and Vyshedskiy
4	13	§103: Libbus in view of Batkin and Vyshedskiy
5	7, 15	§103: Libbus in view of Faarbaek and Headset Profile Bluetooth Communication Standard

Applied references are prior art on the bases below:

Reference	Date(s)	Basis
Libbus	9/17/2009 3/11/2009	Pre-AIA §102(a) Pre-AIA §102(e)
Faarbaek	11/6/2008	Pre-AIA §102(b)
Vyshedskiy	11/4/2004	Pre-AIA §102(b)
Headset Profile Bluetooth Communication Standard	12/8/2008	Pre-AIA §102(b)
Batkin	10/27/2005	Pre-AIA §102(b)

C. Priority Date

The ’444 patent claims priority to U.S. Patent Application No. 15/721,038, filed on September 29, 2017, U.S. Patent Application No. 15/486,777, filed on April 13, 2017, U.S. Patent Application No. 15/140,072, filed on April 27, 2016, U.S. Patent Application No. 14/254,310, filed on April 16, 2014, U.S. Patent Application No. 13/964,490, filed on August 12, 2013, U.S. Patent Application No. 13/108,738, filed on May 16, 2011, and U.S. Patent Application No. 12/796,188, filed on June 8, 2010. Even assuming the ’444 patent is entitled to the June 8, 2010 filing date of its earliest priority application ("Critical Date"),[1] each prior art reference applied in this petition predates the Critical Date of the '444 patent and qualifies as prior art. Specifically, Libbus was filed on March 11, 2009 and published on September 17, 2009, Faarbaek published on November 6, 2008, Vyshedskiy published on November 4, 2004, the Headset Profile was publicly available on December 18, 2008, and Batkin published on October 27, 2005. Thus, Libbus, Faarbaek, Vyshedskiy, the Headset Profile, and Batkin are prior art under at least one of pre-AIA 35 U.S.C. §102(a), §102(b), and §102(e) and AIA 35 U.S.C. §102(a)(1) and §102(a)(2).

D. Claim Construction

Because the evidence and the prior art's description of the claimed elements are similar to the '444 patent specification, no formal claim constructions are necessary in this proceeding.[2] *Wellman, Inc. v. Eastman Chem. Co.*, 642 F.3d

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[1] Petitioner does not concede that the '444 patent is entitled to its priority claims and notes that the references applied in this petition qualify as prior art, regardless of whether the '444 patent is entitled to its priority claim and regardless of whether the '444 patent is deemed a pre-AIA or post-AIA patent.

[2] Petitioner reserves the right to respond to any claim constructions offered by Patent Owner or adopted by the Board.

1355, 1361 (Fed. Cir. 2011).

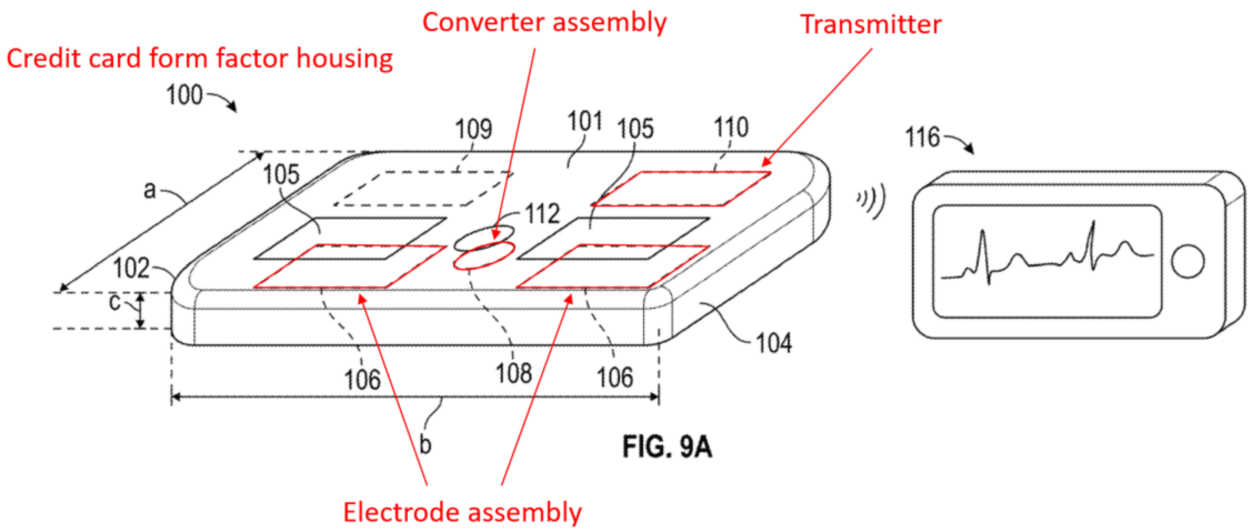
II. TECHNOLOGY OVERVIEW AND THE ’444 PATENT

In his declaration, Dr. Richard Fletcher provides an overview of cardiac monitoring technology relevant to the ’444 patent. APPLE-1003, ¶¶ 29-33.

A. ’444 Patent

The ’444 patent relates to mobile ECG sensors and systems to detect heart electrical signals. APPLE-1001, Abstract, claim 1; APPLE-1003, ¶ 34. The mobile ECG sensor in the ’444 patent includes: (1) an electrode assembly that senses heart-related signals and produces electrical signals representing the sensed heart-related signals; (2) a converter assembly to convert the electrical signals to a modulated signal representing the sensed heart-related signals; (3) a transmitter that transmits the modulated signal to a computing device; and (4) a housing containing the electrode assembly, the converter assembly, and the transmitter, wherein the housing is a credit card form factor. APPLE-1001, claim 1.

As shown below, Figure 9A depicts the ECG sensor 100 with a credit card form factor. APPLE-1001, 7:51-63.



APPLE-1001, Figure 9A (annotated)

B. Prosecution History

During prosecution of the ’444 patent, the Examiner issued a double-patenting rejection, which was overcome by filing a terminal disclaimer and identified “wherein the housing is a credit card form factor” as allowable subject matter. APPLE-1002, 13-19; 41-48. Applicant subsequently amended the claims to include “wherein the housing is a credit card form factor.” *Id.* at 30-37.

During prosecution, the examiner did not consider Faarbaek, which teaches the claim limitation alleged to be missing from the prior art. *Id.* The examiner also did not consider Libbus, Vyshedskiy, the Headset profile, and Batkin. APPLE-1002.

C. Level of Ordinary Skill

A person of ordinary skill in the art ("POSITA") would have had either (1) at least a bachelor of science in electrical engineering, mechanical engineering, or biomedical engineering, or a related discipline, with at least two years of relevant multidisciplinary work experience designing wearable devices and/or sensors for measuring physiological signals or parameters of mammals, or (2) a medical degree and at least five years of relevant work experience designing wearable devices and/or sensors for measuring physiological signals or parameters of mammals. A greater amount of education, i.e., a doctorate in electrical engineering, mechanical engineering, biomedical engineering, or a related discipline with a focus on designing wearable devices and/or sensors for measuring physiological signals or parameters of mammals would also qualify for the hypothetical person of ordinary skill in the art in lieu of fewer years of multidisciplinary work experience. APPLE-1003, ¶ 13. Additional education or industry experience may compensate for a deficit in one of the other aspects of the requirements stated above. *Id.*

III. THE CHALLENGED CLAIMS ARE UNPATENTABLE[3]

A. [GROUND 1] – Libbus and Faarbaek Render Claims 1-4, 6, 8-12, and 14 Obvious

1. Libbus Overview

Libbus is titled "Heart Failure Decompensation Prediction Based on Cardiac Rhythm." APPLE-1004, Cover. Libbus published with figures from a separate unrelated patent application. *See* APPLE-1005 at 99, 113-121, 438. The correct figures were included with the provisional application (APPLE-1006), which is incorporated by reference in its entirety. APPLE-1004, [0001]. Thus, the referenced figures share the same disclosure date as Libbus and are part of the Libbus publication.

Like the '444 patent, Libbus's ECG device is a mobile physiological monitor that can determine the risk of impending decompensation based on measurement of an electrocardiogram signal from a patient. APPLE-1004, [0007],

[3] Apple understands that challenges for failure to meet §101 and §112 cannot be brought in this forum. Apple is not waiving any arguments under these sections (or other arguments not available in an IPR) or arguments regarding claim scope. The general descriptions of the references and the combinations thereof are incorporated into the sections below where the references are cited. All emphasis is added, unless indicated otherwise.

[0048]-[0050], [0071]-[0075]. Libbus's ECG device includes "electrodes" and "electronic components" to take physiological measurements and transmit data. APPLE-1004, [0053], [0056]. The electronic components include "electrocardiogram circuitry," a "processor," and "wireless communication circuitry." APPLE-1004, [0056], [0058], [0059], [0065]. These components work together to acquire, process, and transmit an electrocardiogram signal with a "communication protocol." APPLE-1004, [0059], [0065]; APPLE-1003, ¶ 39. The communication protocol includes Bluetooth, amplitude modulation, and frequency modulation. APPLE-1004, [0059].

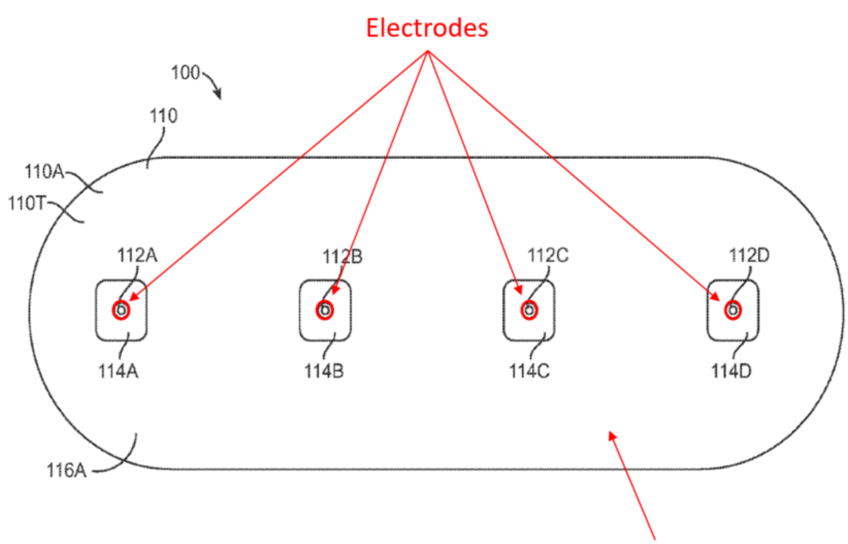
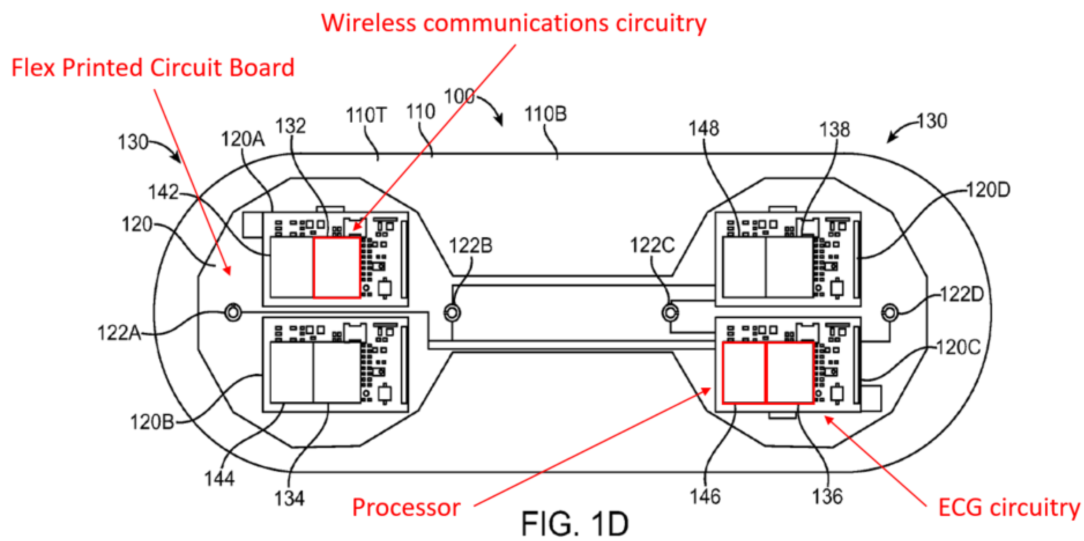
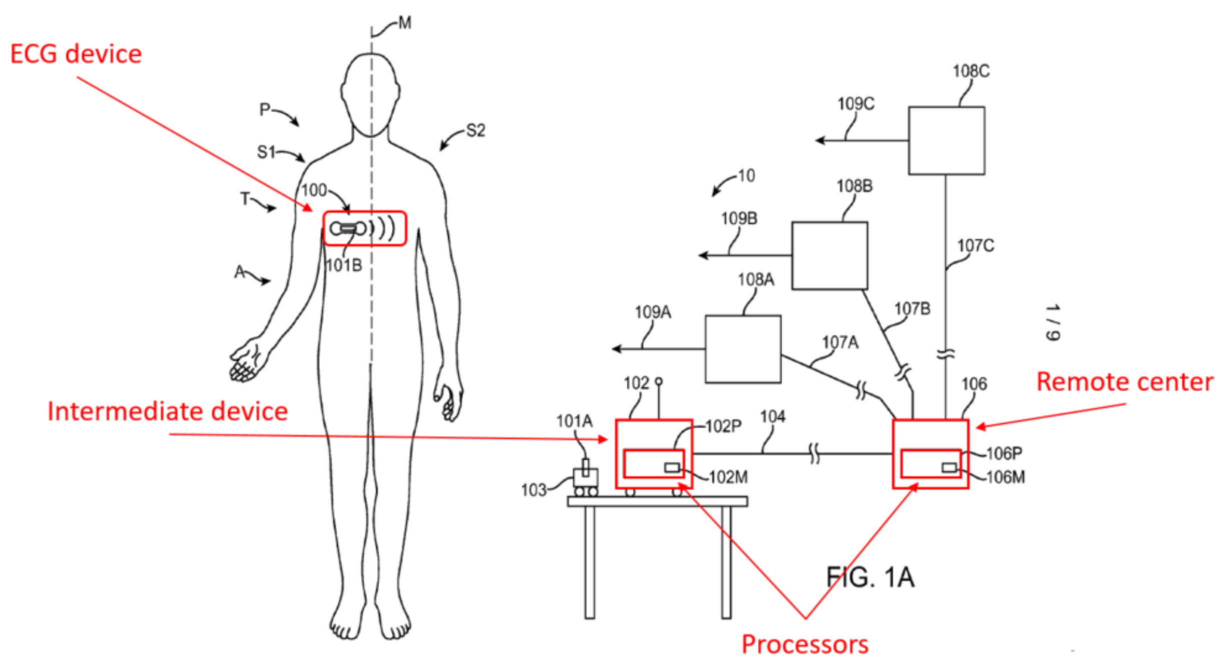


FIG. 1B



APPLE-1006, Figs. 1B and 1D (annotated)

Figure 1A shows an example of a user using Libbus's ECG device to collect and transmit an ECG measurement to an "intermediate device" or "remote center." APPLE-1004, [0047], [0052], [0059], [0060]; APPLE-1003, ¶ 40.



APPLE-1006, Fig. 1A (annotated)

The intermediate device and remote center include "at least one processor" and can wirelessly communicate with the Libbus ECG device in accordance with a communication protocol. APPLE-1004, [0047], [0052], [0059], [0060], [0074].

Libbus's ECG device includes an "electronics housing" and "cover." APPLE-1004, [0067], [0068].

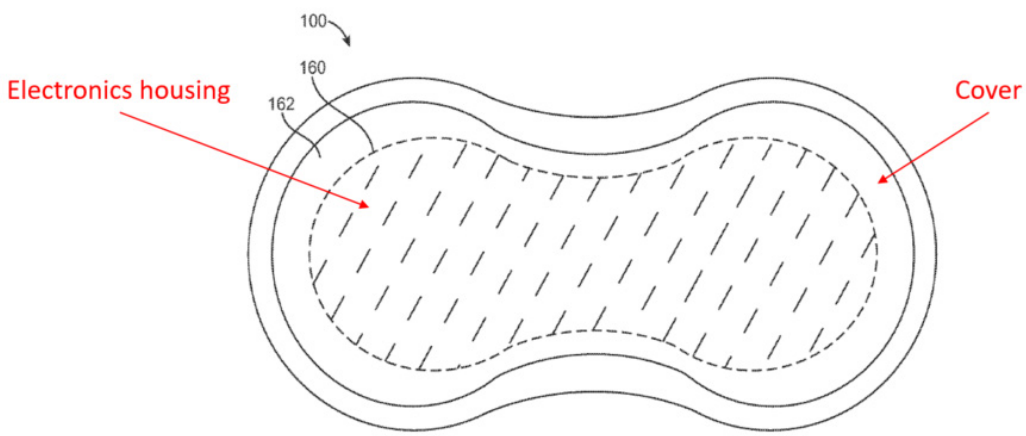


FIG. 1F

APPLE-1006, Fig. 1F (annotated)

Further, like the '444 patent, Libbus's ECG device is mobile. APPLE-1004, [0020], [0048]-[0050], [0074]. Libbus's ECG device has a length from about 4 inches to about 10 inches (about 100 mm to 250 mm), a width from about 2 inches to about 4 inches (about 50 mm to 100 mm), and a thickness from about 0.2 inches to about 0.4 inches (about 5 mm to 10 mm). APPLE-1004, [0069]. And Libbus's ECG device can come in "many shapes" and sizes, "for example at least one of a dogbone, an hourglass, an oblong, a circular or an oval shape." APPLE-1004, [0049].

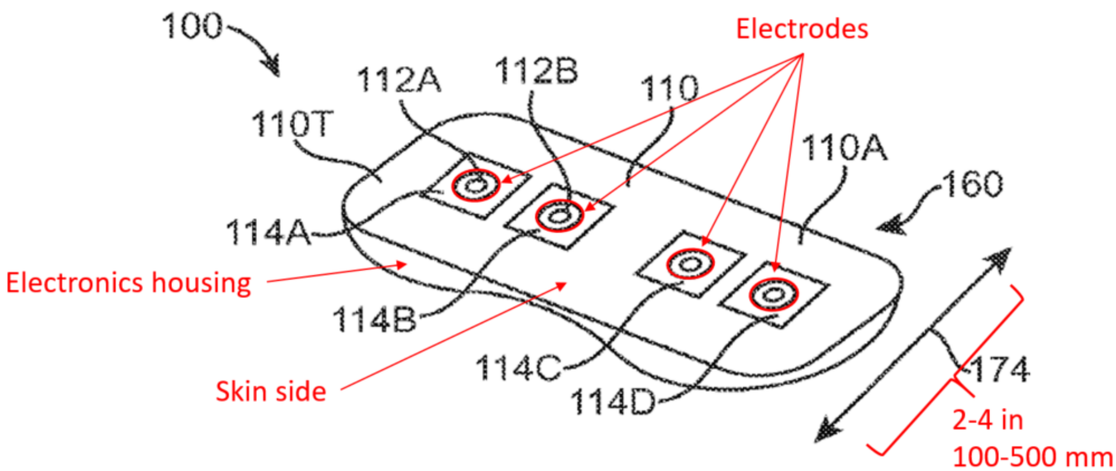


FIG. 1H

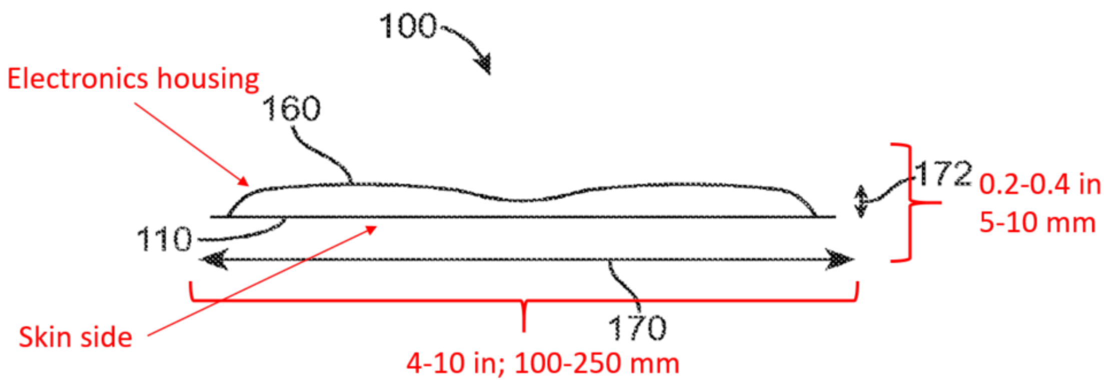


FIG. 1G

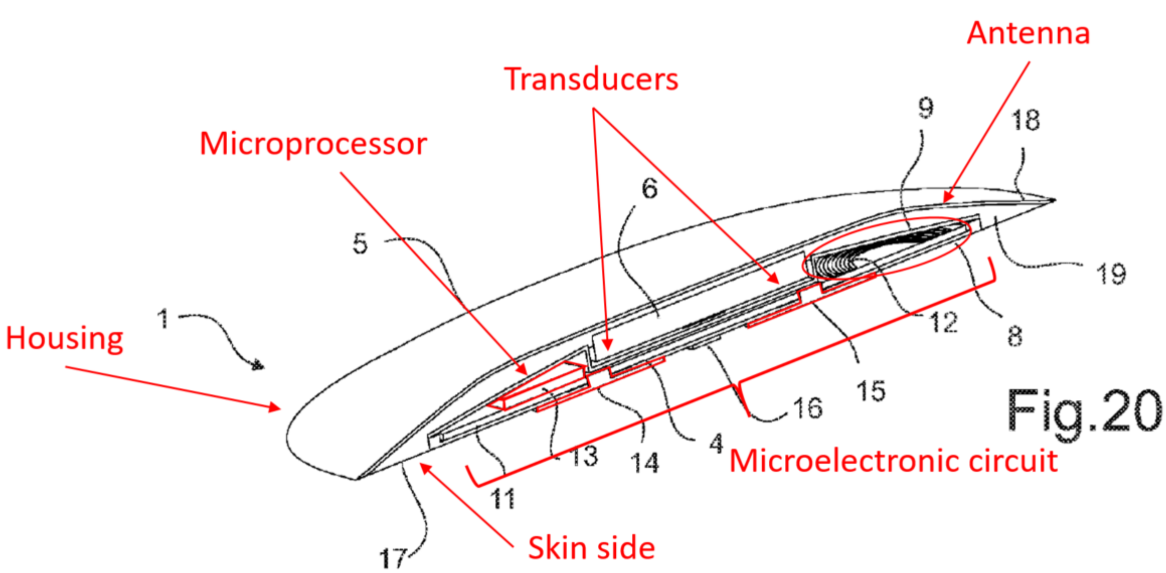
APPLE-1006, Figs. 1G and 1H (annotated)

2. Faarbaek Overview

Faarbaek is titled "Three-Dimensional Adhesive Device Having a Microelectronic System Embedded Therein." APPLE-1007, Cover. Like the '444 patent and Libbus, Faarbaek's device is a mobile physiological monitoring device used to measure electrocardiography. APPLE-1007, [0001], [0020], [0210], [0308]. Faarbaek's ECG device includes "transducer(s)," a "microprocessor," "microelectronic circuit," and "antenna." APPLE-1007, [0307]-[0310]. The transducer components are "electrodes" for physiological monitoring. APPLE-1007, [0159]-[0162].

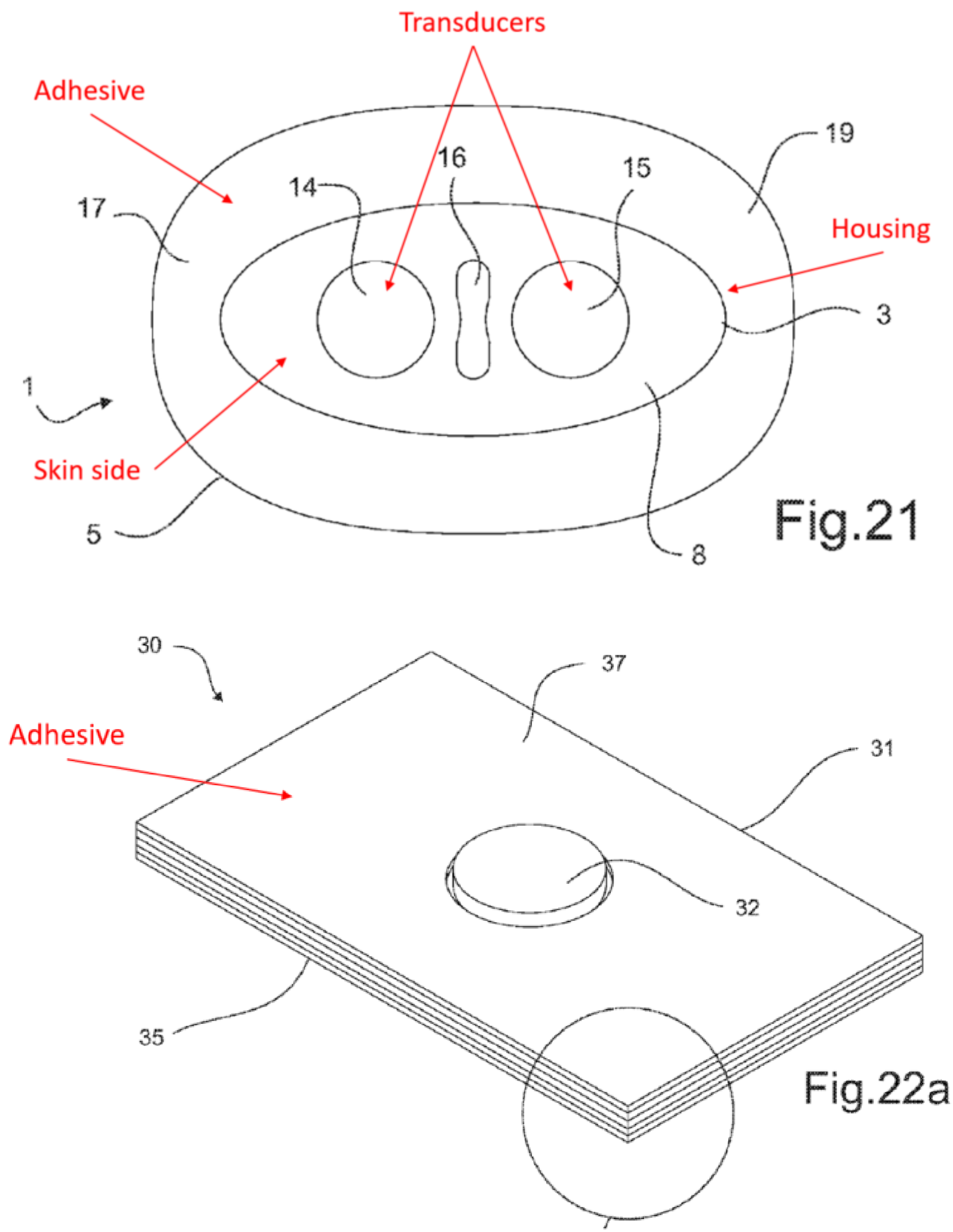
The microprocessor controls and communicates with other components to execute application software and signal processing. APPLE-1007, [0151], [0152], [0310]. These components work together to measure and wirelessly communicate electrocardiograph signals. APPLE-1007, [0001], [0150]-[0153], [0197], [0308]-[0310]; APPLE-1003, ¶ 45.

Faarbaek's ECG device includes a "housing," which contains the transducers, the microprocessor, the microelectronic circuit, and the antenna. APPLE-1007, [0308].



APPLE-1007, Fig. 20 (annotated)

As shown in Figs. 21 and 22a, like the '444 patent, Faarbaek's ECG device may be "rectangular" with a thickness "between 0.5 and 15 mm." APPLE-1007, [0068], [0070], [0071], [0316], [0317].



APPLE-1007, Figs. 21 and 22a (annotated)

Faarbaek further discloses that the device may include "an electromechanical display system." APPLE-1007, [0259], [0343], [0345], [0348], [0349].

3. Libbus-Faarbaek Combination

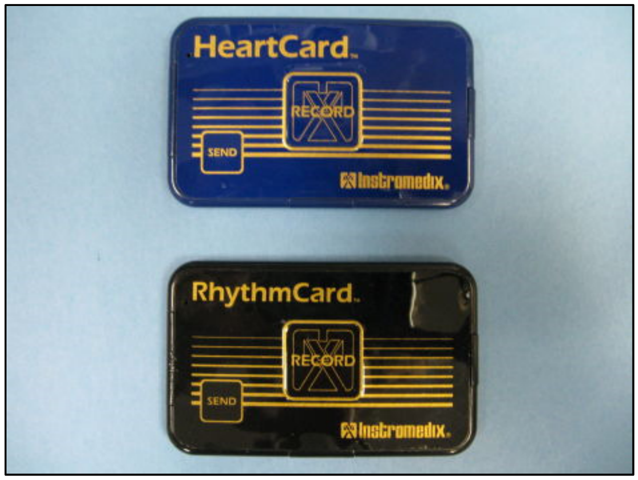
As discussed above, Libbus's ECG device is a mobile physiological monitoring device with electrodes, electrocardiogram circuitry, a processor, and wireless communication circuitry contained within a housing. *See* Section III.A.1. Although Libbus does not explicitly disclose a housing with a credit card form factor, Libbus teaches that the "device can comprise many shapes, for example at least one of a dogbone, an hourglass, an oblong, a circular or an oval shape." APPLE-1004, [0047]. From Libbus's disclosure, a POSITA would have understood or found obvious that the ECG device could come in a variety of sizes and shapes and would have had reason to explore other size and shape options for Libbus's housing. Indeed, a POSITA would have been motivated to turn to Faarbaek for other size and shape options because both Libbus and Faarbaek are directed to mobile physiological monitoring devices. APPLE-1003, ¶ 63.

Faarbaek describes a mobile physiological monitoring device with a housing that may come in several shapes, including "rectangular." APPLE-1007, [0048], [0070]. Faarbaek further teaches that the device is shaped like a rectangle "to obtain as convenient and safe a device as possible." *Id.* Faarbaek also discloses that the "device is between 0.5 and 15 mm . . . at the centre of the adhesive body." APPLE-1007, [0048], [0067], [0068]. From these teachings, a POSITA would have been motivated to incorporate Faarbaek's housing shape and size (e.g., thickness) into Libbus's ECG device because it would provide a more convenient device to monitor physiological signals. APPLE-1003, ¶ 64.

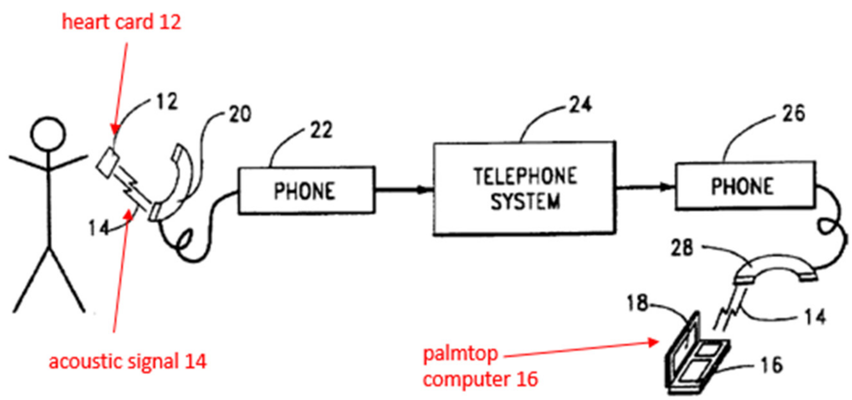
In implementing the Libbus-Faarbaek combination, a POSITA would have modified Libbus's ECG device to incorporate two teachings from Faarbaek—(1) the rectangular shape of the housing, and (2) the dimensions of the housing. APPLE-1003, ¶ 65. A POSITA would have viewed these teachings as being applicable to Libbus and routine to implement for Libbus's ECG device. APPLE-1003, ¶ 65. After all, the Libbus device and Faarbaek device contain the same components—electrodes, electrocardiogram circuitry, a processor, and wireless communication circuitry within a housing. APPLE-1004, [0053], [0056], [0058], [0059], [0065]; APPLE-1007, [0307]-[0310]. And Faarbaek's components are spatially arranged in a similar manner. For instance, like Libbus, Faarbaek's components are interconnected on a printed circuit board (PCB), such as a flex PCB. APPLE-1004, [0054], [0055]; APPLE-1007, [0136], [0206]. The similarities do not end there. The housing in Faarbaek, like Libbus, can be flexible and made of polymer materials. APPLE-1004, [0067], [0068]; APPLE-1007, [0072]-[0077]. With similar dimensions too. APPLE-1003, ¶ 65; APPLE-1004, [0069]; APPLE-1007,

[0067], [0068]. Thus, a POSITA would have been able to routinely incorporate the shape and dimensions of Faarbaek's housing with Libbus. APPLE-1003, ¶ 65. Further, given the overlapping subject matter between Libbus and Faarbaek, as noted above, a POSITA would have had a reasonable expectation of success in modifying the shape and size of Libbus's ECG device based on Faarbaek. APPLE-1003, ¶ 65. Thus, a POSITA would have found it obvious to substitute the housing from Libbus for the housing from Faarbaek to produce an expected result—an ECG sensor in a rectangular shaped housing. APPLE-1003, ¶ 65.

Indeed, a POSITA would have recognized that technologies for mobile ECG sensors with a credit card form factor capable of transmitting FM modulated ECG signals to a remote computer device were developed, as evidenced in the Albert reference, well before the Critical Date. APPLE-1003, ¶ 65. For example, Albert describes Instromedix's Heart Card (pictured below) as a card "to provide a recording of the ECG signal" and "transmission via a wired or wireless telephone system of such recorded or realtime ECG data in the form of a frequency modulated audio signal" to a remote palmtop computer. APPLE-1012, 1:57-64, 3:10-41.



Instromedix, Inc.'s Heart Card.



APPLE-1012, Fig. 1 (annotated).

Moreover, given the similarity between the components, as noted above, and the limited number of design choice options—circular, oval, rectangular or triangular shaped housings—it would have been obvious for a POSITA to try incorporating Libbus's components in Faarbaek's rectangular housing with a reasonable expectation of success. APPLE-1003, ¶ 66.

Such a change in housing shape and size is also an obvious matter of design choice. The rectangular housing is disclosed in the prior art and its substitution presents no unexpected result, so it would be an obvious matter of design choice for a POSITA to modify Libbus to incorporate the rectangular shape and size of the housing with Libbus's electronic components inside. APPLE-1003, ¶ 67.

Additionally, although Libbus teaches displaying physiological data, Libbus does not explicitly disclose a display electrically connected to the converter assembly and positioned on the exterior of the housing. *See* APPLE-1004, [0051]. Faarbaek teaches a display positioned on the housing of the physiological monitoring device. APPLE-1007, [0259]. A POSITA would have been motivated to look for other monitoring device features (e.g., the display) in Faarbaek because both Libbus and Faarbaek are directed to mobile physiological monitoring devices. APPLE-1003, ¶ 69.

Specifically, Faarbaek discloses an "electromechanical display system" included on the exterior of a physiological monitoring device. APPLE-1007, [0259], [0343], [0345], [0348], [0349]. Faarbaek's device includes a display system to allow a user to obtain information about the physiological monitoring device during use. *Id.* From these teachings, a POSITA would have been motivated to include a display on the exterior of Libbus's ECG device because it would provide a display of electrocardiography data in real-time to a user. APPLE-1003, ¶ 69. In implementing the Libbus-Faarbaek combination, a POSITA would have incorporated a display on the exterior of the housing, as taught by Faarbaek. APPLE-1007,

[0259]; APPLE-1003, ¶ 69. As noted above, the Libbus device and Faarbaek device contain similar electronic components spatially arranged in a similar manner within a housing of similar dimensions. APPLE-1004, [0053]-[0056], [0058], [0059], [0065], [0067]-[0069]; APPLE-1007, [0067], [0068], [0072]-[0077], [0136], [0206], [0307]-[0310].

Thus, a POSITA would have been able to readily incorporate Faarbaek's display with Libbus in a routine manner. APPLE-1003, ¶ 70. Further, given the over-lapping subject matter between Libbus and Faarbaek, as noted above, a POSITA would have had a reasonable expectation of success in modifying Libbus's ECG device to include a display based on Faarbaek. APPLE-1003, ¶ 70.

The addition of a display is also an obvious matter of design choice. The display is a generic component disclosed in the prior art and its addition presents no unexpected result, so it would have been an obvious matter of design choice for a POSITA to modify Libbus to incorporate a display on the exterior of Libbus's ECG sensor. APPLE-1003, ¶ 71.

4. Claim 1

[1.0] A mobile ECG sensor comprising:

To the extent the preamble is limiting, Libbus teaches a mobile ECG sensor. APPLE-1004, Abstract; [0011]; [0053]. Figs. 1A and 1B illustrate an example of Libbus's device and system.

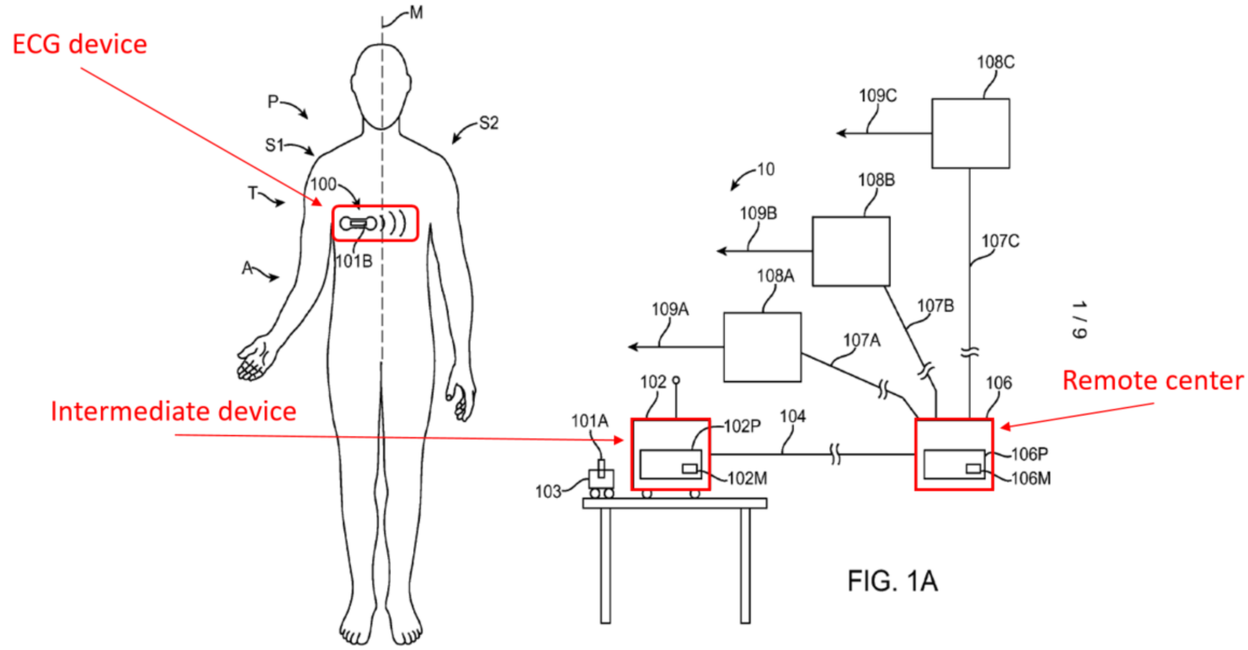


FIG. 1A

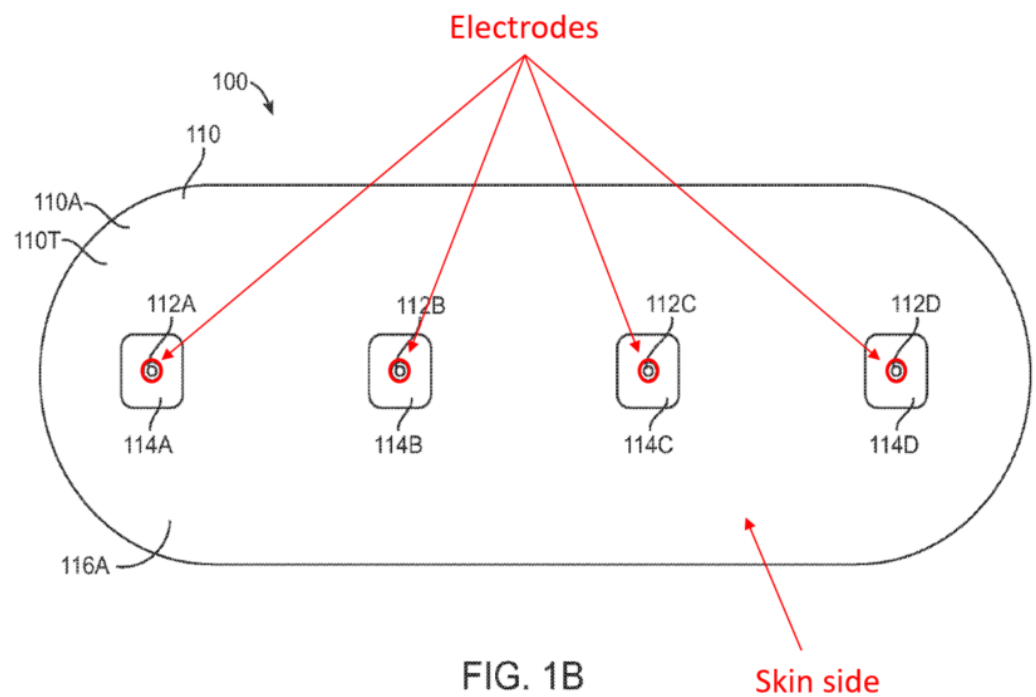


FIG. 1B

APPLE-1006, Figs. 1A and 1B (annotated).

As shown in Fig. 1B, Libbus's device includes "electrodes" to measure an electrocardiogram (ECG) of a user. APPLE-1004, [0011], [0020], [0022], [0048],

[0053]-[0055], [0065], [0071]. Because Libbus's device measures the ECG of the patient, Libbus's device is an ECG sensor. APPLE-1003, ¶ 73.

As shown in Fig. 1A, Libbus's device is mobile and "may be affixed and/or adhered to the body in many ways." APPLE-1004, [0020], [0048], [0049], [0074]. Indeed, the ECG device is "continuously adhered to the patient for at least one week" to measure the electrocardiogram signals. APPLE-1004, [0011], [0020], [0048], [0050]. As such, the ECG device moves with the user. APPLE-1004, [0050].

Moreover, Libbus's device also may contain an activity sensor, such as an accelerometer, to sense activity level and posture of a user as they move. APPLE-1004, [0051], [0056], [0061], [0071], [0072], [0094]. The ability to sense movement and activity level using an activity sensor (e.g., an accelerometer) confirms that Libbus's device moves with the user and, thus, is mobile. APPLE-1003, ¶ 75. For these reasons, Libbus renders obvious [1.0]. APPLE-1003, ¶ 76.

[1.1] an electrode assembly comprising electrodes, wherein the electrode assembly senses heart-related signals when in contact with a user's skin, and produces electrical signals representing the sensed heart-related signals

As shown in Figs. 1B and 1C below, Libbus's device includes an electrode assembly with "[e]lectrodes 112A, 112B, 112C and 112D." APPLE-1004, [0053], [0065], [0071]. In addition to the electrodes, the electrode assembly includes "ECG Circuitry" and a "processor." APPLE-1004, [0023], [0056], [0058], [0065].

The electrodes, ECG circuitry, and processor work together as an electrode assembly to sense heart-related signals when in contact with a user's skin and produce electrical signals representing the sensed heart-related signals, such as an ECG signal. APPLE-1003, ¶ 78; APPLE-1004, [0053], [0056], [0058], [0065], [0071], [0072], [0094].

Libbus further discloses that the electrode assembly senses heart-related signals when in contact with a user's skin. For example, Libbus's device "comprises at least two electrodes … to measure an electrocardiogram (ECG) of the patient." APPLE-1004, [0053], [0065]. The sensed ECG is collected over an extended period and includes multiple heart-related signals, such as a raw ECG signal, a heart rate signal, and a heart rate variability signal. APPLE-1004, [0050], [0051], [0071], [0072], [0092]. Libbus also uses "[g]el 114A, gel 114B, gel 114C and gel 114D … over electrodes 112A, 112B, 112C and 112D, respectively, to provide electrical conductivity between the electrodes and the skin of the patient." APPLE-1004, [0053], [0023]. By measuring an ECG, heart rate, and/or heart rate variability of a patient through electrical conductivity between the electrodes and the skin of the patient, Libbus' electrode assembly senses heart-related signals when in contact with a user's skin. APPLE-1003, ¶ 79.

Libbus's electrode assembly also produces electrical signals, such as ECG signals, representing the sensed heart-related signals. As shown in Fig. 1D below and noted above, Libbus's electrode assembly includes "ECG circuitry" to "generate electrocardiogram signals and data from electrodes." APPLE-1004, [0065].

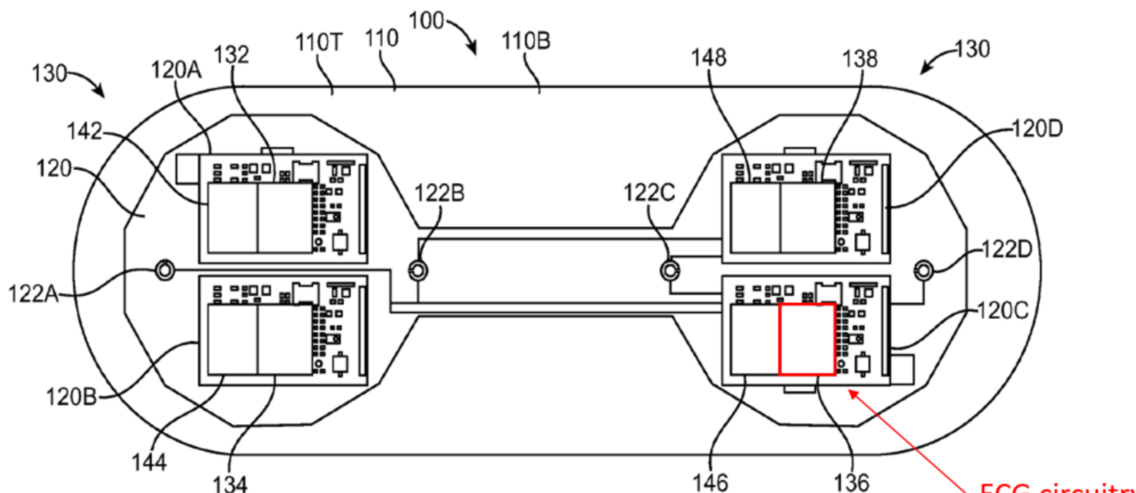


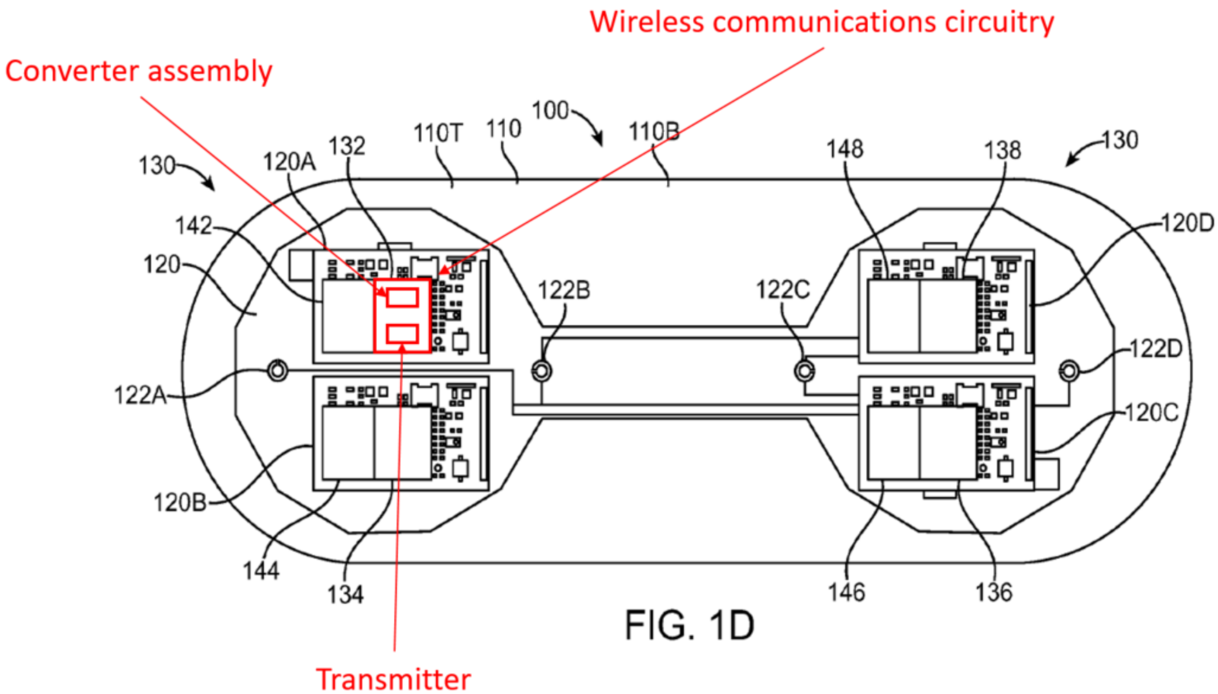
FIG. 1D

APPLE-1006, Fig. 1D (annotated).

The generated ECG signals include multiple electrical signals because the ECG is acquired and generated over an extended period. APPLE-1004, [0011], [0020], [0048], [0050]; APPLE-1003, ¶ 81. This continuous acquisition and generation allows the ECG, among of things, to be used to predict an impending cardiac decompensation event. APPLE-1004, [0071]-[0078]. Also, the sampling rate and frequency of measurement of the ECG can be adjusted as needed. APPLE-1004, [0092]. Adjustment of the sampling rate and frequency of measurement further illustrates that Libbus contemplates multiple electrical signals representing the sensed heart-related signals because it discloses how often to sample and measure the same. APPLE-1003, ¶ 80. Thus, Libbus renders obvious [1.1]. APPLE-1003, ¶ 81.

[1.2] a converter assembly electrically connected to the electrode assembly, configured to convert the electrical signals to a modulated signal, wherein the modulated signal carries the electrical signals representing the sensed heart-related signals;

As shown in Fig. 1D below, Libbus's device includes "wireless communications circuitry." APPLE-1004, [0059]. A POSITA would have understood the wireless communication circuitry to include a converter assembly and a transmitter because the wireless communication circuitry is connected to the electrocardiogram circuitry, modulates an ECG signal, and wirelessly transmits the ECG signal to another device. APPLE-1003, ¶ 84; APPLE-1004, [0059], [0048]. The converter assembly portion of the wireless communications circuitry is "coupled to . . . the electrocardiogram circuitry" portion of the electrode assembly to receive an electrical signal, such as an ECG signal. APPLE-1004, [0059], [0055], [0058]; APPLE-1003, ¶ 84.



APPLE-1006, Fig. 1D (annotated).

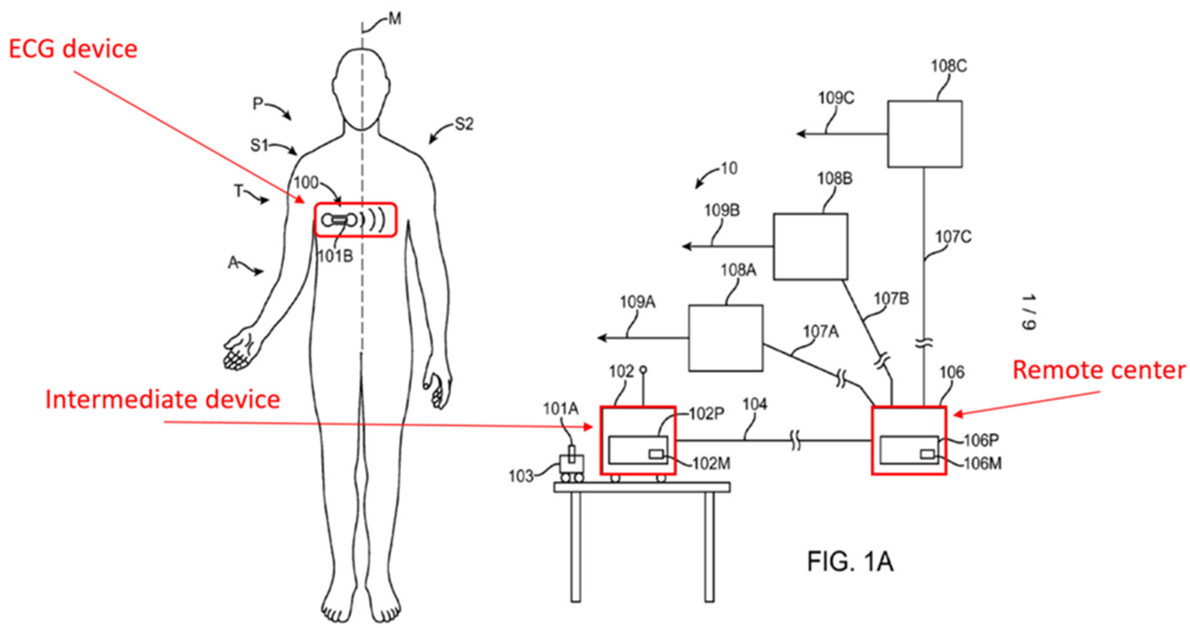
The converter assembly converts the electrical ECG signal to a modulated signal according to a "communication protocol" which includes "Bluetooth," "amplitude modulation, or frequency modulation." APPLE-1004, [0059]. In addition to the explicit disclosure of amplitude or frequency "modulation," a POSITA would have understood that the Bluetooth communication protocol modulates the electrical ECG signal to generate a modulated signal. APPLE-1003, ¶ 85.

The modulated signal, generated by the converter assembly, carries the electrical ECG signal to another computing device, which can be either an intermediate device or a remote center, which process the ECG signals and can display them for analysis by a medical professional. APPLE-1004, [0051], [0059], [0060], [0052], [0047], [0074]. The intermediate device and remote center communicate back and forth with the converter assembly to collect data and extract the ECG signals from the modulated signal for processing and/or display. APPLE-1004, [0059], [0060], [0047]. For example, when the remote center receives the modulated signal, it applies a prediction algorithm to detect impending cardiac decompensation. APPLE-1004, [0048], [0071]-[0075]. The prediction algorithm utilizes the ECG signals to determine the risk of impending decompensation. APPLE-1004, [0072]-[0075]. Because Libbus's intermediate device or remote center is able to process and/or display the ECG signals after receipt of the modulated signal, Libbus's modulated signal necessarily carries the electrical signals representing the sensed heart-related signals. Otherwise, Libbus's intermediate device or remote center would be unable to process and/or display the ECG signals. APPLE-1003, ¶ 86. Thus, Libbus renders obvious [1.2]. APPLE-1003, ¶ 87.

[1.3] a transmitter that transmits the modulated signal wirelessly to a computing device; and

As discussed above, the wireless communications circuitry includes a converter assembly and a transmitter. *See* [1.2]. As shown in Fig. 1A below, the transmitter "transmits" the modulated "electrocardiogram signal" to another computing device, such as an intermediate device or remote center. APPLE-1004,

[0059], [0060], [0052], [0047], [0074]. The intermediate device and remote center are computing devices because each include computer components, such as a processor and memory, and are able to communicate with the transmitter. APPLE-1004, [0059], [0060], [0047], [0074]. The ECG device, the intermediate device, and remote center communicate with one another via the "wireless transmitter." APPLE-1004, [0048], [0060], [0071]-[0075].



APPLE-1006, Fig. 1A (annotated).

Thus, Libbus renders obvious [1.3]. APPLE-1003, ¶ 90.

[1.4] a housing containing the electrode assembly, the converter assembly, and the transmitter, wherein the housing is a credit card form factor.

The housing for Libbus's ECG device is made of two portions, the "housing 160" and the "cover 162." APPLE-1004, [0067], [0068]. As shown in Figs. 1D, 1H, and 1F below, Libbus's housing contains the electrodes and electrocardiogram circuitry, which corresponds to the electrode assembly, and the wireless communications circuitry that corresponds to the converter assembly and the transmitter. APPLE-1004, [0066], [0067], [0068].

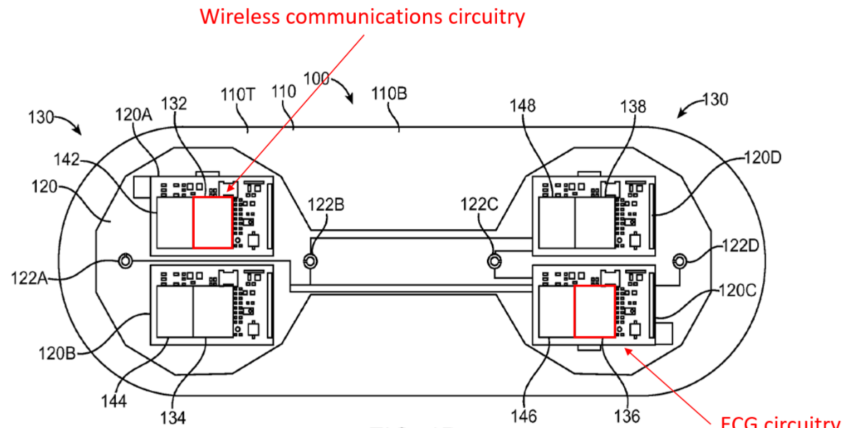


FIG. 1D

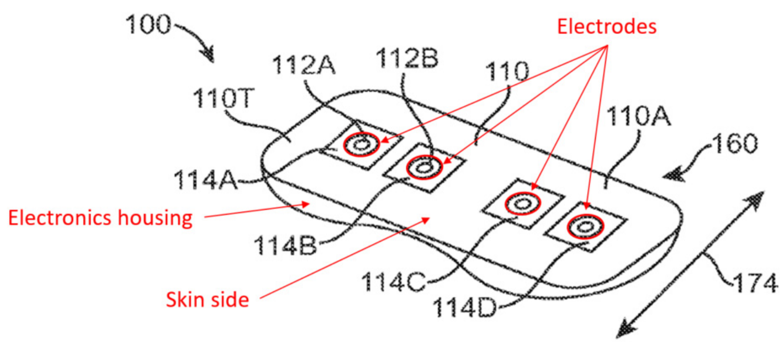


FIG. 1H

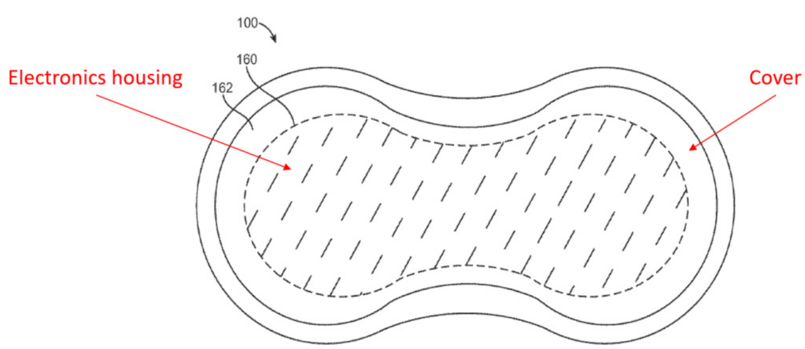


FIG. 1F

APPLE-1006, Figs. 1D, 1H, and 1F (annotated).

As shown in Fig. 1G below, Libbus's device is an hourglass form factor "about 100 mm to about 250 mm" in length, "about 50 mm to 100 mm" in width, and "about 5 mm to about 10 mm" in thickness, and may be made of plastic. APPLE-1004, [0069], [0070], [0049], [0067].

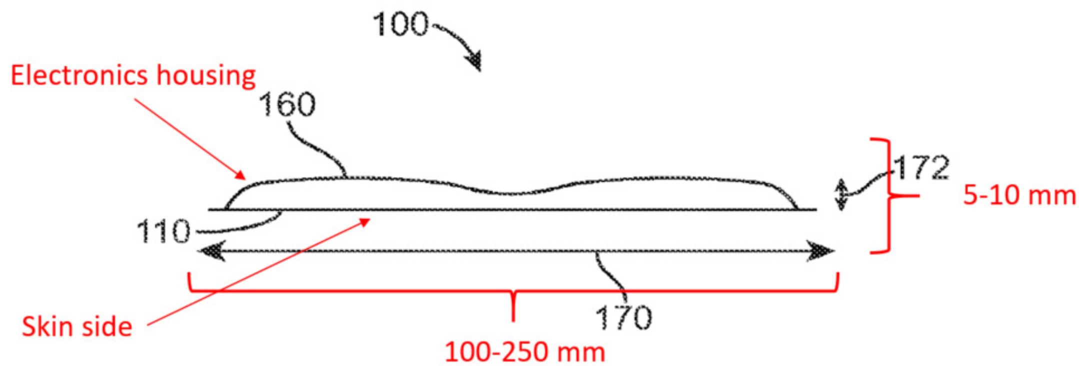


FIG. 1G

APPLE-1006, Figs. 1G (annotated).

As shown in Figure 9A below, the '444 patent's ECG device is a credit card form factor that is "approximately 0.75 mm" in thickness, and that is made of "plastic or polymer." APPLE-1001, [0021], [0050], and [0051].

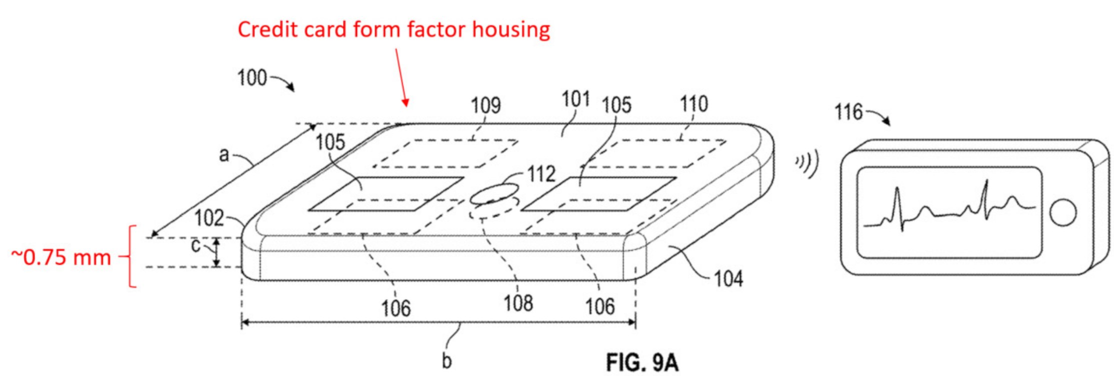


FIG. 9A

APPLE-1001, Fig. 9A (annotated)

Like the credit card form factor in the ’444 patent, Faarbaek’s mobile physiological monitoring device has a housing that may be “rectangular” and “between 0.5 and 15 mm” in thickness. APPLE-1007, [0048], [0067], [0068], [0070]. As discussed above in Section III.A.3, a POSITA would have been motivated to modify the shape and thickness of Libbus’s ECG device to that of Faarbaek because it provides a more convenient device to monitor physiological signals and it confirms that the obvious design choices of shape (e.g., rectangular) and thickness (e.g., 0.5 and 15 mm) were well-known. APPLE-1003, ¶ 95; *see also* APPLE-1012, 1:57-64, 3:10-41. Accordingly, it would have been obvious to a POSITA to use Faarbaek’s size and shape disclosure to modify Libbus’s housing to that of a rectangular shape approximately 0.75 mm in thickness. APPLE-1003, ¶ 96. Thus, the Libbus-Faarbaek combination renders obvious element [1.4].

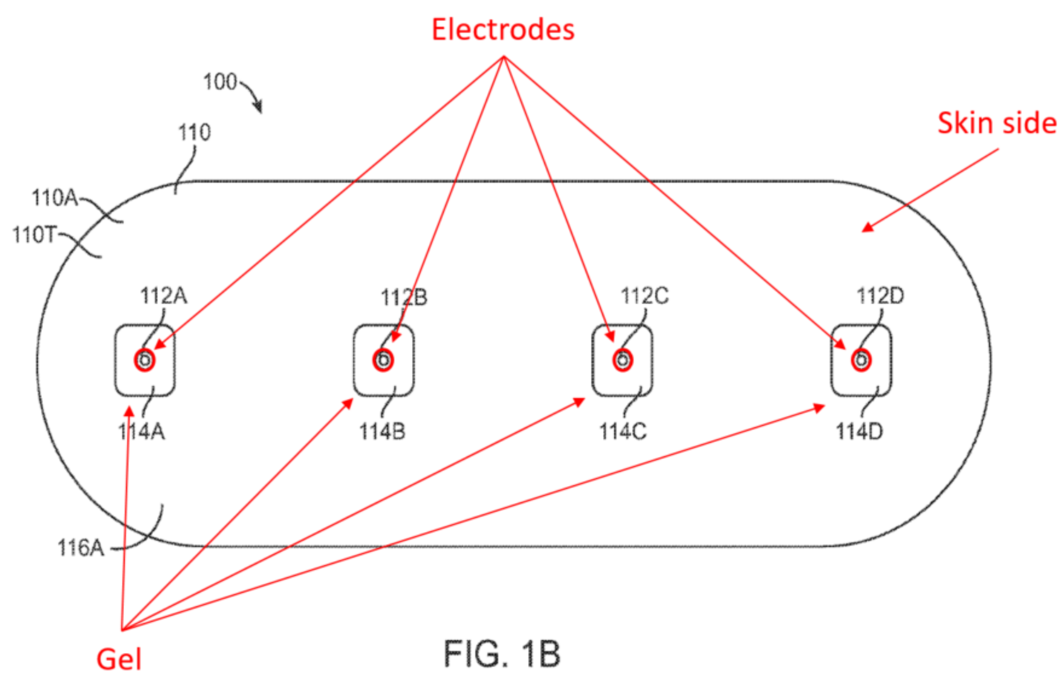
5. Claim 2

[2.0] The mobile ECG sensor according to claim 1, wherein the electrode assembly comprises at least two electrode pads positioned on an exterior surface of the credit card form factor.

Like the credit card form factor in the ’444 patent, Faarbaek’s mobile physiological monitoring device has a housing that may be “rectangular” and “between 0.5 and 15 mm” in thickness. APPLE-1007, [0048], [0067], [0068], [0070]. As discussed above in Section III.A.3, a POSITA would have been motivated to modify the shape and thickness of Libbus’s ECG device to that of Faarbaek. APPLE-

1003, ¶ 98. Accordingly, it would have been obvious to a POSITA to use Faarbaek's size and shape disclosure to modify Libbus's housing to that of a rectangular shape approximately 0.75 mm in thickness. APPLE-1003, ¶ 98. Thus, the Libbus-Faarbaek combination renders obvious a credit card form factor. APPLE-1003, ¶ 98.

FIG. 1B shows a bottom view of the ECG device with at least four electrodes positioned on a lower side that is oriented toward the skin of the patient when placed on the user. APPLE-1004, [0048], [0053]-[0055], [0065], [0071].



APPLE-1006, Fig. 1B (annotated)

As noted above, Libbus's electrode assembly includes electrodes and ECG circuitry, *see* [1.1]. As shown in Figure 1B above, the electrode assembly further includes "gel" positioned over each electrode on the exterior surface to provide electrical conductivity between the electrodes and the skin of the user. APPLE-1004, [0053], [0054], [0055]. A POSITA would have understood that, together, the gel and electrodes form an electrode pad. APPLE-1003, ¶ 100. And, as shown above, the electrode pad is positioned on the exterior surface of the ECG device. APPLE-1004, [0053], [0054]; APPLE-1003, ¶ 100. Thus, Libbus renders obvious element [2.0]. APPLE-1003, ¶ 101.

6. Claim 3

[3.0] The mobile ECG sensor according to claim 2, wherein the credit card form factor comprises a top part with a top surface and an underside, and a bottom part with a topside and a bottom surface, wherein the underside of the top part is affixed to the topside of the bottom part, wherein the electrode assembly further comprises at least two conductive flexible membranes electrically connected to the at least two electrode pads and electrically connected to the converter assembly, and wherein the at least two electrode pads are positioned on the top surface of the top part, and the at least two conductive flexible membranes are positioned between the underside of the top part and the topside of the bottom part.

Like the credit card form factor in the ’444 patent, Faarbaek’s mobile physiological monitoring device has a housing that may be “rectangular” and “between 0.5 and 15 mm” in thickness. APPLE-1007, [0048], [0067], [0068], [0070]. As discussed above in Section III.A.3, a POSITA would have been motivated to modify the shape and thickness of Libbus’s ECG device to that of Faarbaek. APPLE-1003, ¶ 103. Accordingly, it would have been obvious to a POSITA to use Faarbaek’s size and shape disclosure to modify Libbus’s housing to that of a rectangular shape approximately 0.75 mm in thickness. APPLE-1003, ¶ 103. Thus, the Libbus-Faarbaek combination renders obvious a credit card form factor. APPLE-1003, ¶ 103.

Libbus's device includes a top part, adherent patch 110, with a top surface and underside. APPLE-1004, [0053]. Figure 1B shows a top surface of the ECG device's top part and Figure 1C shows the underside of the top part. APPLE-1004, [0053]-[0055]. The top surface of the ECG device's top part comes into contact with the skin of the user and includes the electrode pads for measuring an ECG signal. APPLE-1004, [0053]-[0055], [0065], [0071]. The electrodes also extend from the top surface to the underside of the top part to electrically couple with the flex PCB via flexible connectors. APPLE-1004, [0054], [0055].

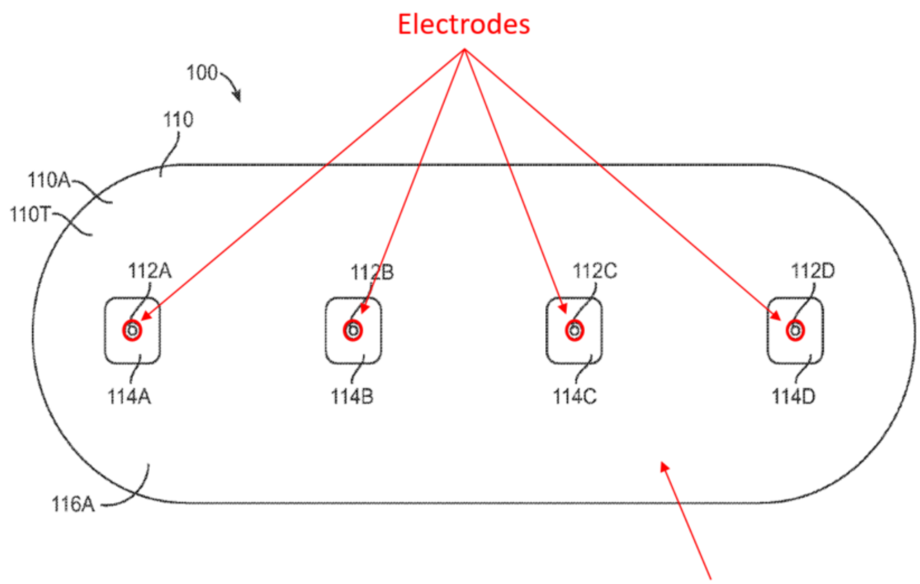


FIG. 1B

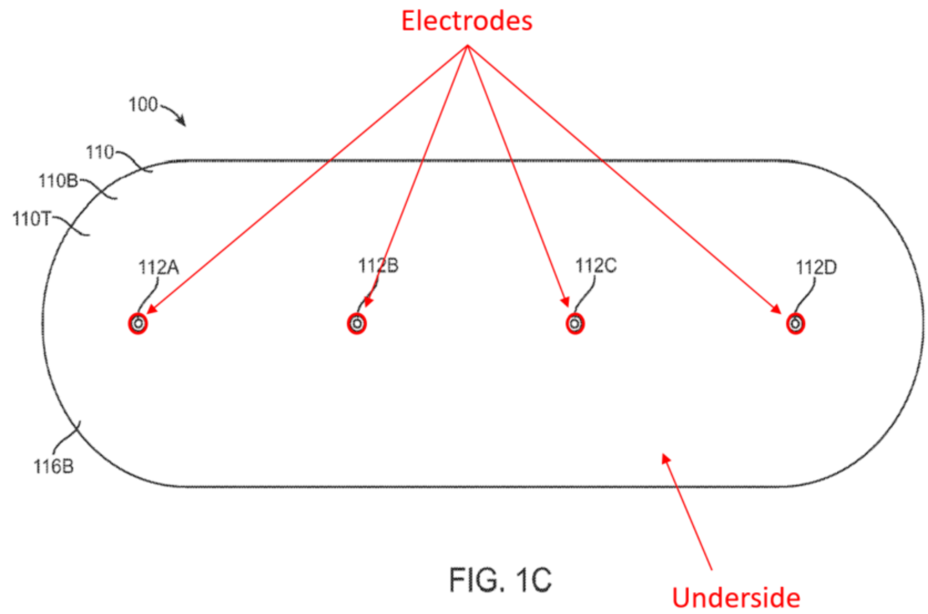


FIG. 1C

APPLE-1006, Fig. 1B and 1C (annotated)

Libbus further discloses a bottom part, a housing 160, positioned to cover the electrode assembly, which is positioned between the top part and bottom part. APPLE-1004, [0066], [0067], [0068]. Given that the housing covers and protects the electrode assembly, a POSITA would have understood the cover to include a topside and a bottom surface. APPLE-1003, ¶ 105; APPLE-1004, [0066]-[0070].

Further, as shown below in Figures 1H and 1G, the underside of the top part of Libbus's device is affixed to the topside of the bottom part. APPLE-1004, [0066]-[0070]. To affix the two, a "sealant adhesive such as epoxy" may be used. APPLE-1004, [0067].

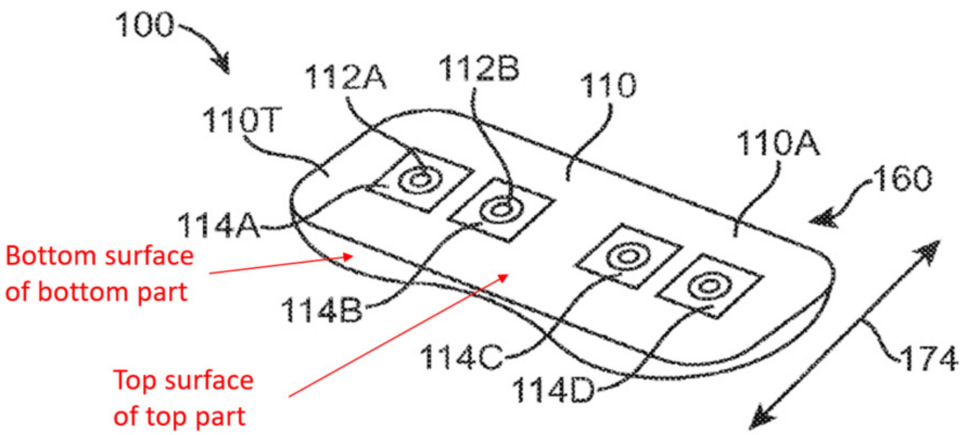


FIG. 1H

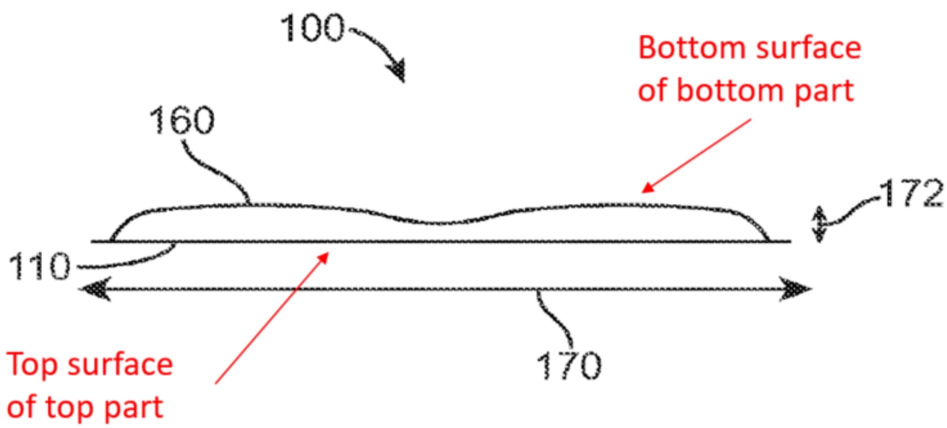


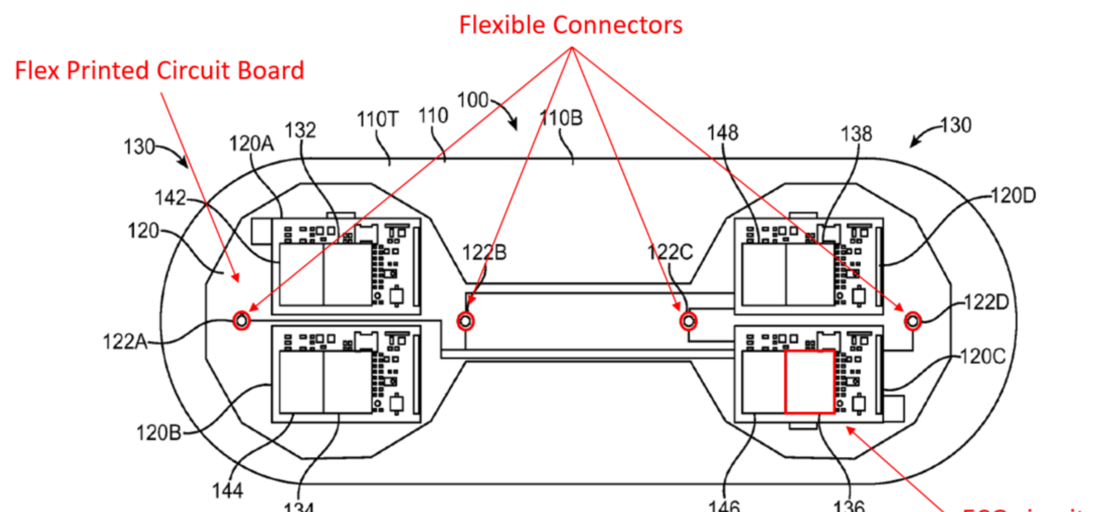
FIG. 1G

APPLE-1006, Figs. 1H and 1G (annotated)

As noted above, Libbus's electrode assembly includes electrodes, ECG circuitry, and electrode pads, *see* [2.0]. Libbus's electrode assembly further includes at least two conductive flexible membranes, the flexible connectors, electrically connected to the electrode pads and electrically connected to the converter assembly. APPLE-1004, [0053]-[0056]. The connectors may be a flex circuit that can provide strain relief between the electrode pads and the flex PCB. APPLE-1004,

[0055]. Thus, a POSITA would have understood the traces and connectors are conductive flexible membranes. APPLE-1003, ¶ 107. Additionally, the flex PCB, traces, and connectors are positioned above the underside of the top part. APPLE-1004, [0053]-[0055].

As shown in Fig. 1D below, the connectors are aligned with the electrode pads to electrically connect with the electrode pads. APPLE-1004, [0055], [0056]. The connectors are also electrically coupled with the converter assembly. APPLE-1004, [0053]-[0056], [0059].



APPLE-1006, Fig. 1D (annotated)

Additionally, as seen in Fig. 1H above, the electrode pads are positioned on the top surface of the top part. APPLE-1004, [0053]-[0056]. This spatial arrangement allows the ECG device to measure an ECG signal when it comes in contact with the skin of the user. APPLE-1004, [0053].

Last, as noted and seen in Figures 1D and 1H above, the conductive flexible membranes, e.g., the connectors, are positioned above the underside of the top part and below the cover. APPLE-1004, [0053]-[0056]. Therefore, the conductive flexible membranes are positioned between the underside of the top part and the topside of the bottom part.

Thus, Libbus renders obvious element [3.0]. APPLE-1003, ¶ 112.

7. Claim 4

[4.0] The mobile ECG sensor according to claim 2, wherein the at least two conductive flexible membranes are in contact with the at least two electrode pads.

See element [3.0]. APPLE-1003, ¶¶ 113-114. Libbus discloses two conductive flexible membranes, e.g., connectors, in contact with the electrode pads. APPLE-1004, [0054], [0055]. As shown in FIG. 1D (reproduced above at [3.0]), the connectors are aligned with the electrode pads to electrically contact the electrode pads. APPLE-1004, [0055], [0056]. Thus, Libbus renders obvious element [4.0]. APPLE-1003, ¶ 115.

8. Claim 6

[6.0] The mobile ECG sensor according to claim 1, wherein the modulated signal is in accordance with a Bluetooth wireless communication standard.

See [1.0]. Libbus discloses a modulated signal in accordance with a Bluetooth wireless communication standard. APPLE-1004, [0059]. A POSITA would have understood that the modulated signal is transmitted in accordance with a

Bluetooth wireless communication standard. APPLE-1003, ¶ 116. Thus, Libbus renders obvious element [6.0]. APPLE-1003, ¶ 117.

9. Claim 8

[8.0] A mobile ECG sensor comprising:

See [1.0]. APPLE-1003, ¶ 118.

[8.1] a credit card form factor, wherein the credit card form factor houses:

See [1.4]. APPLE-1003, ¶ 119.

[8.2] an electrode assembly comprising electrodes positioned on an exterior surface of the credit card form factor, wherein the electrode assembly senses heart-related signals when in contact with a user's skin, and produces electrical signals representing the sensed heart-related signals;

See [1.1] and [2.0]. APPLE-1003, ¶ 120.

[8.3] a converter assembly electrically connected to the electrode assembly, the converter assembly comprising a processor;

As noted above, Libbus's device has wireless communications circuitry that includes a converter assembly and transmitter. *See* [1.2]. The converter assembly portion of the wireless communications circuitry is "coupled to . . . the electrocardiogram circuitry" portion of the electrode assembly to receive an electrical signal, such as an ECG signal. APPLE-1004, [0059], [0055], [0058]; APPLE-1003, ¶122. The converter assembly portion further includes a "processor" to control the collection and transmission of data from the electrocardiogram circuitry. APPLE-1004, [0058], [0059], [0071], [0072], [0074]. The processor further comprises memory, which includes instructions operated by the processor to perform the collection, transmission, and display of acquired data. APPLE-1004, [0058], [0048], [0071]-[0075]; APPLE-1003, ¶ 122. The processor also aids in the acquisition, conversion, and processing of the ECG signals. APPLE-1004, [0071], [0072]. Thus, Libbus renders obvious element [8.3]. APPLE-1003, ¶ 123.

[8.4] a display electrically connected to the converter assembly, the display positioned on the exterior surface of the credit card form factor; and

As discussed above in Section III.A.3, a POSITA would have been motivated to modify Libbus's ECG device to include a display electrically connected to the converter assembly and positioned on the exterior surface based on Faarbaek because it would provide for displaying electrocardiography data in real-time to a user. APPLE-1003, ¶ 125. Faarbaek's physiological monitoring device includes a display to convey information to a user. APPLE-1007, [0259], [0345]. The display is positioned on the "cover layer," i.e., the exterior surface of the Faarbaek's device. *Id.* Faarbaek's display also is electrically connected to a processor, which controls the display of information, such as in the form of "text or lights." APPLE-1007, [0345]. Like Faarbaek's display, the Libbus-Faarbaek combination includes a display electrically connected to a processor, here the processor portion of the converter assembly, to control the display of information. *See* element [8.3]; APPLE-1003, ¶ 125.

Thus, the Libbus-Faarbaek combination renders obvious element [8.4]. APPLE-1003, ¶ 126.

[8.5] a memory comprising instructions to cause the processor to process the sensed heart-related signals and display the heart-related signals on the display.

Libbus's device includes a processor with memory. APPLE-1004, [0058]. Further, the "processor can be configured to control a collection and transmission of data from the impedance circuitry electrocardiogram circuitry and the accelerometer." APPLE-1004, [0058]. Included in the memory is a set of instructions that "can cause the acquisition of patient data from the ECG signal." APPLE-1004, [0094]. Thus, Libbus renders obvious a memory comprising instructions to cause the processor to process the sensed heart-related signals. APPLE-1003, ¶ 128.

As discussed above in Section III.A.3, a POSITA would have been motivated to modify Libbus's ECG device to include a display electrically connected to the converter assembly and positioned on the exterior surface based on Faarbaek, such that it would display the heart-related signals on the display because it would provide for displaying electrocardiography data in real-time to a user. APPLE-1003, ¶ 129. As noted above, Faarbaek's display is also electrically connected to a processor, which controls the display of information, such as in the form of "text or lights." APPLE-1007, [0345], [0259], [0342]. Like Faarbaek's display, the Libbus-Faarbaek combination includes a display electrically connected to a processor, here the processor portion of the converter assembly, to control the display of information. *See* element [8.3]; APPLE-1003, ¶ 129.

Thus, the Libbus-Faarbaek combination renders obvious element [8.5]. APPLE-1003, ¶ 130.

10. Claim 9

[9.0] The mobile ECG sensor according to claim 8, wherein the heart-related signals comprise ECG signals.

See [1.1]. Libbus's device generates electrocardiogram signals and data from the electrodes placed on the user's skin. APPLE-1004, [0065]. Thus, Libbus renders obvious element [9.0]. APPLE-1003, ¶¶ 131-133.

11. Claim 10

[10.0] The mobile ECG sensor according to claim 8, wherein the heart-related signals comprise heart rate signals.

See [1.1]. Libbus's device generates electrocardiogram signals, which include a "heart rate signal." APPLE-1004, [0050], [0051], [0071], [0072], [0092]. Thus, Libbus renders obvious element [9.0]. APPLE-1003, ¶ 136.

12. Claim 11

[11.0] The mobile ECG sensor according to claim 8, further comprising a transmitter electrically connected to the processor and housed in the credit card form factor, wherein the transmitter is capable of transmitting the processed sensed heart-related signal wirelessly.

See [1.2]-[1.4]. As noted above, Libbus's device has wireless communications circuitry, which includes a converter assembly and transmitter.

See [1.2], [1.3]. And both the converter assembly and transmitter are housed in the credit card form factor. *See* [1.4]. The converter assembly portion of the wireless communications circuitry is "coupled to . . . the electrocardiogram circuitry" portion of the electrode assembly so that it can receive an electrical signal, such as an ECG signal. APPLE-1004, [0059], [0055], [0058]; APPLE-1003, ¶ 138. The converter assembly portion further includes a "processor" to control the collection and wireless transmission of data from the electrocardiogram circuitry. APPLE-1004, [0058], [0059], [0071], [0072], [0074]. The converter assembly portion is electrically connected to the transmitter portion of the wireless communication circuitry. APPLE-1004, [0059], [0058], [0060], [0047], [0074]; APPLE-1003, ¶ 138. Thus, the transmitter is electrically connected to the processor. *Id.* Further, the wireless transmissions include the processed sensed heart-related signals, such as ECG signals. APPLE-1004, [0071], [0074]. And the transmitter transmits the processed sensed heart-related signals wirelessly. APPLE-1004, [0059], [0060], [0047], [0071], [0074]. Thus, Libbus renders obvious element [11.0]. APPLE-1003, ¶ 138.

13. Claim 12

[12.0] A mobile ECG sensor comprising:

See element [1.0]. APPLE-1003, ¶ 139.

[12.1] an electrode assembly comprising electrodes, wherein the electrode assembly senses heart-related signals when in contact with a user's skin, and produces electrical signals representing the sensed heart-related signals;

See element [1.1]. APPLE-1003, ¶ 140.

[12.2] a converter assembly electrically connected to the electrode assembly, configured to convert the electrical signals to a modulated signal, wherein the modulated signal carries the electrical signals representing the sensed heart-related signals;

See element [1.2]. APPLE-1003, ¶ 141.

[12.3] a transmitter that transmits the modulated signal wirelessly to a computing device; and

See element [1.3]. APPLE-1003, ¶ 142.

[12.4] a housing containing the electrode assembly, the converter assembly, and the transmitter, wherein the housing is a mobile phone case form factor, and wherein the electrodes are positioned on an exterior surface of the mobile phone case form factor.

As noted above, *see* [1.4], the housing for Libbus's ECG device is made of two portions, the "housing 160" and the "cover 162." APPLE-1004, [0067], [0068]. As shown in Figs. 1D, 1H, and 1F below, Libbus's housing contains the electrodes and electrocardiogram circuitry, which corresponds to the electrode assembly, and the wireless communications circuitry that corresponds to the converter assembly and the transmitter. APPLE-1004, [0066]-[0068].

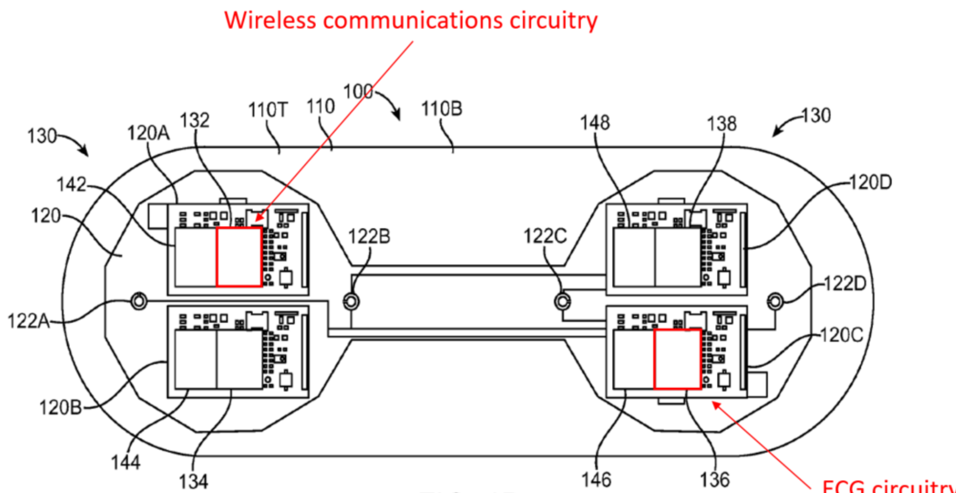


FIG. 1D

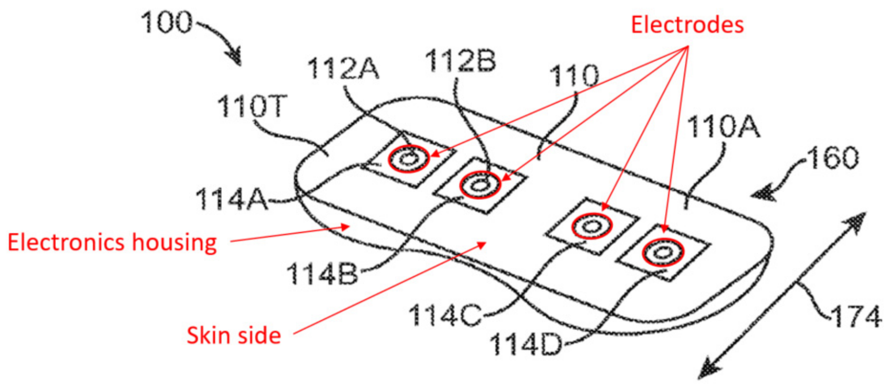


FIG. 1H

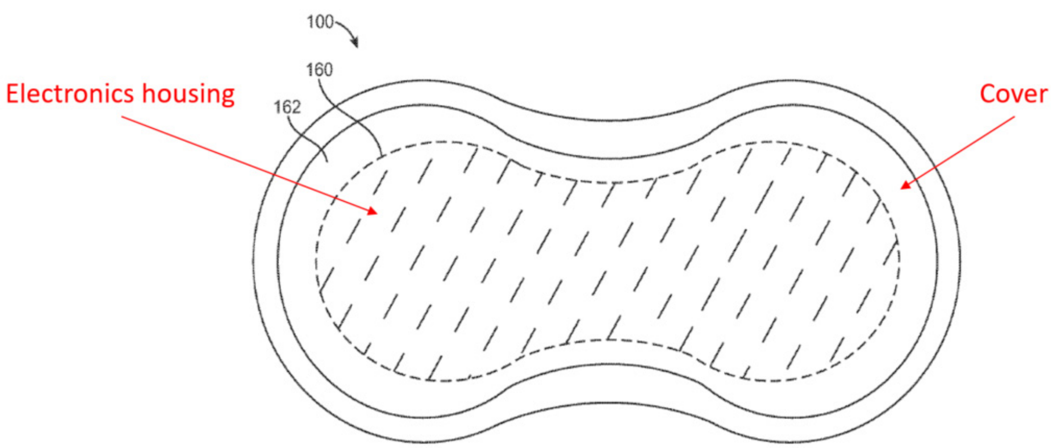


FIG. 1F

APPLE-1006, Figs. 1D, 1H, and 1F (annotated).

As shown in Fig. 1G below, Libbus's device is an hourglass form factor "about 100 mm to about 250 mm" in length, "about 50 mm to 100 mm" in width, and "about 5 mm to about 10 mm" in thickness, and may be made of plastic or metal. APPLE-1004, [0069], [0070], [0049], [0067].

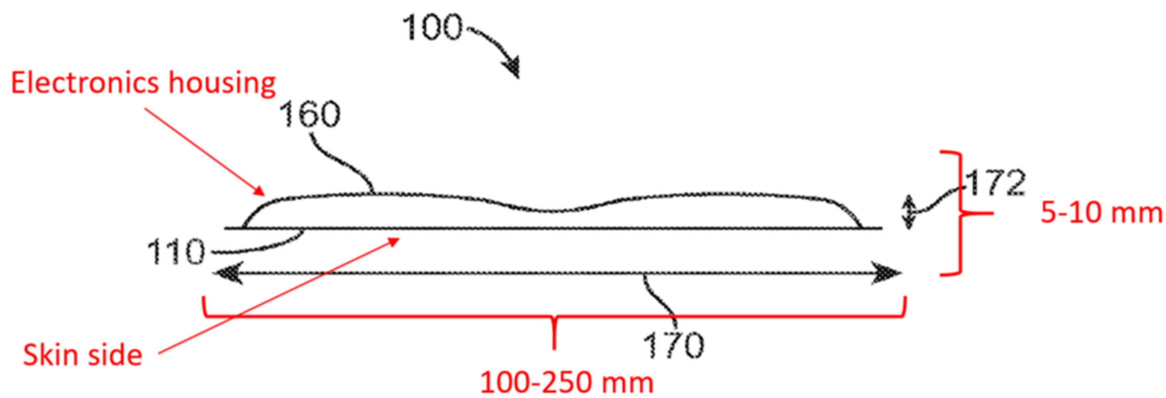
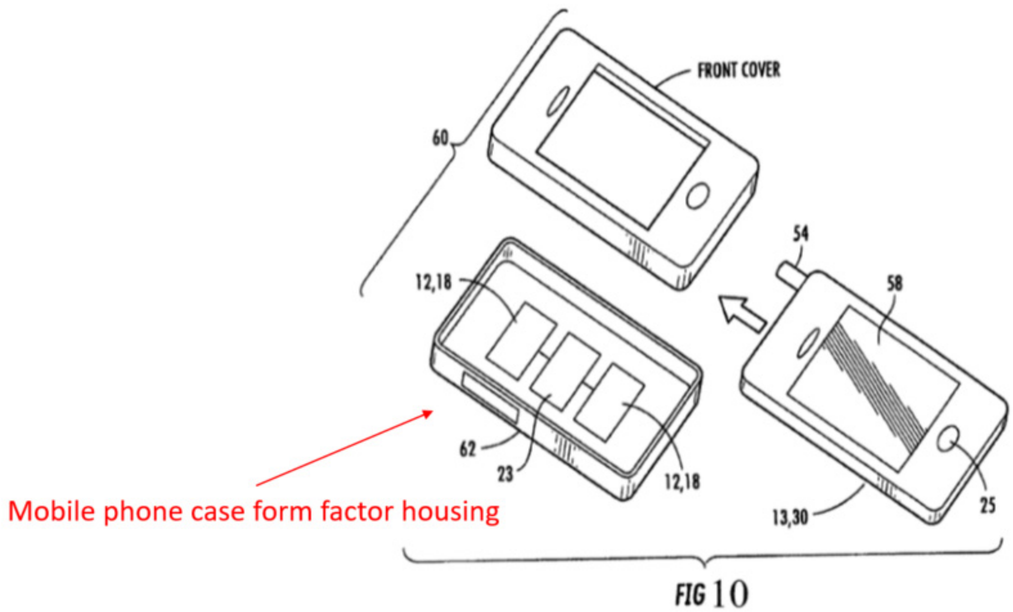


FIG. 1G

APPLE-1006, Fig. 1G (annotated).

Further, Faarbaek describes a mobile physiological monitoring device with a housing that may come in several shapes, including "rectangular." APPLE-1007, [0048], [0070].

As shown in Figure 10 below, the '444 patent's ECG device is a mobile phone case form factor. APPLE-1001, [0049]. Further, the shape of the mobile phone case form factor is rectangular. *Id.* And the '444 patent does not provide any dimensions for the mobile phone case form factor. *Id.*



APPLE-1001, Fig. 10 (annotated)

A POSITA would have understood "mobile phone case form factor" to define the size and shape of the ECG device to be similar to a mobile phone case. APPLE-1003, ¶ 148. As of the Critical Date, mobile phone cases were commonplace, rectangular, and were approximately 115 mm in length, 58 mm in width, and 9 mm in thickness. APPLE-1009, p. 1; APPLE-1003, ¶ 148.

Like the mobile phone case form factor in the '444 patent, Faarbaek's mobile physiological monitoring device has a "rectangular" housing. APPLE-1007, [0048], [0067], [0068], [0070]. As discussed above in Section III.A.3, a POSITA would have been motivated to modify the shape of Libbus's ECG device to that of Faarbaek because it provides a more convenient device to monitor physiological signals and it confirms that the obvious design choices of shape (e.g., rectangular) were well-known. APPLE-1003, ¶ 149. Accordingly, it would have been obvious to a POSITA to use Faarbaek's shape disclosure to modify Libbus's housing to that of a rectangular shape without altering the dimensions of Libbus. APPLE-1003, ¶ 149. Moreover, by the Critical Date, phone cases for smart phones, such as the iPhone and Samsung Galaxy, were common in the marketplace. APPLE-1003, ¶ 149. Smart phone accessories and instrumented phone cases, also known as "sleds," were available and commonly used to enable phones to perform additional functions such as bar code scanning. APPLE-1003, ¶ 149. From these market forces and trends, a POSITA would have been motivated to modify many types of products to be compatible with mobile phone cases, including the form factor of an ECG housing. APPLE-1003, ¶ 149. With these motivations, it would have been obvious to a POSITA to modify the form factor of the Libbus-Faarbaek ECG housing to that of a mobile phone case and a POSITA would have had a reasonable expectation of success in doing so based on their training and education. APPLE-1003, ¶ 149. Thus, the Libbus-Faarbaek combination renders obvious element [12.4]. APPLE-1003, ¶ 150.

14. Claim 14

[14.0] The mobile ECG sensor according to claim 12, wherein the modulated signal is in accordance with a Bluetooth wireless communication standard.

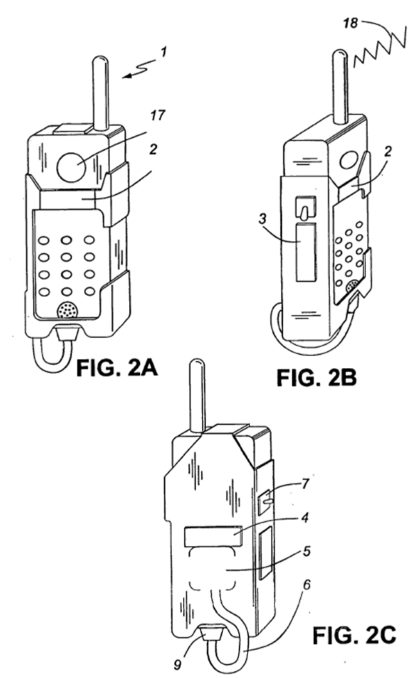
See element [12.0] of III.A.13. Libbus discloses a modulated signal in accordance with a Bluetooth wireless communication standard. APPLE-1004,

[0059]. A POSITA would have understood that the modulated signal is transmitted in accordance with a Bluetooth wireless communication standard. APPLE-1003, ¶¶ 151-52. Thus, Libbus renders obvious element [14.0]. APPLE-1003, ¶ 152.

B. [GROUND 2] – Libbus in view of Batkin Renders Claims 12 and 14 Obvious

1. Batkin Overview

Like the '444 patent, Batkin is directed at remote monitoring of cardiac electrical activity. APPLE-1011, Title. Specifically, Batkin discloses a cell phone case that detects an ECG signal through ECG electrodes and transmits the ECG signal to the cell phone. APPLE-1011, Abstract, [0046] and Fig. 2A-2C.



APPLE-1011, Figs. 2A-2C.

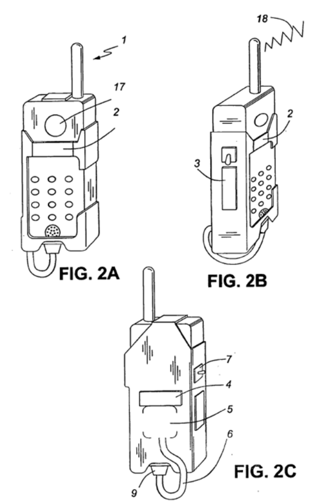
Importantly, Batkin notes that, when the device is incorporated into a case, it is "designed to be carried by an existing telephone or cell phone." APPLE-1011, [0034]. Batkin discloses that the cell phone case has "an electronic circuit 5 to condition and/or analyze the bio-signal and to digitize and/or modulate the bio-signal in preparation for transmission" to the cell phone. APPLE-1011, [0046]. Batkin explains that "the conditioned signal may be in acoustic or electronic form." APPLE-1011, [0051].

Batkin discloses "simultaneous transmissions" of the ECG signal (bio-signal) and voice telephonic transmissions, which "may be effected by any one of known means for combining voice and data communication, as further elaborated below." APPLE-1011, [0034]. Batkin further explains that such "simultaneous transmissions" allow "real-time data transmission and telephonic feedback between the patient and the health care practitioner." APPLE-1011, [0013] and [0034].

2. Libbus-Batkin Combination

As discussed above, Libbus's ECG device is a mobile physiological monitoring device with electrodes, electrocardiogram circuitry, a processor, and wireless communication circuitry contained within a housing. *See* Section III.A.1. Although Libbus does not explicitly disclose a housing with a mobile phone case form factor, Libbus teaches that the "device can comprise many shapes, for example at least one of a dogbone, an hourglass, an oblong, a circular or an oval shape." APPLE-1004, [0047]. From Libbus's disclosure, a POSITA would have understood or found obvious that the ECG device could come in a variety of sizes and shapes and would have had reason to explore other size and shape options for Libbus's housing. Indeed, a POSITA would have been motivated to turn to Batkin for other size and shape options because both Libbus and Batkin are directed to mobile physiological monitoring devices. APPLE-1003, ¶¶ 154-160.

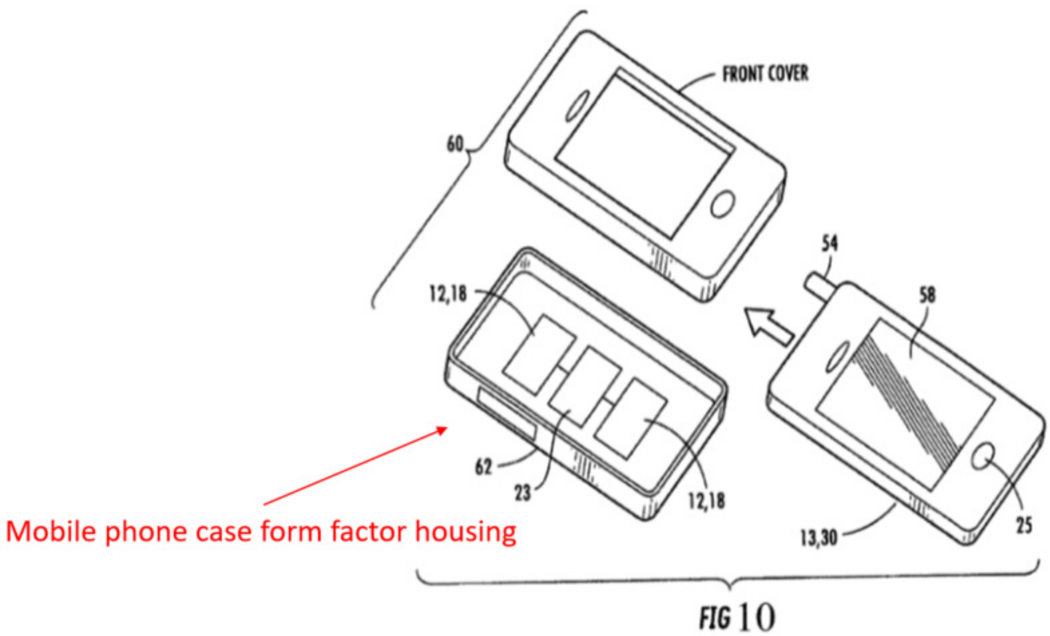
As noted above in section III.B.1, Batkin discloses a cell phone case that detects an ECG signal through ECG electrodes and transmits the ECG signal to the cell phone. APPLE-1011, Abstract, [0046] and Fig. 2A-2C.



APPLE-1011, Figs. 2A-2C.

Importantly, Batkin also notes that when the device is incorporated into a case, it is "designed to be carried by an existing telephone or cell phone." APPLE-1011, [0034].

As shown in Figure 10 below, the '444 patent's ECG device is a mobile phone case form factor. APPLE-1001, [0049]. Like Batkin, the '444 patent's mobile phone case form factor is designed to fit an existing cell phone. *Id.*



APPLE-1001, Fig. 10 (annotated)

And a POSITA would have understood "mobile phone case form factor" to define the size and shape of the ECG device to be similar to a mobile phone case. APPLE-1003, ¶ 159.

As noted above, Batkin describes a mobile physiological monitoring device with a housing that is shaped like an existing cell phone. APPLE-1011, [0034], [0046], and Fig. 2A-2C. From these teachings, a POSITA would have been motivated to incorporate Batkin's housing shaped like a cell phone case into Libbus's ECG device because it would provide a convenient device to monitor physiological signals. APPLE-1003, ¶ 161. In implementing the Libbus-Batkin combination, a POSITA would have modified Libbus's ECG device to incorporate the housing shaped like a cell phone from Batkin. APPLE-1003, ¶ 162. A POSITA would have viewed these teachings as being applicable to Libbus and routine to implement for Libbus's ECG device. APPLE-1003, ¶ 162. Further, given the overlapping subject matter between Libbus and Batkin, as noted above, a POSITA would have had a reasonable expectation of success in modifying the shape and size of Libbus's ECG device based on Batkin. APPLE-1003, ¶ 162. Such a change in housing shape and size is also an obvious matter of design choice. The housing shaped like a cell phone is disclosed in the prior art and its substitution presents no unexpected result, so it would have been an obvious matter of design choice for a POSITA to modify Libbus to incorporate the cell phone shape and size of Batkin's housing with Libbus's electronic components inside. APPLE-1003, ¶ 162.

3. Claim 12

[12.0] A mobile ECG sensor comprising:

See element [1.0]. APPLE-1003, ¶ 163.

[12.1] an electrode assembly comprising electrodes, wherein the electrode assembly senses heart-related signals when in contact with a user's skin, and produces electrical signals representing the sensed heart-related signals;

See element [1.1]. APPLE-1003, ¶ 164.

[12.2] a converter assembly electrically connected to the electrode assembly, configured to convert the electrical signals to a modulated signal, wherein the modulated signal carries the electrical signals representing the sensed heart-related signals;

See element [1.2]. APPLE-1003, ¶ 165.

[12.3] a transmitter that transmits the modulated signal wirelessly to a computing device; and

See element [1.3]. APPLE-1003, ¶ 166.

[12.4] a housing containing the electrode assembly, the converter assembly, and the transmitter, wherein the housing is a mobile phone case form factor, and wherein the electrodes are positioned on an exterior surface of the mobile phone case form factor.

As noted above, *see* [1.4], the housing for Libbus's ECG device is made of two portions, the "housing 160" and the "cover 162." APPLE-1004, [0067], [0068]. As shown in Figs. 1D, 1H, and 1F below, Libbus's housing contains the electrodes and electrocardiogram circuitry, which corresponds to the electrode assembly, and the wireless communications circuitry that corresponds to the converter assembly and the transmitter. APPLE-1004, [0066], [0067], [0068].

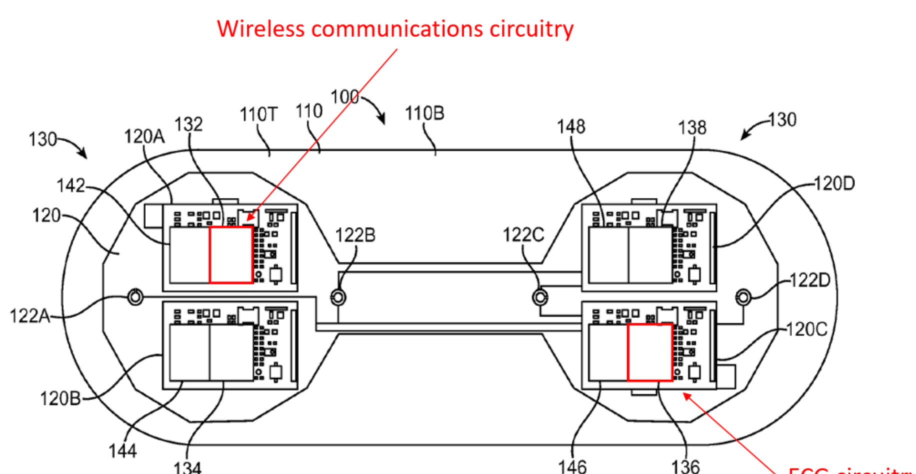


FIG. 1D

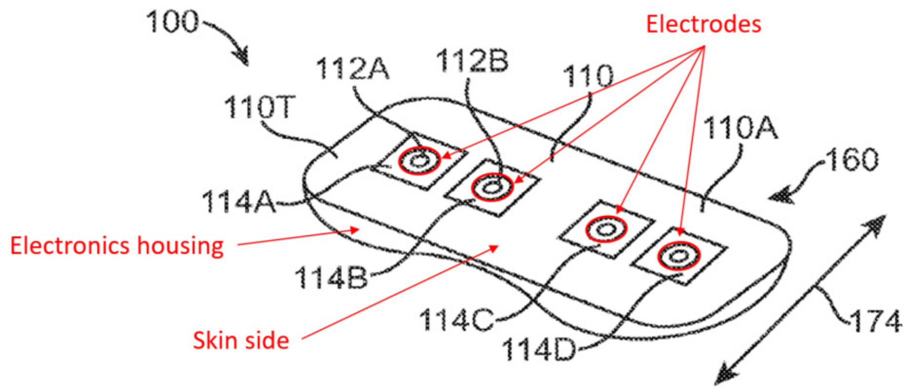


FIG. 1H

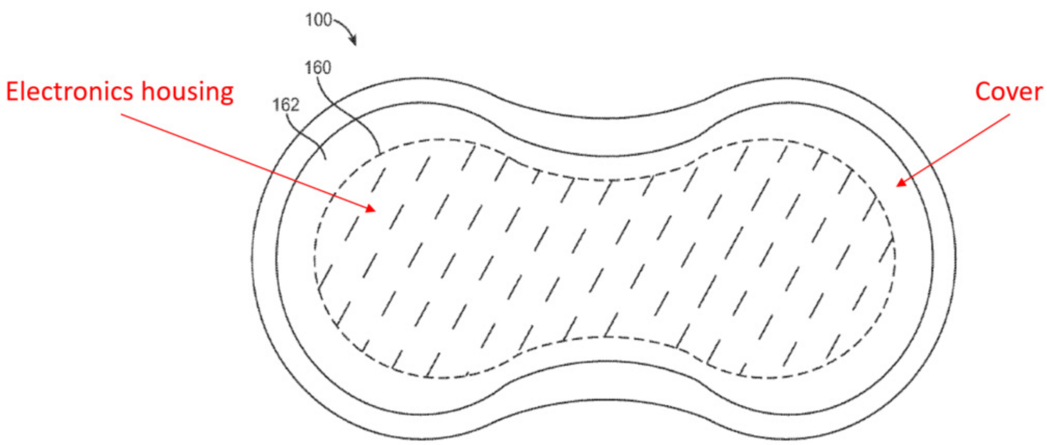
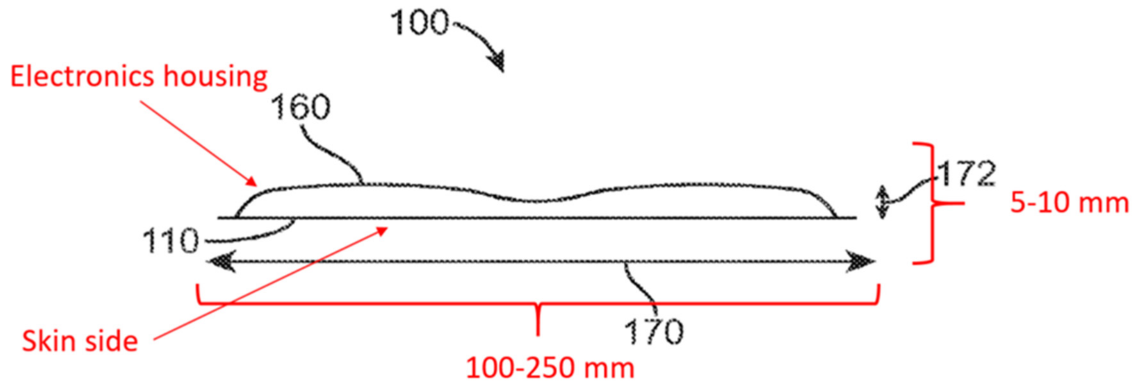


FIG. 1F

APPLE-1006, Figs. 1D, 1H, and 1F (annotated).

As shown in Fig. 1G below, Libbus's device is an hourglass form factor "about 100 mm to about 250 mm" in length, "about 50 mm to 100 mm" in width, and "about 5 mm to about 10 mm" in thickness, and may be made of plastic or metal. APPLE-1004, [0069], [0070], [0049], [0067].



APPLE-1006, Fig. 1G (annotated).

As discussed above in Section III.B.2, a POSITA would have been motivated to incorporate Batkin's housing shaped like a cell phone case into Libbus's ECG device because it would provide a convenient device to monitor physiological signals. APPLE-1003, ¶¶ 167-170. Accordingly, it would have been obvious for a POSITA to use Batkin's disclosure regarding the shape of its housing to modify Libbus's housing to that of a mobile phone case. APPLE-1003, ¶ 167-170.

Thus, the Libbus-Batkin combination renders obvious element [12.4]. APPLE-1003, ¶ 171.

4. Claim 14

[14.0] The mobile ECG sensor according to claim 12, wherein the modulated signal is in accordance with a Bluetooth wireless communication standard.

See element [12.0] of III.B.2. Libbus discloses a modulated signal in accordance with a Bluetooth wireless communication standard. APPLE-1004,

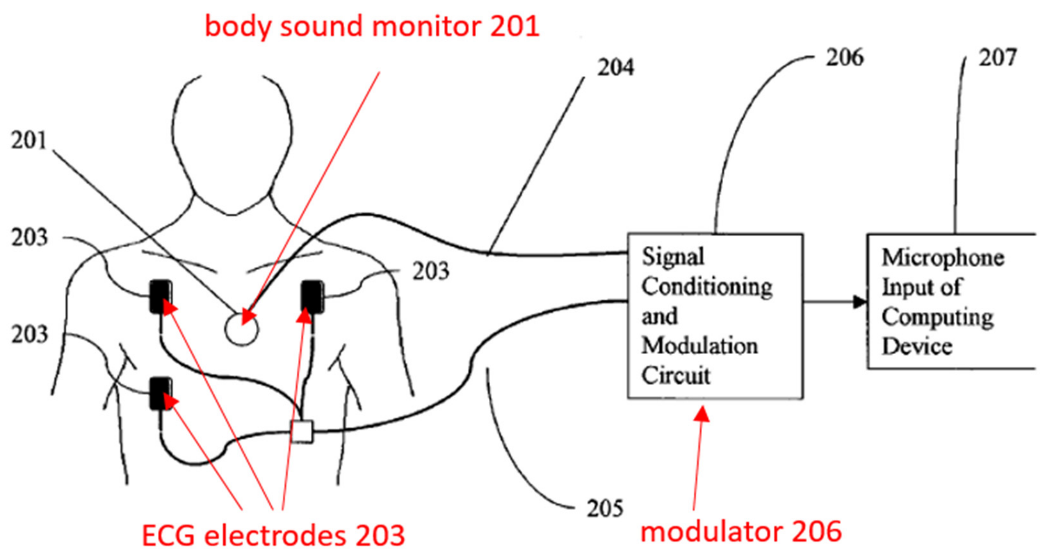
[0059]. A POSITA would have understood that the modulated signal is transmitted in accordance with a Bluetooth wireless communication standard. APPLE-1003, ¶ 172-73. Thus, Libbus renders obvious element [14.0]. APPLE-1003, ¶ 173.

C. [GROUND 3] – Libbus in view of Faarbaek and Vyshedskiy Render Claims 5 and 13 Obvious

1. Vyshedskiy Overview

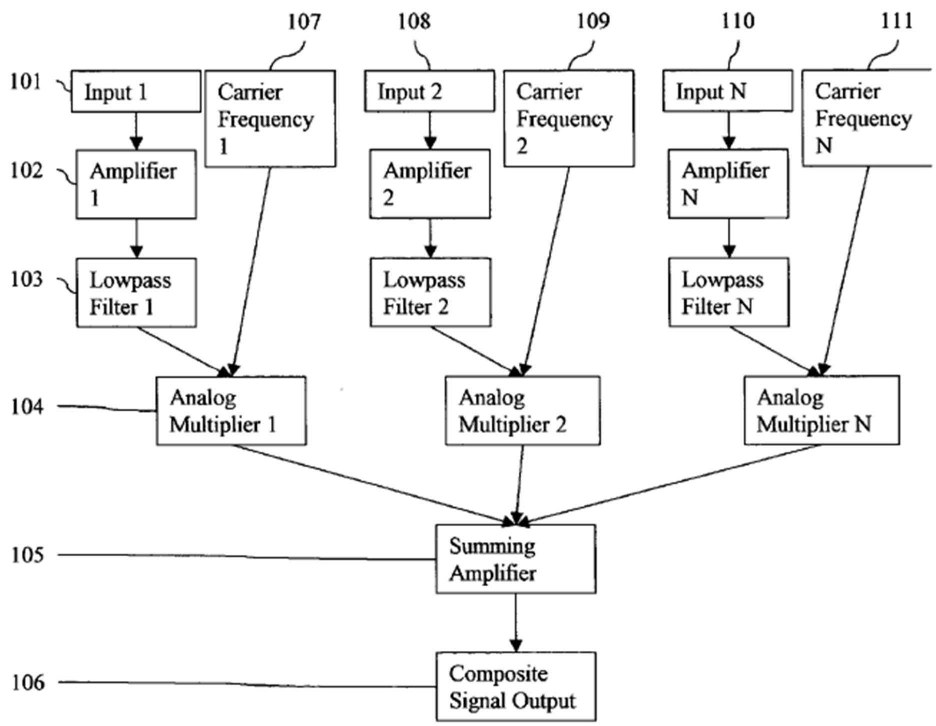
Similar to the ’444 patent, Vyshedskiy discloses a method and apparatus for physiological data acquisition. APPLE-1008, Title. Specifically, Vyshedskiy discloses an “EKG Stethoscope” that collects both body sound and ECG electric signals from the user’s heart (APPLE-1008, [0011]); converts, through modulation, the ECG electric signals to ECG audio signals with certain frequencies (e.g., 6.5-8.5 kHz) to generate a composite audio signal (APPLE-1008, [0028]); and transmits the composite audio signal into a microphone port of a computing device (e.g., a PDA or a cell phone) (APPLE-1008, [0010] and [0011]), where the computing device digitizes and demodulates the composite signal so that both a phonocardiogram and an electrocardiogram can be displayed/visualized together (APPLE-1008, [0013]). A POSITA would have understood that the terms “electrocardiogram,” “EKG,” and “ECG” are synonymous. APPLE-1003, ¶ 54.

First, Vyshedskiy discloses collecting electric signals from the user's heart. Specifically, as shown in Fig. 2 below, Vyshedskiy discloses that the electrocardiographic signal from the patient's skin is picked up by ECG electrodes 203 and transmitted via wire or wirelessly 205 into a Signal Conditioning and Modulation Circuit 206. APPLE-1008, [0033].



APPLE-1008, Fig. 2 (annotated).

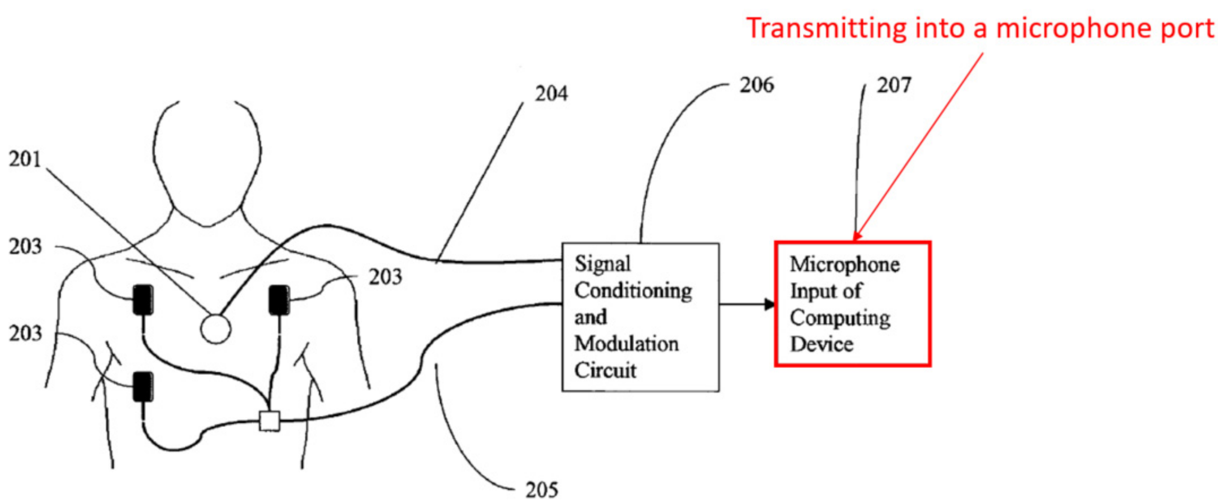
Second, Vyshedskiy discloses converting, through modulation, the electric ECG signals to audio signals with certain frequencies (e.g., 6.5-8.5 kHz), and generating a composite audio signal for transmission into a microphone port of a computing device. Specifically, as shown below in Fig. 1A, Input 101 (e.g., the ECG signal) is amplified by Amplifier 102, filtered by Lowpass Filter 103, and multiplied by a Carrier Frequency 107 in the Analog Multiplier 104. APPLE-1008, [0026]. A plurality of inputs from Input 1, Input 2, to Input N are modulated in the same manner and summed by Summing Amplifier 105 to derive a composite audio signal output for transmission through a microphone port. APPLE-1008, [0027].



APPLE-1008, Fig. 1A.

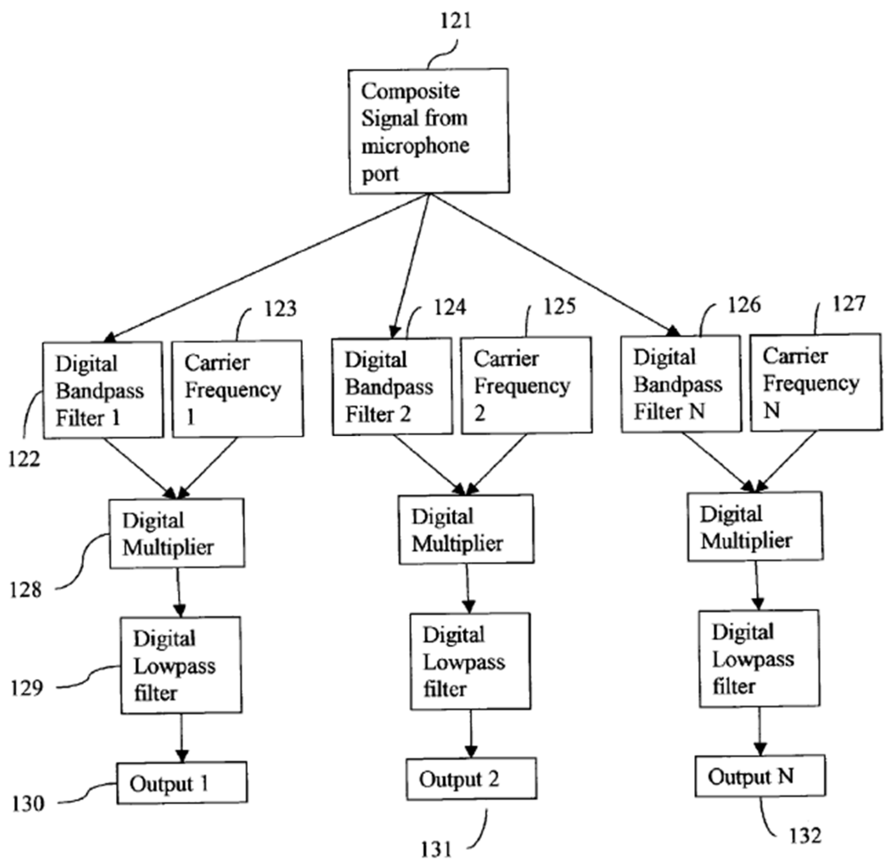
In terms of frequency, Vyshedskiy discloses that the modulated composite signal 106 can have 8 channels, corresponding to Input 1, Input 2, to Input 8. APPLE-1008, [0028]. Vyshedskiy discloses that the carrier frequencies of these 8 channels can be as follows: f1=2,500 Hz, f2=5,000 Hz, f3=7,500 Hz, f4=10,000 Hz, f5=12,500 Hz, f6=15,000 Hz, f7=17,500 Hz, f8=20,000 Hz. APPLE-1008, [0028]. As such, the carrier f1 modulated by input 1 occupies interval from 1,500 Hz to 3,500 Hz, the carrier f2 modulated by input 2 occupies interval from 4,000 Hz to 6,000 Hz, …. APPLE-1008, [0028]. A POSITA would have understood that the carrier f3 modulated by input 3 occupies interval from 6,500 Hz to 8,500 Hz. APPLE-1003, ¶ 57.

Third, as shown below in Fig. 2, Vyshedskiy discloses transmitting the composite audio signal into a microphone port to a computing device (e.g., a PDA or a cell phone). APPLE-1008, [0011].



APPLE-1008, Fig. 2 (annotated).

Vyshedskiy discloses that the computing device digitizes and demodulates the composite signal so that both a phonocardiogram and an electrocardiogram can be displayed/visualized together. APPLE-1008, [0013]. Specifically, as shown below in Fig. 1B, the composite audio signal from microphone port 121 is digitized by the sound card of the computing device. APPLE-1008, [0030]. The frequency band around the carrier frequency 123 is separated by a digital bandpass filter 122, multiplied by a digitally generated carrier frequency 123 in a digital multiplier 128, and filtered by a Digital Lowpass Filter 129. APPLE-1008, [0030].



APPLE-1008, Fig. 1B.

As long as the carrier frequency 123 of Fig. 1B is equal to the carrier frequency 107 of Fig. 1A, the resulting Output signal 130 is equal to the Input 101 of Fig. 1A. APPLE-1008, [0030]. In this way, the computing device digitalizes and demodulates the modulated audio signal in the desired channel (e.g., Channel 3), and extracts the underlying ECG signal. The output (e.g., ECG signal) can now be recorded, visualized/displayed, and analyzed by the computing device. APPLE-1008, [0031].

2. The Libbus-Faarbaek-Vyshedskiy Combination

As discussed above, the Libbus-Faarbaek combination is a mobile physiological monitoring device with electrodes, electrocardiogram circuitry, a processor, and wireless communication circuitry contained within a housing. *See* Section III.A.3. Although Libbus fails to disclose a carrier frequency for its ECG (the frequency modulated signal), Libbus does teach transmitting physiological data with a frequency modulation communication protocol. *See* APPLE-1004, [0059]. From Libbus's disclosure, a POSITA would have turned to other references, like Vyshedskiy, for disclosure of viable carrier frequencies because both Libbus and Vyshedskiy are directed at mobile physiological monitoring devices, which acquire electrocardiography signals. APPLE-1003, ¶ 175.

Specifically, Vyshedskiy discloses that its modulated composite signal 106 with ECG data can have 8 channels, corresponding to Input 1, Input 2, to Input 8. APPLE-1008, [0028]. Vyshedskiy discloses that the carrier frequencies of these 8 channels can be as follows: f1=2,500 Hz, f2=5,000 Hz, f3=7,500 Hz, f4=10,000 Hz, f5=12,500 Hz, f6=15,000 Hz, f7=17,500 Hz, and f8=20,000 Hz. APPLE-1008, [0028]. Vyshedskiy further discloses that each channel (carrier frequency modulated by the input) occupies +/-1000 Hz from the carrier frequency. *Id*. For example, channel 1 (carrier frequency f1 modulated by input 1) occupies from 1500 Hz to 3500 Hz. *Id*. Vyshedskiy further discloses that body sounds are between 20 Hz and 2000 Hz. APPLE-1008, [0016]. To avoid interference, a POSITA would have found it obvious to choose a carrier frequency from about 6 kHz to about 20 kHz (e.g., f3=7,500 Hz, f4=10,000 Hz, f5=12,500 Hz, f6=15,000 Hz, f7=17,500 Hz, f8=20,000 Hz) to avoid interference from human voice, which can reach the frequency of about 5 kHz. *See* APPLE-1013, Fig.1.

A POSITA would have viewed these teachings as being readily able to be incorporated into the Libbus-Faarbaek combination. APPLE-1003, ¶ 177. There are two fundamental ways to transmit modulated audio signals: amplitude modulation (AM) and frequency modulation (FM). While Vyshedskiy discloses using AM, a POSITA would have found it obvious to use FM to transmit the ECG signals because using FM instead of AM involves "a simple substitution of one known element for another." *Asyst Technologies, Inc. v. Emtrak, Inc.*, 544 F.3d 1310, 1315 (Fed. Cir. 2008) (finding claims obvious where the claimed invention differed over a prior art reference only by the substitution of a multiplexer for a bus to connect electronic tags to a central computer, and multiplexers were know in the art at the time of the invention). A POSITA would have been motivated to use FM instead of AM because (1) FM is a newer technology compared to AM and (2) FM has a superior dynamic range with a better signal to noise ratio. APPLE-1003, ¶ 177.

A POSITA would have had a reasonable expectation of success. For example, Saltzstein discloses transmitting ECG audio signals using either AM or FM. APPLE-1014, 11:30-51. Albert also discloses transmitting ECG audio signals using FM. APPLE-1012, Abstract and 2:5-15, 3:10-41. Dick also discloses transmitting ECG signals using FM. APPLE-1015, Fig. 1 and 2:25-32. Further, given the overlapping subject matter between Libbus and Vyshedskiy, a POSITA would have had a reasonable expectation of success in frequency modulating the signal with a carrier frequency in the ranges disclosed by Vyshedskiy. APPLE-1003, ¶¶ 177-78.

3. Claim 5

[5.0] The mobile ECG sensor according to claim 1, wherein the modulated signal is a frequency modulated signal, and wherein the transmitter outputs the frequency modulated signal having a carrier frequency in a range of from about 6 kHz to about 20 kHz.

Libbus includes frequency modulation in the communication protocol when wirelessly transmitting an electrocardiogram signal. APPLE-1004, [0059].

As discussed above in Section III.C.2, a POSITA would have been motivated to further modify the Libbus-Faarbaek combination to include a carrier frequency in the range from Vyshedskiy for frequency modulation. APPLE-1003, ¶¶ 179-181. Thus, the Libbus-Faarbaek-Vyshedskiy combination renders obvious element [5.0]. APPLE-1003, ¶ 181.

4. Claim 13

[13.0] The mobile ECG sensor according to claim 12, wherein the modulated signal is a frequency modulated signal, and wherein the transmitter outputs the frequency modulated signal having a carrier frequency in the range of from about 6 kHz to about 20 kHz.

See element [5.0]. APPLE-1003, ¶ 182.

D. [GROUND 4] – Libbus in view of Batkin and Vyshedskiy Renders Claim 13 Obvious

1. The Libbus-Batkin-Vyshedskiy Combination

As discussed above, the Libbus-Batkin combination is a mobile physiological monitoring device with electrodes, electrocardiogram circuitry, a processor, and wireless communication circuitry contained within a housing. *See* Section III.A.3. Although Libbus fails to disclose a carrier frequency for its ECG (the frequency modulated signal), Libbus does teach transmitting physiological data with a frequency modulation communication protocol. *See* APPLE-1004, [0059]. From Libbus's disclosure, a POSITA would have turned to other references, like Vyshedskiy, for disclosure of viable carrier frequencies because both Libbus and Vyshedskiy are directed at mobile physiological monitoring devices that acquire electrocardiography signals. APPLE-1003, ¶ 184.

For the same reasons set forth above in Section III.C.2 a POSITA would have been motivated to further modify the Libbus-Batkin combination to incorporate the teachings of Vyshedskiy and would have viewed the teachings of Vyshedskiy as being readily able to be incorporated into the Libbus-Batkin combination.

APPLE-1003, ¶ 185. Such a combination, Libbus-Batkin-Vyshedskiy, would include a carrier frequency for frequency modulation in the range taught by Vyshedskiy. APPLE-1003, ¶ 185.

2. Claim 13

[13.0] The mobile ECG sensor according to claim 12, wherein the modulated signal is a frequency modulated signal, and wherein the transmitter outputs the frequency modulated signal having a carrier frequency in the range of from about 6 kHz to about 20 kHz.

Libbus includes frequency modulation in the communication protocol when wirelessly transmitting an electrocardiogram signal. APPLE-1004, [0059].

As discussed above in Section III.D.1, a POSITA would have been motivated to further modify the Libbus-Batkin combination to include a carrier frequency in the range from Vyshedskiy for frequency modulation. APPLE-1003, ¶¶ 183-85. Thus, the Libbus-Batkin-Vyshedskiy combination renders obvious element [13.0]. APPLE-1003, ¶¶ 183-85.

E. [GROUND 5] – Libbus in view of Faarbaek and the Headset Profile of the Bluetooth Communication Standard Renders Claims 7 and 15 Obvious

1. Overview of the Headset Profile

The Headset profile specification defines the protocols and procedures that can be used by devices requiring a full audio connection combined with minimal device control commands. APPLE-1010 at 5, 8. The Headset profile is part of the Bluetooth communication protocol. APPLE-1010 at 1, 7. Such devices include headsets, personal computers, PDAs, and cellular phones. APPLE-1010 at 5, 7, 8. The headset can be wirelessly connected to a device for the purpose of acting as the device's audio input and output mechanism. APPLE-1010 at 5, 8, 9. Such an arrangement increases a user's mobility while maintaining privacy with respect to the audio. APPLE-1010 at 5.

2. The Libbus-Faarbaek-Headset Profile Combination

As discussed above, the Libbus-Faarbaek combination is a mobile physiological monitoring device with electrodes, electrocardiogram circuitry, a processor, and wireless communication circuitry contained within a housing. *See* Section III.A.3. Although Libbus does not explicitly disclose the Headset profile of the Bluetooth communication standard, Libbus does teach transmitting a modulated signal including physiological data according to the Bluetooth communication protocol. *See* [6.0], [14.0]; APPLE-1004, [0059], [0074]. From Libbus's disclosure, a POSITA would have been motivated to look for other Bluetooth profiles in the Bluetooth communication standard because Libbus and the Bluetooth communication standard are directed at wireless communications between various electronic devices. APPLE-1003, ¶ 187.

The Headset profile specification discloses the protocols and procedures for incorporating the Headset profile of the Bluetooth communication standard into various devices, including cellular phones. APPLE-1010, p. 5, 7, 8. The Headset profile further teaches that the profile increases the user's mobility. *Id.*

A POSITA would have viewed these teachings as being readily able to be incorporated into the Libbus-Faarbaek combination. APPLE-1003, ¶ 189. Further, given the overlapping subject matter between Libbus and the Headset profile and Libbus's disclosure of using the Bluetooth communication standard, a POSITA would have had a reasonable expectation of success in modulating the signal with Bluetooth's Headset profile as disclosed by the Headset profile specification. APPLE-1003, ¶ 189.

3. Claim 7

[7.0] The mobile ECG sensor according to claim 1, wherein the modulated signal is in accordance with a headset profile of the Bluetooth wireless communication standard.

Libbus includes modulating a signal when wirelessly transmitting an electrocardiogram signal in accordance with the Bluetooth communication standard. APPLE-1004, [0059], [0074].

As discussed above in Section III.C.2, a POSITA would have been motivated to further modify the Libbus-Faarbaek combination to include a Headset profile from the Bluetooth communication standard for transmitting a modulated signal. APPLE-1003, ¶ 191. Thus, the Libbus-Faarbaek-Headset Profile combination renders obvious element [7.0]; APPLE-1003, ¶ 192.

4. Claim 15

[15.0] The mobile ECG sensor according to claim 12, wherein the modulated signal is in accordance with a headset profile of the Bluetooth wireless communication standard.

See element [7.0]. APPLE-1003, ¶¶ 193-94.

IV. FEES

Please apply any fees to Deposit Account No. 06-1050.

V. CONCLUSION

Petitioner requests cancellation of all Challenged Claims.

VI. MANDATORY NOTICES UNDER 37 C.F.R § 42.8(a)(1)

A. Real Party-In-Interest Under 37 C.F.R. § 42.8(b)(1)

Petitioner, Apple Inc., is the real party-in-interest.

B. Related Matters Under 37 C.F.R. § 42.8(b)(2)

Petitioner is not aware of any litigation, disclaimers, reexamination certificates or petitions for *inter partes* review for the ’444 patent.

C. Lead And Back-Up Counsel Under 37 C.F.R. § 42.8(b)(3)

Apple provides the following designation of counsel.

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D. Service Information

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Respectfully submitted,

Dated: April 27, 2022

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CERTIFICATION UNDER 37 CFR § 42.24

Under the provisions of 37 CFR § 42.24(d), the undersigned hereby certifies that the word count for the foregoing Petition for *Inter Partes* Review totals 10,549 words, which is less than the 14,000 allowed under 37 CFR § 42.24.

Dated: April 27, 2022

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CERTIFICATE OF SERVICE

Pursuant to 37 CFR §§ 42.6(e)(4)(i) et seq. and 42.105(b), the undersigned certifies that on April 27, 2022, a complete and entire copy of this Petition for *Inter Partes Review* and all supporting exhibits were provided, via USPS Priority Mail Express, to the Patent Owner by serving the correspondence address of record as follows:

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