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(54) **WRIST-TYPE BODY COMPOSITION MEASURING APPARATUS**

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A61B 5/00	(2006.01)
A61B 5/00	(2006.01)
A61B 5/053	(2006.01)

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

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(57) **ABSTRACT**

A wrist-type body composition measuring apparatus is provided to measure body composition conveniently. The wrist-type body composition measuring apparatus includes a main body comprising a measurer configured to measure body impedance of a user, and an analyzer configured to analyze a body composition of the user based on the measured body impedance; a strap connected to the main body and configured to be flexible; a first inner electrode and a second inner electrode which are provided on a rear surface of the main body to be in direct contact with the user; and a first outer electrode and a second outer electrode which are provided on a surface of the main body to be in contact with the user during measurement of the body composition, wherein the first outer electrode and the second outer electrode are each formed as a half ring and face each other with a gap therebetween.

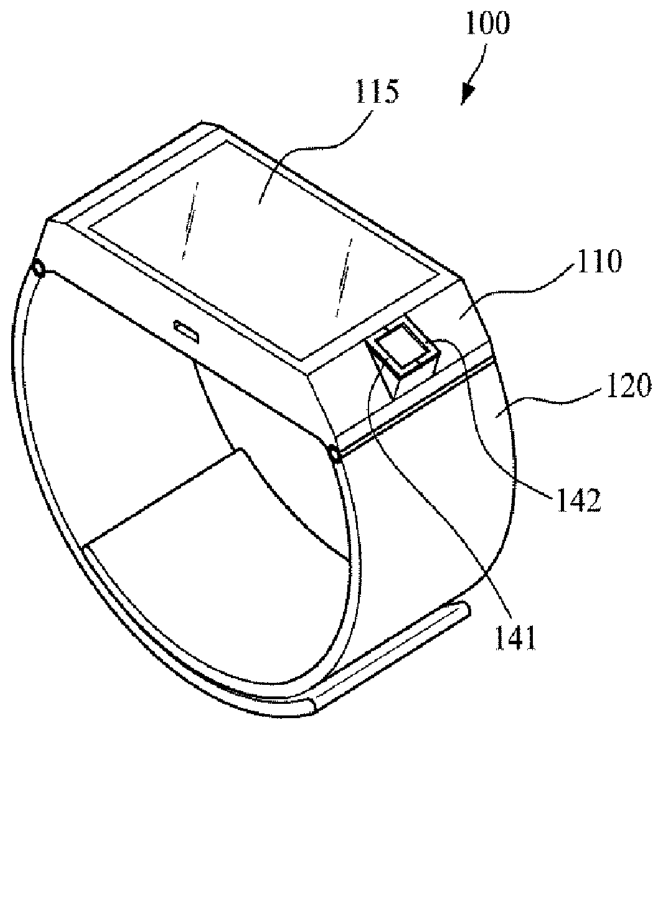


FIG. 1

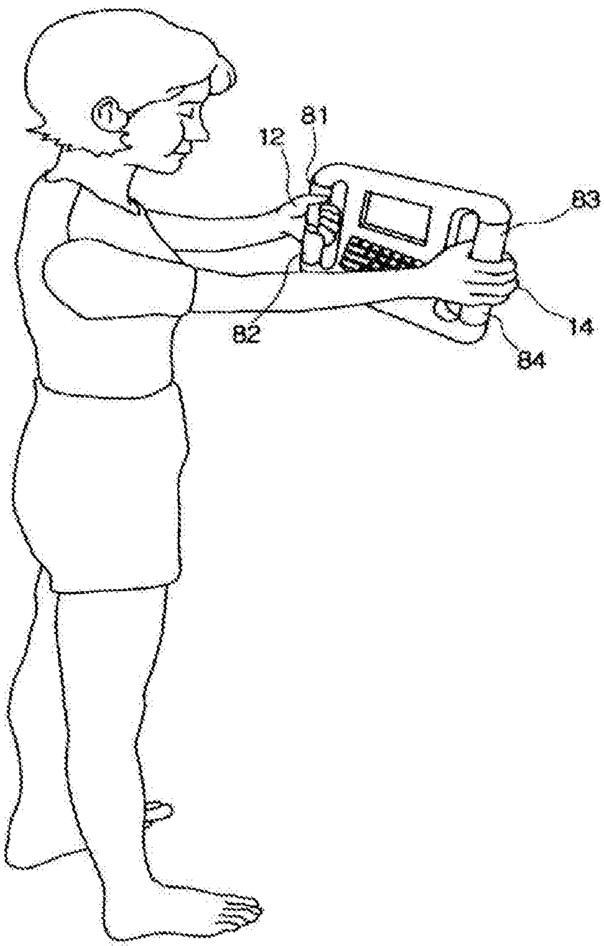


FIG. 2

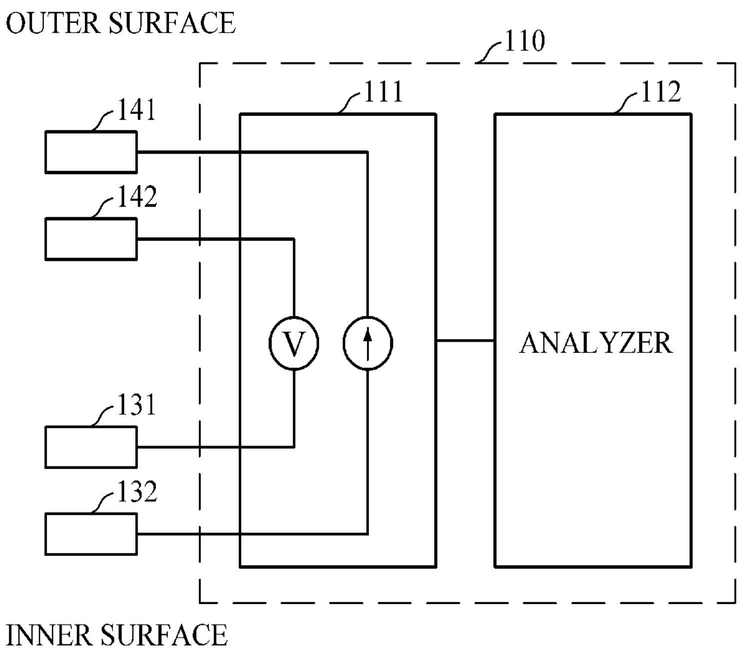

OUTER SURFACE
110
111
112
141
142
V
ANALYZER
131
132
INNER SURFACE

FIG. 3

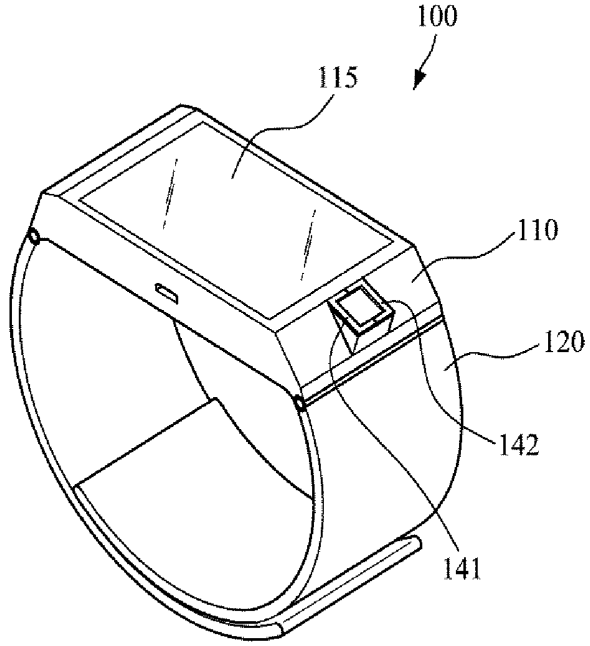


FIG. 4

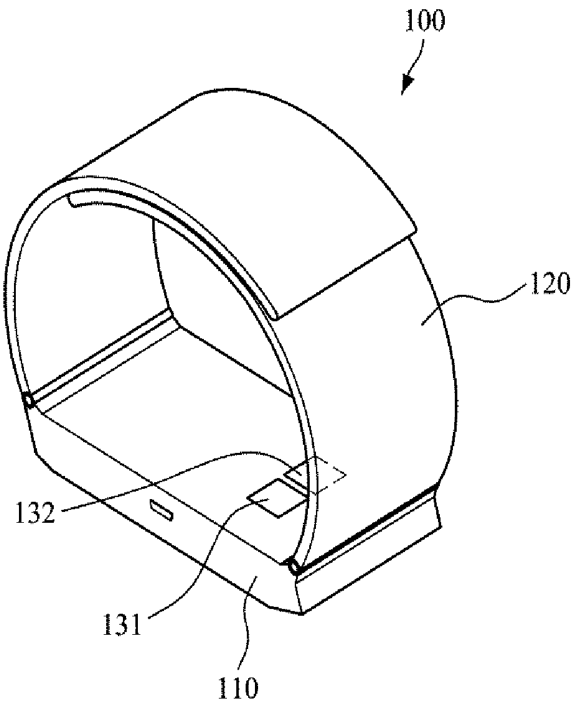


FIG. 5

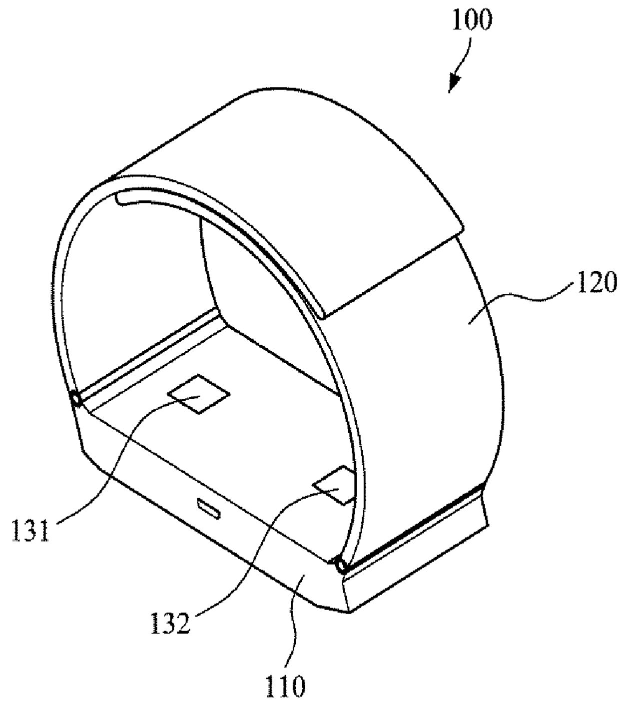


FIG. 6

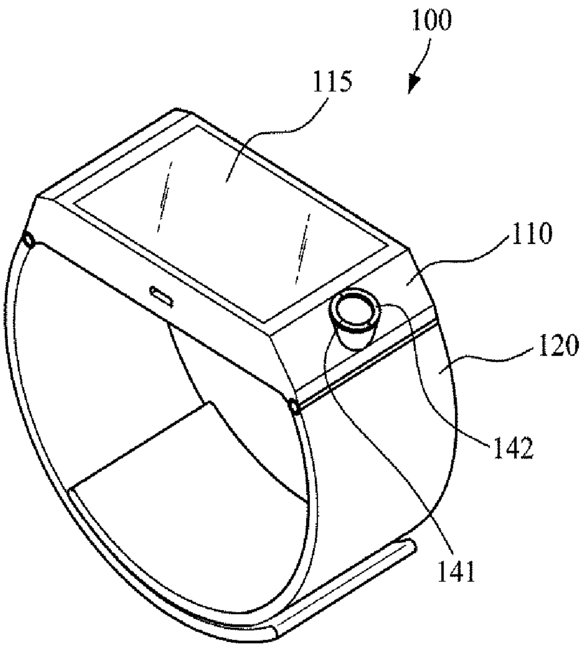


FIG. 7

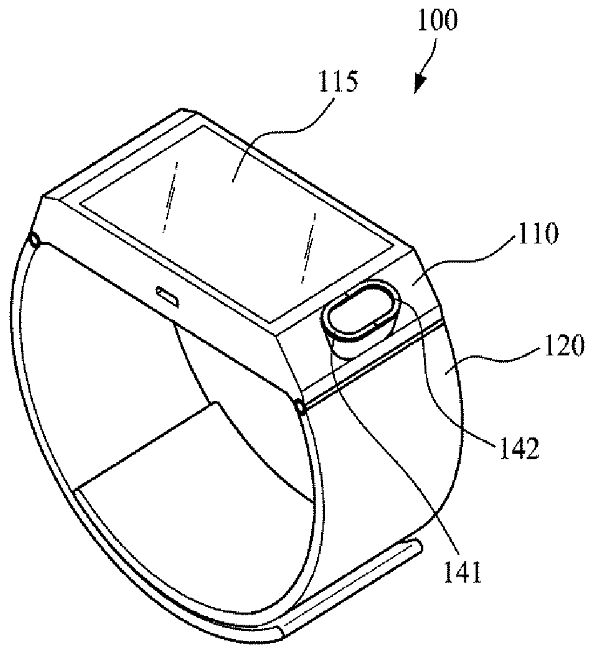


FIG. 8

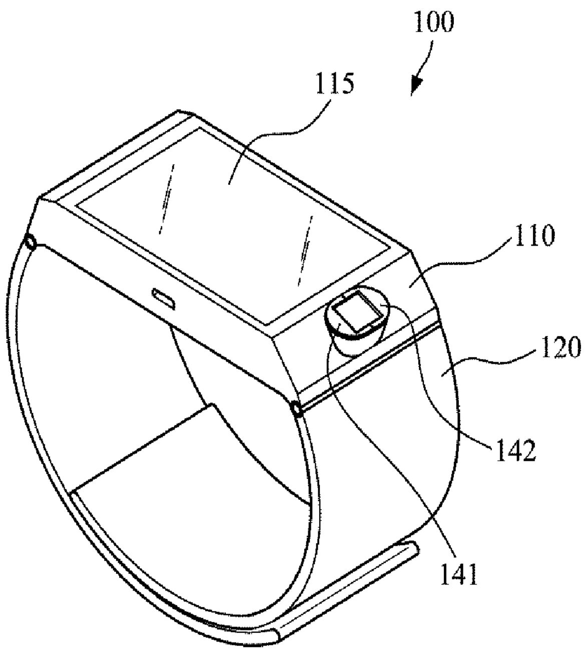


FIG. 9

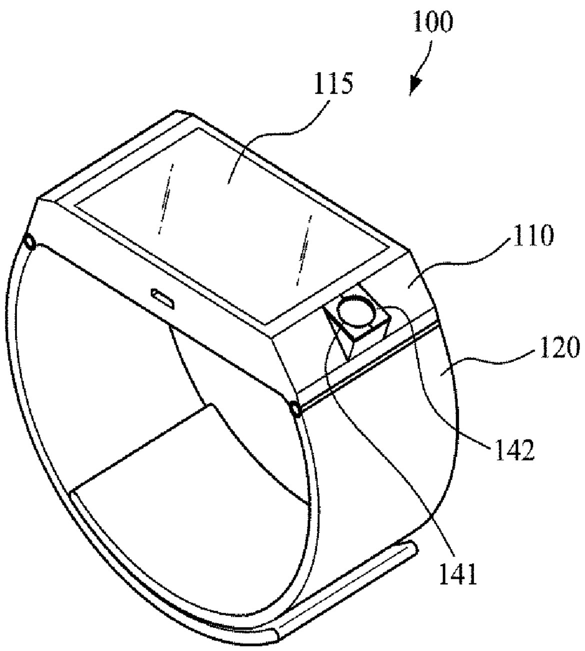


FIG. 10

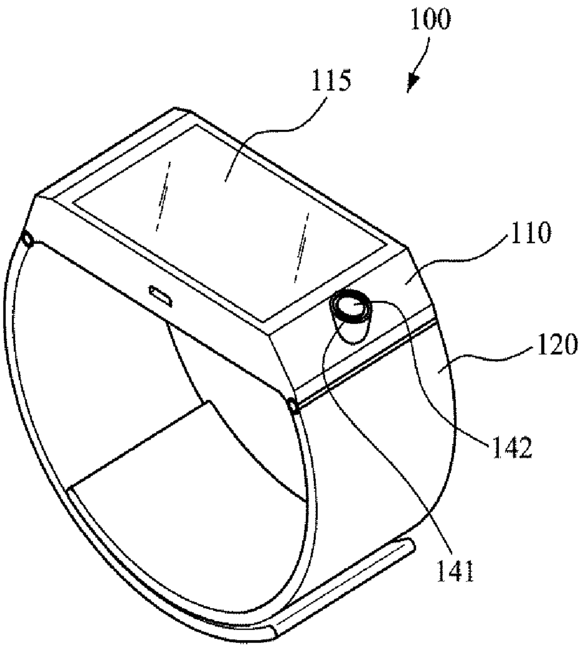


FIG. 11

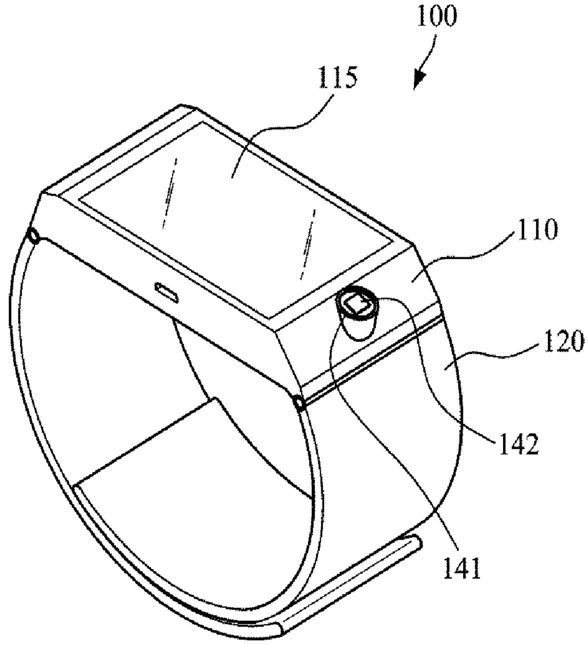


FIG. 12

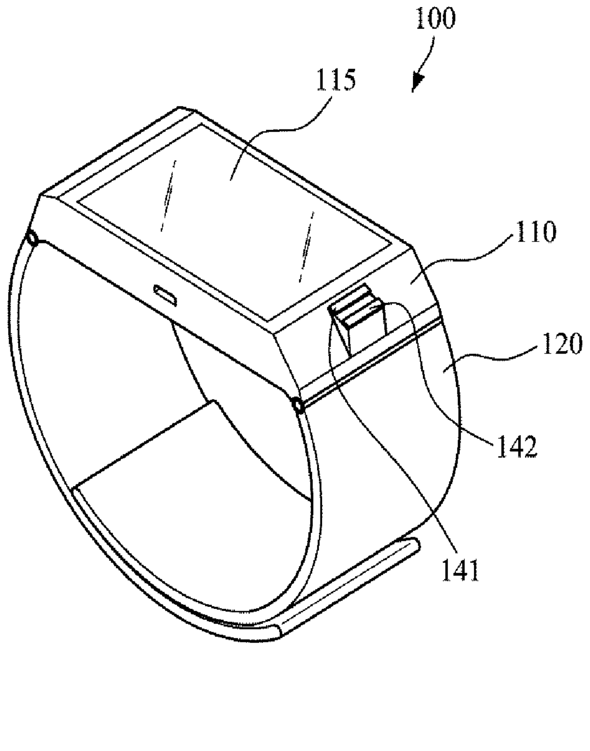


FIG. 13

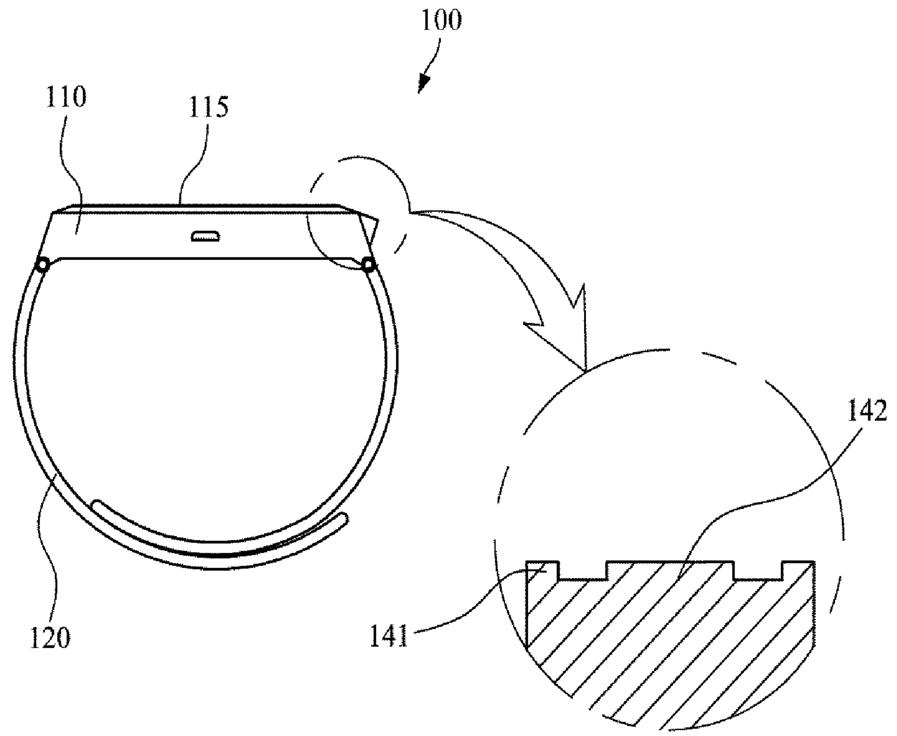


FIG. 14

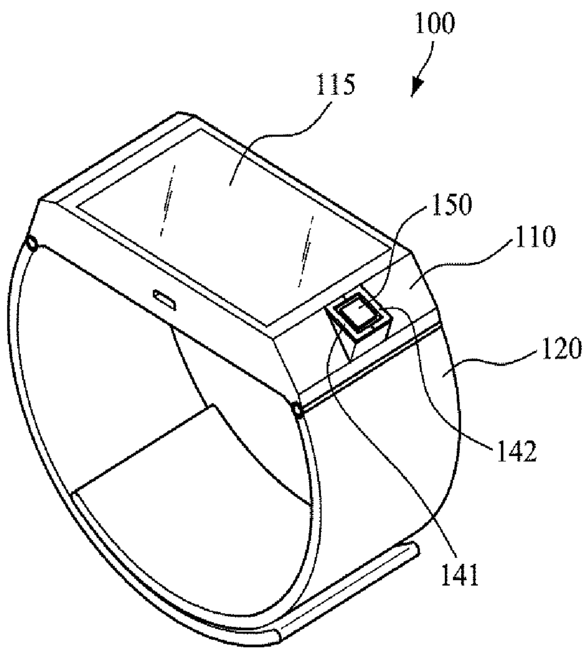


FIG. 15

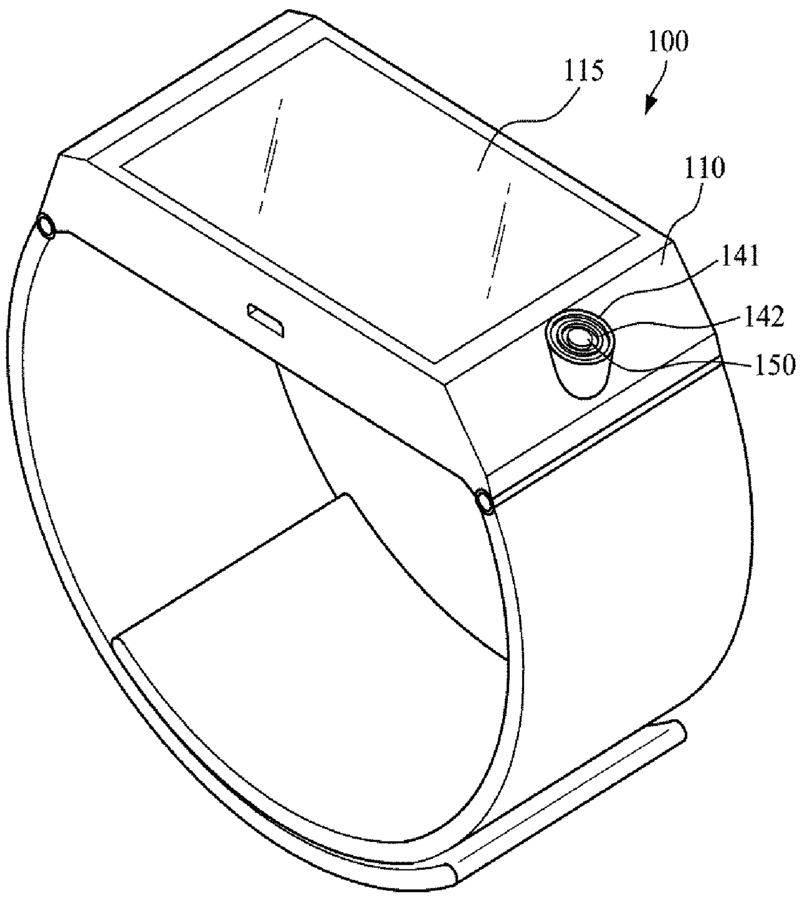
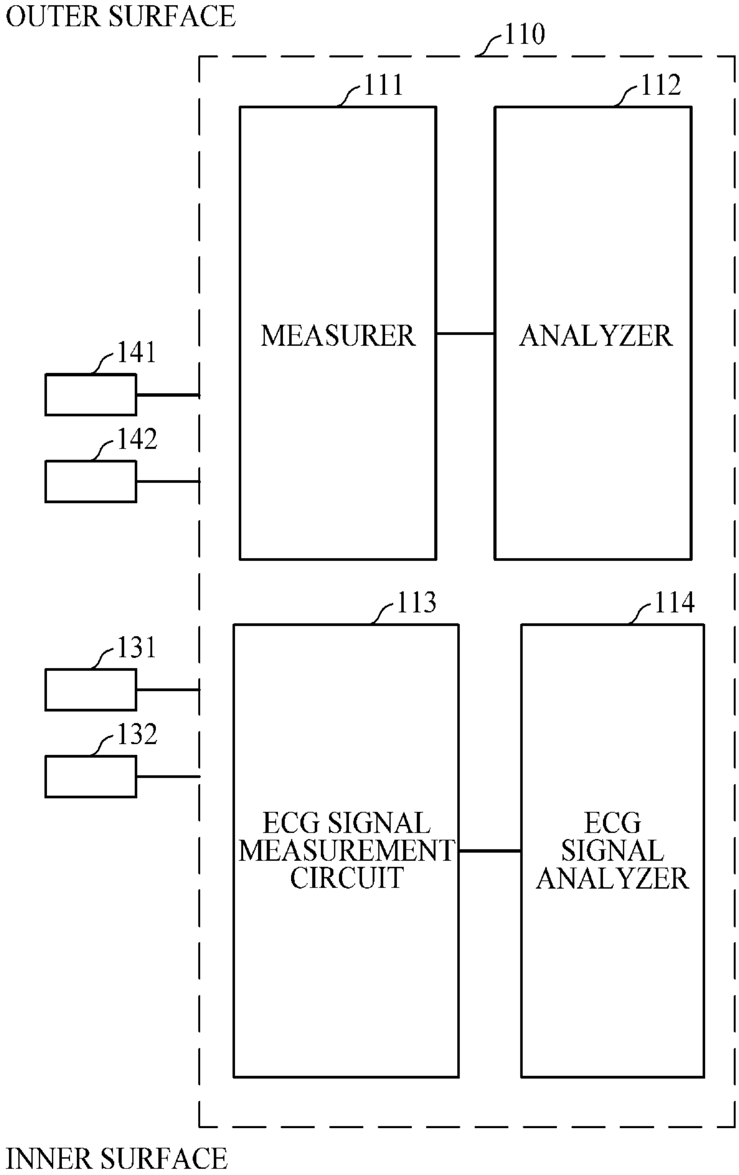


FIG. 16


OUTER SURFACE
110
111
112
MEASURER
ANALYZER
141
142
113
114
131
132
ECG SIGNAL MEASUREMENT CIRCUIT
ECG SIGNAL ANALYZER
INNER SURFACE

WRIST-TYPE BODY COMPOSITION MEASURING APPARATUS

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application is a continuation-in-part of U.S. application Ser. No. 15/211,642, filed on Jul. 15, 2016, which claims priority from Korean Patent Application No. 10-2015-0188853, filed on Dec. 29, 2015 in the Korean Intellectual Property Office, the disclosures of which are incorporated herein by reference in their entireties.

BACKGROUND

1. Field

[0002] Apparatuses and methods consistent with exemplary embodiments relate to measuring biometric information of a user by using an apparatus wearable on the user's wrist.

2. Description of the Related Art

[0003] In the past, body composition was generally measured in hospitals for the purpose of medical check-up. However, with the recent improvement in living standards, and a growing interest in health and diet, people are keen to measure body composition in their daily lives and monitor body composition changes.

[0004] Measuring body composition refers to quantitative measurement of individual elements of body composition, such as water, proteins, bones, fat, and the like, which form the human body.

[0005] As a method of measuring body composition, bioelectrical impedance analysis is commonly used, which is cheap and harmless to humans. In the bioelectrical impedance analysis, a weak electric current is applied to the human body to calculate an amount of body water, muscles, body fat, and the like by using a value of electric resistance, i.e., the electrical impedance, of the human body, and information including a user's stature, weight, age, gender, and the like.

SUMMARY

[0006] One or more exemplary embodiments provide a wrist-type body composition measuring apparatus that may measure body composition conveniently while being carried.

[0007] According to an aspect of an exemplary embodiment there is provided a wrist-type body composition measuring apparatus including: a main body including a measurer configured to measure body impedance of a user, and an analyzer configured to analyze a body composition of the user based on the measured body impedance; a strap connected to the main body and configured to be flexible; a first inner electrode and a second inner electrode which are provided on a rear surface of the main body to be in direct contact with the user; and a first outer electrode and a second outer electrode which are provided on a surface of the main body to be in contact with the user during measurement of the body composition, wherein the first and second outer electrodes are each formed as a half ring and face each other with a gap therebetween.

[0008] Upon applying a current through the first inner electrode and the first outer electrode, the measurer may be further configured to measure a voltage through the second inner electrode and the second outer electrode to measure the body impedance.

[0009] The half ring may have an angular C-shape.

[0010] The half ring may have a semicircular shape.

[0011] The half ring may have a semielliptical shape or a semioval shape.

[0012] The half ring may be formed such that an inner portion has an angular shape and an outer portion has a curved shape.

[0013] The half ring may be formed such that an inner portion has a curved shape and an outer portion has an angular shape.

[0014] An arrangement direction of the first and second inner electrodes and an arrangement direction of the first and second outer electrodes may be perpendicular to a length direction of the strap.

[0015] An arrangement direction of the first and second inner electrodes and an arrangement direction of the first and second outer electrodes may be identical to a length direction of the strap.

[0016] One of an arrangement direction of the first and second inner electrodes and an arrangement direction of the first and second outer electrodes may be identical to a length direction of the strap and the other may be perpendicular to the length direction of the strap.

[0017] Upper surfaces of the first and second outer electrodes may be disposed on an identical plane.

[0018] The first and second outer electrodes may be configured to operate as function buttons to perform predetermined functions when the first and second outer electrodes are pressed.

[0019] The wrist-type body composition measuring apparatus may further comprise a bio-signal sensor disposed in a space between the first and second outer electrodes and configured to collect a bio-signal of the user.

[0020] The bio-signal may include a photoplethysmogram (PPG) signal.

[0021] The measurer may be further configured to measure an electrocardiography (ECG) signal through at least three electrodes selected from the first and second inner electrodes and the first and second outer electrodes.

[0022] Wrist-type body composition measuring apparatus may further comprise an electrocardiography (ECG) signal measurement circuit configured to measure an ECG signal through at least three electrodes selected from among the first inner electrode, the second inner electrode, the first outer electrode, and the second outer electrode.

[0023] The wrist-type body composition measuring apparatus may further comprise a bio-signal sensor disposed inside a space defined by inner portions of the first and second outer electrodes.

[0024] According to an aspect of an exemplary embodiment there is provided a wearable device comprising a first inner electrode and a second inner electrode electrically isolated from each other to be in direct contact with a user of the wearable device and a first outer electrode and a second outer electrode electrically isolated from each other and sized and arranged to be simultaneously touchable by a single finger of the user such that, when touched, the first outer electrode and the first inner electrode form a closed circuit through the user and the second outer electrode and the second inner electrode form a closed circuit through the user.

[0025] The wearable device may further include a bio-signal sensor surrounded by the first and second outer electrodes.

[0026] The first outer electrode may surrounds the second outer electrodes.

[0027] The first and second outer electrodes may face each other with a gap therebetween.

[0028] The wearable device may further comprise a bio-signal sensor disposed in a space between the first and second outer electrodes.

[0029] The bio-signal sensor may include a photoplethysmogram sensor.

[0030] The first outer electrode and the second outer electrode may have an angular C-shape, circular shape, or elliptical shape.

[0031] The first outer electrode and the second outer electrode may have an angular C-shape, semicircular shape, or semielliptical shape.

[0032] The wearable device may further comprise an electrocardiography (ECG) signal measurement circuit configured to measure an ECG signal through at least three of the first inner electrode, the second inner electrode, the first outer electrode and the second outer electrode.

BRIEF DESCRIPTION OF THE DRAWINGS

[0033] The above and/or other aspects will be more apparent by describing certain exemplary embodiments, with reference to the accompanying drawings, in which:

[0034] FIG. **1** is a diagram illustrating a general body composition measuring apparatus using bioelectrical impedance analysis;

[0035] FIG. **2** is a block diagram illustrating an example of a wrist-type body composition measuring apparatus;

[0036] FIG. **3** is a perspective view illustrating an example of a wrist-type body composition measuring apparatus;

[0037] FIG. **4** is a perspective view of the wrist-type body composition measuring apparatus illustrated in FIG. **3**, as seen from the rear side;

[0038] FIG. **5** is a perspective view of another example of the wrist-type body composition measuring apparatus, as seen from the rear side;

[0039] FIG. **6** is a perspective view of another example of the wrist-type body composition measuring apparatus;

[0040] FIG. **7** is a perspective view of still another example of the wrist-type body composition measuring apparatus;

[0041] FIG. **8** is a perspective view of still a further example of the wrist-type body composition measuring apparatus;

[0042] FIG. **9** is a perspective view of still another example of the wrist-type body composition measuring apparatus;

[0043] FIG. **10** is a perspective view of still another of the wrist-type body composition measuring apparatus;

[0044] FIG. **11** is a perspective view of still another example of the wrist-type body composition measuring apparatus;

[0045] FIG. **12** is a perspective view of still another example of the wrist-type body composition measuring apparatus;

[0046] FIG. **13** is a cross-sectional view of an enlarged portion of the wrist-type body composition measuring apparatus illustrated in FIG. **10**;

[0047] FIG. **14** is a perspective view of yet another example of the wrist-type body composition measuring apparatus;

[0048] FIG. **15** is a perspective view of yet another example of the wrist-type body composition measuring apparatus; and

[0049] FIG. **16** is a block diagram illustrating another example of a wrist-type body composition measuring apparatus.

DETAILED DESCRIPTION

[0050] Exemplary embodiments are described in greater detail below with reference to the accompanying drawings.

[0051] In the following description, like drawing reference numerals are used for like elements, even in different drawings. The matters defined in the description, such as detailed construction and elements, are provided to assist in a comprehensive understanding of the exemplary embodiments. However, it is apparent that the exemplary embodiments can be practiced without those specifically defined matters. Also, well-known functions or constructions are not described in detail since they would obscure the description with unnecessary detail.

[0052] FIG. **1** is a diagram illustrating a body composition measuring apparatus using bioelectrical impedance analysis in the related art. The body composition measuring apparatus is designed to measure body composition with both hands **12** and **14** holding electrodes **81**, **82**, **83**, and **84**. However, while carrying the apparatus, it may be inconvenient to use the apparatus, since both hands are required to hold the electrodes.

[0053] FIG. **2** illustrates a wrist-type body composition measuring apparatus **100** according to an exemplary embodiment. FIG. **3** is a perspective view illustrating the wrist-type body composition measuring apparatus **100**, and FIG. **4** is a perspective view of the wrist-type body composition measuring apparatus **100** illustrated in FIG. **3**, as seen from the rear side.

[0054] Referring to FIGS. **2** to **4**, the wrist-type body composition measuring apparatus **100** includes a main body **110**, a strap **120**, a first inner electrode **131** and a second inner electrode **132**, and a first outer electrode **141** and a second outer electrode **142**.

[0055] The main body **110** includes a measurer **111** to measure body impedance and an analyzer **112** to analyze body composition of a user by using the body impedance measured by the measurer **111**. Upon applying an alternating current between electrodes that are in contact with the body, the measurer **111** measures a voltage between the electrodes to calculate the body impedance. The alternating current may be a constant current of about 500 μA having a frequency of 50 kHz. Based on the measured body impedance, and stature, weight, age, and gender of a user, the analyzer **112** may calculate the total body water (TBW), body fat, and body fat percentage (%) using equations stored in the main body **110**.

[0056] The strap **120** is connected to the main body **110**, and is configured to be flexible. The strap **120** may be flexible enough to be wrapped around a user's wrist or may be unwrapped from the wrist, thereby enabling a user to put on or take off the wrist-type body composition measuring apparatus **100**. The strap **120** may be made of urethane, silicone, rubber, leather, and the like.

[0057] The first and second inner electrodes **131** and **132** may be disposed on the rear surface of the main body **110** to be in direct contact with a user's body. That is, the first and second inner electrodes **131** and **132** may be in direct contact with a user's wrist. As illustrated in FIG. **4**, the first and second inner electrodes **131** and **132** may be in a square shape. However, their shape is not limited thereto, and the first and second inner electrodes **131** and **132** may be in other shapes, for example, a rectangle, a lozenge, a circle, a triangle, and the like.

[0058] As illustrated in FIG. **4**, the first and second inner electrodes **131** and **132** may be arranged perpendicular to a length direction of the main body **110** or a length direction of the strap **120**, but the arrangement of the first and second inner electrodes **131** and **132** are not limited thereto.

[0059] As shown in FIG. **5**, the first inner electrode **131** and the second inner electrode **132** may be arranged to be apart from each other in the longitudinal direction of the main body **110**.

[0060] The first and second outer electrodes **141** and **142** are disposed on the surface of the main body **110** to be in contact with a user during measurement of body composition, in which the first and second outer electrodes **141** and **142** are disposed close to each other to allow a user to contact both the first and second outer electrodes **141** and **142** with a finger. The second outer electrode **142** may have a circle shape and the first outer electrode **141** may have a ring shape that surrounds around the second outer electrode **142**. The first and second outer electrodes **141** and **142** may have the same center point. As in the first and second inner electrodes **131** and **132**, the first and second outer electrodes **141** and **142** may be arranged in a direction identical to the length direction of the strap **120**, or may be arranged perpendicular to the length direction of the main body **110** or the length direction of the strap **120**, i.e., to face each other, as illustrated in FIG. **3**. Further, the first outer electrode **141** and the second outer electrode **142** may be disposed to face each other.

[0061] The first and second outer electrodes **141** and **142** may each have a half ring shape and may face each other with a gap therebetween. Herein, the term "half ring" may mean a "C" shape that is curved or angular. For example, the half ring may have an angular "C" shape having a half square/rectangle outline, as shown in FIG. **3**.

[0062] In addition, although the first and second outer electrodes **141** and **142** shown in FIG. **3** are illustrated as angular half rings having a constant width, they are not limited thereto and may have different widths in different directions.

[0063] Once a user puts on the wrist-type body composition measuring apparatus **100** and touches the first and second outer electrodes **141** and **142** with a finger or a part of the palm, the measurer **111** applies an alternating current and measures a voltage to calculate body impedance, and the analyzer **112** analyzes body composition of the user by using the body impedance measured by the measurer **111**.

[0064] As described above, in the wrist-type body composition measuring apparatus **100**, the first and second outer electrodes **141** and **142**, which contact a user during measurement of body composition, are mounted on the surface of the main body **110**, rather than on the strap **120**, such that the strap **120** may be readily changed, and a degree of freedom of the disposition of electrodes and aesthetic impression may be increased. Further, the first and second outer electrodes **141** and **142** are disposed close to each other to allow a user to touch them with a finger, such that body composition may be measured with only a finger or a part of the palm, enabling convenient measurement of body composition.

[0065] Upon applying a current through the first inner electrode **131** and the first outer electrode **141**, the measurer **111** measures the voltage between the second inner electrode **132** and the second outer electrode **142** to measure body impedance.

[0066] Specifically, while the first and second inner electrodes **131** and **132** are in contact with a wrist, the first and second outer electrodes **141** and **142** are contacted with a user's finger or a part of the palm, such that the first outer electrode **141** and the first inner electrode **131** form a closed circuit through the user and the second outer electrode **142** and the second inner electrode **132** form a closed circuit through the user. Then, a sine wave alternating current is applied, and a voltage between the second outer electrode **142** and the second inner electrode **132** is measured, to calculate body impedance based on the applied current and the measured voltage.

[0067] As described above, in the case where body impedance is measured by using two inner electrodes and two outer electrodes, i.e., four electrodes, body impedance may be measured more accurately than the case where only two electrodes are used.

[0068] FIG. **6** is a perspective view of another example of the wrist-type body composition measuring apparatus **100**.

[0069] As illustrated in FIG. **6**, the first outer electrode **141** and the second outer electrode **142** may each be a curved half ring having a semicircular shape, and may face each other with a gap therebetween to isolate them electrically.

[0070] In addition, although the first and second outer electrodes **141** and **142** shown in FIG. **6** are illustrated as half rings having a constant width, they may have different widths.

[0071] FIG. **7** is a perspective view of still a further example of the wrist-type body composition measuring apparatus **100**.

[0072] As illustrated in FIG. **7**, the first outer electrode **141** and the second outer electrode **142** may each be a half ring having a half semioval shape, a half semielliptical shape or a half rectangle with rounded corners shape (i.e., a half racetrack shape), and may face each other with a gap therebetween to isolate them electrically.

[0073] In addition, although the first and second outer electrodes **141** and **142** shown in FIG. **7** are illustrated as half rings having a constant width, they are not limited thereto and may be formed having different widths.

[0074] FIG. **8** is a perspective view of still another example of the wrist-type body composition measuring apparatus **100**.

[0075] As illustrated in FIG. **8**, the first outer electrode **141** and the second outer electrode **142** may each be a half ring and may face each other with a gap therebetween. The inner portions of the first outer electrode **141** and the second outer electrode **142** facing each other may have a rectangular shape while the outer portions have a curved shape. The first and second outer electrodes **141** and **142** may thus form, for example, a polygonal space defined by the inner portions and having upper and lower openings provided by the gap.

[0076] FIG. **9** is a perspective view of another example of the wrist-type body composition measuring apparatus **100**.

[0077] As illustrated in FIG. 9, the first outer electrode 141 and the second outer electrode 142 may each be a half ring and may face each other with a gap therebetween. The inner portions of the first outer electrode 141 and the second outer electrode 142 facing each other may have a curved shape while the outer portions have a rectangular shape. The first and second outer electrodes 141 and 142 may thus form, for example, a circular space defined by the inner portions and having upper and lower openings provided by the gap.

[0078] FIG. 10 is a perspective view of another example of the wrist-type body composition measuring apparatus 100.

[0079] Referring to FIG. 10, the first and second outer electrodes 141 and 142 may be formed in such a manner that one electrode 141 surrounds the other electrode 142. Here, the first outer electrode 141 surrounds the second outer electrode 142, but an opposite configuration may also be implemented. Further, the first and second outer electrodes 141 and 142 may be formed to have the same center.

[0080] In another example, as in the wrist-type body composition measuring apparatus 100 illustrated in FIG. 11, one electrode 141 may surround the other electrode 142, and the two outer electrodes 141 and 142 may be formed to have the same center, in which the inner electrode may be in a square shape and the outer electrode may be in a circular shape. The inner electrode may be in a circular shape and the outer electrode may be in a square shape, and other shapes, rather than a square or circle, may also be applied.

[0081] In addition, as in the wrist-type body composition measuring apparatus 100 illustrated in FIG. 12, the first and second outer electrodes 141 and 142 may be arranged symmetrical to each other. While FIG. 12 illustrates two symmetrical electrodes arranged in a direction identical to the length direction of the strap 120, the two symmetrical electrodes may be arranged perpendicular to the length direction of the strap 120, and may be in other shapes rather than a rectangular shape.

[0082] FIG. 13 is a cross-sectional view of the wrist-type body composition measuring apparatus 100 illustrated in FIG. 10. As illustrated in FIG. 13, upper surfaces of the first and second outer electrodes 141 and 142 may be formed on the same plane. In this case, when a finger or a part of the palm is contacted with the first and second outer electrodes 141 and 142, the contact may be made accurately.

[0083] In the aforementioned embodiments, the first and second outer electrodes 141 and 142 are formed on a lower front side of the main body 110, which is merely illustrative, and the first and second outer electrodes 141 and 142 may be formed on the upper side of the main body 110 or on the left or right side of the main body 110.

[0084] Further, the first and second outer electrodes 141 and 142 may be formed to be pressed, so as to operate as functional buttons that perform predetermined functions upon being pressed. That is, once the first and second outer electrodes are pressed, numbers are input or a screen is moved from side to side to enable a user to select a specific function.

[0085] FIG. 14 is a perspective view of yet another example of the wrist-type body composition measuring apparatus 100. Referring to FIG. 14, the wrist-type body composition measuring apparatus 100 may further include a bio-signal sensor 150. The bio-signal sensor 150 may be disposed between the first outer electrode 141 and the second outer electrode 142 inside the space defined by their inner portions and may collect a bio-signal of the user. In other words, the bio-signal sensor 150 may be surrounded by the first and second electrodes 141 and 142. The bio-signal sensor 150 may be an optical sensor, and more specifically, a photoplethysmogram (PPG) sensor.

[0086] FIG. 15 is a perspective view of yet another example of the wrist-type body composition measuring apparatus 100. Referring to FIG. 15, the bio signal sensor 150 may be disposed inside a space defined by the inner portion of the second outer electrode 142. The first outer electrode 141 may surround the second outer electrode 142 and the second outer electrode 142 in turn may surround the bio-signal sensor 150. Thus, the bio signal sensor 150 may be surrounded by both the first and second electrodes 141 and 142.

[0087] As shown, the first and second outer electrodes 141 and 142 may have a circular ring shape. However, their shape is not limited thereto, and the first and second outer electrodes may have other ring shapes. For example, the first and second outer electrodes 141 and 142 may have a rectangular ring shape, a lozenge-shaped ring shape, an elliptical ring shape, a triangular ring shape or the like. While the first and second outer electrodes 141 and 142 shown in FIG. 15 show rings with a constant width, they may be implemented in different embodiments with different widths. For example, the first and second outer electrodes 141 and 142 may have a ring shape having an angular inner portion and a curved outer portion. Alternatively, the first and second outer electrodes 141 and 142 may have a ring shape having a curved inner portion and an angular outer portion.

[0088] In another example, the first and second outer electrodes 141 and 142 may each have a different ring shape. For example, the first outer electrode 141 may have a circular ring shape, and the second outer electrode 142 may have a rectangular ring shape.

[0089] The bio-signal sensor 150 and the first and second outer electrodes 141 and 142 may have upper surfaces configured to contact a finger or a part of the palm simultaneously. For example, an upper surface of the bio-signal sensor 150 may be disposed on the same plane as upper surfaces of the first and second outer electrodes 141 and 142. However, embodiments are not limited to the above example, and the upper surface of the bio-signal sensor 150 may be formed above or below the upper surfaces of the first and second outer electrodes 141 and 142 if the height differences are not great enough to prevent a simultaneous touching by a finger or a part of the palm.

[0090] A bio-signal, for example a PPG signal, collected by the bio-signal sensor 150 may be transmitted to the analyzer 112 and biometric information of the user may be obtained from the bio-signal. The biometric information may include blood pressure, vascular age, arterial stiffness, aortic pressure waveform, stress index, fatigue, and the like, but is not limited thereto.

[0091] In the aforementioned example, the body impedance is measured using the first and second inner electrodes 131 and 132 and the first and second outer electrodes 141 and 142, and it is also possible to measure an electrocardiography (ECG) signal using these same electrodes.

[0092] FIG. 16 is a block diagram illustrating another example of a wrist-type body composition measuring apparatus. As shown in FIG. 16, the main body 110 may further include an ECG signal measurement circuit 113 and an ECG signal analyzer **114** configured to analyze a measured ECG signal. The ECG signal measurement circuit **113** may measure the ECG signal through all or some of the first and second inner electrodes and the first and second outer electrodes. In other words, the ECG signal may be measured through at least three electrodes from among the first inner electrode **131**, the second inner electrode **132**, the first outer electrode **141** and the second outer electrode **142**.

[0093] For example, in the case where the ECG signal is measured through three electrodes, the first inner electrode **131** may be used as a reference electrode, and either of the first and second outer electrodes **141** and **142** may be used as a positive electrode and the second inner electrode **132** as a negative electrode. Alternatively, the second inner electrode **132** may be used as a reference electrode and either of the first and second outer electrodes **141** and **142** may be used as a positive electrode and the first inner electrode **131** as a negative electrode. Here, the positive electrode and the negative electrode may be switched with each other.

[0094] In another example, in the case where the ECG signal is measured through four electrodes, the first and second outer electrodes **141** and **142** may be short-circuited to each other. Thus, the first inner electrode **131** may be used as a reference electrode, and the short-circuited first and second outer electrodes **141** and **142** may be used as a positive electrode and the second inner electrode **132** as a negative electrode. Alternatively, the second inner electrode **132** may be used as a reference electrode, and the short-circuited first and second outer electrodes **141** and **142** may be used as a positive electrode and the first inner electrode **131** as a negative electrode. Here, the positive electrode and the negative electrode may be switched with each other.

[0095] In addition, when a user wearing the above-described wrist-type body composition measuring apparatus **100** on his/her wrist touches the first outer electrode **141** and the second outer electrode **142** with one finger or a part of the palm, the wrist-type body composition measuring apparatus **100** may measure the body impedance along with the ECG signal.

[0096] When measuring the body impedance along with the ECG signal, the wrist-type body composition measuring apparatus **100** may continuously measure each of the body impedance and the ECG signal sequentially. For example, the measurer **111** measures the body impedance first and then the ECG signal measurement circuit **113** measures the ECG signal while one finger or a part of the palm of the user is contacted with the first and second outer electrodes **141** and **172**. However, the sequence of measurement is not limited to the above example, and the body impedance may be measured after the ECG signal is measured.

[0097] A switch may be added to each electrode to allow the measurer **111** for measuring body impedance and the ECG signal measurement circuit **113** for measuring an ECG signal to share the electrodes with each other. In this case, both of the measurer **111** and the ECG signal measurement circuit **113** may be connected to the electrodes through the switches.

[0098] For example, the first inner electrode **132**, the second inner electrode **132**, the first outer electrode **141**, and the second outer electrode **142** may be used for measuring body impedance, and the first and second inner electrodes **131** and **132** and the first outer electrode **141** may also be used for measuring an ECG signal. When the user wears the wrist-type body composition measuring apparatus **100** on his/her left wrist and touches the first and second outer electrodes **141** and **142** with a right-hand finger in order to measure a bio-signal, the switches connected to the first and second inner electrodes **131** and **132** and the switches connected to the first and second outer electrodes **141** and **142** may be connected to the measurer **111** during a measurement time T1. The body impedance measured by the measurer **111** is transmitted to the analyzer **112**, and the analyzer **112** may analyze body composition using the body impedance.

[0099] After the measurement time T1 elapses, the switches connected to the first and second inner electrodes **131** and **132** and the first outer electrode **141** may be switched to the ECG signal measurement circuit **113**. By doing so, the ECG signal measurement circuit **113** may be connected to the first and second inner electrodes **131** and **132** and the first outer electrode **141** through the switches, so that an ECG signal may be measured during a measurement time T2. The measured ECG signal is transmitted to the ECG signal analyzer **114** and the ECG signal analyzer **114** may analyze the biometric information of the user using the ECG signal.

[0100] The analyzer **112** and the ECG signal analyzer **114** may be integrated into a single module or chip. The analyzer **112** and the ECG signal analyzer **114** may each include an additional circuit for processing the signals transmitted from the measurer **111** and the ECG signal measurement circuit **113**, or may be implemented as a software program and a processor to execute the program which converts the received signal into digital information and processes a resulting converted digital signal.

[0101] Further, although not illustrated herein, the main body **110** may include a wireless communicator. The wireless communicator may include a Bluetooth module, a Radio Frequency (RF) module, and the like. The wireless communicator may transmit body composition information, analyzed by the analyzer **112**, to a smartphone and the like, thus enabling a user to check and manage the body composition information on their smartphone or the like.

[0102] The main body **110** may include a display **115**. The display **115** is mounted in such a manner that a screen of the display **115** may be exposed to the outside of the main body **110**. The display **115** displays the body composition information, analyzed by the analyzer **112**, in numbers or characters to show the information to a user.

[0103] Similar to the aforementioned various exemplary embodiments of the first and second outer electrodes **141** and **142**, the first and second inner electrodes **131** and **132** may be implemented in various embodiments. For example, the first and second inner electrodes **131** and **132** may be each formed as a half ring facing each other with a gap therebetween. In this case, the bio-signal sensor **150** may be disposed in a space between the first and second inner electrodes **131** and **132**.

[0104] The wrist-type body composition measuring apparatus may measure body composition conveniently while being carried. Further, the wrist-type body composition measuring apparatus may increase a degree of freedom of the disposition of electrodes and aesthetic impression. In addition, the wrist-type body composition measuring apparatus may conveniently measure body composition by using only one finger or a part of the palm.

[0105] In the aforementioned description, the wrist-type body composition measuring apparatus **100** may be a wearable device, such as a smart watch or a smart band, which can be worn on a wrist of a user. However, the configuration included in the wrist-type body composition measuring apparatus **100** may be implemented as another wearable device that can be put on a different body part other than the wrist. For example, the wearable device may be implemented as a ring or a garment. The wearable device may include the first inner electrode **131**, the second inner electrode **132**, the first outer electrode **141**, the second outer electrode **142**, the bio-signal sensor **150**, the measurer **111**, and the analyzer **112**, which are all described above.

[0106] In another example, the configuration included in the wrist-type body composition measuring apparatus **100** may be implemented in a portable device, such as a smartphone. For example, the first and second outer electrodes **141** and **142** may be formed on one surface of a portable device, and the first and second inner electrodes **131** and **132** may be formed on another surface of the portable device.

[0107] A number of examples have been described above. Nevertheless, it should be understood that various modifications may be made. For example, suitable results may be achieved if the described techniques are performed in a different order and/or if components in a described system, architecture, device, or circuit are combined in a different manner and/or replaced or supplemented by other components or their equivalents. Accordingly, other implementations are within the scope of the following claims.

[0108] The foregoing exemplary embodiments are merely exemplary and are not to be construed as limiting. The present teaching can be readily applied to other types of apparatuses. Also, the description of the exemplary embodiments is intended to be illustrative, and not to limit the scope of the claims, and many alternatives, modifications, and variations will be apparent to those skilled in the art.

What is claimed is:

1. A wrist-type body composition measuring apparatus comprising:

a main body comprising a measurer configured to measure body impedance of a user, and an analyzer configured to analyze a body composition of the user based on the measured body impedance;

a strap connected to the main body and configured to be flexible;

a first inner electrode and a second inner electrode which are provided on a rear surface of the main body to be in direct contact with the user; and

a first outer electrode and a second outer electrode which are provided on a surface of the main body to be in contact with the user during measurement of the body composition,

wherein the first outer electrode and the second outer electrode are each formed as a half ring and face each other with a gap therebetween.

2. The apparatus of claim **1**, wherein upon applying a current through the first inner electrode and the first outer electrode, the measurer measures a voltage through the second inner electrode and the second outer electrode to measure the body impedance.

3. The apparatus of claim **1**, wherein the half ring has an angular C-shape.

4. The apparatus of claim **1**, wherein the half ring has a semicircular shape.

5. The apparatus of claim **1**, wherein the half ring has a semielliptical or semioval shape.

6. The apparatus of claim **1**, wherein an inner portion of the half ring has an angular shape and an outer portion of the half ring has a curved shape.

7. The apparatus of claim **1**, wherein an inner portion of the half ring is has a curved shape and an outer portion of the half ring has an angular shape.

8. The apparatus of claim **1**, wherein an arrangement direction of the first and second inner electrodes and an arrangement direction of the first and second outer electrodes are perpendicular to a length direction of the strap.

9. The apparatus of claim **1**, wherein an arrangement direction of the first and second inner electrodes and an arrangement direction of the first and second outer electrodes are identical to a length direction of the strap.

10. The apparatus of claim **1**, wherein one of an arrangement direction of the first and second inner electrodes and an arrangement direction of the first and second outer electrodes is identical to a length direction of the strap and the other is perpendicular to the length direction of the strap.

11. The apparatus of claim **1**, wherein upper surfaces of the first and second outer electrodes are disposed on an identical plane.

12. The apparatus of claim **1**, wherein the first and second outer electrodes are configured to operate as buttons to perform predetermined functions when the first and second outer electrodes are pressed.

13. The apparatus of claim **1**, further comprising a bio-signal sensor disposed in a space between the first and second outer electrodes and configured to collect a bio-signal of the user.

14. The apparatus of claim **1**, wherein the bio-signal comprises a photoplethysmogram (PPG) signal.

15. The apparatus of claim **1**, further comprising an electrocardiography (ECG) signal measurement circuit configured to measure an ECG signal through at least three of the first inner electrode, the second inner electrode, the first outer electrode and the second outer electrode.

16. The apparatus of claim **1**, further comprising a bio-signal sensor disposed inside a space defined by inner portions of the first and second outer electrodes.

17. A wearable device comprising:

a first inner electrode and a second inner electrode electrically isolated from each other to be in direct contact with a user of the wearable device; and

a first outer electrode and a second outer electrode electrically isolated from each other and sized and arranged to be simultaneously touchable by a single finger of the user such that, when touched, the first outer electrode and the first inner electrode form a closed circuit through the user and the second outer electrode and the second inner electrode form a closed circuit through the user.

18. The wearable device of claim **17**, further comprising a bio-signal sensor surrounded by the first and second outer electrodes.

19. The wearable device of claim **18**, wherein the first outer electrode surrounds the second outer electrodes.

20. The wearable device of claim **18**, wherein the first and second outer electrodes face each other with a gap therebetween.

21. The wearable device of claim **17**, further comprising a bio-signal sensor disposed in a space between the first and second outer electrodes.

22. The wearable device of claim **21**, wherein the bio-signal sensor is a photoplethysmogram sensor.

23. The wearable device of claim **19**, wherein the first outer electrode and the second outer electrode have an angular C-shape, circular shape, or elliptical shape.

24. The wearable device of claim **20**, wherein the first outer electrode and the second outer electrode have an angular C-shape, semicircular shape, or semielliptical shape.

25. The wearable device of claim **17**, further comprising an electrocardiography (ECG) signal measurement circuit configured to measure an ECG signal through at least three of the first inner electrode, the second inner electrode, the first outer electrode and the second outer electrode.

* * * * *

专利名称(译)	手腕式身体成分测量装置		
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摘要(译)

提供一种腕式身体成分测量装置，以方便地测量身体成分。手腕式身体成分测量装置包括：主体，包括：测量器，被配置为测量用户的身体阻抗;以及分析器，被配置为基于测量的身体阻抗来分析用户的身体成分;连接到主体并配置为柔性的带子;第一内部电极和第二内部电极，设置在主体的后表面上，与使用者直接接触;第一外部电极和第二外部电极设置在主体的表面上，以在测量身体成分期间与使用者接触，其中第一外部电极和第二外部电极各自形成为一半它们之间有一个间隙，并且相互面对。