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(54) **ELECTROCARDIOGRAPHY SCANNER MODULE, MULTI-CONTACT CONNECTOR THEREOF, ELECTROCARDIOGRAPHY SCANNER THEREOF AND SMART CLOTHES USING THE SAME**

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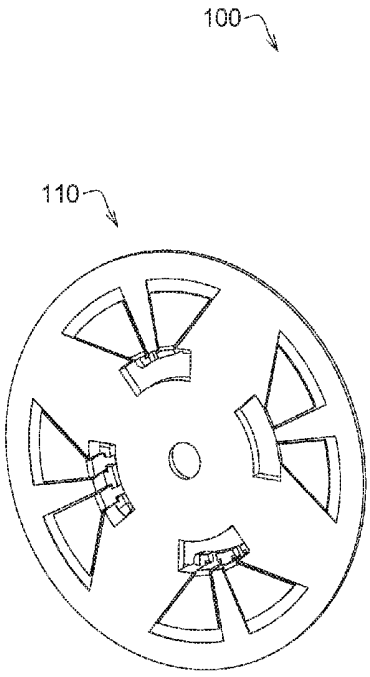
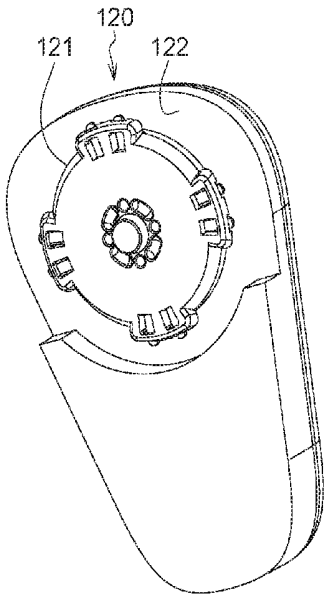
(57) **ABSTRACT**

An electrocardiography (ECG) scanner module, a multi-contact connector thereof, an ECG scanner thereof and smart clothes using the same are provided. The multi-contact connector includes a base, a fitting portion and several first conductive portions. The base is disposed on a wearable carrier having several conductive wires. The fitting portion is disposed on the base and surrounds a receiving portion. The first conductive portions are annularly disposed on an inner periphery surface of the receiving portion, and each first conductive portion connects to the corresponding conductive wire. The ECG scanner includes several second conductive portions, and an end of each second conductive portion is projected from an outer periphery surface of the ECG scanner. When the multi-contact connector connects to the ECG scanner, each second conductive portion provides a radial force for connecting to the corresponding first conductive portion.





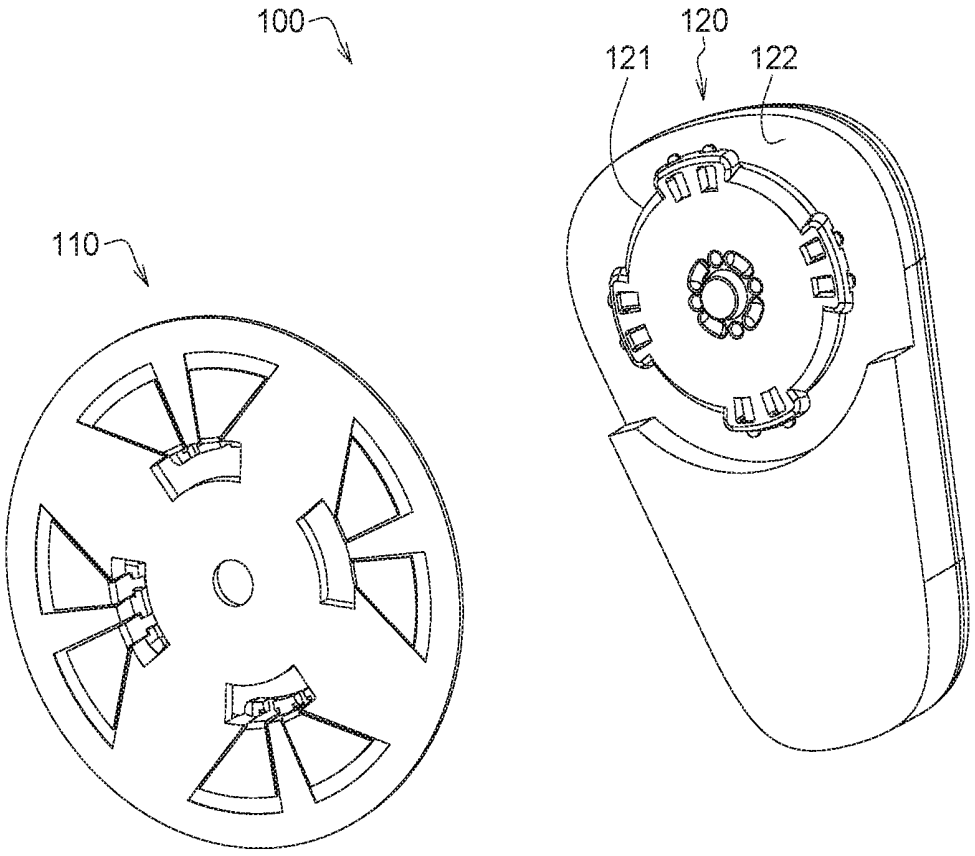


FIG. 1

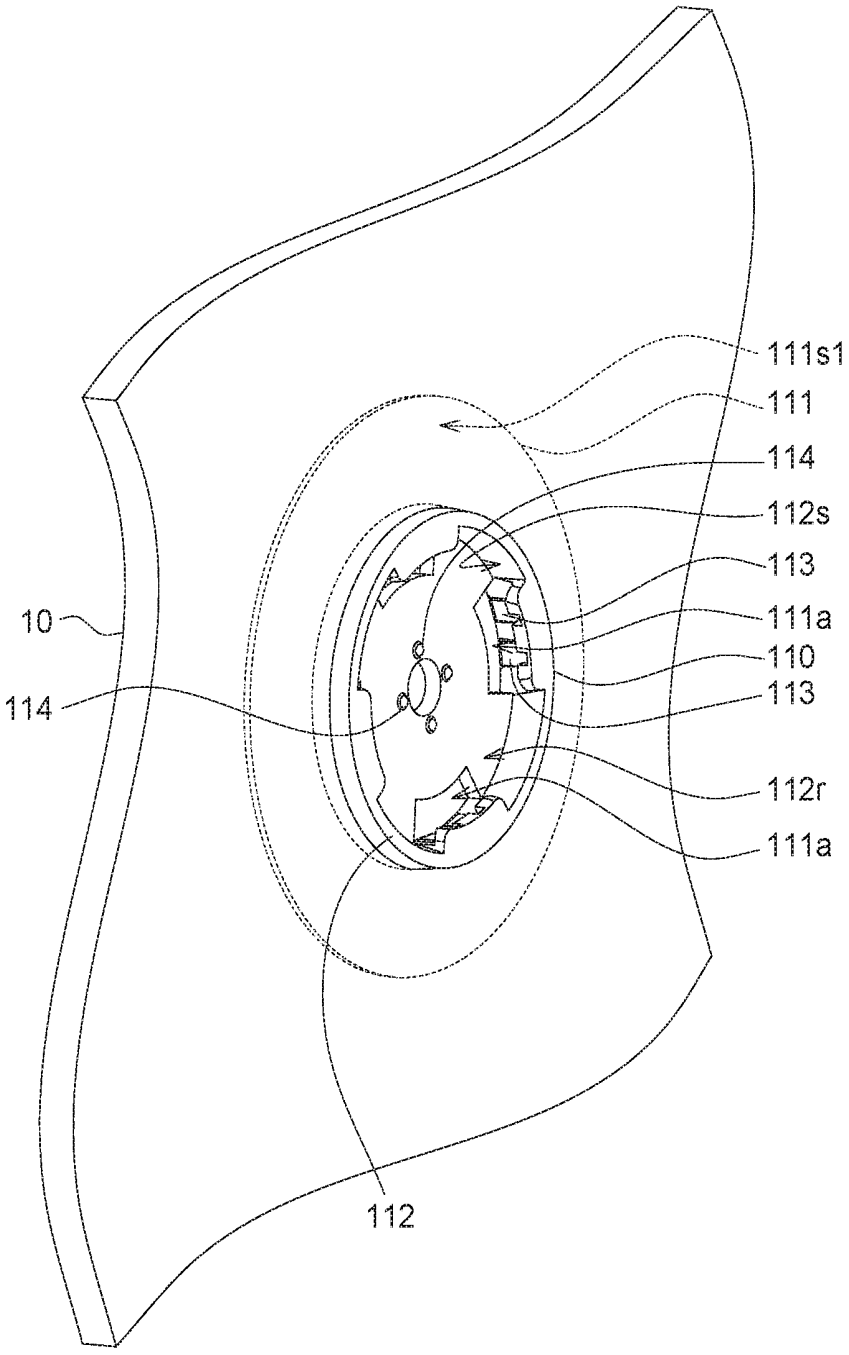


FIG. 2

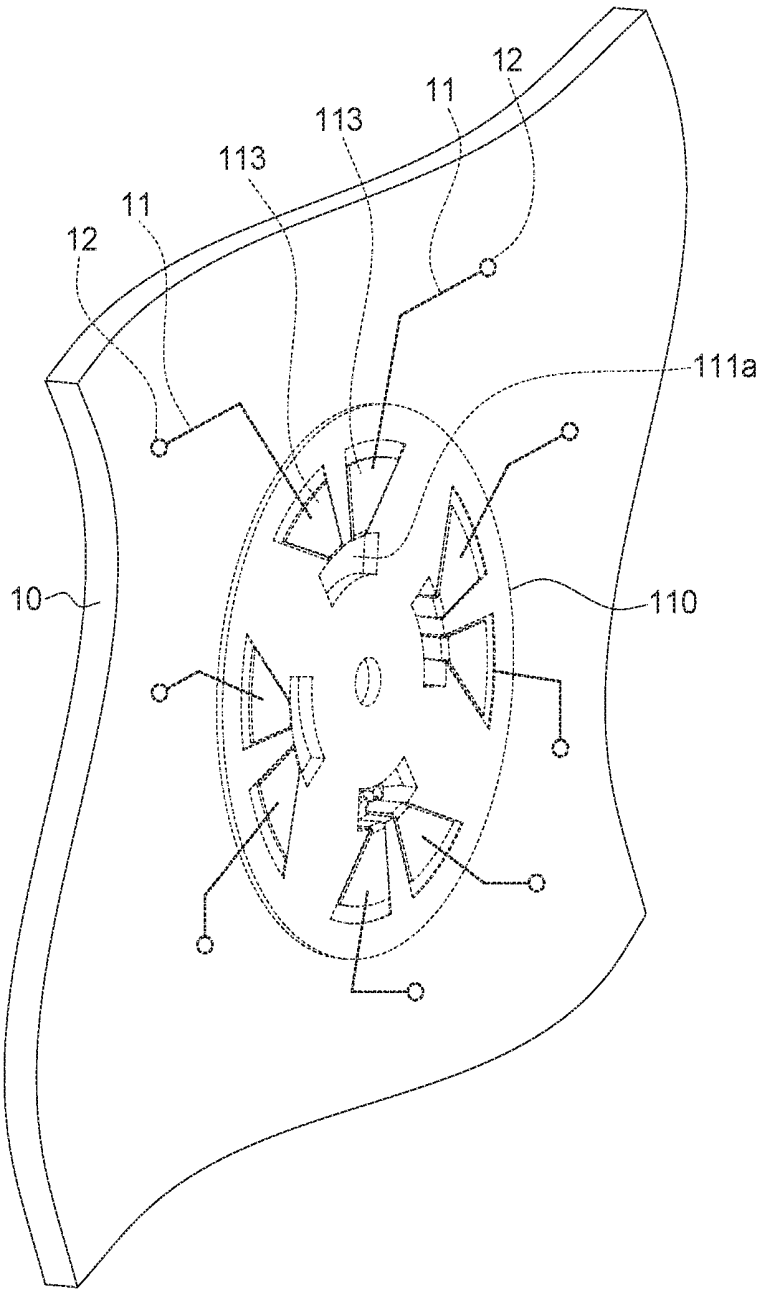


FIG. 3

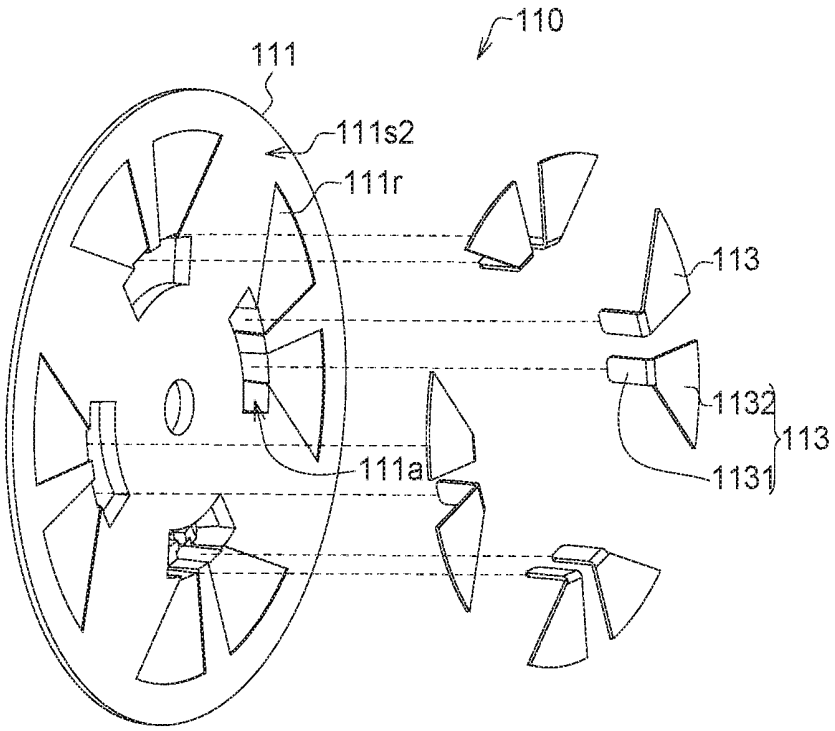


FIG. 4

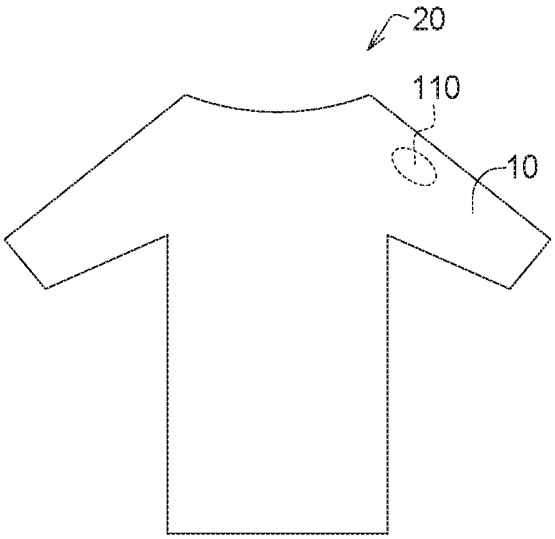


FIG. 5

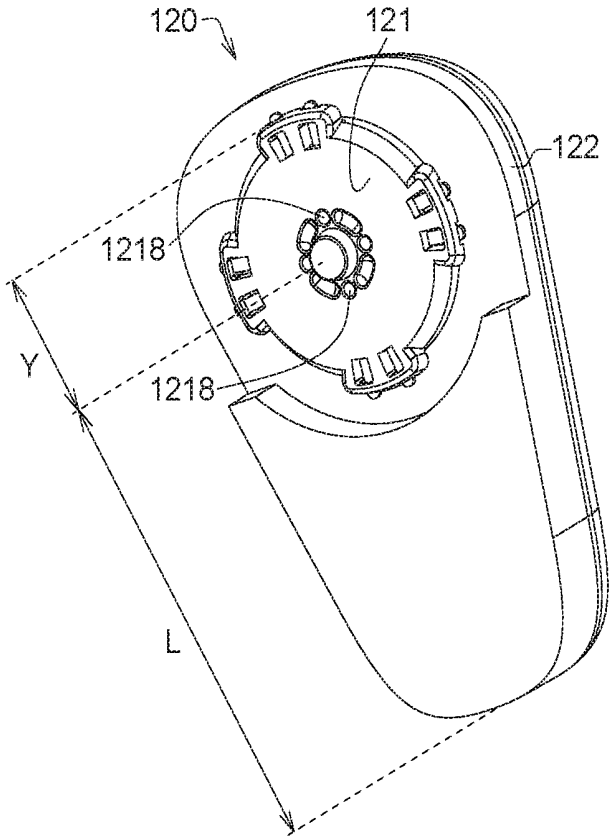


FIG. 6

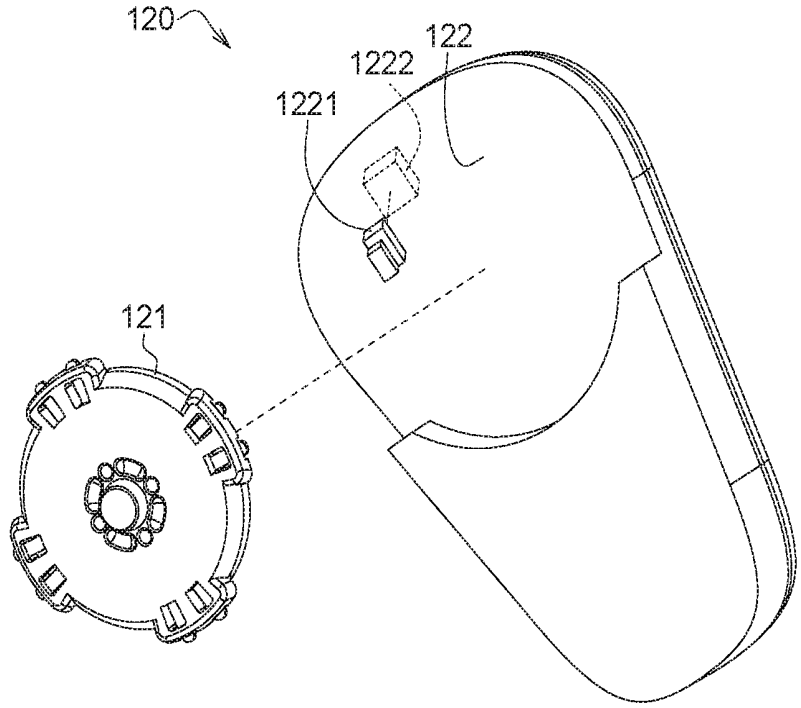


FIG. 7

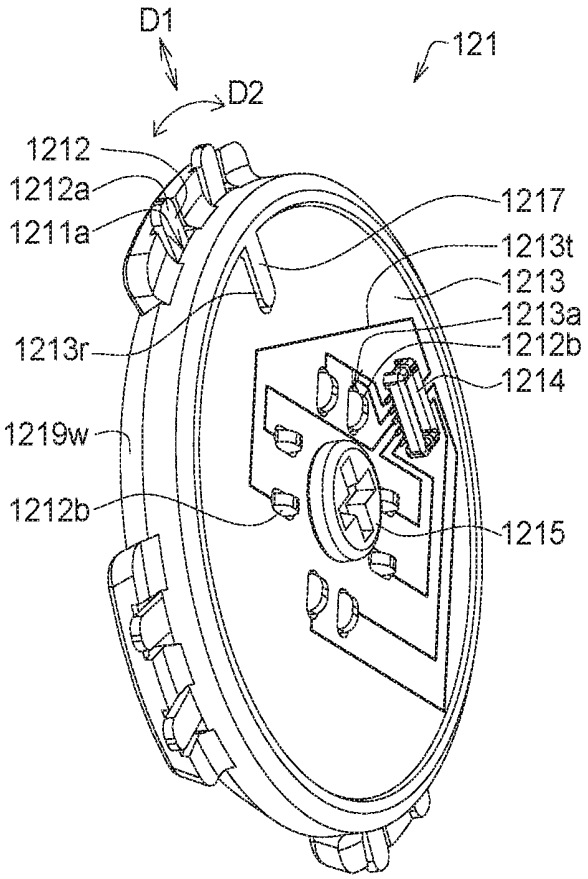

D1
D2
121
1212
1212a
1211a
1213r
1219w
1212b
1217
1213t
1213
1213a
1212b
1214
1215

FIG. 8

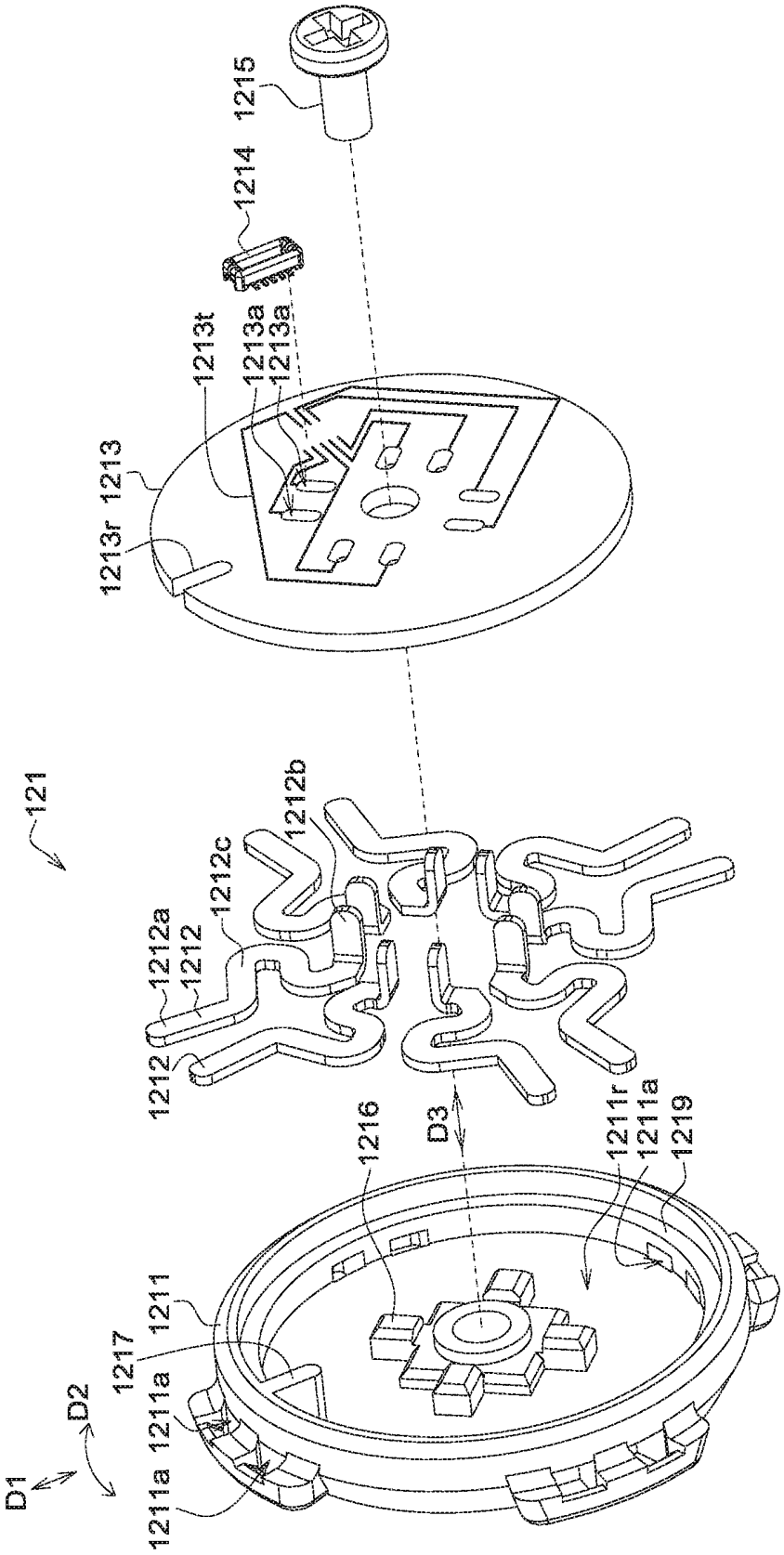

1215
1214
1213t
1213a
1213a
1213
1213r
121
1212b
1212c
1212a
1212
1212
D3
1216
1211r
1211a
1219
1211
1217
1211a
1211a
D2
D1

FIG. 9

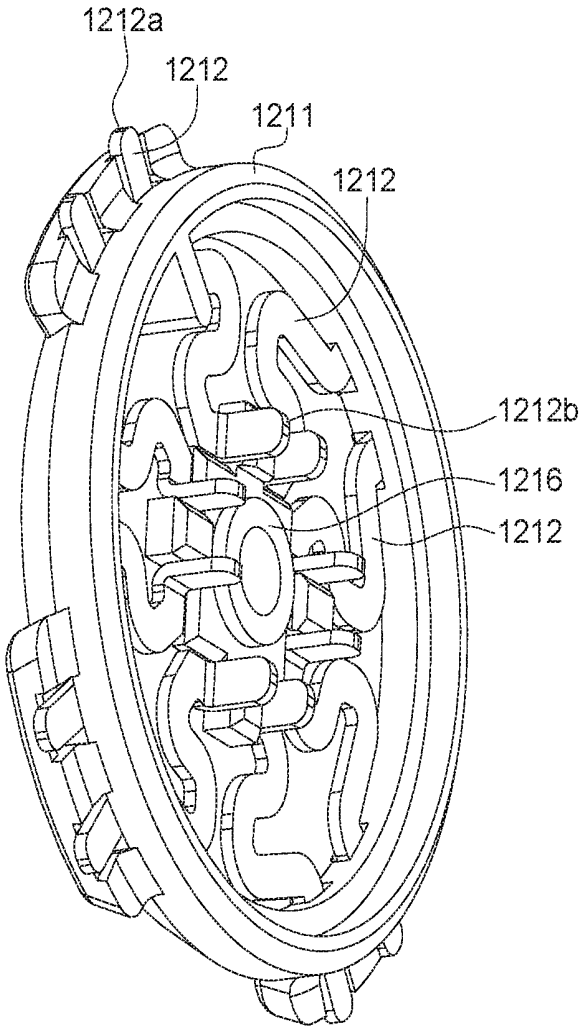


FIG. 10

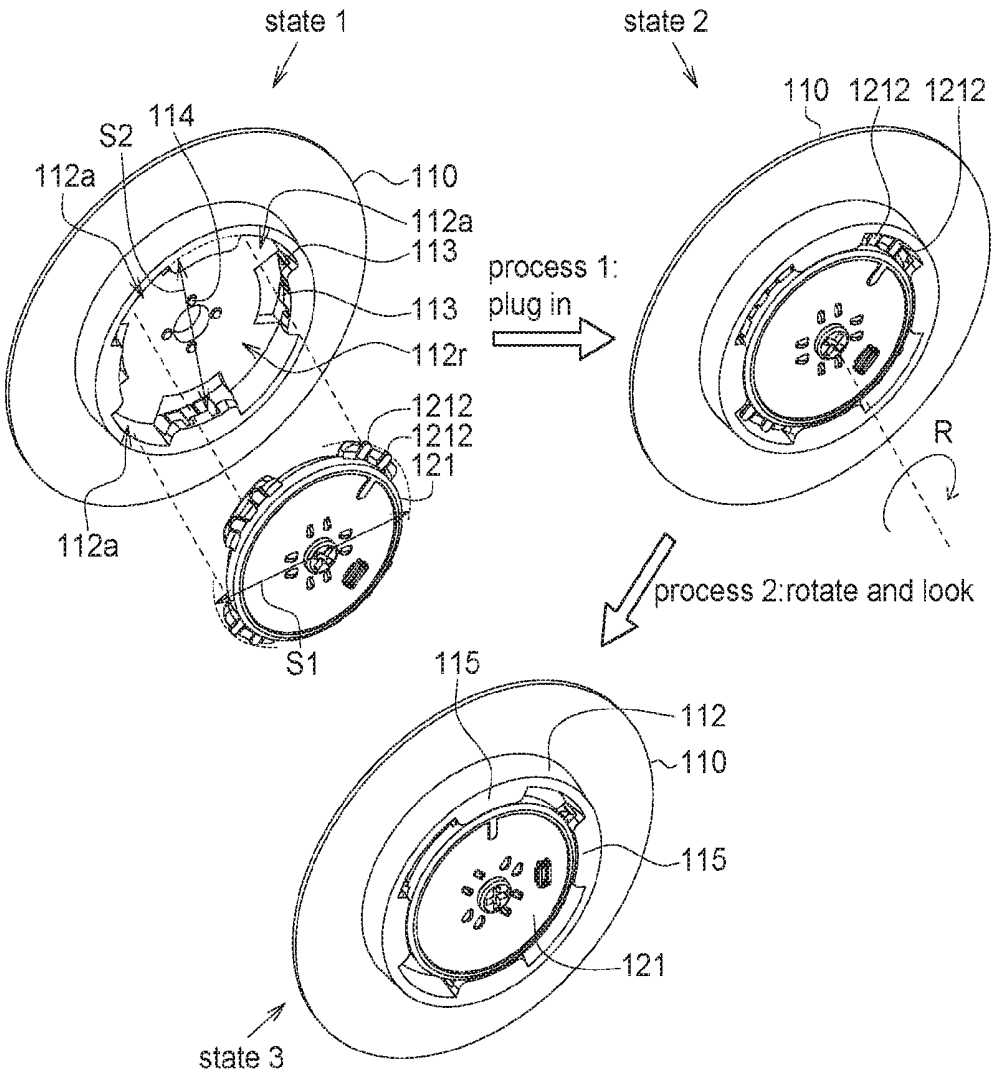

state 1
state 2
S2
114
112a
110
112a
113
113
112r
1212
1212
121
112a
S1
process 1:
plug in
110
1212
1212
R
process 2:rotate and look
115
112
110
115
121
state 3

FIG. 11

ELECTROCARDIOGRAPHY SCANNER MODULE, MULTI-CONTACT CONNECTOR THEREOF, ELECTROCARDIOGRAPHY SCANNER THEREOF AND SMART CLOTHES USING THE SAME

[0001] This application claims the benefit of U.S. provisional application Ser. No. 62/278,996, filed Jan. 15, 2016, the subject matter of which is incorporated herein by reference, and claims the benefit of People's Republic of China application Serial No. 201610235716.9, filed Apr. 14, 2016, the subject matter of which is incorporated herein by reference.

BACKGROUND

[0002] Technical Field

[0003] The disclosure relates in general to an electrocardiography (ECG) scanner module, a connector thereof, an ECG scanner thereof and smart clothes using the same, and more particularly to an ECG scanner module with multiple contacts, a multi-contact connector thereof, an ECG scanner thereof and smart clothes using the same.

[0004] Background

[0005] Conventional smart clothes includes a connector embedded in cloth of the smart clothes for obtaining physiological signal of human body. The ECG scanner is configured to be connected to the connector for receiving and processing the physiological signal of human body from the connector. In one connecting method, the ECG scanner includes a male metal buckle such as a male copper buckle, and the connector includes a female metal buckle such as a female copper buckle. The ECG scanner and the connector connect to each other by buckling the male copper buckle into the female copper buckle along an axial direction.

[0006] However, such conventional method has a disadvantage: the more the number of the contacts is, the larger the contacting area of the male copper buckles and the female copper buckles is, and accordingly a larger pulling and inserting force is needed. As a result, the comfort of the human body wearing the smart clothes and diversity of the functions will be negatively affected. In addition, since the male copper buckle and the female copper buckle are clearance fit, when user moves, the conventional copper buckles generate unnecessary noise due to unsteady of the connecting impedance resulted from shocking. Furthermore, since a pair of copper buckles only transmits one signal, the ECG scanner becomes larger when the number of copper buckles is required to be more, such as eight. As a result, the smart clothes make the user uncomfortable. Thus, conventional copper buckles are not conducive to the design of multiple signals, such as the measurements of multi-lead ECG signal, body fat, blood glucose, etc.

[0007] Thus, it is needed to provide a new connector for solving conventional problems.

SUMMARY

[0008] According to one embodiment of the invention, a multi-contact connector is provided. The multi-contact connector is adapted to be disposed on a wearable carrier and connected to an electrocardiography (ECG) scanner, wherein the wearable carrier has a plurality of conductive wires, the ECG scanner has a plurality of second conductive portions, each of the second conductive portions has a first end projecting from an outer circumferential surface of the ECG scanner, and the multi-contact connector comprises a base, a fitting portion and a plurality of first conductive portions. The base is disposed on the wearable carrier. The fitting portion is disposed on the base and surrounds a first receiving portion. The first conductive portions are annularly disposed on an inner circumferential surface, wherein each first conductive portion is electrically connected to the corresponding conductive wire. Wherein when the ECG scanner and the multi-contact connector connect to each other, each second conductive portion provides a radial force along a radial direction for being electrically connected to the corresponding first conductive portion.

[0009] According to another embodiment of the invention, an ECG scanner is provided. The ECG scanner is adapted to be connected to a multi-contact connector having a plurality of first conductive portions. The ECG scanner comprises a main body and a plug component. The plug component is disposed on the main body and comprises a casing and a plurality of second conductive portions. The casing has a circumferential wall. The second conductive portions have deformability and are annularly arranged in the circumferential wall of the casing, wherein a first end of each second conductive portion projects from an outer circumferential surface of the circumferential wall. Wherein when the ECG scanner and the multi-contact connector connect to each other, each second conductive portion provides a radial force along a radial direction for being electrically connected to the corresponding first conductive portion.

[0010] According to another embodiment of the invention, an ECG scanner module is provided. The ECG scanner module includes the multi-contact connector as mentioned above and the ECG scanner as mentioned above. The ECG scanner is configured to be connected to the multi-contact connector, wherein each second conductive portion of the ECG scanner is configured to be contacted to the corresponding first conductive portion.

[0011] According to another embodiment of the invention, smart clothes is provided. The smart clothes includes the multi-contact connector as mentioned above. Wherein the smart clothes covers a portion of the multi-contact connector, another portion of the multi-contact connector is exposed from the smart clothes, and the first conductive portions of the multi-contact connector are exposed from the smart clothes.

[0012] According to another embodiment of the invention, smart clothes is provided. The smart clothes includes the ECG scanner module as mentioned above. wherein the smart clothes covers a portion of the multi-contact connector, another portion of the multi-contact connector is exposed from the smart clothes, the first conductive portions of the multi-contact connector are exposed from the smart clothes, and the ECG scanner is electrically connected to the multi-contact connector by each second conductive portion contacting the corresponding first conductive portion.

[0013] The above and other aspects of the invention will become better understood with regard to the following detailed description of the preferred but non-limiting embodiment(s). The following description is made with reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] FIG. **1** shows an exploded view of an ECG scanner module according to an embodiment of the invention;

[0015] FIG. **2** shows a diagram of the multi-contact connector being covered by cloth;
[0016] FIG. **3** shows a diagram of an opposite side of the multi-contact connector of FIG. **2**;
[0017] FIG. **4** shows an exploded view of the multi-contact connector of FIG. **1**;
[0018] FIG. **5** shows a diagram of the smart clothes according to an embodiment of the invention;
[0019] FIG. **6** shows an appearance view of the ECG scanner of FIG. **1**;
[0020] FIG. **7** shows an exploded view of the ECG scanner of FIG. **6**;
[0021] FIG. **8** shows an appearance view of the plug component of FIG. **7**;
[0022] FIG. **9** shows an exploded view of the plug component of FIG. **8**;
[0023] FIG. **10** shows an assembly view of a casing and a plurality of second conductive portions of FIG. **9**; and
[0024] FIG. **11** shows a connecting process of the ECG scanner (the main body is not shown) of FIG. **1** and the multi-contact connector of FIG. **2**.
[0025] In the following detailed description, for purposes of explanation, numerous specific details are set forth in order to provide a thorough understanding of the disclosed embodiments. It will be apparent, however, that one or more embodiments may be practiced without these specific details. In other instances, well-known structures and devices are schematically shown in order to simplify the drawing.

DETAILED DESCRIPTION

[0026] FIG. **1** shows an exploded view of an ECG scanner module **100** according to an embodiment of the invention.
[0027] The ECG scanner module **100** of the present embodiment may be combined with smart clothes for the requirement for health and athletics. The ECG scanner module **100** may receive, transmit and analyze physiological signal from human body or animal, such that the management of health and athletics may be much intelligentized.
[0028] The ECG scanner module **100** includes a multi-contact connector **110** and an ECG scanner **120**. The ECG scanner **120** includes a plug component **121** and a main body **122**, wherein the plug component **121** may insert and is electrically connected to the main body **122**.
[0029] Referring to FIGS. **2-4**, FIG. **2** shows a diagram of the multi-contact connector **110** being covered by cloth, FIG. **3** shows a diagram of an opposite side of the multi-contact connector **110** of FIG. **2**, and FIG. **4** shows an exploded view of the multi-contact connector **110** of FIG. **1**.
[0030] The base **110** includes a base **111**, a fitting portion and a plurality of first conductive portions **113**, wherein the fitting portion is, for example, a flange **112**. The flange **112** is disposed on the base **111** and projects from a first surface **111***s***1** of the base **111**. The flange **112** surrounds a first receiving portion **112***r*. These first conductive portions **113** are annularly and circumferentially disposed on an inner circumferential surface **112***s* of the first receiving portion **112***r*.
[0031] The base **111** has a plurality of first openings **111***a*, wherein the first openings **111***a* pass through the base **111** and interconnect with the first receiving portion **112***r*. The first conductive portions **113** pass through the first openings **111***a* and are exposed from the first receiving portion **112***r* (as shown in FIG. **2**). As a result, when the ECG scanner **120** and the multi-contact connector **110** connect to each other, the plug component **121** inserting the first receiving portion **112***r* may be electrically connected to the first conductive portions **113** of the multi-contact connector **110** exposed from the cloth **10** of the smart clothes.

[0032] As shown in FIG. **4**, each first conductive portion **113** includes a first sub-conductive portion **1131** and a second sub-conductive portion **1132** connecting to the first sub-conductive portion **1131**. Each first sub-conductive portion **1131** passes through the corresponding first opening **111***a* and is exposed from the first receiving portion **112***r*. The second sub-conductive portions **1132** are disposed on a second surface **111***s***2** of the base **111**. The base **111** further includes a plurality of recesses **111***r* extending toward the first surface **111***s***1** from the second surface **111***s***2**, but not penetrating the base **111**. Each recess **111***r* may receive the corresponding second sub-conductive portion **1132**, such that the second sub-conductive portions **1132** are engaged with the base **111**, and it may avoid a relative displacement between the base **111** and the second sub-conductive portions **1132**. In another embodiment, the second sub-conductive portions **1132** may be adhered to the recesses **111***r* by adhesion. Alternatively, each sub-conductive portion **1132** may has a size slightly larger than that of the corresponding recess **111***r*, such that each sub-conductive portion **1132** and the corresponding recess **111***r* are in tight fit or transition fit. In addition, as shown in FIG. **4**, the first sub-conductive portions **1131** and the second sub-conductive portions **1132** are shaped as flat-plate shape or string shape.

[0033] In the present embodiment, the number of the first conductive portions **113** is eight. In another embodiment, the number of the first conductive portions **113** may be less or more than eight. The base **111** of the present embodiment has four first openings **111***a*, wherein each first opening **111***a* is corresponding to two first conductive portions **113**, that is, each first opening **111***a* allow two first conductive portions **113** to pass through. The number of the first openings **111***a* and the number of the first conductive portions **113** allowed to pass through the first openings **111***a* are not limited to the present embodiment. The number of the first opening **111***a* may depend on mold design, manufacturability, whether the multi-contact connector **110** is easy to be connected to the ECG scanner **120** or the stability of connecting.

[0034] As shown in FIG. **3**, the cloth **10** is, for example, the cloth of the smart clothes. The cloth **10** includes a plurality of conductive wires **11** and a plurality of pads **12**, wherein each conductive wire **11** is electrically connected to the corresponding pad **12**. The cloth **10** may be made of fibers, woven, non-woven fabric or any other kind of material which may make smart clothes. In addition, the cloth **10** may further includes at least one conductive layer, at least one plating layer, at least one conductive coating layer and/or the at least one conductive adhesive layer, so as to form the conductive wires **11** of the cloth **10**.

[0035] One end of each conductive wire **11** is connected to the corresponding pad **12**, and another end of each conductive wire **11** is connected to the corresponding first conductive portions **113** of the multi-contact connector **110**. When the human body or animal wear the cloth **10**, the pads **12** contact a portion of human body or animal for detecting physiological signal of human body or animal. Then, the physiological signal of human body or animal may be

transmitted to the first conductive portions **113** of the multi-contact connector **110** through the conductive wires **11**.

[0036] The multi-contact connector **110** is electrically connected to the conductive wires **11** of the cloth **10** through the first conductive portions **113** for transmitting the physiological signal (current or voltage) of human body or animal detected from the human body or animal to the ECG scanner **120** electrically connected to the multi-contact connector **110**, wherein the physiological signal may be transmitted to the main body **122** through the plug component **121**. The main body **122** may analyze the physiological signals to obtain physiological information, such as pulse wave velocity (PWV), blood pressure, heart rate, body fat, blood glucose, pulse oximetry (SpO2), etc.

[0037] FIG. **5** shows a diagram of the smart clothes **20** according to an embodiment of the invention. The smart clothes **20** includes the multi-contact connector **110** and the cloth **10**, whether the multi-contact connector **110** is disposed on the cloth **10**. In another embodiment, the smart clothes **20** further includes the ECG scanner **120** which may be connected to the multi-contact connector **110**. The multi-contact connector **110**, the cloth **10** and the CEG scanner **20** have the features similar to the aforementioned descriptions, and the similarities are not repeated here.

[0038] As shown in FIG. **2**, the multi-contact connector **110** may be covered by the cloth **10**, whether the flange **112** is exposed from or projects from the cloth **10**, such that the plug component **121** (as shown in FIG. **1**) of the ECG scanner **120** may be connected to the first conductive portions **113** through the exposed or projecting flange **112**.

[0039] The plug component **121** may be connected to the multi-contact connector **110** by way of inserting or rotating, such that the plug component **121** is electrically connected to and locked to the multi-contact connector **110**.

[0040] Referring to FIGS. **6** and **7**, FIG. **6** shows an appearance view of the ECG scanner **120** of FIG. **1**, and FIG. **7** shows an exploded view of the ECG scanner **120** of FIG. **6**.

[0041] The plug component **121** is disposed on and electrically connected to the main body **122**, and accordingly the main body **122** may analyze physiological signals from the plug component **121** to obtain physiological information. For example, as shown in FIG. **7**, the ECG scanner **120** further includes a connector **1221** and a processor **1222**, wherein the connector **1221** is disposed on the main body **1222** and electrically connected to the processor **1222**. When the plug component **121** is assembled to the main body **122** and electrically connected to the connector **1221**, the processor **1222** may analyze the physiological signals from the multi-contact connector **110** to obtain physiological information.

[0042] Referring to FIGS. **8** to **10**, FIG. **8** shows an appearance view of the plug component **121** of FIG. **7**, FIG. **9** shows an exploded view of the plug component **121** of FIG. **8**, and FIG. **10** shows an assembly view of a casing **1211** and a plurality of second conductive portions **1212** of FIG. **9**.

[0043] The plug component **121** includes the casing **1211**, the second conductive portions **1212** (for example, eight second conductive portions **1212** in the present embodiment), a circuit board **1213**, a connector **1214** and a plurality fixing elements **1215**.

[0044] The fixing elements **1215***s* are, for example, screws or other fasteners. The fixing elements **1215** are configured to fix the second conductive portions **1212** and the circuit board **1213** to the casing **1211**. In the present embodiment, the number of the second conductive portions **1212** may be equal to the number of the first conductive portions **113**.

[0045] The casing **1211** includes a second receiving portion **1211***r*, a block **1216**, a plurality of second openings **1211***a* (In the present embodiment, the number of the second conductive portions **1212** and the number of the second openings **1211***a* are eight, for example) and a protrusion **1217**. The second openings **1211***a* pass through the circumferential wall **1219** of the casing **1211**, that is, the second openings **1211***a* extend to an inner circumferential surface (not shown) from the outer circumferential surface **1219***w* of the circumferential wall **1219***w* for be interconnected with the second receiving portion **1211***r*, such that each second conductive portion **1212** of the second receiving portion **1211***r* located at the second receiving portion **1211***r* may pass through the corresponding second openings **1211***a* and projects from the corresponding second openings **1211**, that is, projects from the outer circumferential surface **1219***w* of the circumferential wall **1219***w*. As a result, when the ECG scanner **120** and the multi-contact connector **110** connect to each other, the second conductive portions **1212** may contact the first conductive portions **113** of the multi-contact connector **110** of FIG. **2**.

[0046] As shown in FIGS. **8** to **10**, these second conductive portions **1212** are annularly and circumferentially disposed on the circumferential wall **1219** of the casing **1211**.

[0047] As shown in FIGS. **8** and **9**, each second conductive portion **1212** has a first end **1212***a* and a second end **1212***b*. The second end **1212***b* of each second conductive portion **1212** presses against the block **1216**, and the first end **1212***a* of each second conductive portion **1212** passes through the corresponding second opening **1211***a*. The first end **1212***a* projects from the corresponding second opening **1211***a* for contacting the corresponding first conductive portions **113** of the multi-contact connector **110**. In addition, the first end **1212***a* is substantially perpendicular to second end **1212***b* in an extending direction. For example, the first end **1212***a* extends in a radial direction D**1**, and the second end **1212***b* extends in an axial direction D**3**. Since the second end **1212***b* extends in the axial direction D**3**, the second end **1212***b* may provide a larger area for firmly pressing against the block **1216**.

[0048] The first end **1212***a* extends in the radial direction D**1**, and each second conductive portion **1212** has flexibility. Furthermore, each second conductive portion **1212** further includes a flexible portion **1212***c* connecting the first end **1212***a* to the second end **1212***b*. The flexible portion **1212***c* is between and connects the first end **1212***a* and the second end **1212***b*, and the flexible portion **1212***c* is shaped as a bending-shape, such as U-shape, S-shape or other bending shape, for generating a normal contacting force. As a result, when the flexible portion **1212***c* is applied by a force, the flexible portion **1212***c* is deformed to provide the second end **1212***b* with a displacement and a normal force. In addition, each second opening **1211***a* has a width (in a circumferential direction D**2**) larger than a width (in the circumferential direction D**2**) of the first end **1212***a*, and accordingly the first end **1212***a* of each second conductive portion **1212** projecting from the corresponding second opening **1211***a* is movable in circumferential direction D**2**.

[0049] The circuit board **1213** has a notch **1213***r* and a plurality of third openings **1213** corresponding to the second conductive portions **1212**. As shown in FIG. **9**, the number of the third openings **1213** is eight, less than or more eight. When the circuit board **1213**, the second conductive portions **1212** and the casing **1211** are assembled to each other, the second end **1212***b* of each second conductive portion **1212** presses against the block **1216** of the casing **1211** and passes through the corresponding third opening **1213***a* of the circuit board **1213**. As a result, the second conductive portions **1212** may be restricted between the block **1216** and the second openings **1211***a*. In addition, when the circuit board **1213** is assembled to the casing **1211**, the protrusion **1217** is engaged with the notch **1213***r* of the circuit board **1213**, such that the protrusion **1217** may prevent the circuit board **1213** from rotating. As a result, the second conductive portions **1212** may be firmly fixed to between casing **1211** and the circuit board **1213**.

[0050] Although not shown in FIG. **8**, the plug component **121** further includes a plurality of solder (not shown), wherein each solder is connected to the second end **1212***b* of the corresponding second conductive portion **1212** and the corresponding trace **1213***t*, such that each second conductive portion **1212** is electrically connected to the corresponding trace **1213***t* of the circuit board **1213**. The conductive wire **1213** is, for example, signal trace which extends to the connector **1214** for electrically connecting the connector **1214** to the corresponding second conductive portion **1212**. As a result, the physiological signal from the second conductive portions **1212** may be transmitted to the connector **1214** through the trace **1213***t*.

[0051] As shown in FIGS. **7** and **8**, when the plug component **121** is assembled to the main body **122**, the connector **1214** of the plug component **121** may be connected to the connector **1221** of the main body **122**, such that the processor **1222** disposed on the main body **122** is electrically connected to the circuit board **1213** through the connectors **1221** and **1214**.

[0052] The connector **1221** is disposed on a circuit board (not shown) of the main body **122**. In the present embodiment, the connector **1221** has a male port, and the connector **1214** has a female port, such that the connector **1221** and the connector **1214** may match to each other. In another embodiment, the connector **1221** has female port, and the connector **1214** has a male port, such that the connector **1221** and the connector **1214** may match to each other.

[0053] FIG. **11** shows a connecting process of the ECG scanner **120** (the main body is not shown) of FIG. **1** and the multi-contact connector **110** of FIG. **2**.

[0054] In process 1 (state 1 to state 2), the plug component **121** of the ECG scanner **120** inserts the first receiving portion **112***r* of the multiple-contact connector **110** by way of the second conductive portions **1212** aligning with the notches **112***a* of the flange **112** of the multi-contact connector **110**. In process 2 (state 2 to state 3), the plug component **121** is rotated around a rotating direction R, such that the plug component **121** and the multi-contact connector **110** are locked to each other. For example, use may hold the main body **122** assembled to the plug component **121** to perform the processes 1 and 2, such that the ECG scanner **120** and the multi-contact connector **110** of the cloth **10** are locked to each other. Each second conductive portion **1212** of the plug component **121** may be electrically connected to the corresponding first conductive portions **113** of the multi-contact connector **110**. As a result, during once operation (process 1 to 2), the second conductive portions **1212** of the ECG scanner **120** may be electrically connected to the first conductive portions **113** of the multi-contact connector **110**, such that the ECG scanner module **100** may provide a multi-contact transmitting function.

[0055] In addition, in process 2, since an outer diameter S1 formed by the outer edges of the first ends **1212***a* of the second conductive portions **1212** is larger than an inner diameter S2 formed by the first conductive portions **113** disposed on the inner circumferential surface (not shown) of the multi-contact connector **110**, and accordingly the second conductive portions **1212** and the first conductive portions **113** are interfered with each other when the plug component **121** is rotated, and thus the second conductive portions **1212** are forced to be pressed to deform in the radial direction D1 (shown in FIG. **8**). As a result, when the ECG scanner **120** and the multi-contact connector **110** connect to each other, each of the second conductive portions **1212** provides a radial pre-force to be firmly electrically connected to the corresponding first conductive portion **113**. As a result, it may avoid the unsteady of the connecting impedance due to clearance fit.

[0056] In addition, in process 2, although the second conductive portions **1212** are interfered with the first conductive portions **113**, due to the second conductive portions **1212** having flexibility, the second conductive portions **1212** move toward an center of the plug component **121** along the radial direction during interfering, and accordingly it may reduce the interfering resistance between the first conductive portions **113** and the second conductive portions **1212**, such that the ECG scanner **120** and the multi-contact connector **110** effortlessly connect to each other by rotating.

[0057] As shown in FIG. **11**, the multi-contact connector **110** further includes a plurality of first positioning portions **114**. As shown in FIG. **6**, the plug component **121** further includes a plurality of second positioning portions **1218**. When the second conductive portions **1212** contact the first conductive portions **113** (as shown in state 3), the first positioning portions **114** are engaged with the second positioning portions **1218**, and accordingly it may provide the user with an assembling feeling or an engaging feeling. Furthermore, during the relative rotation of the ECG scanner **120** and the multi-contact connector **110**, if the user feels the assembling feeling or the engaging feeling, it means the second conductive portions **1212** have already contacted and electrically connected to the first conductive portions **113**.

[0058] In the present embodiment, each first positioning portion **114** is, for example, a protrusion, and each second positioning portion **1218** is, for example, a dent. In another embodiment, each first positioning portion **114** is, for example, a dent, and each second positioning portion **1218** is, for example, a protrusion.

[0059] As shown in FIG. **11**, the multi-contact connector **110** further includes a plurality of blocks **115** and a notch **112***a* formed between adjacent two blocks **115**. The blocks **115** are disposed on the flange **112**, extend toward an inner side of the flange **112** and at least one block **115** is opposite to the corresponding first opening **111***a* in position. As a result, when the second conductive portions **1212** contact the first conductive portions **113** passing through the first openings **111***a* (as shown in state 3), the blocks **115** are aligned with the second conductive portions **1212** of the plug component **121** in position, such that each second

conductive portion **1212** may be blocked by the corresponding block **115** for preventing the plug component **121** from being easily detached from the multi-contact connector **110** in the axial direction.

[0060] In addition, each second conductive portion **1212** provides the corresponding first conductive portion **113** with the radial pre-force, that is, the second conductive portions **1212** are in contact with the first conductive portions **113** in the radial direction, and accordingly assembling of the ECG scanner **120** and the multi-contact connector **110** may save more user labour compared to the axial contact in assembling of the conventional the ECG scanner and the connector. In comparison with axial contact, the radial contact of the ECG scanner module **100** of the present embodiment may save the user labour (applying force by the user) of assembling the ECG scanner **120** to the multi-contact connector **110** by 85%. In addition, the more the number of the pairs of contacts (a pair of the contacts includes one conductive portions **1212** and the corresponding the conductive portions **113**) is, the more the saved-labour is.

[0061] Moreover, as shown in formula (1) below, Fa represents the required applying force of assembling the conventional ECG scanner to the conventional multi-contact connector, n represents the number of the pairs of the contacts, and f represents the required normal force per pair of the contacts.

$$Fa=nf \quad (1)$$

[0062] In formula (2) below, Fr represents the required applying force of assembling the ECG scanner **120** to the multi-contact connector **110**, n represents the number of the pairs of the contacts, f represents the required normal force per pair of the contacts, μ represents the friction coefficient between the second conductive portions **1212** and the first conductive portions **113** which contact the second conductive portions **1212**, L (as shown in FIG. **6**) represents an applying-force arm, for example, a partial length of the main body **122**, and r (as shown in FIG. **6**) represents an applied-force arm, for example, a radius of the plug component **121**, wherein r<L.

$$Fr=nf\mu(r/L) \quad (2)$$

[0063] According to the formulas (1) and (2), if r/L≅0.5 and μ≅0.3, then F_r/F_a≅0.15. In addition, according to the formulas (1) and (2), if r/L≅0.5, n=8 and f≅60 g/contact, then F_a≅480 gf and F_r≅72 gf.

[0064] The applying force of assembling the ECG scanner **120** to the multi-contact connector **110** is about 0.15 times the applying force of assembling the conventional ECG scanner to the conventional multi-contact connector. In addition, since the conductive portion of the ECG scanner of this invention may deform in the radial direction, the conductive portion of the ECG scanner and the conductive portion of the multi-contact connector in the present embodiment of the invention may press against each other due to the radial force resulted from the deformation in the radial direction, such that the second conductive portion may firmly press against the first conductive portion, and accordingly it may prevent the ECG scanner from being easily detached from the multi-contact connector and may increase the stability between the ECG scanner and the multi-contact connector. In comparison with the design of the conventional axial (normal) contact, the multi-contact connector has a thin thickness due to the radial contact of the conductive portion of ECG scanner and the conductive portion of the multi-contact connector. The multi-contact connector of the present embodiment of the invention may be disposed on the wearable carrier, wherein the wearable carrier is, for example, the cloth of smart clothes.

[0065] It will be apparent to those skilled in the art that various modifications and variations can be made to the disclosed embodiments. It is intended that the specification and examples be considered as exemplary only, with a true scope of the disclosure being indicated by the following claims and their equivalents.

What is claimed is:

1. A multi-contact connector, adapted to be disposed on a wearable carrier and connected to an electrocardiography (ECG) scanner, wherein the wearable carrier has a plurality of conductive wires, the ECG scanner has a plurality of second conductive portions, each of the second conductive portions has a first end projecting from an outer circumferential surface of the ECG scanner, the multi-contact connector comprising:

a base disposed on the wearable carrier and having an inner circumferential surface;

a fitting portion disposed on the base and surrounding a first receiving portion; and

a plurality of first conductive portions annularly disposed on the inner circumferential surface, wherein each first conductive portion is electrically connected to the corresponding conductive wire;

wherein when the ECG scanner and the multi-contact connector connect to each other, each second conductive portion provides a radial force along a radial direction for being electrically connected to the corresponding first conductive portion.

2. The multi-contact connector according to claim **1**, wherein the base has a plurality of first openings, the first openings pass through the base and interconnect with the first receiving portion, each first conductive portion passes through the corresponding first opening for being disposed on the inner circumferential surface of the first receiving portion, and each first conductive portion is exposed from the first receiving portion for being electrically connected to the corresponding second conductive portion.

3. The multi-contact connector according to claim **2**, wherein each first conductive portion comprises a first sub-conductive portion and a second sub-conductive portion connecting to the first sub-conductive portion, each first sub-conductive portion passes through the corresponding first opening and is exposed form the first receiving portion, the first receiving portion is located at a first surface of the base, the second sub-conductive portion is disposed on a second surface of the base, and the first surface is opposite to the second surface.

4. The multi-contact connector according to claim **3**, wherein the fitting portion is a flange projecting from the base, and the multi-contact connector further comprises:

at least one block disposed on the flange and extending toward an inner side of the flange, wherein the at least one block is opposite to the corresponding first opening in position.

5. The multi-contact connector according to claim **3**, wherein each first sub-conductive portion and each second sub-conductive portion are shaped as plate-shape, and each first sub-conductive portion is substantially perpendicular to the corresponding second sub-conductive portion.

6. The multi-contact connector according to claim 1, wherein the wearable carrier is smart clothes.

7. An ECG scanner, adapted to be connected to a multi-contact connector having a plurality of first conductive portions, the ECG scanner comprising:

a main body; and

a plug component disposed on the main body and comprising:

a casing having a circumferential wall; and

a plurality of second conductive portions having deformability and annularly arranged in the circumferential wall of the casing, wherein each of the second conductive portions has a first end projecting from an outer circumferential surface of the circumferential wall;

wherein when the ECG scanner and the multi-contact connector connect to each other, each second conductive portion provides a radial force along a radial direction for being electrically connected to the corresponding first conductive portion.

8. The ECG scanner according to claim 7, wherein the casing further comprises a block and a second opening, the second opening passes through the circumferential wall, each of the second conductive portions has a second end pressing against the block, the first end of each second conductive portion passes through the second opening to be electrically connected to the corresponding first conductive portion.

9. The ECG scanner according to claim 8, wherein the first end and the second end of each second conductive portion are substantially perpendicular to each other in an extending direction.

10. The ECG scanner according to claim 7, wherein each second conductive portion has flexibility, an outer diameter formed by the outer edges of the first ends of the second conductive portions is larger than an inner diameter formed by the first conductive portions disposed on the inner circumferential surface of the multi-contact connector so that when the ECG scanner and the multi-contact connector connect to each other, each of the second conductive portions provides a radial pre-force to be firmly electrically connected to the corresponding first conductive portion.

11. The ECG scanner according to claim 7, wherein each second conductive portion further comprises a second end and a flexible portion, the flexible portion is between and connects the first end and the second end, and the flexible portion is shaped as a bending-shape for generating a normal contacting force.

12. An ECG scanner module, comprising:

a multi-contact connector, adapted to be disposed on a wearable carrier have a plurality of conductive wires, wherein the multi-contact connector comprises:

a base disposed on the wearable carrier and having an inner circumferential surface;

a fitting portion disposed on the base and surrounding a first receiving portion; and

a plurality of first conductive portions annularly disposed on the inner circumferential surface, wherein each first conductive portion is electrically connected to the corresponding conductive wire;

an ECG scanner configured to be connected to the multi-contact connector and comprising:

a main body; and

a plug component disposed on the main body and comprising:

a casing having a circumferential wall; and

a plurality of second conductive portions having deformability and annularly arranged in the circumferential wall of the casing, wherein each of the second conductive portions has a first end projecting from an outer circumferential surface of the circumferential wall;

wherein when the ECG scanner and the multi-contact connector connect to each other, each second conductive portion of the ECG scanner is configured to be contacted to the corresponding first conductive portion.

13. The ECG scanner module according to claim 12, wherein the base has a plurality of first openings, the first openings pass through the base and interconnect with the first receiving portion, each first conductive portion passes through the corresponding first opening for being disposed on the inner circumferential surface of the first receiving portion, and each first conductive portion is exposed from the first receiving portion for being electrically connected to the corresponding second conductive portion.

14. The ECG scanner module according to claim 12, wherein each first conductive portion comprises a first sub-conductive portion and a second sub-conductive portion connecting to the first sub-conductive portion, each first sub-conductive portion passes through the corresponding first opening and is exposed form the first receiving portion, the first receiving portion is located at a first surface of the base, the second sub-conductive portion is disposed on a second surface of the base, and the first surface is opposite to the second surface.

15. The ECG scanner module according to claim 12, wherein the multi-contact connector further comprises:

at least one block disposed on the fitting portion and extending toward an inner side of the fitting portion, wherein the at least one block is opposite to the corresponding first opening in position.

16. The ECG scanner module according to claim 14, wherein each first sub-conductive portion and each second sub-conductive portion are shaped as plate-shape, and each first sub-conductive portion is substantially perpendicular to the corresponding second sub-conductive portion.

17. The ECG scanner module according to claim 12, wherein the casing further comprises a block and a second opening, the second opening passes through the circumferential wall, each of the second conductive portions has a second end pressing against the block, the first end of each second conductive portion passes through the second opening, and the first end of each second conductive portion passing through the second opening is configured to be electrically connected to the corresponding first conductive portion.

18. The ECG scanner module according to claim 17, wherein the first end and the second end of each second conductive portion are substantially perpendicular to each other in an extending direction.

19. The ECG scanner module according to claim 12, wherein each second conductive portion has flexibility, an outer diameter formed by the outer edges of the first ends of the second conductive portions is larger than an inner

diameter formed by the first conductive portions disposed on the inner circumferential surface of the multi-contact connector for, when the ECG scanner and the multi-contact connector connect to each other, each of the second conductive portions providing a radial pre-force to be firmly electrically connected to the corresponding first conductive portion.

20. The ECG scanner module according to claim **12**, wherein each of the second conductive portions has a second end and a flexible portion, the flexible portion is between and connects the first end and the second end, and the flexible portion is shaped as a bending-shape.

21. A smart clothes, comprising:

the multi-contact connector as claimed in claim **1**;

wherein the smart clothes covers a portion of the multi-contact connector, another portion of the multi-contact connector is exposed from the smart clothes, and the first conductive portions of the multi-contact connector are exposed from the smart clothes.

22. A smart clothes, comprising:

the ECG scanner module as claimed in claim **12**;

wherein the smart clothes covers a portion of the multi-contact connector, another portion of the multi-contact connector is exposed from the smart clothes, the first conductive portions of the multi-contact connector are exposed from the smart clothes, and the ECG scanner is electrically connected to the multi-contact connector by each second conductive portion contacting the corresponding first conductive portion.

* * * * *

专利名称(译)	心电图扫描仪模块，其多触点连接器，其心电图扫描仪和使用其的智能衣服		
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[标]申请(专利权)人(译)	光宝电子（广州）有限公司 光宝科技股份有限公司		
申请(专利权)人(译)	光宝电子（广州）有限公司 LITE-ON科技股份有限公司		
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摘要(译)

提供了一种心电图（ECG）扫描仪模块，其多触点连接器，其ECG扫描仪和使用该模块的智能衣服。多触点连接器包括基座，配合部分和若干第一导电部分。基座设置在具有多根导线的可穿戴载体上。装配部分设置在基座上并围绕接收部分。第一导电部分环形地设置在接收部分的内周表面上，并且每个第一导电部分连接到相应的导线。ECG扫描仪包括多个第二导电部分，并且每个第二导电部分的一端从ECG扫描仪的外周表面突出。当多触点连接器连接到ECG扫描器时，每个第二导电部分提供径向力以连接到相应的第一导电部分。