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(54) **SCREEN**

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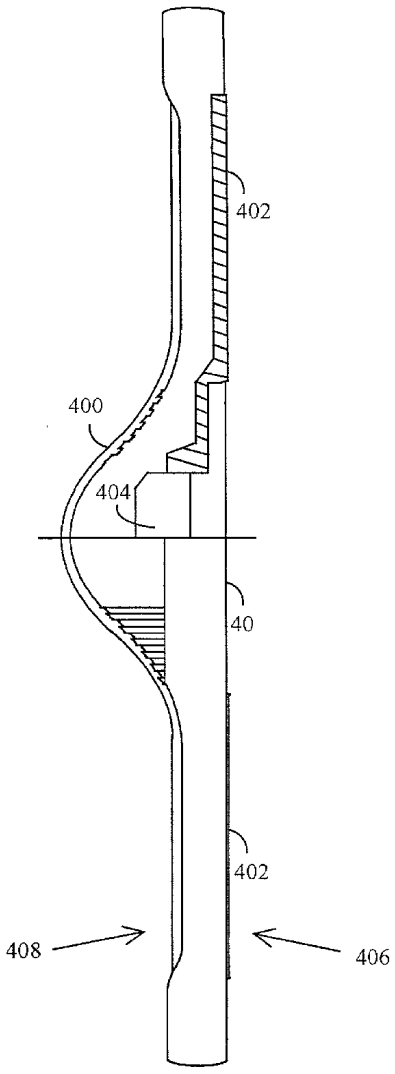
(52) **U.S. Cl.** **600/372**; 600/390

(57) **ABSTRACT**

The invention relates to a screen **(300)**, which is particularly intended for a functional unit measuring heart rate from a user's chest. Electrodes **(304)** of the functional unit and preferably also an electric circuit **(306)** are protected against extracorporeal interference by the screen **(300)**, which closely follows the electrode **(304)** or a supporting structure **(40, 50, 60, 70)** at least at the electrode **(104, 204, 304, 402, 502, 602, 702)**.



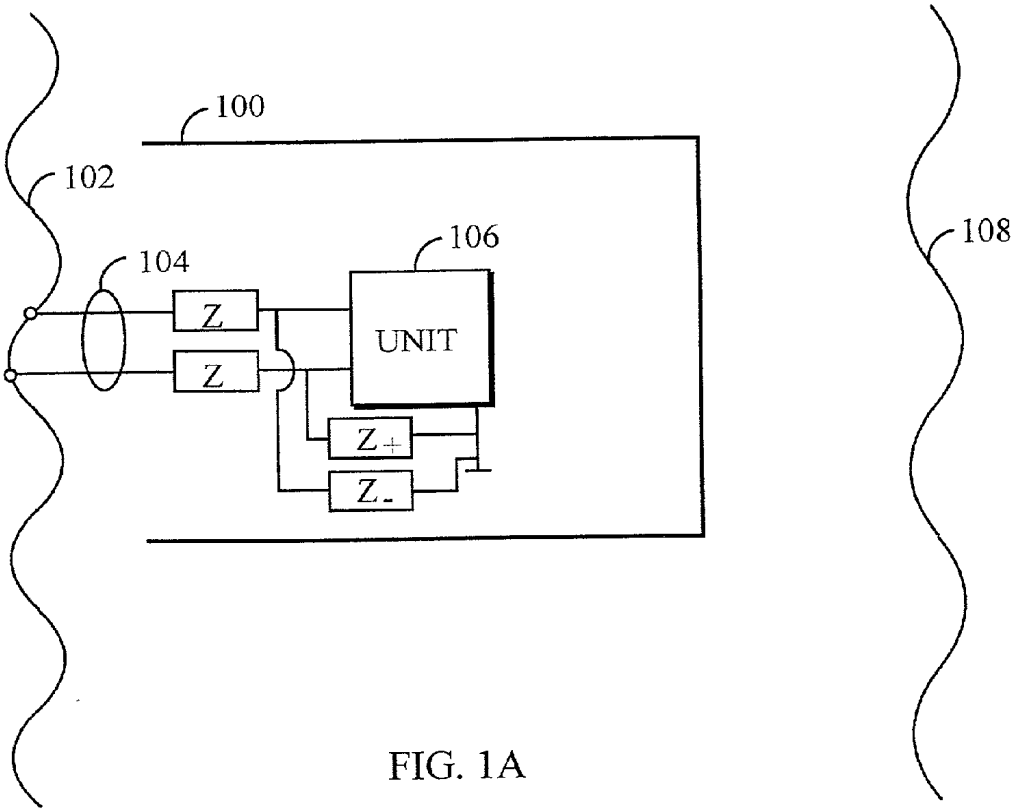


FIG. 1A

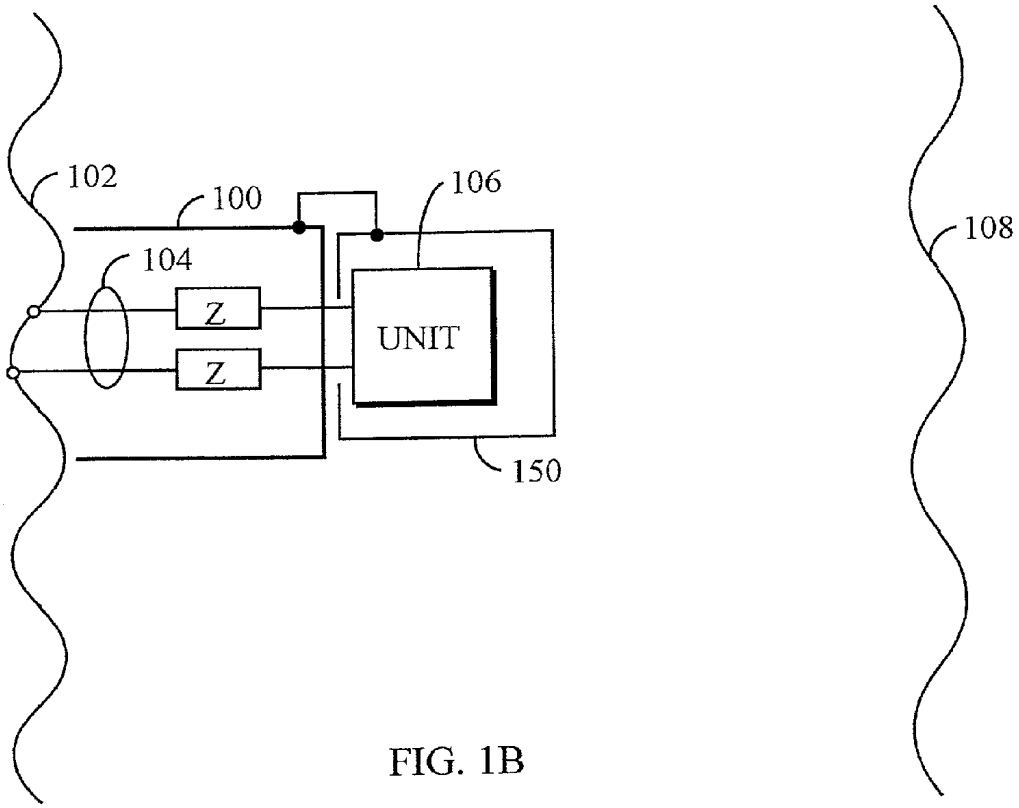


FIG. 1B

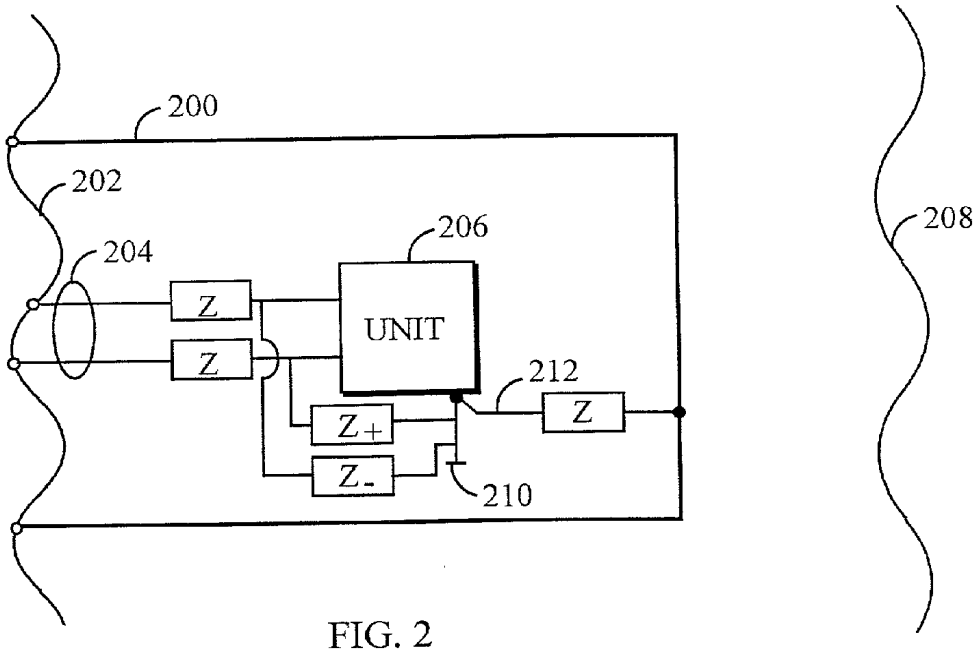

200
202
204
206
208
Z
Z
UNIT
212
Z
Z+
Z-
210

FIG. 2

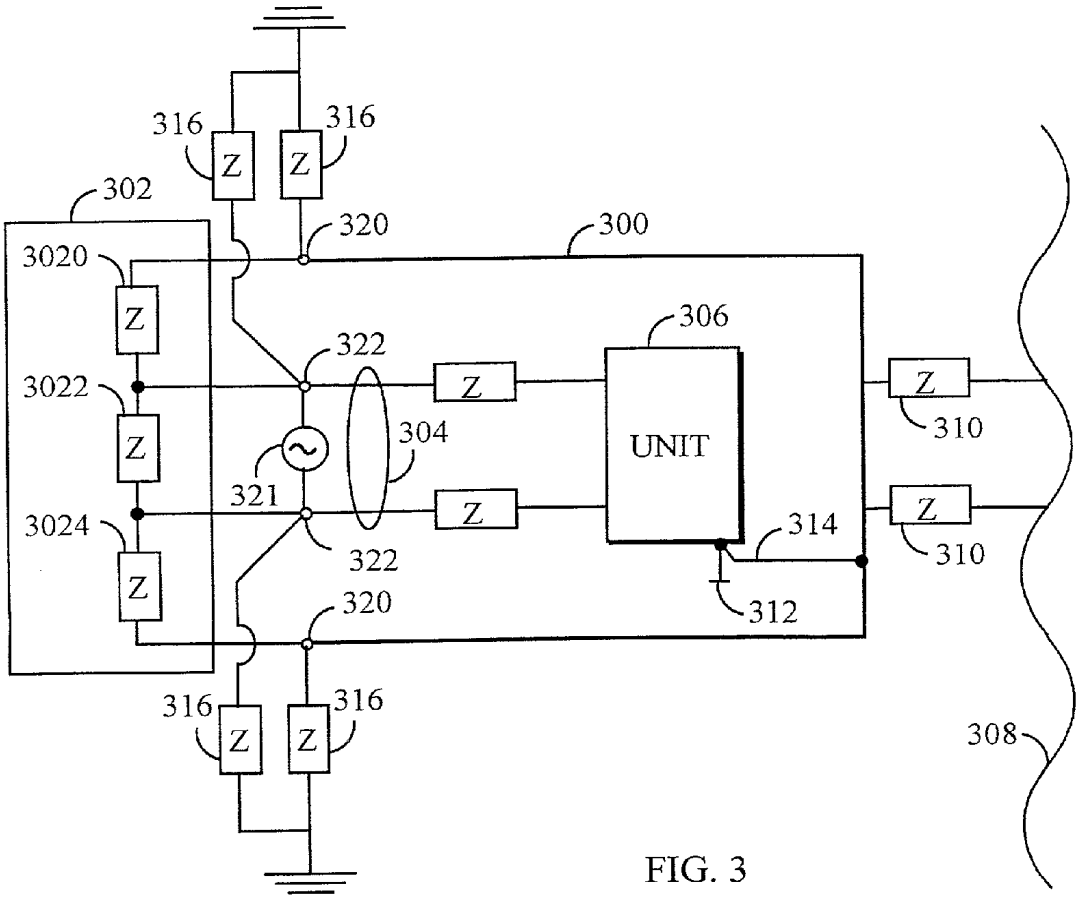

316
316
Z
Z
302
320
300
3020
Z
306
322
3022
Z
Z
304
UNIT
Z
310
321
Z
3024
Z
314
322
Z
310
320
312
316
316
Z
Z
308

FIG. 3

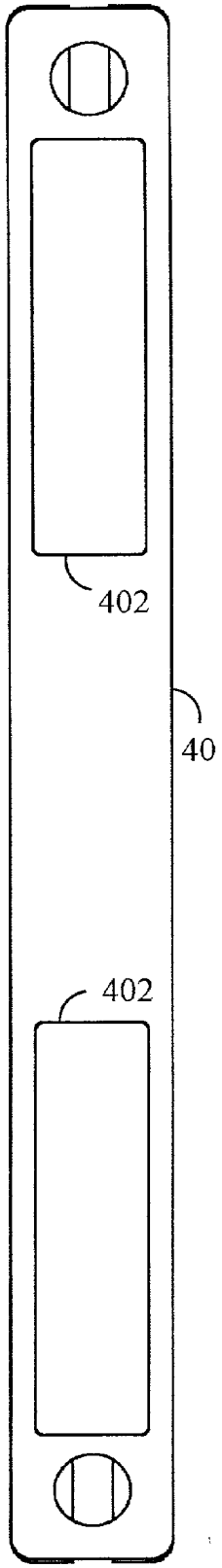


FIG. 4A

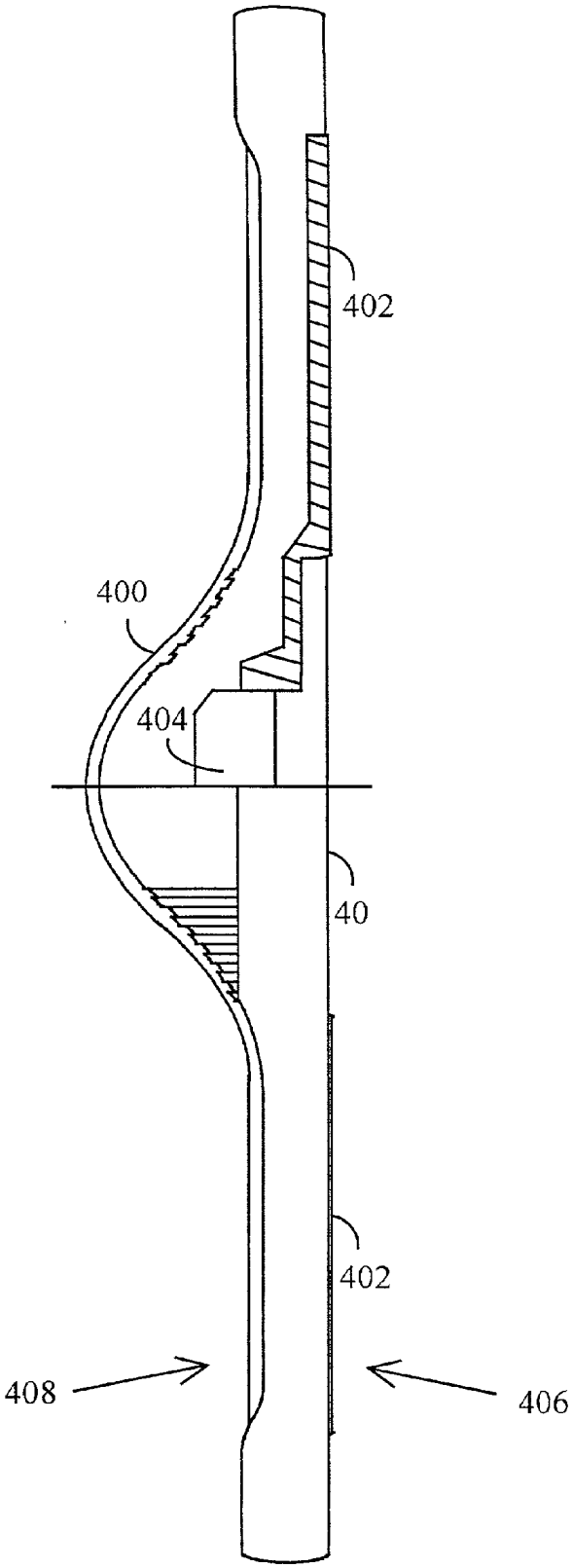


FIG. 4B

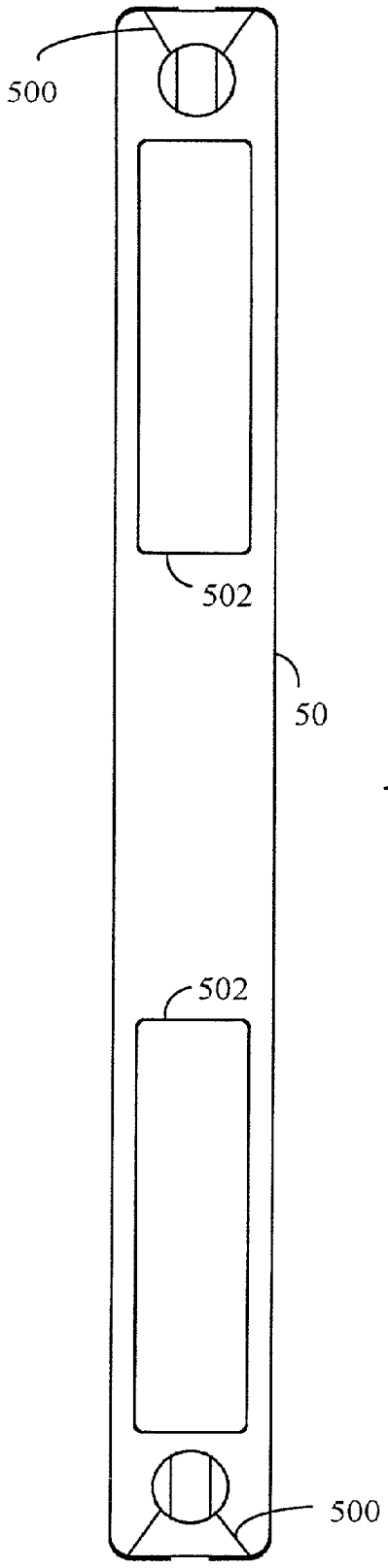


FIG. 5A

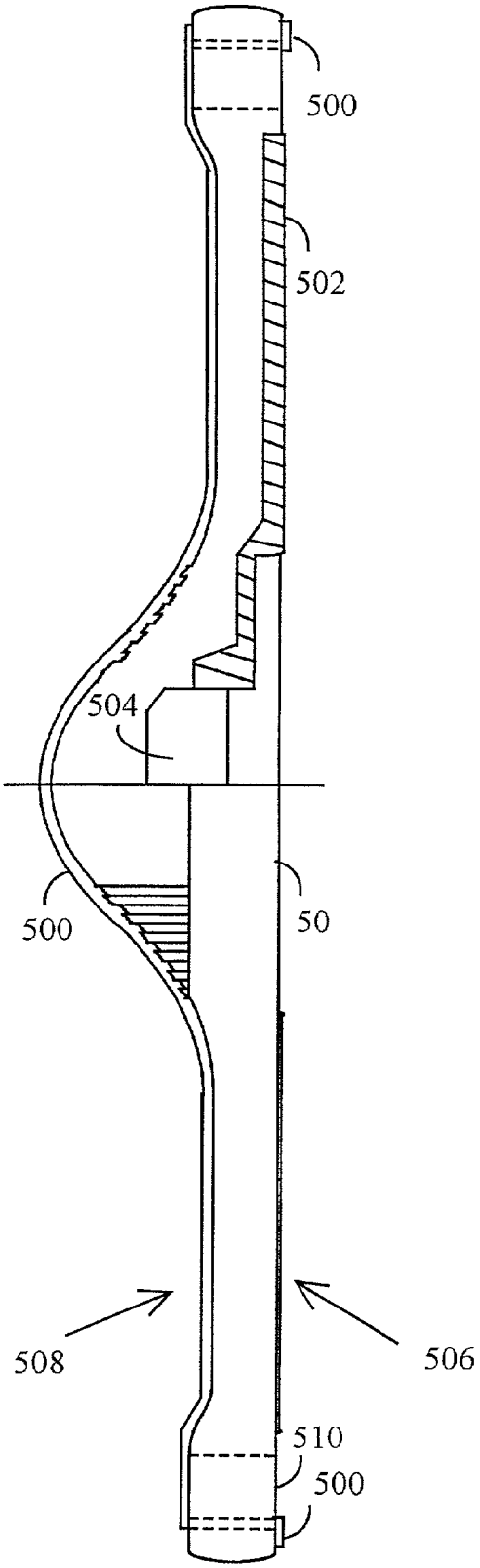


FIG. 5B

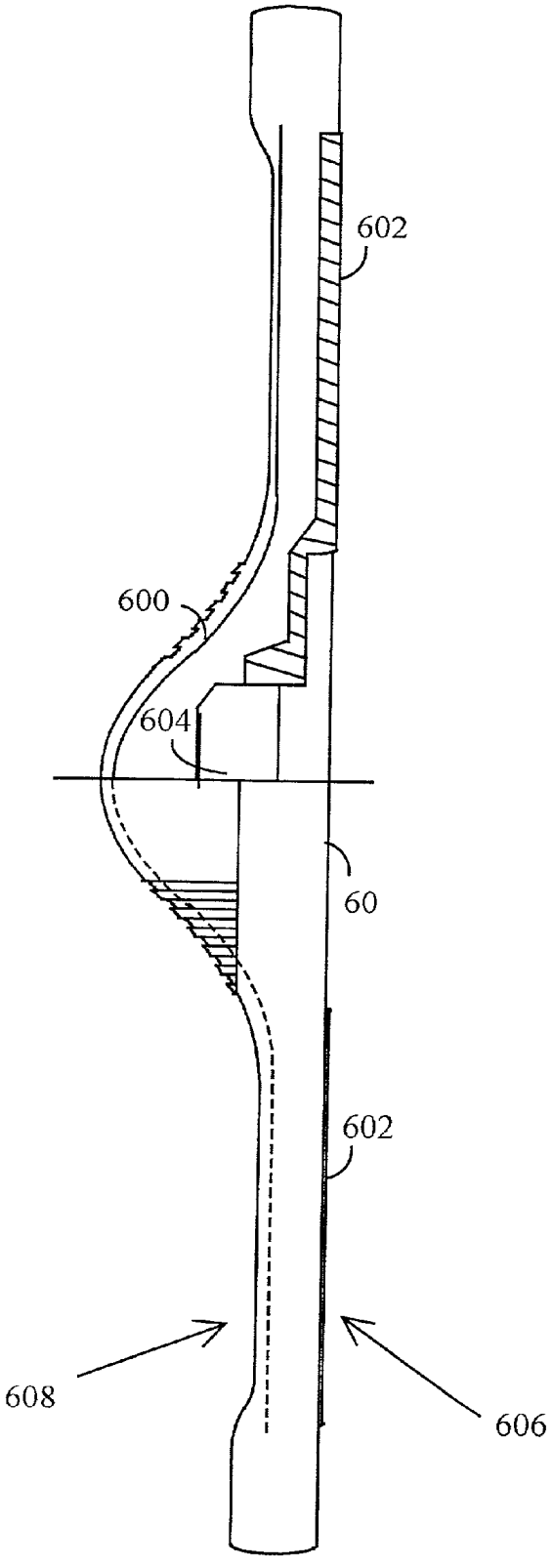


FIG. 6

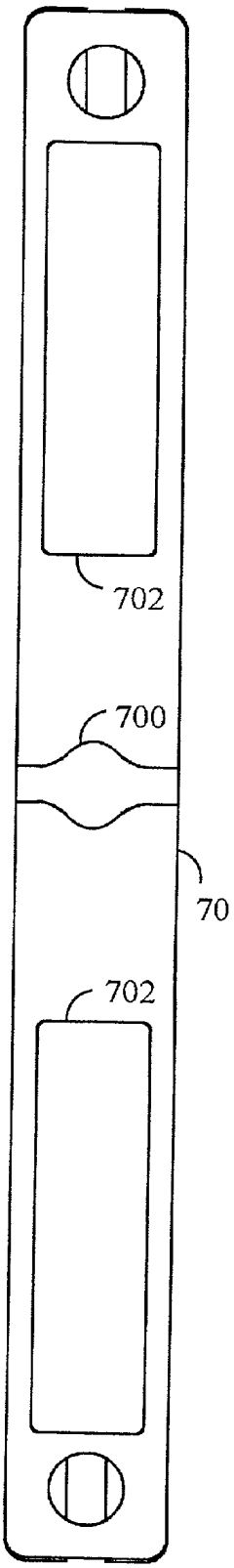


FIG. 7

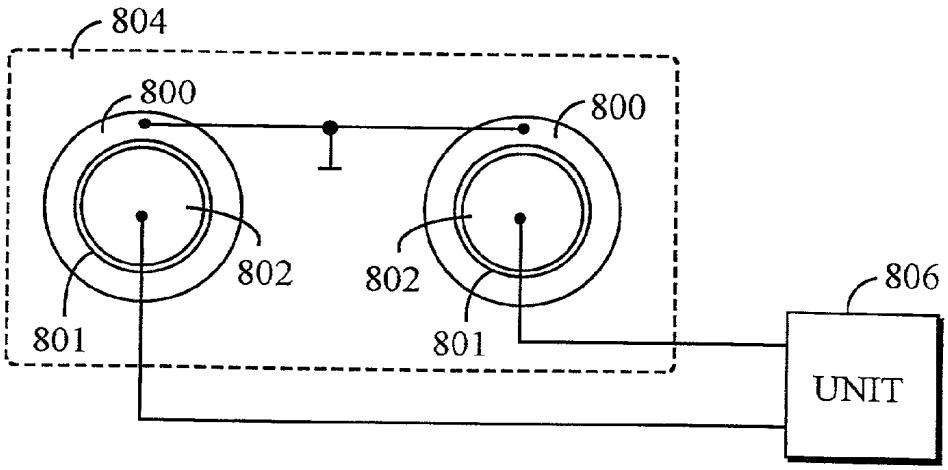


FIG. 8A

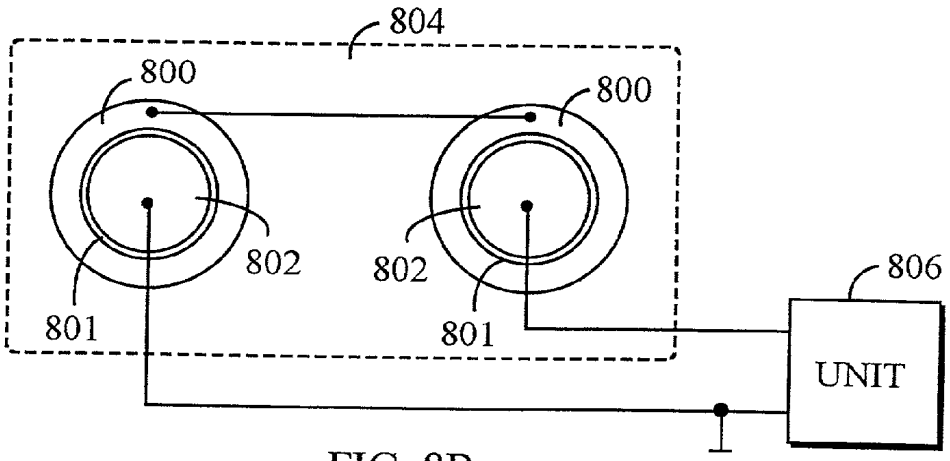


FIG. 8B

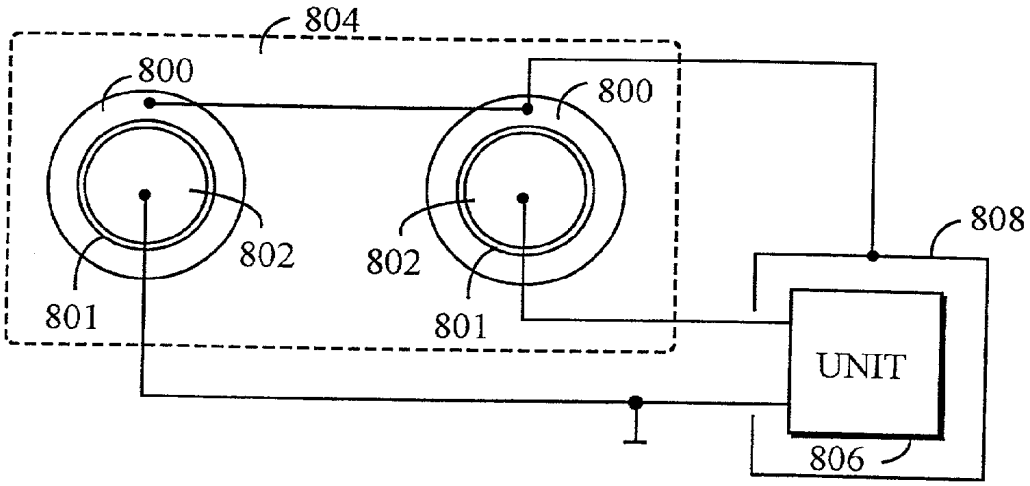


FIG. 8C

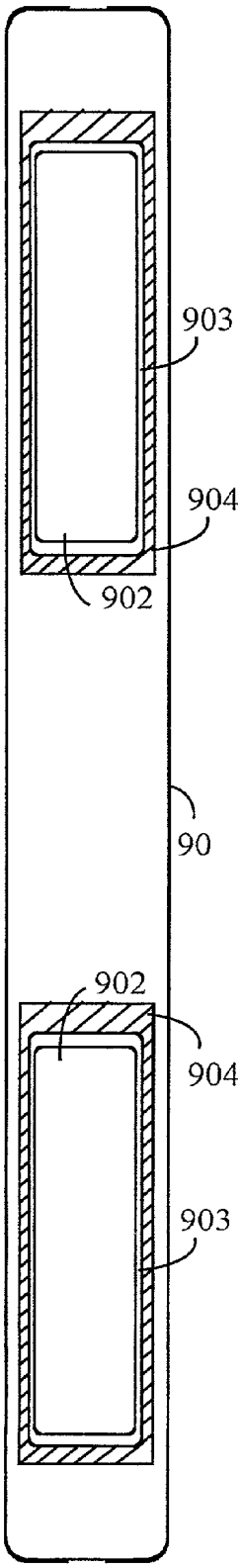


FIG. 9

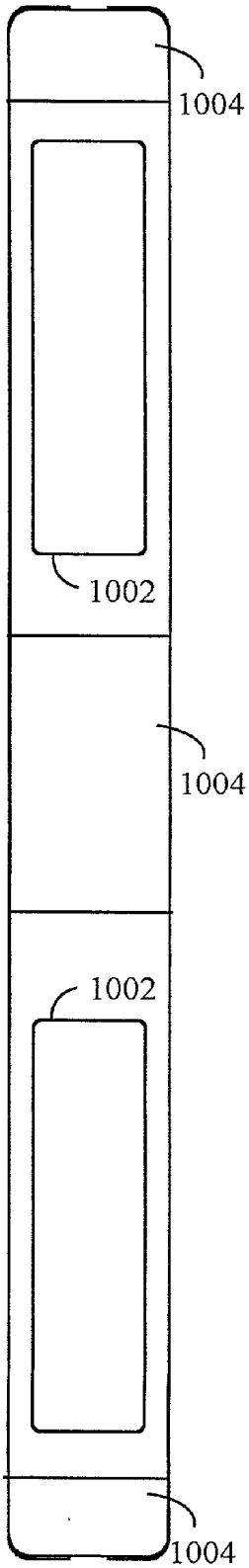


FIG. 10

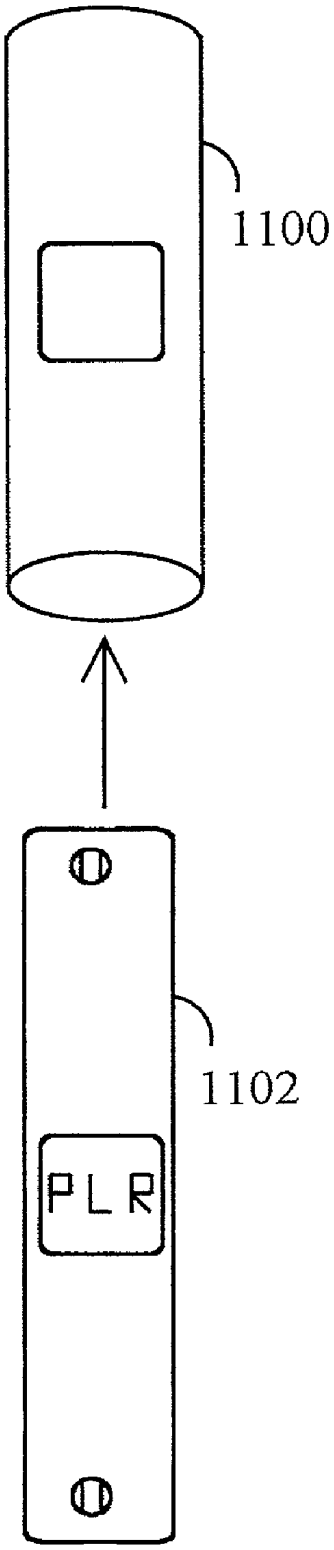


FIG. 11A

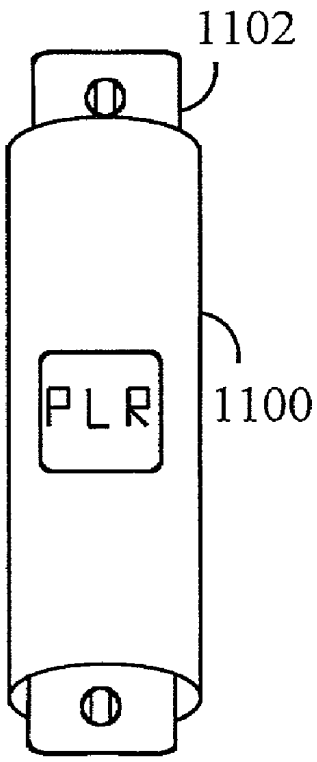


FIG. 11B

SCREEN

FIELD OF THE INVENTION

[0001] The invention relates to a screen which is particularly intended for a non-invasive functional unit measuring the function of at least one organ through skin contact, the functional unit comprising a supporting structure, an electrical circuit for operation, and electrodes for the skin contact, the electrodes being operatively coupled to the electrical circuit and mechanically attached to the supporting structure.

BACKGROUND OF THE INVENTION

[0002] Vital functions can be measured telemetrically using a non-invasive measuring device. An example of such a measuring device is, for example, a system which measures human heart rate and usually comprises as functional units a transmitter unit, a receiver unit and a data transfer unit. The transmitter unit refers to a transmitter unit equipped with electrodes and worn on the human body, particularly on the chest, the transmitter unit usually being implemented in the form of a transmitter belt attached around the body. The receiver unit refers for instance to a watch-like receiver unit which is worn on the wrist, the receiver unit having a telemetric or wired coupling with the transmitter unit. The data transfer unit transfers data received in the receiver unit to a computer, for example. The computer can also control the transmitter unit and the receiver unit via the data transfer unit.

[0003] Heart rate measurement is based on monitoring the function of the heart. When the heart contracts, it generates a series of electric impulses that can be measured in the body. The measurement and analysis of this signal is called electrocardiography (ECG). The signal itself is called an ECG signal. Different phases of the heart cycle can be discerned in the ECG signal. These are called P, Q, R, S, T and U waves.

[0004] The transmitter part located next to the body suffers from electromagnetic interference, and particularly from problems caused by static electricity. A typical problem situation occurs when a user exercises with a shirt on. When the user moves, the shirt moves, flapping against the user's body and the transmitter unit. Synthetic fiber textiles in particular that are poor at conducting electricity attract electric charges specifically in dry weather, at least before the user starts sweating. In terms of electrical engineering, a great amount of charge at random amplitude and at random frequency then moves in the vicinity of the transmitter unit. Such a random movement of a great amount of charge is capacitively coupled to the transmitter unit, interfering with its operation.

BRIEF DESCRIPTION OF THE INVENTION

[0005] An object of the invention is thus to provide a screen so as to solve the above problems caused by static electricity. This is achieved with a screen described in the introduction, the screen being characterized by being arranged to closely follow the electrode or the supporting structure at least at the electrode.

[0006] A plurality of advantages can be achieved by the screen of the invention. The screen prevents disturbance from being connected to the functional unit; hence, the operation of the functional unit becomes more reliable.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] The invention is now described in closer detail in connection with the preferred embodiments with reference to the accompanying drawings, in which

[0008] **FIG. 1A** shows an electric coupling of a screen when the screen is not connected to skin,

[0009] **FIG. 1B** shows the screen's electric coupling, which protects electrodes,

[0010] **FIG. 2** shows the electric coupling of the screen when the screen is connected to skin,

[0011] **FIG. 3** shows an example of an equivalent circuit,

[0012] **FIGS. 4A and 4B** show a transmitter unit when the screen is on the outer surface of the transmitter unit,

[0013] **FIGS. 5A and 5B** show the transmitter unit when the screen is on the outer surface of the transmitter unit and in contact with skin,

[0014] **FIG. 6** shows the transmitter unit with the screen located inside the coating material,

[0015] **FIG. 7** shows the transmitter unit with the screen coming into contact with skin between the electrodes,

[0016] **FIG. 8A** shows a protecting structure around the electrodes,

[0017] **FIG. 8B** shows the protecting structure around the electrodes,

[0018] **FIG. 8C** shows the protecting structure around the electrodes,

[0019] **FIG. 9** shows the protecting structure in the transmitter's belt-like supporting structure,

[0020] **FIG. 10** shows the protecting structure in the transmitter's belt-like supporting structure,

[0021] **FIG. 11A** shows a functional unit and the screen separately, and

[0022] **FIG. 11B** shows the functional unit inside the screen.

DETAILED DESCRIPTION OF THE INVENTION

[0023] The inventive solution is particularly suited for protecting a transmitter unit of a heart-rate-measurement system against electric interference, but a similar solution may also benefit other kind of devices.

[0024] Examine first an inventive solution by means of **FIG. 1A** showing a screen **100**, skin **102**, electrodes **104**, an electrical circuit **106** of a functional unit and a source **108** of disturbance. The functional unit is for example a transmitter unit of a system measuring the function of an organ of a user, the transmitter unit comprising the two electrodes **104**. The electrodes **104** have an electric and usually also galvanic contact with the skin **102**. The interference source **108** is for example a shirt or another piece of clothing the user is wearing. When the shirt moves on the user, the shirt becomes electrically charged. The charge tends to cause

interference to the operation of the electrical circuit **106** of the transmitter unit through capacitive and/or resistive coupling. In the inventive solution, such generation of interference can be prevented by using the screen **100** between the interference generator **108** and both the electrodes **104** and the electrical circuit **106**. Used as a protection of the electrodes **104** and the electrical circuit **106**, the screen **100**, which is preferably an electrically conductive material layer, reduces all types of electromagnetic interference being connected to the electrical circuit **106**. The electrodes **104** can be coupled to a signal earth via impedances Z_+ and Z_- which can be of different magnitude. Impedance Z_- of the two impedances can have a very low impedance.

[**0025**] **FIG. 1B** shows a solution similar to the one in **FIG. 1**A, with the exception that here the screen **100** only protects the electrodes **104**. Furthermore, in the inventive solution the electrical circuit **106** is protected with a unique screen **150**, which is preferably electrically coupled to the screen **100**.

[**0026**] **FIG. 2** shows an inventive solution wherein a screen **200** is electrically coupled to skin **202**. **FIG. 2** also encompasses electrodes **204**, a generator **208** of interference, and a signal earth **210** of an electrical circuit **206** of a transmitter unit. The screen **200** can preferably be electrically coupled also with a signal earth **210** by a conductor **212**, which can have impedance component Z; such a coupling is not, however, necessary for the invention. The electrodes **204** can also be coupled to the signal earth via impedances Z_+ and Z_-, which can be of different magnitude. Impedance Z_- of the two impedances can have a very low impedance. The signal earth **210** protects the operation of the circuit **206** against interference.

[**0027**] **FIG. 3** shows an equivalent circuit of the inventive solution. **FIG. 3** encompasses a screen **300**, skin **302**, electrodes **304**, an electrical circuit **306** of a transmitter unit, a generator **308** of interference, interference impedances **310**, a signal earth **312**, a conductor **314** from the signal earth **312** to the screen **300**, and an impedance **316**. Instead of only comprising the conductor **314**, the coupling can further be provided with an impedance, as in **FIG. 2**. The equivalent circuit of the skin **302** comprises impedances **3020**, **3022**, **3024**. Between the measuring electrodes **304** there is provided the impedance **3022**, over which voltage impulses are generated for example when heart rate is being measured. Heart rate typically provides the electrodes with an approximately 2 mV potential difference, which is presented by a signal source **321**. Correspondingly, the impedances **3020** and **3024** are located between the electrodes **304** and the skin contact of the screen **302**. This clearly shows that it may not be desirable to provide the skin contacts **320** of the screen **302** too near electrode contacts **322**, since a resistive coupling would then exist along the screen **300** between the contacts **322** of the electrodes **304**, the resistive coupling lowering the voltage caused for example by heartbeat to be measured. The impedances **310**, which typically are capacitances, represent the capacitive coupling caused by the shirt **308** generating the interference to the screen **300**. The screen **300** and the contacts **322** of the electrodes **304** are coupled to earth via impedances **316**. On the other hand, it is generally known that the resistance level is high and the coupling typically capacitive; hence, coupling is poor.

[**0028**] **FIGS. 4A and 4B** show a transmitter unit, which is coated with a screen. An electrical circuit **404** of the transmitter unit is preferably encased in a belt part to be attached around the chest. A belt-like encasement structure, which serves as a supporting structure **40**, is usually made of flexible, plastic-like material, which is not electrically conductive. On the belt-like transmitter unit's surface next to skin, which can be called a surface **406** with skin contact, there are provided electrodes **402**. The rest of the transmitter's surface is here defined as a surface **408** without skin contact. Hence, a screen **400** is preferably situated on the plastic encasement structure, being substantially located at the surface **408** without skin contact.

[**0029**] **FIGS. 5A and 5B** show an example of the inventive solution, wherein a screen **500** is electrically coupled to skin. Electrodes **502** are attached to a belt-like supporting structure **50**. Hence, the screen **500** substantially entirely covers a surface **508** without skin contact and continuously extends to a surface **506** with skin contact through an opening **510** in the belt-like supporting structure **50**. The point of the skin contact and the coverage of the screen **500** are not, however, highly relevant for the invention but they can be implemented in various ways.

[**0030**] **FIG. 6** shows an inventive solution wherein a screen **600** is located inside the material of a supporting structure **60** serving as the encasement. Naturally, the screen **600** is however located between an upper surface **608** without skin contact and an electrical circuit **604**. Furthermore, the screen **600** can come into contact with skin on a surface **606** with skin contact, as in the solutions of **FIGS. 5A and 5B**, although skin contact is not necessary for the inventive solution.

[**0031**] **FIG. 7** shows still another embodiment of skin contact in accordance with the inventive solution. The skin contact of a screen **700** on the surface of a supporting structure **70** is located between electrodes **702** on the skin contact surface. The size of the skin contact of the screen **700** is restricted by the fact that the screen must not short-circuit the skin contact zone between the electrodes **702**.

[**0032**] In capacity coupling, the electric field between electrodes and skin, in other words the affected zone associated with the electrodes, extends beyond the actual electrode zone, which causes changes that occur on the edge of the electrodes to affect a signal to be measured. Such interference is generated for example when the belt-like functional unit moves up and down during exercise such as jumping. **FIG. 8A** shows an inventive solution wherein electrodes **802** are enveloped with a protecting structure **800** which belongs to the inventive screen (in FIGS. **1** to **7** the screen **100**, **200**, **300**, **400**, **500**, **600**, **700**), the protecting structure reducing interference generated in connection with jumping, for example. The protecting structures of the electrodes **802** are electrically coupled to each other and earthed for instance to the protective earth of the functional unit. It is usually preferable to separate the protecting structure **800** from the electrode **802** by an isolating material layer **801**, marked with a bold line. During use, the electrodes **802** come into contact with skin **804**. The protecting structure **800** is also coupled to the skin, the protecting structure **800** thus forming a joint potential with the skin **804**. The signals of the electrodes **802** propagate to an

electrical circuit **806** of the functional unit. **FIG. 8B** presents a similar solution to the one in **FIG. 8**A, with the exception that instead of the protecting structure **800**, the earthing has been performed to the other input pole of the electrical circuit **806**. Also in **FIG. 8C** earthing has been performed to the input pole of the electrical circuit **806**. Furthermore, the protecting structure **800** is electrically coupled to a unique screen **808** of the electrical circuit **806**. The protecting structure **800** can also be electrically coupled to the screen **100, 200, 300, 400, 500, 600, 700** shown in FIGS. **1** to **7** (not shown in **FIGS. 8A** to **10**).

[**0033**] **FIG. 9** shows how a protecting structure **904** is positioned around an electrode **902** when the functional unit is for instance a belt-like transmitter unit to be attached around the chest. In the present solution, the protecting structure **904** winds around the electrode **902** and the protecting structure **904** is also in this case preferably electrically separated from the electrode **902** by an isolating material layer **903**, marked with a bold line. In **FIG. 10, a** protecting structure **1004** is a separate zone in the vicinity of electrodes **1002**. The protecting structure **1004** can extend to the side without skin contact of the supporting structure of the belt-like functional unit.

[**0034**] In the solution of the invention, the screen can also be a completely attachable, detachable and separate structure in relation to the functional unit. In such a case, the screen can be placed on the functional unit, if desired. **FIG. 11A** shows one example of a detachable and attachable screen, which can be implemented in various ways. In **FIG. 11A, a** functional unit **1102** and a screen **1100** are separate. The screen **1100** has openings for electrodes. The functional unit **1102** can for example be inserted in the screen **1100** or placed on the belt structure. **FIG. 11B** shows a situation wherein the functional unit **1102** is inserted in the screen **1100**.

[**0035**] The screen of the invention, intended particularly for protecting the electrodes, can be made of conductive polymer, metal or conductive compound plastic comprising electrically non-conductive plastic and electrically conductive material. The screen can be a separate sheet or a layer on or in the coating material of the functional unit. The coating material itself can also be conductive, in which case the conductivity should be sufficiently low in order not to disturb the operation of the electrical circuit by decreasing the signal to be measured. If a sheet-like screen is used, the sheet resistance of the sheet should be sufficiently low in order to accomplish the protecting effect, but sufficiently high for the signal not to decrease due to short circuit when the protection is coupled from two or more points in the vicinity of the electrodes.

[**0036**] Although the invention is described above with reference to the examples in accordance with the accompanying drawings, it is obvious that the invention is not restricted thereto but the invention can be modified in many ways within the scope of the inventive idea disclosed in the attached claims.

1. A screen which is particularly intended for a non-invasive functional unit measuring the function of at least one organ through skin contact, the functional unit comprising a supporting structure, an electrical circuit for operation, and electrodes for the skin contact, the electrodes being operatively coupled to the electrical circuit and mechanically attached to the supporting structure, wherein the screen is arranged to closely follow the electrode or the supporting structure at least at the electrode.

2. A screen as claimed in claim 1, wherein the screen is made of electrically conductive material and the electrodes being substantially located between the screen and skin.

3. A screen as claimed in claim 1, wherein the electrical circuit of the functional unit and the electrodes are protected against disturbance by the screen such that the electrical circuit and the electrodes are both located between the screen and the skin.

4. A screen as claimed in claim 1, wherein the electrical circuit is protected by a unique screen.

5. A screen as claimed in claim 1, wherein the electrical circuit is protected by the unique screen, which is electrically coupled particularly to the screen protecting the electrodes.

6. A screen as claimed in claim 4 or **5**, wherein a protecting structure which belongs to the screen is provided around the electrode, the protecting structure being electrically coupled to the unique screen of the functional unit.

7. A screen as claimed in claim 1, wherein the protecting structure which belongs to the screen is provided around the electrode.

8. A screen as claimed in claim 7, wherein the protecting structure is electrically separated from the supporting structure and the electrodes.

9. A screen as claimed in claim 7, wherein the protecting structure is electrically coupled to the protecting structure of the second electrode.

10. A screen as claimed in claim 7, wherein the protecting structure is electrically coupled to the skin.

11. A screen as claimed in claim 7, wherein the protecting structure is electrically coupled to the screen.

12. A screen as claimed in claim 7, wherein the protecting structure is coupled to the protective earth of the functional unit.

13. A screen as claimed in claim 7, wherein the protecting structure is made of the same material as the supporting structure of the transmitter.

14. A screen as claimed in claim 7, wherein the protecting structure is of electrically conductive plastic, metal or the like.

15. A screen as claimed in claim 1, wherein the screen is electrically isolated from the skin.

16. A screen as claimed in claim 1, wherein the screen is electrically coupled to the skin.

17. A screen as claimed in claim 1, wherein the surface of the functional unit comprises two parts: a surface with skin contact, which is placed next to the skin, and a surface without skin contact, which is any other surface of the functional unit than the surface against the skin, and the screen is also arranged to extend to the functional unit surface with skin contact, generating the galvanic contact of the skin and the screen.

18. A screen as claimed in claim 1, wherein the screen is a separate sheet or structure on the surface of the coating structure isolating the functional unit.

19. A screen as claimed in claim 1, wherein the screen is at least partly the coating structure of the functional unit, the coating structure being isolated from the electrical circuit and the electrodes.

20. A screen as claimed in claim 1, wherein the conductivity of the screen is substantially lower than the conductivity of the electrodes.

21. A screen as claimed in claim 1 or **20**, wherein the screen has more than one skin contacts.

22. A screen as claimed in claim 1, wherein the screen is made of metal, conductive polymer and/or compound plastic.

23. A screen as claimed in claim 1, wherein the screen is a separate sheet inside the coating structure of the functional unit.

24. A screen as claimed in claim 1, wherein the screen has skin contact between the electrodes.

25. A screen as claimed in claim 1, wherein the screen is electrically coupled to a signal earth of the electrical circuit.

26. A screen as claimed in claim 1, wherein the screen is separated from the operation of the functional unit's electrical circuit and the electrodes. cm **27**. A screen as claimed in claim 1, wherein the screen is a separate, attachable and detachable structure in relation to the functional unit.

* * * * *

专利名称(译)	屏幕		
公开(公告)号	US20020026112A1	公开(公告)日	2002-02-28
申请号	US09/978961	申请日	2001-10-17
[标]申请(专利权)人(译)	NISSILA雪峰 KINNUNEN哈努 RYTKY PEKKA BAUMANN让·皮埃尔·		
申请(专利权)人(译)	NISSILA雪峰 KINNUNEN哈努 RYTKY PEKKA BAUMANN JEAN-PIERRE		
当前申请(专利权)人(译)	Polar Electro Oy公司		
[标]发明人	NISSILA SEPPO KINNUNEN HANNU RYTKY PEKKA BAUMANN JEAN PIERRE		
发明人	NISSILA, SEPPO KINNUNEN, HANNU RYTKY, PEKKA BAUMANN, JEAN-PIERRE		
IPC分类号	A61B5/00 A61B5/024 A61B5/0245 A61B5/0408		
CPC分类号	A61B5/0006 A61B5/02438 A61B5/0245 A61B5/0408 A61B5/6831 A61B2562/182 Y10S128/903		
优先权	1998001436 1998-06-22 FI		
其他公开文献	US6600942		
外部链接	Espacenet USPTO		

摘要(译)

屏幕（300）技术领域本发明涉及一种屏幕（300），其特别用于测量来自使用者胸部的心率的功能单元。功能单元的电极（304）并且优选地还有电路（306）被屏幕（300）保护免受体外干扰，屏幕（300）紧密跟随电极（304）或支撑结构（40,50,60,70）至少在电极（104,204,304,402,502,602,702）处。