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PORTABLE ELECTROCARDIOGRAPH

(57) Described herein is a portable electrocardiograph (20), suitable for being hung round the neck of a patient (10) and comprising a central body (22), a plurality of connectors (24) and an electronic unit (26). Each one of the connectors (24₁, 24₂...) is suitable for being associated to a respective electrode (242₁, 242₂...) applied on the chest (12) of the patient for detecting respective electric signals. Each one of the connectors is suitable for receiving the electric signals detected by the respective electrode and for transmitting the electric signals to the electronic unit. The central body comprises a rear surface (220), facing the patient when the electrocardiograph is in use. At least one of the connectors (24_n) is

mounted in a fixed manner on the rear surface of the central body. Each one of the other connectors (24₁, 24₂...) is connected to the central body by means of a respective wire (240₁, 240₂...) which can be wound and unwound. The central body comprises winding/unwinding means (28) suitable for allowing each wire to be unwound independently from the other wires and for allowing each wire to be wound. The electronic unit is configured for receiving the signals from the connectors and for transmitting them to an electronic device (40) external to the electrocardiograph. The invention also relates to an assembly (60) comprising the electrocardiograph and the external electronic device.

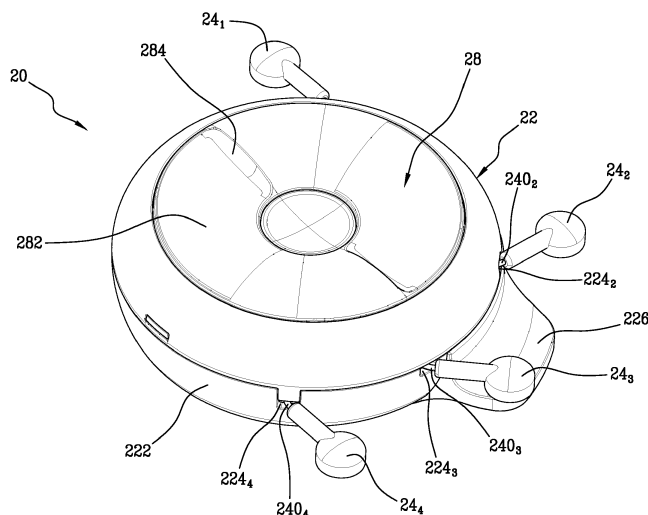


Fig.1

Description

[0001] The present invention relates to a portable electrocardiograph, in particular an electrocardiograph suitable for cooperating with an external electronic device.

[0002] Among the different known systems to observe a patient's cardiac activity, the electrocardiogram is the most widespread and cost-effective method. This technique is based on the fact that activity in the heart leads to the generation of electric potential differences, which vary in space and time, and which can be recorded by means of electrodes placed on the surface of the patient's body.

[0003] The known electrocardiographs comprise a central unit, a user interface and a series of electrodes that can reach up to ten. The central unit receives the electric signals detected by the electrodes and processes them in order to produce the electrocardiogram trace.

[0004] Typically, the user interface comprises a module for entering the commands and the patient's parameters (for example a keyboard) and a module for displaying the results (for example a monitor and/or a printer). Electrocardiographs of the known type are relatively bulky devices, predominantly intended for use in a fixed location, for example in an outpatient department.

[0005] Moreover, known electrocardiographs are professional devices, the use of which is reserved to qualified personnel working in the outpatient department.

[0006] Such known systems, though widely appreciated, are not without any drawbacks.

[0007] For example, because electrocardiographs are intended for use in a fixed location, they usually require to be powered via the power supply network. This means that most known electrocardiographs cannot be used outdoors or in areas where power supply is not reliable, such as in rural areas of emerging and developing countries.

[0008] Other drawbacks derive precisely from the fact that known electrocardiographs are intended for professional use. This particular intended use has in fact implied that there has never been a real need to simplify their use. Typically, the management of the complete set of electrodes is rather complex, both as regards the correct positioning of the individual electrodes on the patient, and as regards the handling of the set of wires and electrodes.

[0009] The electrodes, whose number can reach up to ten, are connected to the central unit by cable. Each electrode must be positioned at a specific point of the patient's chest and, since each patient has a different chest shape, this operation is rather complex.

[0010] In order to avoid inverting the electrodes with each other, a presently adopted solution is differentiating their colours in order to distinguish them. This expedient, however, does not completely solve the problem, because in some cases it is ineffective, for example if the operator is colour blind and/or operates in a poorly lit environment. This second hypothesis is rather frequent,

especially in areas where there is no stable power supply. As regards the positioning of the electrodes, a solution is proposed in the patent publication WO 2016/207745, in the name of the same Applicant. As regards the manipulation of the electrodes, the problem that is briefly described below remains unresolved.

[0011] Usually from the central unit, by means of a special multipolar connector, a single cable departs, containing the wires of each electrode. At a suitable distance from the central unit, the cable is divided into the individual wires, each one dedicated to a single electrode. The length of the individual wires must be defined keeping in mind the greatest possible distance that may be necessary in use. The measures of the wires are therefore determined on the basis of the anthropometric measurements of patients of high stature and with a wide chest, although they represent a very small percentage. What results is a bundle of rather long and numerous wires, which is therefore subject to the easy formation of tangles.

[0012] The possibility, not rare, that a tangle of wires is created lengthens the time necessary to carry out a single electrocardiogram and therefore potentially lengthens the time necessary to obtain a diagnosis. Wire tangles also imply a greater risk of inversion of the electrodes, with consequent alteration of the electrocardiogram.

[0013] Moreover, the cable, complete with the whole bundle of wires and electrodes, is rather bulky on the whole, and can be disconnected from the electrocardiograph at the end of use. It is not uncommon for the electrocardiograph and the cable to be stored in different places, for example because the electrodes must be cleaned. In this case, therefore, when a new electrocardiogram has to be performed, a technical time is required to re-assemble the electrocardiograph and the respective electrodes. This technical time could constitute a problem in the case of an emergency.

[0014] The separate handling of the cable and the electrode wire bundle increases the risk of the latter becoming dirty and/or prematurely worn. Finally, professional electrocardiographs have a relatively high cost that precludes their private use, even beyond the considerations made above on their difficulty of use.

[0015] Therefore, the object of the present invention is to overcome the drawbacks highlighted above with respect to the prior art.

[0016] In particular, a task of the present invention is to make available a portable electrocardiograph which is light and has a low cost.

[0017] Moreover, a task of the present invention is that of making available an electrocardiograph which can be easily used by anyone, even without the aid of qualified personnel for positioning the electrodes on the chest.

[0018] Furthermore, a task of the present invention is to make available an electrocardiograph which can be used anywhere, even in the absence of a power supply network.

[0019] Finally, a task of the present invention is to make available an electrocardiograph which is always operative in a short time.

[0020] This object and these tasks are achieved by a portable electrocardiograph according to claim 1 and by its preferred embodiments described in the dependent claims 2 to 10. Further advantages are obtained through an assembly for acquiring an electrocardiogram according to claim 11.

[0021] To better understand the invention and appreciate its advantages, some of its exemplifying and non-limiting embodiments are described below with reference to the accompanying drawings, wherein:

- Figure 1 shows a first perspective view of an electrocardiograph according to an embodiment of the invention;
- Figure 2 shows a second perspective view of the electrocardiograph of Figure 1;
- Figure 3 shows a front view of the electrocardiograph of Figure 1;
- Figure 4 shows a sectional view according to the line IV-IV of Figure 3;
- Figure 5 shows a cross-sectional view according to the line V-V of Figure 3;
- Figure 6 shows a view of the section made along the line VI-VI of Figure 4; and
- Figure 7 schematically shows an assembly for the acquisition of an electrocardiogram comprising an electrocardiograph according to an embodiment of the invention, during use.

[0022] In the context of the present discussion, some conventions have been adopted in order to make reading easier and smoother. These terminological conventions are clarified below with reference to the attached figures. When referring to the electrocardiograph in use it is intended that it is used correctly in order to obtain a significant electrocardiogram of the patient's cardiac activity.

[0023] In particular, according to some embodiments of the invention, it is understood that in use the electrocardiograph is hung round the neck of the patient, as can be seen schematically in Figure 7. In particular, it is understood that, according to the correct position of use, the terms "ahead", "forward", "front", and the like, with respect to the terms "behind", "backward", "rear", and the like, are defined unequivocally.

[0024] Analogously it is meant that, with respect to the patient 10, the terms "high", "higher", "above" and the like, with respect to the terms "low", "lower", "below" and the like are defined unequivocally.

[0025] In the particular embodiment shown in the accompanying figures, a rotation axis X is defined. Hereinafter, the term "axial" means the direction of any straight line parallel to the rotation axis X; the term "radial" means the direction of any half-line having its origin on the rotation axis X and perpendicular thereto; the term "circumferential" means the direction of any circumference hav-

ing a centre on the rotation axis X and lying in a plane perpendicular to it.

[0026] The invention relates to a portable electrocardiograph, indicated as a whole with 20, and suitable for being hung round the neck of a patient 10, for example by means of a band 18.

[0027] The electrocardiograph 20 comprises a central body 22, a plurality of connectors 24 and an electronic unit 26.

[0028] In the electrocardiograph 20:

- each one of the connectors 241, 242... is suitable for being associated to a respective electrode 2421, 2422... applied on the chest 12 of the patient 10 for detecting respective electric signals;
- each one of the connectors 241, 242... is suitable for receiving the electric signals detected by the respective electrode 2421, 2422... and for transmitting the electric signals to the electronic unit 26;
- the central body 22 comprises a rear surface 220, facing the chest 12 of the patient 10 when the electrocardiograph 20 is in use;
- at least one of the connectors 24n is mounted in a fixed manner on the rear surface 220 of the central body 22;
- each one of the other connectors 241, 242 is connected to the central body 22 by means of a respective wire 2401, 2402 which can be wound and unwound;
- the central body 22 comprises winding/unwinding means 28 suitable for allowing each wire 2401 to be unwound independently from the other wires 2402, and for allowing each wire 2401 to be wound;
- the electronic unit 26 is configured to receive the signals from the connectors 24 and to transmit them to an electronic device 40 external to the electrocardiograph.

[0029] Above and below, the reference 24 indicates the plurality of connectors as a whole, while the references 241, 242... 24n indicate the individual connectors when it is necessary to distinguish them from each other. A similar use is made with the numerical references relating to components that are present in the electrocardiograph 20 in a plurality of specimens.

[0030] In a known manner, the connectors 24 are suitable for being associated with respective electrodes 242 applied to the chest 12 of the patient 10 to detect the electric signals generated by the myocardium. The electrodes 242 can assume different embodiments known in themselves. They are preferably disposable and can be applied to the patient's skin so that they remain stable during signal detection. The electrodes 242 can for example be applied by means of an adhesive layer and/or by means of a suction cup.

[0031] The connectors 24 are also suitable to receive the electric signals detected by the respective electrodes 242 and to transmit these electric signals to the electronic

unit 26, in order to obtain the real electrocardiographic trace. The electrodes 242 and the respective connectors 24 may be present in different numbers, depending on the technique used to detect the electric signals generated by the myocardium of the patient 10. According to the embodiment shown in the attached figures, the electrodes 242 and the respective connectors 24 are six. As can be seen in particular in Figure 2, two connectors (denoted by 245 and 246) are fixedly mounted on the rear surface 220 of the central body 22, while each of the other four connectors (denoted by 241, 242, 243, 244) is connected to the central body 22 by means of a respective wire (2401, 2402, 2403, 2404) which can be wound and unwound.

[0032] At least one connector 24n is mounted in a fixed manner on the rear surface 220 of the central body 22. Said connector 24n is arranged in such a way that, when the electrocardiograph 20 is correctly hung round the neck of the patient 10, it is automatically positioned in the correct position for the respective electrode 242n in order to detect the signals. This technical feature is particularly advantageous when the connectors mounted in a fixed manner on the rear surface 220 of the central body 22 are two: the connectors 245 and 246. In this case, in fact, when the electrocardiograph 20 is correctly hung round the neck of the patient 10, both connectors 245 and 246 and the respective electrodes 2425 and 2426 automatically are placed in the correct position for signal detection, simplifying considerably the step of positioning the electrodes 242 on the chest 12 of the patient 10.

[0033] As mentioned above, the winding/unwinding means 28 are suitable for allowing the unwinding of each wire 2401 completely independently of the other wires 2402, 2403... This feature makes it possible to unwind a single wire for a desired length, regardless of the fact that the other wires are unwound or not and possibly of how much they are unwound.

[0034] In accordance with the embodiments shown in the attached figures, in particular in the sections of Figures 4 and 5, the winding and/or unwinding means 28 comprise a plurality of drums 280, each of which is rotatably mounted inside the central body 22. In Figures 4 and 5, the wires 240 and other components of the electronic unit 26 have been removed to show more clearly the structure of the winding and/or unwinding means 28. Each of the drums 2801 is associated with a single wire 2401 so that, when the drum 2801 rotates in the central body 22, it allows the unwinding or winding of the respective wire 2401. In particular, each drum 2801 can rotate in a first unwinding direction of the respective wire 2401 or, alternatively, in a second, contrary to the first, winding direction of the respective wire 2401. Preferably, therefore, the different drums 280 can rotate independently of one another in the unwinding direction of the wire 240.

[0035] In the embodiment of the invention illustrated in the attached figures (see in particular the sections of Figure 4 and Figure 5), all the drums 280 share a single

rotation axis X. In other embodiments, by virtue of other specific requirements, the drums 280 may have different rotational axes. Preferably, the winding/unwinding means 28 are suitable for allowing all the wires 240 to be wound at the same time. In this way, it is possible for the user to rewind all the wires 240 with a single action. According to some embodiments, the winding and/or unwinding means 28 comprise a device suitable for rotating all the drums 280 simultaneously in the winding direction.

[0036] The device for rotating the drums 280 in the winding direction can be advantageously operated by means of a crown 282 to be rotated manually. Preferably, the crown 282 is shaped in such a way as to allow an effective support of the user's fingers for rotation only in the winding direction of the wires 240. According to the embodiment shown in the accompanying figures, the crown 282 comprises two thrust surfaces 284 which exit the prevailing development plane of the crown 282 and develop in the direction parallel to the rotation axis X. The two thrust surfaces 284 allow the user to easily apply a torque to the crown 282 in the winding direction of the wires 240. At the same time, the crown 282 does not provide an equally convenient support for rotation in the opposite unwinding direction of the wires 240. In fact, the differences in height introduced by the two thrust surfaces 284 are connected by as many ramps which extend with minimum slope for a very wide arch of the crown 282 itself. In accordance with the embodiment of the invention shown in the figures, the unwinding of the wires 240 occurs by directly pulling each individual wire.

[0037] In addition or as an alternative to the crown 282, the device for rotating the drums 280 in the winding direction may comprise elastic means which are loaded with the rotation of the drums 280 in the unwinding direction.

[0038] In a preferable embodiment of the invention, the different drums 280 are at least partially constrained to each other when they rotate in the winding direction of the wires 240. In particular, it is preferable that each drum 2801 rotates together with all the other drums 2802, 2803... until the respective wires 2401 are completely wound.

[0039] Since the unwinding length of each individual wire 2401 may be decided independently of that of the other wires 2402, 2403..., it is preferable that the rotation in the winding direction of the different drums 280 is only partially constrained.

[0040] In particular, in the embodiment shown in the attached figures, this functionality is obtained in the manner described below.

[0041] Each drum 2801 has a diameter such that the respective wire 2401 can be completely wound in less than one revolution of the drum 2801 itself. In other words, the wire 2401 may extend from the central body 22 for a maximum length included within the circumference of the respective drum 2801. In this way all the wires 240 can be completely rewound with a maximum of one revolution of the crown 282.

[0042] As can be seen in particular in the sections of Figures 5 and 6, the crown 282 comprises, inside the central body 22, a finger 286 which extends parallel to the rotation axis X. Furthermore, the drums 280 each comprise a block 288 extending radially inwardly towards the rotation axis X. The finger 286 of the crown 282 is shaped so as to come into contact in a circumferential direction with the blocks 288 of the drums 280 when the crown 282 rotates.

[0043] When the user pulls a first wire 2401, the first drum 2801 rotates in the unwinding direction and the relative block 2881 pushes on the finger 286 also rotating the crown 282. When the user pulls a second wire 2402 the second drum 2802 also rotates in the unwinding direction but the relative block 2882 does not push, at least initially, on the finger 286 because this has already been moved circumferentially by the first block 2881. The second block 2882 starts to push on the finger 286 only if the rotation imposed on the second drum 2802 is greater than the rotation previously imposed on the first drum 2801. Analogously, it happens with all the wires 240 that are gradually unwound by the user. Therefore, at the end of the unwinding step of the wires 240, the crown 282 will have undergone a rotation equal to the greater rotation between those imposed by the user to the different drums 280. In order to wind the wires, the user acts on the crown 282, for example by means of the thrust surfaces 284, by making it rotate in the winding direction. While the crown 282 rotates, the finger 286 pushes onto the various blocks 288 which it meets gradually, in turn rotating the respective drums 280 in the winding direction. Therefore, the finger 286 begins to push on the drum block which had undergone the major rotation during the unwinding step, and then gradually pushes over the other blocks it encounters. When the finger 286 encounters the drum block that had undergone the minor rotation, all the blocks 288 are aligned and thereafter, until the wires 240 are completely wound, all the drums 280 rotate together.

[0044] Preferably, the wires 240 are connected to the electronic unit 26 by means of a fixed coupling. To achieve this, in the embodiment shown in the figures, the electronic unit 26 is arranged radially inside the drums 280. Each of the wires 240 comprises a fixed end on the electronic unit 26 and then extends up to radially cross the wall of the respective drum 280. Preferably each wire 240 passes through the wall of the respective drum 280 at the block 288. As can be seen, for example, in the section of Figure 6, the block 288 can advantageously comprise a labyrinth suitable for blocking the wire 240 with respect to the wall of the drum 280. In this way, the length of the portion of wire 240 radially external to the drum 280 and the length of the portion of wire radially internal to the drum 280 are definitively established.

[0045] The portion of wire 240 radially external to the drum 280 is that which is destined to be alternately wound on the drum itself and unwound by the drum itself. Its length must be sufficient for the connector 24 to always

reach the respective correctly positioned electrode 24, whatever the size and shape of the chest 12 of the patient 10.

[0046] The portion of wire 240 radially internal to the drum 280 extends partially in a radial direction (near the drum 280) and partially in an axial direction (near the electronic unit 26). Since the drum 280 rotates in the central body 22, while the electronic unit 26 is fixed with respect to the central body 22, the portion of wire 240 radially internal to the drum 280 must be sufficiently long to absorb the deformations imposed by the rotation of the drum 280 itself without undergoing damage.

[0047] The solution described above allows to obtain the whole electrocardiographic acquisition system without any sliding contact. The sliding contacts are indeed rather delicate because they are structurally exposed to wear and to the formation of oxides and dirt. For these reasons, sliding contacts are often the cause of malfunctions.

[0048] Preferably the winding/unwinding means 28 wind the wires 240 inside the central body 22. In other words, when the wires 240 are completely wound, preferably they are not reachable from the outside and remain protected inside the central body 22.

[0049] Advantageously, the central body 22 comprises a plurality of openings 224 and each of the wires 2401, 2402... passes through a respective opening 2241, 2242... of the central body 22: in this way, keeping the wires 240 wound inside of the central body 22 and making them slide in the respective openings 224, it is prevented that dirt or foreign bodies may interfere in the winding and unwinding steps of the wires 224.

[0050] The fact that each wire 2401 slides in a respective opening 2241 allows it to be managed separately from the other wires 2242, 2243..., thus preventing them from becoming entangled.

[0051] In the embodiments shown in the accompanying figures, the central body 22 of the electrocardiograph 20 further comprises a side wall 222. Preferably the openings 224, through which the wires 240 connecting the connectors 24 pass, are located on the side wall 222 of the central body 22.

[0052] Preferably the openings 2241, 2242..., through which the wires 2401, 2402... pass, are spaced the one from the others. In this particular embodiment, the distance between the openings 2241, 2242... keeps the wires separate from each other, further limiting the risk of them becoming entangled.

[0053] Preferably the openings 2241, 2242... are arranged in such a way that, when the electrocardiograph 20 is correctly hung round the neck of the patient 10 as in Figure 7, the openings are oriented in the direction of the correct positioning of the electrode 2421, 2422... to be associated with the respective connector 241, 242...

[0054] More particularly, in the embodiments shown in the accompanying figures, the central body 22 comprises a hook 30 adapted to receive a band 18 for hanging the electrocardiograph 20. The hook 30 is placed in the upper

part of the central body 22, in particular above the centre of gravity of the electrocardiograph 20. Preferably, the hook 30 is also centred in the rear part of the central body 22. In this way, when the electrocardiograph 20 is hanging, it spontaneously assumes a predefined position with respect to the chest 12 of the patient 10. The arrangement of the openings 224 is therefore preferably defined on the basis of this predefined position of the electrocardiograph 20 with respect to the chest 12 of the patient 10.

[0055] In other words, two openings (indicated in Figure 7 with 2241 and 2242) are advantageously directed towards the shoulders of the patient 10, where the first two electrodes 2421 and 2422 are to be placed; a third opening 2243 faces the lower area of the left pectoral of the patient 10, where the third electrode 2423 is to be placed; the fourth opening 2244 faces the lower left area of the rib cage of the patient 10, where the fourth electrode 2423 is to be placed.

[0056] The procedure for the correct positioning of the electrodes 242 is not a subject of the present invention. For this purpose, for example, the teachings provided by patent document WO 2016/207745, published in the name of the same Applicant, may be useful. However, the particular arrangement of the openings 224 greatly helps to prevent gross errors during the connection of the connectors 24 to the electrodes 242. By inverting between two connectors any one would in fact obtain an unnatural crossing of the respective wires which would certainly result as a warning to the user.

[0057] The possibility to hang the electrocardiograph 20 round the neck of the patient 10 helps to arrange it automatically so that the openings 224 are correctly oriented. However, as the skilled person may well understand, this mode of use is not strictly necessary and the electrocardiograph 20 may also rest against the chest 12 of the patient 10 when the latter is lying down or partially lying down.

[0058] In accordance with some embodiments of the invention, the rear surface 220 of the central body 22 of the electrocardiograph 20 comprises at least one flexible wing 226. In this case the at least one connector 24n fixedly mounted on the rear surface 220 of the central body 22 is advantageously mounted on the flexible wing 226.

[0059] As already reported above, the connectors fixedly mounted on the rear surface 220 of the central body 22 are advantageously two, conventionally indicated with 24n-1 and 24n. In this case, it is preferable that the rear surface 220 of the central body 22 comprises two flexible wings 226 and that each of the two connectors mounted in a fixed manner is mounted on a respective flexible wing 226.

[0060] This particular arrangement of the two fixed connectors advantageously allows, thanks to the flexibility of the flexible wings 226, to adapt the electrocardiograph 20 to each specific configuration of the chest 12, for example also in the case of a patient 10 affected by the so-called pigeon chest or pectus carinatum.

[0061] As already reported above, the electronic unit 26 is configured for receiving the electric signals from the connectors 24 and for transmitting them to an electronic device 40 external to the electrocardiograph 20. The electronic unit 26 preferably comprises a transceiver 260, suitable for receiving the electric signals and transmitting them to the electronic device 40 external to the electrocardiograph 20.

[0062] In accordance with some embodiments of the invention, the electronic unit 26 further comprises a processing unit 262 (for example a microprocessor) configured to receive and to process the electric signals from the connectors 24, for example in order to verify the correct placement of the electrodes 242. For this purpose, the processing unit 262 can operate according to a preloaded logic, which exploits, for example, Einthoven's law, as illustrated in publication WO 2016/207745. In accordance with some embodiments, the processing unit 262 is also configured to process the signals received from the connectors 24 in order to make them suitable for the successive steps necessary to produce the electrocardiogram trace; for example, the processing unit 262 can advantageously convert the analog signals provided by the electrodes 242 into digital signals suitable for being transmitted by the transceiver 260.

[0063] In accordance with some embodiments of the invention, for example those shown in the attached figures, the electronic unit 26 further comprises a power supply circuit suitable for ensuring the operation of the electrocardiograph even in the absence of a power supply network. The supply circuit preferably comprises a battery 264 and a recharging circuit 266 of the battery. The recharging circuit 266 is preferably suitable for being supplied wirelessly from the outside of the central body 22, for example by means of an induction charging base. This solution advantageously allows to avoid the provision of sockets, pins, connectors or the like on the outer wall of the central body 22.

[0064] The object of the present invention is also an assembly 60 for the acquisition of an electrocardiogram, represented schematically in Figure 7. The assembly 60 comprises an electrocardiograph 20 according to any one of the embodiments described above and an electronic device 40, comprising a user interface 42.

[0065] Preferably, the user interface 42 of the electronic device 40 comprises a command input module 420 and a display module 422.

[0066] The electronic device 40 is preferably of the mobile type, such as a smartphone, a tablet, a PDA, a personal laptop; alternatively, the electronic device 40 is a fixed personal computer or a smart TV.

[0067] A considerable advantage offered by the invention is that of exploiting, for the operation of the electrocardiograph 20, the user interface 42 of the electronic device 40: in this way it is possible to contain weights and overall dimensions of the electrocardiograph 20 according to the invention, the components of which are reduced compared to known solutions.

[0068] This allows, for example, that the electrocardiograph 20 can be hung round the neck without any safety or comfort problem for the patient 10. Moreover, it is probable that the user already has an electronic device 40 suitable for cooperating with the electrocardiograph 20 in the assembly 60. Preferably, in fact, the transmission of the signals by the electronic unit 26 takes place through standard channels that exploit commonly used protocols. Transmission occurs preferably via Bluetooth technology.

[0069] In addition or alternatively, by way of example, the transmission of the signals from the electrocardiograph 20 to the electronic device 40 may take place via cable (for example via a USB cable) or in other wireless modes, in particular by means of short distance radio signals (e.g. via Wi-Fi technology) or through infrared or laser-based technologies.

[0070] In this way it is possible to contain the costs and the complexity of the electrocardiograph 20, whose components are reduced compared to the known solutions.

[0071] As the skilled person can understand, the invention allows to overcome the drawbacks highlighted above with reference to the prior art.

[0072] In particular, the present invention makes available a portable electrocardiograph which, by exploiting the components of an external electronic device, is light and low-cost.

[0073] Furthermore, the present invention provides an electrocardiograph which, thanks to its particular structure, can be easily used by anyone, even without the aid of qualified personnel for positioning the electrodes on the chest.

[0074] Furthermore, the present invention makes available an electrocardiograph which can be used anywhere, even in the absence of a power supply network.

[0075] Finally, the present invention makes available an electrocardiograph which, keeping the wires always organized and protected, is always operative in a short time and prevents the wires themselves from becoming dirty and/or prematurely worn.

[0076] It is clear that the specific features are described in relation to various embodiments of the invention with exemplifying and non-limiting intent. Obviously, a person skilled in the art may make further modifications and variations to this invention, in order to meet contingent and specific requirements. For example, the technical features described in connection with an embodiment of the invention may be extrapolated from it and applied to other embodiments of the invention. Such modifications and variations are, however, contained within the scope of the invention, as defined by the following claims.

Claims

1. Portable electrocardiograph (20), suitable for being hung round the neck of a patient (10), comprising a central body (22), a plurality of connectors (24) and

an electronic unit (26),
wherein:

- each one of the connectors (24₁, 24₂...) is suitable for being associated to a respective electrode (242₁, 242₂...) applied on the chest (12) of the patient (10) for detecting respective electric signals;
- each one of the connectors (24₁, 24₂...) is suitable for receiving the electric signals detected by the respective electrode (242₁, 242₂...) and for transmitting the electric signals to the electronic unit (26);
- the central body (22) comprises a rear surface (220), facing the chest (12) of the patient (10) when the electrocardiograph (20) is in use;
- at least one of the connectors (24_n) is mounted in a fixed manner on the rear surface (220) of the central body (22);
- each one of the other connectors (24₁, 24₂...) is connected to the central body (22) by means of a respective wire (240₁, 240₂...) which can be wound and unwound;
- the central body (22) comprises winding/unwinding means (28) suitable for allowing each wire (240₁) to be unwound independently from the other wires (240₂, 240₃...) and for allowing each wire (240₁) to be wound;
- the electronic unit (26) is configured for receiving the electric signals from the connectors (24) and for transmitting them to an electronic device (40) external to the electrocardiograph.

2. Electrocardiograph (20) according to claim 1, wherein the winding/unwinding means (28) wind up the wires (240) inside the central body (22).
3. Electrocardiograph (20) according to one or more of the preceding claims, wherein the central body (22) comprises a plurality of openings (224) corresponding to the plurality of connectors (24), and wherein each one of the wires (240₁, 240₂...) of the connectors passes through a respective opening (224₁, 224₂...) of the central body (22).
4. Electrocardiograph (20) according to one or more of the preceding claims, wherein the central body (22) further comprises a side wall (222) and wherein each one of the wires (240₁, 240₂...) passes through a respective opening (224₁, 224₂...) placed on the side wall (222) of the central body (22).
5. Electrocardiograph (20) according to claim 3 or 4, wherein the openings (224₁, 224₂...) through which the wires (240₁, 240₂...) pass are spaced the one from the others.
6. Electrocardiograph (20) according to one or more of

claims 3 to 5, wherein the central body (22) comprises a hook (30) suitable for hanging the electrocardiograph (20), wherein the hook (30) is arranged in such a manner that, when the electrocardiograph (20) is hung round the neck of a patient (10), the electrocardiograph (20) spontaneously assumes a predefined position with respect to the chest (12) of the patient (10). 5

7. Electrocardiograph (20) according to one or more of claims 3 to 6, wherein when the electrocardiograph (20) is in use it assumes a predefined position with respect to the chest (12) of the patient (10), wherein the arrangement of the openings (224) is defined on the basis of the predefined position of the electrocardiograph (20) with respect to the chest (12) of the patient (10) in such a manner that each opening (224₁, 224₂...) is oriented in the direction of the correct placement of the electrode (242₁, 242₂...) to be associated to the respective connector (24₁, 24₂...). 10 15 20
8. Electrocardiograph (20) according to one or more of the preceding claims, wherein the rear surface (220) of the central body (22) comprises at least one flexible wing (226), and wherein the at least one of the connectors (24_n) which is mounted in a fixed manner on the rear surface (220) of the central body (22) is mounted on the flexible wing (226). 25
9. Electrocardiograph (20) according to one or more of the preceding claims, wherein the winding/unwinding means (28) are suitable for allowing all the wires (240) to be wound at the same time. 30
10. Electrocardiograph (20) according to one or more of the preceding claims, wherein the winding/unwinding means (28) comprise a plurality of drums (280) mounted in a rotatable manner inside the central body (22), each one of the drums (280₁, 280₂...) being associated to a single wire (240₁, 240₂...). 35 40
11. Assembly (60) for acquiring an electrocardiogram, the assembly comprising an electrocardiograph (20) according to one or more of the preceding claims and an electronic device (40) external to the electrocardiograph and comprising a user interface (42). 45

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Fig.1

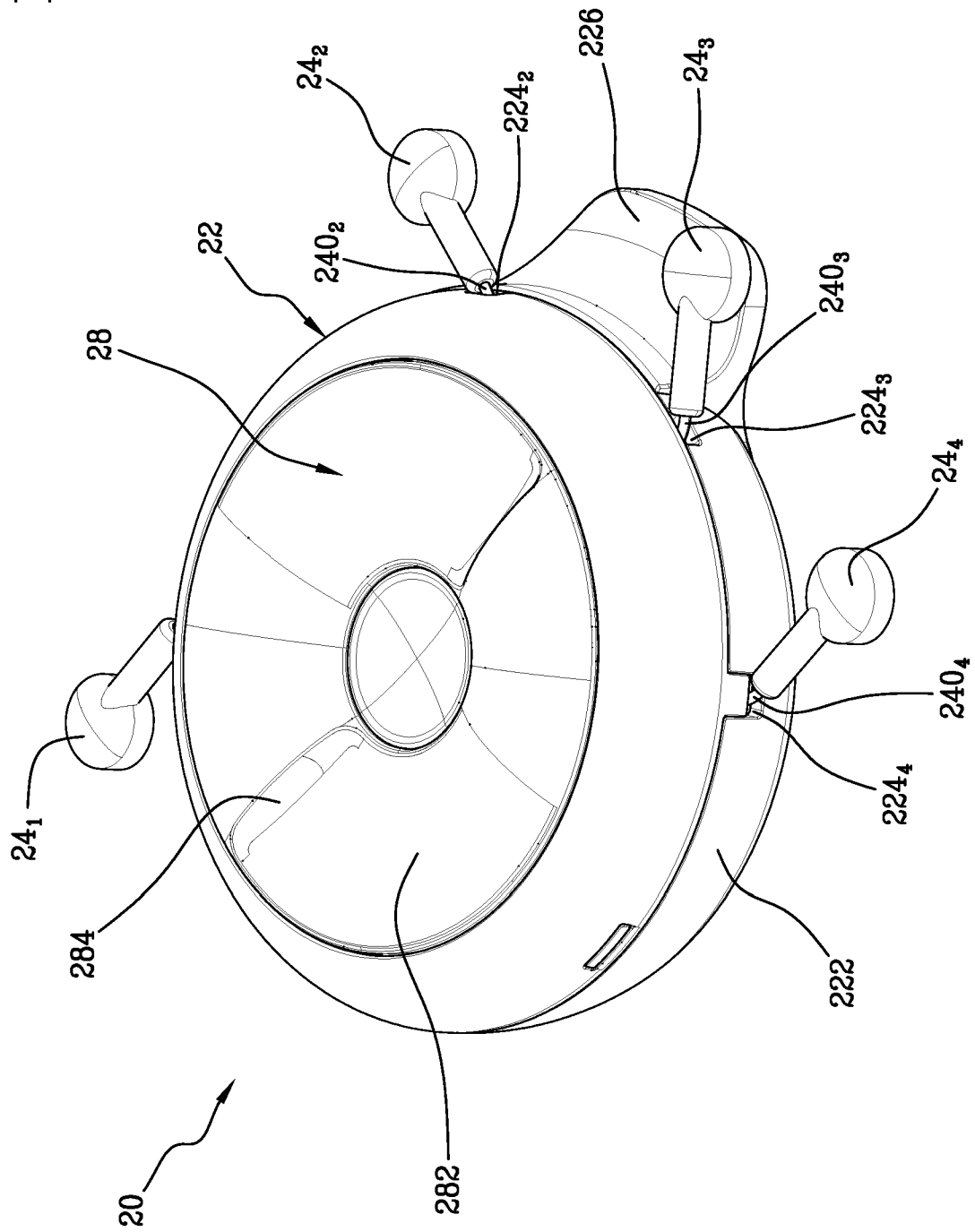


Fig.2

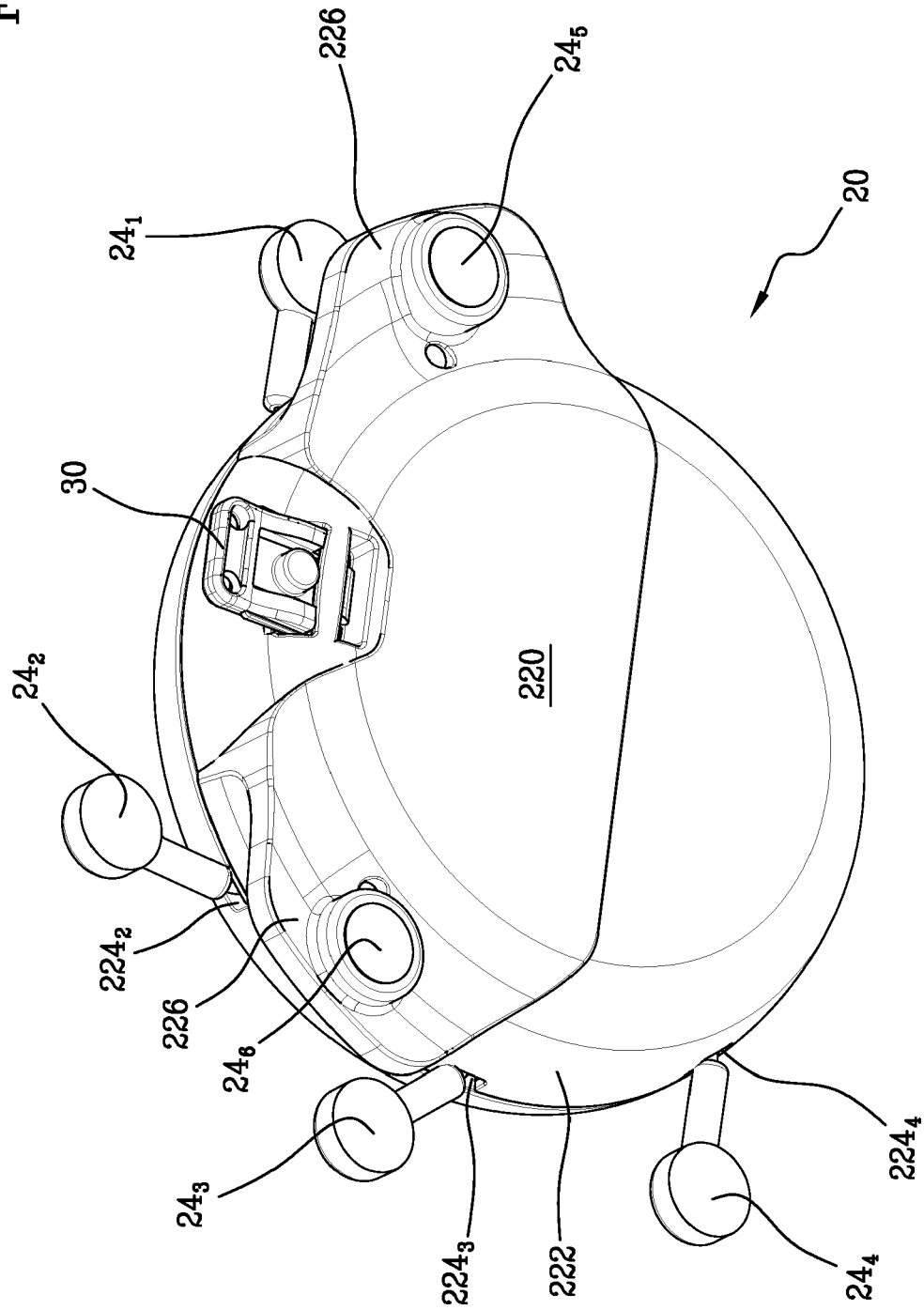


Fig.3

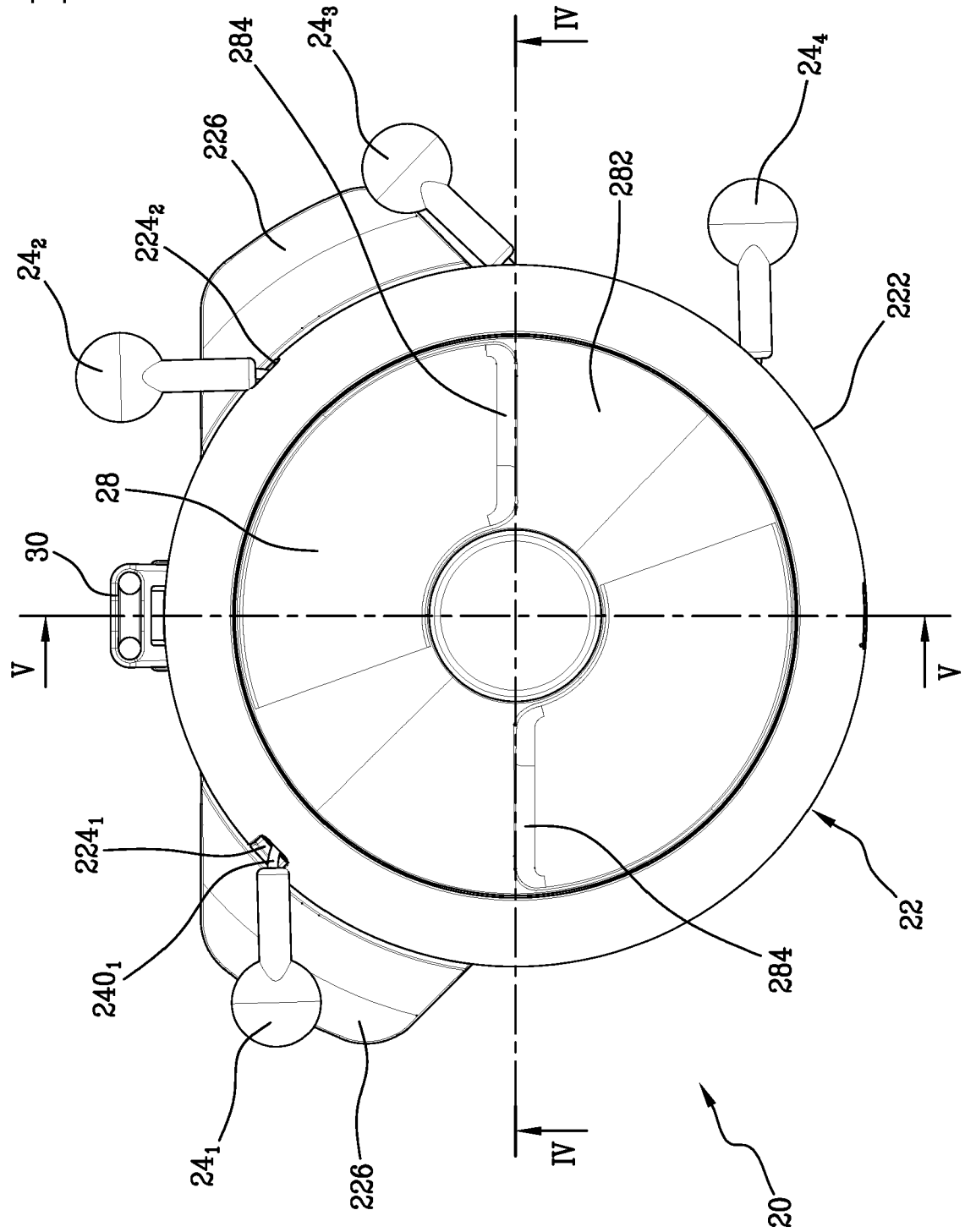
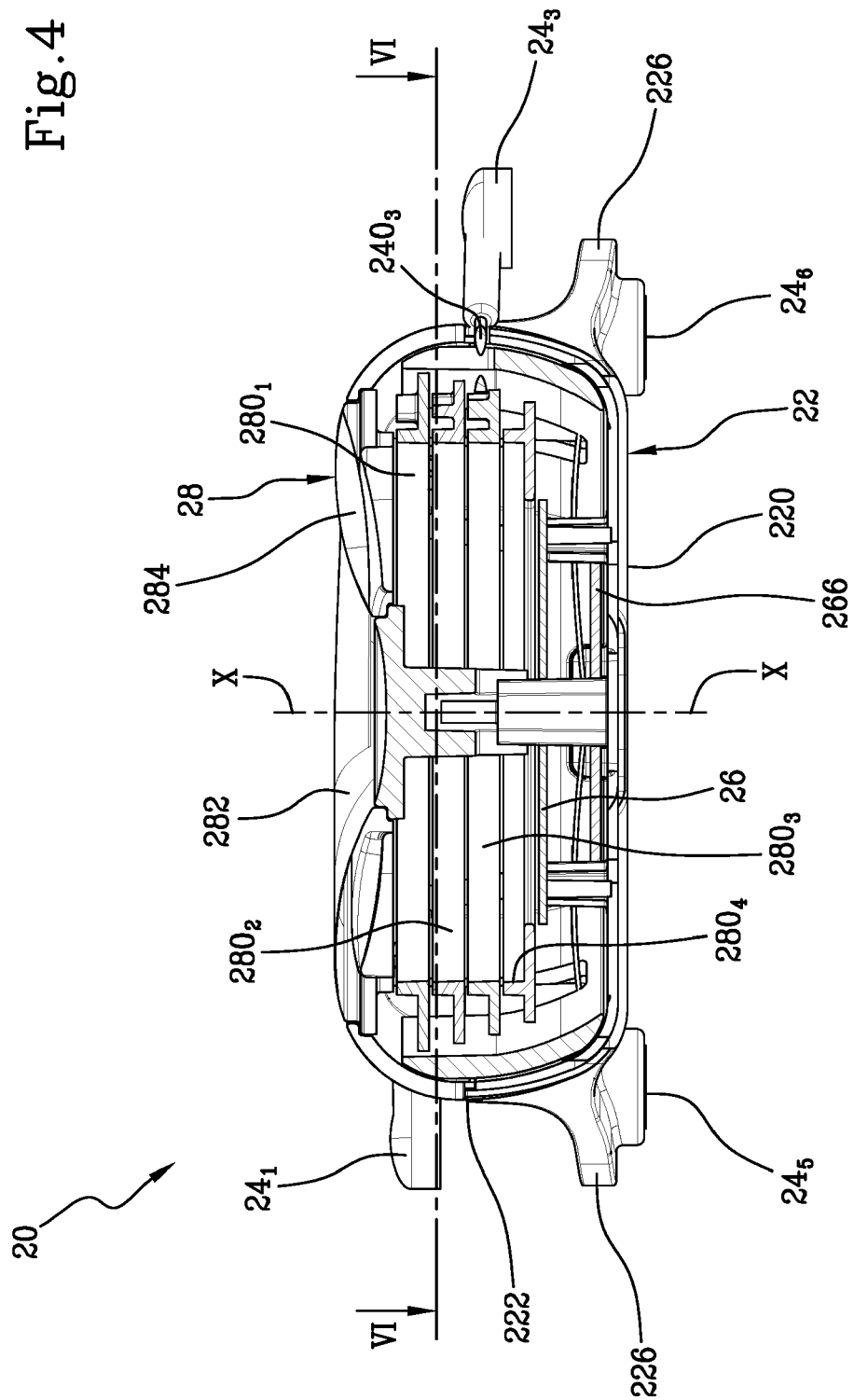


Fig. 4



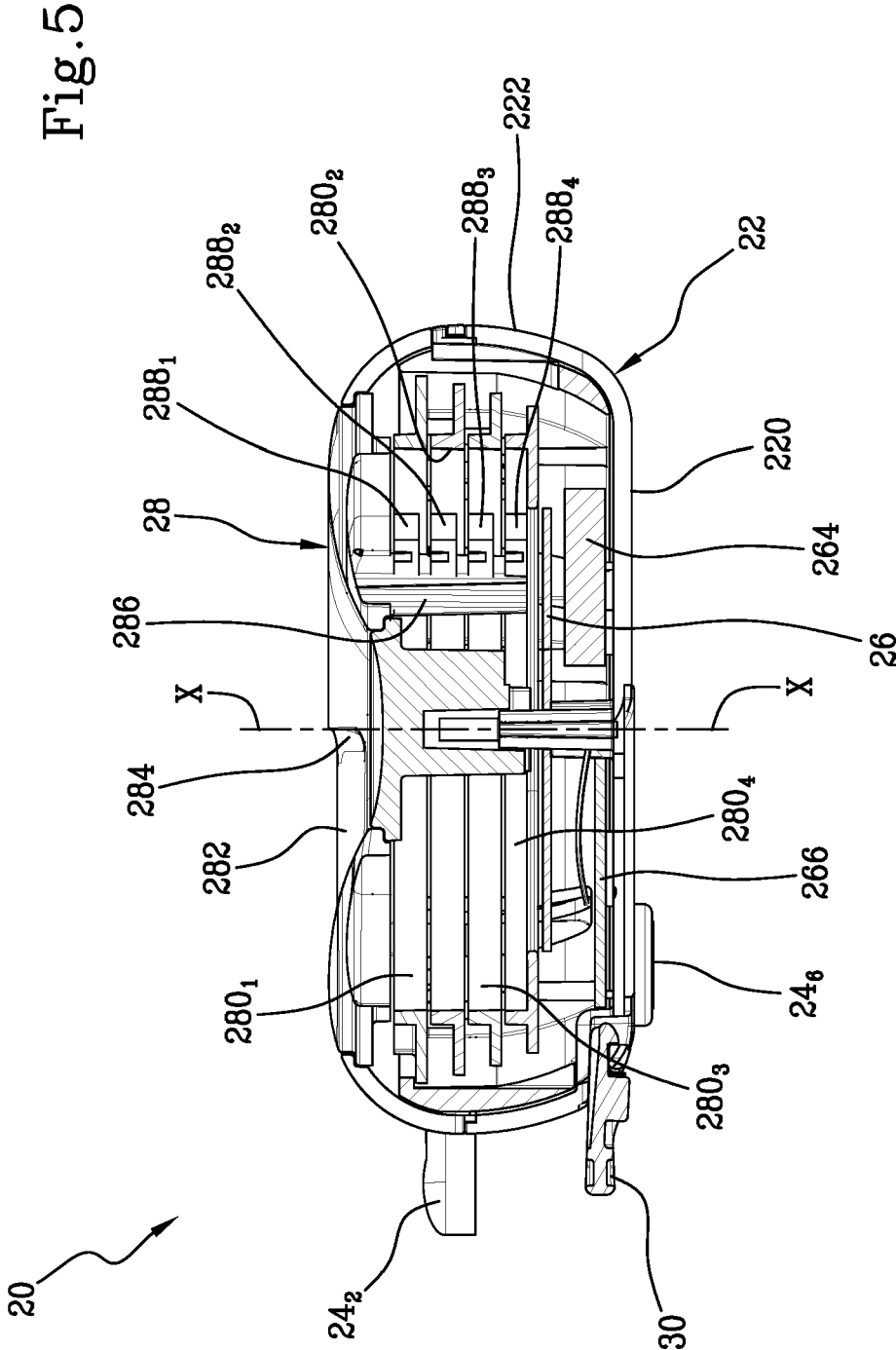
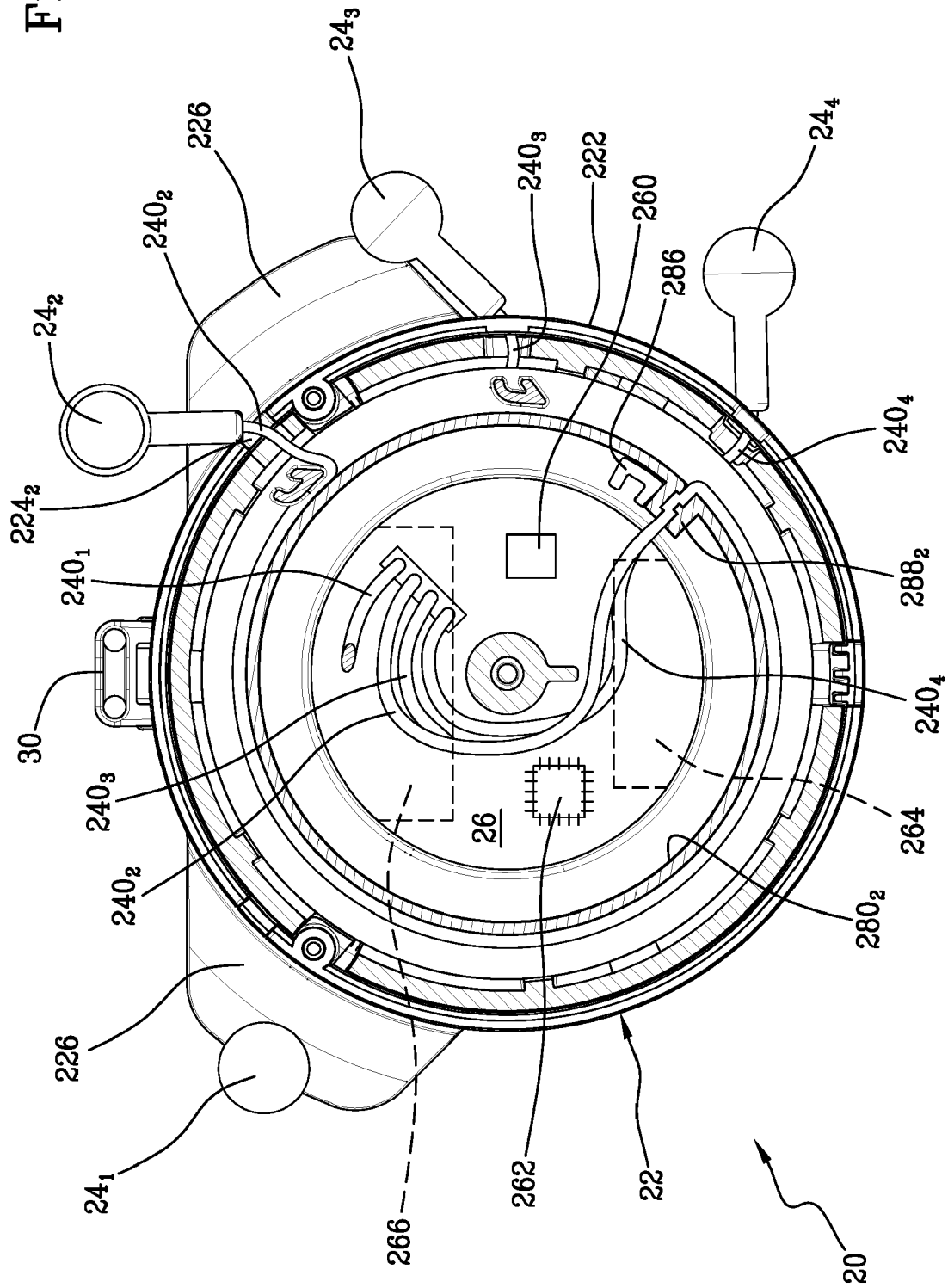
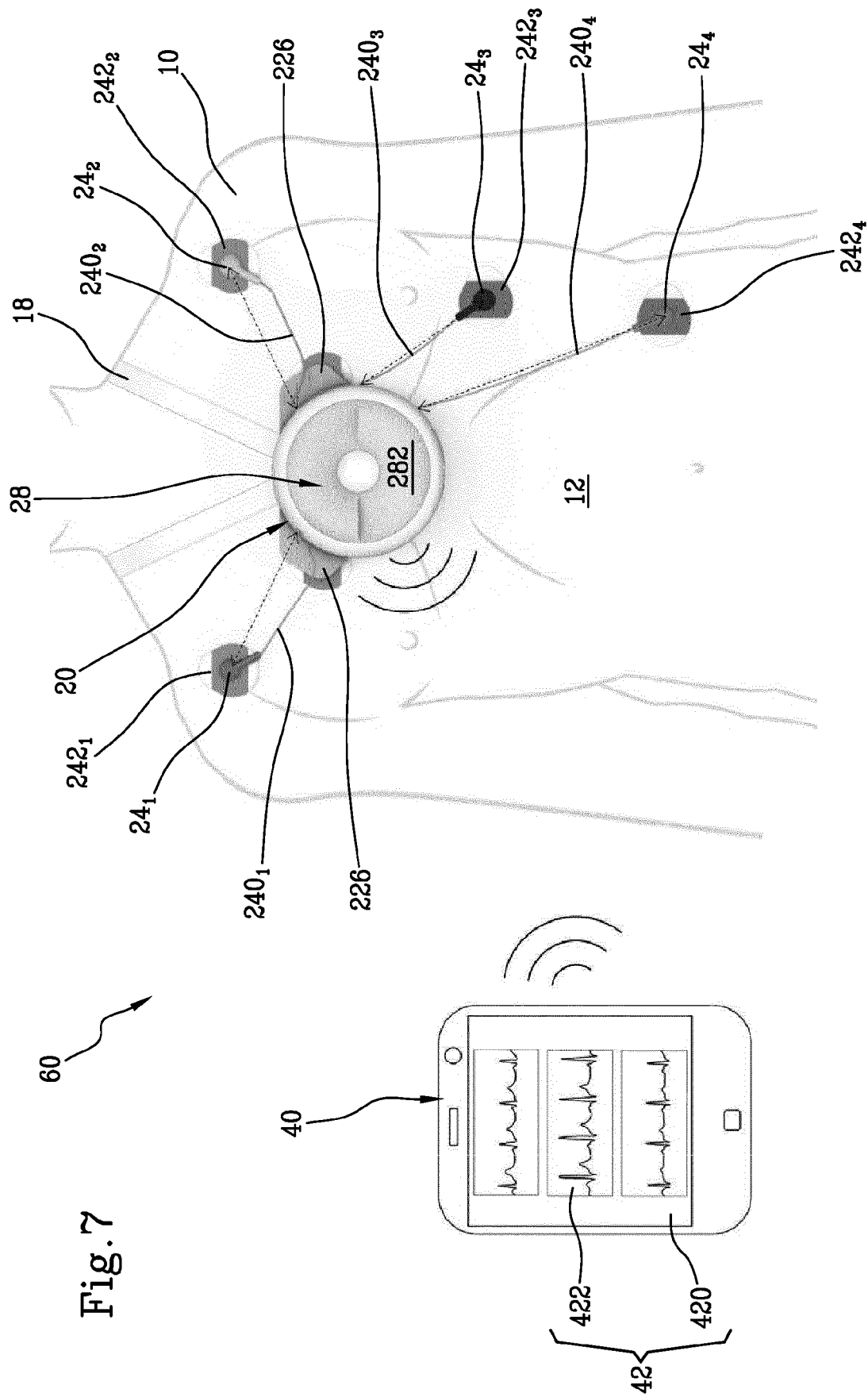


Fig. 6







EUROPEAN SEARCH REPORT

Application Number
EP 18 18 2617

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	CN 206 102 646 U (TAIZHOU PEOPLE'S HOSPITAL) 19 April 2017 (2017-04-19) * figures 1, 2 * * page 4, lines 3-5 * * page 5, lines 1-3 * * page 7, lines 5-7 * * page 8, lines 8-18 * -----	1-11	INV. A61B5/0404 A61B5/00 A61B5/0408
			TECHNICAL FIELDS SEARCHED (IPC)
			A61B
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 31 July 2018	Examiner Almeida, Mariana
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

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EPO FORM 1503 03/02 (P04C01)

31-07-2018

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
CN 206102646	U	19-04-2017	NONE

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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- WO 2016207745 A [0010] [0056] [0062]

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发明人	BRIANTE, NICCOLÒ MAURIZI, NICCOLÒ		
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代理机构(译)	BELLONI , GIANCARLO		
优先权	102017000078552 2017-07-13 IT		
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摘要(译)

本文描述了一种便携式心电图仪 (20)，其适于悬挂在患者颈部 (10) 上并且包括中心体 (22)，多个连接器 (24) 和电子单元 (26)。连接器 (24₁, 24₂) 中的每一个适于与施加在患者胸部 (12) 上的相应电极 (24₂₁, 24₂₂) 相关联，以检测相应的电信号。每个连接器适合于接收由相应电极检测的电信号并用于将电信号传输到电子单元。中心体包括后表面 (220)，当心电图仪在使用时，后表面面向患者。至少一个连接器 (24_n) 以固定方式安装在中心体的后表面上。其他连接器 (24₁, 24₂) 中的每一个通过相应的线 (240₁, 240₂) 连接到中心体，线 (240₁, 240₂) 可以缠绕和展开。中心体包括卷绕/退绕装置 (28)，其适于允许每根电线独立于其它电线展开并允许每根电线缠绕。电子单元被配置用于接收来自连接器的信号并将它们传输到心电图仪外部的电子设备 (40)。本发明还涉及一种包括心电图仪和外部电子设备的组件 (60)。

