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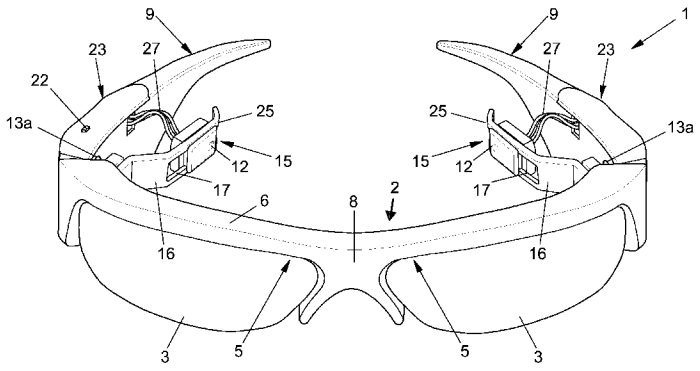

FIG.1

(57) Abstract: Method for acquiring and processing heart rate data comprises the steps of: • Providing at least one pair of glasses (1) comprising a microcontroller (1 1), at least one heart rate sensor (12) positionable against an anatomic area of a user, at least one configuration memory (102), at least one data memory (103), a clock/calendar electronic circuit (104), at least one visual and/or audible signalling unit (13), at least one rechargeable autonomous electrical power supply source (14), and at least one switch for at least switching on/off the heart rate detection function. • Providing at least one programming and data transfer unit (100) external to the glasses (1) • Providing at least one connection system (101) between glasses (1) and external programming and data transfer unit (100) • Programming the configuration memory (102) of the glasses (1) by means of said external programming and data transfer unit (100), with at least a minimum heart rate threshold value, a maximum heart rate threshold value, and a heart rate reading frequency value • Acquiring a plurality of readings in the data memory (103) of the glasses (1) during an activity in which the user wears the glasses (1), wherein each reading comprises a detected heart, rate value and the corresponding time of detection • Processing, in real time during said activity, by means of the visual and/or audible signalling unit (13), at least one alarm signal when the current reading comprises a detected heart rate value that is not below the maximum heart rate threshold or not above the minimum heart rate threshold.

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METHOD FOR ACQUIRING AND PROCESSING HEART RATE DATA

DESCRIPTION

The present invention refers to a method for acquiring and processing heart rate data.

It is very important to monitor, especially during a prolonged physical effort, at least some of the main vital parameters of a person, as one of his anomalies can be symptomatic of a dysfunction or pathology on a coronary and/or cardiovascular, and/or more generally a circulatory level.

Some of such pathologies are silent and asymptomatic and only their early and timely diagnosis can contribute to avoid the worst, which sometimes means the onset of permanent damage and sometimes even death.

The use of glasses has been proposed having a sensor of the heart rate.

Such glasses, in addition to the function to which they are normally assigned, are per se limited only to provide to the wearer an indication of the detected heart rate.

Therefore, the technical task of the present invention is to provide an extremely convenient, practical and efficient method for acquiring and processing heart rate data.

Another aim of the invention is to realize a method for acquiring and processing heart rate data by means of special glasses, which permits to greatly expand the minimum functionalities and purposes intended for the method itself.

The technical task, and also these and other aims, according to the present invention, are reached with a method for acquiring and processing heart rate data, characterized in that it comprises the steps of:

- Providing at least one pair of glasses comprising a microcontroller, at least one heart rate sensor positioned against an anatomic area of a user, at least one configuration memory, at least one data memory, a clock/calendar electronic circuit, at least one visual and/or audible signalling unit, at least one rechargeable autonomous electrical power supply source, and at least one switch for at least switching on/off the heart rate detection function.
- Providing at least one programming and data transfer unit external to the glasses
- Providing at least one connection system between said glasses and said external programming and data transfer unit
- Programming the configuration memory of the glasses, by means of said external programming and data transfer unit, with at least a minimum heart rate threshold value, a maximum heart rate threshold value, and a heart rate reading frequency value
- Acquiring a plurality of readings in the data memory of the glasses during an activity in which the user wears the glasses, wherein each reading comprises a detected heart rate value and the corresponding time of detection
- Processing, in real time during said activity, by means of the visual and/or audible signalling unit, at least one alarm signal when the current reading

comprises a detected heart rate value that is not below the maximum heart rate threshold or not above the minimum heart rate threshold.

Preferably the programming and data transfer unit in turn comprises a controller to which a data input unit for the user, a data output unit for the user, an electrical power supply source and a data memory are connected.

Preferably according to the method of the invention, after the conclusion of said activity by the user, a step of connecting said glasses to said programming and data transfer unit by means of said connection system is made, by means of the connection system, wherein the readings acquired during said activity are stored in said data memory

of the programming and data transfer unit, and the autonomous electrical power supply source is recharged by electrical power supply source of the programming and data transfer unit.

Preferably, the connection system is wired, but the method according to the invention does not exclude the adoption of a wireless connection system between said glasses and said programming and data transfer unit.

Preferably, the recharging of said autonomous electrical power supply source of the glasses and the storing of the readings in the data memory of said programming and data transfer unit occur simultaneously.

Preferably, according to the method of the invention, a graphical processing step is provided, wherein on the output device of said programming and data transfer unit, paths are shown in a comparative or alternative form, processed from the said

programming and data transfer unit and showing for the user's activities the corresponding readings performed.

Preferably, according to the method of the invention, a step of loading various user profiles into said data memory of said programming and data transfer unit is provided, each user profile comprising corresponding minimum and maximum threshold heart rate and reading frequency values, and a programming step of the configuration memory of the glasses with a profile selected from said programming and data transfer unit.

According to the method of the invention, a profile program, wherein the minimum and maximum threshold heart rate values be variable during the acquisition time of the heart rate, is also possible.

Further features and advantages of the invention will be more evident from the description of a preferred but non exclusive embodiment of the acquisition and data processing of heart rate data according to the finding, shown in an indicative and non limitative way in the annexed drawings, in which:

- figure 1 shows a view of a preferred embodiment of glasses used in the method,
- figure 2 shows a top plan view of the glasses on the wearer, with a cross-section of the frame in the hinged areas of front temple pieces,
- figure 3 shows a top plan view of the glasses,
- figure 4 shows in detail the frame in the hinged area between the right temple piece and the front of the frame, wherein an arrow shows the

translation direction for regulating the linear position of the sensor along the support element,

- figure 5 shows in detail the frame in the hinged area between the left temple piece and the front of the frame, wherein an arrow shows the translation direction for regulating the linear position of the sensor along the support element,
- figures 6 and 7 show in detail the frame in the hinged area between the right temple piece and the front of the frame, wherein an arrow shows the regulation of the angular position of the support element of the sensor,
- figure 8 shows in detail the frame in the hinged area between the left temple piece and the front of the frame, wherein an arrow shows the flexion to which the support element of the sensor can be subject, shown with a continuous line in a rest position and with a dotted line in a flexed position, taken when the glasses are worn,
- figure 9 schematically shows the architecture of the parts concurring to the execution of the method.

With reference to the cited figures, the method of acquiring and processing heart rate data uses at least one pair of glasses 1, at least one programming and data transfer unit 100 separated and external to the glasses 1, and at least one connection system 101 between the programming and data transfer unit 100 and the glasses 1.

The glasses 1 comprise a microcontroller 11 to which one or more heart rate sensors 12 are connected, which can be positioned against an anatomic area of a

user and suitable for the detection of the heart rate, a configuration memory 102, a data memory 103, a clock/calendar electronic circuit 104, a visual and/or audible signalling unit 13, and a rechargeable autonomous electrical power supply source 14, for example a battery.

To the controller 11 also at least one interface port 20 is connected, for example a USB port, by which the glasses 1 can be connected with the connection system 101.

The glasses 1 further comprise a switch 22 for starting/stopping at least some of their functions, and in particular at least the heart rate detection function.

The external programming and data transfer unit 100 has a controller 106 to which a data memory 107, an input unit 108 for the user, an output unit 109 for the user, and an electrical power supply source 110 are connected.

The programming and data transfer unit 100 comprises a resident software suitably dedicated for interfacing the glasses 1 and processing the transferred data.

The input unit 108 for the user can be for example a push-board, a keypad, a keyboard, a touch-screen.

The output unit 109 for the user can be for example a display, a screen, a touch-screen.

The electrical power supply source 110 can be for example a battery or a power supply connected to the mains.

The programming and data transfer unit 100 finally comprises at least one interface port 111, for example one USB port, with which it can be connected to the connection system 101.

The programming and data transfer unit 100 can alternatively take the form of a proprietary unit, a personal computer (desktop or laptop), a computer tablet or a smart phone with a suitable computational and memory capacity.

The connection system 101 can comprise for example a multi-core cable equipped with a connector 112 for the connection to the interface port 20 with the glasses 1 and a connector 113 for the connection to the interface port 111 of the programming and data transfer unit 100.

The user who intends to monitor the heart rate during the execution of a certain physical activity, for example a sports racing, first must plan the configuration memory 102 present in the glasses 1 by setting an user profile comprising a minimum threshold heart rate, a maximum threshold heart rate, and a rate value or reading frequency value.

The setting of the user profile can be made thanks to the input unit 108 of the programming and data transfer unit 100, to which the glasses 1 must be connected through the connection system 101.

Advantageously, through the input unit 108 various user profiles can be loaded in the data memory 107 of the programming and data transfer unit 100, each profile comprising corresponding minimum and maximum threshold heart rate and reading frequency values.

More precisely, the user connects the glasses 1 to the programming and data transfer unit 100 through the connection system 101, and performs through the input unit 108, the selection of the user profile which he likes most. The controller 1o6 acquires the selection and controls the transfer of the profile acquired from

said data memory 107 of the programming and data transfer unit 100 to the configuration memory 102 of the glasses 1.

If the configuration memory 102 is initially empty the configuration values referring to the minimum and maximum heart rate and reading frequency threshold are written; if on the contrary the configuration memory 102 is not empty, having a previous program, the present configuration values are overwritten on the previous ones so to update them.

The configuration memory 102 is also programmed with the current date and time data, in order to adjust calendar and clock so that the readings which will be performed thereafter be referred to the precise date-hour time.

After programming or reprogramming the configuration memory 102, the user disconnects the glasses 1 from the programming and data transfer unit 100, wearing them in order to perform the physical activity which must be monitored.

During the physical activity the microcontroller 11, following the sampling rate corresponding to the selected profile, controls the execution of a series of readings of the heart rate and through the electronic circuit of clock-calendar 104, associates to each detected heart rate value the corresponding detection time.

The microcontroller 11 controls the storage of the readings with the corresponding time of occurrence in the data memory 103, present in the glasses 1.

The readings are therefore organized as tables of pairs of date-hour values and of detected heart rate and the tables in turn can be organized in multiple sessions, corresponding to different drive cycles from the user of the switch 22. Advantageously, the microcontroller 11 controls the visual and/or audible

signalling unit in order to process in real time during the performance of the physical activity of the user, at least one alarm signal when the current reading comprises a value of detected heart rate not lower than the maximum set heart rate threshold or not greater than the minimum set heart rate threshold.

After the conclusion of the physical activity the user connects the glasses 1 to the external programming and data transfer unit 100 through the connection system 101. At this point the controller 106 controls the transfer of the readings acquired during the physical activity of the data memory 103 of the glasses 1 to the data memory 107 of the programming and data transfer unit 100, and also controls the transfer of electrical energy from the electrical supply source 110 of the programming and data transfer unit 100 to the autonomous electrical supply source 14 of the glasses 1 for reloading it. These two steps can be also performed at the same time.

Advantageously, the controller 106 of the programming and data transfer unit 100 uses the readings stored in the memory 107 in order to process and visualize on the output device 109 some paths in a comparative or alternative form, which reproduce for the activities of the user the corresponding readings performed.

Reference is made now more in detail to a preferred construction for the glasses 1 which can be used in the method for acquiring and processing heart rate data of the present invention. The glasses 1 as seen comprise the switch 22 which is advantageously miniaturized and serves for starting/stopping in particular the function of acquiring the heart rate but also the function of generating the alarm signal.

The switch 22 can also serve for starting/stopping other functions among which for example there is the function of programming the configuration memory of the glasses, the data transfer function and the energy recharging function. Apart from that, for starting/stopping the function of heart rate detection, the starting/stopping of all other functions cannot be necessarily controlled by the user 22, but from the connection/disconnection itself between glasses 1 and programming and data transfer unit 100, through the connection system 101.

The frame 2 has a front 5 equipped with two open circles 6, a connecting bridge 8 among the circles 6, and temple pieces 9 connected through a respective hinge 10 to the front 5.

The temple pieces 9 have a box-like enlargement 23 at their portion proximal to the front 5 of the frame 2.

The microcontroller 11 for ergonomic reasons is made of two distinct electronic cards 11a and 11b.

The visual and/or audible signalling unit 13 for the generation of a light signal correlated to the detected heart rate preferably comprises one or more LEDs 13a, whereas for the generation of an audible signal correlated to the detected heart rate, it preferably comprises one or more buzzers (not shown).

The glasses 1 have adjustable means for a stable positioning of the sensor 12 against the anatomical area destined to the detection of the heart rate.

The positioning means comprise in particular at least one support element 15 for the sensor 12.

The support element 15 has an elastic flexible longitudinal body which is hinged to a temple pieces 9 of the frame 2.

The support element 15 is made in particular of a longitudinal plate 16 providing at least one longitudinal plan portion 25 and which, at its longitudinal end 16a proximal to the front 5 of the frame 2, is hinged through a pin 18 to the temple piece 9 and is placed with one of its main faces at a short distance facing the inner face of the box-like portion 23 of the temple piece 9.

The pin 18 is so oriented to permit an oscillation of the plate 16 in its main lying plane substantially parallel to the inner face of the box-like portion 23 of the temple piece 9.

The sensor 12 is supported along a translation guide 17 made from the body of the support element 15.

More precisely the translation guide 17 is developed in the longitudinal direction of the support element 15.

The precise regulation of the angular and linear position of the sensor 12 can be made by providing a friction coupling between the support element 15 and the temple piece 9 through the pin 18, and a friction coupling between the sensor 12 and the support element 15 through the translation guide 17. In practice for the precise regulation of the angular position of the sensor 12, it is sufficient to manually apply on the support element 15 a rotational force greater than the friction force which maintains the support element integrated with the temple piece 9, whereas for the precise regulation of the linear position of the sensor 12 it is sufficient to manually apply on the sensor 12 a translation force greater than the

friction force which maintains the sensor 12 integrated with the support element 15.

Once having placed the sensor 12 against the anatomical detection area, the elastic flexion to which the support element is subjected due to the interference with the head of the wearer, generates the friction force necessary for maintaining the sensor 12 integrated with the anatomical detection area in any situation, either when the wearer is not active or when he is performing a physical activity of some importance.

The glasses 1 are provided with a second sensor 12 carried by a second support element 15 associated to the opposed temple piece 9.

The second support element 15 is structurally and functionally equal to the first one.

Also the second sensor 12 is structurally and functionally equal to the first one.

The autonomous electrical power supply source 14 and the microcontroller 11 are housed in special seats provided in the frame 2 and in particular in the box-like enlarged portion 23 of the temple piece 9.

The electrical cables 26 for connecting the autonomous electrical power supply source 14 to the microcontroller 11 are developed along the temple pieces 9, the bridge 8 and the upper arc of the circles 6 of the front 5 of the frame 2.

In particular the frame 2 has a duct 19 for the passage of the electrical cables 26.

The electrical cables 27 for connecting the sensor 12 to the microcontroller 11 instead can be developed in the space between the support element 15 and the inner face of the box-like enlarged portion 23 of the temple piece 9.

The method for acquiring and processing heart rate data according to the invention provides for the possibility, through the data processing software installed in the programming and data transfer unit 100, of a series of operating modes, among which: the creation of graphs visualizing the paths showing the downloaded data of heart rate readings, in function of the time (date-hour) with visual indication of the events of possible overcoming of the threshold values, as explained before; the creation and managing of the user profiles in order to program the glasses 1 in different modes according to the user and to visualize the corresponding paths in a comparative or alternative form, as explained before; the possibility of integrating and combining the reading paths with data coming from other devices, for example a GPS navigator, an altimeter, maps or plans of the territory; the possibility of statistically processing the data, obtain metrics, make comparisons among different users or session of the same user; the possibility of storing in a data memory data and sessions also separated for different user profiles; and the possibility of remotely sharing the data, statistical information integrated among different users.

Therefore a series of possibilities and extensions of the minimum functionalities is likely to occur, if the connection of the unit 100 in turn with other external devices is realized, through cabled or wireless connection means. The connection could be an Internet connection.

All this connects and integrates the world of Social Networking. The method for acquiring and processing heart rate data so conceived is suitable for various changes and variations, all within the scope of the inventive concept; furthermore all details can be substituted with technical equivalent elements.

CLAIMS

1. A method for acquiring and processing heart rate data, characterized in that it comprises the steps of:

   - Providing at least one pair of glasses (1) comprising a microcontroller (11), at least one heart rate sensor (12) positionable against an anatomic area of a user, at least one configuration memory (102), at least one data memory (103), a clock/calendar electronic circuit (104), at least one visual and/or audible signalling unit (13), at least one rechargeable autonomous electrical power supply source (14), and at least one switch for at least switching on/off the heart rate detection function.
   - Providing at least one programming and data transfer unit (100) external to the glasses (1)
   - Providing at least one connection system (101) between said glasses (1) and said external programming and data transfer unit (100)
   - Programming the configuration memory (102) of the glasses (1) by means of said external programming and data transfer unit (100), with at least a minimum heart rate threshold value, a maximum heart rate threshold value, and a heart rate reading frequency value
   - Acquiring a plurality of readings in the data memory (103) of the glasses (1) during an activity in which the user wears the glasses (1), wherein each reading comprises a detected heart rate value and the

corresponding time of detection

- Processing, in real time during said activity, by means of the visual and/or audible signalling unit (13), at least one alarm signal when the current reading comprises a detected heart rate value that is not below the maximum heart rate threshold or not above the minimum heart rate threshold.

2. The method for acquiring and processing heart rate data according to the preceding claim, characterized in that the programming and data transfer unit (100) in turn comprises a controller (106) to which a data input unit (108) for the user, a data output unit (109) for the user, an electrical power supply source (110) and a data memory (107) are connected.
3. The method for acquiring and processing heart rate data according to the preceding claim, characterized in that it comprises a step, after the conclusion of said activity, of connecting said glasses (1) to said programming and data transfer unit (100) by means of said connection system (101), wherein the controller (106) of the programming and data transfer unit (100) commands the transfer of the readings acquired during said activity in said data memory (103) of the glasses (1) into its own data memory (107), and the transfer of electricity from its own electrical power supply source (110) to said autonomous electrical power supply source (14) of the glasses (1).
4. The method for acquiring and processing heart rate data according to the preceding claim, characterized in that the recharging of said autonomous electrical power supply source (14) and memorization of the readings in the

data memory (107) of said programming and data transfer unit (100) occur simultaneously.

5. The method for acquiring and processing heart rate data according to any preceding claim, characterized in that it comprises a processing and display step, wherein the controller (106) of said programming and data transfer unit (100) processes and displays, on said output device (109) of said programming and data transfer unit (100), graphs in a comparative or alternative form showing the corresponding readings recorded for the user's activities.

6. The method for acquiring and processing heart rate data according to any preceding claim, characterized in that it comprises a step of loading various user profiles into said data memory (107) of said programming and data transfer unit (100), each user profile comprising corresponding minimum and maximum threshold heart rate and reading frequency values.

7. The method for acquiring and processing heart rate data according to the preceding claim, characterized in that when a user selects a profile via said data input unit (108), the controller (106) of said programming and data transfer unit (100) programs the configuration memory of the glasses (1) with the selected profile.

8. The method for acquiring and processing heart rate data according to any of claims 5 to 7, characterized in that it comprises a step of integrating and combining the graphs with data originating from other devices.

9. The method for acquiring and processing heart rate data according to any of

claims 5 to 8, characterized in that it comprises a step of statistically analyzing the readings.

10. The method for acquiring and processing heart rate data according to any of claims 5 to 9, characterized in that it comprises a step of remotely sharing readings originating from various programming and data transfer units (100).
11. The method for acquiring and processing heart rate data according to any preceding claim, characterized in that said glasses (1) comprise adjustable means for stably positioning the sensor (12) against said anatomical area.
12. The method for acquiring and processing heart rate data according to the preceding claim, characterized in that said adjustable means comprise at least one support element (15) for said at least one sensor (12), said support element (15) having an elastically flexible body.
13. The method for acquiring and processing heart rate data according to the preceding claim, characterized in that said sensor (12) is slidingly supported by said support element (15), which is in turn hinged to a temple piece (9) of the frame (2).

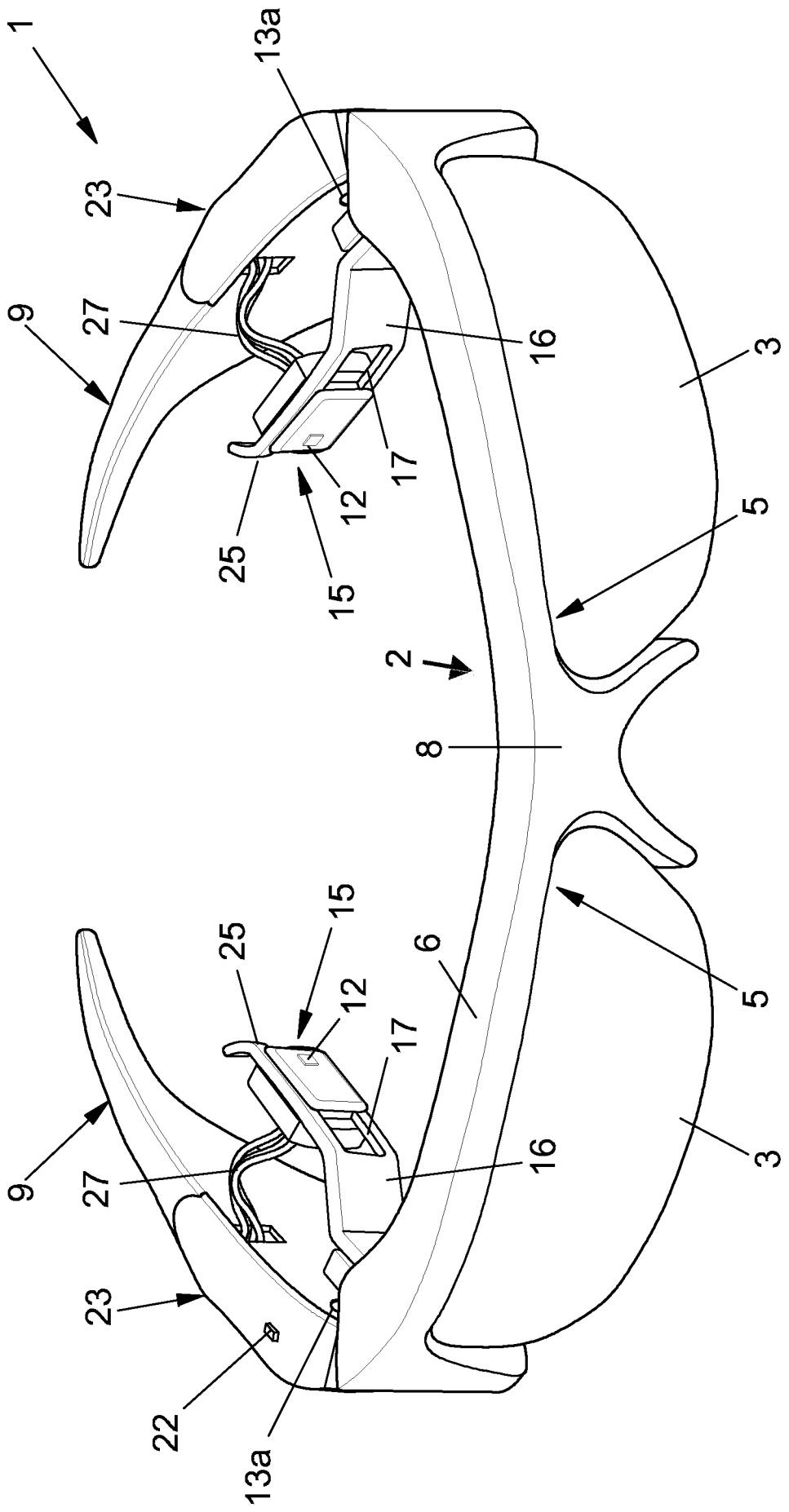


FIG.1

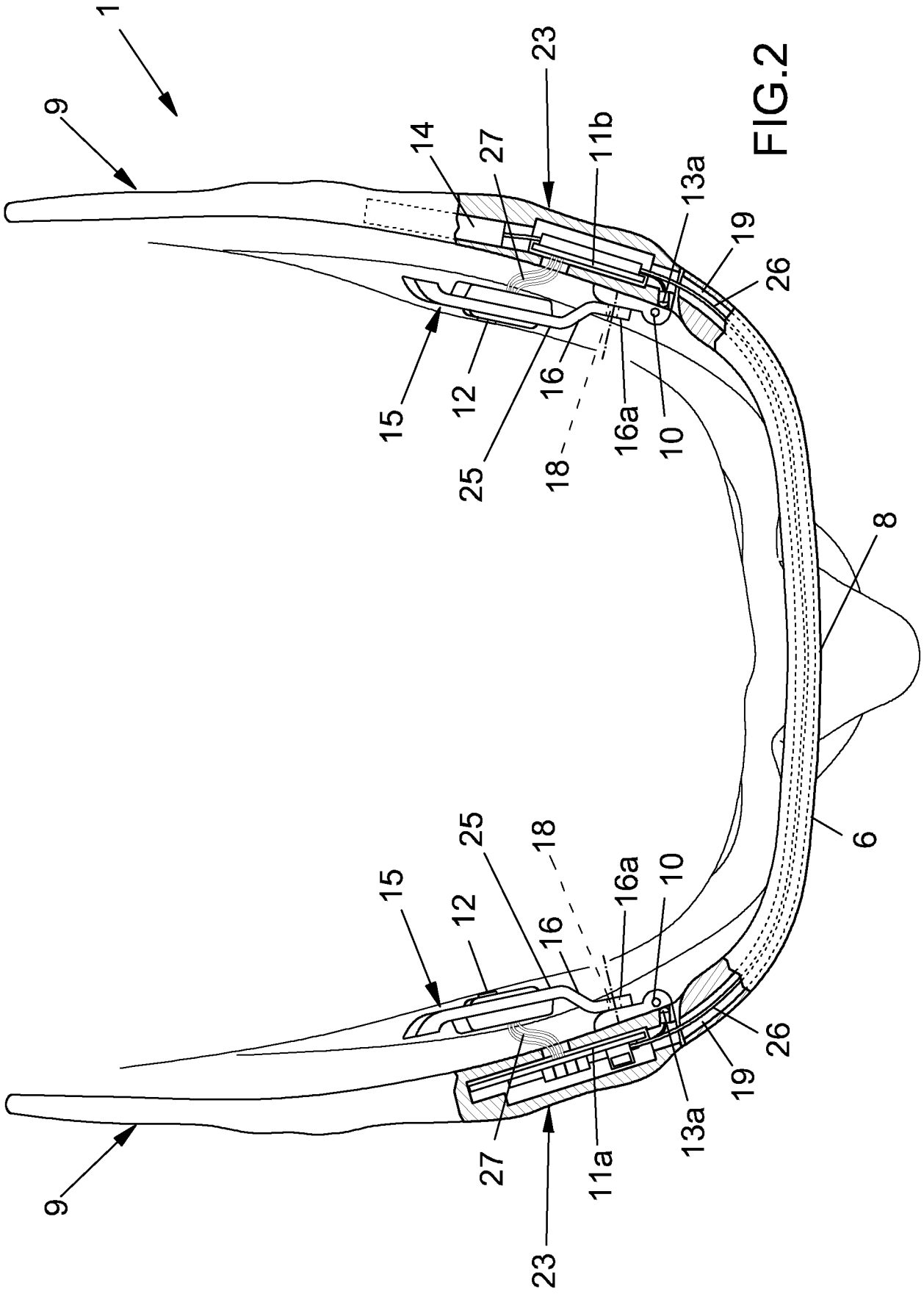


FIG.2

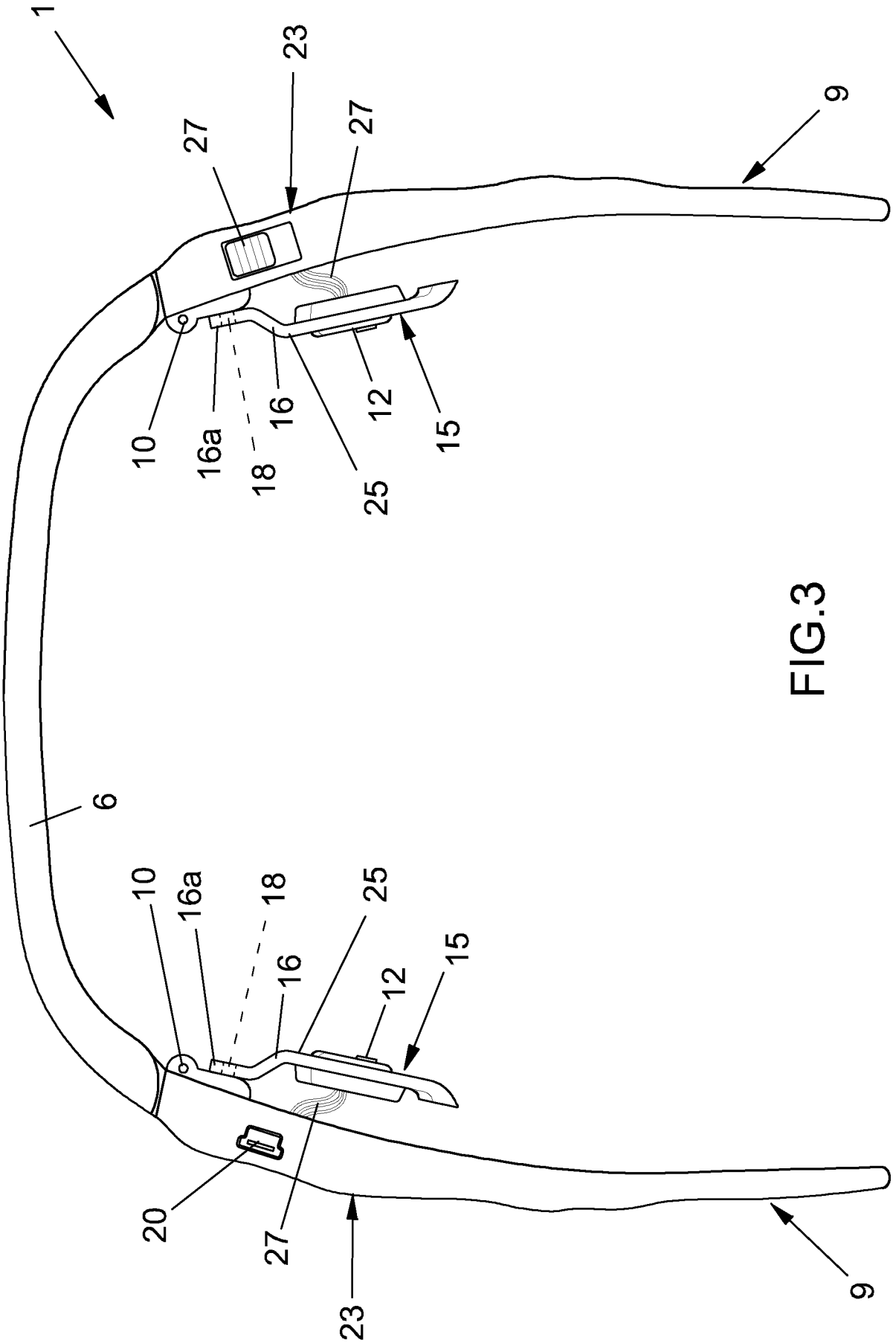
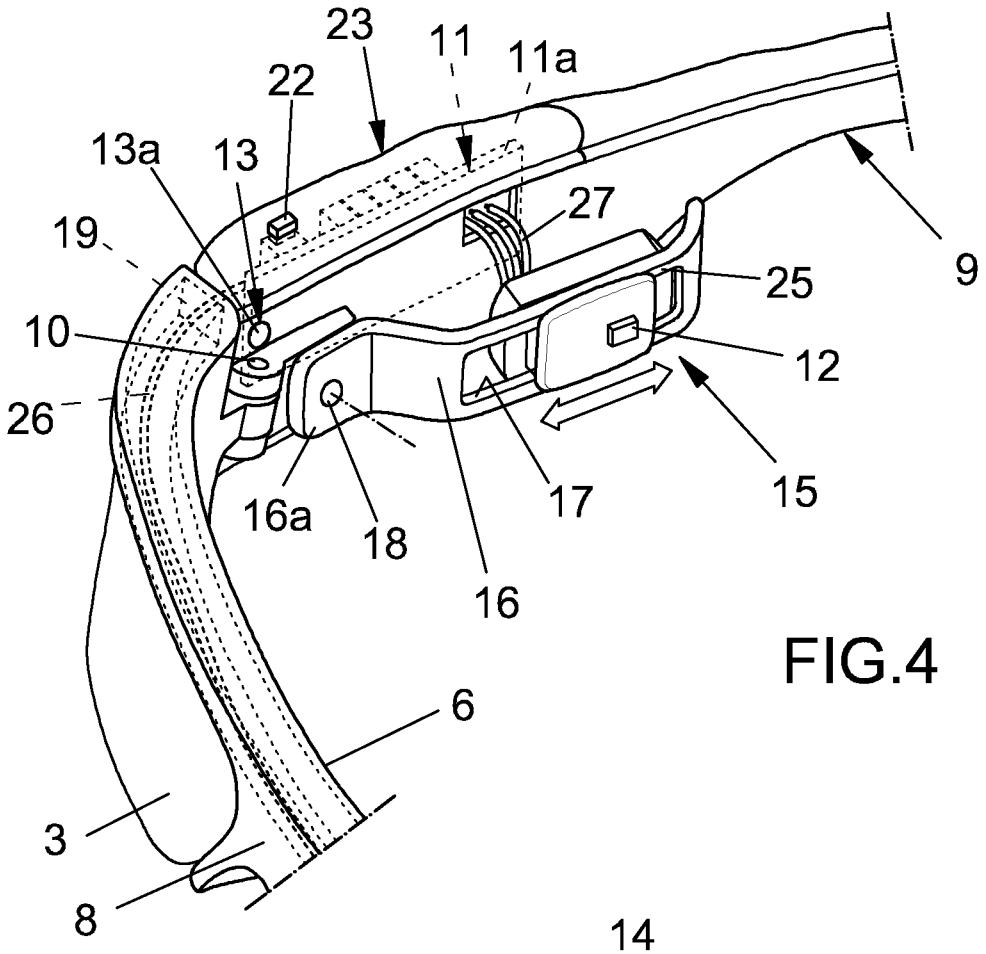


FIG.3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11
11a
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13a
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12
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15
16a
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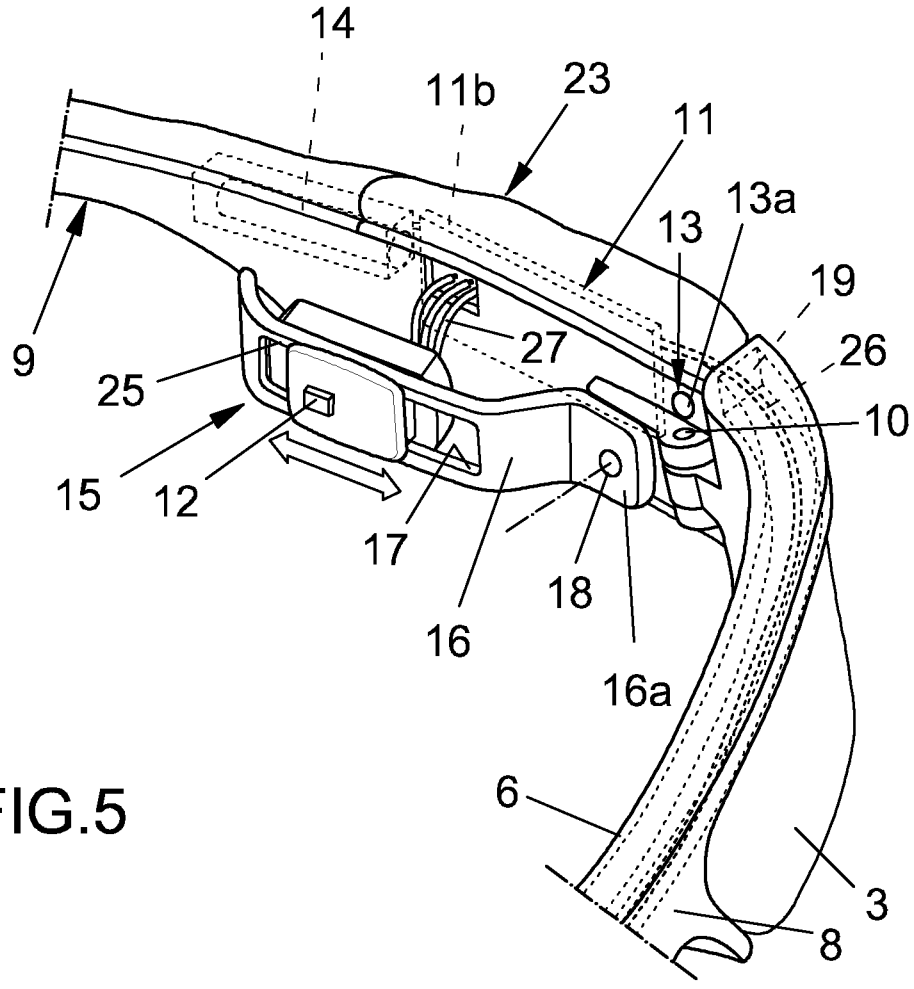
FIG.4


14
11b
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16a
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8

FIG.5

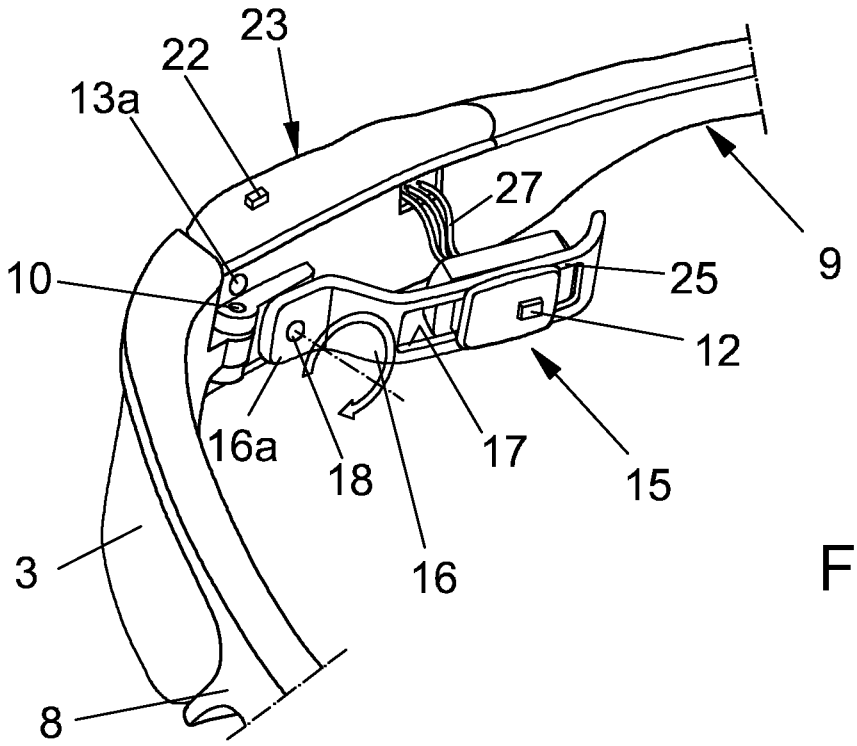


FIG.6

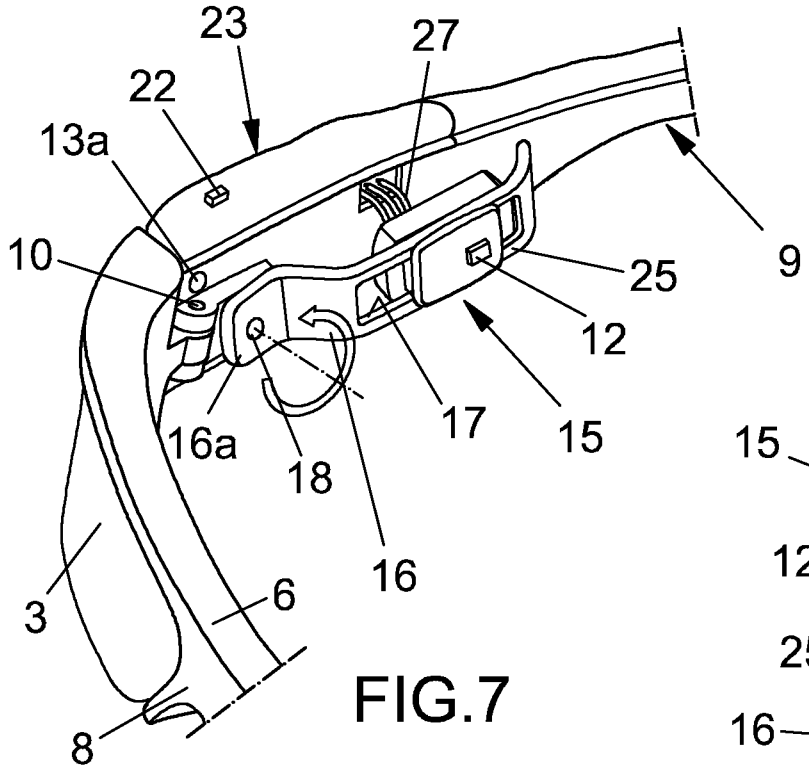


FIG.7

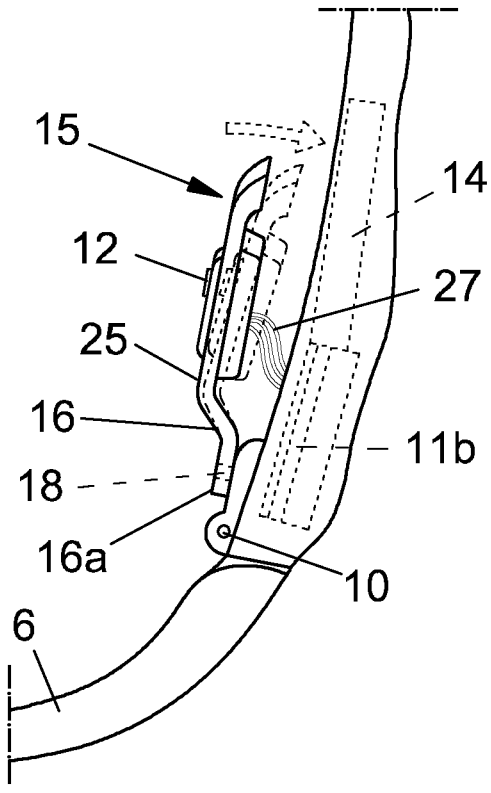
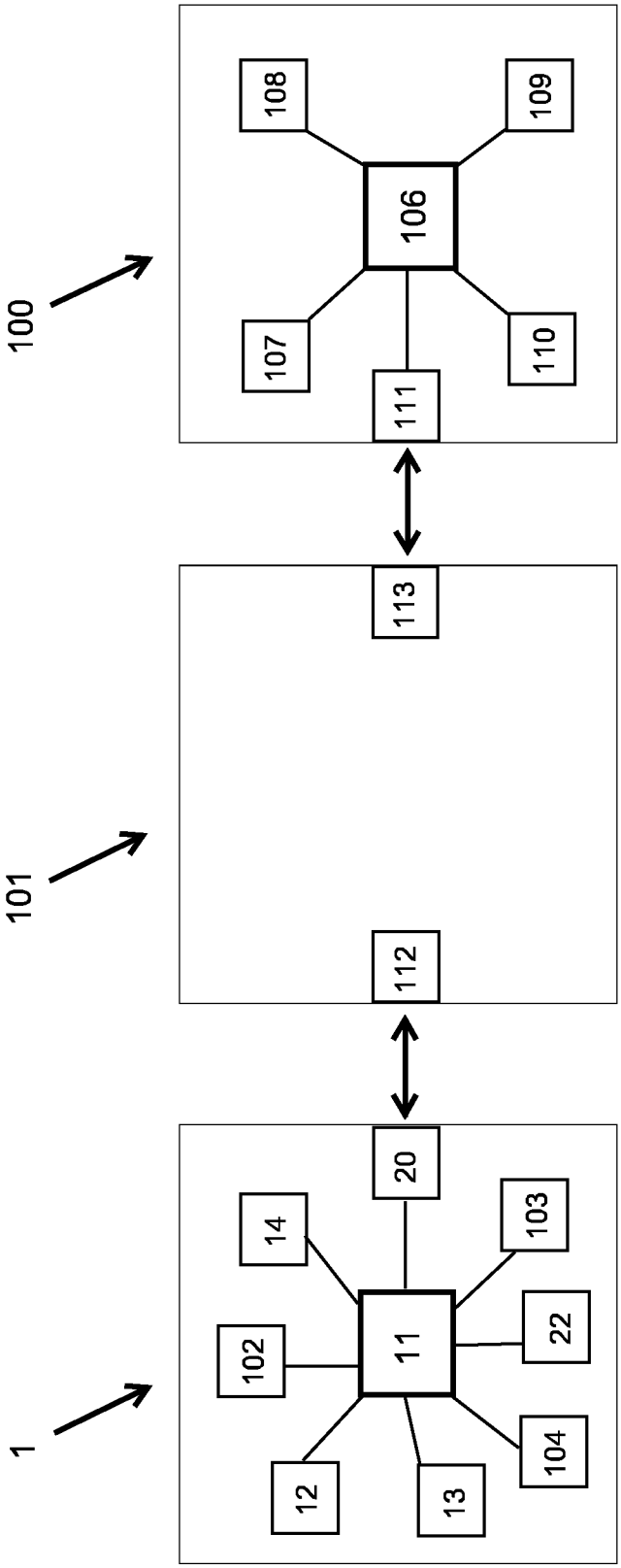


FIG.8


100
108
109
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107
110
111
113
101
112
1
20
14
103
102
11
22
104
12
13

FIG. 9

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2014/050336

A. CLASSIFICATION OF SUBJECT MATTER
INV. A61B5/024 A61B5/00 G02C11/00
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
A61B G02C A63B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2007/109491 A1 (HOWELL THOMAS A [US] ET AL) 17 May 2007 (2007-05-17) paragraphs [0029] - [0038], [0047] - [0051], [0058] - [0068], [0077] - [0079]	1-13
X	IT MI20 101 083 A1 (CARRARA MARCO) 17 December 2011 (2011-12-17) the whole document	1-5
A	US 6 431 705 B1 (LINDEN HARRY A [US]) 13 August 2002 (2002-08-13) the whole document	1-13

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

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Date of the actual completion of the international search	Date of mailing of the international search report
17 April 2014	30/04/2014

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Manschot, Jan

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2014/050336

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2007109491 A1	17-05-2007	NONE	
IT MI20101083 A1	17-12-2011		
US 6431705 B1	13-08-2002	NONE	

专利名称(译)	获取和处理心率数据的方法		
公开(公告)号	EP2943117A1	公开(公告)日	2015-11-18
申请号	EP2014700278	申请日	2014-01-09
[标]申请(专利权)人(译)	卡拉拉MARCO		
申请(专利权)人(译)	卡拉拉MARCO		
当前申请(专利权)人(译)	卡拉拉MARCO		
[标]发明人	CARRARA MARCO		
发明人	CARRARA, MARCO		
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优先权	102013902116434 2013-01-10 IT		
外部链接	Espacenet		

摘要(译)

用于获取和处理心率数据的方法包括以下步骤：·提供至少一对眼镜（1），其包括微控制器（11），至少一个可定位在用户的解剖区域上的心率传感器（12），至少一个配置存储器（102），至少一个数据存储器（103），时钟/日历电子电路（104），至少一个视觉和/或听觉信号单元（13），至少一个可充电自主电源源（14）和至少一个开关，用于至少接通/断开心率检测功能。 •在眼镜（1）外部提供至少一个编程和数据传输单元（100）•在眼镜（1）与外部编程和数据传输单元（100）之间提供至少一个连接系统（101）•借助于所述外部编程和数据传输单元（100）对眼镜（1）的配置存储器（102）进行编程，具有至少最小心率阈值，最大心率阈值和心率读取频率值·在用户佩戴眼镜（1）的活动期间获取眼镜（1）的数据存储器（103）中的多个读数，其中每个读数包括检测到的心脏，速率值和相应的检测时间•在所述活动期间，通过视觉和/或听觉信号单元（13）实时处理当当前读数包括不低于最大心率阈值的检测到的心率值时的至少一个警报信号或不高于最低心率阈值。