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Komulainen et al.

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(54) **WRIST-WORN PHYSICAL ACTIVITY MEASUREMENT APPARATUS**

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(51) **Int. Cl.**

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G01C 22/00	(2006.01)
A61B 5/11	(2006.01)
A61B 5/00	(2006.01)
A44C 5/10	(2006.01)
A44C 5/00	(2006.01)

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

CPC ***A63B 24/0062*** (2013.01); ***A44C 5/105*** (2013.01); ***A61B 5/1118*** (2013.01); ***A61B 5/681*** (2013.01); ***G01C 22/006*** (2013.01); *A44C 5/0015* (2013.01)

(58) **Field of Classification Search**

CPC A44C 5/105; A63B 24/0062
USPC 702/160; 368/281; 59/80; 24/365
See application file for complete search history.

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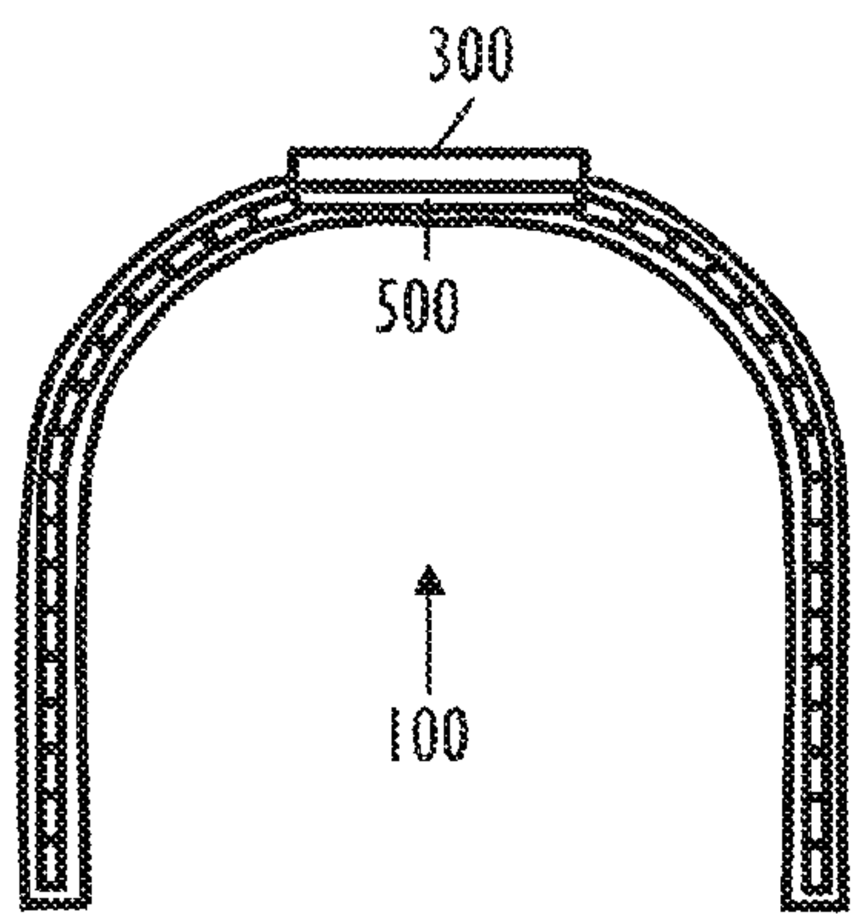
(57) **ABSTRACT**

A wrist-worn physical activity measurement apparatus is disclosed. The apparatus includes a bracelet comprising a plurality of links, each link being formed at one side to comprise a part and at the opposite side a counterpart interlocking with a part of an adjacent link, and a flexible casing encasing the plurality of the links. The apparatus is attachable around a curvature of a wrist of a user such that the links and the adjacent links are pivotably lockable in relation to each other in order to wrap and lock around the wrist.

17 Claims, 4 Drawing Sheets



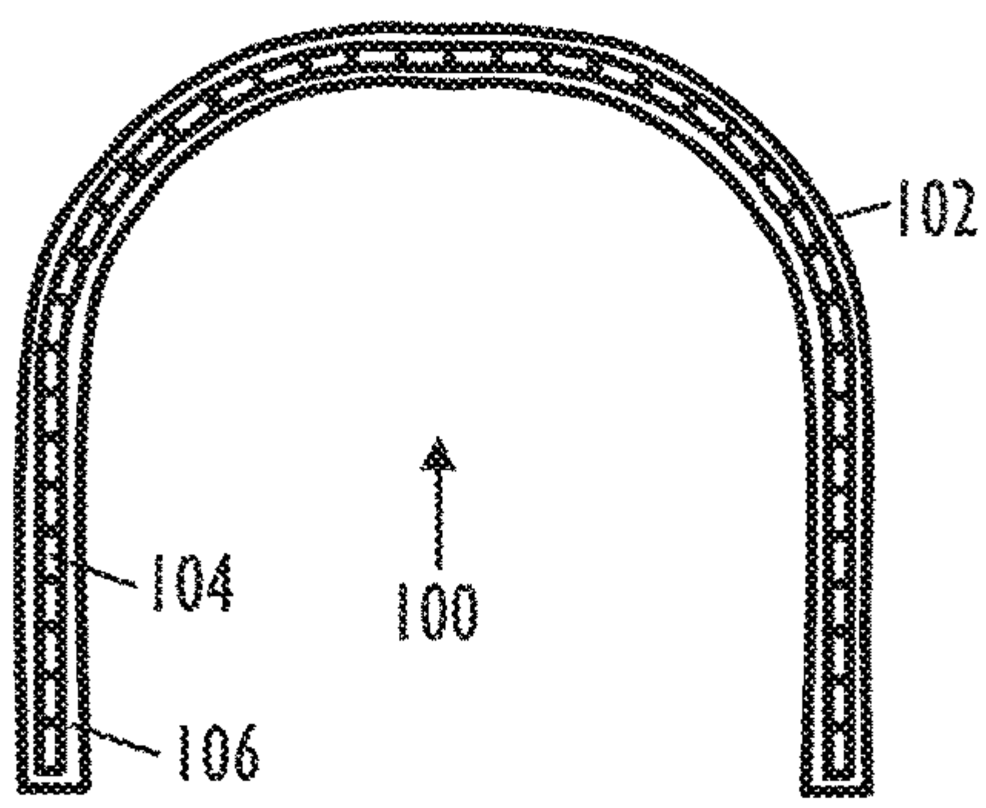


FIG. 1

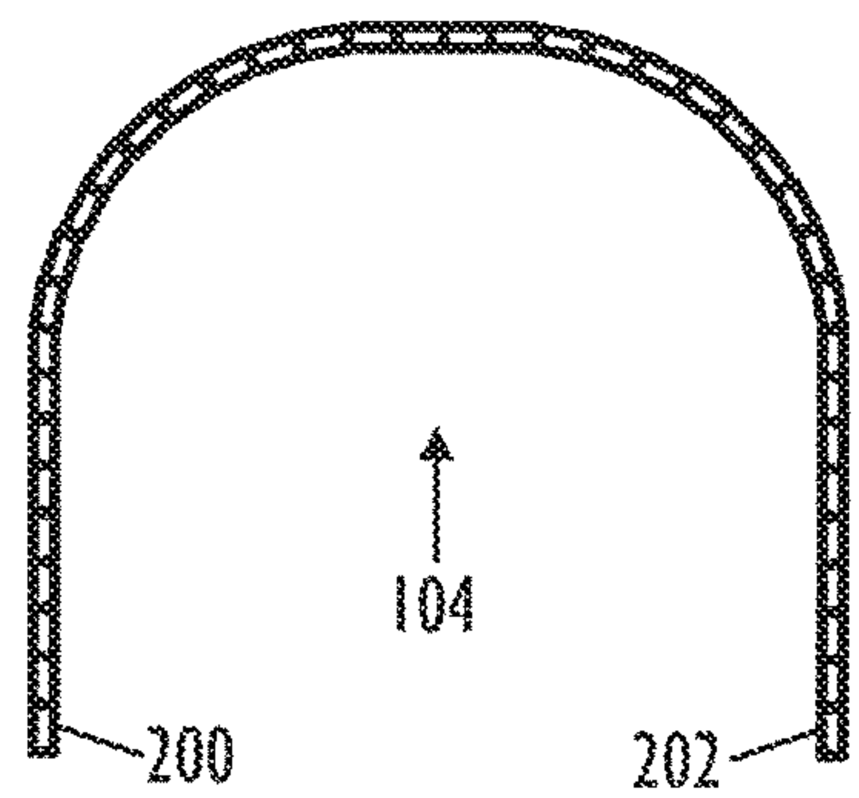


FIG. 2

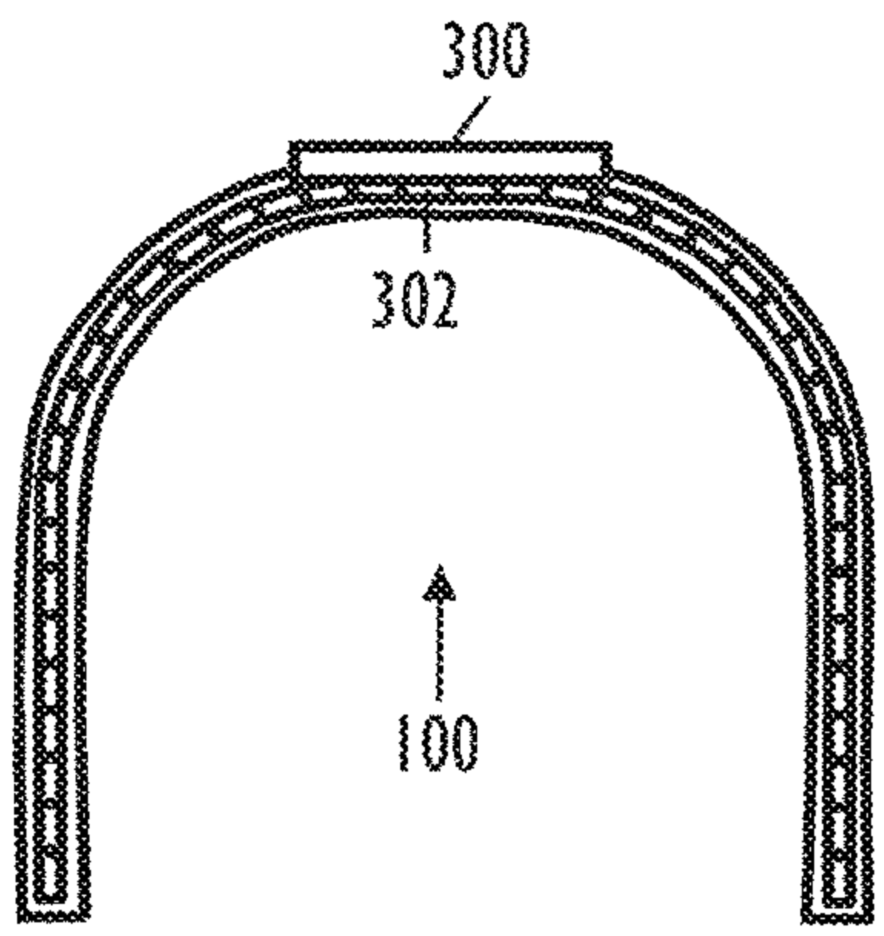


FIG. 3

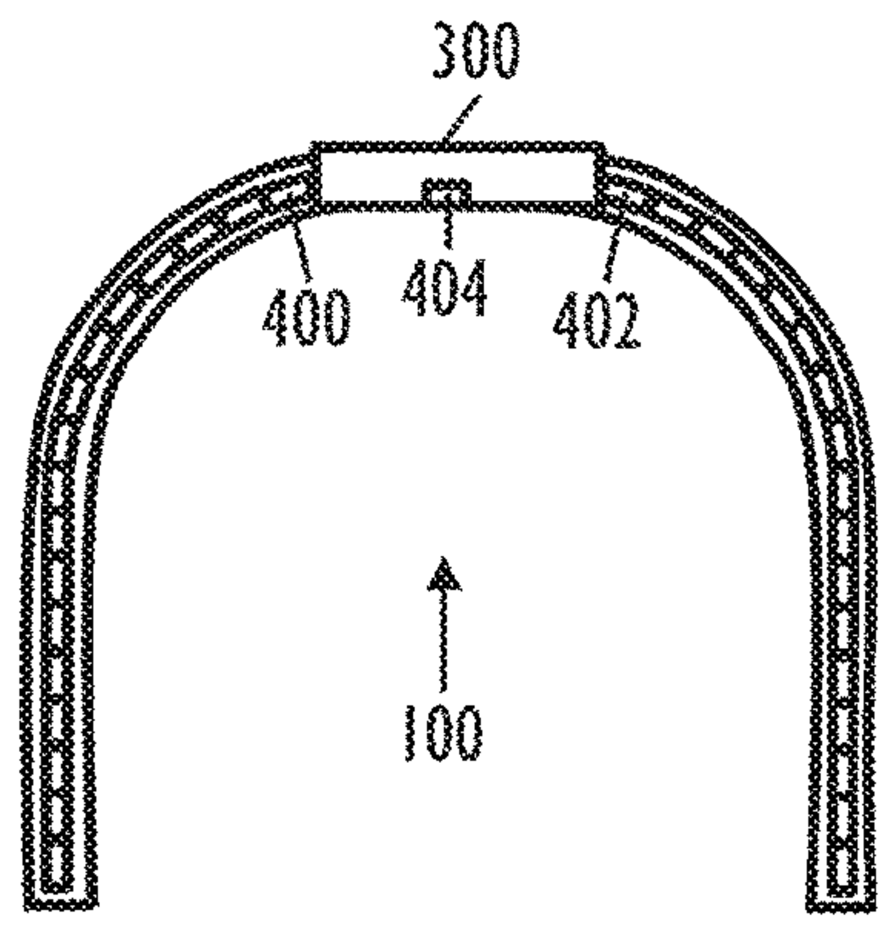


FIG. 4

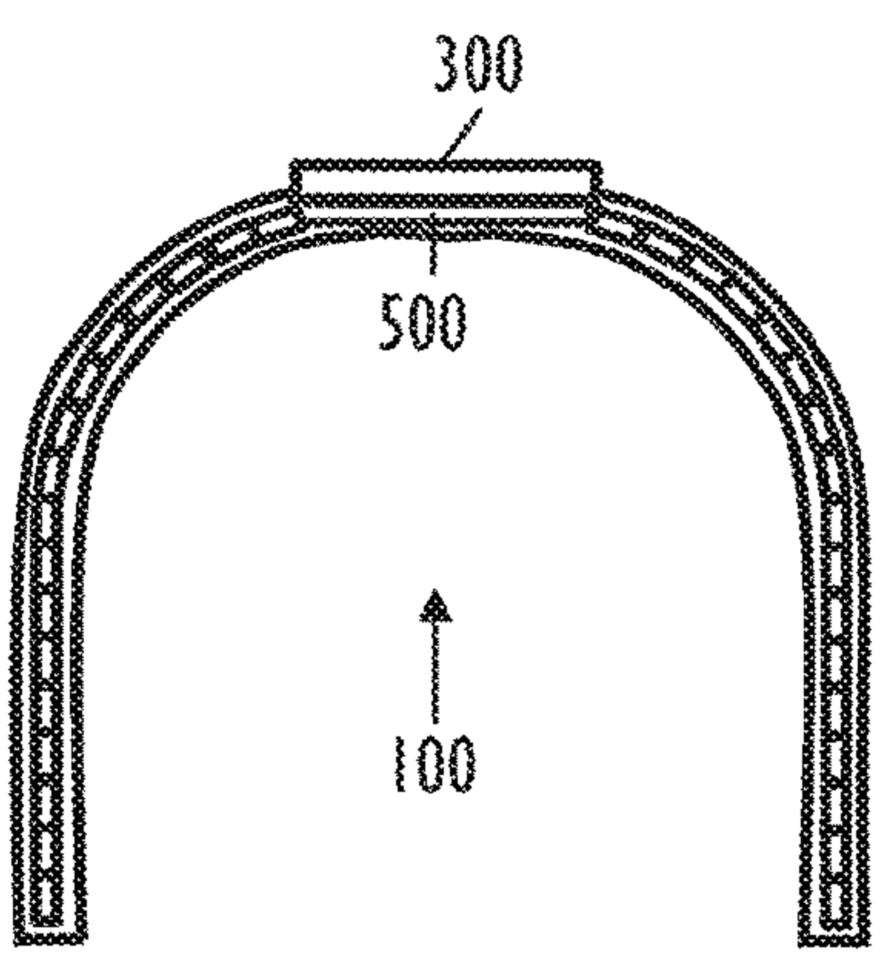


FIG. 5

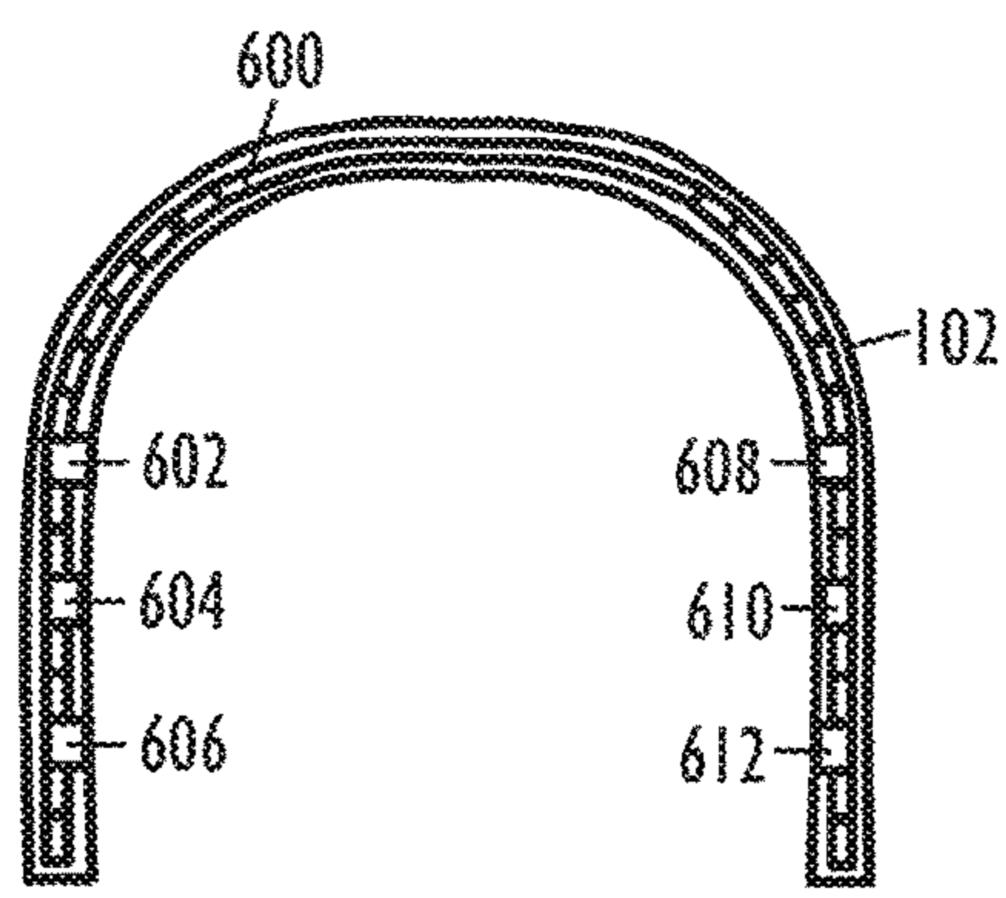


FIG. 6

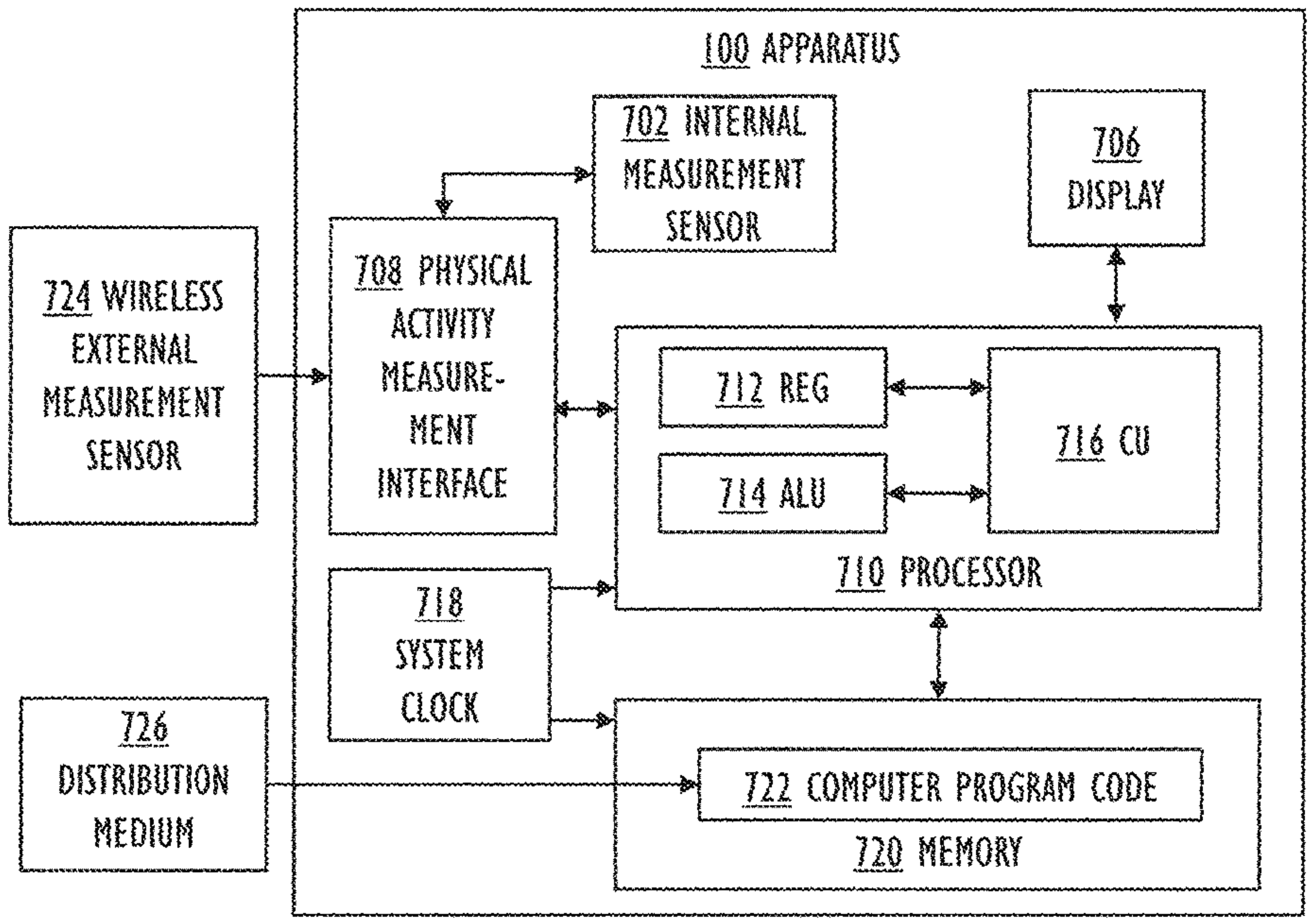


FIG. 7

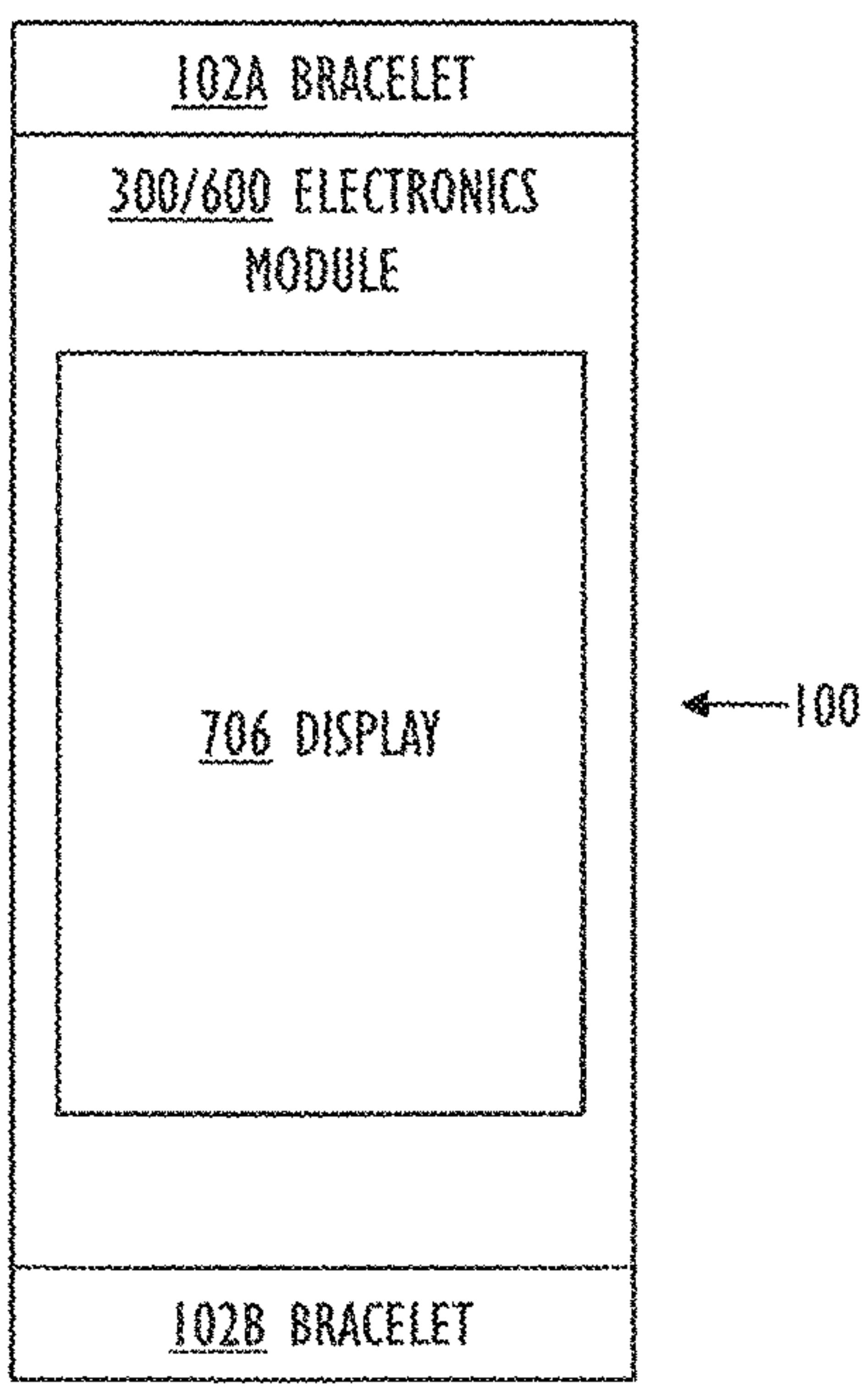


FIG. 8

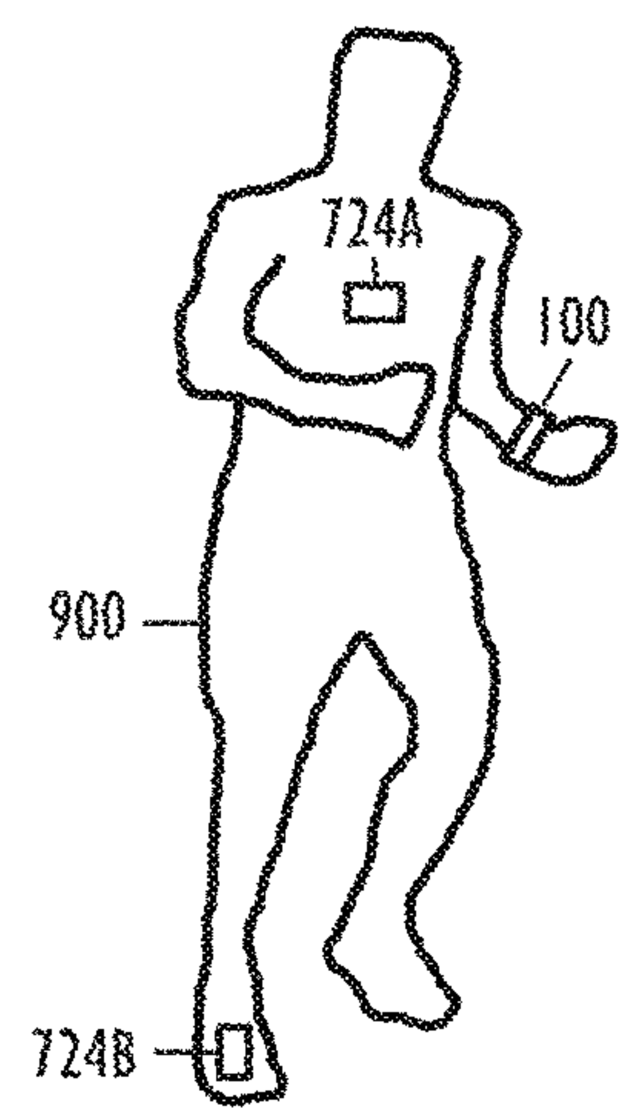


FIG. 9

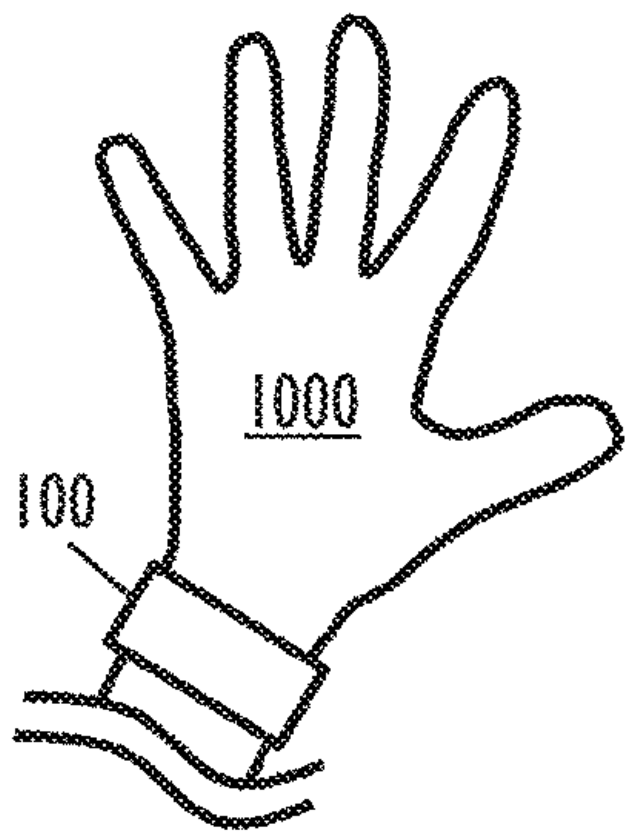


FIG. 10

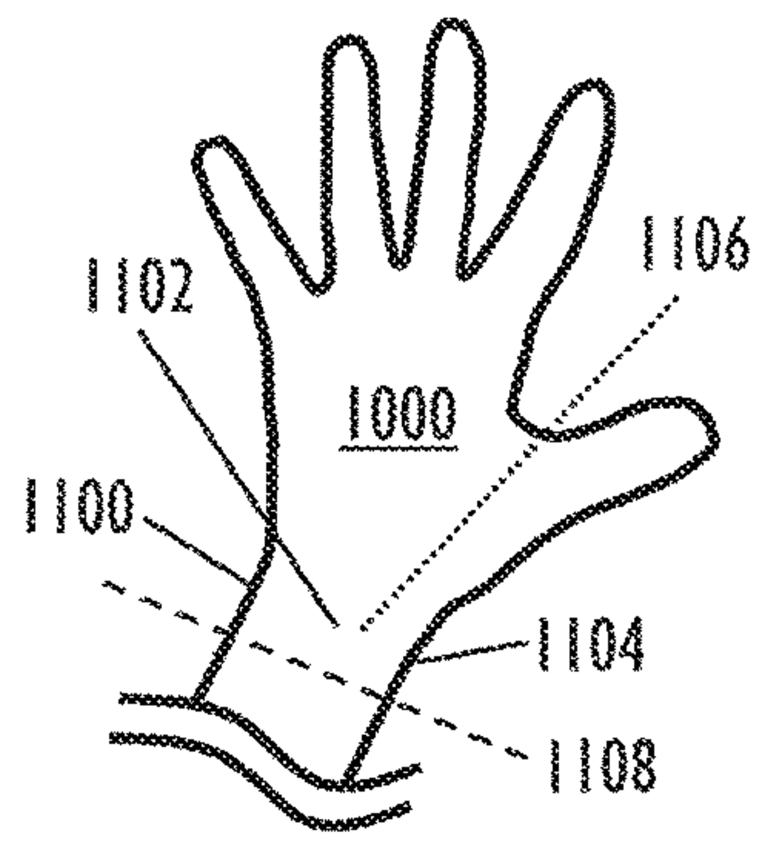


FIG. 11

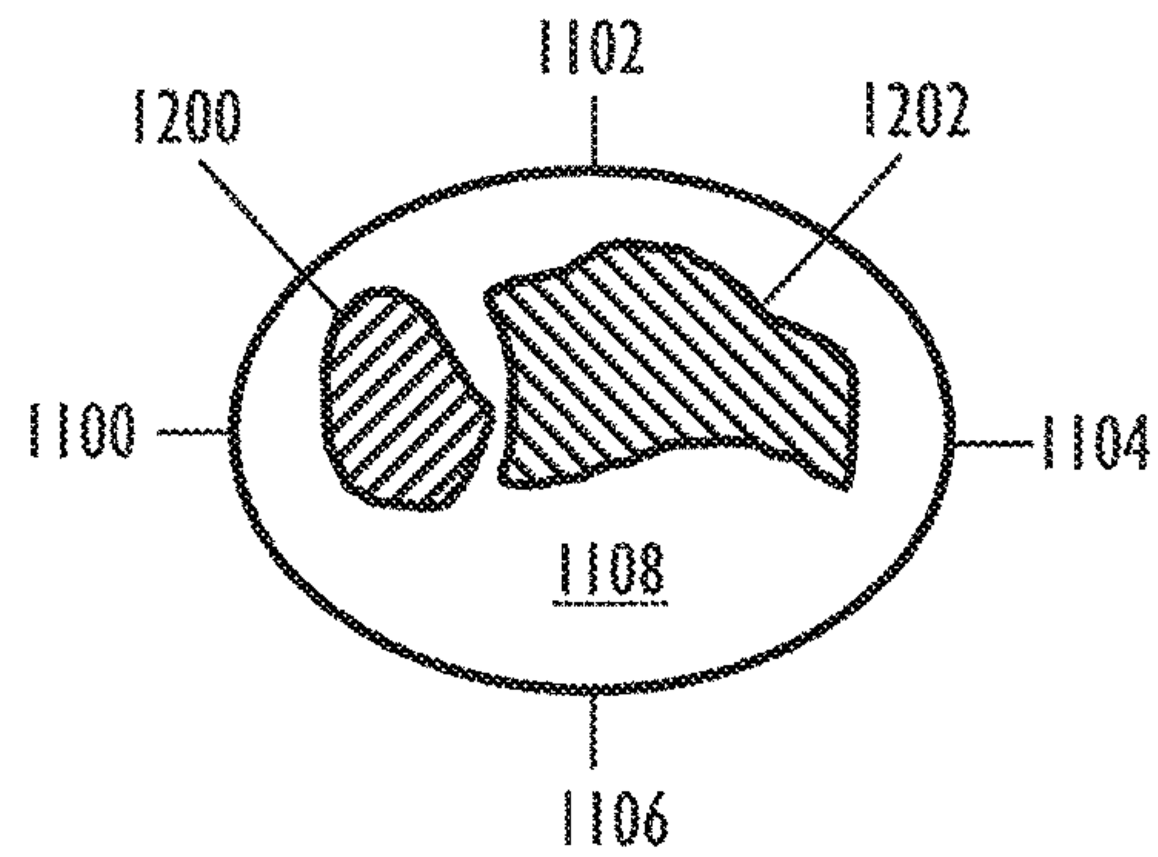


FIG. 12

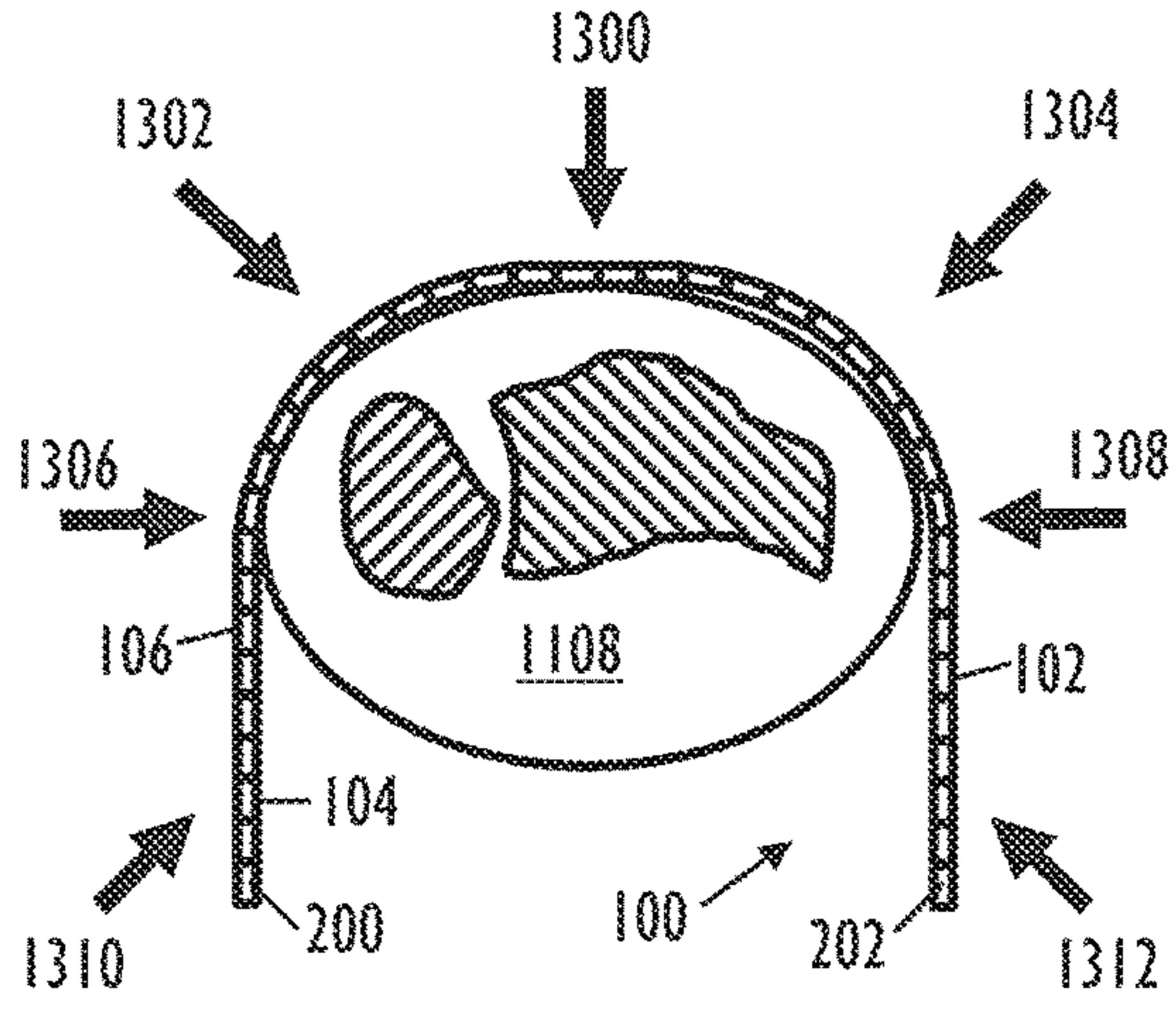


FIG. 13

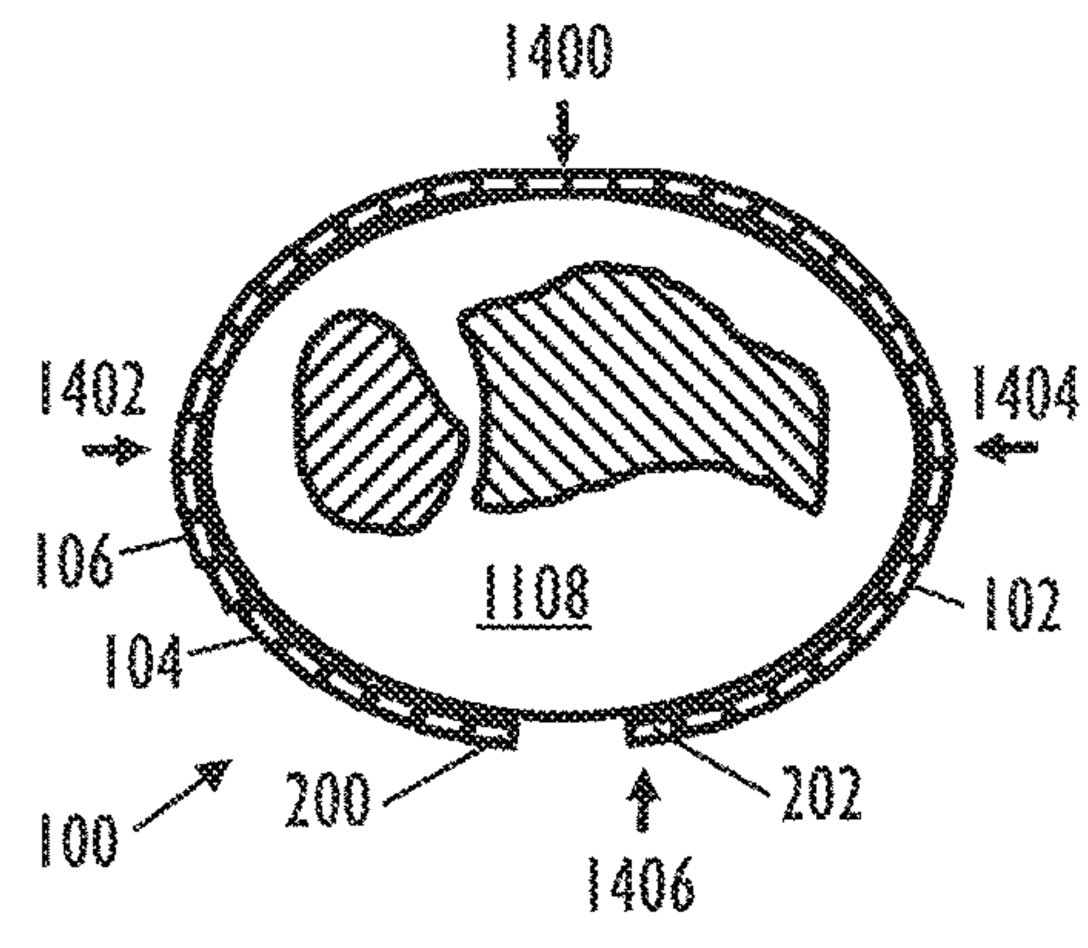


FIG. 14

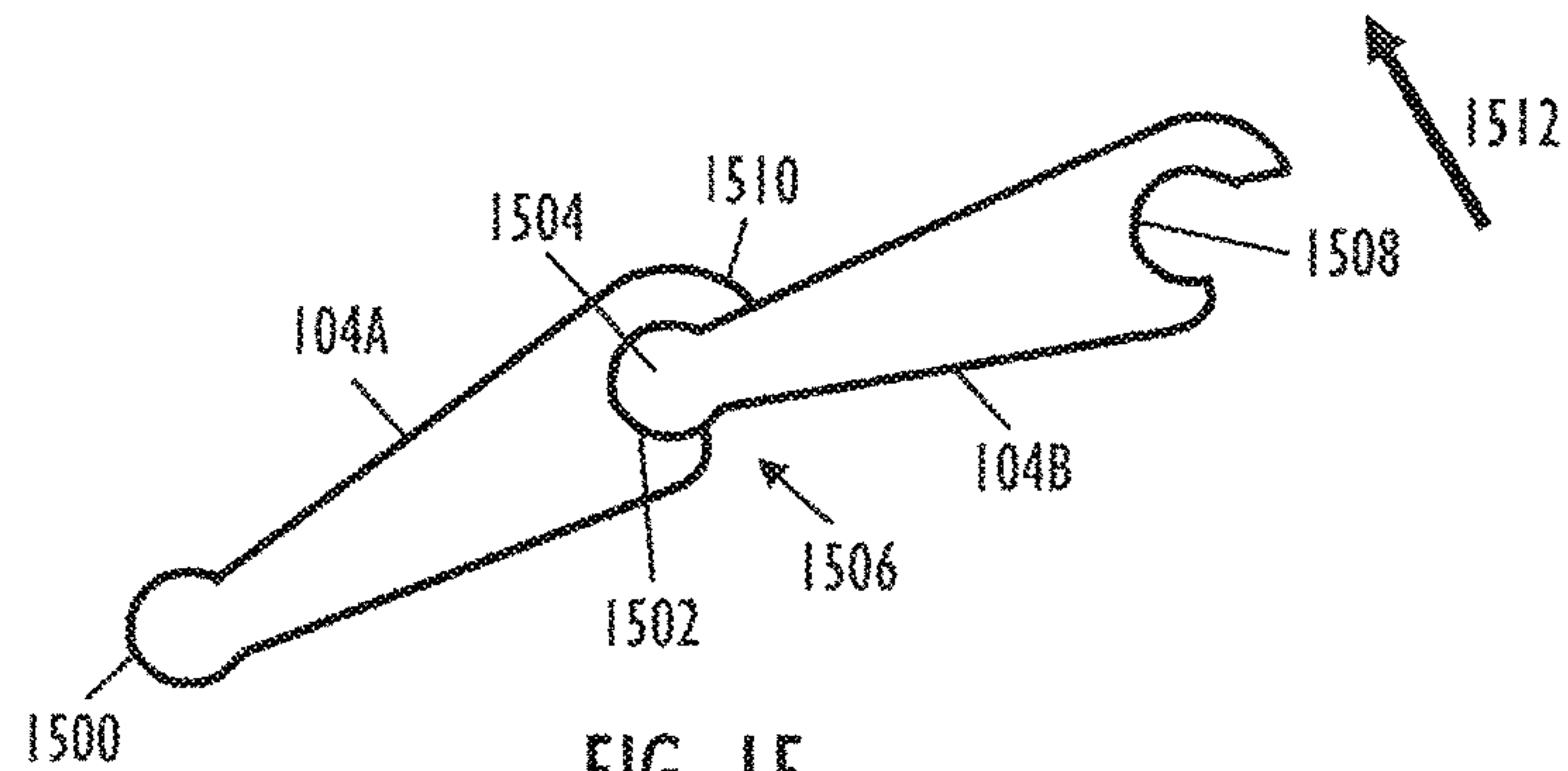


FIG. 15

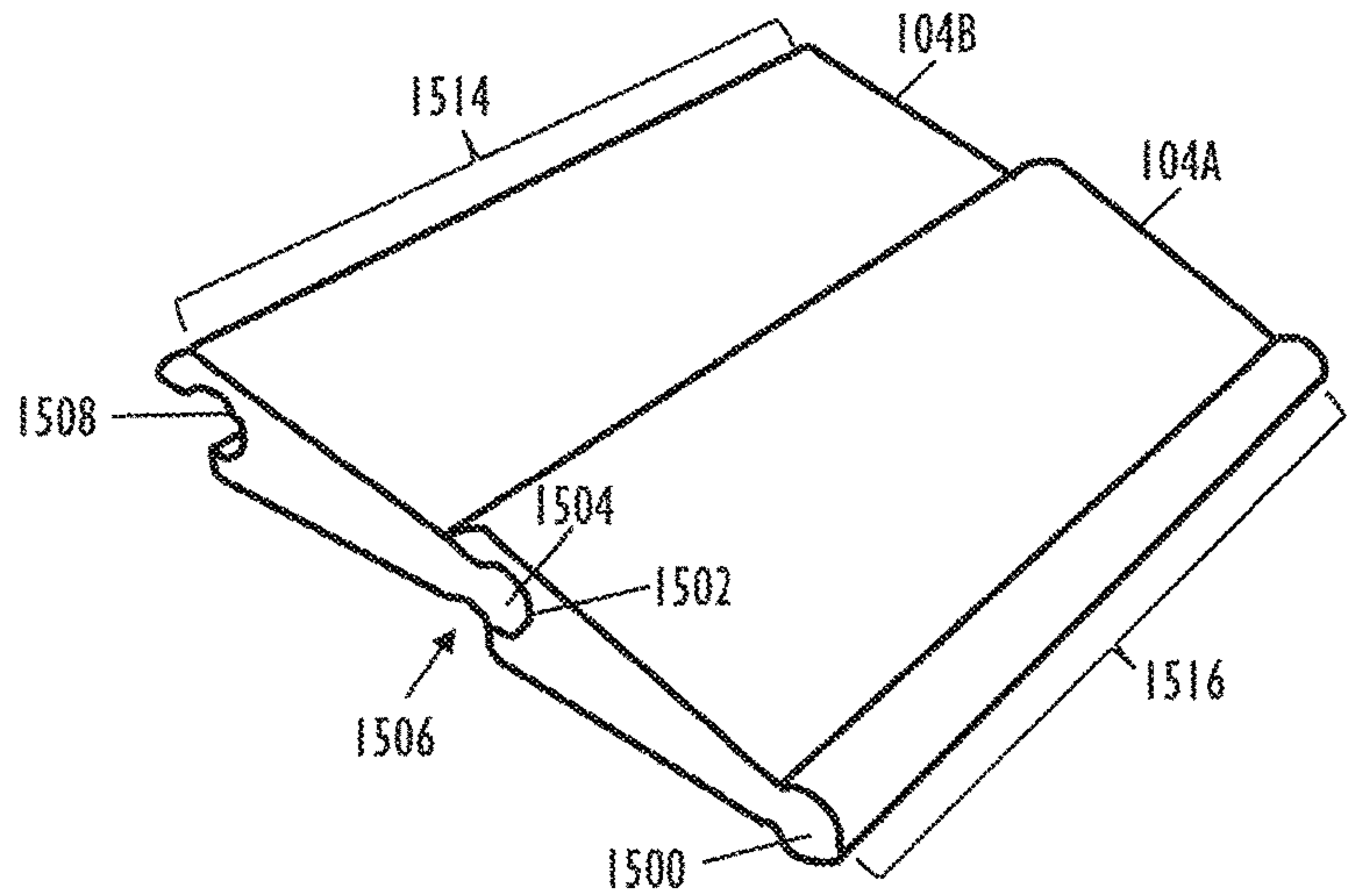


FIG. 16

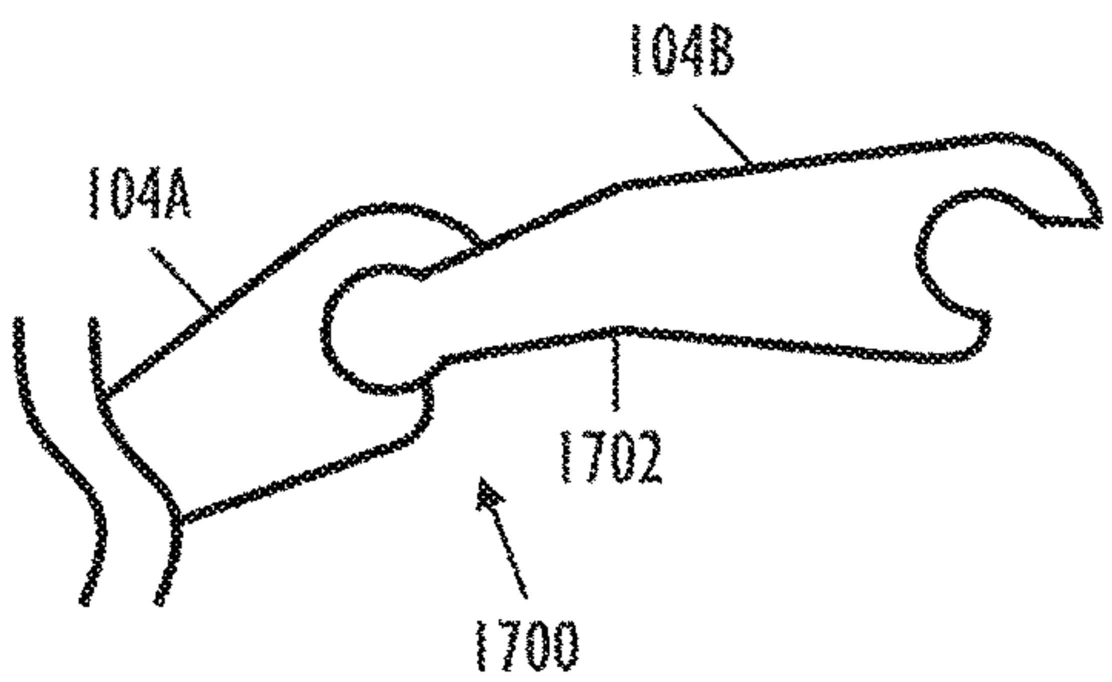


FIG. 17

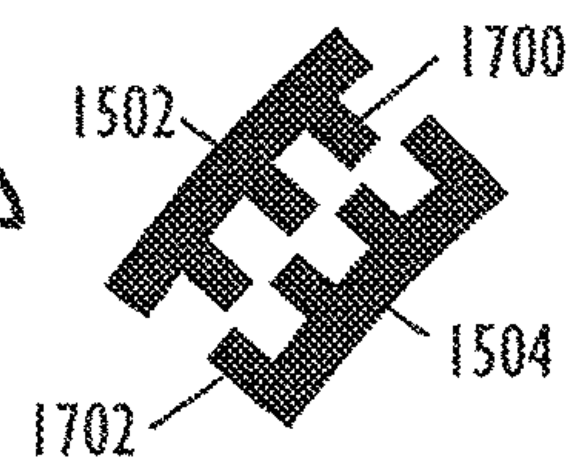


FIG. 18A

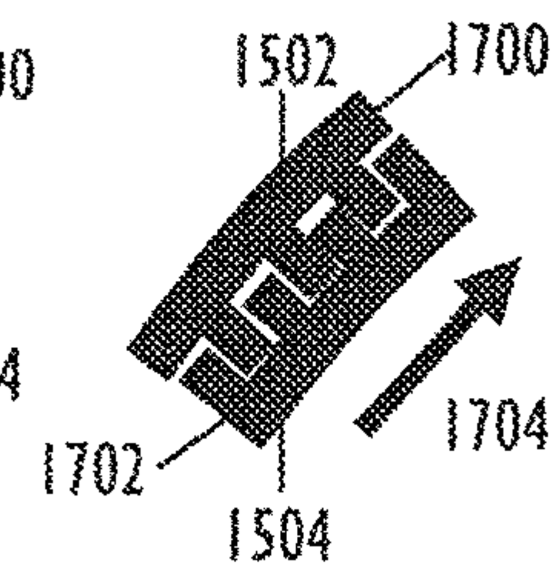


FIG. 18B

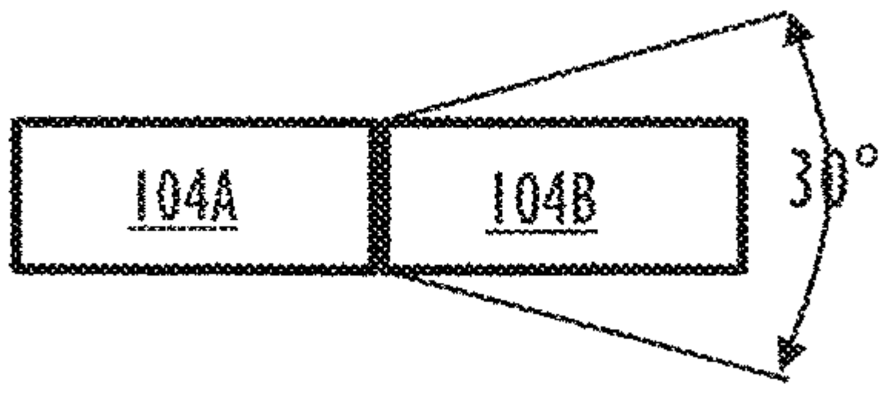


FIG. 19A

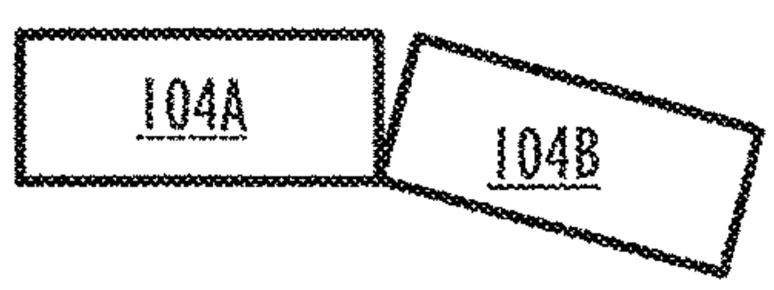


FIG. 19B

WRIST-WORN PHYSICAL ACTIVITY MEASUREMENT APPARATUS

BACKGROUND

Field

The invention relates to a wrist-worn physical activity measurement apparatus.

Description of the Related Art

Wrist-worn apparatuses capable of a physical activity measurement such as sports watches utilize a bracelet for attaching the apparatus around the wrist. Usability of the apparatus may be affected by how easy and comfortable it is to attach, wear and take off the apparatus.

SUMMARY

The present invention seeks to provide an improved wrist-worn physical activity measurement apparatus.

According to an aspect of the present invention, there is provided an apparatus as specified in claim **1**.

BRIEF DESCRIPTION OF THE DRAWINGS

Example embodiments of the present invention are described below, by way of example only, with reference to the accompanying drawings, in which

FIGS. **1**, **2**, **3**, **4**, **5**, **6**, **7**, **8** and **9** illustrate example embodiments of a structure of an apparatus;

FIGS. **10**, **11**, **12**, **13** and **14** illustrate example embodiments of a use of the apparatus; and

FIGS. **15**, **16**, **17**, **18**A, **18**B, **19**A and **19**B illustrate further example embodiments of the structure of the apparatus.

DETAILED DESCRIPTION

The following embodiments are only examples. Although the specification may refer to "an" embodiment in several locations, this does not necessarily mean that each such reference is to the same embodiment(s), or that the feature only applies to a single embodiment. Single features of different embodiments may also be combined to provide other embodiments. Furthermore, words "comprising" and "including" should be understood as not limiting the described embodiments to consist of only those features that have been mentioned and such embodiments may contain also features/structures that have not been specifically mentioned.

It should be noted that while Figures illustrates various example embodiments of the apparatus **100**, they are only a simplified block diagrams that only shows some structures and functional entities. It is apparent to a person skilled in the art that the described apparatus **100** may also comprise other functions and structures. It should be appreciated that details of some functions and structures, are irrelevant to the actual invention. Therefore, they need not be discussed in more detail here.

FIG. **1** illustrates an example embodiment of a structure of a wrist-worn physical activity (such as sports, exercise or other physical activity) measurement apparatus **100**.

The apparatus **100** comprises a bracelet **102** comprising a plurality of links **104**, and a flexible casing **106** encasing the plurality of the links **104**.

FIG. **2** illustrates the plurality of the links **104**: in this example embodiment there are forty links forming a chain from the first link **200** to the last link **202**, but, naturally, the number and size of the links **104** may vary in order to accommodate wrists with varying circumferences.

In an example embodiment, the apparatus **100** further comprises an electronics module coupled with the bracelet **102**.

In an example embodiment of FIG. **3**, the electronics module **300** is attached to at least one **302** of the links **104**: in this example embodiment to six of the links **104**, but, naturally, the number of the links **104** may vary as required in order to achieve the required fixing.

In an example embodiment of FIG. **4**, the electronics module **300** is attached between two **400**, **402** of the links **104**.

In an example embodiment of FIG. **5**, at least one **500** of the links **104** is a special link, in which the electronics module **300** is integrated.

In an example embodiment, the electronics module **300** comprises a biosignal measurement sensor, and/or a processor module comprising one or more processors and one or more memories including computer program code.

FIG. **4** further illustrates an example embodiment, wherein the electronics module **300** comprises a biosignal measurement sensor **404**. In an example embodiment, the measurement sensor **404** is an optical measurement sensor capable of measuring heart rate information from the wrist of the user. In an example embodiment, the optical measurement sensor **404** operates as follows: at least one LED projects light on the skin of the wrist, whereupon an electro-optical cell detects heart rate by examining pulsing volume of blood flow in the wrist.

FIG. **6** illustrates an example embodiment, wherein the electronics module **300** is distributed in the bracelet **102**: a main electronics module **600** communicates with a plurality of measurement sensors **602**, **604**, **606**, **608**, **610**, **612**. In an example embodiment, the measurement sensors **602**, **604**, **606**, **608**, **610**, **612** are bioimpedance measurement sensors capable of measuring physiological parameters such as heart rate information from the wrist of the user. In an example embodiment, the bioimpedance measurement sensors **602**, **604**, **606**, **608**, **610**, **612** measure the resistance of wrist tissue to an electric current in order to capture physiological signals of the user. In an example embodiment, the measurement sensors **602**, **604**, **606**, **608**, **610**, **612** are coupled with the main electronics module **600** by conductors, which may run inside the bracelet **102** independently, or integrated with the links **104** or the flexible encasing **106**.

Besides these two types of biosignal measurement sensors, also other types of biosignal measurement sensors may be embedded into the electronics module **300**. These types include but are not limited to the following: a PPG (photoplethysmography) sensor, a Laser Doppler-based blood flow sensor, a magnetic blood flow sensor, an EMFI pulse sensor, a polarization blood flow sensor.

FIG. **6** also illustrates an example embodiment, wherein the main electronics module **600** is of flexible material which adapts to the curvature of the wrist. Accordingly, the electronics module **300** may be embedded inside a (possibly waterproof) casing, or, alternatively, the electronics module **600** may be implemented with flexible printed electronics.

FIG. **7** illustrates an example embodiment, wherein the apparatus **100** comprises the electronics module **300**, **600**, which comprises one or more processors **710**, and one or more memories **720** including computer program code **722**. The one or more memories **720** and the computer program code **722** are configured to, with the one or more processors **710**, cause the apparatus **100** at least to perform a function related to a physical activity measurement on the user, wherein the function comprises at least one of a control of an apparatus **100** internal sensor **702** measuring functioning of the body of the user, a control of an apparatus **100** external sensor **724** measuring functioning of the body of the user, a control of a heart rate measurement of the user, a control of an acceleration measurement related to a movement of the user, a control of a well-being measurement of the user.

In an example embodiment, the apparatus **100** comprises a physical activity measurement sensor interface **708**, which may be utilized to obtain measurement data obtained by monitoring a user of the apparatus **100**.

The sensors **702**, **724** may produce the physical activity-related measurement data such as sports, exercise or activity related data. A non-exhaustive list of sensors **702**, **724** includes heart rate sensors, motion sensors, location sensors, swimming sensors and bike sensors, as well as other sensors gathering information regarding the training. The heart rate sensors include, but are not limited to, a cardiovascular sensor (such as an electrocardiogram ECG sensor), an optical heart rate sensor (heart rate, heart rate variability), and a bioimpedance sensor. Motion sensors may include accelerometers worn on chest, wrist, or ankle, for example. Location sensors may utilize GPS (Global Positioning System) or other satellite-based, or radio system-based system for locating the user and measuring various parameters (speed, distance, location, route) relating to the movement of the user. Swimming sensors may measure swimming specific parameters such as number of strokes or distance, for example. Bike sensors may be sensors attached to various parts of the bike for measuring speed, cadence, or power, for example. The gathered sensor information may be utilized to calculate further physical activity-related measurement data of the user such as total energy consumption, an energy consumption speed, an activity level, a cumulated activity, for example.

As illustrated in FIG. **7**, the sensors may be internal measurement sensors **702** (within the apparatus **100**) and/or wireless external measurement sensors **724** (outside of the apparatus **100**). The apparatus **100** may comprise a transceiver communicating with the wireless external measurement sensor(s) **724**, or even just a receiver for receiving measurements from the wireless external measurement sensors **724**. For the internal measurement sensors **702**, the interface **708** may be a suitable hardware communication interface such as a wired interface or an appropriate communication bus.

The term 'processor' **710** refers to a device that is capable of processing data. Depending on the processing power needed, the apparatus **100** may comprise several processors **710** such as parallel processors or a multicore processor. When designing the implementation of the processor **710**, a person skilled in the art will consider the requirements set for the size and power consumption of the apparatus **100**, the necessary processing capacity, production costs, and production volumes, for example. The processor **710** and the memory **720** may be implemented by an electronic circuitry.

The term 'memory' **720** refers to a device that is capable of storing data run-time (=working memory) or permanently (=non-volatile memory). The working memory and the non-volatile memory may be implemented by a random-access memory (RAM), dynamic RAM (DRAM), static RAM (SRAM), a flash memory, a solid state disk (SSD), PROM (programmable read-only memory), a suitable semiconductor, or any other means of implementing an electrical computer memory.

In an example embodiment, a system clock **718** constantly generates a stream of electrical pulses, which cause the various transferring operations within the apparatus **100** to take place in an orderly manner and with specific timing.

In an example embodiment, the processor **710** may be implemented as a microprocessor implementing functions of a central processing unit (CPU) on an integrated circuit. The CPU is a logic machine executing a computer program code **722**. The computer program code **722** may be coded as a computer program using a programming language, which may be a high-level programming language, such as C++, C, or Java, or a low-level programming language, such as a machine language, or an assembler. The CPU may comprise a set of registers **712**, an arithmetic logic unit (ALU) **714**, and a control unit (CU) **716**. The control unit **716** is controlled by a sequence of the computer program code **722** transferred to the CPU from the (working) memory **720**. The control unit **716** may contain a number of microinstructions for basic operations. The implementation of the microinstructions may vary, depending on the CPU design. The microprocessor **710** may also have an operating system (a dedicated operating system of an embedded system, a real-time operating system, or even a general-purpose operating system), which may provide the computer program code **722** with system services.

A non-exhaustive list of implementation techniques for the processor **710** and the memory **720** includes, but is not limited to: logic components, standard integrated circuits, application-specific integrated circuits (ASIC), system-on-a-chip (SoC), application-specific standard products (ASSP), microprocessors, microcontrollers, digital signal processors, special-purpose computer chips, field-programmable gate arrays (FPGA), and other suitable electronics structures.

The computer program code **722** may be implemented by software and/or hardware. In an example embodiment, the software may be written by a suitable programming language, and the resulting executable code **722** may be stored on the memory **720** and run by the processor **710**.

In an example embodiment, the functionality of the hardware may be designed by a suitable hardware description language (such as Verilog or VHDL), and transformed into a gate-level netlist (describing standard cells and the electrical connections between them), and after further phases the chip implementing the processor **710**, memory **720** and the code **722** of the apparatus **100** may be fabricated with photo masks describing the circuitry.

In an example embodiment, the processor **710** and the memory **720** of the apparatus **100** are a part of a microcontroller.

In an example embodiment, the processor **110** and the memory **120**, and the other electronic circuits **404**, **602**, **604**, **606**, **608**, **610**, **612** are separate entities, communicatively coupled together by an appropriate serial bus, for example. In general, interfaces between the various elements may be implemented with suitable interface technologies, such as a message interface, a method interface, a sub-routine call interface, a block interface, an appropriate serial/parallel bus, or any hardware/software means enabling communication between various sub-units of the apparatus **100**.

An example embodiment provides a computer-readable medium **726** for the apparatus **100** comprising a computer program comprising the computer program code **722**. Said computer program code **722**, when loaded into the apparatus **100** and executed in the apparatus **100**, causes the apparatus **100** to perform the function(s) related to the physical activity measurement on the user. In an example embodiment, the computer program code **722** may be in source code form, object code form, executable file, or in some intermediate form. The computer-readable medium 726 may comprise at least the following: any entity or device capable of carrying computer program code 722 to the apparatus 100, a record medium, a computer memory, a read-only memory, an electrical carrier signal, a telecommunications signal, and a software distribution medium. In some jurisdictions, depending on the legislation and the patent practice, the computer-readable medium 726 may not be the telecommunications signal. In an example embodiment, the computer-readable medium 726 may be a non-transitory computer readable storage medium.

In an example embodiment, the apparatus 100 comprises a display 706. The display 706 may be implemented with suitable technologies including, but not limited to at least the following: LCD (liquid crystal display), EL (electroluminescence), LED (light emitting diode), and OLED (organic light emitting diode).

FIG. 8 illustrates an example embodiment of the apparatus 100: a wrist-worn physical activity measurement apparatus with the electronics module 300/600, the display 706 facing outwards, and the bracelet 102A, 1028 for attaching the apparatus 100 to the wrist.

FIG. 9 illustrates an example embodiment of the apparatus 100. The user 900 is provided with the wrist-worn apparatus 100. Furthermore, the user 900 may be provided with a heart rate transmitter 724A strapped around the chest, and possibly also with a shoe-mounted stride sensor 724B. The accessories 724A, 724B communicate wirelessly with the apparatus 100. Various accessories may be flexibly used as needed, i.e. all of them are not necessarily needed all the time, or by all users, or in all use cases.

Next, with reference to FIGS. 10, 11, 12, 13 and 14, let us study example embodiments relating to the use of the apparatus 100.

The apparatus 100 is attached to the left hand (or, naturally, to the right hand) 1000 of the user. The hand 1000 comprise an ulna side 1100 of the wrist, a back of the hand side 1102 of the wrist, a radius side 1104 of the wrist, and a palm side 1106 of the wrist.

FIG. 12 illustrates a cross-section 1108 of the hand 1000, with cross-sections of an ulna bone 1200 and a radius bone 1202.

FIG. 13 illustrates the apparatus 100 being positioned over the wrist 1108. Each link 104 is formed at one side to comprise a part and at the opposite side a counterpart interlocking with a part of an adjacent link 104. The apparatus 100 is attachable around a curvature of the wrist 1108 of the user such that the links 104 and the adjacent links 104 are pivotably lockable in relation to each other in order to wrap and lock around the wrist 1108.

In an example embodiment, the bracelet 102 is dimensioned and adapted such that it is attachable around the wrist 1108 by pressing 1300, 1302, 1304, 1306, 1308, 1310, 1312 in from the outwards towards the wrist 1108 by the user. FIG. 13 is the starting position, wherein the apparatus 100 is positioned over the wrist 1108, whereas FIG. 14 is the finishing position, wherein the apparatus 100 is wrapped and locked around the wrist 1108.

In an example embodiment, also illustrated with FIGS. 13 and 14, the apparatus 100 forms an open loop when in open position such that it is positionable around the wrist 1108 as in FIG. 13, and the apparatus 100 forms an open loop when in closed position wrapped and locked around the wrist 1108 as in FIG. 14, wherein the ends 200, 202 of the bracelet 102 opposite to each other are closer to each other in the closed position of FIG. 14 than in the open position of FIG. 13. In order to take off the apparatus 100, the ends 200, 202 are pulled outwards, whereby the loop opens wider releasing the locking around the wrist 1108.

In an example embodiment, the bracelet 102 does not require a traditional pin buckle or other means of attaching the ends 200, 202 with each other. This is because, as shown in FIG. 14, the open loop wraps and locks around the wrist 1108, and the ends 200, 202 remain free. This solution further enhances the usability of the apparatus 100: attachment is simplified, wearing comfort is increased, and taking off is simplified.

In an example embodiment, the links 104 and the adjacent links 104 are pivotable such that they exert a clamping force 1400, 1402, 1404, 1406 against the wrist 1108.

In an example embodiment a part of the links 104 and the adjacent links 104 are positioned, dimensioned and adapted such that a greater clamping force 1402, 1404 is directed towards ulna and radius bones 1200, 1202 of the wrist 1108 than towards the palm side 1106 of the wrist 1108 and the back of the hand side 1102 of the wrist 1108. This may enhance the wearing comfort of the apparatus 100 even further.

Note that in FIGS. 13 and 14 the flexible casing 106 is not illustrated so clearly as in FIGS. 1, 3, 4, 5 and 6 in order to make the illustration clearer, i.e., the casing 106 is more closely integrated with the links 104.

In an example embodiment, the flexible casing 106 in the inside of the bracelet 102, which comes into contact with the wrist 1108 when attached, comprises non-skid material, such as polyurethane, thermoplastic polyurethane (TPU), silicon, rubber, synthetic rubber, or other material with causes increased friction between the skin of wrist 1108 and the inside of the bracelet 102. Furthermore, said surface of the casing 106 may comprise appropriate texture to increase the friction. The increased friction may aid in preventing the bracelet 102 from moving around the wrist 1108.

Next, with reference to FIGS. 15, 16, 17, 18A, 18B, 19A and 19B let us study further example embodiments of the structure of the apparatus 100, especially relating to the structure and functionality of the links 104.

In an example embodiment, the links 104 are made of suitably rigid material such as plastic, composite or metal. In an example embodiment, the flexible casing 106 is made of plastic, polyurethane, thermoplastic polyurethane (TPU), silicon, rubber, synthetic rubber, or other suitably flexible material. The links 104 form the "backbone" of the bracelet 102, whereas the flexible casing 106, while encasing the links 104, improves the wearing comfort as hair or skin cannot stick between the links 104, and, furthermore, dirt cannot accumulate in spaces between the links 104.

In an example embodiment, illustrated in FIG. 16, the side and the opposite side are two lateral surfaces of the link 104: for the sake of the clarity, the lateral surfaces 1514, 1516 are illustrated from the link 104A and the adjacent link 104B, and the part 1504 and the counterpart 1502 interlock with each other. Alternatively, the side and the opposite side may be defined as two edges (=narrow surfaces) of the link 104. Naturally, these lateral surfaces 1514, 1516 (or edges) need not be straight, i.e., they may comprise also other forms, but in such a way that the link 104A and the adjacent link 104B may be mechanically coupled with each other by the part 1504 and the counterpart 1502 pivotably lockable.

In an example embodiment of FIGS. 15 and 16, the link 104A and the adjacent link 104B are identical. This simplifies the structure of the apparatus 100. However, in an example embodiment, some of the links 104 are identical with each other, whereas some of the links 104 may have a different structure, in order to accommodate the electronics module **300**, **600**, **602**, **604**, **606**, **608**, **610**, **612**, or in order to fit the curvature of the wrist **1108** better, for example.

In an example embodiment of FIGS. **15** and **16**, the part and the counterpart comprise a snap-fit joint **1506**. In a snap-fit joint **1506**, the part and the counterpart comprise locating and locking features. The locking features move aside for engagement with a mating part, followed by a return of the locking feature toward its original position. The locating features are inflexible, providing strength and stability.

In an example embodiment of FIGS. **15** and **16**, the part and the counterpart comprise a ball **1504** and a socket **1502** joint **1506**. In an example embodiment, the socket **1502** forms the locking features, whereas the ball **1504** forms the locating features of the snap-fit joint. As can be seen in FIGS. **15** and **16**, the links **104**A, **104**B are identical, comprising further a ball **1500** and a socket **1508** to mate with their adjacent links **104**.

In an example embodiment of FIG. **17**, the part and the counterpart comprise an eccentric joint **1700**. In an example embodiment, the eccentric joint **1700** comprises a bending **1702** in the link **104**B such that the link **104**B more naturally follows the curvature of the wrist **1108**.

In an example embodiment, the part and the counterpart comprise a gear wheel mechanism causing that the links **104**A and the adjacent **104**B links are pivotable in relation to each other stepwise. In an example embodiment of FIG. **18**A, the ball **1504** comprises cogs **1702** and the socket **1502** comprises matching cogs **1700**. FIG. **18**B shows the gear wheel mechanism in action: as the ball **1504** rotates into direction **1704**, the cogs **1702** of the ball **1504** move in relation to the cogs **1700** of the socket **1502** stepwise, locking into each position. In order this to work, the cogs **1700** and/or the cogs **1702** are made of flexible material such as plastic.

In an example embodiment, the apparatus **100** further comprises friction structures causing friction between the part and the counterpart as the link **104**A and the adjacent link **104**B are moved relative to each other. The purpose of such friction is to achieve a predetermined stiffness to the joint between the link **104**A and the adjacent link **104**B so that they are pivotably lockable in relation to each other in order to wrap and lock around the wrist **1108**. Such friction structures may employ suitable dimensioning, and/or suitable texturing, and/or suitable geometry of the part and the counterpart.

In an example embodiment, the apparatus **100** further comprises feedback structures causing senseable feedback to the user while pivoting the links **104** and the adjacent links **104**. In an example embodiment, the cogs **1700**, **1702** generate the feedback, which the user may sense (by feeling and/or hearing, for example). In another example embodiment, the friction structures generate the feedback.

In an example embodiment of FIGS. **19**A and **19**B, the part and the counterpart are positioned, dimensioned and adapted such that the links **104**A and the adjacent links **104**B are pivotable in relation to each by a limited angle. In an example embodiment, the limited angle is 30 degrees or less. In an example embodiment, the limited angle is 15 degrees or less. In an example embodiment, the limited angle is 9 and 15 degrees. In an example embodiment, the part and the counterpart are positioned, dimensioned and adapted such that the link **104**A and the adjacent link **104**B may, from the initial position, only pivot towards the wrist **1108**. This is shown in FIG. **15**, wherein the structure **1510** prohibits the turning of the adjacent link **104**B into a direction **1512**.

It will be obvious to a person skilled in the art that, as technology advances, the inventive concept can be implemented in various ways. The invention and its embodiments are not limited to the example embodiments described above but may vary within the scope of the claims.

The invention claimed is:

1. A wrist-worn physical activity measurement apparatus comprising:

an inelastic bracelet comprising a first end, a second end and a plurality of links therebetween, each link being formed at one side to comprise a part and at an opposite side a counterpart interlocking with the part of an adjacent link, except for the links that form the first and second ends, which are only interlocked on one side;

a flexible casing surrounding the plurality of links, wherein the apparatus is attachable around a curvature of a wrist of a user such that the links and the adjacent links are pivotably lockable in relation to each other in an open position and a closed position in order to wrap and lock around the wrist while the first and second ends of the bracelet remain unconnected in the closed position, wherein the apparatus forms an open loop when in the open position such that it is positionable around the wrist, and the apparatus forms an open loop when in the closed position wrapped and locked around the wrist, wherein the first and second ends of the bracelet are closer to each other in the closed position than in the open position, but are not connected to each other; and

an electronics module coupled with the bracelet, wherein the part and the counterpart are positioned, dimensioned and adapted such that the links and the adjacent links are pivotable in relation to each by a limited angle.

2. The apparatus of claim **1**, wherein the electronics module is attached to at least one of the links.

3. The apparatus of claim **1**, wherein the electronics module is attached between two of the links.

4. The apparatus of claim **1**, wherein at least one of the links is a special link, in which the electronics module is integrated.

5. The apparatus of claim **1**, wherein the electronics module comprises at least one of a biosignal measurement sensor, a processor module comprising one or more processors and one or more memories including computer program code.

6. The apparatus of claim **1**, wherein the electronics module comprises: a sensor for measuring physical activity of the user, an electronic circuit for wireless communication, one or more processors, and one or more memories including computer program code.

7. The apparatus of claim **1**, wherein the bracelet is dimensioned and adapted such that it is attachable around the wrist by pressing it from outwards towards the wrist by the user.

8. The apparatus of claim **1**, wherein the links and the adjacent links are pivotable such that they exert a clamping force against the wrist.

9. The apparatus of claim **8**, wherein the links and the adjacent links are positioned, dimensioned and adapted such that a greater clamping force is directed towards ulna and radius bones of the wrist than towards the palm side of the wrist and the back of the hand side of the wrist.

10. The apparatus of claim **1**, wherein the flexible casing in the inside of the bracelet, which comes into contact with the wrist when attached, comprises non-skid material.

11. The apparatus of claim **1**, wherein the link and the adjacent link are identical.

12. The apparatus of claim **1**, wherein the part and the counterpart comprise a snap-fit joint.

13. The apparatus of claim **1**, wherein the part and the counterpart comprise a ball and a socket joint.

14. The apparatus of claim **1**, wherein the part and the counterpart comprise an eccentric joint.

15. The apparatus of claim **1**, wherein the part and the counterpart comprise a gear wheel mechanism causing the links and the adjacent links to be stepwise pivotable in relation to each other.

16. The apparatus of claim **1**, further comprising friction structures causing friction between the part and the counterpart as the link and the adjacent link are moved relative to each other.

17. The apparatus of claim **1**, further comprising feedback structures causing senseable feedback to the user while pivoting the links and the adjacent links.

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