PTO/AIA/15 (03-13)
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UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 CFR 1.53(b))

Attorney Docket No.	P22914USC10
First Named Inventor	Fletcher R. Rothkopf
Title	WEARABLE ELECTRONIC DEVICE
Express Mail Label No.	n/a

APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents.

1. [ ] **Fee Transmittal Form** (PTO/SB/17 or equivalent)
2. [ ] **Applicant asserts small entity status.** See 37 CFR 1.27
3. [ ] **Applicant certifies micro entity status.** See 37 CFR 1.29. Applicant must attach form PTO/SB/15A or B or equivalent.
4. [x] **Specification** [*Total Pages* 96] Both the claims and abstract must start on a new page. *(See MPEP § 608.01(a) for information on the preferred arrangement)*
5. [x] **Drawing(s)** (35 U.S.C. 113) [*Total Sheets* 26]
6. **Inventor's Oath or Declaration** [*Total Pages* 4] *(including substitute statements under 37 CFR 1.64 and assignments serving as an oath or declaration under 37 CFR 1.63(e))*
   a. [ ] Newly executed (original or copy)
   b. [x] A copy from a prior application (37 CFR 1.63(d))
7. [x] **Application Data Sheet** **See note below.* See 37 CFR 1.76 (PTO/AIA/14 or equivalent)
8. **CD-ROM or CD-R** in duplicate, large table, or Computer Program (*Appendix*)
   [ ] Landscape Table on CD
9. **Nucleotide and/or Amino Acid Sequence Submission** (*if applicable, items a. – c. are required*)
   a. [ ] Computer Readable Form (CRF)
   b. [ ] Specification Sequence Listing on:
      i. [ ] CD-ROM or CD-R (2 copies); or
      ii. [ ] Paper
   c. [ ] Statements verifying identity of above copies

ADDRESS TO:

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

ACCOMPANYING APPLICATION PAPERS

10. [ ] **Assignment Papers** (cover sheet & document(s))
    Name of Assignee _____
11. [ ] **37 CFR 3.73(c) Statement** (*when there is an assignee*) [x] **Power of Attorney**
12. [ ] **English Translation Document** (*if applicable*)
13. [ ] **Information Disclosure Statement** (PTO/SB/08 or PTO-1449)
    [ ] Copies of citations attached
14. [ ] **Preliminary Amendment**
15. [ ] **Return Receipt Postcard** (*MPEP § 503*) (*Should be specifically itemized*)
16. [ ] **Certified Copy of Priority Document(s)** (*if foreign priority is claimed*)
17. [ ] **Nonpublication Request** Under 35 U.S.C. 122(b)(2)(B)(i). Applicant must attach form PTO/SB/35 or equivalent.
18. [x] **Other:** Certification and Request for Prioritized Examination

***Note**: (1) Benefit claims under 37 CFR 1.78 and foreign priority claims under 1.55 **must** be included in an Application Data Sheet (ADS).
(2) For applications filed under 35 U.S.C. 111, the application must contain an ADS specifying the applicant if the applicant is an assignee, person to whom the inventor is under an obligation to assign, or person who otherwise shows sufficient proprietary interest in the matter. See 37 CFR 1.46(b).

19. CORRESPONDENCE ADDRESS

[x] The address associated with Customer Number: 62579 **OR** [ ] Correspondence address below

Name					
Address					
City		State		Zip Code	
Country		Telephone		Email	

Signature	/Peter J. Nagle/	Date	September 23, 2022
Name (Print/Type)	Peter J. Nagle	Registration No. (Attorney/Agent)	70,361

This collection of information is required by 37 CFR 1.53(b). The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

APPLE 2012
Masimo v. Apple
IPR2023-00634

Privacy Act Statement

The **Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (*i.e.*, GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	P22914USC10
	Application Number	
Title of Invention	WEARABLE ELECTRONIC DEVICE	

The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76.
This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.

Secrecy Order 37 CFR 5.2:

☐ Portions or all of the application associated with this Application Data Sheet may fall under a Secrecy Order pursuant to 37 CFR 5.2 (Paper filers only. Applications that fall under Secrecy Order may not be filed electronically.)

Inventor Information:

Inventor 1 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Fletcher	R.	Rothkopf	

Residence Information (Select One) ◉ US Residency ○ Non US Residency ○ Active US Military Service

City	Los Altos	State/Province	CA	Country of Residence	US

Mailing Address of Inventor:

Address 1	One Apple Park Way		
Address 2			
City	Cupertino	State/Province	CA
Postal Code	95014	Country	US

Inventor 2 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Jonathan		Ive	

Residence Information (Select One) ◉ US Residency ○ Non US Residency ○ Active US Military Service

City	San Francisco	State/Province	CA	Country of Residence	US

Mailing Address of Inventor:

Address 1	2808 Broadway Street		
Address 2			
City	San Francisco	State/Province	CA
Postal Code	94115	Country	US

Inventor 3 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Julian		Hoenig	

Residence Information (Select One) ◉ US Residency ○ Non US Residency ○ Active US Military Service

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	P22914USC10
	Application Number	
Title of Invention	WEARABLE ELECTRONIC DEVICE	

City	San Francisco	State/Province	CA	Country of Residence	US

Mailing Address of Inventor:

Address 1	610 Elizabeth Street		
Address 2			
City	San Francisco	State/Province	CA
Postal Code	94114	Country	US

Inventor 4 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Rico		Zorkendorfer	

Residence Information (Select One) (•) US Residency ( ) Non US Residency ( ) Active US Military Service

City	San Francisco	State/Province	CA	Country of Residence	US

Mailing Address of Inventor:

Address 1	3928 17th Street		
Address 2			
City	San Francisco	State/Province	CA
Postal Code	94114	Country	US

All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the **Add** button. Add

Correspondence Information:

Enter either Customer Number or complete the Correspondence Information section below.
For further information see 37 CFR 1.33(a).

☐ **An Address is being provided for the correspondence Information of this application.**

Customer Number	62579		
Email Address		Add Email	Remove Email

Application Information:

Title of the Invention	WEARABLE ELECTRONIC DEVICE		
Attorney Docket Number	P22914USC10	Small Entity Status Claimed	☐
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	26	Suggested Figure for Publication (if any)	6

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	P22914USC10
	Application Number	
Title of Invention	WEARABLE ELECTRONIC DEVICE	

Filing By Reference:

Only complete this section when filing an application by reference under 35 U.S.C. 111(c) and 37 CFR 1.57(a). Do not complete this section if application papers including a specification and any drawings are being filed. Any domestic benefit or foreign priority information must be provided in the appropriate section(s) below (i.e., "Domestic Benefit/National Stage Information" and "Foreign Priority Information").

For the purposes of a filing date under 37 CFR 1.53(b), the description and any drawings of the present application are replaced by this reference to the previously filed application, subject to conditions and requirements of 37 CFR 1.57(a).

Application number of the previously filed application	Filing date (YYYY-MM-DD)	Intellectual Property Authority or Country

Publication Information:

☐ Request Early Publication (Fee required at time of Request 37 CFR 1.219)

☐ **Request Not to Publish.** I hereby request that the attached application not be published under 35 U.S.C. 122(b) and certify that the invention disclosed in the attached application **has not and will not** be the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.

Representative Information:

Representative information should be provided for all practitioners having a power of attorney in the application. Providing this information in the Application Data Sheet does not constitute a power of attorney in the application (see 37 CFR 1.32). Either enter Customer Number or complete the Representative Name section below. If both sections are completed the customer Number will be used for the Representative Information during processing.

Please Select One:	◉ Customer Number	○ US Patent Practitioner	○ Limited Recognition (37 CFR 11.9)
Customer Number	62579		

Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, 365(c), or 386(c) or indicate National Stage entry from a PCT application. Providing benefit claim information in the Application Data Sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78.
When referring to the current application, please leave the "Application Number" field blank.

Prior Application Status	Pending		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
	Continuation of	17672653	2022-02-15

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	P22914USC10
	Application Number	
Title of Invention	WEARABLE ELECTRONIC DEVICE	

Prior Application Status	Pending		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
17672653	Continuation of	17188966	2021-03-01

Prior Application Status	Patented				Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
17188966	Continuation of	16826130	2020-03-20	10942491	2021-03-09

Prior Application Status	Patented				Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
16826130	Continuation of	14842617	2015-09-01	10599101	2020-03-24

Prior Application Status	Expired		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
14842617	Claims benefit of provisional	62044974	2014-09-02

Prior Application Status	Patented				Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
16826130	Continuation of	15261917	2016-09-10	10627783	2020-04-21

Prior Application Status	Patented				Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
15261917	Continuation of	14842617	2015-09-01	10599101	2020-03-24

Prior Application Status	Expired		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
14842617	Claims benefit of provisional	62044974	2014-09-02

Prior Application Status	Patented				Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
16826130	Continuation of	15261914	2016-09-10	10613485	2020-04-07

Prior Application Status	Patented				Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
15261914	Continuation of	14842617	2015-09-01	10599101	2020-03-24

Prior Application Status	Expired		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
14842617	Claims benefit of provisional	62044974	2014-09-02

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	P22914USC10
	Application Number	
Title of Invention	WEARABLE ELECTRONIC DEVICE	

Prior Application Status	Patented			Remove	
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
16826130	Continuation of	15261912	2016-09-10	10620591	2020-04-14
Prior Application Status	Patented			Remove	
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
15261912	Continuation of	14842617	2015-09-01	10599101	2020-03-24
Prior Application Status	Expired			Remove	
Application Number	Continuity Type		Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)	
14842617	Claims benefit of provisional		62044974	2014-09-02	
Prior Application Status	Pending			Remove	
Application Number	Continuity Type		Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)	
17672653	Continuation of		17188995	2021-03-01	
Prior Application Status	Patented			Remove	
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
17188995	Continuation of	16826130	2020-03-20	10942491	2021-03-09
Prior Application Status	Patented			Remove	
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
16826130	Continuation of	14842617	2015-09-01	10599101	2020-03-24
Prior Application Status	Expired			Remove	
Application Number	Continuity Type		Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)	
14842617	Claims benefit of provisional		62044974	2014-09-02	
Prior Application Status	Patented			Remove	
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
16826130	Continuation of	15261917	2016-09-10	10627783	2020-04-21
Prior Application Status	Patented			Remove	
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
15261917	Continuation of	14842617	2015-09-01	10599101	2020-03-24
Prior Application Status	Expired			Remove	
Application Number	Continuity Type		Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)	
14842617	Claims benefit of provisional		62044974	2014-09-02	

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	P22914USC10
	Application Number	
Title of Invention	WEARABLE ELECTRONIC DEVICE	

Prior Application Status	Patented				Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
16826130	Continuation of	15261914	2016-09-10	10613485	2020-04-07
Prior Application Status	Patented				Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
15261914	Continuation of	14842617	2015-09-01	10599101	2020-03-24
Prior Application Status	Expired				Remove
Application Number	Continuity Type		Prior Application Number		Filing or 371(c) Date (YYYY-MM-DD)
14842617	Claims benefit of provisional		62044974		2014-09-02
Prior Application Status	Patented				Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
16826130	Continuation of	15261912	2016-09-10	10620591	2020-04-14
Prior Application Status	Patented				Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
15261912	Continuation of	14842617	2015-09-01	10599101	2020-03-24
Prior Application Status	Expired				Remove
Application Number	Continuity Type		Prior Application Number		Filing or 371(c) Date (YYYY-MM-DD)
14842617	Claims benefit of provisional		62044974		2014-09-02
Prior Application Status	Pending				Remove
Application Number	Continuity Type		Prior Application Number		Filing or 371(c) Date (YYYY-MM-DD)
	Continuation of		17188966		2021-03-01
Prior Application Status	Pending				Remove
Application Number	Continuity Type		Prior Application Number		Filing or 371(c) Date (YYYY-MM-DD)
	Continuation of		17188995		2021-03-01
Prior Application Status	Pending				Remove
Application Number	Continuity Type		Prior Application Number		Filing or 371(c) Date (YYYY-MM-DD)
	Continuation of		17899498		2022-08-30

Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the **Add** button.

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	P22914USC10
	Application Number	
Title of Invention	WEARABLE ELECTRONIC DEVICE	

Foreign Priority Information:

This section allows for the applicant to claim priority to a foreign application. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55. When priority is claimed to a foreign application that is eligible for retrieval under the priority document exchange program (PDX)[i] the information will be used by the Office to automatically attempt retrieval pursuant to 37 CFR 1.55(i)(1) and (2). Under the PDX program, applicant bears the ultimate responsibility for ensuring that a copy of the foreign application is received by the Office from the participating foreign intellectual property office, or a certified copy of the foreign priority application is filed, within the time period specified in 37 CFR 1.55(g)(1).

Remove

Application Number	Country[i]	Filing Date (YYYY-MM-DD)	Access Code[i] (if applicable)

Additional Foreign Priority Data may be generated within this form by selecting the **Add** button.

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications

☐ This application (1) claims priority to or the benefit of an application filed before March 16, 2013 and (2) also contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013.
NOTE: By providing this statement under 37 CFR 1.55 or 1.78, this application, with a filing date on or after March 16, 2013, will be examined under the first inventor to file provisions of the AIA.

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	P22914USC10
	Application Number	
Title of Invention	WEARABLE ELECTRONIC DEVICE	

Authorization or Opt-Out of Authorization to Permit Access:

When this Application Data Sheet is properly signed and filed with the application, applicant has provided written authority to permit a participating foreign intellectual property (IP) office access to the instant application-as-filed (see paragraph A in subsection 1 below) and the European Patent Office (EPO) access to any search results from the instant application (see paragraph B in subsection 1 below).

Should applicant choose not to provide an authorization identified in subsection 1 below, applicant **must opt-out** of the authorization by checking the corresponding box A or B or both in subsection 2 below.

NOTE: This section of the Application Data Sheet is **ONLY** reviewed and processed with the **INITIAL** filing of an application. After the initial filing of an application, an Application Data Sheet cannot be used to provide or rescind authorization for access by a foreign IP office(s). Instead, Form PTO/SB/39 or PTO/SB/69 must be used as appropriate.

1. Authorization to Permit Access by a Foreign Intellectual Property Office(s)

A. Priority Document Exchange (PDX) - Unless box A in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the European Patent Office (EPO), the Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), the State Intellectual Property Office of the People's Republic of China (SIPO), the World Intellectual Property Organization (WIPO), and any other foreign intellectual property office participating with the USPTO in a bilateral or multilateral priority document exchange agreement in which a foreign application claiming priority to the instant patent application is filed, access to: (1) the instant patent application-as-filed and its related bibliographic data, (2) any foreign or domestic application to which priority or benefit is claimed by the instant application and its related bibliographic data, and (3) the date of filing of this Authorization. See 37 CFR 1.14(h)(1).

B. Search Results from U.S. Application to EPO - Unless box B in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the EPO access to the bibliographic data and search results from the instant patent application when a European patent application claiming priority to the instant patent application is filed. See 37 CFR 1.14(h)(2).

The applicant is reminded that the EPO's Rule 141(1) EPC (European Patent Convention) requires applicants to submit a copy of search results from the instant application without delay in a European patent application that claims priority to the instant application.

2. Opt-Out of Authorizations to Permit Access by a Foreign Intellectual Property Office(s)

☐ A. Applicant **DOES NOT** authorize the USPTO to permit a participating foreign IP office access to the instant application-as-filed. If this box is checked, the USPTO will not be providing a participating foreign IP office with any documents and information identified in subsection 1A above.

☐ B. Applicant **DOES NOT** authorize the USPTO to transmit to the EPO any search results from the instant patent application. If this box is checked, the USPTO will not be providing the EPO with search results from the instant application.

NOTE: Once the application has published or is otherwise publicly available, the USPTO may provide access to the application in accordance with 37 CFR 1.14.

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	P22914USC10
	Application Number	
Title of Invention	WEARABLE ELECTRONIC DEVICE	

Applicant Information:

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Applicant 1

If the applicant is the inventor (or the remaining joint inventor or inventors under 37 CFR 1.45), this section should not be completed. The information to be provided in this section is the name and address of the legal representative who is the applicant under 37 CFR 1.43; or the name and address of the assignee, person to whom the inventor is under an obligation to assign the invention, or person who otherwise shows sufficient proprietary interest in the matter who is the applicant under 37 CFR 1.46. If the applicant is an applicant under 37 CFR 1.46 (assignee, person to whom the inventor is obligated to assign, or person who otherwise shows sufficient proprietary interest) together with one or more joint inventors, then the joint inventor or inventors who are also the applicant should be identified in this section.

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(•) Assignee	( ) Legal Representative under 35 U.S.C. 117	( ) Joint Inventor
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If applicant is the legal representative, indicate the authority to file the patent application, the inventor is:

Name of the Deceased or Legally Incapacitated Inventor:

If the Applicant is an Organization check here. [x]

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Assignee 1

Complete this section if assignee information, including non-applicant assignee information, is desired to be included on the patent application publication. An assignee-applicant identified in the "Applicant Information" section will appear on the patent application publication as an applicant. For an assignee-applicant, complete this section only if identification as an assignee is also desired on the patent application publication.

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Signature	/Peter J. Nagle/			Date (YYYY-MM-DD)	2022-09-23
First Name	Peter J.	Last Name	Nagle	Registration Number	70361

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This collection of information is required by 37 CFR 1.76. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 23 minutes to complete, including gathering, preparing, and submitting the completed application data sheet form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent CooperationTreaty.

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WEARABLE ELECTRONIC DEVICE

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application is a continuation patent application of U.S. Patent Application No. 17/672,653, filed February 15, 2022, and titled "Wearable Electronic Device," which is a continuation patent application of U.S. Patent Application No. 17/188,966, filed March 1, 2021, and titled "Wearable Electronic Device," which is a continuation patent application of U.S. Patent Application No. 16/826,130, filed March 20, 2020, and titled "Wearable Electronic Device," now U.S. Patent No. 10,942,491, issued March 9, 2021, which is a continuation patent application of U.S. Patent Application No. 14/842,617, filed September 1, 2015, and titled "Wearable Electronic Device," now U.S. Patent No. 10,599,101, issued March 24, 2020, which is a nonprovisional patent application of and claims the benefit of U.S. Provisional Patent Application No. 62/044,974, filed September 2, 2014, the disclosures of which are hereby incorporated herein by reference in their entireties. U.S. Patent Application No. 16/826,130, filed March 20, 2020, and titled "Wearable Electronic Device," now U.S. Patent No. 10,942,491, issued March 9, 2021 is also a continuation patent application of U.S. Patent Application No. 15/261,917, filed September 10, 2016, and titled "Wearable Electronic Device," now U.S. Patent No. 10,627,783, issued April 21, 2020, which is a continuation application of U.S. Patent Application No. 14/842,617, filed September 1, 2015, and titled "Wearable Electronic Device," now U.S. Patent No. 10,599,101, issued March 24, 2020, which is a nonprovisional patent application of and claims the benefit of U.S. Provisional Patent Application No. 62/044,974, filed September 2, 2014, the disclosures of which are hereby incorporated herein by reference in their entireties. U.S. Patent Application No. 16/826,130, filed March 20, 2020, and titled "Wearable Electronic Device," now U.S. Patent No. 10,942,491, issued March 9, 2021 is also a continuation patent application of U.S. Patent Application No. 15/261,914, filed September 10, 2016, and titled "Wearable Electronic Device," now U.S. Patent No. 10,613,485, issued April 7, 2020, which is a continuation patent application of U.S. Patent Application No. 14/842,617, filed September 1, 2015, and titled "Wearable Electronic Device," now U.S. Patent No. 10,599,101, issued March 24, 2020, which is a nonprovisional patent application of and claims the benefit of U.S. Provisional Patent Application No. 62/044,974, filed September 2, 2014, the disclosures of which are hereby incorporated herein by reference in their entireties. U.S. Patent Application

No. 16/826,130, filed March 20, 2020, and titled "Wearable Electronic Device," now U.S. Patent No. 10,942,491, issued March 9, 2021 is also a continuation patent application of U.S. Patent Application No. 15/261,912, filed September 10, 2016, and titled "Wearable Electronic Device," now U.S. Patent No. 10,620,591, issued April 14, 2020, which is a continuation patent application of U.S. Patent Application No. 14/842,617, filed September 1, 2015, and titled "Wearable Electronic Device," now U.S. Patent No. 10,599,101, issued March 24, 2020, which is a nonprovisional patent application of and claims the benefit of U.S. Provisional Patent Application No. 62/044,974, filed September 2, 2014, the disclosures of which are hereby incorporated herein by reference in their entireties. U.S. Patent Application No. 17/672,653, filed February 15, 2022, and titled "Wearable Electronic Device," is also a continuation patent application of U.S. Patent Application No. 17/188,995, filed March 1, 2021, and titled "Wearable Electronic Device," which is a continuation patent application of U.S. Patent Application No. 16/826,130, filed March 20, 2020, and titled "Wearable Electronic Device," now U.S. Patent No. 10,942,491, issued March 9, 2021, which is a continuation patent application of U.S. Patent Application No. 14/842,617, filed September 1, 2015, and titled "Wearable Electronic Device," now U.S. Patent No. 10,599,101, issued March 24, 2020, which is a nonprovisional patent application of and claims the benefit of U.S. Provisional Patent Application No. 62/044,974, filed September 2, 2014, the disclosures of which are hereby incorporated herein by reference in their entireties. U.S. Patent Application No. 16/826,130, filed March 20, 2020, and titled "Wearable Electronic Device," now U.S. Patent No. 10,942,491, issued March 9, 2021 is also a continuation patent application of U.S. Patent Application No. 15/261,917, filed September 10, 2016, and titled "Wearable Electronic Device," now U.S. Patent No. 10,627,783, issued April 21, 2020, which is a continuation application of U.S. Patent Application No. 14/842,617, filed September 1, 2015, and titled "Wearable Electronic Device," now U.S. Patent No. 10,599,101, issued March 24, 2020, which is a nonprovisional patent application of and claims the benefit of U.S. Provisional Patent Application No. 62/044,974, filed September 2, 2014, the disclosures of which are hereby incorporated herein by reference in their entireties. U.S. Patent Application No. 16/826,130, filed March 20, 2020, and titled "Wearable Electronic Device," now U.S. Patent No. 10,942,491, issued March 9, 2021 is also a continuation patent application of U.S. Patent Application No. 15/261,914, filed September 10, 2016, and titled "Wearable Electronic Device," now U.S. Patent No. 10,613,485, issued April 7, 2020, which is a continuation patent application

of U.S. Patent Application No. 14/842,617, filed September 1, 2015, and titled "Wearable Electronic Device," now U.S. Patent No. 10,599,101, issued March 24, 2020, which is a nonprovisional patent application of and claims the benefit of U.S. Provisional Patent Application No. 62/044,974, filed September 2, 2014, the disclosures of which are hereby incorporated herein by reference in their entireties. U.S. Patent Application No. 16/826,130, filed March 20, 2020, and titled "Wearable Electronic Device," now U.S. Patent No. 10,942,491, issued March 9, 2021 is also a continuation patent application of U.S. Patent Application No. 15/261,912, filed September 10, 2016, and titled "Wearable Electronic Device," now U.S. Patent No. 10,620,591, issued April 14, 2020, which is a continuation patent application of U.S. Patent Application No. 14/842,617, filed September 1, 2015, and titled "Wearable Electronic Device," now U.S. Patent No. 10,599,101, issued March 24, 2020, which is a nonprovisional patent application of and claims the benefit of U.S. Provisional Patent Application No. 62/044,974, filed September 2, 2014, the disclosures of which are hereby incorporated herein by reference in their entireties. This application is also a continuation patent application of U.S. Patent Application No. 17/188,966, filed March 1, 2021, and titled "Wearable Electronic Device." This application is also a continuation patent application of U.S. Patent Application No. 17/188,995, filed March 1, 2021, and titled "Wearable Electronic Device." This application is also a continuation patent application of U.S. Patent Application No. 17/899,498, filed August 30, 2022, and titled "Wearable Electronic Device."

FIELD

[0002] The following disclosure generally relates to an electronic device, and more specifically to a wearable electronic device having a range of features, including touch input, force input, an interchangeable attachment system, health monitoring functionality, wireless power charging, wireless authentication and transaction functionality, and other features and functionality.

BACKGROUND

[0003] Portable electronic devices have become increasingly popular, and the features and functionality provided by portable electronic devices continue to expand to meet the needs and expectations of many consumers. However, some traditional portable electronic devices, particularly wearable electronic devices, may have relatively limited functionality or are only able to perform a specialized set of functions or tasks. For example, some traditional electronic wristwatches may be configured to perform a relatively limited set of functions, including displaying time, date, and performing basic timing functions. The embodiments described herein are directed to a wearable electronic device that provides a wide range of functionality, as compared to some traditional wearable electronic devices.

SUMMARY

[0004] The embodiments included herein are directed to a consumer product, which may include a portable or wearable electronic device that is configured to provide an expansive feature set integrated or incorporated into a compact form factor. In some aspects of the present disclosure, a consumer product may integrate or combine multiple subsystems into a single device to provide a wide range of functionality, including biometric sensing, touch-based user input, near-field communications, and other desirable features. In some aspects, multiple subsystems are integrated into the relatively compact space of a wrist-worn device.

[0005] Some example embodiments are directed to wearable electronic device having a housing that includes a flat bottom portion, a top portion defining a cavity, and a curved side portion that extends from the bottom portion to the top portion. A band may be attached to the housing and configured to secure the wearable electronic device to a user. A display may be at least partially disposed within the cavity and may have a viewable area. The device may also include a cover disposed above the display and including a flat middle portion larger than the viewable area of the display, a curved edge portion surrounding the flat middle portion and coinciding with the curved side portion along a perimeter of the cavity to form a continuous contoured surface.

[0006] In some embodiments, the continuous contoured surface is tangent with the flat bottom portion of the housing at a first end of the contour. The continuous contoured surface may also be tangent with the flat middle portion of the cover at a second end of the contour. In some embodiments, the continuous contoured surface has a constant radius.

[0007] In some embodiments, the cavity has a rectangular shape. The curved edge portion of the housing may have four sides that surround the cavity, each side is orthogonal to two adjacent sides. Each side may be connected to an adjacent side by a rounded corner. In some embodiments, the rounded corners have a curvature that corresponds to a curvature of the continuous contoured surface formed by the curved edge portion of the cover and the curved side portion of the housing.

[0008] Some embodiments include a crown module that is positioned at least partially within an aperture formed within the curved side portion of the housing. The crown module may include

an outer surface configured to receive a rotary user input. The crown module may be offset with respect to a centerline of the housing between the top portion and the flat bottom portion. The offset may be toward the top portion of the housing. The crown module may include a dial having a portion that is higher than an interface between the cover and the housing.

[0009] In some example embodiments, a port is formed in the curved side portion of the housing. An acoustic module may be disposed within the housing and configured to produce an audio output through the port. The acoustic module may include an acoustic element and an acoustic cavity that acoustically couples the acoustic element to the port. The port may include an orifice that is offset with respect to the acoustic cavity to prevent the direct ingress of liquid into the acoustic module.

[0010] In some embodiments, the device includes a gasket positioned between the housing and the cover. The housing may also include a ledge formed along a perimeter of the cavity. The gasket may be positioned along the ledge that is formed along the perimeter of the cavity. The gasket, the cover, and the housing may be configured to cooperate to form a substantially water-proof seal.

[0011] In some example embodiments, the device includes a biosensor module that is disposed in an opening formed in the flat bottom portion of the housing. The biosensor module may include a chassis positioned in the opening of the housing and defining an array of windows. An array of light sources may be attached to the chassis and configured to emit light into the user through the array of windows. The biosensor module may also include an optically transparent rear cover disposed over the chassis and over the array of windows and operative to pass light emitted from the array of light sources into the user. In some embodiments, the rear cover has a convex outer contour.

[0012] Some example embodiments are directed to an electronic device having a housing comprising a bottom portion defining an opening and a band attached to the housing and configured to secure the electronic device to a user. A biosensor module may be disposed within the opening of the housing. A rear cover may be disposed over the biosensor module and may include an edge protruding outwardly from the bottom portion of the housing and an outer surface having a convex curved contour. In some embodiments, the outer surface of the rear

cover defines one or more windows that provide operational access to one or more optical components of the biosensor module. The one or more windows may have a curvature that matches the convex curved contour of the outer surface.

[0013] In some embodiments, the biosensor module includes an array of light sources that are configured to emit light into a body of the user. The biosensor module may also include a photodetector configured to receive light produced by a light source of the array of light sources that is reflected from the body and produce a sensor signal. In some cases, the biosensor module is removably coupled to the housing.

[0014] In some embodiments, the device also includes a processing unit configured to compute a health metric associated with the user based on the sensor signal. The device may also include a display disposed within the housing and configured to display the health metric.

[0015] Some example embodiments are directed to a wearable electronic device, having a housing including a top portion, a cavity formed within the top portion, and a curved side portion that surrounds the cavity. The device may also include a transparent cover disposed over the cavity of the housing and may include a flat middle portion at a center of the transparent cover, a curved outer portion that emanates from and surrounds the flat middle portion and extends outwardly to an edge of the transparent cover, and a mask positioned relative to an internal surface of the transparent cover. The mask may have an outer boundary located proximate to the edge of the transparent cover and an inner boundary located within the curved outer portion of the transparent cover.

[0016] In some embodiments, the device includes a display disposed below the transparent cover. A perimeter portion of a viewable area of the display may be disposed below the mask. The device may also include an antenna having a shape that corresponds to a shape of the cavity formed within the housing. The antenna may be disposed in a groove formed in the internal surface of the transparent cover. The groove may be formed between the outer boundary and the inner boundary of the mask. In some embodiments, the cover is formed from a sapphire material. The antenna may be configured to facilitate wireless communication between the wearable electronic device and an external device.

[0017] Some example embodiments are directed to an electronic device having a housing including a first end, a second end opposite the first end, a first side extending between the first and second ends, and a second side opposite to the first side and extending between the first and second ends. The first end may define a first groove extending between the first and second sides and may be configured to receive a first lug portion of a first band. The second end may define a second groove extending between the first and second sides and may be configured to receive a second lug portion of a second band. The first and second grooves may have an inwardly curved concave shape with an undercut feature that retains the first and second lug portions. In some embodiments, the first groove extends through a solid portion of the housing to form a continuous interior shape.

[0018] In some embodiments, the device includes a display at least partially disposed within a cavity of the housing. A cover may be disposed above the display and at least a portion of the first groove is disposed below the cover. The first and second grooves may be formed at an angle with respect to a centerline of the housing. The first and second grooves may be angled upward toward a top of the housing and inward toward the center of the housing. The first and second grooves may cross the centerline of the housing.

[0019] Some example embodiments are directed to a wearable electronic device including a housing and a band attached to the housing and configured to secure the wearable electronic device to a user. A crown may be disposed relative to the housing and configured to receive a rotational input. An encoder may be operatively coupled to the crown and configured to produce an encoder output that corresponds to the rotational input. A speaker module may be disposed within the housing and configured to produce an audio output that corresponds to the encoder output. A haptic device may be disposed within the housing and configured to produce a haptic output that corresponds to the encoder output. In some embodiments, the haptic output is synchronized with the audio output. The crown may be further configured to translate along an axis and actuate a tactile switch.

[0020] In some embodiments, the device also includes a display element within the housing. The device may be configured to display a list of items on the display element and scroll the list of items in response to the encoder output. The device may also be configured to synchronize

the audio and haptic outputs with the scrolling of the list of items. In some embodiments, the crown is further configured to translate along an axis and actuate a tactile switch. The crown may be operative to select an item of the list of items when the tactile switch is actuated.

[0021] Some example embodiments are directed to a wearable electronic device having a housing that includes a bottom portion and an aperture formed in the bottom portion. A band may be attached to the housing and configured to secure the wearable electronic device to a user. A biosensor module may be disposed in the aperture of the housing. The biosensor module may include an array of light sources configured to emit light into a body of the user, and a photodetector configured to receive light produced by a light source of the array of light sources that is reflected from the body and produce a sensor signal. The device may also include a processing unit that is configured to compute a health metric associated with the user based on the sensor signal. A display may be disposed within the housing and configured to display the health metric.

[0022] In some embodiments, the array of light sources and the photodetector are configured to function as multiple photoplethysmography (PPG) sensors. Each PPG sensor may be configured to be used to compute a separate health metric. In some embodiments, a first light source of the array of light sources includes a green LED adapted to detect blood perfusion in the body. A second light source of the array of light sources may include an infrared LED adapted to detect water content of the body. The health metric may include one or more of: a heart rate, a respiration rate, a blood oxygenation level, and a blood volume estimate.

[0023] In some embodiments, the device also includes at least one pair of electrodes disposed on an exterior surface of the housing. The at least one pair of electrodes may be configured to produce a signal when the at least one pair of electrodes is in contact with the body. In some case, the signal is used to compute an additional health metric that includes one or more of: a heart function, a body fat estimate, and a body fat estimate.

[0024] Some example embodiments are directed to a wearable electronic device including a housing and a band attached to the housing and configured to secure the wearable electronic device to a user. The device may also include an array of light emitting diodes (LEDs) disposed within the housing, the array of LEDs being configured to emit light. A photodetector may be

disposed within the housing and configured to receive light produced by an LED of the array of LEDs that is reflected from a body of the user and produce a first sensor signal in response to the received light. The device may also include at least one pair of electrodes disposed on an exterior surface of the wearable electronic device. The electrodes may be configured to produce a second sensor signal when the electrodes are in contact with a respective portion of the body. The device may also include a processing unit that is configured to compute one or more health metrics based on the first and second sensor signals. The device may also include a display disposed at least partially within the housing and configured to display the one or more health metrics.

[0025] Some example embodiments are directed to a wearable electronic device including a housing and a band attached to the housing and configured to secure the wearable electronic device to a user. A cover may be disposed relative to the housing and a display may be attached to a lower surface of the cover. A force sensor may be positioned between the cover and the housing and attaching the cover to the housing. The force sensor may be configured to detect the force of a touch on the cover. The force sensor may also form a barrier to prevent ingress of liquid into the wearable electronic device. In some embodiments, an antenna may be disposed relative to the cover and external from the housing. The antenna may be configured to facilitate wireless communication with an external device.

[0026] In some example embodiments, a wearable electronic device may include a housing and a band attached to the housing and configured to secure the wearable electronic device to a user. A display element may be positioned within the housing and a rechargeable battery may be disposed within the housing and operatively coupled to the display element. The device may also include a receive coil within the housing configured to inductively couple with an external transmit coil. A power conditioning circuit may be configured to recharge the rechargeable battery using power received by the receive coil. The power conditioning circuit may be configured to provide power to the display element. The device may also include a first alignment magnet positioned within the receive coil and configured to align the device with respect to a second alignment magnet positioned within the external transmit coil.

[0027] Some example embodiments are directed to a wearable electronic device that includes a housing and a band attached to the housing and configured to secure the wearable electronic device to a user. A cover may be positioned relative to the housing and a display may be disposed within the housing and below the cover. A force sensor may be disposed within the housing and configured to detect a force of a touch on the cover. A touch sensor may be disposed between the display and the cover. The touch sensor may be configured to detect a location of the touch on the cover. In some embodiments, the force sensor is disposed along a perimeter of the display. The device may also include a processing unit and memory disposed within the housing. The processing unit may be configured to interpret a touch gesture on a surface of the cover using a force output from the force sensor and a touch output from the touch sensor.

BRIEF DESCRIPTION OF THE DRAWINGS

[0028] The disclosure will be readily understood by the following detailed description in conjunction with the accompanying drawings, wherein like reference numerals designate like structural elements.

[0029] FIG. 1 depicts an example wearable electronic device having a device body and band.

[0030] FIG. 2 depicts an example schematic diagram of a wearable electronic device.

[0031] FIG. 3 depicts an example functional diagram for a wearable electronic device.

[0032] FIG. 4 depicts an example wearable electronic device as part of a system of devices.

[0033] FIG. 5 depicts a system of interchangeable components for a wearable device.

[0034] FIG. 6 depicts an example wearable electronic device having a device body and band.

[0035] FIG. 7 depicts an exploded view of components of an example wearable electronic device.

[0036] FIG. 8 depicts an example housing for a wearable electronic device.

[0037] FIG. 9 depicts an example force sensor configured to use a capacitive measurement.

[0038] FIGs. 10A-B depict plan views of example force sensors.

[0039] FIG. 11 depicts an example force sensor configured to use a resistive measurement.

[0040] FIG. 12 depicts an example pixelated force sensor configured to use a resistive measurement.

[0041] FIGs. 13A-B depict example force sensor structures.

[0042] FIGs. 14A-C depict an example touch sensor based on mutual capacitance.

[0043] FIGs. 15A-B depict an example touch sensor based on self capacitance.

[0044] FIG. 16 depicts an example device having biosensors.

[0045] FIG. 17 depicts an example device having wireless communications with an external device.

[0046] FIG. 18 depicts an example electronic device and example dock of an inductive charging system.

[0047] FIG. 19 depicts a block diagram of an example inductive charging system.

[0048] FIG. 20 depicts an example acoustic module.

[0049] FIGs. 21A-B depict an example cover and antenna.

[0050] FIGs. 22A-B depict an example haptic module.

[0051] FIG. 23 depicts an example device having a crown module with an encoder.

[0052] FIGs. 24A-B depict an example device having a crown module with a tactile switch.

[0053] FIGs. 25A-C depict an example receiving feature for a band.

[0054] FIG. 26 depicts example elements of a display.

DETAILED DESCRIPTION

[0055] Provided herein are descriptions and examples of a consumer product, which may include a portable electronic device, a wearable electronic device, or other type of device. By way of example and not by way of limitation, the consumer product may be an electronic device, a mechanical device, or an electromechanical device. Specific example devices include mobile phones, personal digital assistants, music players, timekeeping devices, health monitoring devices, tablet computers, laptop computers, glasses (electronic or otherwise), portable storage devices, and the like.

[0056] In one particular embodiment, the consumer product is a portable and, more specifically, a wearable consumer product. A wearable consumer product is one that can be worn by or otherwise secured to a user. For example, the consumer product may be a wearable electronic device including, but not limited to, a wearable computer, a wearable watch, a wearable communication device, a wearable media player, a wearable health monitoring device, and the like. A wearable consumer product may be worn by a user in a variety of ways. In some examples, the consumer product is a wrist-worn product and may include a band that can be wrapped around a user's wrist to secure the consumer product to the user's body. The device may include one or more other types of attachments including, for example, an armband, lanyard, waistband, chest strap, and the like.

[0057] Some aspects of the disclosure are directed to a wearable electronic device having improved functionality and/or versatility as compared to some traditional wearable devices. For example, some aspects of the disclosure are directed to a consumer product, such as a portable electronic device, having an expansive feature set integrated or incorporated into a compact form factor. In some aspects of the present disclosure, a consumer product may integrate or combine multiple subsystems into a single device to provide a wide range of functionality, including biometric sensing, touch-based user input, near-field communications, and other desirable features. In some aspects, multiple subsystems are integrated into the relatively compact space of a wrist-worn device. Some aspects of the following disclosure are directed to the integration of a variety of subsystems or modules to provide functionality that may not be possible using some traditional device platforms. In some cases, the configuration and/or functionality

provided by the various subsystems may be configurable by the end user, the manufacturer, and/or a vendor of the device. Example subsystems or modules of a consumer product and their respective functions are described below with respect to FIGs. 2 and 3.

[0058] Some aspects of the disclosure are directed to a consumer product that is configured to communicate wirelessly with any of a number of other devices, such as a mobile phone, computer, tablet computing devices, personal media players, televisions, networked home appliances, networked home controls, electronic systems in vehicles, and so on. Through wireless communication with other devices, the consumer product may transmit and/or receive various notifications, messages, or other information between devices. The wireless communication may also facilitate the relay of alerts or other device outputs to notify the user of an event or action. In some aspects, the consumer product may communicate wirelessly with any of a number of electronic accessories, including headset devices, portable speaker devices, portable microphone devices, display screens, and so on. An example communication system is described below with respect to FIG. 4 and with respect to other examples provided herein.

[0059] In some aspects, the consumer product may include a system of interchangeable components used to attach or secure the consumer product to the user. The system of interchangeable components may include a set of interchangeable bands or attachment devices that are configured to connect or attach to a receiving feature on the body of the product. The receiving feature may be standardized within the system of interchangeable components and allow multiple types of bands or attachment devices to be used with the same housing or body. The system of interchangeable components may also allow for an interchange between different bodies, which may include different types of electronic devices or other consumer products. Each body of the different devices or products may have a similar receiving feature that is standardized within the system of interchangeable components. An example system of interchangeable components is described below with respect to FIG. 5 and with respect to other examples provided herein.

[0060] Some aspects of the present disclosure are directed to a consumer product that includes a body that includes a case or housing used to protect as well as support the internal components of the product in their assembled position. The housing may enclose and support various

components, including, for example, integrated circuits, subsystems, modules, and other internal components of the device. In some aspects, the housing forms a water-resistant or water-proof barrier and also provides structural rigidity necessary to protect internal components. The housing may be formed as a single piece, which may enhance the structural rigidity, water impermeability, and manufacturability of the housing. An example housing and example internal components for a consumer product are provided below with respect to FIGs. 6-8 and with respect to other examples provided herein.

[0061] In some aspects, the consumer product includes a force sensor that is configured to detect and measure the magnitude of a force or pressure on a surface of the product. In some implementations, the force sensor includes a capacitive-based sensor that is configured to estimate the force based on a deflection or movement between capacitive plates that is caused by and correlates to the amount of force caused by a touch. In some implementations, the force sensor is a resistance- or charge-based sensor that is configured to estimate the force based on the deflection of a sheet or film that is positioned relative to the touch-sensitive surface of the product. In some implementations, the output from the force sensor is combined with the output from a touch sensor, which may be self-capacitive or mutually capacitive, or a combination of the two. Example force and touch sensors are described below with respect to FIGs. 9-15B and with respect to other examples provided herein.

[0062] In some aspects, the consumer product includes one or more biosensors. The biosensors may include optical and/or electronic biometric sensors that may be used to compute one or more health metrics. Example health metrics include, without limitation, a heart rate, a respiration rate, blood oxygenation level, a blood volume estimate, blood pressure, or a combination thereof. In some embodiments, the biosensors include an electrical sensor that may be used to measure electrocardiographic (ECG) characteristics, galvanic skin resistance, and other electrical properties of the user's body. An example consumer product having multiple biosensors is described below with respect to FIG. 16 and with respect to other examples herein.

[0063] In some aspects, the consumer product is configured to perform wireless communication with an external device. In some implementations, the wireless communication may include a Near Field Communication (NFC) interface. The NFC interface may be used to identify the

device and initiate a secure data connection, which may be used to authorize transactions, purchases, or conduct other forms of e-commerce. An example consumer product having wireless communications with an external device is described in more detail below with respect to FIG. 17 and with respect to other examples herein.

[0064] In some aspects, the consumer product is configured to recharge an internal battery using a wireless charging system. In some implementations, the consumer product includes one or more receiving inductive coils that are configured to cooperate with one or more transmitting inductive coils that are located in a charging dock or other external device. The wireless charging system may allow the transfer of power and/or wireless communications with the consumer product without the use of an external port or terminal connection. An example consumer product having wireless charging capabilities is described in more detail below with respect to FIGs. 18-19 and with respect to other examples herein.

[0065] In some aspects, the consumer product includes one or more acoustic modules that are configured to function as a speaker and/or a microphone for the product. The speaker and/or microphone may include features that enhance the water/liquid resistance or impermeability of the consumer product. The consumer product may also include a haptic module or actuator that is configured to produce a haptic output that may be perceived by the user. In some implementations, the output of an acoustic module, such as a speaker, and the haptic module may be used to provide feedback or an alert to the user. In some cases, an acoustic module and the haptic module provide feedback to the user and may be coordinated with a user input, such as user-interface selecting, user-interface scrolling, or other user input command. An example acoustic module is described below with respect to FIG. 20 and an example haptic module is described below with respect to FIGs. 22A-B.

[0066] In some aspects, the consumer product includes a dial or crown that is coupled to an encoder or other rotary sensor for detecting a rotary input. In some implementations, the output from the optical encoder is used to drive an aspect of a user interface or control other functionality of the product. Additionally, the dial or crown may include a tactile switch that can be actuated by pressing inward on the dial or crown. An example consumer product having a

crown is described below with respect to FIGs. 23-24B and with respect to other examples herein.

[0067] The description that follows includes sample devices, components, modules, systems, methods, and apparatuses that embody various elements of the present disclosure. However, it should be understood that various elements of the described disclosure may be combined and/or practiced in a variety of forms in addition to those described herein. In particular, the modules and components are described in a particular combination with respect to some examples provided below. However other combinations are possible, which may be achieved by adding, removing, and/or re-arranging modules to obtain a device or system having the desired characteristics.

[0068] FIG. 1 depicts a wearable consumer product 10. For example, the consumer product 10 may be a wearable electronic device. In one example, the consumer product 10 may be a wearable multifunctional electronic device including multiple functionalities such as time keeping, health monitoring, sports monitoring, medical monitoring, communications, navigation, computing operations, and/or the like. The functionalities may include but are not limited to: keeping time; monitoring a user's physiological signals and providing health-related information based on those signals; communicating (in a wired or wireless fashion) with other electronic devices or services, which may be different types of devices having different functionalities; providing alerts to a user, which may include audio, haptic, visual and/or other sensory output, any or all of which may be synchronized with one another; visually depicting data on a display; gathering data form one or more sensors that may be used to initiate, control, or modify operations of the device; determining a location of a touch on a surface of the device and/or an amount of force exerted on the device, and using either or both as input; accepting voice input to control one or more functions; accepting tactile input to control one or more functions; capturing and transmiting images; and so on. These and other functions and features will be described in more detail herein.

[0069] The wearable consumer product 10 can take a variety of forms. In one example, the consumer product 10 may be a wrist-worn electronic device. The device may include a variety of types of form factors including, wristbands, armbands, bracelets, jewelry, and/or the like.

[0070] In the illustrated embodiment, the consumer product 10 includes a device body 11. The device body 11 may include a housing that carries, encloses and supports both externally and internally various components (including, for example, integrated circuit chips and other circuitry) to provide computing and functional operations for the consumer product 10. The components may be disposed on the outside of the housing, partially within the housing, through the housing, completely inside the housing, and the like. The housing may, for example, include a cavity for retaining components internally, holes or windows for providing access to internal components, and various features for attaching other components. The housing may also be configured to form a water-resistant or water-proof enclosure for the body 11. For example, the housing may be formed from as a single unitary body and the openings in the unitary body may be configured to cooperate with other components to form a water-resistant or water-proof barrier.

[0071] Examples of components that may be contained in the device body 11 include processing units, memory, display, sensors, biosensors, speakers, microphones, haptic actuators, batteries, and so on. In some cases, the device body 11 may take on a small form factor. In cases such as these, the components may be packaged and/or in order to provide the most functionality in the smallest space. The components may also be configured to take up a minimal amount of space, which may facilitate the device body 11 having a small form factor. Additionally, the integration and assembly of the various components may be configured to enhance the reliability of the consumer product 10.

[0072] The construction of the housing of the device body 11 may be widely varied. For example, housing may be formed from a variety of materials including plastic, rubber, wood, silicone, glass, ceramics, fiber composites, metal or metal alloys, (e.g., stainless steel, aluminum), precious metals (e.g., gold, silver), or other suitable materials, or a combination of these materials.

[0073] Also in the illustrated embodiment, the wearable electronic device includes a band 12 or strap or other means for attaching to a user. The band 12 may, for example, be configured to attach to the body and provide a loop for securing to the wrist of the user. The band 12 may be integral with the housing or it may be a separate part. If integral, the band 12 may be a

continuation of the housing. In some cases, the integral band may be formed from the same material as the housing. If the band 12 is separate, the band may be fixed or releasably coupled to the housing. In both cases, the band 12 may be formed from similar or different materials as the housing. In most cases, the band 12 is formed from a flexible material such that it can conform to a user's body. Furthermore, the band 12 itself may be a single integral part or it may include attachment ends that provide an open and closed configuration. The attachment ends may, for example, be manifested as a clasp or other similar attachment mechanism or device. This particular configuration allows a user to open the band 12 for placement on the arm and close the band 12 in order to secure the band and body to the arm. The band 12 may be widely varied. By way of example, they may be formed from rubber, silicone, leather, metal, mesh, links and/or the like.

[0074] FIG. 2 depicts an example schematic diagram of a wearable electronic device. By way of example, device 100 of FIG. 2 may correspond to the consumer product 10 shown in FIG. 1. To the extent that multiple functionalities, operations, and structures are disclosed as being part of, incorporated into, or performed by device 100, it should be understood that various embodiments may omit any or all such described functionalities, operations, and structures. Thus, different embodiments of the device 100 may have some, none, or all of the various capabilities, apparatuses, physical features, modes, and operating parameters discussed herein.

[0075] As shown in FIG. 2, the device 100 includes one or more processing units 102 that are configured to access a memory 104 having instructions stored thereon. The instructions or computer programs may be configured to perform one or more of the operations or functions described with respect to the device 100. For example, the instructions may be configured to control or coordinate the operation of a display 120, one or more input/output components 106, one or more communication channels 108, one or more sensors 110, a speaker 122, a microphone 124 and/or one or more haptic feedback devices 112.

[0076] The processing units 102 of FIG. 2 may be implemented as any electronic device capable of processing, receiving, or transmitting data or instructions. For example, the processing units 102 may include one or more of: a microprocessor, a central processing unit (CPU), an application-specific integrated circuit (ASIC), a digital signal processor (DSP), or combinations

of such devices. As described herein, the term "processor" is meant to encompass a single processor or processing unit, multiple processors, multiple processing units, or other suitably configured computing element or elements.

[0077] The memory 104 can store electronic data that can be used by the device 100. For example, a memory can store electrical data or content such as, for example, audio and video files, documents and applications, device settings and user preferences, timing and control signals or data for the various modules, data structures or databases, and so on. The memory 104 can be configured as any type of memory. By way of example only, the memory can be implemented as random access memory, read-only memory, Flash memory, removable memory, or other types of storage elements, or combinations of such devices.

[0078] In the schematic diagram of FIG. 2, the one or more input components 106 are represented as a single item within the schematic diagram. However, input components 106 may represent a number of different input components, including buttons, switches, and dials for accepting user input, and so on. More specifically, the input components 106 may correspond to the buttons, dials, crowns or other devices for receiving input. Generally, the input components 106 are configured to translate a user-provided input into a signal or instructions that may be accessed using instructions executed on the processing units 102. In the present example, the input components 106 may include the hardware configured to receive the user input (e.g., button, switch, crown, and encoder) which is operatively coupled to circuitry and firmware used to generate signals or data that are able to be accessed using processor instructions. Each input component 106 may include specialized circuitry for generating signals or data and, additionally or alternatively, circuitry and firmware for generating signals or data may be shared between multiple input components 106. In some cases, the input components 106 produce user-provided feedback for application-specific input that corresponds to a prompt or user interface object presented on display 120. For example, the crown (item 642 of FIG. 6) may be used to receive rotational input from the user, which may be translated into an instruction to scroll a list or object presented on the display 120. The input components 106 may also produce user input for system-level operations. For example the input components 106 may be configured to interact directly with hardware or firmware being executed on the device 100 for system-level

operations, including, without limitation, power on, power off, sleep, awake, and do-not-disturb operations.

[0079] As shown in FIG. 2, the device 100 may also include one or more acoustic elements, including a speaker 122 and a microphone 124. The speaker 122 may include drive electronics or circuitry and may be configured to produce an audible sound or acoustic signal in response to a command or input. Similarly, the microphone 124 may also include drive electronics or circuitry and is configured to receive an audible sound or acoustic signal in response to a command or input. The speaker 122 and the microphone 124 may be acoustically coupled to respective ports or openings in the housing that allow acoustic energy to pass, but may prevent the ingress of liquid and other debris. As shown in FIG. 2, the speaker 122 and microphone 124 are also operatively coupled to the processing units 102, which may control the operation of the speaker 122 and microphone 124. In some cases, the processing units 102 are configured to operate the speaker 122 to produce an acoustic output that corresponds to an application or system-level operation being performed on the device 100. In some cases, the speaker 122 is operatively coupled to other modules, including, for example, input components 106, such as a crown or button. In some implementations, the device 100 is configured to produce an audible output that corresponds to the operation of the crown or buttons using the speaker 122. The microphone 124 may be configured to produce an output or signal in response to an acoustic stimulus. For example, the microphone 124 may be operatively coupled to the memory 104 and may be configured to record audio input, including human speech, music, or other sounds. In some cases, the microphone 124 may be configured to receive voice signals, which may be interpreted as voice commands by the processing units 102.

[0080] The one or more communication channels 108 may include one or more wireless interface(s) that are adapted to provide communication between the processing unit(s) 102 and an external device. In general, the one or more communication channels 108 may be configured to transmit and receive data and/or signals that may be interpreted by instructions executed on the processing units 102. In some cases, the external device is part of an external communication network that is configured to exchange data with wireless devices. Generally, the wireless interface may include, without limitation, radio frequency, optical, acoustic, and/or magnetic signals and may be configured to operate over a wireless interface or protocol. Example wireless

interfaces include radio frequency cellular interfaces, fiber optic interfaces, acoustic interfaces, Bluetooth interfaces, infrared interfaces, USB interfaces, Wi-Fi interfaces, TCP/IP interfaces, network communications interfaces, or any conventional communication interfaces.

[0081] In some implementations, the one or more communications channels 108 may include a dedicated wireless communication channel between the device 100 and another user device, such as a mobile phone, tablet, computer, or the like. In some cases, output, including audio sounds or visual display elements, are transmitted directly to the other user device for output to the user. For example, an audible alert or visual warning may be transmitted to a user's mobile phone for output on that device. Similarly, the one or more communications channels 108 may be configured to receive user input provided on another user device. In one example, the user may control one or more operations on the device 100 using a user interface on an external mobile phone, table, computer, or the like.

[0082] Additionally, as described in more detail below with respect to FIG. 17, the communications channels 108 may include a Near Field Communication (NFC) interface. The NFC interface may be used to identify the device and initiate a secure data connection, which may be used to authorize transactions, purchases, or conduct other forms of e-commerce.

[0083] As shown in FIG. 2, the device 100 also includes one or more sensors 110 represented as a single item within the schematic diagram. However, the sensors 110 may represent a number of different sensors, including devices and components that are configured to detect environmental conditions and/or other aspects of the operating environment. Example sensors 110 include an ambient light sensor (ALS), proximity sensor, temperature sensor, barometric pressure sensor, moisture sensor, and the like. Thus, the sensors 110 may also be used to compute an ambient temperature, air pressure, and/or water ingress into the device. In some embodiments, the sensors 110 may include one or more motion sensors for detecting movement and acceleration of the device 100. The one or more motion sensors may include one or more of the following: an accelerometer, a gyroscope, a tilt sensor, or other type of inertial measurement device.

[0084] The device 100 also includes one or more biosensors 118 and may include optical and/or electronic biometric sensors that may be used to compute one or more health metrics. As

described in more detail below with respect to FIG. 16, one or more of the biosensors 118 may include a light source and a photodetector to form a photoplethysmography (PPG) sensor. The optical (e.g., PPG) sensor or sensors may be used to compute various health metrics including, without limitation, a heart rate, a respiration rate, blood oxygenation level, a blood volume estimate, blood pressure, or a combination thereof. One or more of the biosensors 118 may also be configured to perform an electrical measurement using one or more electrodes. The electrical sensor(s) may be used to measure electrocardiographic (ECG) characteristics, galvanic skin resistance, and other electrical properties of the user's body. Additionally or alternatively, one or more of the biosensors 118 may be configured to measure body temperature, exposure to UV radiation, and other health-related information.

[0085] The device 100 may also include one or more haptic devices 112. The haptic device 112 may include one or more of a variety of haptic technologies such as, but not necessarily limited to, rotational haptic devices, linear actuators, piezoelectric devices, vibration elements, and so on. In general, the haptic device 112 may be configured to provide punctuated and distinct feedback to a user of the device. More particularly, the haptic device 112 may be adapted to produce a knock or tap sensation and/or a vibration sensation. As shown in FIG. 2, the haptic device 112 may be operatively coupled to the processing unit 102 and memory 104. In some embodiments, the haptic device 112 may be directly controlled by the processing unit 102. In some embodiments, the haptic device 112 may be controlled, at least in part, by the operation of an input component 106, including, for example, a button, dial, crown, or the like. The operation of the haptic device 112 may also be paired or linked to the operation of one or more other output devices, including, for example, the display 120 or the speaker 122.

[0086] As shown in FIG. 2, the device 100 may include a battery 114 that is used to store and provide power to the other components of the device 100. The battery 114 may be a rechargeable power supply that is configured to provide power to the device 100 while it is being worn by the user. The device 100 may also be configured to recharge the battery 114 using a wireless charging system. Accordingly, in some cases, the device may include a wireless power module 116 that may be configured to receive power from an external device or dock. The wireless power module 116 may be configured to deliver power to components of the device, including the battery 114. The wireless power module 116 and an external charging station or

dock may also be configured to transmit data between the device and a base or host device. In some cases, the wireless power module 116 may interface with the wireless charging station or dock to provide an authentication routine that is able to identify specific hardware, firmware, or software on the device in order to facilitate device maintenance or product updates. A more detailed description of an example wireless charging station is provided below with respect to FIGs. 18-19.

[0087] The device 100 may include a variety of other components, including for example, a camera or camera modules. The camera may be configured to capture an image of a scene or subject located within a field of view of the camera. The image may be stored in a digital file in accordance with any one of a number of digital formats. In some embodiments, the device 100 includes a camera, which includes an image sensor formed from a charge-coupled device (CCD) and/or a complementary metal–oxide–semiconductor (CMOS) device. The camera may also include one or more optical components disposed relative to the image sensor, including, for example, a lens, an filter, a shutter, and so on.

[0088] FIG. 3 depicts functional elements of the device 100, in accordance with some embodiments. In particular, FIG. 3 depicts the inputs that may be received and outputs that may be produced on an example device 100. By way of example, the device 100 may correspond to the devices shown in FIGs. 1 and 2. As shown in FIG. 3, the device 100 may include a force input 302 that may be produced using a force sensor that is configured to detect and measure the magnitude of a force of a touch on a surface of the device. The force input 302 may include a non-binary output that is generated in response to a touch. For example, the force input 302 may include a range of values or analog value that corresponds to the amount of force exerted on a surface of the device. Additionally or alternatively, the force input 302 may include binary (e.g., on, off) output in response to the force of a touch. The force input 302 may be used to control various aspects of the device. For example, the force input 302 may be used to control an aspect, such as a cursor or item selection on a user interface presented on the display of the device. The force input 302 may also be used to control the audio output 308, haptic output 312, and other functionality of the device. The force input 302 may also be used to distinguish between different types of input from the user. For example, a light touch from the user may be interpreted as a scroll command and used to index or scroll through a list of items on the display.

A harder touch from the user may be interpreted as a selection or confirmation of an item on the display. In some embodiments, the force input 302 is used to distinguish an intentional touch from the user from an incidental or accidental touch that may be ignored.

[0089] As shown in FIG. 3, the device 100 may also include a touch input 306 that may be produced using a touch sensor that is configured to detect and measure the location of a touch on a surface of the device. In some implementations, the touch sensor is a capacitive-based touch sensor that is disposed relative to the display or display stack of the device. The touch sensor may be a separate non-integrated sensor relative to the force sensor. In alternative embodiments, the touch sensor may also be physically and/or logically integrated with the force sensor to produce a combined output. The touch input 306 may be used to control various aspects of the device. For example, the touch input 306 may be used to control an aspect of the user interface presented on the display of the device. The touch input 306 may also be used to control the audio output 308, haptic output 312, and other functionality of the device.

[0090] In some cases, the logical integration of the force input 302 and the touch input 306 enhances the versatility or adaptability of device 100 by enabling a more sophisticated user interface than is currently available on some traditional wearable devices. In particular, the force input 302 and the touch input 306 may be combined to interpret a wider range of gestures and input commands than may be possible using, for example, only a touch input. For example, the force input 302 may provide a magnitude of a force of a touch, which may be used to distinguish between two touch input commands that have a similar location or gesture path. An improved touch interface using both force input 302 and touch input 306 may be particularly advantageous when interpreting touch commands on a relatively small area surface, such as a display screen or cover glass of a wearable electronic device.

[0091] As shown in FIG. 3, the device 100 may also include a button/dial input 310 that may be produced using an input device that is configured to receive input from the user. As described previously, the device 100 may include one or more buttons disposed on or near an external surface of the housing and are configured to receive input from a user. The device may also include a dial or crown that is configured to accept rotational input from the user. As described

in more detail below with respect to FIGs. 24A-B, the dial or crown may also include a push feature that is adapted to accept input from the user.

[0092] The device 100 may also accept audio input 314 using a microphone or other acoustic sensing device. The audio input 314 may be adapted to accept input from the user, including voice commands and other audio signal input. The audio input 314 may also be adapted to detect and measure ambient audio conditions that may be used to adjust the volume of the audio output 308 or operation of the haptic output 312. The audio input 314 may also be used to record an audio stream or voice message in accordance with an audio recording application or software program.

[0093] As shown in FIG. 3, the device 100 may include a display output 304 in accordance with some embodiments. The display output 304 includes visual or graphical output that may be produced using the display element of the device. In some embodiments, the display output 304 includes a graphical user interface produced using an operating system or software application executed on one or more processing units of the device. In one example, the display output 304 includes a graphical depiction that resembles a watch face or other timekeeping device. In other examples, the display output 304 includes a graphical interface for an e-mail, text messaging, or other communication-oriented program. The display output 304 may also present visual information that corresponds to one of the other functional aspects of the device 100. For example, the display output 304 may include information that corresponds to the biosensor input 320, sensor input 318, force input 302, touch input 306, and others.

[0094] As shown in FIG. 3 the device 100 may include an audio output 308 that may be produced with a speaker or acoustic module. The audio output 308 may include sounds or audio signals that are associated with the operation of the device. For example, the audio output 308 may correspond to the operation of an input device to provide audio feedback to the user. For example the audio output 308 may correspond to an input received in the form of a force input 302, touch input 306, and/or button/dial input 310. In some cases, the audio output 308 may also include a portion of an auditory alert that may be produced alone or combined with a haptic output 312 and/or display output 304 of the device 100.

[0095] The device 100 may also include a sensor input 318 produced using one or more sensors that may be configured to monitor and detect various environmental conditions. For example, the sensor input 318 may include signals or data produced using an ambient light sensor, proximity sensor, temperature sensor, barometric pressure sensor, or other sensor for monitoring environmental conditions surrounding or near the device. In general, the sensor input 318 may be used to adapt the functionality of the device 100 to conform to the one or more environmental conditions. For example, the brightness of the display output 304, the volume of the audio output 308, and/or the operation of the input to the device 100 may be based on the sensor input 318.

[0096] In some embodiments, the sensor input 318 includes input produced by one or more motion sensors. The motion sensors may include one or more of the following: an accelerometer, a gyroscope, a tilt sensor, or other type of inertial measurement device. A sensor input 318 produced using one or more motion sensors may be used to monitor and detect changes in motion of the device 100. Changes in linear and angular motion may be used to determine or estimate an orientation of the device relative to a known location or fixed datum. The sensor input 318 produced from the one or more motion sensors may also be used to track the movement of the user. The movement of the user may be used to facilitate navigation or map-guided functionality of the device. Additionally, input related to the gross movement of the user can be used as a pedometer or activity meter, which may be stored and tracked over time to determine health metrics or other health-related information. Additionally, in some embodiments, sensor input 318 from the one or more motion sensors may be used to identify motion gestures. For example, the motion sensors can be used to detect an arm raise or the position of a user's body (within a predetermined confidence level of certainty).

[0097] The device 100 may also include a biosensor input 320 produced using one or more biosensors or biosensor modules that are configured to monitor physiological and/or health conditions of a user. As discussed above with respect to FIG. 2, the device may include one or more optical sensors for measuring heart rate, blood pressure, oxygen saturation, or a combination thereof. The device may also include one or more sensors having electrical contacts that are disposed to contact the user's body. The sensors may be configured to measure electrocardiographic (ECG) characteristics, galvanic skin resistance, and other electrical

properties of the user's body. Additionally or alternatively, sensors may be configured to measure body temperature, exposure to UV radiation, and other health related information. The biosensor input 320 may be combined with other aspects of the device to provide heath-monitoring functionality. For example, the biosensor input 320 may be used to compute data that is presented using the display output 304. The operation of the biosensor input 320 may also be controlled using the force input 302, touch input 306, or other user input 310 to provide an interactive health monitoring function or application.

[0098] As shown in FIG. 3, the device may include a haptic output 312 that may be produced using one or more haptic devices that are configured to provide haptic feedback to the user. In particular, the haptic output 312 may be produced using one or more electromechanical subassemblies that are configured to induce motion or vibration in the device, which may be perceived or sensed by the user. In some cases, the haptic actuator or device is tuned to operate based on a resonance or near resonance with respect to the device, which may enhance haptic output. In some cases, the haptic actuator or device is configured to operate based on a resonance or near resonance with respect to some components of the device, such as the band or clasp of the device.

[0099] In some embodiments, the haptic output 312 may correspond to the operation of one or more other modules or subsystems. For example, the haptic output 312 may include a vibration or haptic feedback that corresponds to an audio alert or visual alert or signal produced by the acoustic module or display, respectively. Additionally or alternatively, the haptic output 312 may be operated in conjunction with an input from the user. The haptic output 312 may include haptic or force feedback that confirms that the user input was or is being received. By way of example, a haptic output 312 may include a click or vibration when the crown of the device is turned or a button is depressed. The haptic output 312 may also be coordinated with other functionality of the device including, for example, message transmission operations, power management operations, force sensor operations, biosensor operations, to provide a notification, to provide an alert, and others.

[0100] As shown in FIG. 3, the device 100 may also include communications input/output (I/O) 316, which may facilitate communication with an external device or system. The

communications I/O 316 may be produced using one or more wireless interfaces, including radio frequency cellular interfaces, fiber optic interfaces, acoustic interfaces, Bluetooth interfaces, Near Field Communication interfaces, infrared interfaces, USB interfaces, Wi-Fi interfaces, TCP/IP interfaces, network communications interfaces, or any conventional communication interfaces. In some cases, the communications I/O 316 may include signals and data received from an external device that has been paired or is otherwise in electronic communication with the device 100. The external data included in the communications I/O 316 may include, for example, message data associated with an electronic communication, notification data associated with an event, and/or data related to audio or visual content. The communications I/O 316 may also include an authorization or identification of external devices in communication with the device 100 or users associated with one or more external devices. Similarly, the communications I/O 316 may be used to output various forms of data or signals to one or more devices or systems that are external to the device 100. For example, the communications I/O 316 may include data or computations that are produced using the biosensor input 320 and/or the sensor input 318.

[0101] FIG. 4 depicts an example wearable electronic device 100 as part of a system of devices. By way of example, the wearable electronic device 100 of FIG. 4 may correspond to the devices shown in any of the previous figures. Generally, the wearable electronic device 100 may communicate wirelessly with any of a number of other devices, such as mobile phone 420, computer 430, tablet computing devices, personal media players, televisions, networked home appliances, networked home controls, electronic systems in vehicles, and so on. Additionally, the wearable electronic device 100 may communicate wirelessly with any of a number of electronic accessories, including headset devices, portable speaker devices, portable microphone devices, display screens, and so on. Communication may be through a wired or wireless connection, including any technology mentioned herein.

[0102] In some embodiments the wearable electronic device 100 may accept a variety of bands, straps, or other retention mechanisms (collectively, "bands"). These bands may be removably connected to the electronic device by a feature formed into the band or band assembly that is accepted in a recess or other aperture within the device and locks thereto. An example band interface is described in more detail below with respect to FIGs. 25A-C.

[0103] In general, a user may change combinations of bands and electronic devices, thereby permitting mixing and matching of the two categories. It should be appreciated that devices having other forms and/or functions may include similar recesses and may releasably mate with a lug and/or band incorporating a lug. In this fashion, a system of bands and devices may be envisioned, each of which is compatible with another. A single band may be used to connect to devices, as one further example; in such embodiments the band may include electrical interconnections that permit the two devices to transmit signals to one another and thereby interact with one another.

[0104] Insofar as the electronic device 100 may connect either physically or through a data communication link with other computing devices, the combination of devices and bands may be thought of as an ecosystem having multiple parts that interact with one another, may intelligently communicate with one another, may share functionality and/or may substitute for one another in terms of operations, output, input and the like. Examples of devices existing in such an ecosystem follow, but are illustrative rather that limiting.

[0105] As one example, a number of electronic devices 100, 420, 430 may each have identical or similar attachment structures that permit them to share a band or connector. A user may thus change the interconnected band and device(s) with respect to one another, permitting a number of different physical connections between different ecosystem components. In some embodiments, a band that serves to retain an electronic device only may be swapped for bands having additional functionalities, such as transmitting data between devices connected to the band, adding functionality to a connected device that the device lacks, providing additional power to a connected device, and so on. Further, different bands may look different, so that the appearance of the electronic device(s) in combination with a band(s) may change by changing the band(s) and/or device(s) with respect to one another.

[0106] As another example, electronic devices 100, 420, 430 may communicate with one another as part of the overall ecosystem. Data may be passed from one device 420 to another 100. This may be useful if the user 410 is wearing one electronic device 100 but is not near another device 430 that wishes to notify the user or interact with the user in some fashion. Continuing the example, the computer 430 may transmit a reminder or message to the wearable device 100 to

gain the user's attention. As another example, the computer 430 (or any other electronic device in the ecosystem) may transmit a state of an application or even the device itself to the wearable device 100. Thus, for example, if an application operating on the computer needs the user's attention, it may be gained through an alert issued by the wearable device.

[0107] Data communication between devices in an ecosystem may also permit the devices to share functionality. As one non-limiting example, electronic devices may share sensor data with one another to permit one device access to data it normally would not have, from a sensor it does not physically incorporate. Thus, any given device 100, 420, 430 may draw on the abilities of other devices in the ecosystem to provide an enhanced and relatively seamless experience for a user 410.

[0108] FIG. 5 depicts a system 500 of interchangeable components for a wearable device. By way of example, one or more of the devices of FIG. 5 may correspond to the devices shown in any of the previous figures. FIG. 5 depicts a system 500 including a variety of interchangeable components, including multiple device bodies 515, 525, 535 that are configured to connect via a standard interface to any one of a number of different bands 551a-b, 552a-b, 553a-b, 554a-b, and 555a-b. In addition, each of the three devices may be configured to connect via a standard interface to another type of non-band component, such as a lug 556a-b, non-band component, or other device.

[0109] As shown in FIG. 5, the system 500 may include a body or device that is adapted to attach to one or more bands, straps, or other similar component that may be used to attach the device to the body of a user. In some embodiments, the device may be interchangeable or interchanged to provide a different set of functions or features. In some embodiments, the bands or attachment components may be interchangeable or interchanged to provide desired functionality or features.

[0110] In the example depicted in FIG. 5, each of the devices includes at least one receiving feature 504 that is configured to interconnect with a corresponding feature 502 that is attached to or integrally formed with the end of each of the bands or other mating parts. In some embodiments, receiving feature 504 includes a channel or groove that is formed in one end of the device body. The mating feature 502 of a respective band or component may be configured to

slidably engage with the receiving feature 504 of a respective device body to attach the band or component. An example receiving feature is described in more detail below with respect to FIGs. 25A-C. In some embodiments, the receiving feature 504 and the mating feature 502 are standardized in the system 500 and, thus, any of the bands (551a-b, 552a-b, 553a-b, 554a-b, and 555a-b) can be interchangeably used with any of the device bodies 515, 525, 535.

[0111] With respect to FIG. 5, each of the bands may be formed from a different material or using a different construction. In the present example, bands 551a-b may be formed from a textile material that may be constructed from a pattern of thread or fiber material. The textile material may include a variety of materials, including natural fibers, synthetic fibers, metallic fibers, and so on. The bands 552a-b may be formed from a woven material and may be constructed from an array of warp fibers or threads interwoven with one or more weft fibers or threads. Similarly, the warp and weft fibers may include a variety of materials, including natural fibers, synthetic fibers, metallic fibers, and so on. The bands 553a-b may be formed from leather material 553a-b. In one example, the bands 553a-b are formed from a sheet or strip of cowhide; however, the bands 553a-b may also be formed from one of any number of types of animal hide. The leather material 553a-b may also include a synthetic leather material, such as vinyl or plastic. The bands 554a-b may be formed from a metallic mesh or link construction. For example the bands 554a-b may be formed from a Milanese mesh or other similar type of construction. The bands 555a-b may be formed from a silicone or other elastomer material.

[0112] In some cases, the band is a composite construction including various materials, which may be selected based on the end use or application. In some embodiments, a first band strap, or a first portion of the first band strap, may be made up of a first material and a second band strap, or a second portion of the second band strap, may be made from a second, different material. The band may also be made up of a plurality of links and, as such, the band may be resizable by, for example, adding or removing links. Example bands and band constructions are provided below in Section 12.

[0113] In the system 500, an interchangeable band may allow for individual customization of the device or to better adapt the device for a range of uses or applications. In some instances, the type of band that is selected and installed can facilitate a particular user activity. For example,

band 551a-b may be formed from a textile material and include a durable clasp that may be particularly well suited for exercise or outdoor activities. Alternatively, as discussed above the band 554a-b may be formed from a metallic material and include a thin or low-profile clasp that may be well suited for more formal or fashion-focused activities.

[0114] In some embodiments, the band may be coupled to a separate component having the mating feature 502. The band may be coupled using pins, holes, adhesives, screws, and so on. In yet other embodiments, the band may be co-molded or overmolded with at least a portion of the component having the mating feature 502. In some embodiments, the band is coupled to the component via a pin that allows the straps to rotate with respect to the component. The pin may be formed integrally with or disposed in a loop formed in the end of the band.

[0115] In the example system 500, each of the bands is shown as having a generic band clasp. However, the type of band clasp that is used may vary between embodiments. On example band clasp may include a first band strap having a buckle or tang assembly which is configured to interface with a second band strap having a series of apertures or holes formed with the strap. Additionally or alternatively, the bands may include a magnetic clasp having one or more magnetic elements on a first band strap that is configured to mate to one or more magnetic or ferromagnetic elements on a second band strap.

[0116] As shown in FIG. 5, the system may include multiple device bodies 515, 525, 535 that may vary in size, shape, and composition. The device body 515, 525, 535 may include one or more of the embodiments described herein and may include, but is not limited to a wearable computer, a wearable watch, a wearable communication device, a wearable media player, a wearable health monitoring device, and/or the like. In particular, the device body may correspond to the device body described with respect to device body 610 of device 100 (shown in FIG. 6).

1. Example Wearable Electronic Device

[0117] FIG. 6 depicts an example wearable electronic device, which may include various aspects of the device(s) described above. In some embodiments, multiple modules or subsystems are physically and operationally integrated together to provide particular functionality or device

features. In particular, the interaction between the subsystems, or the subsystems themselves, may be configurable by the user, manufacturer, or vendor to adapt the device to produce certain functionality. Some example combinations and interactions between the various modules and subsystems are expressly provided in the present description. However, the combinations and interactions provided herein are merely illustrative in nature and are not intended to be limiting on the scope of the disclosure.

[0118] FIG. 6 depicts an example configuration of a wearable electronic device 100. In particular, FIG. 6 depicts an electronic wearable device 100 including a device body 610 that may be configured to be attached to the wrist of a user using a band assembly 620. This configuration may also be referred to herein as a wearable device, a device, an electronic wristwatch, or an electronic watch. While these terms may be used with respect to certain embodiments, the functionality provided by the example electronic wearable device 100 may be substantially greater than or vary with respect to many traditional electronic watches or timekeeping devices.

[0119] In the present example, the exterior surface of the device body 610 is defined, in part, by the exterior surface of the housing 601 and the exterior surface of the cover 609. In the example depicted in FIG. 6, the device body 610 is substantially rectangular with round or curved side portions. The outer surfaces of the cover 609 and the housing 601 coincide at a joint interface and cooperate to form a continuous contoured surface. The continuous contoured surface may have a constant radius and may be tangent to a flat middle portion of the cover 609 and/or a flat bottom portion of the housing 601. In some embodiments, the cover 609 has substantially the same shape as a flat bottom portion and at least a portion of the curved side portions of the housing 601. A more complete description of the geometry of the cover 609 and the housing 601 is provided below with respect to FIGs. 7 and 8.

[0120] In the example of FIG. 6, the device 100 includes a display (item 120 of FIG. 2) that is disposed at least partially within an opening or cavity defined within a top portion of the housing 601 of the device body 610. The display may be formed from a liquid crystal display (LCD), organic light emitting diode (OLED) display, organic electroluminescence (OEL) display, or other type of display device. The display may be used to present visual information to the user

and may be operated in accordance with one or more display modes or the software applications being executed on the device 100. By way of example, the display may be configured to present the current time and date similar to a traditional watch or timepiece. The display may also present a variety of other visual information that may correspond to or be produced using one of the other modules in the device 100. For example, the display may be configured to display one of a variety of notification messages, which may be generated based on data received from the one or more sensors, the wireless communication system, or other subsystem of the device 100. The display may also be configured to present visual information or data that is based on the output of one or more sensor outputs. The display may also provide status or information related to a wireless charging process or battery power. The display may also present visual output or information related to media being produced using a speaker or acoustic module of the device 100. Accordingly, a variety of other types of visual output or information may be presented using the display.

[0121] In the current example, the display includes or is integrated with a cover 609 that helps to protect the display from physical impact or scratches. In the field of wearable devices, the cover 609 may also be referred to generically as a crystal or cover glass, regardless of the material that is used to form the cover 609. In some cases, the cover 609 is formed from a sheet or block of sapphire material. Sapphire may provide superior optical and surface hardness properties as compared to other materials. In some cases, the sapphire material has a hardness of approximately 9 on the Mohs scale. In alternative embodiments, the cover 609 is formed from a glass, polycarbonate, or other optically transparent material. The cover 609 may also be coated with one or more optical or mechanical enhancing materials or surface treatments. For example, interior and/or exterior surfaces of the cover 609 may be coated with an anti-reflective (AR), oleophobic or other coating to enhance the visible or functional properties of the display. Additionally, in some cases, the cover 609 may be configured to cooperate with an antenna used to facilitate wireless communication with an external device. FIGs. 21A-B, described in more detail below, provide one example embodiment of a cover configured to cooperate with an antenna.

[0122] In the example depicted in FIG. 6, the cover 609 is formed from a transparent material and, when assembled has an external surface and an internal surface. The cover 609 is disposed

above the display and encloses a cavity or opening formed in the top portion of the housing 601. In some embodiments, the external surface of the cover 609 cooperates with the external surface of the housing to form a substantially continuous external peripheral surface of the electronic device. As shown in FIG. 6, the external surface of the cover 609 has a flat middle portion at the center of the cover, which extends outwardly. The cover 609 also includes a curved edge portion that emanates from and surrounds the flat middle portion and extends outwardly to an edge at the side of the cover 609. In some embodiments, the cover 609 also includes an opaque mask disposed relative to the internal surface of the transparent cover. The opaque mask may correspond to or otherwise define the viewable area of the display 120. The mask may have an outer boundary that is located proximate the edge of the side of the cover 609 and has an inner boundary located within the curved edge portion of the cover 609.

[0123] As shown in FIG. 6, the cover 609 is disposed relative to a top portion of the housing 601. The housing 601 includes a top portion defining an opening, which is surrounded by a curved side portion. In the present example, the curved edge portion of the cover 609 coincides with the curved side portion of the housing 601 to form a continuous external surface of the electronic device 100. In some instances, the cover 609 may have a contour that follows or otherwise corresponds to a similar contour of the housing 601 to form a substantially continuous surface at the interface between the two components. As shown in FIG. 6, the cover 609 protrudes above the housing 601.

[0124] In some instances, the cover 609 is disposed relative to a touch sensor (item 702 of FIG. 7). In some embodiments, the touch sensor may be integrated with the display or other element of the device 100. The touch sensor may be formed from one or more capacitive sensor electrodes or nodes that are configured to detect the presence and/or location of an object or the user's finger that is touching or nearly touching the surface of the display. In some cases, the touch sensor includes an array of sensing nodes formed in accordance with a mutual capacitance sensing scheme.

[0125] In one example, the touch sensor may include an array of mutual capacitance touch nodes that can be formed by a two-layer electrode structure separated by a dielectric material. One layer of electrodes may comprise a plurality of drive lines and another layer of electrodes may

comprise a plurality of sense lines, and where the drive lines and the sense lines cross, mutual capacitive sense nodes are formed (also referred to as coupling capacitance). In some implementations, the drive lines and sense lines may cross over each other in different planes separated from one another by a dielectric. Alternatively, in other embodiments the drive lines and sense lines can be formed substantially on a single layer. An example touch sensor and touch-sensing node are described in more detail below with respect to FIGs. 14A-C and 15A-B.

[0126] Alternatively or additionally, the touch sensor may include one or more self-capacitive nodes or electrodes that are configured to detect a discharge of electrical current or charge when an object, such as a user's finger, contacts or nearly contacts a surface of the housing 601 or other surface of the device 100. Other types of electronically sensing nodes, including resistive, inductive, or the like, may also be integrated into a surface of the device 100.

[0127] In some embodiments, the device 100 may also include a force sensor (item 705 of FIG. 7). The force sensor may be disposed relative to the display 120 or integrated with other elements of the device 100. In some cases, the force sensor includes one or more force sensing structures or force-sensing nodes for detecting and measuring the magnitude of a force or pressure due to a touch on a surface of the device 100. The force sensor may be formed from or implement one or more types of sensor configurations. For example, capacitive and/or strain based sensor configurations may be used alone or in combination to detect and measure the magnitude of a force or pressure due to a touch. As described in more detail below, a capacitive force sensor may be configured to detect the magnitude of a touch based on the displacement of a surface or element on the device. Additionally or alternatively, a strain-based force sensor may be configured to detect the magnitude of a touch based on the deflection. Example force sensor and force-sensing modules are described in more detail below with respect to FIGs. 9-12.

[0128] As shown in FIG. 6, the device 100 also includes device body 610 including a housing 601 that upon which may be mounted or integrated with various components of the device 100. The housing 601 serves to surround at a peripheral region as well as support the internal components of the product in their assembled position. In some embodiments, the housing 601 may enclose and support internally various components (including for example integrated circuit chips and other circuitry) to provide computing and functional operations for the device 100.

The housing 601 may also help define the shape or form of the device. That is, the contour of the housing 601 may embody the outward physical appearance of the device. As such, it may include various ornamental and mechanical features that improve the aesthetical appearance and tactile feel of the device. For example, the housing 601 may include a contoured surface that includes rectilinear contours, curvilinear contours, or combinations thereof. The housing 601 may also include various surface features, including textures, patterns, decorative elements, and so on.

[0129] In the present example, the housing 601 is formed from a single piece, which may also be referred to as single-body, unitary, or uni-body design or construction. By utilizing a single-body construction, the structural integrity of the device may be improved as compared to a multi-piece construction. For example, a single body may be more easily sealed from contaminants as compared to a multi-piece enclosure. Additionally, a single-body enclosure may be more rigid due, in part, to the absence of joints or seams. The rigidity of the housing 601 may be further enhanced by increasing the material thickness in areas where mechanical stress may be greatest, while also maintaining or thinning other areas where mechanical stress may be lower or reduced. Variations in the thickness of the housing 601 may be possible by machining or casting the housing 601 as a single piece. Additionally, a single-body housing 601 may include one or more features for mounting or integrating the internal components of the device 100, which may facilitate manufacturing and/or assembly of the device 100.

[0130] An example housing 601 is described in more detail below with respect to FIG. 8. The housing 601 may be formed from a variety of materials, including, without limitation plastic, glass, ceramics, fiber composites, metal (e.g., stainless steel, aluminum, magnesium), other suitable materials, or a combination of these materials. Further, the housing 601 may include a surface treatment or coating, which may be formed from a variety of materials, including, without limitation aluminum, steel, gold, silver and other metals, metal alloys, ceramics, wood, plastics, glasses, and the like.

[0131] As discussed above, the display, the touch sensor, and force sensor may be disposed within the housing 601. In this example, one or more buttons 644 and a crown 642 used to receive user input may also be disposed within or relative to the housing 601. Other types of

user input, including for example, one or more dials, slides, or similar user input devices or mechanisms may also be disposed within or relative to the housing 601. As described in more detail with respect to FIGs. 7 and 8, the housing 601 may include various features for attaching and mounting the subassemblies and modules of the device 100. In particular, the housing 601 may have one or more openings for receiving the cover 609, the display, the force sensor, or other components. The housing 601 may also include one or more holes or openings for receiving the button 644 and crown 642 that are located around the perimeter of the device 100. In some embodiments, the housing 601 also includes internal features, such as bosses and threaded portions, that can be used to attach modules or components within the housing 601.

[0132] The device 100 may also include an ambient light sensor (ALS) that is configured to detect and measure changes in ambient lighting conditions. The ALS may include a photodiode and one or more optical elements or lenses for collecting light. An ALS may be located on an external facing surface that is less likely to be blocked when the device is worn or in use. The ALS may be used to adjust settings, including screen brightness and other visual output depending on the overall lighting conditions.

[0133] The housing 601 may also include one or more motion-sensing elements or devices for detecting motion of the device 100. For example, the device 100 may include one or more accelerometers that are configured to sense acceleration or changes in motion. Additionally or alternatively, the device 100 may include one or more gyroscopic sensors that are configured to detect changes in direction. In some cases, the one or more gyroscopic sensors may include a spinning mass that can be used to detect changes in angular velocity. Multiple motion-sensing elements may be used to detect motion along multiple directions or axes. The motion sensors may also be used to identify motion gestures. For example, the motion sensors can be used to detect an arm raise or the position of a user's body (within a predetermined confidence level of certainty). The one or more motion-sensing elements may be used to determine an orientation of the device relative to a known or fixed datum. For example, the device may include a compass and/or global positioning system (GPS) that can be used to identify an absolute position. The one or more motion sensing elements may then measure deviation or movement with respect to the absolute position to track movement of the device or the user wearing the device. In some implementations, the one or more motion-sensing elements are used to detect gross movement of

the device or user. The gross movement may be used as a pedometer or activity meter, which may be tracked over time and used to calculate a health metric or other health-related information.

[0134] Described in more detail with respect to FIG. 8, the housing 601 may also include one or more openings or orifices coupled to an acoustic module or speaker 122, which may include a speaker and/or a microphone subassembly. Although the housing 601 may include one or more openings or orifices, the housing 601 may still be substantially waterproof/water resistant and may be substantially impermeable to liquids. For example, the opening or orifice in the housing or enclosure may include a membrane or mesh that is substantially impermeable to liquid ingress. Additionally or alternatively, the geometry of the opening or orifice and other internal features of the housing 601 may be configured to reduce or impede the ingress of liquid or moisture into the device 100. In one example, the opening is formed from one or more orifices that are offset with respect to an internal acoustic chamber or cavity, which may prevent a direct path from the outside of the housing 601 into the acoustic module.

[0135] As shown in FIG. 6, the device 100 includes a device body 610 that may be attached to a user's wrist using a band 620. In the present example, the band 620 include a first band strap 621 attached to a first receiving feature 623 and a second band strap 622 attached to a second receiving feature 624. In some embodiments, the first and second band straps 621, 622 include a lug feature that is configured to attach to the first and second receiving features 623, 624, respectively. As shown in FIG. 6, the free ends of the band straps 621, 622 are connected with a clasp 625.

[0136] The band straps 621, 622 are formed from a flexible or compliant material that may be specially configured for a particular application. The band straps 621, 622 may be formed from a variety of materials, including, for example, leather, woven textiles, or metallic mesh materials. The material and construction of the band straps 621, 622 may depend on the application. For example, the band straps 621, 622 may be formed from a woven textile material configured for exposure to impact and moisture typically associated with outdoor activities. In another example, the band straps 621, 622 may be formed from a metallic mesh material that may be

configured to have a fine finish and construction that may be more appropriate for professional or social activities.

[0137] Similarly, the clasp 625 of the band 620 may be configured for a particular application or to work with a particular style of band. For example, if the band straps 621, 622 are formed from a metallic mesh material, the clasp 625 may include a magnetic clasp mechanism. In the present example, the device 100 is configured to be attached to the wrist of a user. However, in alternative embodiments, the device may be configured to be attached to the arm, leg or other body part of the user.

[0138] The housing 601 includes one or more features for attaching the band straps 621, 622. In the present example, the housing 601 includes a first receiving feature 623 and a second receiving feature 624 for attaching the first band strap 621 and the second band strap 622, respectively. In this example, the band straps 621, 622 include a lug portion that is adapted to mechanically engage with the receiving features 623, 624. A more detailed description of the receiving features and lugs is provided below with respect to FIGs. 25A-C. As shown in FIG. 6, the first 623 and second receiving features 624 may be integrally formed into the housing 601. In alternative embodiments, the receiving features may be formed from separate parts and may be attached to the housing 601 during manufacturing. In some embodiments, the receiving features 623, 624 may be configured to release the band straps 621, 622 from the device body 610 (e.g., the housing 601). For example, one or both of the receiving features 623, 624 may include a button or slide, which may be actuated by the user to release a corresponding band strap 621 and 622. One advantage of a releasable lug is that the user can swap between a variety of bands that may be specially configured for a particular use scenario. For example, some bands may be specially configured for sport or athletic activities and other bands may be configured for more formal or professional activities.

[0139] The device 100 may also include a rear cover 608 located on the rear-facing surface of the housing 601 of the device body 610. The rear cover 608 may improve the strength and/or scratch resistance of the surface of the device 100. For example, in some embodiments, the rear cover 608 may be formed from a sapphire sheet, zirconia, or alumina material having superior scratch resistance and surface finish qualities. In some cases, the sapphire material has a

hardness greater than 6 on the Mohs scale. In some cases, the sapphire material has a hardness of approximately 9 on the Mohs scale. Due to the superior strength of the sapphire material, a cover glass formed from a sapphire sheet may be very thin. For example, the thickness of a sapphire cover sheet may be less 300 microns thick. In some cases, the thickness of a sapphire cover sheet may be less than 100 microns thick. In some cases, the thickness of a sapphire cover sheet may be less than 50 microns thick. In some embodiments, the rear cover 608 is contoured in shape. For example, the rear cover 608 may have a convex curved surface.

[0140] FIG. 7 depicts an example exploded view of various modules and subassemblies of the device 100. As shown in FIG. 7, multiple components are configured to be disposed within and/or attached to the housing 601. The exploded view provided in FIG. 7 depicts one example arrangement of the components of the device 100. However, in other embodiments, arrangement, placement, and/or grouping of the subassemblies and the components of the subassemblies may vary.

[0141] In the present example, a main cavity of the housing 601 houses an electronics subassembly 720 and the battery 114 of the device. The electronics subassembly 720 includes one or more electrical circuit assemblies for coupling the various electrical components of the device 100 to each other and to power supplied by the battery 114. The electronics subassembly 720 may also include structural elements or components that provide structural rigidity for the electronics subassembly 720 and/or structural mounting or support for other components disposed within the housing 601. As shown in FIG. 7, within the cavity of the housing 601, the speaker 122, the crown module 642, and the battery 114 are all disposed above the electronics subassembly 720. In the present embodiment the top surface of the speaker 122, the crown module 642, and the battery 114 have a substantially similar height. In some embodiments, the speaker 122, the crown module 642, and the battery 114, when assembled in the housing 601, define an area for the display 120 within the cavity. Thus, as shown in FIG. 7, the display 120 may overlay the speaker 122, the crown module 642, and the battery 114, which overlay the electronics subassembly 720.

[0142] As shown in FIG. 7, the cover 609 is configured to fit within a corresponding recess formed within the housing 601. In particular, the cover 609 includes a vertical portion having a

height that corresponds to the depth of the recess formed within the housing 601. In this example, the device 100 includes a force sensor 705 disposed between the housing 601 and a cover subassembly 704. As described in more detail below with respect to FIGs. 9 and 10A-B, the force sensor 705 may be configured to detect a force placed on a surface of the cover 609 by detecting a relative deflection between the cover 609 (or cover subassembly 704) and the housing 601. In the present example, the force sensor 705 also forms a gasket or seal between the cover subassembly 704 and the housing 601. In some implementations, the seal is a water-proof or water-resistant seal that helps to prevent water or liquid ingress into the internal cavity of the housing 601. The force sensor 705 may also be used to join the cover subassembly 704 to the housing 601 using an adhesive or film.

[0143] In some embodiments, the cover subassembly 704 includes the cover 609 which is disposed above the touch sensor 702 and display 120. In the present example, the touch sensor 702 and the display 120 are attached to each other by an optically clear adhesive layer (OCA). Similarly, an OCA layer is used to attach the touch sensor 702 to the cover 609. Other adhesives or bonding techniques may be used to attach the display 120 and the touch sensor 702 to the cover 609. In some embodiments, the touch sensor 702 is integrated into the display 120 and the display 120 (and integrated touch sensor 702) are attached to the cover 609.

[0144] As shown in FIG. 7, the speaker 122 is also disposed within the cavity of the housing 601. The speaker 122 is adapted to mechanically and acoustically interface with a port formed in the side of the housing 601. In some embodiments, the port is configured to prevent a direct path for water or liquid into an acoustic chamber or cavity of the speaker 122. In some embodiments, the device 100 also includes a microphone that is similarly coupled to another port formed in the side of the housing 601. A more detailed description of the speaker 122 and microphone is provided below with respect to the acoustic module of FIG. 20.

[0145] In the present example, the haptic device 112 is also disposed within the cavity of the housing 601 proximate to the speaker 122. In some embodiments, the haptic device 112 is rigidly mounted to a portion of the housing 601. A rigid mounting between the housing 601 and the haptic device 112 may facilitate the transmission of vibrations or other energy produced by the haptic device 112 to the user. In the present example, the haptic device 112 includes a

moving mass that is configured to oscillate or translate in a direction that is substantially parallel with a rear face of the housing 601. In some implementations, this orientation facilitates the perception of a haptic output produced by the haptic device 112 by a user wearing the device 100. While this configuration is provided as one example, in other implementations, the haptic device 112 may be placed in a different orientation or may be configured to produce a haptic response using a rotating mass or other type of moving mass.

[0146] As shown in FIG. 7, the device also includes an antenna subassembly 722. In this example, a portion of the antenna subassembly 722 is disposed within the housing 601 and a portion of the antenna subassembly 722 is disposed within the cover assembly. In some implementations, a portion of the antenna subassembly 722 is disposed relative to a feature formed within the cover 609. An example embodiment is described in more detail below with respect to FIGs. 21A-B.

[0147] In the example depicted in FIG. 7, the device 100 also includes a crown module 642 which is disposed in an aperture or hole in the housing 601. When installed, a portion of the crown module 642 is located outside of the housing 601 and a portion of the crown module 642 is disposed within the housing 601. The crown module 642 may be configured to mechanically and/or electrically cooperate with the electronics subassembly 720. A more detailed description of an example crown module is provided below with respect to FIGs. 23 and 24A-B. The housing 601 also includes a button 644, which is disposed in an opening of the housing 601 and may be configured to mechanically and/or electrically cooperate with the electronics subassembly 720.

[0148] In the example depicted in FIG. 7, a biosensor module 710 is disposed in an opening formed in the rear surface of the housing 601. In some embodiments, the biosensor module 710 includes the rear cover 608 and may also include a chassis or plate that facilitates attachment of the biosensor module 710 to the housing 601. The chassis or plate or the cover sheet 608 may also include features or elements that facilitate a watertight seal between the biosensor module 710 and the housing 601. For example, the rear cover 608 may include a shelf or flange that may be used to form a seal between the biosensor module 710 and the housing 601. As described in more detail below with respect to FIG. 16, the biosensor module 710 may include one or more

light sources, one or more photodetectors, and one or more electrodes or conductive elements that are configured to detect and measure a physiological condition or property of the user.

[0149] In some embodiments, the rear cover 608 has an edge that protrudes outwardly from the back surface of the housing 601. The rear cover 608 may also have a convex curved area located between the edges of the rear cover 608. The convex curved area of the rear cover 608 may include one or more windows or apertures that provide operational access to one or more internal components located within the housing 601. In some embodiments, the windows have a curvature that matches the curvature of the convex curved area of the rear cover.

2. Example Housing

[0150] As described above, a wearable electronic device may include a device body that includes a housing or enclosure shell. As previously described, the housing may function as a chassis that physically integrates the various components of the device. The housing may also form a protective shell or housing for the components and function as a barrier against moisture or debris. In the present examples, the housing is formed as a uni-body, unitary, or single body or component. A single-body construction may be advantageous by providing mounting features directly into the housing, which may reduce space, reduce part count, and increase structural rigidity as compared to some alternative configurations. Additionally, a single-body construction may improve the housing's ability to prevent the ingress of moisture or debris by reducing or eliminating seams or joints between external components.

[0151] FIG. 8 depicts an example housing 601 in accordance with some embodiments. In the present example, the housing 601 is formed as a single body or component. As shown in FIG. 8, the housing 601 is formed as a single part or body. The housing 601 may be formed, for example, by machining or shaping a solid or cast blank having the approximate shape of the housing 601. In some implementations, the housing 601 may be configured to provide structural integrity for potentially delicate internal components and also withstand a reasonable impact.

[0152] In the present embodiment, the housing 601 is formed as a uni-body, unitary, or single-body construction having a flat bottom portion 801 and a top portion including flange 812. The top portion defines an internal cavity 805, which is surrounded by four sides 802a-d that are

integrally formed with the bottom portion 801. The internal cavity 805 can also be described as being defined by the top portion, the four sides 802a-d and the bottom portion 801. In this example, the internal cavity 805 has a rectangular (square) shape, although the specific shape may vary with different implementations. In the present example, the four sides 802a-d define a curved side portion of the housing 601 that extends from the bottom portion 801 to the top portion of the housing 601. Each side 802a-d is orthogonal to an adjacent side and each side 802a-d is connected to an adjacent side by a rounded corner. For example, side 802a is orthogonal to two adjacent sides 802b and 802d and is connected to those sides by respective rounded corners. The shape or contour of the rounded corners may correspond to the curvature of the curved portion of the housing 601. Specifically, the curvature of the rounded corners may match or correspond to the curvature of the continuous external surface formed by the housing 601 and the cover 609, as described above with respect to FIG. 6.

[0153] The sides 802a-d may vary in thickness in order to provide the structural rigidity for the device. In general, areas of high stress may have an increased material thickness as compared to areas of low stress, which may have a reduced material thickness. In particular, portions of the sides 802a-d near the bottom portion 801 may have an increased thickness as compared to portions of the sides 802a-d located further away from the bottom portion 801. This configuration may improve the structural rigidity and overall stiffness of the housing 601.

[0154] As shown in FIG. 8, one or more mounting features may be formed directly into the housing 601, which may reduce the number of parts and also enhance the structural integrity of the device. As shown in FIG. 8, receiving features 623, 624 may be formed as channels or openings that are configured to receive an end of a band (e.g., a lug) having a mating feature. As described above with respect to FIG. 5, the receiving features 623, 624 may be standardized and configured to work with a system of interchangeable components. Forming the receiving features 623, 624 directly into the housing 601 may reduce parts and also facilitate structural rigidity of the device.

[0155] In the example depicted in FIG. 8, the housing 601 can be described as having two ends (a first end and a second end opposite the first end), and a first side and a second side opposite the first side, the sides being continuous with the ends. In this example, the first and second ends

and the first and second sides having an outwardly curved three-dimensional shape. In this example, the receiving feature 623 is formed from a first groove situated in the first end. Similarly, the receiving feature 624 is formed from a second groove situated in the second end. In the present example the grooves have openings at the interface of the first and second sides and first and second ends. As shown in FIG. 8 the groove also has an inwardly curved concave three-dimensional shape with an undercut feature. For example, the middle portion of the groove of receiving features 623, 624 may have a width that is greater than the opening of the receiving features 623, 624. In some embodiments, the upper portion of the housing overhangs the lower portion of the housing at the groove opening. In the example depicted in FIG. 8, the groove is cut into a solid portion of the housing such that the groove forms a continuous interior shape.

[0156] The geometry of the receiving features may be located with respect to other features or components of the device. In the example depicted in FIG. 8, at least a portion of the groove of the receiving features 623, 624 may be disposed underneath the cover (item 609 of FIGs. 6-7). With respect to FIG. 6, the groove of the receiving features 623, 624 is located underneath the opening for the cover, which is defined by the sealing ledge 810 and flange 812 formed in the upper portion of the housing 601. In some embodiments, the length of the groove extends further than the width of the opening configured to receive the cover (and thus the cover, when assembled). In some embodiments, the grooves are formed at an angle relative to the centerline of the housing. In some cases, the angle is approximately 5 degrees. In some embodiments, the groove is located underneath the centerline of the housing 601. In some embodiments, the groove is angled upward toward the top of the housing 601 and inward toward the center of the housing 601. The groove 601 may angle upward and cross the centerline of the housing. In some cases, the groove crosses the vertical centerline of the housing 601.

[0157] In the present embodiment, the housing 601 also includes an aperture 821 formed into the side 802c of the housing 601 for attaching a crown or crown module (item 642 of FIGs. 6-7). In some embodiments, the aperture 821 for the crown is offset upwardly from the centerline of the housing 601. In some embodiments, the aperture 821 for the crown is positioned such that an upper portion of a crown (when installed) is higher than the interface of cover 609 and housing 601. With respect to FIG. 6, the interface may correspond to the upper edge of the flange 812.

[0158] The housing 601 also includes an opening 822 formed into the side 802c of the housing 601 for attaching the button (item 644 of FIGs. 6-7). In some embodiments, the aperture 821 for the crown and the opening 822 for the button are disposed with the length defined by a flat part of the cover. In some embodiments, the aperture 821 for the crown is disposed above the centerline of the housing 601 and the opening 822 for the button is disposed below the centerline of the housing 601. In some embodiments, the aperture 821 for the crown and the opening 822 for the button are disposed on a curved surface of the housing 601. The housing 601 may also include various other internal features, including threaded features and bosses, for attaching other internal components of the device.

[0159] In some cases, the housing 601 may be formed as a single-piece or integral enclosure shell to enhance the structural rigidity and/or liquid-sealing properties of the device. As described above with respect to FIGs. 6 and 7, the housing 601 may be integrated with a cover (e.g., crystal) and other external components to provide a substantially sealed housing. In the present embodiment, the housing 601, includes a sealing ledge 810 formed around the perimeter of the main cavity 805 formed within the housing 601. In some embodiments, the sealing ledge 810 (and thus the cover when installed) is located in the center of the housing 601. The sealing ledge 810 may be defined by a substantially flat portion 811 that is adapted to form a seal between the housing 601 and another component (e.g., the force sensor 705 or cover 609 of FIGs. 6-7). The sealing ledge 810 may be formed at a depth that is substantially similar or corresponds to the thickness of the mating cover.

[0160] As shown in FIG. 8, the sealing ledge 810 may also include flange 812 that protrudes from the flat portion and forms a continuous surface with the side walls 802a-d. In some cases, the flange 812 is configured to cooperate with the cover (item 609 of FIGs. 6-7) to form a substantially continuous surface. In some implementations, the sides 802a-d and the cover or crystal are configured to cooperate or mechanically interface to improve the strength and the water sealing properties of the device.

[0161] As also shown in FIG. 8, an opening or aperture 815 may be formed in the bottom portion 801 of the housing 601. In some embodiments, the opening or aperture 815 is located at the center of the housing 601. As described above with respect to FIG. 7, the aperture 815 may be

used to integrate a sensor array or other module used to collect measurements that may be used to compute a health metric or other health-related information. The present embodiment may be advantageous by integrating multiple components in a single opening 815, which may facilitate a water-proof or water-resistant property of the device. Additionally, by integrating a sensor array into a module that attaches via the opening 815, same housing 601 may be used with a variety of sensing configurations or arrays. For example, the number or sensors or components may be increased or decreased without modifying the housing 601. This may allow for flexibility in the product development and may facilitate upgrades as new sensing configurations are available.

[0162] As previously discussed above with respect to FIGs. 6-7, the housing 601 may also be configured to serve as a protective housing for one or more acoustic elements, such as a microphone or speaker. Additionally, in some embodiments, the housing 601 may also be configured to inhibit the ingress of foreign particulate or moisture. In particular, the housing 601 may include a speaker port having orifices 831, 832 that are configured to transmit acoustic signals but also prevent the ingress of liquid or other foreign particulate. In the present example, the speaker port includes orifices 831, 832 that are offset with respect to an acoustic chamber or cavity to prevent the direct ingress of liquid into the speaker subassembly or acoustic module. In the present example, a shielding or umbrella portion of the housing, which is substantially free of openings, is formed between the orifices 831, 832, which helps to prevent the direct ingress of liquid. Similarly, the housing 601 includes a microphone port having orifices 833, 834 that are offset from a corresponding acoustic chamber or cavity to prevent the direct ingress of liquid into the microphone subassembly or acoustic module.

[0163] In the example depicted in FIG. 8, the orifices 831, 832 of the speaker port are located on one side of the aperture 821 for the crown and the orifices 833, 834 for the microphone are located on the other side of the aperture 821. Both the orifices 831, 832 of the speaker port and the orifices 833, 834 for the microphone are located on a curved portion of the housing 601.

3. Example Force Sensor and Touch Sensor

[0164] As discussed previously, a wearable electronic device may include one or more sensors for detecting the location and force of a touch. For the purposes of the following description of the force sensor and touch sensor, the described device 100 is one example of that shown and

discussed above with respect to FIGs. 2-7. However, certain features of the device 100 including the external surface geometry, may be simplified or vary with respect to aspects of the device 100 discussed above.

[0165] In some embodiments, a force sensor and a touch sensor may be disposed relative to the display of a wearable electronic device for to form a touch-sensitive surface. The following description is provided with respect to individual force and touch sensors that may be used to determine the force and location of a touch, respectively. However, in some embodiments, a single integrated sensor may be used to detect both the force and location of a touch on the device.

[0166] In one embodiment, an output from a force sensor may be combined with a touch sensor to provide both location and force of a single touch or of multiple touches on the surface of a device. In an alternative embodiment, a hybrid or integrated force and touch sensor may be used to sense both touch force and location of a single touch or of multiple touches. In either embodiment, by sensing both the force and location of a touch, multiple types of user input may be generated and interpreted. In one example, a first touch may be correlated with a first force and a first touch location or gesture. Based on the magnitude of the force, the first touch may be interpreted as a first type of input or command. A second touch may be sensed as having a second, different force and a similar location or gesture as the first touch. Based in part on the magnitude of the second force, the second touch may be interpreted as a second type of input or command. Thus, a force sensor (alone or in combination with another touch sensor) may be used to produce different responses or outputs depending on the force of the touch.

[0167] The one or more force sensors may be formed from or may be implemented as one or more types of sensor configurations. For example, capacitive and/or strain based sensor configurations may be used alone or in combination to detect and measure the magnitude of a touch. As described in more detail below, a capacitive force sensor may be configured to detect the magnitude of a touch based on the displacement of a surface or element on the device. Additionally or alternatively, a strain-based force sensor may be configured to detect the magnitude of a touch based on a deflection of the surface, such as the cover glass.

[0168] By way of example, the force sensor may include a capacitive force sensor, which may be formed from one or more capacitive plates or conductive electrodes that are separated by a compressible element or other compliant member. As a force is applied to a surface of the device, the compressible element may deflect resulting in a predictable change in the capacitance between the plates or electrodes. In some implementations, a capacitive force sensor may be formed from transparent materials and disposed over the display. In other implementations, a capacitive force sensor may be formed from non-transparent materials and disposed beneath or around the perimeter of a display.

[0169] FIG. 9 depicts a detail cross-sectional view of a portion of a force sensor 900 that may be arranged around the perimeter of a display 120. As shown in FIG. 9, a force-sensing structure 901 of the force sensor 900 may be disposed beneath the cover 609 and along the side of an edge or the perimeter of the display 120. In this example, the force sensor 900 is configured to detect and measure the force of a touch on the surface 911 of the cover 609. In the present embodiment, a first capacitive plate 902 is fixed with respect to the cover 609. A second, lower capacitive plate 904 is fixed with respect to the housing 601 and may be disposed on a shelf or mounting surface located along the perimeter of the device. The first capacitive plate 902 and the second capacitive plate 904 are separated by a compressible element 906.

[0170] In the configuration depicted in FIG. 9, a touch on the surface 911 of the device may cause a force to be transmitted through the cover 609 of the device and to the force sensor 900. In some cases, the force causes the compressible element 906 to compress, thereby bringing the first capacitive plate 902 and the second capacitive plate 904 closer together. The change in distance between the first and second capacitive plates 902, 904 may result in a change of capacitance, which may be detected and measured. For example, in some cases, a force-sensing circuit may measure this change in capacitance and output a signal that corresponds to the measurement. A processor, integrated circuit or other electronic element may correlate the circuit output to an estimate of the force of the touch. Although the term "plate" may be used to describe certain elements, such as the capacitive plates or conductive electrodes, it should be appreciated that the elements need not be rigid but may instead be flexible (as in the case of a trace or flex).

[0171] FIG. 10A depicts an example configuration of the force sensor 1000 having four individual force-sensing structures 1001a-d arranged around the perimeter of a display in a device. For the sake of clarity, the crystal, display, and other elements of the device are omitted from the depiction of FIG. 10A. Each of the force-sensing structures 1001a-d may be formed from a pair of capacitive plates separated by a compressible element. Additionally, each force-sensing structure 1001a-d may be separated by a small gap at or near the corners of the opening in the housing 601. In the example depicted in FIG. 10A, the four individual force-sensing structures 1001a-d may each be operatively coupled to force-sensing circuitry that is configured to detect a change in the capacitance of each force-sensing structure 1001a-d. Using the example arrangement depicted in FIG. 10A, the approximate location of the touch may be determined by comparing the relative change in capacitance of each force-sensing structure 1001a-d. For example, a change in capacitance of structure 1001b that is larger as compared to a change in capacitance of structure 1001d may indicate that the touch is closer to structure 1001b. In some embodiments, the degree of the difference in the change in capacitance may be used to provide a more accurate location estimate.

[0172] While the configuration shown in FIG. 10A depicts the force-sensing structures as individual elements separated by a small gap, in some embodiments, the force-sensing structure may be formed as a single continuous piece. FIG. 10B depicts a force sensor 1050 formed as a single force-sensing structure 1051 formed as a continuous part along the perimeter of the display. Similar to the example described above, the force-sensing structure 1051 may be operatively coupled to force sensing circuitry that is configured to detect a change in the capacitance of one or more capacitive elements of the force-sensing structure 1051. While the force-sensing structure 1051 is formed as a continuous structure, there may be multiple sensing elements (e.g., capacitive plates) that are disposed within the structure at different locations, and which may be configured to detect deflection or compression of the structure over a portion of entire area of the force-sensing structure 1051. In some embodiments, the force-sensing structure 1051 may also function as a seal or gasket to prevent ingress of moisture or other foreign contaminants into the main cavity of the housing. Additionally, the force-sensing structure 1051 may be integrated with one or more sealing or adhesive layers that also function as a barrier for foreign contaminants.

[0173] As mentioned previously, the force sensor may additionally or alternatively include a strain-based sensing configuration. The strain-based sensing configuration may include, for example, a charge-based or resistive sensor configuration. FIG. 11 depicts a cross-sectional view of a device having an example force sensor 1100 that uses one or more force-sensitive films to detect and measure the force of a touch on a surface 1111 of the cover 609. In this example, the force sensitive film 1102 and 1104 are formed from a transparent material and are disposed relative to a viewable portion of the display 120. As shown in FIG. 11, the force sensor 1100 includes a first force-sensitive film 1102 and a second force-sensitive film 1104 that are separated by one or more intermediate layers 1106. The force-sensitive films 1102, 1104 may be configured to produce different electrical outputs in response to a strain or deflection of the cover 609. In some cases, the intermediate layer 1106 is compressible to allow the first force-sensitive film 1102 to deflect with respect to the second force-sensitive film 1104. In other cases, the intermediate layer 1106 may not be compressible and the first force-sensitive film 1102 deflects in a predictable manner with respect to the second force-sensitive film 1104. While FIG. 11 depicts an example force sensor 1100 having two force-sensitive films, alternative embodiments may include only a single force-sensitive film or, alternatively, include more than two force-sensitive films.

[0174] In general, a transparent force-sensitive film may include a compliant material that exhibits an electrical property that is variable in response to deformation or deflection of the film. The transparent force-sensitive film may be formed from a piezoelectric, piezo-resistive, resistive, or other strain-sensitive materials. Transparent resistive films can be formed by coating a substrate with a transparent conductive material. Potential transparent conductive materials include, for example, polyethyleneioxythiophene (PEDOT), indium tin oxide (ITO), carbon nanotubes, graphene, silver nanowire, other metallic nanowires, and the like. Potential substrate materials include, for example, glass or transparent polymers like polyethylene terephthalate (PET) or cyclo-olefin polymer (COP). Typically, when a piezo-resistive or resistive film is strained, the resistance of the film changes as a function of the strain. The resistance can be measured with an electrical circuit. In this way, a transparent piezo-resistive or resistive film can be used in a similar fashion as a strain gauge.

[0175] If transparency is not required, then other film materials may be used, including, for example, Constantan and Karma alloys for the conductive film and a polyimide may be used as a substrate. Nontransparent applications include force sensing on track pads or the back of display elements. In general, transparent and non-transparent force-sensitive films may be referred to herein as "force-sensitive films" or simply "films."

[0176] In some embodiments, the force-sensitive film is patterned into an array of lines, pixels, or other geometric elements herein referred to as film elements. The regions of the force-sensitive film or the film elements may also be connected to sense circuitry using electrically conductive traces or electrodes. FIG. 12 depicts a cross-sectional view a device having a strain-based force sensor 1200 formed from one or more strain pixel elements 1202 and 1204 separated by intermediate layer 1206. Each of the pixel elements 1202, 1204 may be separated by a gap 1210. In the present example, each pixel element 1202, 1204 may exhibit a measurable change in an electrical property in response to a force being applied to the device. By way of example, as a force is applied to a surface 1211 on the cover 609, one or more of the pixel elements 1202, 1204 is deflected or deformed. Sense circuitry, which is in electrical communication with the one or more pixel elements 1202, 1204, may be configured to detect and measure the change in the electrical property of the film due to the deflection. Based on the measured electrical property of the pixel elements 1202, 1204, an estimated amount of force can be computed. In some cases, the estimated force may represent the magnitude of a touch on the surface 1211 of the device, and be used as an input to a graphical user interface or other element of the device. Additionally, in some embodiments, the relative strain of the individual pixel elements may be compared to estimate a location of the touch. While FIG. 12 depicts an example force sensor 1200 having two layers of pixel elements, alternative embodiments may include only a single layer of pixel elements or, alternatively, include more than two layers of pixel elements.

[0177] The pixel elements 1202, 1204 may be specifically configured to detect strain along one or more directions. In some cases, each pixel element 1202, 1204 includes an array of traces generally oriented along one direction. This configuration may be referred to as a piezo-resistive or resistive strain gauge configuration. In general, in this configuration the force-sensitive-film is a material whose resistance changes in response to strain. The change in resistance may be due to a change in the geometry resulting from the applied strain. For example, an increase in length

combined with decrease in cross-sectional area may occur in accordance with Poisson's effect. The change in resistance may also be due to a change in the inherent resistivity of the material due to the applied strain. For example, the applied strain may make it easier or harder for electrons to transition through the material. The overall effect is for the total resistance to change with strain due to the applied force.

[0178] Further, in a piezo-resistive or resistive strain gauge configuration, each pixel may be formed from a pattern of the force-sensitive-film, aligned to respond to strain along a particular axis. For example, if strain along an x-axis is to be measured, the pixel should have a majority of its trace length aligned with the x-axis. By way of example, FIG. 13A depicts a pixel element 1302 having traces that are generally oriented along the x-axis and may be configured to produce a strain response that is substantially isolated to strain in the x-direction. Similarly, FIG. 13B depicts a pixel element 1304 having traces that are generally oriented along the y-axis and may be configured to produce a strain response that is substantially isolated to strain in the y-direction.

[0179] In some embodiments, the force-sensitive film may be formed from a solid sheet of material and is in electrical communication with a pattern of electrodes disposed on one or more surfaces of the force-sensitive film. The electrodes may be used, for example, to electrically connect a region of the solid sheet of material to sense circuitry. This configuration may be referred to as a piezo-strain configuration. In this configuration, the force-sensitive film may generate a charge when strained. The force-sensitive film may also generate different amounts of charge depending on the degree of the strain. In some cases, the overall total charge is a superposition of the charge generated due to strain along various axes.

[0180] As mentioned previously, a force sensor may be combined with a touch sensor that is configured to detect and measure the location of a touch on the surface of the device. FIG. 14A depicts a simplified schematic representation of an example mutual capacitance touch sensor. As shown in FIG. 14A, a touch sensor 1430 may be formed by an array of nodes 1402 formed at the intersection of an array of drive lines 1404 and sense lines 1406. In this example, stray capacitance C_{stray} may be present at each node 1402 (although FIG. 14A depicts only one C_{stray} for one column for purposes of simplifying the figure). In the example of FIG. 14A, AC stimuli

V_{stim} 1414, V_{stim} 1415 and V_{stim} 1417 can be at different frequencies and phases. Each stimulation signal on a row can cause a charge $Q_{sig}=C_{sig}\times V_{stim}$ to be injected into the columns through the mutual capacitance present at the affected nodes 1402. A change in the injected charge (Q_{sig_sense}) can be detected when a finger, palm or other object is present at one or more of the affected nodes 1402. V_{stim} signals 1414, 1415 and 1417 can include one or more bursts of sine waves. Note that although FIG. 14A illustrates rows 1404 and columns 1406 as being substantially perpendicular, they need not be aligned, as described above. Each column 1406 may be operatively coupled to a receive channel of a charge-monitoring circuit.

[0181] FIG. 14B depicts a side view of an exemplary node in a steady-state (no touch) condition according to examples of the disclosure. In FIG. 14B, electric field lines 1408 between a column 1406 and a row 1404 separated by dielectric 1410 is shown at node 1402.

[0182] FIG. 14C depicts a side view of an exemplary pixel in a dynamic (touch) condition. An object such as finger 1412 can be placed near node 1402. Finger 1412 can be a low-impedance object at signal frequencies, and can have an AC capacitance C_{finger} from the column trace 1406 to the body. The body can have a self-capacitance to ground C_{body} of about 200 pF, where C_{body} can be much larger than C_{finger}. If finger 1412 blocks some electric field lines 1408 between row and column electrodes (those fringing fields that exit the dielectric 1410 and pass through the air above the row electrode), those electric field lines can be shunted to ground through the capacitance path inherent in the finger and the body, and as a result, the steady state signal capacitance C_{sig} can be reduced by DC_{sig}. In other words, the combined body and finger capacitance can act to reduce C_{sig} by an amount DC_{sig} (which can also be referred to herein as C_{sig_sense}), and can act as a shunt or dynamic return path to ground, blocking some of the electric field lines as resulting in a reduced net signal capacitance. The signal capacitance at the pixel becomes C_{sig}-DC_{sig}, where DC_{sig} represents the dynamic (touch) component. Note that C_{sig}-DC_{sig} may always be nonzero due to the inability of a finger, palm or other object to block all electric fields, especially those electric fields that remain entirely within the dielectric material. In addition, it should be understood that as finger 1412 is pushed harder or more completely onto the touch sensor, finger 1412 can tend to flatten, blocking more and more of the electric fields lines 1408, and thus DC_{sig} may be variable and representative of how completely finger 1412 is pushing down on the panel (i.e., a range from "no-touch" to "full-touch").

[0183] Additionally or alternatively, the touch sensor may be formed from an array of self-capacitive pixels or electrodes. FIG. 15A depicts an example touch sensor circuit corresponding to a self-capacitance touch pixel electrode and sensing circuit. Touch sensor circuit 1509 can have a touch pixel electrode 1502 with an inherent self-capacitance to ground associated with it, and also an additional self-capacitance to ground that can be formed when an object, such as finger 1512, is in proximity to or touching the touch pixel electrode 1502. The total self-capacitance to ground of touch pixel electrode 1502 can be illustrated as capacitance 1504. Touch pixel electrode 1502 can be coupled to sensing circuit 1514. Sensing circuit 1514 can include an operational amplifier 1508, feedback resistor 1516, feedback capacitor 1510 and an input voltage source 1506, although other configurations can be employed. For example, feedback resistor 1516 can be replaced by a switch capacitor resistor. Touch pixel electrode 1502 can be coupled to the inverting input of operational amplifier 1508. An AC input voltage source 1506 can be coupled to the non-inverting input of operational amplifier 1508. Touch sensor circuit 1509 can be configured to sense changes in the total self-capacitance 1504 of touch pixel electrode 1502 induced by finger 1512 either touching or in proximity to the touch sensor panel. Output 1520 can be used by a processor to determine a presence of a proximity or touch event, or the output can be inputted into a discreet logic network to determine the presence of a touch or proximity event.

[0184] FIG. 15B depicts an example self-capacitance touch sensor 1530. Touch sensor 1530 can include a plurality of touch pixel electrodes 1502 disposed on a surface and coupled to sense channels in a touch controller, can be driven by stimulation signals from the sense channels through drive/sense interface 1525, and can be sensed by the sense channels through the drive/sense interface 1525 as well. After touch controller has determined an amount of touch detected at each touch pixel electrode 1502, the pattern of touch pixels in the touch screen panel at which touch occurred can be thought of as an "image" of touch (e.g., a pattern of fingers touching the touch screen). The arrangement of the touch pixel electrodes 1502 in FIG. 15B is provided as one example; however, the arrangement and/or the geometry of the touch pixel electrodes may vary depending on the embodiment.

[0185] As previously mentioned, a force sensor may be implemented alone or in combination with another type of touch sensor to sense both touch force and touch location, which may

enable more sophisticated user touch input than using touch location alone. For example, a user may manipulate a computer-generated object on a display using a first type of interaction using a relatively light touch force at a given touch location. The user may also interact with the object using a second type of interaction by using a relatively heavy or sharper touch force at the given location. As one specific example, a user may manipulate or move a computer-generated object, such as a window, using a relatively light touch force. Additionally or alternatively, the user may also select or invoke a command associated with the window using a relatively heavy or sharper touch force. In some cases, multiple types of interactions may be associated with multiple amounts of touch force.

[0186] Additionally, it may be advantageous for the user to be able to provide an analog input using a varying amount of force. A variable, non-binary input may be useful for selecting within a range of input values. The amount of force may, in some cases, be used to accelerate a scrolling operation, a zooming operation, or other graphical user interface operation. It may also be advantageous to use the touch force in a multi-touch sensing environment. In one example, the force of a touch may be used to interpret a complex user input performed using multiple touches, each touch having a different magnitude or degree of force. As a specific but non-limiting example, touch and force may be used in a multi-touch application that allows the user to play a varying tone or simple musical instrument using the surface of the device. In such a housing, the force of each touch may be used to interpret a user's interaction with the buttons or keys of a virtual instrument. Similarly, the force of multiple touches can be used to interpret a user's multiple touches in a game application that may accept multiple non-binary inputs at different locations.

4. Sensor or Biosensor Module

[0187] As described above with respect to FIG. 2, a wearable electronic device may include one or more sensors that can be used to calculate a health metric or other health-related information. For the purposes of the following description of the biosensor module, the described device 100 is one example of that shown and discussed above with respect to FIGs. 2-7. However, certain features of the device 100 including the external surface geometry, may be simplified or vary with respect to aspects of the device 100 discussed above.

[0188] In some embodiments, a wearable electronic device may function as a wearable health assistant that provides health-related information (whether real-time or not) to the user, authorized third parties, and/or an associated monitoring device. The wearable health assistant may be configured to provide health-related information or data such as, but not limited to, heart rate data, blood pressure data, temperature data, blood oxygen saturation level data, diet/nutrition information, medical reminders, health-related tips or information, or other health-related data. The associated monitoring device may be, for example, a tablet computing device, phone, personal digital assistant, computer, and the like.

[0189] In accordance with some embodiments, the electronic device can be configured in the form of a wearable electronic device that is configured or configurable to provide a wide range of functionality. As described above with respect to FIG. 2, the wearable electronic device 100 may include a processing units 102 coupled with or in communication with a memory 104, one or more communications channels 108, output devices such as a display 120 and speaker 122, one or more input components 106, and other modules or components. An example wearable electronic device 100 may be configured to provide or calculate information regarding time, health information, biostatistics, and/or status to externally connected or communicating devices and/or software executing on such devices. The device 100 may also be configured to send and receive messages, video, operating commands, and other communications.

[0190] With reference to FIG. 16, an example device 100 may include various sensors for measuring and collecting data that may be used to calculate a health metric or other health-related information. As one example, the wearable communication device can include an array of light sources 1611-1613 and a detector 1614 that are configured to function as an optical sensor or sensors. In one example, an optical sensor or sensors may implemented as a pairing of one or more light sources 1611-1613 and the detector 1614. In one example implementation, the detector 1614 is configured to collect light and convert the collected light into an electrical sensor signal that corresponds to the amount of light incident on a surface of the detector 1614. In one embodiment, the detector may be a photodetector, such as a photodiode. In other embodiments, the detector 1614 may include a phototube, photosensor, or other light-sensitive device.

[0191] In some cases, the one or more optical sensors may operate as a photoplethysmography (PPG) sensor or sensors. In some instances, a PPG sensor is configured to measure light and produce a sensor signal that can be used to estimate changes in the volume of a part of a user's body. In general, as light from the one or more light sources passes through the user's skin and into the underlying tissue, some light is reflected, some is scattered, and some light is absorbed, depending on what the light encounters. The light that is received by the detector 1614 may be used to generate a sensor signal, which may be used to estimate or compute a health metric or other physiological phenomena.

[0192] The light sources may operate at the same light wavelength range, or the light sources can operate at different light wavelength ranges. As one example, with two light sources, one light source may transmit light in the visible wavelength range while the other light source can emit light in the infrared wavelength range. In some cases, a modulation pattern or sequence may be used to turn the light sources on and off and sample or sense the reflected light. With reference to FIG. 16, the first light source 1611 may include, for example, a green LED, which may be adapted for detecting blood perfusion in the body of the wearer. The second light source 1612 may include, for example, an infrared LED, which may be adapted to detect changes in water content or other properties of the body. The third 1613 light source may be a similar type or different types of LED element, depending on the sensing configuration.

[0193] The optical (e.g., PPG) sensor or sensors may be used to compute various health metrics, including, without limitation, a heart rate, a respiration rate, blood oxygenation level, a blood volume estimate, blood pressure, or a combination thereof. In some instances, blood may absorb light more than surrounding tissue, so less reflected light will be sensed by the detector of the PPG sensor when more blood is present. The user's blood volume increases and decreases with each heartbeat. Thus, in some cases, a PPG sensor may be configured to detect changes in blood volume based on the reflected light, and one or more physiological parameters of the user may be determined by analyzing the reflected light. Example physiological parameters include, but are not limited to, heart rate, respiration rate, blood hydration, oxygen saturation, blood pressure, perfusion, and others.

[0194] While FIG. 16 depicts one example embodiment, the number of light sources and/or detectors may vary in different embodiments. For example, another embodiment may use more than one detector. Another embodiment may also use fewer or more light sources than are depicted in the example of FIG. 16. In particular, in the example depicted in FIG. 16, the detector 1614 is shared between multiple light sources 1611-1613. In one alternative embodiment, two detectors may be paired with two corresponding light sources to form two optical sensors. The two sensors (light source/detector pairs) may be operated in tandem and used to improve the reliability of the sensing operation. For example, output of the two detectors may be used to detect a pulse wave of fluid (e.g., blood) as it passes beneath the respective detectors. Having two sensor readings taken at different locations along the pulse wave may allow the device to compensate for noise created by, for example, movement of the user, stray light, and other effects.

[0195] In some implementation, one or more of the light sources 1611-1613 and the detector 1614 may also be used for optical data transfer with a base or other device. For example, the detector 1614 may be configured to detect light produced by an external mating device, which may be interpreted or translated into a digital signal. Similarly, one or more of the light sources 1611-1613 may be configured to transmit light that may be interpreted or translated into a digital signal by an external device.

[0196] Returning to FIG. 16, the device 100 may also include one or more electrodes to measure electrical properties of the user's body. In this example, a first electrode 1601 and second electrode 1602 are disposed on the rear face of the device 100. The first 1601 and second 1602 electrodes may be configured to make contact with the skin of the user's wrist when the device is being worn. As shown in FIG. 16, a third electrode 1603 and fourth electrode 1604 may be disposed along a periphery of the device body 610. In the configuration of FIG. 16, the third 1603 and fourth 1604 electrodes are configured to come into contact with the skin of the user's other hand (that is not wearing the device 100). For example, the third 1603 and fourth 1604 electrodes may be contacted when the user pinches the device 100 between two digits (e.g., a forefinger and thumb).

[0197] FIG. 16 depicts one example arrangement of electrodes. However, in other embodiments, one or more of the electrodes may be placed in locations that are different than the configuration of FIG. 16. For example, one or more electrodes may be placed on a top surface or other surface of the device 100. Additionally, fewer electrodes or more electrodes may be used to contact the user's skin, depending on the configuration.

[0198] Using the electrodes of the device, various electrical measurements may be taken, which may be used to compute a health metric or other health-related information. By way of example, the electrodes may be used to detect electrical activity of the user's body. In some cases, the electrodes may be configured to detect electrical activity produced by the heart of the user to measure heart function or produce an electrocardiograph (ECG). As another example, the electrodes of the device may be used to detect and measure conductance of the body. In some cases, the measured conductance may be used to compute a galvanic skin response (GSR), which may be indicative of the user's emotional state or other physiological condition. By way of further example, the electrodes may also be configured to measure other health characteristics, including, for example, a body fat estimate, body or blood hydration, and blood pressure.

[0199] In some embodiments, the optical sensors and electrodes discussed above with respect to FIG. 16 may be operatively coupled to sensing circuitry and the processing units 102 to define a health monitoring system. In this capacity, the processing units 102 may be any suitable type of processing device. In one embodiment, the processing units 102 include a digital signal processor. The processing units 102 may receive signals from the optical sensor(s) and/or electrodes and process the signals to correlate the signal values with a physiological parameter of the user. As one example, the processing units 102 can apply one or more demodulation operations to the signals received from the optical sensor. Additionally, the processing units 102 may control the modulation (i.e., turning on and off) of the light sources according to a given modulation pattern or sequence. The processing units 102 may also be used to calculate one or more biometrics or other heath related information.

[0200] In some implementations, the wearable electronic device may also receive sensor data or output from an external device. For example, an external mobile device having a global positioning system (GPS) may relay location information to the wearable device, which may be

used to calibrate an activity metric, such as a pedometer or distance calculator. Similarly, sensor output of the wearable electronic device may be transmitted to an external device to compute health-related information. For example, output from an accelerometer in the wearable electronic device may be used determine a body position or gesture, which may be relayed to an external device and used to compute health-related information, such as activity level.

[0201] In some embodiments, some or all of the biosensors may be integrated into a module that is separate from and attached to the housing 601 of the device 100. As described above with respect to FIG. 6, in some embodiments, the biosensors are disposed relative to or attached to a rear cover 608 that is formed from an optically transparent material and is configured to be positioned with the opening of the housing 601. In some embodiments, the rear cover 608 is disposed completely within the area of the cover so that the two components completely overlap when viewed from above. In some embodiments, the rear cover 608 has an edge that protrudes outwardly from the back surface of the housing 601. In some embodiments, an edge of the rear cover 608 extends past a flat portion of the back surface of the housing 601. The rear cover 608 may also have a convex, curved outer contour. The rear cover 608 may have a convex shape that is located within the center and surrounded by the edges of the rear cover 608. The convex curved area of the rear cover 608 may include one or more windows or apertures that provide operational access to one or more internal components located within the housing. For example, the rear cover 608 may include an array of windows, each window including an aperture or opening for a respective light source 1611-1613 and/or the detector 1614. In some embodiments, the windows have a curvature that matches the curvature of the convex curved area of the rear cover 608. In some embodiments, rear cover 608 includes a chamfered edge and a curved bottom surface, the windows being disposed within the curved surface. In some embodiments, two openings of the rear cover 608 are located along a first axis (e.g., an x-axis) and two openings are located along a second axis (e.g., a y-axis) that is transverse to the first axis.

5. Example Wireless Communications with External Devices

[0202] A wearable electronic device may include a functionality for performing wireless communications with an external device. For the purposes of the following description, the described device 100 is one example of that shown and discussed above with respect to FIGs.

2-7. However, certain features of the device 100, including the external surface geometry, may be simplified or vary with respect to aspects of the device 100 discussed above.

[0203] In some embodiments, the wireless communications are performed in accordance with a Near Field Communications (NFC) protocol. The communication may include an identification protocol and a secured data connection that can be used to identify the user, authorize activity, perform transactions, or conduct other aspects of electronic commerce.

[0204] FIG. 17 depicts an example system 1700 including a device 100 that is located proximate to a station 1710. The station 1710 may include a variety of devices, including, without limitation, a payment kiosk, a vending machine, a security access point, a terminal device, or other similar device. In some cases, the station 1710 is incorporated into a larger system or device. For example, the station 1710 may be incorporated into a security gate of a building or a payment center for a vending system.

[0205] As shown in FIG. 17, the device 100 is a wearable electronic device that may be placed proximate to the station 1710. In this example, a second device 1720 is carried by a user, and may also be placed proximate to the station 1710. In some embodiments, the device 100 and/or the second device 1720 includes a radio-frequency identification (RFID) system that is configured to enable one-way or two-way radio-frequency (RF) communications with the station 1710. The one- or two-way communication may include an identification of the device 100 and the station 1710 to initiate a secured data connection between the two devices. The secured data connection may be used to authorize a transaction between the user and an entity that is associated with the station 1710.

[0206] In some embodiments, the user may initiate a communication with the station 1710 by placing the device 100 near an active region on the station 1710. In some implementations, the station 1710 is configured to automatically detect the presence of the device 100 and initiate an identification process or routine. The RFID system of the device may include a unique identifier or signature that may be used to authenticate the identity of the user. As previously mentioned, the identification process or routine may be used to establish a secure data connection between the device 100 and the station 1710. The secure data connection may be used to authorize a purchase or download of data to or from the device 100. In some cases, the secure data

connection may be used to authorize the transfer of funds from a credit card or financial institution in exchange for a product that is associated with the station 1710. Other transactions or forms of electronic commerce may also be performed using the wireless communication between the device 100 and the station 1710.

6. Example Wireless Power System

[0207] As discussed above, a wearable electronic device may include an internal battery that is rechargeable using an external power source. For the purposes of the following description, the described device 100 is one example of that shown and discussed above with respect to FIGs. 2-7. However, certain features of the device 100, including the external surface geometry, may be simplified or vary with respect to aspects of the device 100 discussed above.

[0208] One challenge associated with small devices is that it may be difficult to incorporate an electrical port for coupling the device to an external power source. Because wearable electronic devices have limited space for an external connector, it may be advantageous to electrically couple to a device without a cable or external connector. In at least some embodiments, the wearable electronic device described herein may be configured to operate as a receiver in a wireless power transfer system.

[0209] A wireless power transfer system, one example of which is an inductive power transfer system, typically includes a power-transmitting structure to transmit power and a power-receiving structure to receive power. In some examples, a power-receiving electronic device includes or otherwise incorporates an inductive power-receiving element configured to receive wireless power and/or charge one or more internal batteries. Similarly, a charging device may include or otherwise incorporate an indicative power-transmitting element configured to wirelessly transmit power to the power-receiving electronic device. The charging device may be configured as a base or dock on which the power-receiving electronic device rests or to which it physically connects in some embodiments. In other embodiments, the charging device may be proximate the electronic device but not necessarily touching or physically coupled.

[0210] In many examples, the battery-powered electronic device may be positioned on an external surface of the power-transmitting device, otherwise referred to as a dock. In these

systems, an electromagnetic coil within the dock (e.g., transmit coil) may produce a time-varying electromagnetic flux to induce a current within an electromagnetic coil within the electronic device (e.g., receive coil). In many examples, the transmit coil may transmit power at a selected frequency or band of frequencies. In one example the transmit frequency is substantially fixed, although this is not required. For example, the transmit frequency may be adjusted to improve inductive power transfer efficiency for particular operational conditions. More particularly, a high transmit frequency may be selected if more power is required by the electronic device and a low transmit frequency may be selected if less power is required by the electronic device. In other examples, a transmit coil may produce a static electromagnetic field and may physically move, shift, or otherwise change its position to produce a spatially-varying electromagnetic flux to induce a current within the receive coil.

[0211] The electronic device may use the received current to replenish the charge of a rechargeable battery or to provide power to operating components associated with the electronic device. Thus, when the electronic device is positioned on the dock, the dock may wirelessly transmit power at a particular frequency via the transmit coil to the receive coil of the electronic device.

[0212] A transmit coil and receive coil may be disposed respectively within housings of the dock and electronic device so as to align along a mutual axis when the electronic device is placed on the dock. If misaligned, the power transfer efficiency between the transmit coil and the receive coil may decrease as misalignment increases. Accordingly, in many examples, the wireless power transfer system may include one or more alignment assistance features to effect alignment of the transmit and receive coils along the mutual axis.

[0213] FIG. 18 depicts a front perspective view of an example wireless power transfer system 1800 in an unmated configuration. The illustrated embodiment shows an inductive power transmitter dock 1802 that is configured to couple to and wirelessly transmit power to an inductive power receiver accessory, in this case device 100. The wireless power transfer system 1800 may include one or more alignment assistance features to effect alignment of the device 100 with the dock 1802 along a mutual axis. For example, the housings of the dock 1802 and the device 100 may assist with alignment. In one implementation, a portion of the housing of the

device 100 may engage and/or interlock with a portion of the housing of the dock 1802 in order to effect the desired alignment. In some embodiments, a bottom portion of the device 100 may be substantially convex and a top surface of the dock 1802 may be substantially concave. In other examples, the interfacing surfaces of the dock 1802 and the device 100 may be substantially flat, or may include one or more additional housing features to assist with effecting mutual alignment.

[0214] In some embodiments, one or more actuators in the dock 1802 and/or device 100 can be used to align the transmitter and receiver devices. In yet another example, alignment assistance features, such as protrusions and corresponding indentations in the housings of the transmitter and receiver devices, may be used to align the transmitter and receiver devices. The design or configuration of the interface surfaces, one or more alignment assistance mechanisms, and one or more alignment features can be used individually or in various combinations thereof.

[0215] Alignment assistance can also be provided with one or more magnetic field sources. For example, a permanent magnet within the dock 1802 may attract a permanent magnet within the device 100. In another example, a permanent magnet within the device 100 may be attracted by a magnetic field produced by the dock 1802. In further examples, multiple alignment assistance features may cooperate to effect alignment of the transmit and receive coils. Power transfer efficiency may also decrease if the power consumption of the electronic device changes (e.g., the electronic device transitions from a trickle charge mode to constant current charge mode) during wireless power transfer.

[0216] As discussed previously with respect to FIG. 2, the device 100 may include a processor coupled with or in communication with a memory, one or more communication interfaces, output devices such as displays and speakers, and one or more input devices such as buttons, dials, microphones, or touch-based interfaces. The communication interface(s) can provide electronic communications between the communications device and any external communication network, device or platform, such as, but not limited to, wireless interfaces, Bluetooth interfaces, Near Field Communication interfaces, infrared interfaces, USB interfaces, Wi-Fi interfaces, TCP/IP interfaces, network communications interfaces, or any conventional communication interfaces. The device 100 may provide information regarding time, health, statuses or

externally connected or communicating devices and/or software executing on such devices, messages, video, operating commands, and so forth (and may receive any of the foregoing from an external device), in addition to communications.

[0217] In the example depicted in FIG. 18, the dock 1802 may be connected to an external power source, such as an alternating current power outlet, by power cord 1808. In other embodiments, the dock 1802 may be battery operated. In still further examples, the dock 1802 may include a power cord 1808 in addition to an internal or external battery. Similarly, although the embodiment is shown with the power cord 1808 coupled to the housing of the dock 1802, the power cord 1808 may be connected by any suitable means. For example, the power cord 1808 may be removable and may include a connector that is sized to fit within an aperture or receptacle opened within the housing of the dock 1802.

[0218] Although the device 100 is shown in FIG. 18 as larger than the dock 1802, the depicted scale may not be representative of all embodiments. For example, in some embodiments the dock 1802 may be larger than the device 100. In still further embodiments the two may be substantially the same size and shape. In other embodiments, the dock 1802 and device 100 may take separate shapes.

[0219] FIG. 19 depicts a simplified block diagram of relevant aspects of the device 100 and dock 1802. It may be appreciated that certain components of both the dock 1802 and device 100 are omitted from the figure for clarity. Likewise, the positions of the elements that are shown are meant to be illustrative rather than necessarily portraying a particular size, shape, scale, position, orientation, or relation to one another, although some embodiments may have elements with one or more of such factors as illustrated.

[0220] As described previously with respect to FIG. 2, the device 100 may include one or more electronic components located within the housing 601. For clarity, some of the components and modules described or depicted in various embodiments are omitted from the depiction of FIG. 19. As shown in FIG. 19, the device 100 may include an internal battery 114 that may be used to provide power to the various internal components of the device 100. As described previously, the internal battery 114 may be rechargeable by an external power supply. In the present

example, the internal battery 114 is operably connected to a receive coil 1869 via power conditioning circuit 1810.

[0221] In the present example, the device 100 includes a receive coil 1869 having one or more windings for inductively coupling with a transmit coil 1832 of the dock 1802. The receive coil 1869 may receive power wirelessly from the dock 1802 and may pass the received power to a battery 114 within the device 100 via power conditioning circuit 1810. The power conditioning circuit 1810 may be configured to convert the alternating current received by the receive coil 1869 into direct current power for use by other components of the device. In one example, the processing units 102 may direct the power, via one or more routing circuits, to perform or coordinate one or more functions of the device 100 typically powered by the battery 114.

[0222] As shown in FIG. 19, the dock 1802 includes a transmit coil 1832 having one or more windings. The transmit coil 1832 may transmit power to the device 100 via electromagnetic induction or magnetic resonance. In many embodiments, the transmit coil 1832 may be shielded with a shield element that may be disposed or formed around portions of the transmit coil 1832. Similarly, the receive coil 1869 may also include a shield element that may be disposed or formed around a portion of the receive coil 1869.

[0223] As shown in FIG. 19, the dock 1802 also includes a processor 1834 that may be used to control the operation of or coordinate one or more functions of the dock 1802. In some embodiments, the dock 1802 may also include one or more sensors 1836 to determine whether the device 100 is present and ready to receive transmitted power from the dock 1802. For example, the dock 1802 may include an optical sensor, such as an infrared proximity sensor. When the device 100 is placed on the dock 1802, the infrared proximity sensor may produce a signal that the processor 1834 uses to determine the presence of the device 100. The processor 1834 may, optionally, use another method or structure to verify the presence of the electronic device via sensor 1836. Examples of different sensors that may be suitable to detect or verify the presence of device 100 may include a mass sensor, a mechanical interlock, switch, button or the like, a Hall effect sensor, or other electronic sensor. Continuing the example, after the optical sensor reports that the device 100 may be present, the processor 1834 may activate a communication channel to attempt to communicate with the device 100.

[0224] As illustrated in FIG. 19, a bottom surface of the housing of the device 100 may partially contact a top surface of the dock housing. In some implementations, the interfacing surfaces of the device 100 and the dock 1802 may be formed with complementary geometries. For example, as depicted in FIG. 19, the bottom surface of the device 100 is convex and the top surface of the dock 1802 is concave, following the same curvature as the bottom surface of the device 100. In this manner, the complementary geometries may facilitate alignment of the electronic device and dock for efficient wireless power transfer.

[0225] In some embodiments, the dock 1802 and device 100 may include other alignment assistance features. For example the device 100 may include an alignment magnet 1838 which is positioned and oriented to attract a corresponding alignment magnet 1840 within the dock 1802. In some cases, when the device 100 is positioned proximate the dock 1802, the alignment magnets 1838, 1840 may be mutually attracted, thereby affecting alignment of the portable electronic device 100 and the dock 1802 along a mutual axis. In other examples, the dock 1802 may include a ferromagnetic material in place of the alignment magnet 1840. In these examples, the alignment magnet 1838 may be attracted to the ferromagnetic material. In still further cases, the receive coil 1869 or transmit coil 1832 may produce a static magnetic field that either attracts or repels either or both of the alignment magnets 1838, 1840.

[0226] As shown in FIG. 19, the alignment magnets 1838, 1840 may be positioned within a respective coil 1869, 1832. When the alignment magnets 1838, 1840 are drawn together, the coils 1869, 1832 may be placed into alignment. Additionally, the complementary geometries of the device 100 and the dock 1802 may further facilitate alignment when the alignment magnets 1838, 1840 are drawn together.

7. Example Acoustic Module

[0227] As described above, the device may include one or more devices for transmitting and receiving acoustic energy. For the purposes of the following description of the acoustic module, the described device 100 is one example of that shown and discussed above with respect to FIGs. 2-7. However, certain features of the device 100, including the external surface geometry, may be simplified or vary with respect to aspects of the device 100 discussed above. As previously discussed, in some embodiments, the device may include a speaker for transmitting acoustic

energy and/or a microphone for receiving acoustic energy. For the purposes of the following description, a speaker device and a microphone are referred to generically as an acoustic module, which may be configured to transmit and/or receive acoustic energy depending on the particular implementation.

[0228] FIG. 20 depicts a simplified schematic cross-sectional view of a first embodiment of a device having an acoustic module 2006. The representation depicted in FIG. 20 is not drawn to scale and may omit some elements for clarity. The acoustic module 2006 may represent either a portion of a speaker and/or microphone device described above with respect to the electronic device 100 of FIG. 2.

[0229] As shown in FIG. 20, an acoustic port 2020 may be formed in the housing 601 of the electronic device. In the present example, the acoustic port 2020 includes first and second orifices 2031, 2032 that are formed in the housing 601 and acoustically couple the acoustic cavity 2011 of the acoustic module 2006 to the external environment (external to the electronic device). In the present embodiment, the first and second orifices 2031, 2032 are offset with respect to the opening of the acoustic cavity 2011. This configuration may help reduce the direct ingress of liquid 2001 into acoustic cavity 2011 of the acoustic module 2006 Also, as shown in FIG. 20 a shield 2021 or umbrella structure that is formed between the orifices 2031, 2032 blocks the direct ingress of liquid 2001 into the acoustic cavity 2011. As shown in FIG. 20, the acoustic module 2006 also includes a screen element 2015 disposed at one end of the acoustic cavity 2011, which may also prevent the ingress of liquid or other foreign debris into the acoustic cavity 2011. The acoustic module 2006 also includes a seal 2016 disposed between the housing 601 and the connector element 2012 of the module, which may also be configured to prevent the ingress of water into the device and/or module.

[0230] In the present example depicted in FIG. 20, the acoustic module 2006 may correspond to the speaker 122 described with respect to some embodiments. As shown in FIG. 20, the acoustic module 2006 includes various components for producing and transmitting sound, including a diaphragm 2010, a voice coil 2009, a center magnet 2008, and side magnets/coils 2007. These components may cooperate to form a speaker acoustic element. In one implementation, the diaphragm 2010 is configured to produce sound waves or an acoustic signal in response to a

stimulus signal in the center magnet 2008. For example, a modulated stimulus signal in the center magnet 2008 causes movement of the voice coil 2009, which is coupled to the diaphragm 2010. Movement of the diaphragm 2010 creates the sound waves, which propagate through the acoustic cavity 2011 of acoustic module 2006 and eventually out the acoustic port 2020 to a region external to the device. In some cases, the acoustic cavity 2011 functions as an acoustical resonator having a shape and size that is configured to amplify and/or dampen sound waves produced by movement of the diaphragm 2010.

[0231] As shown in FIG. 20, the acoustic module 2006 also includes a yoke 2014, support 2013, connector element 2012, and a cavity wall 2017. These elements provide the physical support of the speaker elements. Additionally, the connector element 2012 and the cavity wall 2017 together form at least part of the acoustic cavity 2011. The specific structural configuration of FIG. 20 is not intended to be limiting. For example, in alternative embodiments, the acoustic cavity may be formed from additional components or may be formed from a single component.

[0232] The acoustic module 2006 depicted in FIG. 20 is provided as one example of a type of speaker acoustic module. In other alternative implementations, the acoustic module may include different acoustic elements for producing and transmitting sound, including, for example, a vibrating membrane, piezoelectric transducer, vibrating ribbon, or the like. Additionally, in other alternative implementations, the acoustic module may be a microphone acoustic module having one or more elements for converting acoustic energy into an electrical impulse. For example, the acoustic module may alternatively include a piezoelectric microphone acoustic element for producing a charge in response to acoustic energy or sound.

[0233] As previously mentioned, because the acoustic port 2020 connects the acoustic module 2006 to the external environment, there is a possibility that liquid may accumulate or infiltrate the interior of the module. In some cases, the screen element 2015 or other protective features may not prevent all liquid from entering the acoustic cavity 2011 of the module. For example, if the device is subjected to a liquid under pressure or a directed stream of liquid, some liquid ingress may occur. Additionally, naturally occurring moisture in the air may condense and accumulate over time resulting in the presence of liquid within the module. Thus, in some implementations, the acoustic module 2006 may include one or more elements configured to

expel water or liquid that accumulates in, for example, the acoustic cavity 2011 of the module. The liquid expulsion process may include modifying the charge on a portion of the wall of the acoustic cavity 2011 to change the surface energy of the wall and/or producing an acoustic pulse using the diaphragm 2010 to help expel liquid from the acoustic cavity 2011. In some embodiments, the screen 2015 may also have hydrophilic or hydrophobic properties that may facilitate removal of liquid held within the acoustic cavity 2011.

8. Example Antenna and Cover

[0234] As previously described, a wearable electronic device may be configured to communicate wirelessly with various external devices and communication networks. For the purposes of the following description, the described device 100 is one example of that shown and discussed above with respect to FIGs. 2-7. However, certain features of the device 100, including the external surface geometry, may be simplified or vary with respect to aspects of the device 100 discussed above.

[0235] In some embodiments, as previously discussed with respect to FIG. 2, the device may include one or more communication channels that are configured to transmit and receive data and/or signals over a wireless communications network or interface. Example wireless interfaces include radio frequency cellular interfaces, Bluetooth interfaces, Wi-Fi interfaces, or any other known communication interface.

[0236] In some implementations an antenna may be disposed with respect to the cover (e.g., crystal) of a device to facilitate wireless communications with an external device or communication network. In some cases, it may be advantageous to integrate an antenna into the cover to improve the transmission and reception of wireless signals from the device. In particular, the cover of the device may have dielectric properties that facilitate the transmission of radio frequency signals while also protecting the antenna from physical damage or interference. Additionally, if the antenna is integrated into a perimeter portion of the cover, the visual appearance or clarity of the cover may be minimized. Furthermore, the embodiments described below with respect to FIGs. 21A-B may be used to integrate an antenna external to the housing, without increasing the thickness of the device body.

[0237] FIG. 21A depicts a perspective exploded view of a cover 2100 and an antenna assembly 2130. The cover 2100 depicted in FIG. 21A is viewed from an inner surface 2124 that is configured to attach to or interface with the opening of the housing (described above with respect to FIG. 1). As shown in FIG. 21A, a groove 2128 may be formed within the inner surface 2124. In this example, the groove 2128 is formed around the periphery of the cover 2100. As mentioned previously, this may be advantageous in minimizing the visual impact of having the antenna assembly 2130 located within the cover 2100.

[0238] As shown in FIG. 21A the antenna assembly 2130 includes an antenna ring 2134 and a terminal 2140 which may interface with an electrical connector 2150. In the present embodiment, the groove 2128 formed in the surface of the cover 2100 may be configured to accept the antenna ring 2134. In particular, the groove 2128 may receive the entire antenna ring 2134 without a portion of the antenna ring 2134 protruding past the inner surface 2124, when the antenna ring 2134 is installed. In some cases, the groove 2128 is formed to be a clearance or near clearance fit with the diameter of the antenna ring 2134. Thus, in some cases, the antenna ring 2134 may substantially fill the groove 2128 when the ring is installed. In some cases, the groove 2128 may be configured to retain the antenna ring 2134 due to a slight interference fit or due to a feature formed within either the cover 2100 and/or the antenna assembly 2130. In the present embodiment, the antenna assembly 2130 may be installed in the cover 2100 and then connected to other electronics via the terminal 2140 and the connector 2150, which may protrude into an opening in the case or housing.

[0239] FIG. 21B depicts a cross-sectional view of the cover and antenna at the connection point. In particular, FIG. 21B depicts a detail cross-sectional view of the cover 2100 installed within the housing 601 at a region near the terminal 2140. In this example, the cover 2100 is attached to a shelf of the housing 601 via a compressible element 2122. The compressible element 2122 may provide a seal against water or other contaminates and also provide compliance between the cover 2100 and the housing 601. The compressible element 2122 may be formed from a nitrile or silicone rubber and may also include an adhesive or other bonding agent.

[0240] As shown in FIG. 21B, the antenna ring 2134 is disposed entirely within the groove 2128. In this case, the antenna ring 2134 does not protrude past the inner surface 2124. The antenna

ring 2134 is electrically connected to the terminal 2140, which protrudes into an opening in the housing 601. As shown in FIG. 21B, the terminal 2140 includes conductive pads 2142 for electrically connecting to the antenna ring 2134. In this example, spring clips 2152 are configured to mechanically and electrically connect to the conductive pads 2142 on the terminal 2140. One advantage to the configuration depicted in FIG. 21B is that the antenna assembly 2130 may be installed in the cover 2100 before the cover 2100 is installed in the housing 601. The terminal 2140 and connector 2150 facilitate a blind connection that may assist electrical connection as the cover 2100 is installed. Additionally, the configuration depicted in FIG. 21B may allow for some movement between the cover 2100 and the housing 601 without disturbing the electrical connection with the antenna ring 2134.

9. Example Haptic Module

[0241] As described above, the device may include one or more haptic modules for providing haptic feedback to the user. The embodiments described herein may relate to or take the form of durable and thin haptic feedback elements suitable to provide a perceivable single pulse haptic feedback. In general, a haptic device may be configured to produce a mechanical movement or vibration that may be transmitted through the housing and/or other component of the device. In some cases, the movement or vibration may be transmitted to the skin of the user and perceived as a stimulus or haptic feedback by the user. In some implementations, the haptic feedback may be coupled to one or more device outputs to alert the user of an event or activity. For example, a haptic output may be produced in combination with an audio output produced by the speaker, and/or a visual output produced using the display.

[0242] The space constraints associated with a small wrist-worn device may present unique challenges to integrating a haptic mechanism into wearable electronics. In particular, a haptic mechanism may use a moving mass used to create the movement or vibration of the haptic output. The larger the mass that is moved, the easier it may be to create a perceivable stimulus using the haptic mechanism. However, a large moving mass and the supporting mechanism may be difficult to integrate into the compact space of, for example, the housing of a wearable electronic wristwatch.

[0243] Thus, the haptic module implemented in some embodiments may be configured to maximize the mechanical energy that is produced in a very compact form factor. FIGs. 22A-B depict one example haptic mechanism that may be particularly well suited for use in a wearable electronic device. While the embodiment described with respect to FIGs. 22A-B is provided as one example, the haptic module is not limited to this particular configuration.

[0244] FIG. 22A depicts a three-quarters perspective view of a haptic device 112, with a top, front and left sidewall of the housing 2220 removed to expose internal components. FIG. 22B depicts a cross-sectional perspective view of the haptic device 112 cut in half to expose the internal components. In this example, a coil 2200 is used to induce movement of a frame 2260, which houses a central magnet array 2210. As shown in FIGs. 22A-B, the movement of the frame 2260 is guided by a shaft 2250 that is fixed with respect to a housing 2220.

[0245] In the present example, the coil 2200 may be energized by transmitting a current (e.g., from the battery) along a length of a wire that forms the coil 2200. A direction of the current along the wire of the coil 2200 determines a direction of a magnetic field that emanates from the coil 2200. In turn, the direction of the magnetic field determines a direction of movement of the frame 2260 housing the central magnet array 2210. One or more springs may bias the frame 2260 towards the middle region of the travel. In this example, the frame 2260 and central magnet array 2210, through operation of the coil 2200, function as a moving mass, which generates a tap or vibration. The output of the haptic device 112, created by the moving mass of the frame 2260 and central magnet array 2210, may be perceived as a haptic feedback or stimulus to the user wearing the device.

[0246] For example, when the coil 2200 is energized, the coil 2200 may generate a magnetic field. The opposing polarities of the magnets in the magnet array 2210 generates a radial magnetic field that interacts with the magnetic field of the coil 2200. The Lorentz force resulting from the interaction of the magnetic fields causes the frame 2260 to move along the shaft 2250 in a first direction. Reversing current flow through the coil 2200 reverses the Lorentz force. As a result, the magnetic field or force on the central magnet array 2210 is also reversed and the frame 2260 may move in a second direction. Thus, frame 2260 may move in both directions along the shaft 2250, depending on the direction of current flow through the coil 2200.

[0247] As shown in FIG. 22A, the coil 2200 encircles the central magnet array 2210, which is disposed near the center of the frame 2260. As previously described, the coil 2200 may be energized by transmitting a current along the length of the wire forming the coil 2200, and the direction of the current flow determines the direction of the magnetic flux emanating from the coil 2200 in response to the current. Passing an alternating current through the coil 2200 may cause the central magnet array 2210 (and frame 2260) to move back and forth along a shaft 2250. In order to prevent the central magnet array 2210 from being attracted to the shaft 2250, which could increase friction between the two and thereby increase the force necessary to move the central magnet array 2210 and frame 2260, the shaft 2250 may be formed from a non-ferrous material such as tungsten, titanium, stainless steel, or the like.

[0248] As depicted in FIGs. 22A-B, the coil 2200 is positioned within a frame 2260 that holds the central magnet array 2210, but is not affixed to the coil 2200. Rather, an air gap separates the coil 2200 from the central magnet array 2210 and the frame 2260 is free to move with respect to the coil 2200, which is generally stationary. Further, the frame 2260 generally moves with the central magnet array 2210. As illustrated in FIGs. 22A-B, the frame 2260 may have an aperture formed therein of sufficient size to contain the coil 2200. Even when the frame and central magnet array are maximally displaced within the housing 2220 (e.g., to one end or the other of the shaft 2250), the coil 2200 does not contact any portion of the frame 2260. It should be appreciated that the coil 2200 remains stationary in the housing 2220 while the frame 2260 and central magnet array 2210 move, although in other embodiments the coil 2200 may move instead of, or in addition to, the frame and/or central magnet array. However, by keeping the coil 2200 stationary, it may be easier to provide interconnections for the coil, such as between the coil and the flex, and therefore reduce the complexity of manufacture.

[0249] As shown in FIGs. 22A-B, the central magnet array 2210 may be formed from at least two magnets 2211, 2212 of opposing polarities. A center interface 2270 may be formed from a ferrous or non-ferrous material, depending on the embodiment. A ferrous material for the center interface 2270 may enhance the overall magnetic field generated by the central magnet array 2210, while a non-ferrous material may provide at least a portion of a return path for magnetic flux and thus assist in localizing the flux within the housing 2220. In some embodiments, the magnets 2211, 2212 are formed from neodymium while the frame is tungsten. This combination

may provide a strong magnetic field and a dense mass, thereby yielding a high weight per volume structure that may be used as the moving part of the haptic device 112.

10. Example Crown Module

[0250] As described above, the device may include a crown that may be used to accept user input to the device. For the purposes of the following description, the described device 100 is one example of that shown and discussed above with respect to FIGs. 2-7. However, certain features of the device 100, including the external surface geometry, may be simplified or vary with respect to aspects of the device 100 discussed above.

[0251] In some embodiments, a crown may be used to accept rotary input from the user, which may be used to control aspects of the device. The crown may be knurled or otherwise textured to improve grip with the user's finger and/or thumb. In some embodiments, a crown may be turned by the user to scroll a display or select from a range of values. In other embodiments, the crown may be rotated to move a cursor or other type of selection mechanism from a first displayed location to a second displayed location in order to select an icon or move the selection mechanism between various icons that are output on the display. In a time keeping application, the crown may also be used to adjust the position of watch hands or index digits displayed on the display of the device. The crown may also be used to control the volume of a speaker, the brightness of the display screen, or control other hardware settings.

[0252] In some embodiments, the crown may also be configured to accept linear, as well as rotary, input. For example, the crown may be configured to translate along an axis when pressed or pulled by the user. In some cases, the linear actuation may be used as additional user input. The actuation may provide a binary output (actuated/not actuated) or may also provide a non-binary output that corresponds to the amount of translation along the axis of motion. In some instances, the linear input to the crown may be combined with the rotary input to control an aspect of the device.

[0253] The embodiments described herein may be used for at least a portion of the crown module integrated into a wearable electronic device. The embodiments are provided as examples and may not include all of the components or elements used in a particular implementation.

Additionally, the crown module is not intended to be limited to the specific examples described below and may vary in some aspects depending on the implementation.

[0254] In some embodiments, an optical encoder may be used to detect the rotational motion of the crown. More specifically, the example provided below with respect to FIG. 23 may use an optical encoder to detect rotational movement, rotational direction and/or rotational speed of a component of the electronic device. Once the rotational movement, rotational direction and/or rotational speed have been determined, this information may be used to output or change information and images that are presented on a display or user interface of the electronic device.

[0255] Integrating an optical encoder into the space constraints of a typical wearable electronic device may be particularly challenging. Specifically, some traditional encoder configurations may be too large or delicate for use in a portable electronic device. The optical encoder described below may provide certain advantages over some traditional encoder configurations and may be particularly well suited for use with a crown module of a wearable electronic device.

[0256] As shown in the example embodiment of FIG. 23, the optical encoder of the present disclosure includes a light source 2370, a photodiode array 2380, and a shaft 2360. However, unlike typical optical encoders, the optical encoder of the present disclosure utilizes an encoding pattern disposed directly on the shaft 2360. For example, the encoding pattern includes a number of light and dark markings or stripes that are axially disposed along the shaft 2360. Each stripe or combination of stripes on the shaft 2360 may be used to identify a position of the shaft 2360. For example, as light is emitted from the light source 2370 and reflected off of the shaft 2360 into the photodiode array 2380, a position, rotation, rotation direction and rotation speed of the shaft 2360 may be determined. Once the rotation direction and speed are determined, this information may be used to output or change information or images that are presented on the display or user interface of the electronic device.

[0257] In other embodiments, the shape or form of the shaft of the encoder may be used to determine a position, rotation, rotation direction and rotation speed of the shaft. For example, the shaft may be fluted or have a number of channels that cause the light to be reflected in a number of different directions. Accordingly, a diffractive pattern may be used to determine the rotation, rotation direction and rotation speed of the shaft.

[0258] FIG. 23 illustrates a simplified depiction of the device 100 and crown module 642 in accordance with some embodiments. As shown in FIG. 23, the crown module 642 may be integrated with the housing 601 of the device 100 and may be formed from a dial 2340 disposed at the end of a shaft 2360. In the present embodiment, the crown module 642 also forms part of the optical encoder. As discussed above, the crown module 642 includes an optical encoder that includes a shaft 2360, a light source 2370, and a photodiode array 2380. Although a photodiode array is specifically mentioned, embodiments disclosed herein may use various types of sensors that are arranged in various configurations for detecting the movement described herein. For example, the movement of the shaft 2360 may be detected by an image sensor, a light sensor such as a CMOS light sensor or imager, a photovoltaic cell or system, photo resistive component, a laser scanner and the like.

[0259] The optical encoder may produce an encoder output that is used to determine positional data of the crown module 642. In particular, the optical encoder may produce an output that is used to detect that movement of the dial 2340 including the direction of the movement, speed of the movement and so on. The movement may be rotational movement, translational movement, angular movement, and so on. The optical encoder may also be used to detect the degree of the change of rotation of the dial 2340 and/or the angle of rotation of the dial 2340 as well as the speed and the direction of the rotation of the dial 2340.

[0260] The signals or output of the optical encoder may be used to control various aspects of other components or modules of the device. For example, continuing with the time keeping application example discussed above, the dial 2340 may be rotated in a clockwise manner in order to advance the displayed time forward. In one implementation, the optical encoder may be used to detect the rotational movement of the dial 2340, the direction of the movement, and the speed at which the dial 2340 is being rotated. Using the output from the optical encoder, the displayed hands of a time keeping application may rotate or otherwise move in accordance with the user-provided rotational input.

[0261] Referring back to FIG. 23, the crown module 642 may be formed from dial 2340 that is coupled to the shaft 2360. In some cases, the shaft 2360 and dial 2340 may be formed as a single piece. As the shaft 2360 is coupled to, or is otherwise a part of the dial 2340, as the dial 2340

rotates or moves in a particular direction and at a particular speed, the shaft 2360 also rotates or moves in the same direction and with the same speed.

[0262] As shown in FIG. 23, the shaft 2360 of the optical encoder includes an encoding pattern 2365. As discussed above, the encoding pattern 2365 may be used to determine positional information about the shaft 2360 including rotational movement, angular displacement and movement speed. As shown in FIG. 23, the encoding pattern 2365 may include a plurality of light and dark stripes.

[0263] Although light stripes and dark stripes are specifically mentioned and shown, the encoding pattern 2365 may consist of various types of stripes having various shades or colors that provide surface contrasts. For example, the encoding pattern 2365 may include a stripe or marking that has a high reflective surface and another stripe that has a low reflective surface regardless of the color or shading of the stripes or markings. In another embodiment, a first stripe of the encoding pattern 2365 may cause specular reflection while a second stripe of the encoding pattern 2365 may cause diffuse reflection. When the reflected light is received by the photodiode array 2380, a determination may be made as to the position and movement of the shaft such as described below. In embodiments where a holographic or diffractive pattern is used, the light from the light source 2370 may diffract from the shaft 2360. Based on the diffracted light, the photodiode array 2380 may determine the position, movement and direction of movement of the shaft 2360.

[0264] In some embodiments, the stripes of the encoding pattern 2365 extend axially along the shaft 2360. The stripes may extend along the entire length of the shaft 2360 or partially along a length of the shaft 2360. In addition, the encoding pattern 2365 may also be disposed around the entire circumference of the shaft 2360. In other embodiments, the encoding pattern 2365 may include a radial component. In yet other embodiments, the encoding pattern 2365 may have both a radial component and an axial component.

[0265] In some embodiments, the crown module may also include a tactile switch for accepting translational input from the user. FIGs. 24A-B depict another example of a crown module 642a having a tactile switch assembly 2410. As shown in FIG. 24A, the tactile switch assembly 2410

may include a dial 2448 (or button), a coupling 2418, a shear plate 2456, and a tactile switch 2414.

[0266] In the embodiment depicted in FIGs. 24A-B, the dial 2448 is translatable and/or rotatable relative to the housing. The ability of the dial 2448 to translate and rotate relative to the housing allows a user to provide a rotational force and/or translating force to the tactile switch assembly. In particular, the dial 2448 of the present example may be operably coupled to or form part of an optical encoder, in accordance with the example described above with respect to FIG. 23.

[0267] In the present example, the dial 2448 includes an outer surface 2432 that is configured to receive a rotary or rotational user input and a stem 2450 that extends from an interior surface 2434 of the dial 2448. The stem 2450 may define a coupling aperture that extends longitudinally along a length or a portion of a length of the stem 2450. In the depicted example, the stem 2450 may be hollow or partially hollow.

[0268] In the example depicted in FIGs. 24A-B, the coupling 2418 may be a linkage, such as a shaft, that couples the dial 2448 to the tactile switch 2414. The coupling 2418 may be integrally formed with the dial 2448 or may be a separate component operably connected thereto. For example, the stem 2450 of the dial 2448 may form the coupling member that is integrally formed with the dial 2448. The coupling 2418 may be made of a conductive material, such as one or more metals or metal alloys. Due to the conductive characteristics, the coupling 2418 may further act to electrically couple the dial 2448 to the tactile switch 2414 and shear plate 2456. In the example depicted in FIGs. 24A-B, the shear plate 2456 is positioned between the coupling 2418 and the tactile switch 2414. In some embodiments, the shear plate 2456 may prevent or reduce shearing forces from the coupling from being transmitted to the tactile switch. The shear plate 2456 also allows transfer of linear force input from the dial 2448 to the switch 2414.

[0269] The configuration depicted in FIGs. 24A-B may be used to accept both rotational and translational input from the user. For example, if a user provides a rotational force to the dial 2448, the coupling 2418 and dial 2448 may rotate in the direction of the force. The coupling 2418 may be attached to or integrated with one or more sensors that are configured to detect rotational movement. For example the coupling 2418 may be integrated with an optical encoder, similar to the example described above with respect to FIG. 23. Additionally, if a user provides

a translational force to the dial 2448, the force may be transmitted through the dial 2448 and coupling 2418 to actuate the switch 2414. In some cases, the switch 2414 includes a metal dome switch that is configured to provide a tactile feedback when actuated. In some cases, the actuation of a dome switch may be perceived by the user as a click or release as the switch 2414 is actuated. Once the force has been removed from the dial 2448, the dome switch resiliently returns to its original position, providing a biasing force against the coupling 2418 to return both the dial 2448 and the coupling 2418 to their original positions. In some embodiments, the tactile switch 2414 may include a separate biasing element, such as a spring, that exerts a force (either directly or indirectly via the shear plate) against the coupling. FIG. 24A depicts the tactile switch assembly 2410 when there is no force applied (un-actuated). FIG. 24B depicts the tactile switch assembly 2410 when there is a translational force applied to the dial 2448 (actuated).

11. Example Band Attachment Mechanism

[0270] For the purposes of the following description, the described device 100 is one example of that shown and discussed above with respect to FIGs. 2-7. However, certain features of the device 100, including the external surface geometry, may be simplified or vary with respect to aspects of the device 100 discussed above.

[0271] As described above, a wearable electronic device may include a band that is attached to a device body having one or more receiving features. In particular, the housing may include or form a receiving feature that facilitates an interchange or replacement of different bands that are used to secure the device to the wrist of the user. By replacing or interchanging bands the device may be adapted for multiple uses ranging from sporting activities to professional or social activities.

[0272] In some embodiments, the receiving features are configured to be operated without the use of special tools or fixtures. For example, the bands may be interchanged by hand or with the help of a simple tool, such as a pointed object. Additionally or alternatively, a tool or other component, such as a component of the device to which the attachment system is coupled, may be configured to actuate a button or other component of the attachment system to secure and/or release the band from the device. In one embodiment, the lug portion of a band may be configured to be inserted into an opening or channel portion of the receiving feature. Once the

lug of the band has been inserted into the opening, the lug may slide within the opening of the device until the band is secured or otherwise coupled to the device. The coupling between the band and the receiving feature may provide a secure attachment of the band to the housing or device body. Just as the band is configured to slide into the channel of the receiving feature, the lug may also slide out of the channel of the receiving feature allowing the band to be detached from the device body.

[0273] In one embodiment, the receiving feature includes a locking mechanism, which may be integrated with portions of either the band or the receiving feature. In one example, as the band is inserted into a receiving feature of the device, the locking mechanism interfaces with a portion of the receiving feature to lock or otherwise secure the band within the receiving feature. The locking mechanism may also be configured to interface with a releasing mechanism associated with the receiving feature. For example, a releasing mechanism may be configured to disengage or release the locking mechanism. In some implementations, actuation of the releasing mechanism causes the locking mechanism to be released and allows the band to be removed by sliding within the receiving feature.

[0274] FIG. 25A depicts a receiving feature and band assembly as viewed from the bottom of the device body. As shown in FIG. 25A, a receiving feature 623a includes an opening or channel 2501 that is formed into the body or housing of the device. The channel 2501 is configured to receive the lug 2510 attached to an end of the band strap 621a. The receiving feature 623a may also include a locking mechanism 2530 that is configured to maintain the band strap 621a within the channel 2501 once it has been installed. As discussed above, the locking mechanism 2530 may be releasable by the user, which may facilitate band replacement. In this example, the locking mechanism 2530 includes a spring-loaded retaining mechanism that engages the lug 2510 to retain the lug 2510 in the channel 2501 and maintain the attachment of the band strap 621a to the device. As shown in FIG. 25A, the locking mechanism 2530 also includes a button located on the bottom of the housing that may be depressed by the user to release the locking mechanism and allow the lug 2510 and the band strap 621a to be removed from the channel 2501. In the present example, the button of the locking mechanism 2530 is located on a curved portion of the case or housing. In some embodiments, the button of the locking mechanism 2530 is located along the centerline of the case or housing.

[0275] In some embodiments, the opening or channel 2501 of the receiving feature 623a includes a port or connector for receiving a mating electrical component. In some embodiments, the connector or port is covered by a label or sticker so that the inside surface of the opening or channel 2501 appears continuous. The connector or port may be located along the vertical centerline of the case or housing.

[0276] FIG. 25B depicts an example exploded view of the receiving feature 623a and the lug 2510 of the band strap 621a. As shown in FIG. 25B, the band strap 621a may be formed from a separate part and attached to lug 2510 via a pivot or other type of joint. In other embodiments, the band strap 621a may have an end feature that is integrally formed as part of the band strap 621a. As also shown in FIG. 25B, the lug 2510 may be attached to the receiving feature 623a by aligning the axis of the lug 2510 with the axis of the channel 2501 and then sliding the lug 2510 into the channel 2501.

[0277] FIG. 25C depicts an example assembly sequence of the lug 2510 being inserted into the channel 2501 of the receiving feature 623a. As shown in FIG. 25C, the lug 2510 may be positioned along the side of the receiving feature 623a having the lug 2510 approximately aligned with the channel 2501 of the receiving feature 623a. The lug 2510 (and band strap 621a) may then be inserted into the channel 2501 of the receiving feature 623a by sliding the lug 2510 along the length of the channel 2501. Once the lug 2510 is approximately centered in the channel 2501 of the receiving feature 623a, the locking mechanism 2530 or other securing feature may engage, thereby retaining the lug 2510 (and band strap 621a) within the channel 2501. As previously discussed, the lug 2510 (and band strap 621a) may be removed from the receiving feature 623a by depressing the button of the locking mechanism 2530, which may disengage the lock and allow movement of the lug 2510 within the channel 2501.

[0278] The example described above is provided with respect to one example embodiment. The geometry of the end of the band strap and/or the geometry of the channel may vary depending on the implementation. Additionally, the engagement mechanism may vary depending on the design of the band strap and the device body. The geometry or layout of the features may vary and remain within the scope of the present disclosure. Additionally, while the examples provided above are described with respect to attaching a band strap to a device body, the

receiving feature (623a) may be used to attach a variety of other parts to the device body. For example a lanyard, cable, or other accessory may be attached to the device body using the receiving feature and other similar features.

12. Example Bands

[0279] As described above, a wearable electronic device may include a band that is used to secure the device to the wrist of a user. In some embodiments, the band may be formed from two band straps that are attached to the housing of the device body. The band straps may be secured around the wrist of a user by a clasp or latching mechanism. As also described above, the device may be configured to facilitate replacement of the band. This feature may allow the use of a variety of types of bands, which may adapt the device for multiple uses ranging from sporting activities to professional or social activities.

[0280] In some cases, the band may be formed from a woven textile material. In one example, the band is formed from a woven material that includes one or more strands or threads formed from a natural or synthetic material. The woven material may be formed, for example, from a plurality of warp threads that are woven around one or more weft threads. More specifically, the woven material may include a plurality of warp threads disposed along the length of the band, and at least one weft thread positioned perpendicular to, and coupled to, woven or interlaced between the plurality of warp threads. In some cases, the plurality of warp threads may run the entire length of the woven portion of the band strap. Additionally, in some cases, the at least one weft thread may include a single thread that may be continuously woven between the plurality of warp threads or, alternatively, may include a plurality of threads that may be woven between the plurality of warp threads. A weft thread that is woven between a plurality of warp threads may form consecutive cross-layers with respect to the plurality warp threads in order to form the band.

[0281] In some cases, one or more of the strands or threads may be a metallic or conductive material. This may improve the strength of the band and may also facilitate coupling with magnetic elements, such as a metallic clasp. In some cases, other elements may be woven into the band, including, for example, product identifying elements, decorative elements, or functional components.

[0282] In other embodiments, the band may be formed from a metallic mesh material. In one example, the metallic mesh is formed from an array of links that are interlocked to form a sheet of fabric. Some or all of the links in the mesh may be formed from a ferromagnetic material, which may facilitate magnetic engagement with a magnetic clasp. In some cases, each link of the mesh is formed from a section of metallic filament that is bent or formed into a closed shape. Each closed shape may be interlocked with one or more adjacent links to form a portion of the sheet or fabric. In some cases, a metallic filament is formed around a series of rods or pins that are disposed at a regular spacing within the mesh. In some cases, one or more strands or filaments that may be formed from a ferromagnetic material are woven or integrated with the links of the mesh.

[0283] In other examples, the band may be formed from a sheet of material. For example, the band may be formed from a synthetic leather, leather, or other animal hide. Additionally or alternatively, the band may be formed from a polymer material, an elastomer material, or other type of plastic or synthetic. In some cases, the band is formed from a silicone sheet material.

[0284] The clasp that is used to attach the free ends of the band straps may vary depending on the material that is used and the construction of the band. For example, as mentioned above, a metallic mesh material may use a metallic clasp to join the ends of the band. Additionally, a leather band may be integrated with magnetic and/or ferromagnetic components and may include a magnetic clasp. In some embodiments, the free ends of the band straps are secured using a buckle or tang on a first band strap that is configured to interface with a hole or aperture in a second band strap. A variety of other clasp configurations may also be used.

13. Example Display

[0285] For the purposes of the following description, the described device 100 is one example of that shown and discussed above with respect to FIGs. 2-7. However, certain features of the device 100, including the external surface geometry, may be simplified or vary with respect to aspects of the device 100 discussed above. As described above, the device includes a display disposed within the housing or enclosure. The device may be formed from a liquid crystal display (LCD), organic light emitting diode (OLED) display, organic electroluminescence (OEL) display, or other type of display device. The display may be used to present visual information

to the user, including, for example, a graphical user interface, notifications, health statistics, and the like. In some cases, the display may be configured to present the current time and date similar to a traditional watch or timepiece.

[0286] In some embodiments, the display is formed from an organic light emitting diode (OLED) display element. An active region of the display may include an array of light-emitting display pixels 2604 such as array 2602, shown in FIG. 26. Pixels 2604 may be arranged in rows and columns in array 2602 and may be controlled using a pattern of control lines. Each pixel may include a light-emitting element such as organic light-emitting diode 2612 and associated control circuitry 2610. Control circuitry 2610 may be coupled to the data lines 2606 and gate lines 2608 so that control signals may be received from driver circuitry, which may be implemented as an integrated circuit. Although described as an OLED display, certain embodiments may implement other display technology, such as LCD displays and the like.

[0287] To the extent that multiple functionalities, operations, and structures are disclosed as being part of, incorporated into, or performed by device 100, it should be understood that various embodiments may omit any or all such described functionalities, operations, and structures. Thus, different embodiments of the device 100 may have some, none, or all of the various capabilities, apparatuses, physical features, modes, and operating parameters discussed herein

[0288] Although the disclosure above is described in terms of various exemplary embodiments and implementations, it should be understood that the various features, aspects and functionality described in one or more of the individual embodiments are not limited in their applicability to the particular embodiment with which they are described, but instead can be applied, alone or in various combinations, to one or more of the other embodiments of the invention, whether or not such embodiments are described and whether or not such features are presented as being a part of a described embodiment. Thus, the breadth and scope of the present invention should not be limited by any of the above-described exemplary embodiments but instead defined by the claims herein presented.

CLAIMS

We claim:

1. A wearable electronic device, comprising:

a housing comprising:

a flat bottom portion;

a top portion defining a cavity; and

a curved side portion that extends from the bottom portion to the top portion;

a band attached to the housing and configured to secure the wearable electronic device to a user;

a display at least partially disposed within the cavity and having a viewable area; and

a cover disposed above the display and comprising:

a flat middle portion larger than the viewable area of the display; and

a curved edge portion surrounding the flat middle portion and coinciding with the curved side portion along a perimeter of the cavity to form a continuous contoured surface.

2. The wearable electronic device of claim 1, wherein:

the continuous contoured surface is tangent with the flat bottom portion of the housing at a first end of the contour; and

the continuous contoured surface is tangent with the flat middle portion of the cover at a second end of the contour.

3. The wearable electronic device of claim 2, wherein the continuous contoured surface has a constant radius.

4. The wearable electronic device of claim 1, wherein

the cavity has a rectangular shape;

the curved edge portion of the housing has four sides that surround the cavity;

each side is orthogonal to two adjacent sides; and

each side is connected to an adjacent side by a rounded corner.

5. The wearable electronic device of claim 4, wherein:

the rounded corners have a curvature that corresponds to a curvature of the continuous contoured surface formed by the curved edge portion of the cover and the curved side portion of the housing.

6. The wearable electronic device of claim 1, further comprising:

a crown module positioned at least partially within an aperture formed within the curved side portion of the housing; wherein:

the crown module comprises an outer surface configured to receive a rotary user input.

7. The wearable electronic device of claim 6, wherein:

the crown module is offset with respect to a centerline of the housing between the top portion and the flat bottom portion; and

the offset is toward the top portion of the housing; and

the crown module includes a dial having a portion that is higher than an interface between the cover and the housing.

8. The wearable electronic device of claim 1, further comprising:

a port formed in the curved side portion of the housing;

an acoustic module disposed within the housing and configured to produce an audio output through the port, the acoustic module comprising:

an acoustic element; and

an acoustic cavity that acoustically couples the acoustic element to the port; wherein:

the port includes an orifice that is offset with respect to the acoustic cavity to prevent the direct ingress of liquid into the acoustic module.

9. The wearable electronic device of claim 1, further comprising:

a gasket positioned between the housing and the cover; and

a ledge formed along a perimeter of the cavity, wherein:

the gasket is positioned along the ledge that is formed along the perimeter of the cavity; and

the gasket, the cover, and the housing are configured to cooperate to form a substantially water-proof seal.

10. The wearable electronic device of claim 1, further comprising:

a biosensor module disposed in an opening formed in the flat bottom portion of the housing, the biosensor module comprising:

a chassis positioned in the opening of the housing and defining an array of windows;

an array of light sources attached to the chassis and configured to emit light into the user through the array of windows; and

an optically transparent rear cover disposed over the chassis and over the array of windows and operative to pass light emitted from the array of light sources into the user.

11. The wearable electronic device of claim 10, wherein the rear cover has a convex outer contour.

12. An electronic device, comprising:

a housing comprising a bottom portion defining an opening;

a band attached to the housing and configured to secure the electronic device to a user;

a biosensor module disposed within the opening;

a rear cover disposed over the biosensor module and comprising

an edge protruding outwardly from the bottom portion of the housing; and

an outer surface having a convex curved contour.

13. The electronic device of claim 12, wherein:

the outer surface of the rear cover defines one or more windows that provide operational access to one or more optical components of the biosensor module; and

the one or more windows have a curvature that matches the convex curved contour of the outer surface.

14. The electronic device of claim 12, wherein the biosensor module comprises:

an array of light sources configured to emit light into a body of the user; and

a photodetector configured to receive light produced by a light source of the array of light sources that is reflected from the body and produce a sensor signal.

15. The electronic device of claim 14, further comprising:

a processing unit configured to compute a health metric associated with the user based on the sensor signal; and

a display disposed within the housing and configured to display the health metric

16. The electronic device of claim 12, wherein the biosensor module is removably coupled to the housing.

17. A wearable electronic device, comprising:

a housing comprising:

a top portion;

a cavity formed within the top portion; and

a curved side portion that surrounds the cavity; and

a transparent cover disposed over the cavity of the housing and comprising:

a flat middle portion at a center of the transparent cover;

a curved outer portion that emanates from and surrounds the flat middle portion and extends outwardly to an edge of the transparent cover; and

a mask positioned relative to an internal surface of the transparent cover, wherein the mask has an outer boundary located proximate to the edge of the transparent cover and an inner boundary located within the curved outer portion of the transparent cover.

18. The wearable electronic device of claim 17, further comprising:

a display disposed below the transparent cover, wherein a perimeter portion of a viewable area of the display is disposed below the mask.

19. The wearable electronic device of claim 17, wherein the device further comprises:

an antenna having a shape that corresponds to a shape of the cavity formed within the housing, wherein:

the antenna is disposed in a groove formed in the internal surface of the transparent cover; and

the groove is formed between the outer boundary and the inner boundary of the mask.

20. The wearable electronic device of claim 19, wherein:

the cover is formed from a sapphire material; and

the antenna is configured to facilitate wireless communication between the wearable electronic device and an external device.

ABSTRACT

A consumer product that is a portable and, in some cases, a wearable electronic device. The wearable electronic device may have functionalities including: keeping time; monitoring a user's physiological signals and providing health-related information based on those signals; communicating with other electronic devices or services; visually depicting data on a display; gather data form one or more sensors that may be used to initiate, control, or modify operations of the device; determine a location of a touch on a surface of the device and/or an amount of force exerted on the device, and use either or both as input.

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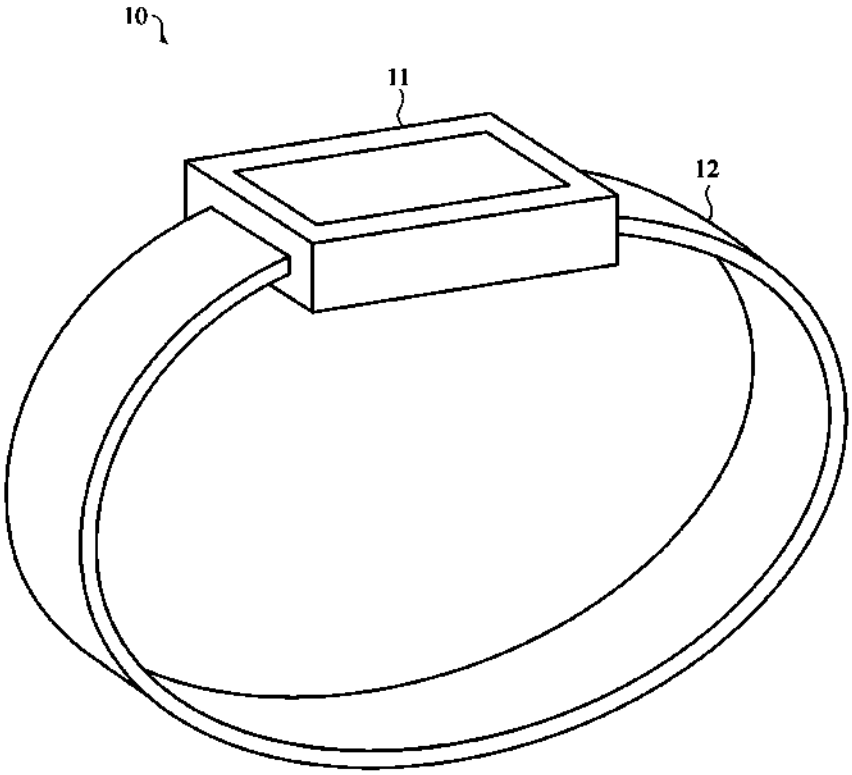


FIG. 1

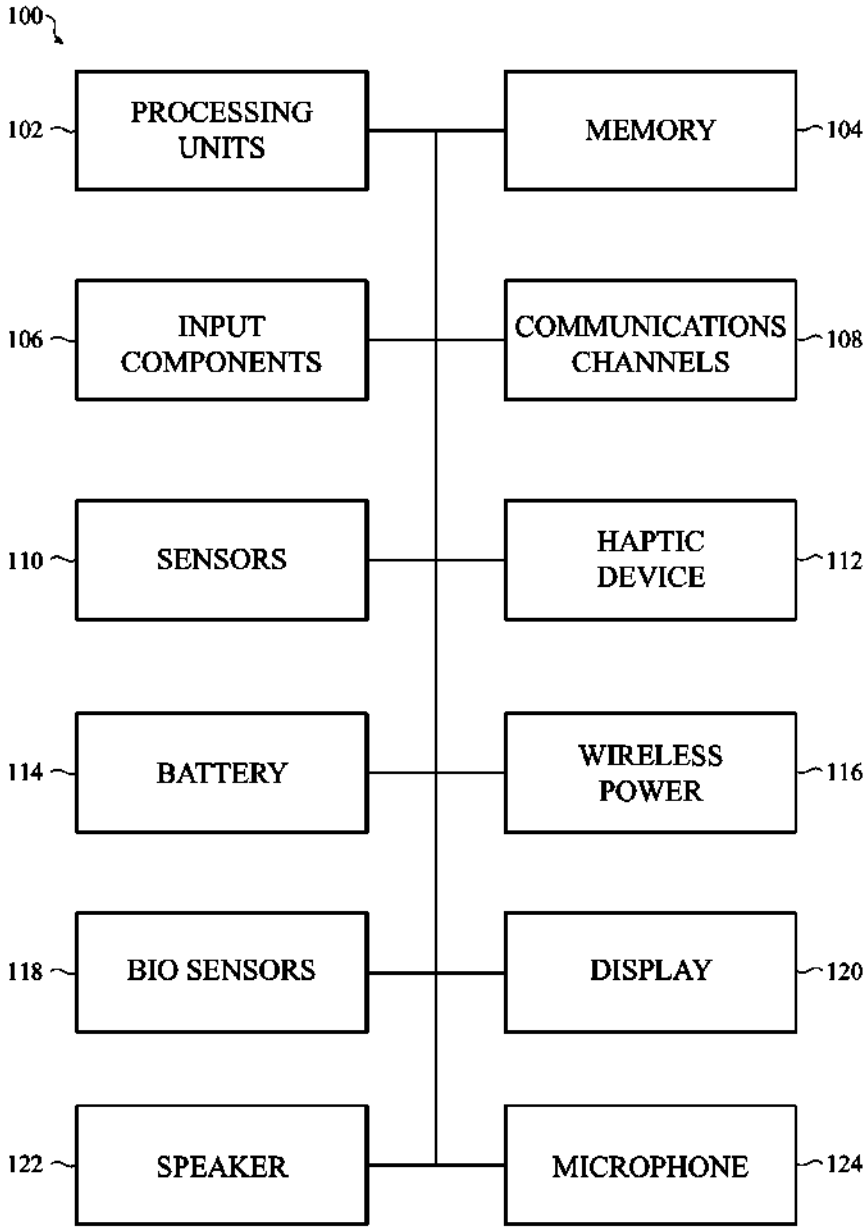

100
PROCESSING UNITS
102
MEMORY
104
INPUT COMPONENTS
106
COMMUNICATIONS CHANNELS
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SENSORS
110
HAPTIC DEVICE
112
BATTERY
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WIRELESS POWER
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BIO SENSORS
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DISPLAY
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SPEAKER
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MICROPHONE
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FIG. 2

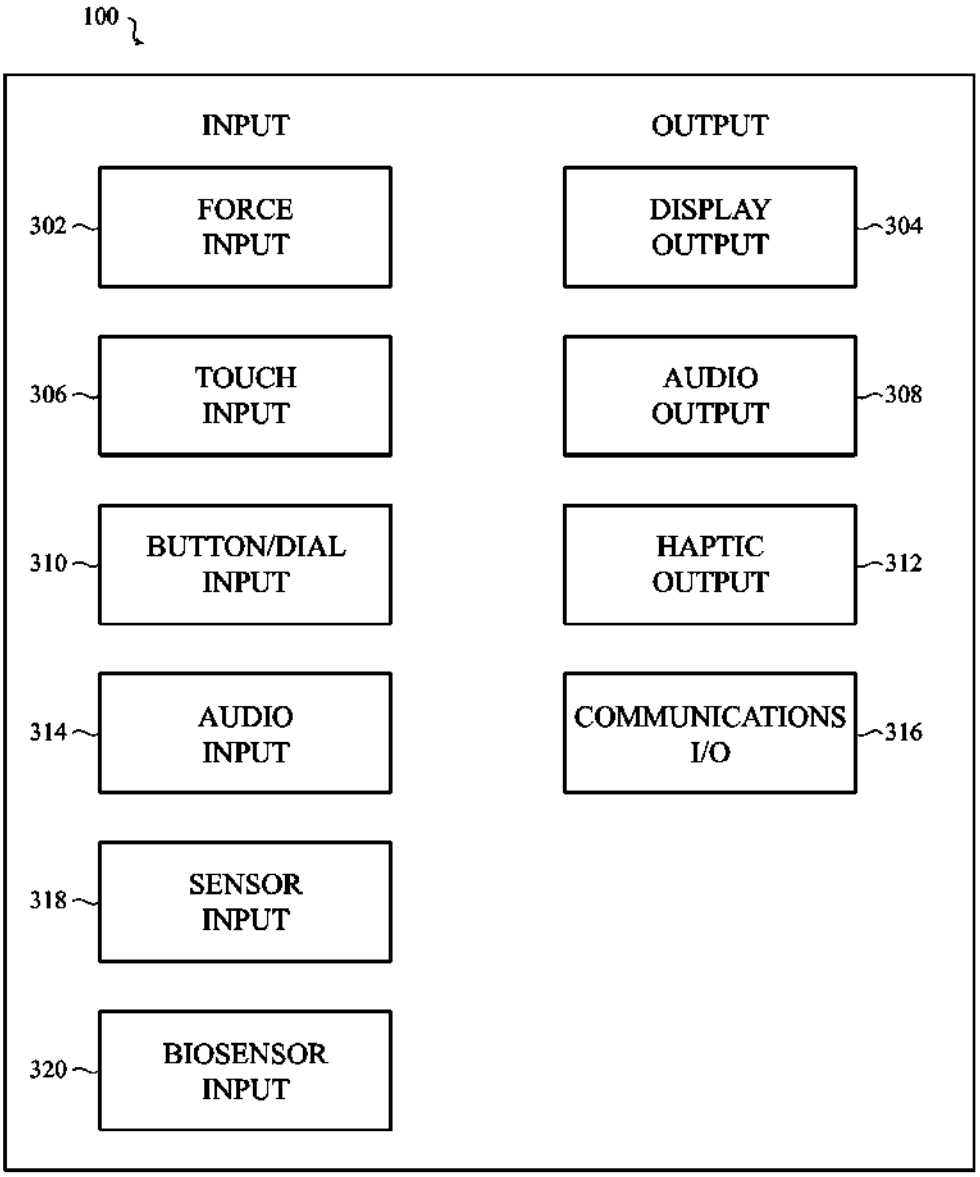

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INPUT
OUTPUT
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FORCE INPUT
304
DISPLAY OUTPUT
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TOUCH INPUT
308
AUDIO OUTPUT
310
BUTTON/DIAL INPUT
312
HAPTIC OUTPUT
314
AUDIO INPUT
316
COMMUNICATIONS I/O
318
SENSOR INPUT
320
BIOSENSOR INPUT

FIG. 3

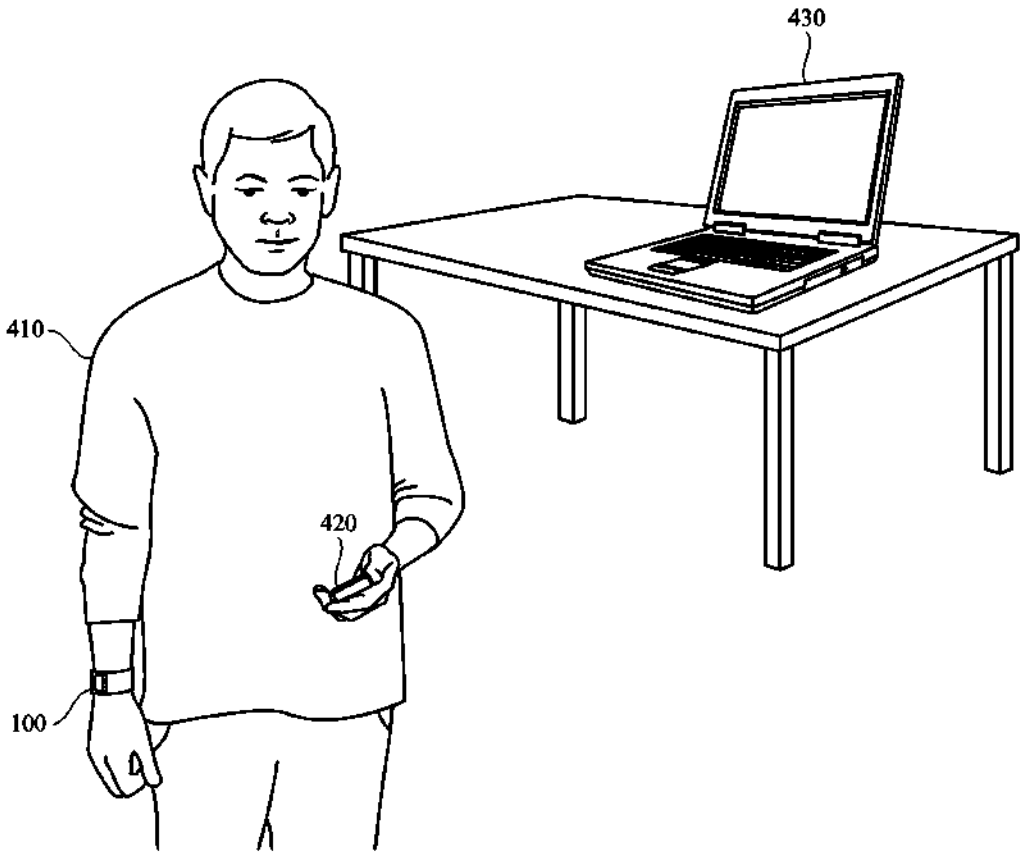


FIG. 4

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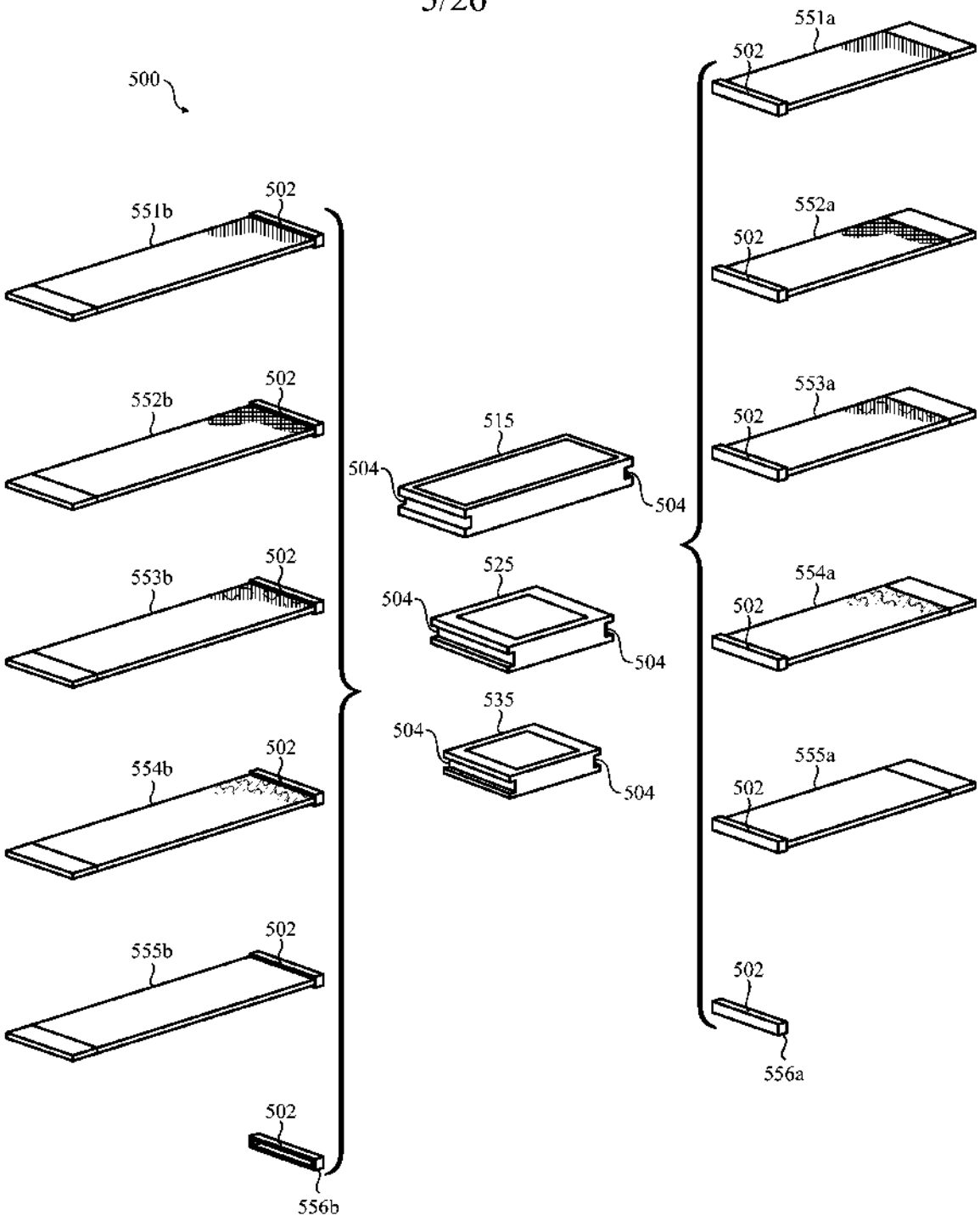

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FIG. 5

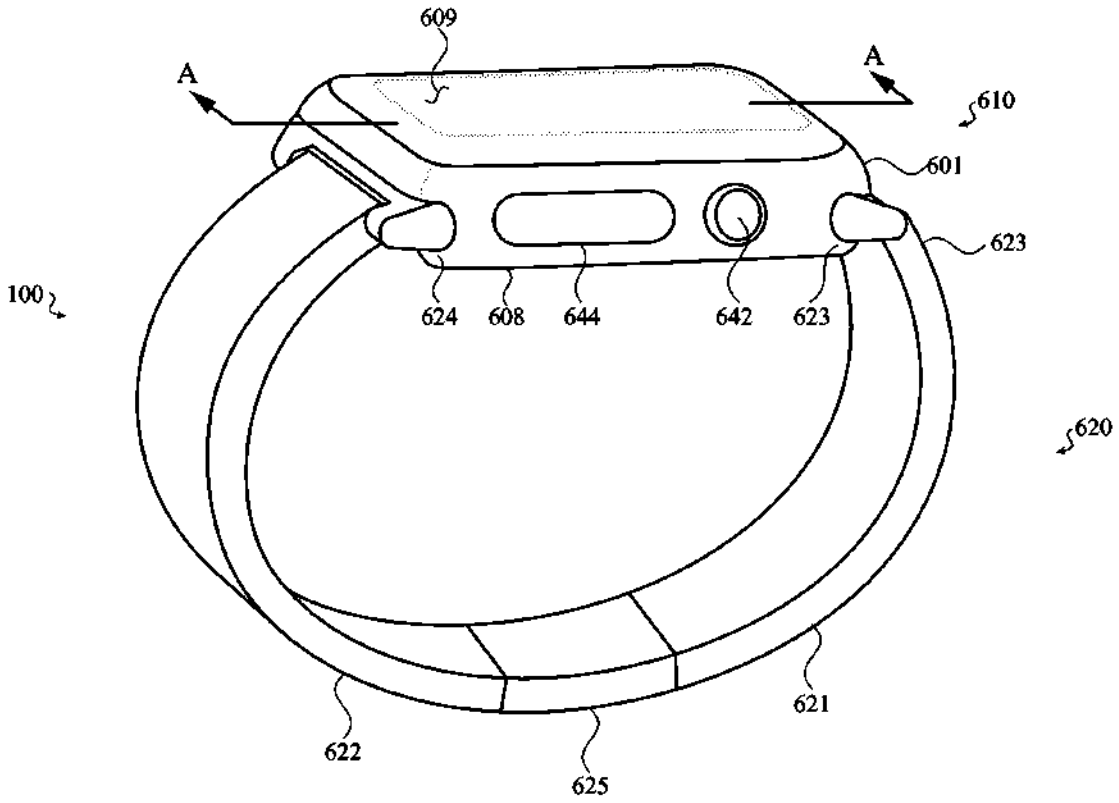


FIG. 6

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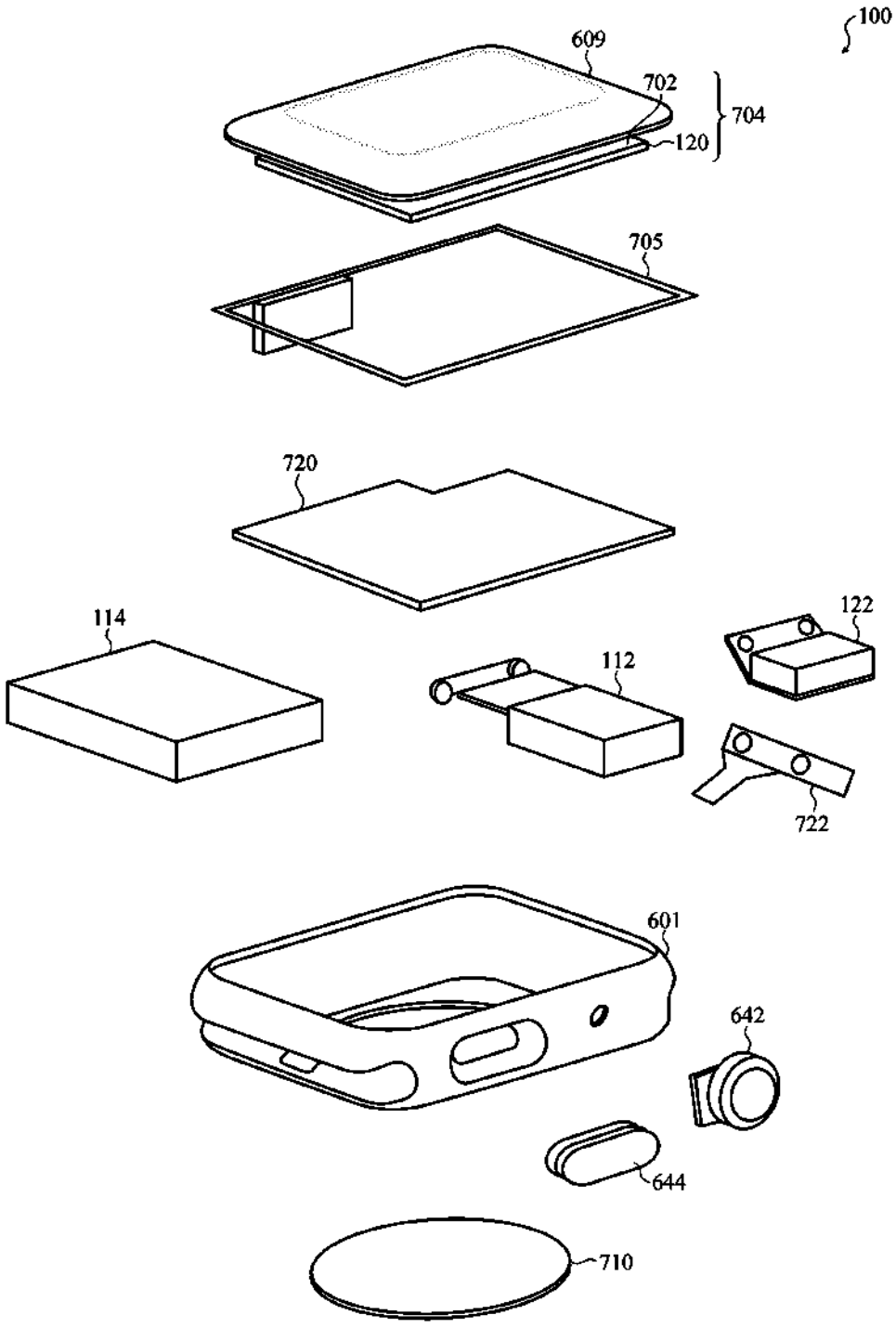


FIG. 7

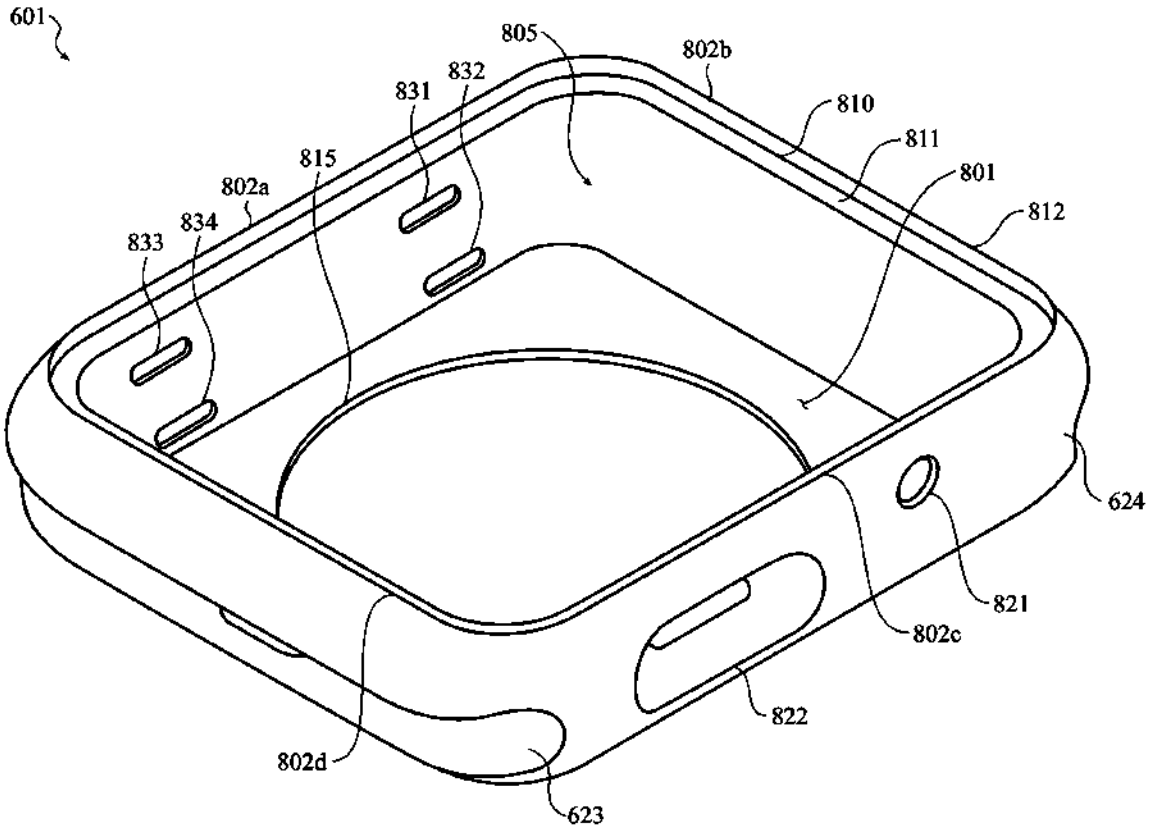

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FIG. 8

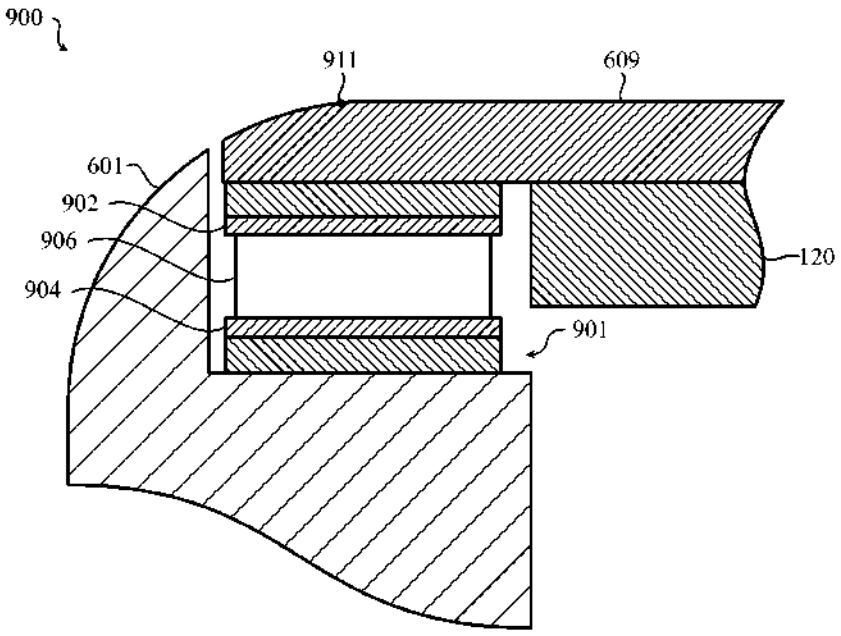


FIG. 9

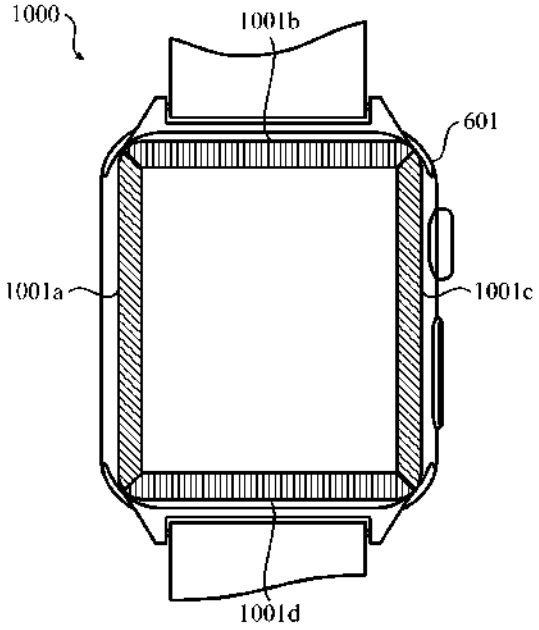


FIG. 10A

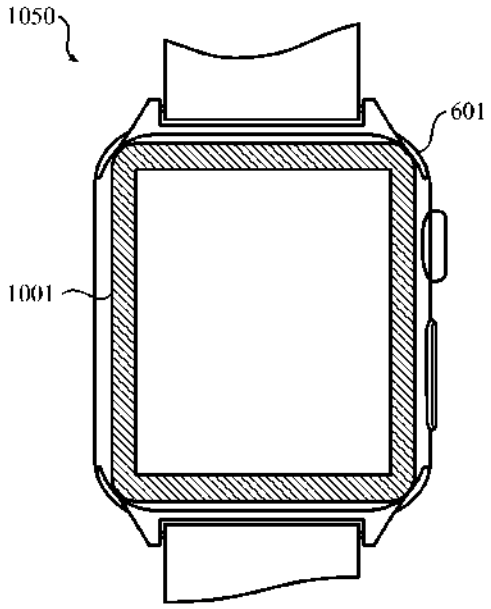


FIG. 10B

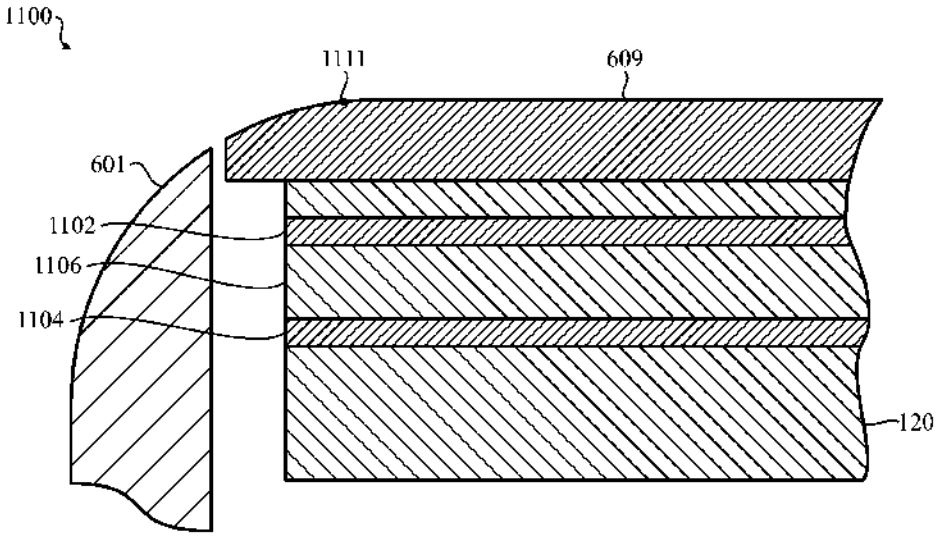


FIG. 11

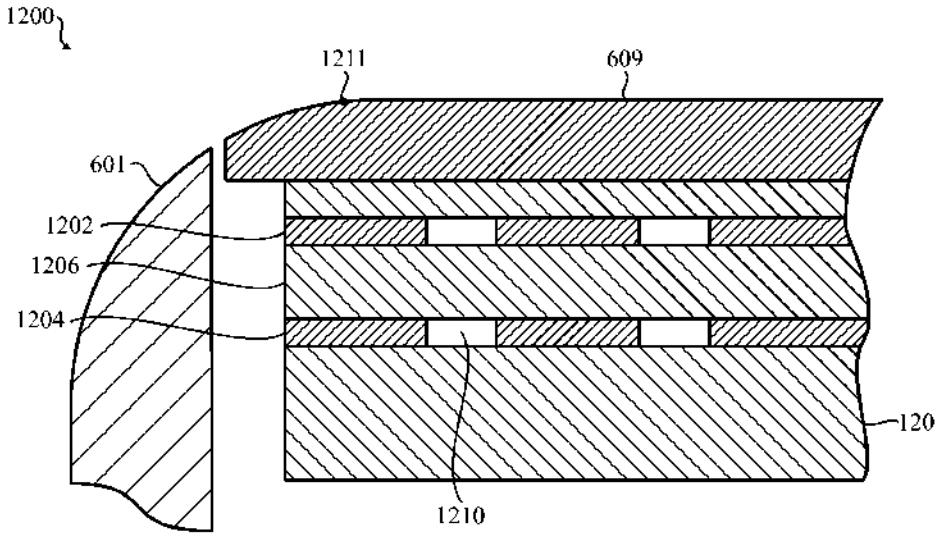


FIG. 12

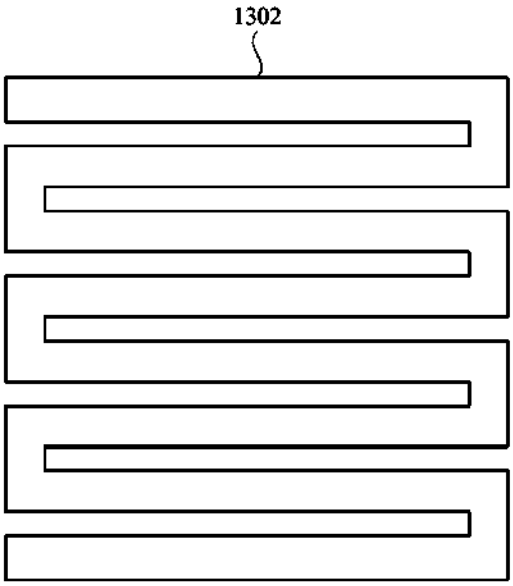


FIG. 13A

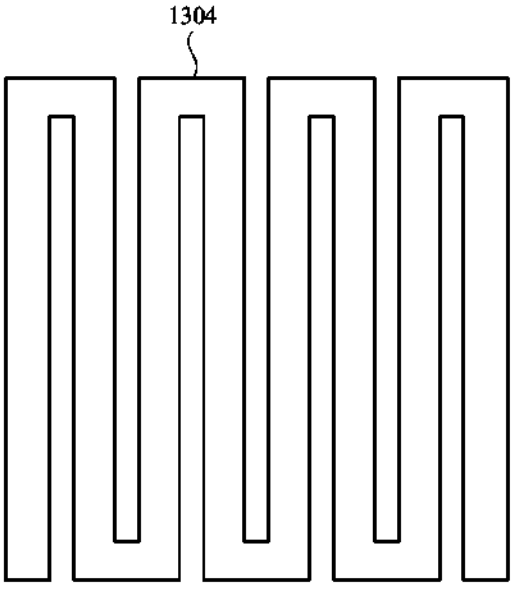


FIG. 13B

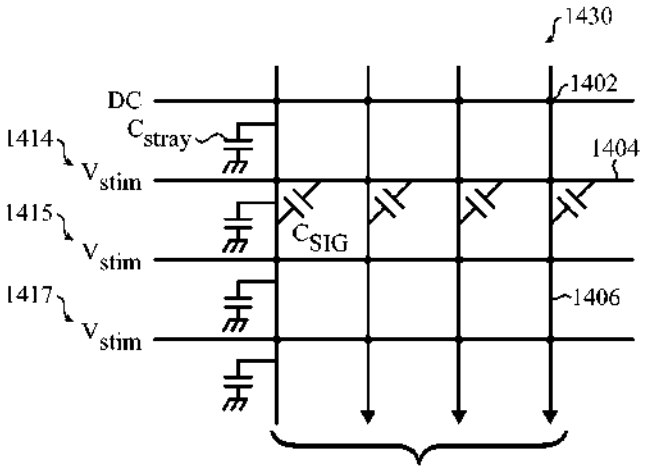


FIG. 14A

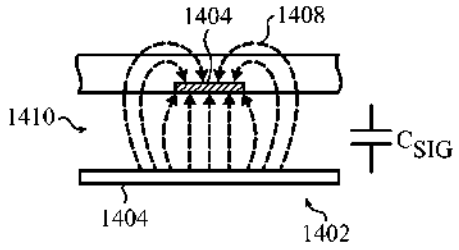


FIG. 14B

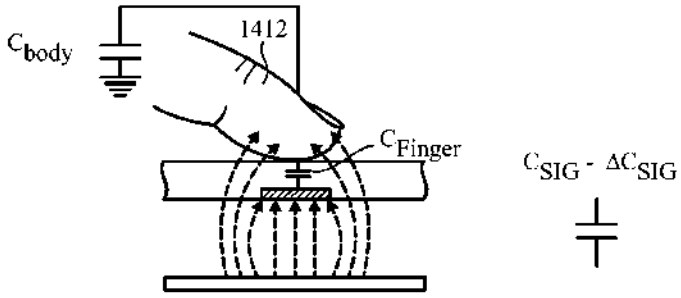


FIG. 14C

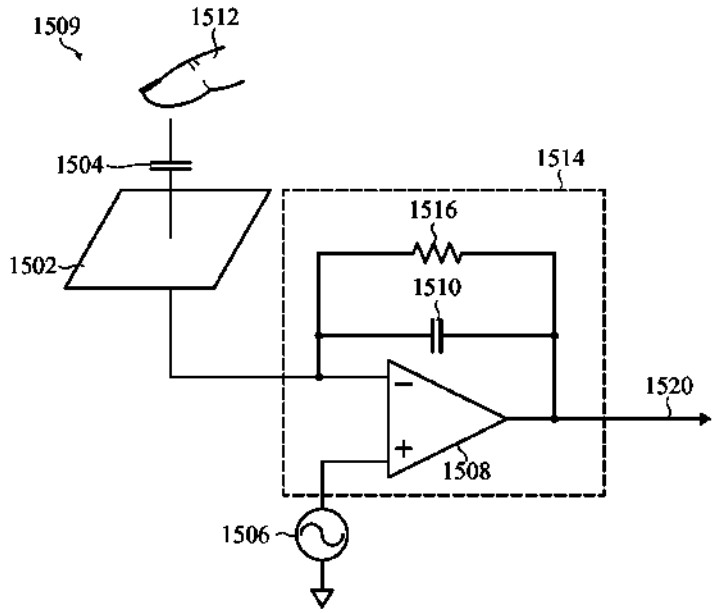


FIG. 15A

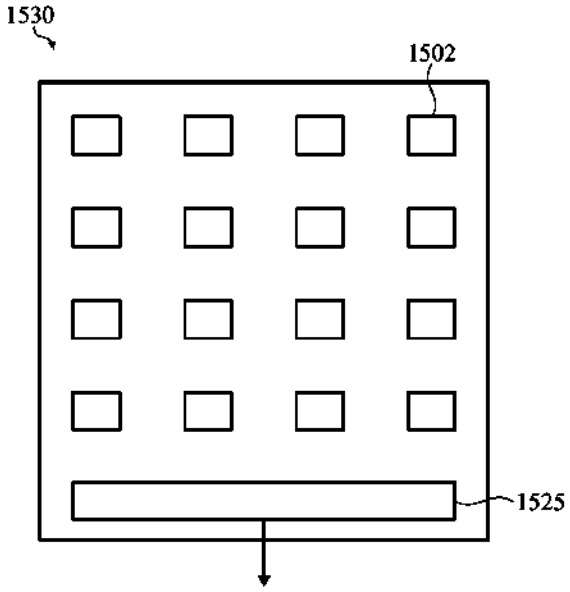


FIG. 15B

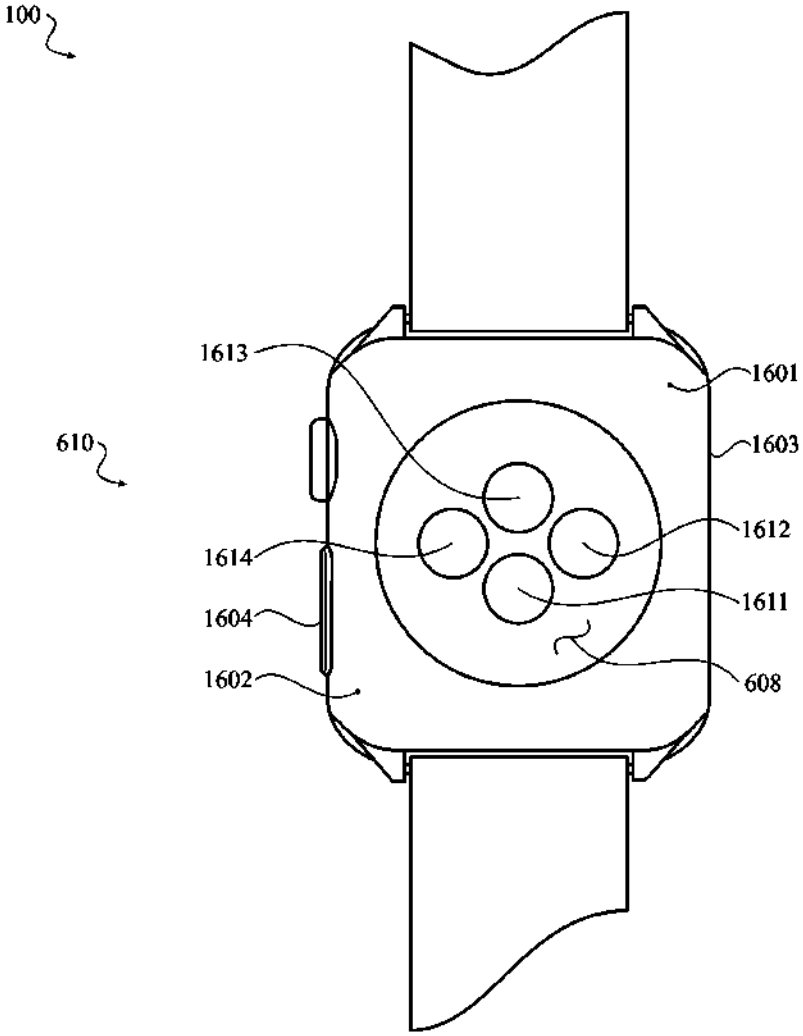


FIG. 16

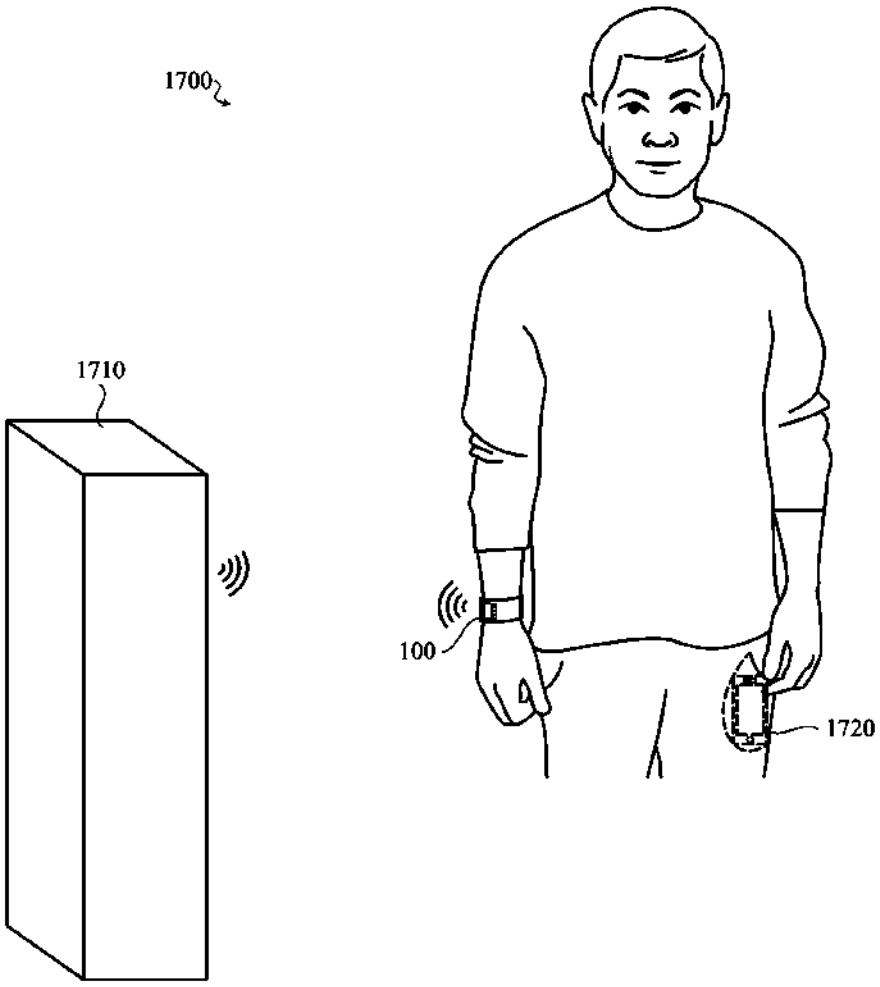


FIG. 17

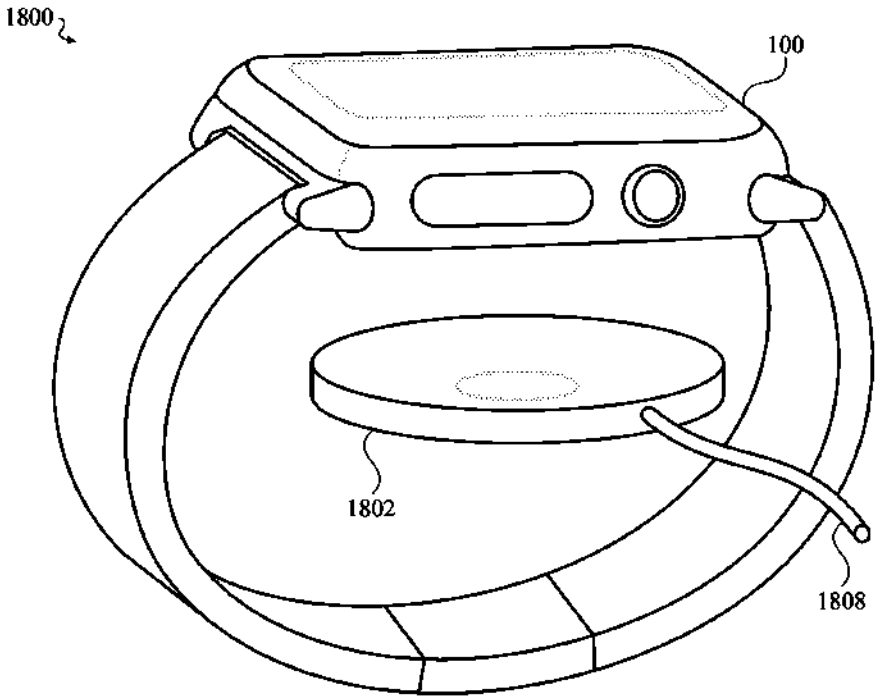


FIG. 18

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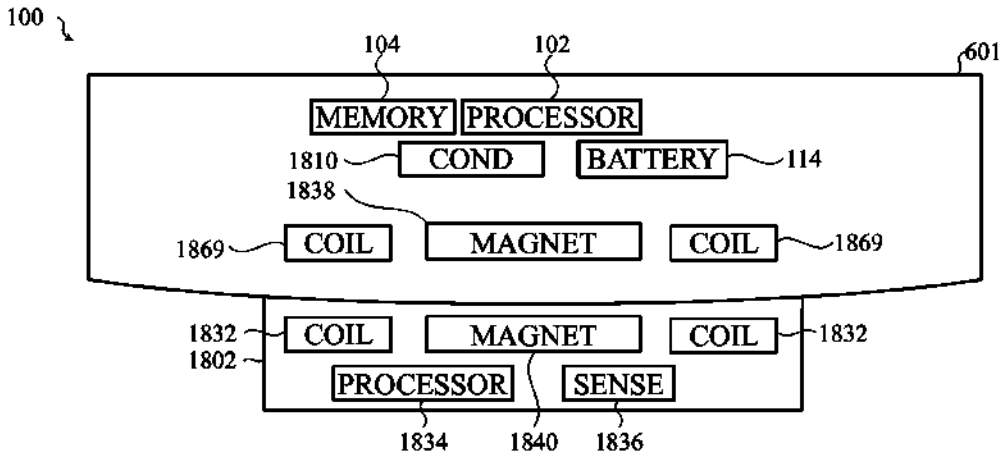

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FIG. 19

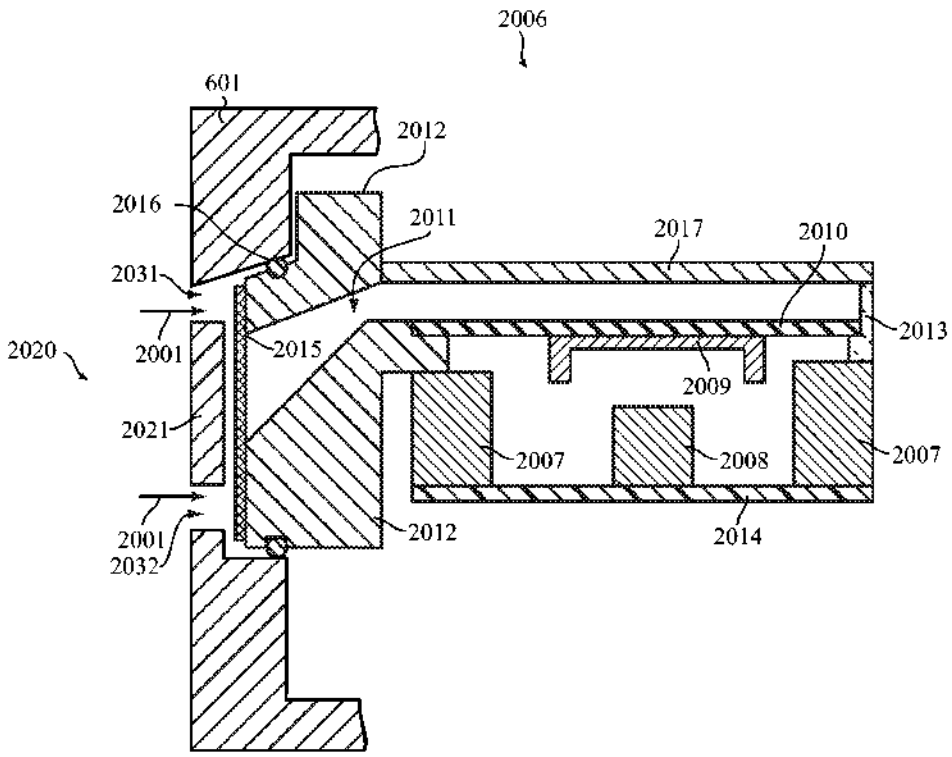

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FIG. 20

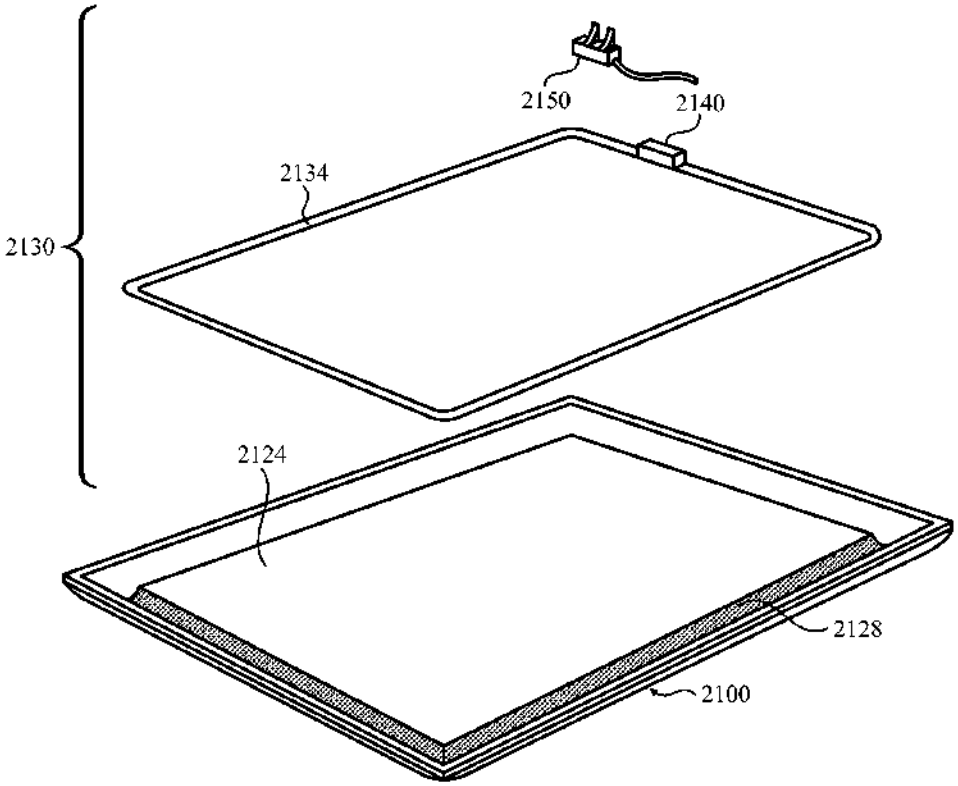


FIG. 21A

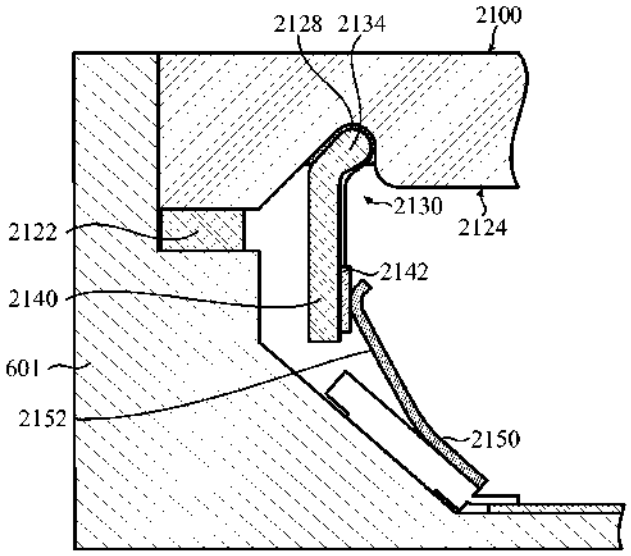


FIG. 21B

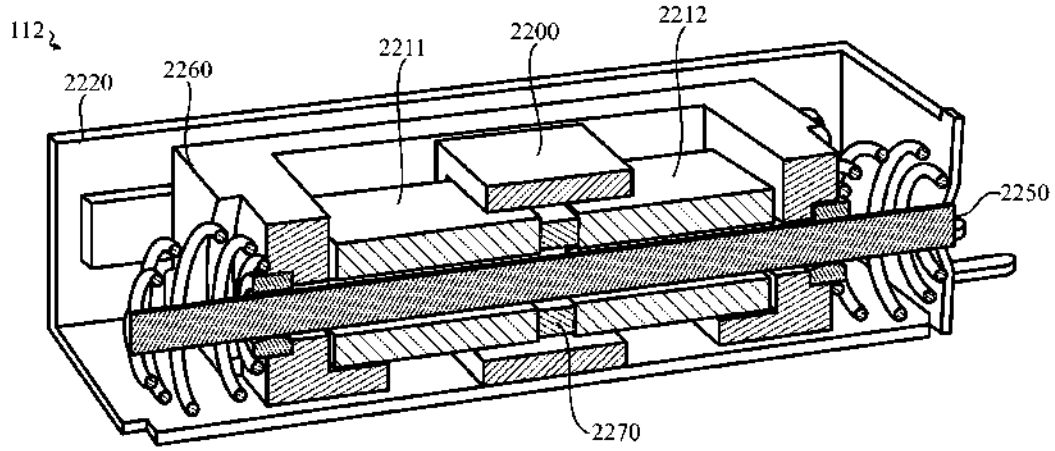


FIG. 22A

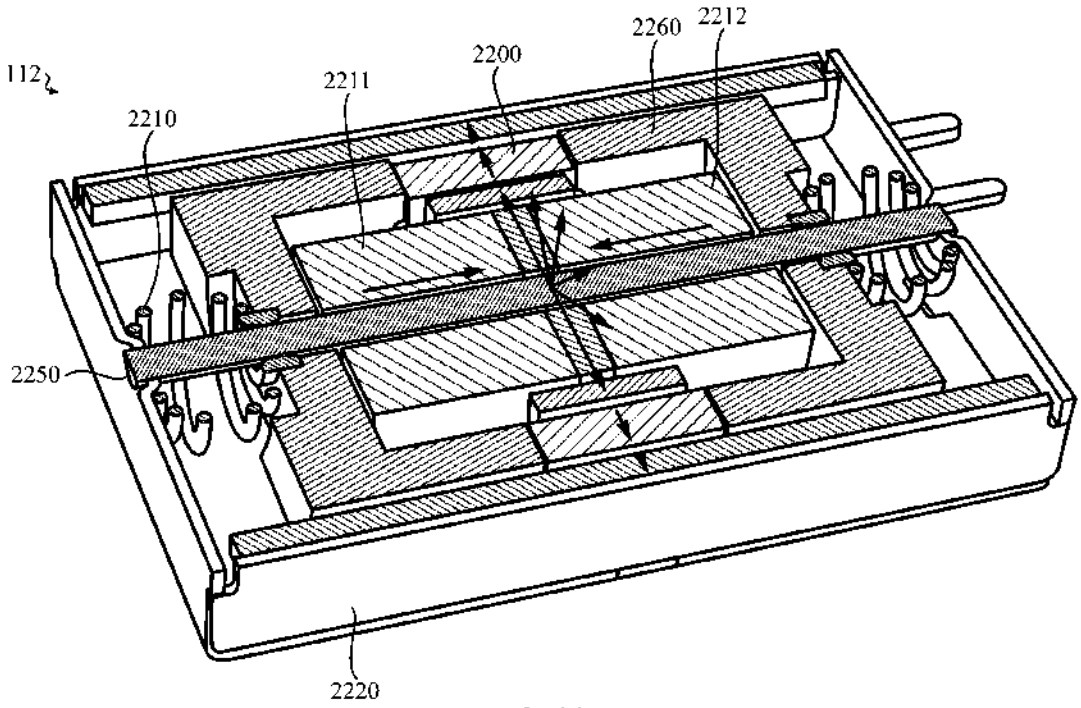


FIG. 22B

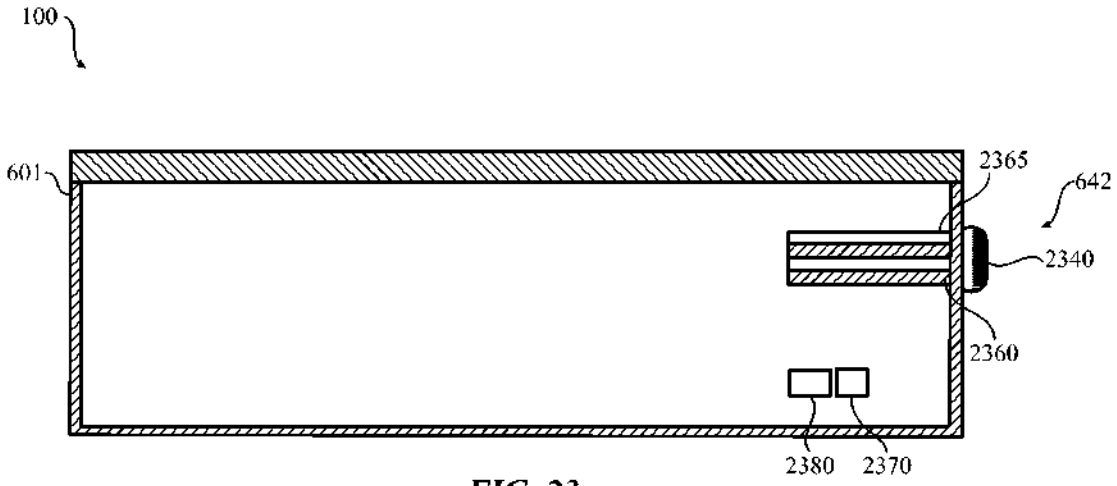


FIG. 23

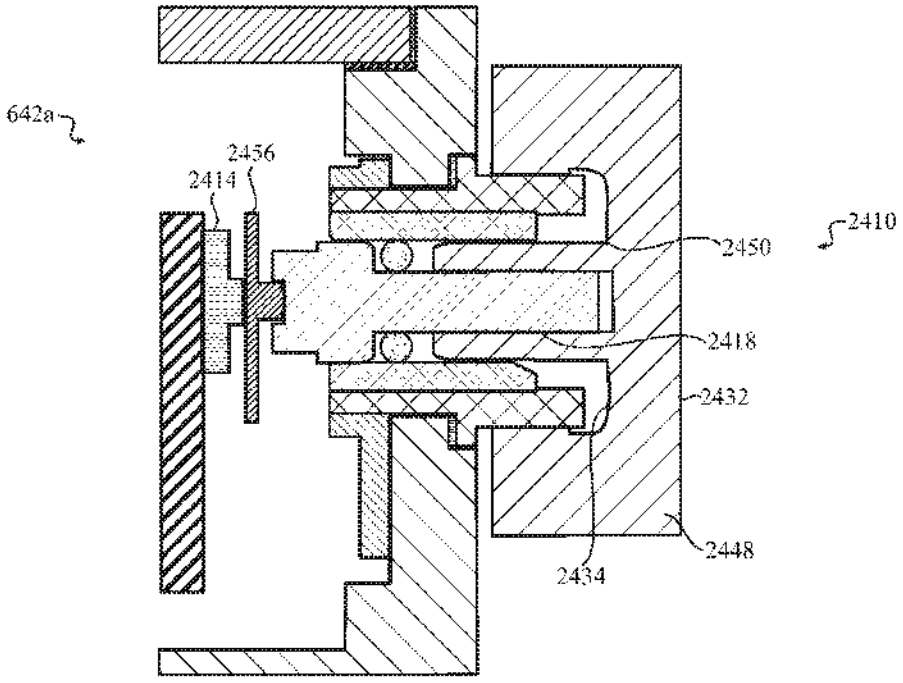


FIG. 24A

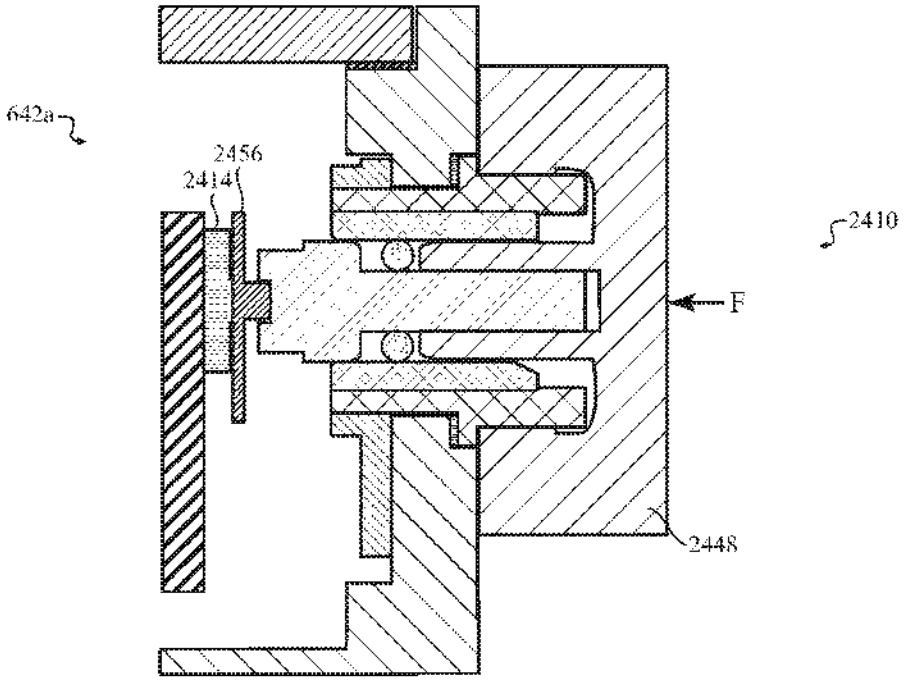


FIG. 24B

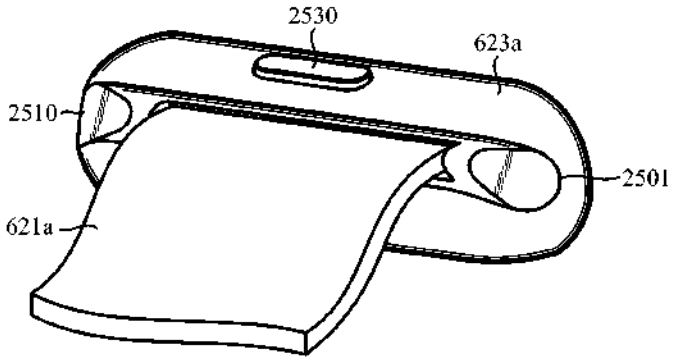


FIG. 25A

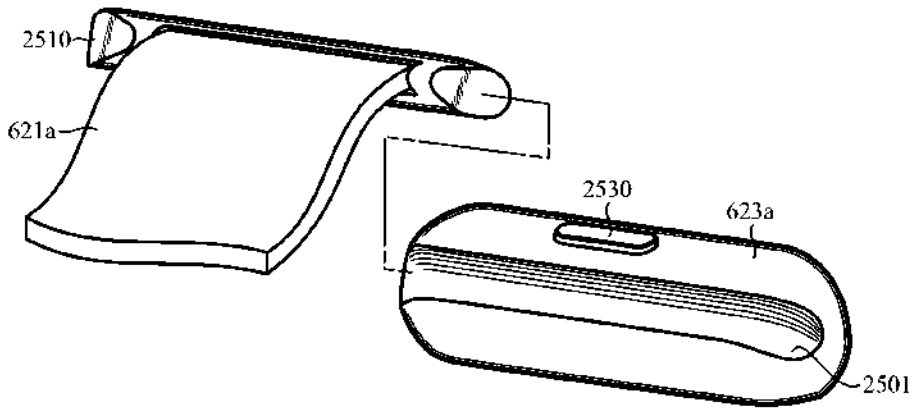


FIG. 25B

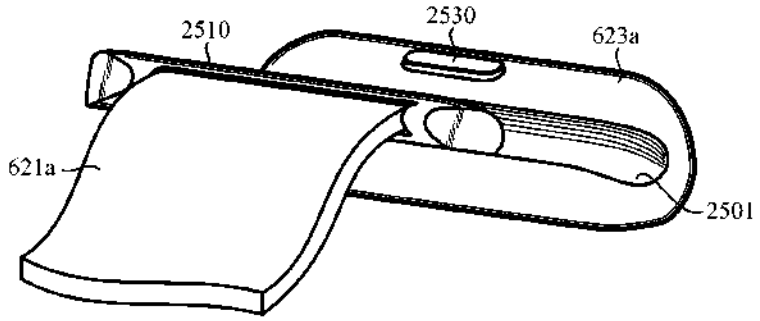


FIG. 25C

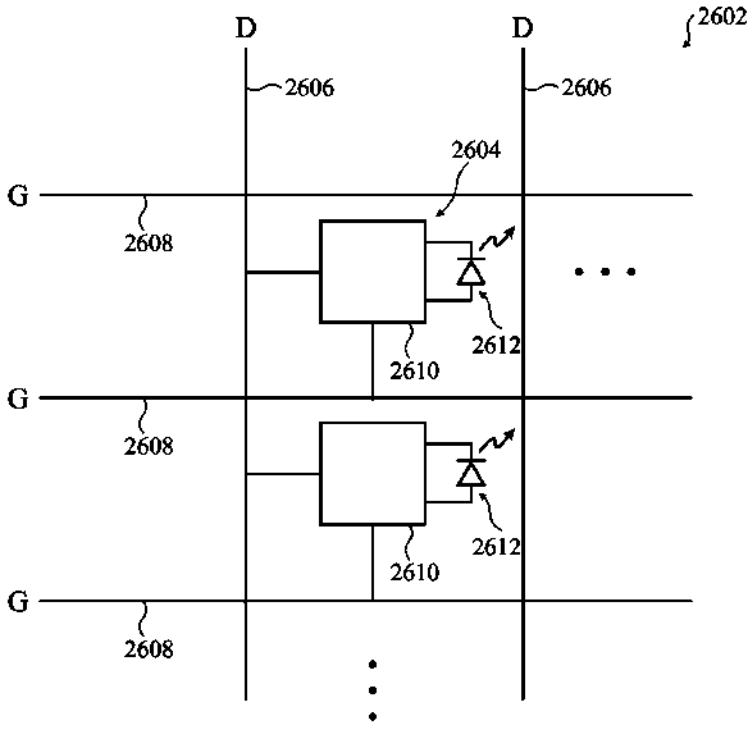


FIG. 26

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DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN APPLICATION DATA SHEET (37 CFR 1.76)

Title of Invention	WEARABLE ELECTRONIC DEVICE P22914US1

As the below named inventor, I hereby declare that:

This declaration is directed to:

☐ The attached application, or

☒ United States application or PCT international application number 14/842,617

filed on September 1, 2015.

The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

WARNING:

Petitioner/applicant is cautioned to avoid submitting personal information in documents filed in a patent application that may contribute to identity theft. Personal information such as social security numbers, bank account numbers, or credit card numbers (other than a check or credit card authorization form PTO-2038 submitted for payment purposes) is never required by the USPTO to support a petition or an application. If this type of personal information is included in documents submitted to the USPTO, petitioners/applicants should consider redacting such personal information from the documents before submitting them to the USPTO. Petitioner/applicant is advised that the record of a patent application is available to the public after publication of the application (unless a non-publication request in compliance with 37 CFR 1.213(a) is made in the application) or issuance of a patent. Furthermore, the record from an abandoned application may also be available to the public if the application is referenced in a published application or an issued patent (see 37 CFR 1.14). Checks and credit card authorization forms PTO-2038 submitted for payment purposes are not retained in the application file and therefore are not publicly available.

LEGAL NAME OF INVENTOR

Inventor: Fletcher R. Rothkopf Date (Optional):

Signature:

Note: An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form or must have been previously filed. Use an additional PTO/AIA/01 form for each additional inventor.

This collection of information is required by 35 U.S.C. 115 and 37 CFR 1.63. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 1 minute to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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LEGAL NAME OF INVENTOR

Inventor: Jonathan Ive Date (Optional): 01/05/2020

Signature: J. Ive

Note: An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form or must have been previously filed. Use an additional PTO/AIA/01 form for each additional inventor.

This collection of information is required by 35 U.S.C. 115 and 37 CFR 1.63. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 1 minute to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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LEGAL NAME OF INVENTOR

Inventor: Julian Hoenig Date (Optional):

Signature:

Note: An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form or must have been previously filed. Use an additional PTO/AIA/01 form for each additional inventor.

This collection of information is required by 35 U.S.C. 115 and 37 CFR 1.63. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 1 minute to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN APPLICATION DATA SHEET (37 CFR 1.76)

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filed on September 1, 2015.

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LEGAL NAME OF INVENTOR

Inventor: Rico Zorkendorfer Date (Optional): _____

Signature: _____

Note: An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form or must have been previously filed. Use an additional PTO/AIA/01 form for each additional inventor.

This collection of information is required by 35 U.S.C. 115 and 37 CFR 1.63. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 1 minute to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: **Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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Document Description: Power of Attorney

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POWER OF ATTORNEY BY APPLICANT

I hereby revoke all previous powers of attorney given in the application identified in either the attached transmittal letter or the boxes below.

Application Number	Filing Date

(Note: The boxes above may be left blank if information is provided on form PTO/AIA/82A.)

☑ I hereby appoint the Patent Practitioner(s) associated with the following Customer Number as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the application referenced in the attached transmittal letter (form PTO/AIA/82A) or identified above: 62579

OR

☐ I hereby appoint Practitioner(s) named in the attached list (form PTO/AIA/82C) as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the patent application referenced in the attached transmittal letter (form PTO/AIA/82A) or identified above. (Note: Complete form PTO/AIA/82C.)

Please recognize or change the correspondence address for the application identified in the attached transmittal letter or the boxes above to:

☑ The address associated with the above-mentioned Customer Number

OR

☐ The address associated with Customer Number:

OR

☐ Firm or Individual Name					
Address					
City		State		Zip	
Country					
Telephone		Email			

I am the Applicant (if the Applicant is a juristic entity, list the Applicant name in the box):

Apple Inc.

☐ Inventor or Joint Inventor (title not required below)
☐ Legal Representative of a Deceased or Legally Incapacitated Inventor (title not required below)
☑ Assignee or Person to Whom the Inventor is Under an Obligation to Assign (provide signer's title if applicant is a juristic entity)
☐ Person Who Otherwise Shows Sufficient Proprietary Interest (e.g., a petition under 37 CFR 1.46(b)(2) was granted in the application or is concurrently being filed with this document) (provide signer's title if applicant is a juristic entity)

SIGNATURE of Applicant for Patent

The undersigned (whose title is supplied below) is authorized to act on behalf of the applicant (e.g., where the applicant is a juristic entity).

Signature	/JM/	Date (Optional)	April 20, 2021
Name	Jeffrey L. Myers, Assistant Secretary and Chief IP Counsel of Apple Inc.		
Title	Assistant Secretary and Chief IP Counsel		

NOTE: Signature - This form must be signed by the applicant in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications. If more than one applicant, use multiple forms.

☐ Total of forms are submitted.

This collection of information is required by 37 CFR 1.131, 1.32, and 1.33. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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Doc Code: TRACK1.REQ
Document Description: TrackOne Request

PTO/AIA/424 (04-14)

CERTIFICATION AND REQUEST FOR PRIORITIZED EXAMINATION UNDER 37 CFR 1.102(e) (Page 1 of 1)

First Named Inventor:	Fletcher R. Rothkopf	Nonprovisional Application Number (if known):	
Title of Invention:	WEARABLE ELECTRONIC DEVICE		

APPLICANT HEREBY CERTIFIES THE FOLLOWING AND REQUESTS PRIORITIZED EXAMINATION FOR THE ABOVE-IDENTIFIED APPLICATION.

1. The processing fee set forth in 37 CFR 1.17(i)(1) and the prioritized examination fee set forth in 37 CFR 1.17(c) have been filed with the request. The publication fee requirement is met because that fee, set forth in 37 CFR 1.18(d), is currently $0. The basic filing fee, search fee, and examination fee are filed with the request or have been already been paid. I understand that any required excess claims fees or application size fee must be paid for the application.

2. I understand that the application may not contain, or be amended to contain, more than four independent claims, more than thirty total claims, or any multiple dependent claims, and that any request for an extension of time will cause an outstanding Track I request to be dismissed.

3. The applicable box is checked below:

I. ☑ **Original Application (Track One) - Prioritized Examination under § 1.102(e)(1)**

i. (a) The application is an original nonprovisional utility application filed under 35 U.S.C. 111(a). This certification and request is being filed with the utility application via EFS-Web.

---OR---

(b) The application is an original nonprovisional plant application filed under 35 U.S.C. 111(a). This certification and request is being filed with the plant application in paper.

ii. An executed inventor's oath or declaration under 37 CFR 1.63 or 37 CFR 1.64 for each inventor, **or** the application data sheet meeting the conditions specified in 37 CFR 1.53(f)(3)(i) is filed with the application.

II. ☐ **Request for Continued Examination - Prioritized Examination under § 1.102(e)(2)**

i. A request for continued examination has been filed with, or prior to, this form.
ii. If the application is a utility application, this certification and request is being filed via EFS-Web.
iii. The application is an original nonprovisional utility application filed under 35 U.S.C. 111(a), or is a national stage entry under 35 U.S.C. 371.
iv. This certification and request is being filed prior to the mailing of a first Office action responsive to the request for continued examination.
v. No prior request for continued examination has been granted prioritized examination status under 37 CFR 1.102(e)(2).

Signature /Peter J. Nagle/	Date September 23, 2022
Name (Print/Typed) Peter J. Nagle	Practitioner Registration Number 70,361

Note: *This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4(d) for signature requirements and certifications. Submit multiple forms if more than one signature is required.**

☐ *Total of _____ forms are submitted.

Privacy Act Statement

The **Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (*i.e.*, GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Doc Code: PA..
Document Description: Power of Attorney

PTO/AIA/82A (07-13)
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TRANSMITTAL FOR POWER OF ATTORNEY TO ONE OR MORE REGISTERED PRACTITIONERS

NOTE: This form is to be submitted with the Power of Attorney by Applicant form (PTO/AIA/82B) to identify the application to which the Power of Attorney is directed, in accordance with 37 CFR 1.5, unless the application number and filing date are identified in the Power of Attorney by Applicant form. If neither form PTO/AIA/82A nor form PTO/AIA82B identifies the application to which the Power of Attorney is directed, the Power of Attorney will not be recognized in the application.

Application Number	Not Yet Assigned
Filing Date	Herewith
First Named Inventor	Fletcher R. Rothkopf
Title	WEARABLE ELECTRONIC DEVICE
Art Unit	Not Yet Assigned
Examiner Name	Not Yet Assigned
Attorney Docket Number	P22914USC10

SIGNATURE of Applicant or Patent Practitioner

Signature	/Peter J. Nagle/	Date (Optional)	September 23, 2022
Name	Peter J. Nagle	Registration Number	70,361
Title (if Applicant is a juristic entity)			
Applicant Name (if Applicant is a juristic entity)	Apple Inc.		

NOTE: This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4(d) for signature requirements and certifications. If more than one applicant, use multiple forms.

☑ *Total of 1 forms are submitted.

This collection of information is required by 37 CFR 1.131, 1.32, and 1.33. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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Electronic Patent Application Fee Transmittal	
Application Number:	
Filing Date:	
Title of Invention:	WEARABLE ELECTRONIC DEVICE
First Named Inventor/Applicant Name:	Fletcher R. Rothkopf
Filer:	Peter James Nagle/Stephanie Klepp
Attorney Docket Number:	P22914USC10
Filed as Large Entity	
Filing Fees for Track I Prioritized Examination - Nonprovisional Application under 35 USC 111(a)	

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
UTILITY APPLICATION FILING	1011	1	320	320
UTILITY SEARCH FEE	1111	1	700	700
UTILITY EXAMINATION FEE	1311	1	800	800
REQUEST FOR PRIORITIZED EXAMINATION	1817	1	4200	4200
Pages:				
Claims:				
Miscellaneous-Filing:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
PUBL. FEE- EARLY, VOLUNTARY, OR NORMAL	1504	1	0	0
PROCESSING FEE, EXCEPT PROV. APPLS.	1830	1	140	140
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
		Total in USD ($)		**6160**

Electronic Acknowledgement Receipt	
EFS ID:	46685517
Application Number:	17951973
International Application Number:	
Confirmation Number:	5622
Title of Invention:	WEARABLE ELECTRONIC DEVICE
First Named Inventor/Applicant Name:	Fletcher R. Rothkopf
Customer Number:	62579
Filer:	Peter James Nagle/Stephanie Klepp
Filer Authorized By:	Peter James Nagle
Attorney Docket Number:	P22914USC10
Receipt Date:	23-SEP-2022
Filing Date:	
Time Stamp:	17:53:01
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$6160
RAM confirmation Number	E20229MH53433215
Deposit Account	
Authorized User	
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Transmittal of New Application	P22914USC10_Transmittal.pdf	260463 f0236420090118c63144366ccd3543a6645f887540b	no	2
Warnings:					
Information:					
2	Application Data Sheet	P22914USC10_ADS.pdf	253136 d8a66670376d011fc623e8a435c277a45cfe2aad1	no	12
Warnings:					
Information:					
This is not an USPTO supplied ADS fillable form					
3		P22914USC10_Application.pdf	417289 e59c□56664b0ed5abfdbabbc91b8fa6514495 5e3	yes	96

Multipart Description/PDF files in .zip description

Document Description	Start	End
Specification	1	90
Claims	91	95
Abstract	96	96

Warnings:					
Information:					
4	Drawings-only black and white line drawings	P22914USC10_Drawings.pdf	505284 e78e138556db21df834bb1fb95f223e0b189c8ba	no	26
Warnings:					
Information:					

5	Oath or Declaration filed	P22914USC10_Declarations.pdf	519654 0ad62e0f55ef6c8ea78a99f60b82895a20c85b8c	no	4
Warnings:					
Information:					
6	Track One Request	P22914USC10_TrackOne.pdf	140979 ede9449f6b52c1739199cc9cf7b5fa697043c583	no	2
Warnings:					
Information:					
7	Power of Attorney	P22914USC10_PoA.pdf	102329 d806dd23af8c55c069cba6fa5c96711c8bd07fa7	no	1
Warnings:					
Information:					
8	Power of Attorney	P22914USC10_Transmittal_POA.pdf	107188 efc872fde505c6c99a3090f8b91f269d65b8babe	no	1
Warnings:					
Information:					
9	Fee Worksheet (SB06)	fee-info.pdf	51107 72a9f6d6c4467b8680055c1f7c3fa54d36788036	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	2357429		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:

Inventor(s):	Fletcher R. Rothkopf et al.		
App. No.:	17/951,973	Con. No.:	5622
Filed:	September 23, 2022	Art Unit:	Not Yet Assigned
Title:	WEARABLE ELECTRONIC DEVICE	Examiner:	Not Yet Assigned

PRELIMINARY AMENDMENT

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Commissioner:

Please amend the above-identified application as follows:

Amendments to the Claims begin on page 2 of this paper.

Remarks begin on page 5 of this paper.

Amendments to the Claims:

1. – 20. (Cancelled)

21. (New) An electronic device, comprising:

a housing defining a first opening opposite to a second opening;

a band attached to the housing and configured to secure the electronic device to a user;

a display positioned in the first opening;

an antenna configured to facilitate wireless communication between the electronic device and a mobile phone, wherein the wireless communication comprises transmission of information to the mobile phone for visual display to the user;

a cover disposed over the second opening and forming a portion of an exterior surface of the electronic device;

a biosensor module disposed within the second opening below the cover; and

a wireless charging receive coil aligned with the second opening and below the cover; wherein:

the cover is configured to pass optical signals generated by the biosensor module; and

the cover is configured to pass wireless power from an external wireless charging device to the wireless charging receive coil.

22. (New) The electronic device of claim 21, wherein the biosensor module comprises:

a light source configured to emit light toward a region of skin of the user: and

a detector configured to receive light reflected from the region of skin.

23. (New) The electronic device of claim 22, wherein:

the cover defines a first opening to transmit the light from the light source; and

the cover defines a second opening to receive the light reflected from the region of skin.

24. (New) The electronic device of claim 23, wherein:

the light source and the detector are configured to measure changes in light absorption by the region of skin;

the electronic device is configured to compute a health metric using the measured changes in light absorption; and

the display is configured to display information associated with the health metric.

25. (New) The electronic device of claim 24, wherein the light source and the detector are configured to operate as a photoplethysmogram (PPG) sensor.

26. (New) The electronic device of claim 21, wherein:

the cover is a disk having a disk diameter that is greater than an opening diameter of the second opening; and

the cover forms a water-tight seal with the housing along a perimeter of the cover.

27. (New) The electronic device of claim 21, wherein:

the second opening has an opening diameter;

the wireless charging receive coil has a coil diameter that is less than the opening diameter; and

the wireless charging receive coil is configured to receive the wireless power through the second opening.

28. (New) The electronic device of claim 21, wherein:

the cover has a convex contoured shape that protrudes toward the user; and

the convex contoured shape facilitates alignment between the cover and a mating surface of the external wireless charging device.

29. (New) The electronic device of claim 28, wherein:

the electronic device is magnetically coupled to the external wireless charging device through the cover.

30. (New) The electronic device of claim 21, wherein:

the wireless charging receive coil has a coil diameter that is less than a diameter of the biosensor module; and

the wireless charging receive coil is configured to receive the wireless power through the biosensor module.

31. (New) The electronic device of claim 21, wherein:

the electronic device is configured to compute a health metric using the biosensor module; and

the health metric is one or more of: a heart rate, a respiration rate, a blood oxygenation level, a blood volume estimate, or blood pressure.

REMARKS

This Amendment is being submitted to cancel claims 1 – 20 and add claims 21 – 31.

The Assignee believes no fees or petitions are due with this filing. However, should any such fees or petitions be required, please consider this a request therefor and authorization to charge Deposit Account No. 504621 as necessary.

If the Examiner should require any additional information or amendment, please contact the undersigned attorney.

Dated: September 26, 2022

Respectfully submitted,

/Benno M. Guggenheimer/

Benno M. Guggenheimer
Registration No. 66,686
Attorney for Assignee
USPTO Customer No. 62579

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Phone: (303) 223-1100
Fax: (303) 223-1111

Electronic Acknowledgement Receipt	
EFS ID:	46689549
Application Number:	17951973
International Application Number:	
Confirmation Number:	5622
Title of Invention:	WEARABLE ELECTRONIC DEVICE
First Named Inventor/Applicant Name:	Fletcher R. Rothkopf
Customer Number:	62579
Filer:	Benno Maxim Guggenheimer/Stephanie Klepp
Filer Authorized By:	Benno Maxim Guggenheimer
Attorney Docket Number:	P22914USC10
Receipt Date:	26-SEP-2022
Filing Date:	
Time Stamp:	11:27:37
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		P22914USC10_Preliminary_Amendment.pdf	27833 00824c78a9410ad6785e9956343ddc3614c9e92f	yes	5

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Preliminary Amendment	1	1
	Claims	2	4
	Applicant Arguments/Remarks Made in an Amendment	5	5
Warnings:			
Information:			
	Total Files Size (in bytes):	27833	

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.
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New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
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www.uspto.gov

APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
17/951,973	09/23/2022		1820	P22914USC10	11	1

CONFIRMATION NO. 5622

FILING RECEIPT

62579
APPLE INC./BROWNSTEIN
c/o Brownstein Hyatt Farber Schreck, LLP
410 Seventeenth Street
Suite 2200
Denver, CO 80202

Date Mailed: 10/21/2022

Receipt is acknowledged of this non-provisional utility patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF FIRST INVENTOR, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection.

Please verify the accuracy of the data presented on this receipt. If an error is noted on this Filing Receipt, please submit a written request for a corrected Filing Receipt, including a properly marked-up ADS showing the changes with strike-through for deletions and underlining for additions. If you received a "Notice to File Missing Parts" or other Notice requiring a response for this application, please submit any request for correction to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections provided that the request is grantable.

Inventor(s)

Fletcher R. Rothkopf, Los Altos, CA;
Jonathan Ive, San Francisco, CA;
Julian Hoenig, San Francisco, CA;
Rico Zorkendorfer, San Francisco, CA;

Applicant(s)

Apple Inc., Cupertino, CA;

Power of Attorney: The patent practitioners associated with Customer Number 62579

Domestic Priority data as claimed by applicant

This application is a CON of 17/672,653 02/15/2022 PAT 11,474,483
which is a CON of 17/188,966 03/01/2021
which is a CON of 16/826,130 03/20/2020 PAT 10,942,491
which is a CON of 14/842,617 09/01/2015 PAT 10,599,101
which claims benefit of 62/044,974 09/02/2014
and said 16/826,130 03/20/2020 is a CON of 15/261,917 09/10/2016 PAT 10,627,783
which is a CON of 14/842,617 09/01/2015 PAT 10,599,101
which claims benefit of 62/044,974 09/02/2014
and said 16/826,130 03/20/2020 is a CON of 15/261,914 09/10/2016 PAT 10,613,485
which is a CON of 14/842,617 09/01/2015 PAT 10,599,101
which claims benefit of 62/044,974 09/02/2014
and said 16/826,130 03/20/2020 is a CON of 15/261,912 09/10/2016 PAT 10,620,591
which is a CON of 14/842,617 09/01/2015 PAT 10,599,101

which claims benefit of 62/044,974 09/02/2014
and said 17/672,653 02/15/2022 is a CON of 17/188,995 03/01/2021
which is a CON of 16/826,130 03/20/2020 PAT 10,942,491
which is a CON of 14/842,617 09/01/2015 PAT 10,599,101
which claims benefit of 62/044,974 09/02/2014
and said 16/826,130 03/20/2020 is a CON of 15/261,917 09/10/2016 PAT 10,627,783
which is a CON of 14/842,617 09/01/2015 PAT 10,599,101
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and said 16/826,130 03/20/2020 is a CON of 15/261,914 09/10/2016 PAT 10,613,485
which is a CON of 14/842,617 09/01/2015 PAT 10,599,101
which claims benefit of 62/044,974 09/02/2014
and said 16/826,130 03/20/2020 is a CON of 15/261,912 09/10/2016 PAT 10,620,591
which is a CON of 14/842,617 09/01/2015 PAT 10,599,101
which claims benefit of 62/044,974 09/02/2014
This application is a CON of 17/188,966 03/01/2021
and is a CON of 17/188,995 03/01/2021
and is a CON of 17/899,498 08/30/2022

Foreign Applications for which priority is claimed (You may be eligible to benefit from the **Patent Prosecution Highway** program at the USPTO. Please see http://www.uspto.gov for more information.) - None.
Foreign application information must be provided in an Application Data Sheet in order to constitute a claim to foreign priority. See 37 CFR 1.55 and 1.76.

Permission to Access Application via Priority Document Exchange: Yes

Permission to Access Search Results: Yes

Applicant may provide or rescind an authorization for access using Form PTO/SB/39 or Form PTO/SB/69 as appropriate.

If Required, Foreign Filing License Granted: 10/20/2022
The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 17/951,973**
Projected Publication Date: 01/26/2023
Non-Publication Request: No
Early Publication Request: No
Title

WEARABLE ELECTRONIC DEVICE

Preliminary Class

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications: No

PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing

of patent applications on the same invention in member countries, but **does not result** in a grant of "an international patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

Applicants also are advised that in the case of inventions made in the United States, the Director of the USPTO must issue a license before applicants can apply for a patent in a foreign country. The filing of a U.S. patent application serves as a request for a foreign filing license. The application's filing receipt contains further information and guidance as to the status of applicant's license for foreign filing.

Applicants may wish to consult the USPTO booklet, "General Information Concerning Patents" (specifically, the section entitled "Treaties and Foreign Patents") for more information on timeframes and deadlines for filing foreign patent applications. The guide is available either by contacting the USPTO Contact Center at 800-786-9199, or it can be viewed on the USPTO website at http://www.uspto.gov/web/offices/pac/doc/general/index.html.

For information on preventing theft of your intellectual property (patents, trademarks and copyrights), you may wish to consult the U.S. Government website, http://www.stopfakes.gov. Part of a Department of Commerce initiative, this website includes self-help "toolkits" giving innovators guidance on how to protect intellectual property in specific countries such as China, Korea and Mexico. For questions regarding patent enforcement issues, applicants may call the U.S. Government hotline at 1-866-999-HALT (1-866-999-4258).

LICENSE FOR FOREIGN FILING UNDER

Title 35, United States Code, Section 184

Title 37, Code of Federal Regulations, 5.11 & 5.15

GRANTED

The applicant has been granted a license under 35 U.S.C. 184, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" followed by a date appears on this form. Such licenses are issued in all applications where the conditions for issuance of a license have been met, regardless of whether or not a license may be required as set forth in 37 CFR 5.15. The scope and limitations of this license are set forth in 37 CFR 5.15(a) unless an earlier license has been issued under 37 CFR 5.15(b). The license is subject to revocation upon written notification. The date indicated is the effective date of the license, unless an earlier license of similar scope has been granted under 37 CFR 5.13 or 5.14.

This license is to be retained by the licensee and may be used at any time on or after the effective date thereof unless it is revoked. This license is automatically transferred to any related applications(s) filed under 37 CFR 1.53(d). This license is not retroactive.

The grant of a license does not in any way lessen the responsibility of a licensee for the security of the subject matter as imposed by any Government contract or the provisions of existing laws relating to espionage and the national security or the export of technical data. Licensees should apprise themselves of current regulations especially with respect to certain countries, of other agencies, particularly the Office of Defense Trade Controls, Department of

State (with respect to Arms, Munitions and Implements of War (22 CFR 121-128)); the Bureau of Industry and Security, Department of Commerce (15 CFR parts 730-774); the Office of Foreign AssetsControl, Department of Treasury (31 CFR Parts 500+) and the Department of Energy.

NOT GRANTED

No license under 35 U.S.C. 184 has been granted at this time, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" DOES NOT appear on this form. Applicant may still petition for a license under 37 CFR 5.12, if a license is desired before the expiration of 6 months from the filing date of the application. If 6 months has lapsed from the filing date of this application and the licensee has not received any indication of a secrecy order under 35 U.S.C. 181, the licensee may foreign file the application pursuant to 37 CFR 5.15(b).

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The United States represents the largest, most dynamic marketplace in the world and is an unparalleled location for business investment, innovation, and commercialization of new technologies. The U.S. offers tremendous resources and advantages for those who invest and manufacture goods here. Through SelectUSA, our nation works to promote and facilitate business investment. SelectUSA provides information assistance to the international investor community; serves as an ombudsman for existing and potential investors; advocates on behalf of U.S. cities, states, and regions competing for global investment; and counsels U.S. economic development organizations on investment attraction best practices. To learn more about why the United States is the best country in the world to develop technology, manufacture products, deliver services, and grow your business, visit http://www.SelectUSA.gov or call +1-202-482-6800.

PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875

Application or Docket Number: 17/951,973

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY FEE($)
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A			N/A	320
SEARCH FEE (37 CFR 1.16(k), (l), or (m))	N/A	N/A	N/A			N/A	700
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	800
TOTAL CLAIMS (37 CFR 1.16(i))	11 minus 20 =	0			OR	x =	0
INDEPENDENT CLAIMS (37 CFR 1.16(h))	1 minus 3 =					x =	0
APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).						0
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))							0
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL			TOTAL	1820

APPLICATION AS AMENDED - PART II

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY ADDITIONAL FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE($)
AMENDMENT A	Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE($)	ADDITIONAL FEE($)		RATE($)	ADDITIONAL FEE($)
AMENDMENT B	Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".
The "Highest Number Previously Paid For" (Total or Independent) is the highest found in the appropriate box in column 1.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
17/951,973	09/23/2022	Fletcher R. Rothkopf	P22914USC10

CONFIRMATION NO. 5622

62579
APPLE INC./BROWNSTEIN
c/o Brownstein Hyatt Farber Schreck, LLP
410 Seventeenth Street
Suite 2200
Denver, CO 80202

NEW OR REVISED PPD NOTICE

OC00000136698781

NOTICE OF NEW OR REVISED PROJECTED PUBLICATION DATE

The above-identified application has a new or revised projected publication date. The current projected publication date for this application is 01/26/2023. If this is a new projected publication date (there was no previous projected publication date), the application has been cleared by Licensing & Review or a secrecy order has been rescinded and the application is now in the publication queue.

If this is a revised projected publication date (one that is different from a previously communicated projected publication date), the publication date has been revised due to processing delays in the USPTO or the abandonment and subsequent revival of an application. The application is anticipated to be published on a date that is more than six weeks different from the originally-projected publication date.

More detailed publication information is available through the private side of Patent Application Information Retrieval (PAIR) System. The direct link to access PAIR is currently http://pair.uspto.gov. Further assistance in electronically accessing the publication, or about PAIR, is available by calling the Patent Electronic Business Center at 1-866-217-9197.

Questions relating to this Notice should be directed to the Office of Data Management, Application Assistance Unit at (571) 272-4000, or (571) 272-4200, or 1-888-786-0101.

PART 1 - ATTORNEY/APPLICANT COPY
page 1 of 1

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United States Patent and Trademark Office
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www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/951,973	09/23/2022	Fletcher R. Rothkopf	P22914USC10	5622

62579 7590 11/17/2022

APPLE INC./BROWNSTEIN
c/o Brownstein Hyatt Farber Schreck, LLP
410 Seventeenth Street
Suite 2200
Denver, CO 80202

EXAMINER
CENTRAL, DOCKET

ART UNIT	PAPER NUMBER
OPAP	

NOTIFICATION DATE	DELIVERY MODE
11/17/2022	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

patentdocket@bhfs.com

Decision Granting Request for Prioritized Examination (Track I)	**Application No.** 17/951,973	**Applicant(s)** Rothkopf et al.	
	Examiner FIKIRTE A GEREMEW	**Art Unit** OMBL	**AIA (FITF) Status** Yes

1. THE REQUEST FILED 23 September 2022 IS **GRANTED** .

   The above-identified application has met the requirements for prioritized examination
   - A. ☑ for an original nonprovisional application (Track I).
   - B. ☐ for an application undergoing continued examination (RCE).

2. **The above-identified application will undergo prioritized examination**. The application will be accorded special status throughout its entire course of prosecution until one of the following occurs:
   - A. filing a **petition for extension of time** to extend the time period for filing a reply;
   - B. filing an **amendment to amend the application to contain more than four independent claims, more than thirty total claims** , or a multiple dependent claim;
   - C. filing a **request for continued examination** ;
   - D. filing a notice of appeal;
   - E. filing a request for suspension of action;
   - F. mailing of a notice of allowance;
   - G. mailing of a final Office action;
   - H. completion of examination as defined in 37 CFR 41.102; or
   - I. abandonment of the application.

Telephone inquiries with regard to this decision should be directed to FIKIRTE GEREMEW at (703) 756-1930. In his/her absence, calls may be directed to Petition Help Desk at (571) 272-3282.

/FIKIRTE A GEREMEW/ PROGRAM SUPPORT ASSISTANT, OMBL	

PTO/SB/08A (08-03) U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE Substitute for Form 1449A/PTO **INFORMATION DISCLOSURE STATEMENT BY APPLICANT** *(Use as many sheets as necessary)*	**APPLICATION NO.:** 17/951,973	**FILING DATE:** September 23, 2022
	INVENTOR(S): Fletcher R. Rothkopf	**ART UNIT:** 3792
	EXAMINER NAME: Brian T Gedeon	**ATTY. DOCKET NO.:** P22914USC10

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EXAMINER INITIALS*	Cite No.[1]	DOCUMENT NUMBER Country Code[3] – Number[4] – Kind Code[5] (if known)	PUBLICATION DATE MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear	T[6]
	C88.	JPS60103936	06/1985	Seiko Instr. & Electronics		
	C89.	JPS60103937	06/1985	Seiko Instr. & Electronics		
	C90.	JPH02285214	11/1990	Canon KK		
	C91.	JPH04093719	03/1992	Ricoh Co. Ltd.		
	C92.	JPH04157319	05/1992	Ricoh Co. Ltd.		
	C93.	JPH05203465	08/1993	Omron Corp.		
	C94.	JPH05312595	11/1993	Ricoh Co. Ltd.		
	C95.	JPH06347293	12/1994	Canon Inc.		
	C96.	JPH06050927	12/1994	Omron Corp.		
	C97.	JPH06331761	12/1994	ETA SA Fab Ebauches		
	C98.	JPH07116141	05/1995	Casio Computer Co. Ltd.		
	C99.	JPH0914941	01/1997	Tsubakimoto Chain Co.		
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	C101.	JPH11121210	04/1999	Alps Electric Co. Ltd.		
	C102.	JPH11191508	07/1999	Hitachi Denshi Ltd.		
	C103.	JP2000258559	09/2000	Citizen Watch Co. Ltd.		
	C104.	JP2000316824	11/2000	Casio Computer Co. Ltd.		
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	C106.	JP2001084934	03/2001	Jeol Ltd.		
	C107.	JP2001167651	06/2001	Seiko Instruments Inc.		
	C108.	JP2001202178	07/2001	Seiko Epson Corp.		
	C109.	JP2001215288	08/2001	Seiko Instruments Inc.		
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	C111.	JP2002071480	03/2002	Tokai Rika Co. Ltd.		
	C112.	JP2002165768	06/2002	Casio Computer Co. Ltd.		
	C113.	JP2003050668	02/2003	Shimadzu Corp.		
	C114.	JP2003151410	05/2003	Alps Electric Co. Ltd.		
	C115.	JP2003331693	11/2003	Nidec Copal Corp.		
	C116.	JP2004028979	11/2004	Asulab SA		
	C117.	JP2004184396	07/2004	Seiko Epson Corp.		
	C118.	JP2005017011	01/2005	Seiko Epson Corp.		
	C119.	JP2005063200	03/2005	Sony Corp.		
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	C121.	JP2005108630	04/2005	Seiko Epson Corp.		
	C122.	JP2006101505	04/2006	Microsoft Corp.		
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	C125.	JP2007101380	04/2007	Seiko Instruments Inc.		
	C126.	JP2007149620	06/2007	Stanley Electric Co. Ltd.		
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FOREIGN PATENT DOCUMENTS

EXAMINER INITIALS*	Cite No.[1]	DOCUMENT NUMBER Country Code[3] – Number[4] – Kind Code[5] (if known)	PUBLICATION DATE MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear	T[6]
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	C129.	JP2008053980	03/2008	NEC Corp.		
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	C133.	JP2008235226	10/2008	Yamaha Corp.		
	C134.	JP2009009382	01/2009	Ricoh Co. Ltd.		
	C135.	JP2009070657	04/2009	Hitachi Kokusai Denki Engineering KK		
	C136.	JP2009519737	05/2009	Konin-Klijke Philips Electronics NV		
	C137.	JP2009540399	11/2009	Immersion Corporation		
	C138.	JP2010032545	02/2010	Mitutoyo Corp.		
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FOREIGN PATENT DOCUMENTS

EXAMINER INITIALS*	Cite No.[1]	DOCUMENT NUMBER Country Code[3] – Number[4] – Kind Code[5] (if known)	PUBLICATION DATE MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear	T[6]
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	C165.	KR20110011393	02/2011	LG Electronics Inc.		
	C166.	KR20110012784	02/2011	Bionet Co., Ltd.		
	C167.	KR20110103761	09/2011	LG Electronics Inc.		
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	C170.	KR20130131873	12/2013	Lee		
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	C172.	KR20140064689	05/2014	Samsung Electronics Co. Ltd.		
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	C174.	KR20160017070	02/2016	Apple Inc.		
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	C195.	WO2020173085	09/2020	Guangdong Lemovt Intelligent Co. Ltd.		

OTHER PRIOR ART – NON PATENT LITERATURE DOCUMENTS			
EXAMINER INITIALS*	Cite No.[1]	Include name of Author, title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), volume-issue number(s), publisher, page(s) and date.	T[6]
	D1.	Author Unknown, "Desirable Android Wear smartwatch from LG," Gulf News, Dubai, 3 pages, January 30, 2015.	
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	D6.	Author Unknown, "MyKronoz ZeTime: World's Most Funded Hybrid Smartwatch Raised over $3M on Kickstarter, Running until April 27th," Business Wire, New York, New York, 3 pages, April 21, 2017.	
	D7.	Author Unknown, "RedEye mini Plug-in Universal Remote Adapter for iPhone, iPod touch and iPad," Amazon.com, 4 pages, date unknown.	
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	D9.	Author Unknown, "Vesag Wrist Watch for Dementia Care from VYZIN," http://vyasa-kaaranam-ketkadey.blogspot.com/2011/03/vesag-wrist-watch-for-dementia-care.html, 2 pages, March 31, 2011.	
	D10.	Author Unknown, "Vyzin Electronics Private Limited launches "Vesag Watch," http://www.virtualpressoffice.com/showJointPage.do?page=jp&showId=1544, 5 pages, January 6, 2011.	
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	D20.	Rick, "How VESAG Helps Health Conscious Citizens," http://sensetekgroup.com/2010/11/29/wireless-health-monitoring-system/, 2 pages, November 29, 2010.	
	D21.	Sadhu, Rajendra, "How VESAG Helps People Who Want to 'Be There'?," http://ezinearticles.com/?How-Vesag-Helps-People-Who-Want-to-Be-There?&id-5423873, 1 page, November 22, 2010.	
	D22.	Sadhu, Rajendra, "Mobile Innovation Helps Dementia and Alzheimer's Patients," http://www.itnewsafrica.com/2010/11/mobile-innovation-helps-dementia-andalzheimer%E2%80%99s-patients/, 3 pages, November 22, 2010.	
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	D24.	Tran et al., "Universal Programmable Remote Control/Telephone," www.ip.com, 2 pages, May 1, 1992.	

EXAMINER	DATE CONSIDERED

EXAMINER: Initial if citation considered, whether or not citation is in conformance with MPEP 609; Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

Electronic Acknowledgement Receipt	
EFS ID:	47127338
Application Number:	17951973
International Application Number:	
Confirmation Number:	5622
Title of Invention:	WEARABLE ELECTRONIC DEVICE
First Named Inventor/Applicant Name:	Fletcher R. Rothkopf
Customer Number:	62579
Filer:	Peter James Nagle/Sonya Domingo
Filer Authorized By:	Peter James Nagle
Attorney Docket Number:	P22914USC10
Receipt Date:	01-DEC-2022
Filing Date:	23-SEP-2022
Time Stamp:	16:06:01
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Transmittal Letter	P2914USC10_IDS_Transmittal.pdf	28118 744e6082545db703167069e11247c4f201789de	no	3

Warnings:

Information:					
2	Information Disclosure Statement (IDS) Form (SB08)	P22914USC10_PTO-SB-08.pdf	192453 bc69bf6b90b906debc9f8e3f4b66d5e0388281bc	no	20
Warnings:					
Information:					
This is not an USPTO supplied IDS fillable form					
			Total Files Size (in bytes):	220571	

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.
National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.
New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

Docket No. P22914USC10

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the Application of:		
Fletcher R. Rothkopf et al.	Examiner:	Brian T Gedeon
Application No. 17/951,973	Art Unit:	3792
Filed: September 23, 2022	Confirmation No.	5622
For: WEARABLE ELECTRONIC DEVICE		

INFORMATION DISCLOSURE STATEMENT TRANSMITTAL

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

The Examiner is requested to consider the references noted on the enclosed Form PTO/SB/08A and B during examination of the above-identified patent application. These references are submitted for the Examiner's consideration and are submitted pursuant to the duty of disclosure under 37 C.F.R. § 1.56. In submitting these references, no representation is made or implied that the references are or are not material to the examination of the application. The Examiner is requested to review the cited references and is encouraged to make his or her own determination of materiality of the references cited.

Pursuant to 37 C.F.R. § 1.98(d), copies of all foreign and non-patent literature references cited on the attached Form PTO/SB/08A and B were previously furnished to or cited by the Patent Office in parent Application Nos. 14/842,617, filed September 1, 2015, now U.S. Patent No. 10,599,101, 15/261,912, filed September 10, 2016, now U.S. Patent No. 10,620,591, 15/261,914, filed September 10, 2016, now U.S. Patent No. 10,613,485, 15/261,917, filed September 10, 2016, now U.S. Patent No. 10,627,783, 16/826,130, filed March 20, 2020, now U.S. Patent No. 10,942,494, and 17/672,653, filed February 15, 2022, now U.S. Patent No. 11,474,483.

☒ In accordance with **37 CFR 1.97(b),** the information disclosure statement is being filed:

☒ (1) within three months of the filing date of a national application other than a continued prosecution application under §1.53(b);

☐ (2) within three months of the date of the national stage as set forth in §1.491 in an international application;

☐ (3) before the mailing of a first Office Action on the merits; or

☐ (4) before the mailing of a first Office Action after the filing of a request for continued examination under §1.114.

☐ In accordance with **37 CFR 1.97(c)**, the information disclosure statement is being filed after the period specified in 37 CFR 1.97(b) above, but before the mailing date of any of a final action under §1.113, a notice of allowance under §1.311, or an action that otherwise closes prosecution in the application, and is accompanied by **one** of the following:

☐ (1) The statement specified under **37 CFR 1.97(e)**, as follows:

☐ Each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement; **or**

☐ No item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in §1.56(c) more than three months prior to the filing of the information disclosure statement; **or**

☐ (2) The fee set forth in §1.17(p)

☐ In accordance with **37 CFR 1.97(d)**, the information disclosure statement is being filed after the period specified in 37 CFR 1.97(c) above, but on or before payment of the issue fee, and is accompanied by both of the following:

☐ Each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement; **or**

☐ No item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in §1.56(c) more than three months prior to the filing of the information disclosure statement; **and**

☐ The fee set forth in §1.17(p)

STATEMENT OF RELATEDNESS UNDER M.P.E.P. § 2001.06(b)

In satisfaction of the duty of disclosure under 37 C.F.R. § 1.56, and as required by M.P.E.P §2001.06(b), the Examiner is requested to consider the pending application(s) listed below which are owned by the Assignee of the present application. The pending application(s) may include subject matter similar to that of the present application.

- U.S. Patent Application Serial No. 17/377,482; filed July 16, 2021; pending
- U.S. Patent Application Serial No. 17/840,222; filed June 14, 2022; pending and
- U.S. Patent Application Serial No. 17/951,020; filed September 22, 2022; pending

FEE AUTHORIZATION

☐ The required fee specified in 37 C.F.R. § 1.17(p), is being paid concurrently herewith by credit card authorization through the USPTO Electronic Filing System;

☒ The Director is hereby authorized any fee deficiency or credit any overpayment, to Deposit Account No. 50-4621; **or**

☒ No fee is believed due. However, the Director is hereby authorized to charge any deficiency or credit any overpayment to Deposit Account No. 50-4621.

If the Examiner has any questions, please contact the undersigned attorney.

Dated: December 1, 2022.

Respectfully submitted,

/Peter J. Nagle/
Peter J. Nagle, Registration No. 70,361
Attorney for Assignee
USPTO Customer No. 60879

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UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/951,973	09/23/2022	Fletcher R. Rothkopf	P22914USC10	5622

62579 7590 12/22/2022

APPLE INC./BROWNSTEIN
c/o Brownstein Hyatt Farber Schreck, LLP
410 Seventeenth Street
Suite 2200
Denver, CO 80202

EXAMINER	
GEDEON, BRIAN T	

ART UNIT	PAPER NUMBER
3792	

NOTIFICATION DATE	DELIVERY MODE
12/22/2022	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

patentdocket@bhfs.com

Office Action Summary	Application No. 17/951,973	Applicant(s) Rothkopf et al.	
	Examiner BRIAN T GEDEON	Art Unit 3792	AIA (FITF) Status Yes

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☑ Responsive to communication(s) filed on 29 September 2022.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2a)☐ This action is **FINAL.** 2b) ☑ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

5) ☑ Claim(s) 21-31 is/are pending in the application.

5a) Of the above claim(s) _____ is/are withdrawn from consideration.

6) ☐ Claim(s) _____ is/are allowed.

7) ☑ Claim(s) 21-31 is/are rejected.

8) ☐ Claim(s) _____ is/are objected to.

9) ☐ Claim(s) _____ are subject to restriction and/or election requirement

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to **PPHfeedback@uspto.gov.**

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☑ The drawing(s) filed on 23 September 2022 is/are: a)☑ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

a)☐ All b)☐ Some** c)☐ None of the:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)

2) ☑ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) Paper No(s)/Mail Date _____.

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date _____.

4) ☐ Other: _____.

DETAILED ACTION

Notice of Pre-AIA or AIA Status

1. The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA.

Priority

2. This application is a continuation of US Application nos. 17/899,498 filed 30 August 2022, which is a continuation of US Application nos. 17/672,653, now US Patent no. 11,474,483, filed 15 February 2022 which is an application is a continuation of US Application nos. 17/188,966 and 17/188,995 both filed 1 March 2021, both are continuations of US Application no. 16/826,130, now US Patent no. 10,942,491 filed 20 March 2020, which is a continuation of US Application nos. 15/261, 914 now US Patent no. 10,613,485, 15/261,912, now US Patent no. 10,620,591, and 15/261,917 now US Patent no. 10,627,783 filed 10 September 2016, which are continuations of US Application no. 14/842,617, now US Patent no. 10,599,101 filed 1 September 2015, which claims the benefit of domestic priority of US Provisional Application no. 62/044,974 filed 2 September 2014.

Information Disclosure Statement

3. The information disclosure statement filed 1 December 2022 has been considered.

Response to Amendment

4. The preliminary amendment filed 26 September 2022 has been acknowledged. Claims 21-31 are pending, wherein claims 21-31 are new.

Double Patenting

5. The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. A nonstatutory double patenting rejection is appropriate where the conflicting claims are not identical, but at least one examined application claim is not patentably distinct from the reference claim(s) because the examined application claim is either anticipated by, or would have been obvious over, the reference claim(s). See, e.g., *In re Berg*, 140 F.3d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) or 1.321(d) may be used to overcome an actual or provisional rejection based on nonstatutory double patenting provided the reference application or patent either is shown to be commonly owned with the examined application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement. See MPEP § 717.02 for applications subject to examination under the first inventor to file

provisions of the AIA as explained in MPEP § 2159. See MPEP § 2146 *et seq.* for applications not subject to examination under the first inventor to file provisions of the AIA. A terminal disclaimer must be signed in compliance with 37 CFR 1.321(b).

The USPTO Internet website contains terminal disclaimer forms which may be used. Please visit www.uspto.gov/patent/patents-forms. The filing date of the application in which the form is filed determines what form (e.g., PTO/SB/25, PTO/SB/26, PTO/AIA/25, or PTO/AIA/26) should be used. A web-based eTerminal Disclaimer may be filled out completely online using web-screens. An eTerminal Disclaimer that meets all requirements is auto-processed and approved immediately upon submission. For more information about eTerminal Disclaimers, refer to www.uspto.gov/patents/process/file/efs/guidance/eTD-info-I.jsp.

6. Claims 21-31 are rejected on the ground of nonstatutory double patenting as being unpatentable over claims 1-20 of U.S. Patent No. 10,627,783 in view of U.S. Patent no. 10,620,591.

In regard to claim 21, claim 1 of the '783 patent recites the following claimed features: a housing defining a front opening; a band attached to the housing; a display and front cover positioned in the front opening, the cover positioned over the display; a biosensor positioned and aligned with the rear opening; a wireless charging coil aligned with the second opening, wherein a cover of the second opening is configured to pass optical signals generated by the biosensor and the cover configured to pass wireless power from an external wireless charging device to the wireless charging coil located within the housing. Missing from the '783 is the antenna for wireless communication. Similar, and commonly owned patent '591 discloses antenna for wireless

communications with an external device used in a similar setting. The wireless antenna of the '591 is considered capable of communicating with any wireless or remote device including a mobile phone. Modification of the '783 patent in view of the '591 patent is considered obvious to one of ordinary skill in the art since the modification is considered to comprise a combination of known elements in a similar manner to achieve a similar intended function.

In regard to present claims 22-24, claims 2-4 of the '783 patent recite features that overlap the features of the present claims.

In regard to present claim 25, claim 5 of the '783 patent properly reads in the limitations recited therein.

In regard to present claim 26, claim 6 of the '783 patent properly reads in the limitations recited therein.

In regard to present claim 27, claim 7 of the '783 patent properly reads in the limitations recited therein.

In regard to present claim 28, claim 8 of the '783 patent properly reads in the limitations recited therein.

In regard to present claim 29, claim 13 of the '783 patent properly reads in the limitations recited therein.

In regard to present claim 30, claim 11 of the '783 patent properly reads in the limitations recited therein.

In regard to present claim 31, claim 19 of the '783 patent properly reads in the limitations recited therein.

Conclusion

7. Any inquiry concerning this communication or earlier communications from the examiner should be directed to BRIAN T GEDEON whose telephone number is (571)272-3447. The examiner can normally be reached M-F 8:00 am to 5:30 PM ET.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at http://www.uspto.gov/interviewpractice.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl H Layno can be reached on 571-272-4949. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of published or unpublished applications may be obtained from Patent Center. Unpublished application information in Patent Center is available to registered users. To file and manage patent submissions in Patent Center, visit: https://patentcenter.uspto.gov. Visit https://www.uspto.gov/patents/apply/patent-center for more information about Patent Center and https://www.uspto.gov/patents/docx for information about filing in DOCX format. For additional questions, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/BRIAN T GEDEON/
Primary Examiner, Art Unit 3792
17 December 2022

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/951,973	Rothkopf et al.
	Examiner	Art Unit
	BRIAN T GEDEON	3792

CPC - Searched*		
Symbol	Date	Examiner
A61B 5/02,28,308,318,346,349	12/17/2022	BTG

CPC Combination Sets - Searched*		
Symbol	Date	Examiner

US Classification - Searched*			
Class	Subclass	Date	Examiner

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes		
Search Notes	Date	Examiner
Detailed SEARCH history attached.	12/17/2022	BTG
Inventor name search.	12/17/2022	BTG
CPC search limited by keyword search.	12/17/2022	BTG

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner
	US PGPUB, USPAT claim text search.	12/17/2022	BTG

PTO/SB/08A (08-03) U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE Substitute for Form 1449A/PTO INFORMATION DISCLOSURE STATEMENT BY APPLICANT *(Use as many sheets as necessary)*	**APPLICATION NO.:** 17/951,973	**FILING DATE:** September 23, 2022
	INVENTOR(S): Fletcher R. Rothkopf	**ART UNIT:** 3792
	EXAMINER NAME: Brian T Gedeon	**ATTY. DOCKET NO.:** P22914USC10

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L7	12	(US-0116306-$ | US-0122656-$ | US-0130971-$ | US-0272784-$ | US-20040130971-$ | US-20090122656-$ | US-20120272784-$ | US-20160116306-$).DID.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/30 09:09 AM
L8	0	"201700192391".pn.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/30 09:10 AM
L9	0	(201600327911|20170045958).PN.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/30 09:10 AM
L10	1	"20170192391".pn.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/30 09:10 AM
L11	3	(20160327911|20170045958).PN.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/30 09:10 AM
L12	4	(8188989|9947741).PN.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/30 09:11 AM
L13	244	(US-0003655-$ | US-0010751-$ | US-0013775-$ | US-0033430-$ | US-0037396-$ | US-0050054-$ | US-	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/30 09:11 AM

		0051649-$ | US- 0053468-$ | US- 0054813-$ | US- 0058375-$ | US- 0061636-$ | US- 0067711-$ | US- 0068857-$ | US- 0069443-$ | US- 0069444-$ | US- 0069447-$ | US- 0071050-$ | US- 0071098-$ | US- 0073119-$ | US- 0075082-$ | US- 0075558-$ | US- 0081375-$ | US- 0082414-$ | US- 0087443-$ | US- 0090148-$ | US- 0098016-$ | US- 0112859-$ | US- 0113044-$ | US- 0130914-$ | US- 0132516-$ | US- 0146975-$ | US- 0149099-$ | US- 0152452-$ | US- 0168178-$ | US- 0174590-$ | US- 0197936-$ | US- 0206248-$ | US- 0211042-$ | US- 0217207-$ | US- 0221460-$ | US- 0222756-$ | US- 0227217-$ | US- 0229671-$ | US- 0247421-$ | US- 0250377-$ | US- 0258784-$ | US- 0259301-$ | US- 0285443-$ | US- 0306437-$ | US- 0312051-$ | US- 0313703-$ | US- 0327630-$ | US- 0340318-$ | US- 0341031-$ | US- 0378070-$ | US- 0378071-$ | US- 0378072-$ | US- 15483374-$ | US- 2237860-$ | US- 2497935-$ | US- 2771734-$ | US- 20030174590-$ | US- 20040082414-$ | US- 20050075558-$ | US-					

		20060250377-$ | US- 20070013775-$ | US- 20070050054-$ | US- 20070211042-$ | US- 20070222756-$ | US- 20070229671-$ | US- 20070247421-$ | US- 20080130914-$ | US- 20090051649-$ | US- 20090073119-$ | US- 20090146975-$ | US- 20090152452-$ | US- 20090217207-$ | US- 20090285443-$ | US- 20090312051-$ | US- 20100033430-$ | US- 20100053468-$ | US- 20100081375-$ | US- 20100149099-$ | US- 20110090148-$ | US- 20120067711-$ | US- 20120068857-$ | US- 20120075082-$ | US- 20120112859-$ | US- 20120113044-$ | US- 20120206248-$ | US- 20130037396-$ | US- 20130087443-$ | US- 20140071050-$ | US- 20140071098-$ | US- 20140132516-$ | US- 20140197936-$ | US- 20140327630-$ | US- 20140340318-$ | US- 20150221460-$ | US- 20150227217-$ | US- 20150341031-$ | US- 20160054813-$ | US- 20160058375-$ | US- 20160061636-$ | US- 20160098016-$ | US- 20160168178-$ | US- 20160258784-$ | US- 20160259301-$ | US- 20160306437-$ | US- 20160313703-$ | US- 20160378070-$ | US- 20160378071-$ | US- 20160378072-$ | US- 20170003655-$ | US- 20170010751-$ | US- 20170069443-$ | US- 20170069444-$ | US- 20170069447-$ | US- 3040514-$ | US- 3056030-$ | US- 3130539-$ | US- 3495398-$ | US-					

		3621649-$ | US- 4007347-$ | US- 4031341-$ | US- 4037068-$ | US- 4077200-$ | US- 4133404-$ | US- 4170104-$ | US- 4258096-$ | US- 4287400-$ | US- 4289400-$ | US- 4311990-$ | US- 4324956-$ | US- 4345119-$ | US- 4364674-$ | US- 4379642-$ | US- 4417824-$ | US- 4581509-$ | US- 4600316-$ | US- 4617461-$ | US- 4641026-$ | US- 4670737-$ | US- 4783772-$ | US- 4884073-$ | US- 4922070-$ | US- 4931794-$ | US- 4952799-$ | US- 4980685-$ | US- 5034602-$ | US- 5214278-$ | US- 5258592-$ | US- 5288993-$ | US- 5347123-$ | US- 5383166-$ | US- 5471054-$ | US- 5572314-$ | US- 5583560-$ | US- 5726645-$ | US- 5748111-$ | US- 5841050-$ | US- 5847335-$ | US- 5867082-$ | US- 5943233-$ | US- 5953001-$ | US- 5963332-$ | US- 5423873-$ | US- 6069567-$ | US- 6134189-$ | US- 6154201-$ | US- 6175679-$ | US- 6246050-$ | US- 6252825-$ | US- 6304247-$ | US- 6355891-$ | US- 6422740-$ | US- 6477117-$ | US- 6525278-$ | US- 6556222-$ | US- 6646635-$).DID.					

L14	99	(US-6661438-$ | US-6672758-$ | US-6794992-$ | US-6809275-$ | US-6888076-$ | US-6909378-$ | US-6914551-$ | US-6961099-$ | US-6963039-$ | US-6985107-$ | US-6987568-$ | US-6998553-$ | US-7016263-$ | US-7081905-$ | US-7119289-$ | US-7135673-$ | US-7167083-$ | US-7244927-$ | US-7265336-$ | US-7274303-$ | US-7292741-$ | US-7358481-$ | US-7369308-$ | US-7404667-$ | US-7465917-$ | US-7520664-$ | US-7528824-$ | US-7545367-$ | US-7593755-$ | US-7605846-$ | US-7634263-$ | US-7646677-$ | US-7710456-$ | US-7761246-$ | US-7763819-$ | US-7772507-$ | US-7778115-$ | US-7781726-$ | US-7791597-$ | US-7856255-$ | US-7858583-$ | US-7865324-$ | US-8063892-$ | US-8138488-$ | US-8167126-$ | US-8169402-$ | US-8195313-$ | US-8248815-$ | US-8263886-$ | US-8263889-$ | US-8312495-$ | US-8368677-$ | US-8371745-$ | US-8373661-$ | US-8410971-$ | US-8432368-$ | US-8439559-$ | US-8441450-$ | US-	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/30 09:11 AM

		8446713-$ | US-8477118-$ | US-8493190-$ | US-8525777-$ | US-8568313-$ | US-8576044-$ | US-8593598-$ | US-8614881-$ | US-8666682-$ | US-8704787-$ | US-8711093-$ | US-8724087-$ | US-8730167-$ | US-8743088-$ | US-8824245-$ | US-8859971-$ | US-8860674-$ | US-8863219-$ | US-8878657-$ | US-8885856-$ | US-8895911-$ | US-8920022-$ | US-8922399-$ | US-8928452-$ | US-8994827-$ | US-9024733-$ | US-9041663-$ | US-9086738-$ | US-9105413-$ | US-9123483-$ | US-9176598-$ | US-9202372-$ | US-9213409-$ | US-9223296-$ | US-9277156-$ | US-9350850-$ | US-9449770-$ | US-9607505-$ | US-9620312-$ | US-9627163-$ | US-RE41637-$ | US-X6-$).DID.					
L15	7	(3355873|20110007468|20120177237).PN.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/30 09:12 AM
L16	0	rothkoph-fletcher-r.in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/30 09:23 AM
L17	253	((("Rothkopf") near3 ("Fletcher") near3 ("R"))).INV.	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2018/05/30 09:23 AM
L18	850	biosensor AND ((wrist NEAR watch) OR wristwatch)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/30 09:24 AM
L19	4	L17 AND L18	(US-PGPUB; USPAT; USOCR; FPRS; EPO;	OR	ON	ON	2018/05/30 09:24 AM

			JPO)				
L20	1954995	curve	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/30 09:29 AM
L21	244	L18 AND L20	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/30 09:29 AM
L22	8927	smartwatch	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/30 10:23 AM
L23	89438	biosensor	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/30 10:23 AM
L24	218	L22 AND L23	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/30 10:23 AM
L25	21	(US-20160350514-$ or US-20160274726-$ or US-20150313542-$ or US-20160367987-$ or US-20160198996-$ or US-20160091965-$).did. or (US-9848825-$ or US-9737221-$ or US-9737212-$ or US-9704154-$ or US-9629120-$ or US-9622214-$ or US-8738118-$ or US-8727977-$ or US-8630633-$ or US-8617069-$ or US-8527038-$ or US-7674231-$ or US-7474592-$ or US-6694158-$ or US-5722397-$).did.	(US-PGPUB; USPAT)	OR	ON	ON	2018/05/30 10:35 AM
L26	36	("20030176815" | "20050228297" | "20060252999" | "20070049461" | "20070167844" | "20080039731" | "20090216132" | "20100081951" | "20100106029" | "20100292589" | "20110003665" | "20110152637" | "20120244995" | "20130296723" | "20130338460" | "20140073969" | "20140107493" | "20140167973" | "20140249398" |	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2018/05/30 10:37 AM

		"20140257533" | "20140257534" | "20140257535" | "20140274159" | "20140278139" | "20140354527" | "20150374310" | "4830017" | "4893631" | "4987898" | "5243992" | "5617867" | "6371920" | "6443906" | "6475153" | "6723054" | "7539532").PN. OR ("9848825").URPN.					
L27	16	("20010008074" | "20040020856" | "20040152957" | "20070279852" | "20120293323" | "20130222271" | "20140207264" | "20140275852" | "20140378777" | "20150026647" | "20150371516" | "6619835" | "6736759" | "6832109" | "8988349" | "9288836").PN. OR ("9737212").URPN.	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2018/05/30 10:39 AM
L28	49	("20020055117" | "20030165954" | "20030175993" | "20060057707" | "20080022089" | "20080038738" | "20080266546" | "20130146659" | "20130231711" | "20130234850" | "20130346168" | "20140139422" | "20140139486" | "20140139637" | "20140143737" | "20140180595" | "20140239065" | "20140275850" | "20140275852" | "20140275854" | "20140276244" | "20140316305" | "20140366123" | "20150073907" | "20150186609" | "20150196200" | "20150238150" | "20150366518" |	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2018/05/30 10:41 AM

		"20150371215" | "20160036811" | "20160037346" | "20160125600" | "20160162873" | "20160239624" | "20160286210" | "20160328282" | "20160374588" | "20160379205" | "20170011210" | "20170011223" | "20170018150" | "20170031449" | "20170039358" | "20170071483" | "8784271" | "9100493" | "9299238").PN. OR ("9704154").URPN.					
L29	13	("20020167488" | "20040030753" | "20050195805" | "20050272408" | "20060036642" | "20110080289" | "20110234414" | "20120052922" | "20120218101" | "20130002441" | "20130325922" | "20150279168" | "8744113").PN. OR ("9622214").URPN.	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2018/05/30 10:55 AM
L30	17	("20030099459" | "4736196" | "5537102" | "5883576" | "5936530" | "6158884" | "6255951" | "6350055" | "6396403" | "6431455" | "7133843").PN. OR ("7474592").URPN.	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2018/05/30 10:57 AM
L31	45	(US-20160350514-$ or US-20160274726-$ or US-20150313542-$ or US-20160367987-$ or US-20160198996-$ or US-20160091965-$ or US-20140278139-$ or US-20140107493-$ or US-20110003665-$ or US-20150026647-$ or US-20140378777-$ or US-20140275852-$ or US-20170071483-$ or US-20170039358-$ or US-20170011210-$ or US-20160379205-$ or	(US-PGPUB; USPAT)	OR	ON	ON	2018/05/30 12:03 PM

		US-20150186609-$ or US-20140366123-$ or US-20140276244-$ or US-20140139486-$ or US-20130234850-$ or US-20030175993-$).did. or (US-9848825-$ or US-9737221-$ or US-9737212-$ or US-9704154-$ or US-9629120-$ or US-9622214-$ or US-8738118-$ or US-8727977-$ or US-8630633-$ or US-8617069-$ or US-8527038-$ or US-7674231-$ or US-7474592-$ or US-6694158-$ or US-5722397-$ or US-6443906-$ or US-9288836-$ or US-9423418-$ or US-9091715-$ or US-6431455-$ or US-6350055-$ or US-6255951-$ or US-6158884-$).did.					
L32	1	"15261912"	(US-PGPUB; USPAT)	OR	ON	ON	2018/05/30 12:09 PM
L33	33545	(smartwatch) OR (smart NEAR watch)	(US-PGPUB; USPAT)	OR	ON	ON	2018/05/30 12:28 PM
L34	223931	apple	(US-PGPUB; USPAT)	OR	ON	ON	2018/05/30 12:28 PM
L35	8043	L33 AND L34	(US-PGPUB; USPAT)	OR	ON	ON	2018/05/30 12:28 PM
L36	2386928	curve$4	(US-PGPUB; USPAT)	OR	ON	ON	2018/05/30 12:29 PM
L37	1219	L35 AND L36	(US-PGPUB; USPAT)	OR	ON	ON	2018/05/30 12:29 PM
L38	1756218	rectangular	(US-PGPUB; USPAT)	OR	ON	ON	2018/05/30 12:29 PM
L39	345	L37 AND L38	(US-PGPUB; USPAT)	OR	ON	ON	2018/05/30 12:29 PM
L40	18177	((("Apple") near3 ("Inc"))).AS,AANM.	(USPAT)	OR	ON	ON	2018/05/30 02:59 PM
L41	33545	(smartwatch) OR (smart NEAR watch)	(US-PGPUB; USPAT)	OR	ON	ON	2018/05/30 02:59 PM
L42	407	L40 AND L41	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/30 02:59 PM
L43	279935	crown	(US-PGPUB; USPAT; USOCR; FPRS; EPO;	OR	ON	ON	2018/05/30 03:02 PM

			JPO)				
L44	18	L42 AND L43	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/30 03:02 PM
L45	120000	(heart NEAR rate)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/30 03:03 PM
L46	39	L42 AND L45	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/30 03:03 PM
L47	482	"iwatch"	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/30 03:09 PM
L48	23	L40 AND L47	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/30 03:09 PM
L49	1	"15261912"	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/30 03:12 PM
L50	248238	(photosensor OR photodetector)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/30 03:21 PM
L51	16	L42 AND L50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/30 03:21 PM
L52	155606	sapphire	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/30 03:23 PM
L53	16	L42 AND L52	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/30 03:23 PM
L54	58538	(transparent NEAr cover)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/30 03:59 PM
L55	3	L42 AND L54	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/30 03:59 PM
L56	6820268	cover	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/30 04:00 PM
L57	81	L41 AND L54	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/30 04:00 PM
L58	42	("20030197648" | "20050156908" | "20060196849" | "20060273304" | "20080164578" | "20090104409" | "20090124062" | "20100231466" | "20110019123" | "20110072856" |	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2018/05/30 04:04 PM

		"20110223840" | "20120118228" | "20120135177" | "20120299841" | "20130002583" | "20130071601" | "20130140965" | "20130188366" | "20130236699" | "20140178647" | "20150085429" | "20150085432" | "20160058375" | "20160064800" | "20160378069" | "20160378070" | "20160378071" | "3740944" | "3911670" | "4561783" | "5369267" | "5545277" | "6206563" | "6406769" | "6677906" | "7712954" | "8596860" | "8721917" | "8824140" | "9271395" | "9288294" | "9369553").PN. OR ("9977464").URPN.					
L59	850	biosensor AND ((wrist NEAR watch) OR wristwatch)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/30 04:08 PM
L60	719	L AND L59	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2018/05/30 04:08 PM
L61	0	L40 AND L59	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2018/05/30 04:08 PM
L62	58057	((wrist NEAR watch) OR wristwatch)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/30 04:08 PM
L63	967	L40 AND L62	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/30 04:09 PM
L64	48	L45 AND L63	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/30 04:09 PM
L65	68	L52 AND L63	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/30 04:14 PM
L66	5183	L45 AND L62	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/30 04:17 PM
L67	221	L52 AND L66	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/30 04:18 PM
L68	72	(US-20160350514-$ or US-20160274726-$ or US-20150313542-$ or US-20160367987-$ or	(US-PGPUB; USPAT)	OR	ON	ON	2018/05/31 09:38 AM

		US-20160198996-$ or US-20160091965-$ or US-20140278139-$ or US-20140107493-$ or US-20110003665-$ or US-20150026647-$ or US-20140378777-$ or US-20140275852-$ or US-20170071483-$ or US-20170039358-$ or US-20170011210-$ or US-20160379205-$ or US-20150186609-$ or US-20140366123-$ or US-20140276244-$ or US-20140139486-$ or US-20130234850-$ or US-20030175993-$ or US-20160313703-$ or US-20160064804-$ or US-20160064800-$ or US-20150085429-$).did. or (US-20130236699-$ or US-20090124062-$).did. or (US-9848825-$ or US-9737221-$ or US-9737212-$ or US-9704154-$ or US-9629120-$ or US-9622214-$ or US-8738118-$ or US-8727977-$ or US-8630633-$ or US-8617069-$ or US-8527038-$ or US-7674231-$ or US-7474592-$ or US-6694158-$ or US-5722397-$ or US-6443906-$ or US-9288836-$ or US-9423418-$ or US-9091715-$ or US-6431455-$ or US-6350055-$ or US-6255951-$ or US-6158884-$ or US-9781984-$ or US-9575591-$ or US-D727198-$).did. or (US-D728624-$ or US-D737159-$ or US-D741726-$ or US-D752044-$ or US-D758219-$ or US-D758363-$ or US-9459781-$ or US-					

		D768634-$ or US-9507459-$ or US-9547425-$ or US-D790517-$ or US-9288294-$ or US-8596860-$ or US-9791833-$ or US-9591913-$ or US-9680205-$ or US-7654732-$ or US-7682070-$).did.					
L69	40	("20100193972" | "20110186324" | "20110210825" | "20110222248" | "20110241949" | "20120028679" | "20120133597" | "20120223865" | "20130044074" | "20130052947" | "20130078917" | "20130140965" | "20130229362" | "20130234910" | "20130300618" | "20130321216" | "20140080411" | "20140112511" | "20140132462" | "20140133074" | "20140170975" | "20140209691" | "20140213178" | "20140218250" | "20140226291" | "20140232609" | "20150035709" | "20150207913" | "20150311960" | "20150351292" | "5768217" | "6825751" | "7233291" | "7506436" | "7815820" | "8502739" | "8679393" | "8766858" | "8780581" | "8803745").PN. OR ("9680205").URPN.	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2018/05/31 09:53 AM
L70	3	(9242085|20080033504|9011355).pn.	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2018/05/31 09:54 AM
L71	37	("1313644" | "1692079" | "1817475" | "20040025984" | "20070125816" | "20080060224" | "20080086911" | "20120102691" |	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2018/05/31 11:05 AM

		"20140070042" | "20140094728" | "20150135410" | "20160255944" | "20160272458" | "20160345653" | "20160345661" | "3890801" | "4941236" | "5485848" | "6301754" | "6799887" | "7562640" | "7618384" | "7690220" | "7752774" | "8147417" | "8370998" | "8522456" | "8769844" | "9044372" | "9129503" | "9144273" | "9204690" | "9307804" | "9365387").PN. OR ("9781984").URPN.					
L72	4437806	(contour$4 OR round$4 OR curve$4)	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2018/05/31 12:08 PM
L73	58102	((wrist NEAR watch) OR wristwatch)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/31 12:08 PM
L74	15419	L72 AND L73	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2018/05/31 12:08 PM
L75	66	watchface	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2018/05/31 12:08 PM
L76	26	("2225474" | "3469391" | "4034552" | "4167850" | "4194355" | "4417821" | "4506992").PN. OR ("4903253").URPN.	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2018/05/31 12:12 PM
L77	69	("20100061191" | "3640065" | "4903253" | "5265009" | "5386933" | "6655831" | "6712501" | "6970157" | "7004469" | "7106197" | "7708457" | "8647268" | "8766805" | "9060683" | "9551608" | "D287471" | "D439172" | "D496589" | "D513195" | "D528018" | "D528439" | "D528928" | "D558227" | "D563434" | "D569389" | "D572266" | "D574735" | "D578922" | "D584170" | "D586823" | "D589375" | "D596610" | "D616417" | "D637094" | "D637918" | "D650706" | "D651216" | "D666503" | "D681483" |	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2018/05/31 12:12 PM

		"D699701" | "D712870" | "D728624" | "D737156" | "D737157" | "D737158" | "D737159" | "D741726" | "D744356" | "D745421" | "D746707" | "D746868" | "D747288" | "D751070" | "D752044" | "D756357" | "D756824" | "D757819" | "D758363" | "D759011" | "D759725" | "D765655" | "D766752" | "D771035" | "D771504" | "D777163" | "D782537" | "D784326" | "D790517").PN. OR ("D798905").URPN.					
L78	0	akana-joan.in.	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2018/05/31 12:19 PM
L79	717	akana-jody.in.	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2018/05/31 12:19 PM
L80	406132	((wrist NEAR watch) OR wristwatch OR watch)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/31 12:26 PM
L81	18177	((("Apple") near3 ("Inc"))).AS,AANM.	(USPAT)	OR	ON	ON	2018/05/31 12:26 PM
L82	2430	L81 AND L80	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/31 12:26 PM
L83	124655	rectangular AND orthogonal AND (contour$4 OR round$4 OR curve$4 OR curvature)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/31 12:27 PM
L84	71	L82 AND L83	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/31 12:27 PM
L85	76	(US-20160350514-$ or US-20160274726-$ or US-20150313542-$ or US-20160367987-$ or US-20160198996-$ or US-20160091965-$ or US-20140278139-$ or US-20140107493-$ or US-20110003665-$ or US-20150026647-$ or US-20140378777-$ or US-20140275852-$ or US-20170071483-$ or US-20170039358-$ or	(US-PGPUB; USPAT)	OR	ON	ON	2018/05/31 12:42 PM

		US-20170011210-$ or US-20160379205-$ or US-20150186609-$ or US-20140366123-$ or US-20140276244-$ or US-20140139486-$ or US-20130234850-$ or US-20030175993-$ or US-20160313703-$ or US-20160064804-$ or US-20160064800-$ or US-20150085429-$).did. or (US-20130236699-$ or US-20090124062-$).did. or (US-9848825-$ or US-9737221-$ or US-9737212-$ or US-9704154-$ or US-9629120-$ or US-9622214-$ or US-8738118-$ or US-8727977-$ or US-8630633-$ or US-8617069-$ or US-8527038-$ or US-7674231-$ or US-7474592-$ or US-6694158-$ or US-5722397-$ or US-6443906-$ or US-9288836-$ or US-9423418-$ or US-9091715-$ or US-6431455-$ or US-6350055-$ or US-6255951-$ or US-6158884-$ or US-9781984-$ or US-9575591-$ or US-D727198-$).did. or (US-D728624-$ or US-D737159-$ or US-D741726-$ or US-D752044-$ or US-D758219-$ or US-D758363-$ or US-9459781-$ or US-D768634-$ or US-9507459-$ or US-9547425-$ or US-D790517-$ or US-9288294-$ or US-8596860-$ or US-9791833-$ or US-9591913-$ or US-9680205-$ or US-7654732-$ or US-					

		7682070-$ or US-4903253-$ or US-8766805-$ or US-D578922-$ or US-D647107-$).did.					
L86	78	ely-colin-m.in.	(US-PGPUB; USPAT)	OR	ON	ON	2018/05/31 12:43 PM
L87	52	de-jong-erik-g.in.	(US-PGPUB; USPAT)	OR	ON	ON	2018/05/31 12:46 PM
L88	75	memering-dale-n.in..in.	(US-PGPUB; USPAT)	OR	ON	ON	2018/05/31 12:48 PM
L89	75	memering-dale-n.in.	(US-PGPUB; USPAT)	OR	ON	ON	2018/05/31 12:48 PM
L90	4	mylvaganam-jeffrey-c.in.	(US-PGPUB; USPAT)	OR	ON	ON	2018/05/31 12:51 PM
L91	3	("20120169465"|"20120245439"|"20130231574").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2018/05/31 01:00 PM
L92	1	"20150186609".pn.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/31 01:54 PM
L93	908170	convex	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/31 02:15 PM
L94	9	L85 AND L93	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/31 02:15 PM
L95	1304822	mask	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/31 02:18 PM
L96	14	L85 AND L95	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/31 02:19 PM
L97	8	(20150186609|20140275852|20140107493|20130236694903253).pn.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/06/01 08:01 AM
L98	3	"14145856"	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/06/01 09:52 AM
L99	1	"14073550"	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/06/01 09:55 AM
L100	17	("20110121449"|"20130072765"|"20140121471"|"20140334083"|"20150065840"|"3515798"|"6500367"|"8591411").PN.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/06/01 09:58 AM
L101	77	(US-20160350514-$ or US-20160274726-$ or US-20150313542-$ or US-20160367987-$ or	(US-PGPUB; USPAT)	OR	ON	ON	2018/06/01 02:39 PM

		US-20160198996-$ or US-20160091965-$ or US-20140278139-$ or US-20140107493-$ or US-20110003665-$ or US-20150026647-$ or US-20140378777-$ or US-20140275852-$ or US-20170071483-$ or US-20170039358-$ or US-20170011210-$ or US-20160379205-$ or US-20150186609-$ or US-20140366123-$ or US-20140276244-$ or US-20140139486-$ or US-20130234850-$ or US-20030175993-$ or US-20160313703-$ or US-20160064804-$ or US-20160064800-$ or US-20150085429-$).did. or (US-20130236699-$ or US-20090124062-$ or US-20150124415-$).did. or (US-9848825-$ or US-9737221-$ or US-9737212-$ or US-9704154-$ or US-9629120-$ or US-9622214-$ or US-8738118-$ or US-8727977-$ or US-8630633-$ or US-8617069-$ or US-8527038-$ or US-7674231-$ or US-7474592-$ or US-6694158-$ or US-5722397-$ or US-6443906-$ or US-9288836-$ or US-9423418-$ or US-9091715-$ or US-6431455-$ or US-6350055-$ or US-6255951-$ or US-6158884-$ or US-9781984-$ or US-9575591-$ or US-D727198-$).did. or (US-D728624-$ or US-D737159-$ or US-D741726-$ or US-D752044-$ or US-D758219-$ or US-D758363-$ or US-					

		9459781-$ or US-D768634-$ or US-9507459-$ or US-9547425-$ or US-D790517-$ or US-9288294-$ or US-8596860-$ or US-9791833-$ or US-9591913-$ or US-9680205-$ or US-7654732-$ or US-7682070-$ or US-4903253-$ or US-8766805-$ or US-D578922-$ or US-D647107-$).did.					
L102	280007	crown	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/06/01 02:39 PM
L103	6	L101 AND L102	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/06/01 02:39 PM
L104	740594	acoustic	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/06/01 02:40 PM
L105	21	L101 AND L104	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/06/01 02:40 PM
L106	2738169	gasket OR seal	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/06/01 02:42 PM
L107	0	L101 AND LL6	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/06/01 02:42 PM
L108	16	L101 AND L106	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/06/01 02:42 PM
L109	1304822	mask	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/06/01 03:06 PM
L110	14	L101 AND L109	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/06/01 03:06 PM
L111	33714	(smartwatch) OR (smart NEAR watch)	(US-PGPUB; USPAT)	OR	ON	ON	2018/06/01 04:33 PM
L112	2738169	gasket OR seal	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/06/01 04:33 PM
L113	2278	L111 AND L112	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/06/01 04:33 PM
L114	180804	ledge	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/06/01 04:33 PM

L115	73	L113 AND L114	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/06/01 04:34 PM
L116	77	(US-20160350514-$ or US-20160274726-$ or US-20150313542-$ or US-20160367987-$ or US-20160198996-$ or US-20160091965-$ or US-20140278139-$ or US-20140107493-$ or US-20110003665-$ or US-20150026647-$ or US-20140378777-$ or US-20140275852-$ or US-20170071483-$ or US-20170039358-$ or US-20170011210-$ or US-20160379205-$ or US-20150186609-$ or US-20140366123-$ or US-20140276244-$ or US-20140139486-$ or US-20130234850-$ or US-20030175993-$ or US-20160313703-$ or US-20160064804-$ or US-20160064800-$ or US-20150085429-$).did. or (US-20130236699-$ or US-20090124062-$ or US-20150124415-$).did. or (US-9848825-$ or US-9737221-$ or US-9737212-$ or US-9704154-$ or US-9629120-$ or US-9622214-$ or US-8738118-$ or US-8727977-$ or US-8630633-$ or US-8617069-$ or US-8527038-$ or US-7674231-$ or US-7474592-$ or US-6694158-$ or US-5722397-$ or US-6443906-$ or US-9288836-$ or US-9423418-$ or US-9091715-$ or US-6431455-$ or US-6350055-$ or US-6255951-$ or US-6158884-$ or US-9781984-$ or US-9575591-$ or US-	(US-PGPUB; USPAT)	OR	ON	ON	2018/06/01 04:36 PM

		D727198-$).did. or (US-D728624-$ or US-D737159-$ or US-D741726-$ or US-D752044-$ or US-D758219-$ or US-D758363-$ or US-9459781-$ or US-D768634-$ or US-9507459-$ or US-9547425-$ or US-D790517-$ or US-9288294-$ or US-8596860-$ or US-9791833-$ or US-9591913-$ or US-9680205-$ or US-7654732-$ or US-7682070-$ or US-4903253-$ or US-8766805-$ or US-D578922-$ or US-D647107-$).did.					
L117	461759	gasket	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/06/01 04:36 PM
L118	5	L116 AND L117	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/06/01 04:36 PM
L119	6	(15261914|15261917|15627321|15870718|15879223|14842617)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/06/04 04:46 PM
L120	77	(US-20160350514-$ or US-20160274726-$ or US-20150313542-$ or US-20160367987-$ or US-20160198996-$ or US-20160091965-$ or US-20140278139-$ or US-20140107493-$ or US-20110003665-$ or US-20150026647-$ or US-20140378777-$ or US-20140275852-$ or US-20170071483-$ or US-20170039358-$ or US-20170011210-$ or US-20160379205-$ or US-20150186609-$ or US-20140366123-$ or US-20140276244-$ or US-20140139486-$ or US-20130234850-$ or US-20030175993-$ or US-20160313703-$ or US-20160064804-$ or US-20160064800-$ or	(US-PGPUB; USPAT)	OR	ON	ON	2018/06/04 06:22 PM

		US-20150085429-$).did. or (US-20130236699-$ or US-20090124062-$ or US-20150124415-$).did. or (US-9848825-$ or US-9737221-$ or US-9737212-$ or US-9704154-$ or US-9629120-$ or US-9622214-$ or US-8738118-$ or US-8727977-$ or US-8630633-$ or US-8617069-$ or US-8527038-$ or US-7674231-$ or US-7474592-$ or US-6694158-$ or US-5722397-$ or US-6443906-$ or US-9288836-$ or US-9423418-$ or US-9091715-$ or US-6431455-$ or US-6350055-$ or US-6255951-$ or US-6158884-$ or US-9781984-$ or US-9575591-$ or US-D727198-$).did. or (US-D728624-$ or US-D737159-$ or US-D741726-$ or US-D752044-$ or US-D758219-$ or US-D758363-$ or US-9459781-$ or US-D768634-$ or US-9507459-$ or US-9547425-$ or US-D790517-$ or US-9288294-$ or US-8596860-$ or US-9791833-$ or US-9591913-$ or US-9680205-$ or US-7654732-$ or US-7682070-$ or US-4903253-$ or US-8766805-$ or US-D578922-$ or US-D647107-$).did.					
L121	132091	sapphire	(US-PGPUB; USPAT)	OR	ON	ON	2018/06/04 07:38 PM
L122	9	L120 AND L121	(US-PGPUB; USPAT)	OR	ON	ON	2018/06/04 07:39 PM

L123	77	(US-20160350514-$ or US-20160274726-$ or US-20150313542-$ or US-20160367987-$ or US-20160198996-$ or US-20160091965-$ or US-20140278139-$ or US-20140107493-$ or US-20110003665-$ or US-20150026647-$ or US-20140378777-$ or US-20140275852-$ or US-20170071483-$ or US-20170039358-$ or US-20170011210-$ or US-20160379205-$ or US-20150186609-$ or US-20140366123-$ or US-20140276244-$ or US-20140139486-$ or US-20130234850-$ or US-20030175993-$ or US-20160313703-$ or US-20160064804-$ or US-20160064800-$ or US-20150085429-$).did. or (US-20130236699-$ or US-20090124062-$ or US-20150124415-$).did. or (US-9848825-$ or US-9737221-$ or US-9737212-$ or US-9704154-$ or US-9629120-$ or US-9622214-$ or US-8738118-$ or US-8727977-$ or US-8630633-$ or US-8617069-$ or US-8527038-$ or US-7674231-$ or US-7474592-$ or US-6694158-$ or US-5722397-$ or US-6443906-$ or US-9288836-$ or US-9423418-$ or US-9091715-$ or US-6431455-$ or US-6350055-$ or US-6255951-$ or US-6158884-$ or US-9781984-$ or US-9575591-$ or US-D727198-$).did. or (US-D728624-$ or US-D737159-$ or US-	(US-PGPUB; USPAT)	OR	ON	ON	2018/06/07 03:23 PM

		D741726-$ or US-D752044-$ or US-D758219-$ or US-D758363-$ or US-9459781-$ or US-D768634-$ or US-9507459-$ or US-9547425-$ or US-D790517-$ or US-9288294-$ or US-8596860-$ or US-9791833-$ or US-9591913-$ or US-9680205-$ or US-7654732-$ or US-7682070-$ or US-4903253-$ or US-8766805-$ or US-D578922-$ or US-D647107-$).did.					
L124	77772	crown AND (rotary OR rotation)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/06/07 03:23 PM
L125	5	L123 AND L124	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/06/07 03:24 PM
L126	33999	(smartwatch) OR (smart NEAR watch)	(US-PGPUB; USPAT)	OR	ON	ON	2018/06/07 03:24 PM
L127	162	L126 AND L124	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/06/07 03:24 PM
L128	406910	(watch OR wristwatch OR (wrist NEAR watch))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/06/07 03:32 PM
L129	3396	L124 AND L128	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/06/07 03:32 PM
L130	2	"20150124415".pn.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/06/07 03:36 PM
L131	1	"15261912"	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/06/07 03:52 PM
L132	14	(speaker SAME (recess OR aperture) SAME fluid SAME (intrusion OR ingress))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/06/07 04:03 PM
L133	299	(waterproof NEAR port)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/06/07 04:04 PM
L134	0	L126 AND L133	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/06/07 04:04 PM
L135	25	L128 AND L133	(US-PGPUB; USPAT;	OR	ON	ON	2018/06/07

			USOCR; FPRS; EPO; JPO)				04:04 PM
L136	319	(waterproof SAME (audio OR acoustic) SAME port)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/06/07 04:09 PM
L137	8	L126 AND L136	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/06/07 04:09 PM
L138	56	L128 AND L136	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/06/07 04:09 PM
L139	81	(US-20160350514-$ or US-20160274726-$ or US-20150313542-$ or US-20160367987-$ or US-20160198996-$ or US-20160091965-$ or US-20140278139-$ or US-20140107493-$ or US-20110003665-$ or US-20150026647-$ or US-20140378777-$ or US-20140275852-$ or US-20170071483-$ or US-20170039358-$ or US-20170011210-$ or US-20160379205-$ or US-20150186609-$ or US-20140366123-$ or US-20140276244-$ or US-20140139486-$ or US-20130234850-$ or US-20030175993-$ or US-20160313703-$ or US-20160064804-$ or US-20160064800-$ or US-20150085429-$).did. or (US-20130236699-$ or US-20090124062-$ or US-20150124415-$).did. or (US-9848825-$ or US-9737221-$ or US-9737212-$ or US-9704154-$ or US-9629120-$ or US-9622214-$ or US-8738118-$ or US-8727977-$ or US-8630633-$ or US-8617069-$ or US-8527038-$ or US-7674231-$ or US-7474592-$ or US-6694158-$ or US-5722397-$ or US-6443906-$ or US-	(US-PGPUB; USPAT)	OR	ON	ON	2018/06/07 04:49 PM

		9288836-$ or US-9423418-$ or US-9091715-$ or US-6431455-$ or US-6350055-$ or US-6255951-$ or US-6158884-$ or US-9781984-$ or US-9575591-$ or US-D727198-$).did. or (US-D728624-$ or US-D737159-$ or US-D741726-$ or US-D752044-$ or US-D758219-$ or US-D758363-$ or US-9459781-$ or US-D768634-$ or US-9507459-$ or US-9547425-$ or US-D790517-$ or US-9288294-$ or US-8596860-$ or US-9791833-$ or US-9591913-$ or US-9680205-$ or US-7654732-$ or US-7682070-$ or US-4903253-$ or US-8766805-$ or US-D578922-$ or US-D647107-$ or US-3577876-$ or US-9300344-$ or US-9615476-$ or US-9625944-$).did.					
L140	1	"8229535".pn.	(US-PGPUB; USPAT)	OR	ON	ON	2018/06/07 04:50 PM
L141	39	("0012016"|"0012017"|"0022016"|"0032012"|"0032017"|"0042018"|"0052010"|"0052011"|"0052015"|"0052018"|"0062008"|"0062010"|"0062017"|"0072015"|"0072016"|"0082013"|"0082015"|"0082016"|"0092016"|"0102017"|"0112014"|"0112016"|"0122005"|"20040264301"|"20110242064"|"20130261405"|"20150098309"|"20160018846"|"20160320583"|"20170011210"|"20170031449"|"20170139489"|"20170216668"|"20170238138"|"20170251561	(US-PGPUB; USPAT)	OR	ON	ON	2018/12/11 05:21 PM

		"|"20170301314"|"2018 0136613"|"2018013668 6"|"4396298").PN.					
L142	1267679	(translation$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/12/11 05:22 PM
L143	4	L141 AND L142	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/12/11 05:24 PM
L144	10	("0062016"|"10001817"| "20130191220"|"20160 147432"|"20160170598 "|"20160170608"|"6396 006"|"8294670"|"95520 23"|"9659482").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2018/12/11 05:28 PM
L145	2	("20110158057"|"91410 87").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2018/12/11 05:28 PM
L146	4	("20180239306"|"20180 246469"|"20180299834 "|"9971405").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2018/12/11 05:28 PM
L147	5	("20040047244"|"20150 366098"|"20180307363 "|"5960366"|"9520100"). PN.	(US-PGPUB; USPAT)	OR	ON	ON	2018/12/11 05:29 PM
L148	22	(US-2288215-$ | US-2788236-$ | US-2797592-$ | US-3410247-$ | US-4311026-$ | US-4766642-$ | US-5509174-$ | US-6502982-$ | US-6834430-$ | US-7111365-$ | US-7285738-$ | US-7371745-$ | US-7591582-$ | US-8607662-$ | US-8783944-$ | US-8905631-$ | US-9052696-$ | US-9244438-$).DID.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/12/11 06:07 PM
L149	2	L142 AND L148	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/12/11 06:07 PM
L150	4	"15178089"	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/12/11 06:18 PM
L151	22	(US-2288215-$ | US-2788236-$ | US-2797592-$ | US-3410247-$ | US-4311026-$ | US-4766642-$ | US-5509174-$ | US-	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/12/12 07:10 AM

		6502982-$ | US-6834430-$ | US-7111365-$ | US-7285738-$ | US-7371745-$ | US-7591582-$ | US-8607662-$ | US-8783944-$ | US-8905631-$ | US-9052696-$ | US-9244438-$).DID.					
L152	25	(US-4396298-$ | US-6977868-$ | US-7385874-$ | US-7708457-$ | US-7732724-$ | US-7946758-$ | US-8143981-$ | US-8508511-$ | US-9028134-$ | US-9086717-$ | US-9101184-$ | US-9241635-$ | US-9256209-$ | US-9386932-$ | US-9426275-$ | US-9437357-$ | US-9501044-$ | US-9532723-$ | US-9545541-$ | US-9599964-$ | US-9680831-$ | US-9946297-$ | US-9971305-$ | US-D717679-$ | US-D800172-$).DID.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/12/12 07:19 AM
L155	13	(9836025|9709956|9620312).pn.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/12/12 09:13 AM
L156	4	"14842617"	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/12/12 09:14 AM
L157	49919	crown SAME ((rotary OR rotation OR rotat$4) OR (translat$4 OR translatable))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/12/12 09:20 AM
L158	3	L155 AND L157	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/12/12 09:20 AM
L159	15	"14455375"	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/12/12 09:22 AM
L160	1	"15261914"	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/12/12 09:30 AM

L161	1	"8954135".pn.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2019/01/08 09:51 AM
L162	12	(US-10092203-$ | US-5999168-$ | US-6241684-$ | US-6361502-$ | US-6982930-$ | US-7113450-$ | US-7468036-$ | US-7791588-$ | US-9039614-$ | US-9042971-$ | US-9898032-$ | US-9979426-$).DID.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2019/02/15 09:35 AM
L163	2846978	wireless	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2019/02/15 09:38 AM
L164	9	L162 AND L163	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2019/02/15 09:38 AM
L165	25	(US-0049059-$ | US-0196517-$ | US-0235491-$ | US-0270358-$ | US-0320346-$ | US-0338642-$ | US-0368442-$ | US-0375579-$ | US-20110270358-$ | US-20140368442-$ | US-20140375579-$ | US-20150049059-$ | US-20150320346-$ | US-20150338642-$ | US-20160338642-$ | US-20180196517-$ | US-20180235491-$).DID.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2019/02/15 09:44 AM
L166	3	(US-3362154-$ | US-9001625-$).DID.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2019/02/15 09:45 AM
L167	21	(US-0017846-$ | US-0027461-$ | US-0073486-$ | US-0329368-$ | US-0335891-$ | US-0341342-$ | US-0364815-$ | US-20140073486-$ | US-20170027461-$ | US-20180329368-$ | US-20180335891-$ | US-20180341342-$ | US-20180364815-$ | US-20190017846-$).DID.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2019/02/15 09:46 AM
L168	88408	haptic	(US-PGPUB; USPAT;	OR	ON	ON	2019/02/15

			USOCR; FPRS; EPO; JPO)				09:55 AM
L169	5	L165 AND L168	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2019/02/15 09:55 AM
L170	0	L166 AND L168	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2019/02/15 09:56 AM
L171	6	L162 AND L168	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2019/02/15 09:56 AM
L172	9	(7822469|8908477|20170216519).pn.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2019/05/06 10:15 AM
L173	9	(10209148|10114342|8677285|20130235704|20160241688).pn.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2019/05/23 10:39 AM
L174	993	haptic AND crown	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2019/05/23 10:40 AM
L175	0	L173 AND L174	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2019/05/23 10:40 AM
L176	81	(US-20160350514-$ or US-20160274726-$ or US-20150313542-$ or US-20160367987-$ or US-20160198996-$ or US-20160091965-$ or US-20140278139-$ or US-20140107493-$ or US-20110003665-$ or US-20150026647-$ or US-20140378777-$ or US-20140275852-$ or US-20170071483-$ or US-20170039358-$ or US-20170011210-$ or US-20160379205-$ or US-20150186609-$ or US-20140366123-$ or US-20140276244-$ or US-20140139486-$ or US-20130234850-$ or US-20030175993-$ or US-20160313703-$ or US-20160064804-$ or US-20160064800-$ or US-20150085429-$).did. or (US-20130236699-$ or US-20090124062-$ or US-20150124415-$).did. or (US-9848825-$ or US-9737221-$ or US-	(US-PGPUB; USPAT)	OR	ON	ON	2019/05/23 10:49 AM

		9737212-$ or US-9704154-$ or US-9629120-$ or US-9622214-$ or US-8738118-$ or US-8727977-$ or US-8630633-$ or US-8617069-$ or US-8527038-$ or US-7674231-$ or US-7474592-$ or US-6694158-$ or US-5722397-$ or US-6443906-$ or US-9288836-$ or US-9423418-$ or US-9091715-$ or US-6431455-$ or US-6350055-$ or US-6255951-$ or US-6158884-$ or US-9781984-$ or US-9575591-$ or US-D727198-$).did. or (US-D728624-$ or US-D737159-$ or US-D741726-$ or US-D752044-$ or US-D758219-$ or US-D758363-$ or US-9459781-$ or US-D768634-$ or US-9507459-$ or US-9547425-$ or US-D790517-$ or US-9288294-$ or US-8596860-$ or US-9791833-$ or US-9591913-$ or US-9680205-$ or US-7654732-$ or US-7682070-$ or US-4903253-$ or US-8766805-$ or US-D578922-$ or US-D647107-$ or US-3577876-$ or US-9300344-$ or US-9615476-$ or US-9625944-$).did.					
L177	18	L176 AND Haptic	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2019/05/23 10:50 AM
L178	2	("7021442"|"7894957").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2019/07/29 08:05 AM
L179	2	("7021442"|"7894957").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2019/07/29 08:11 AM

L180	2	("7021442"|"7894957").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2019/07/29 08:11 AM
L181	25	(3733803|4520306|6377239|6882596|6967903|7286063|7655874|8975543|9836025|10331082|20080088417|20170090599|20190163324).pn.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2019/07/29 08:13 AM
L182	3	"9627163".pn.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2019/07/29 08:20 AM
L183	3	"9627163".pn.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2019/08/13 07:07 PM
L184	15	("10331082"|"20050088417"|"20170090599"|"20190163324"|"3733803"|"4520306"|"6377239"|"6882596"|"6967903"|"7021442"|"7286063"|"7655874"|"7894957"|"8975543"|"9836025").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2019/08/13 08:09 PM
L185	5	(7021442|7894957).pn.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2019/08/13 08:11 PM
L186	4	("20190250754"|"20190294117"|"20190302902"|"5177355").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2019/11/24 05:25 PM
L187	3	(5477508|8275327).pn.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2020/02/28 01:14 PM
L188	4	(10613485|10620591|10627783|10599101).pn.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2020/05/01 01:23 PM
L189	83	(US-20160350514-$ or US-20160274726-$ or US-20150313542-$ or US-20160367987-$ or US-20160198996-$ or US-20160091965-$ or US-20140278139-$ or US-20140107493-$ or US-20110003665-$ or US-20150026647-$ or US-20140378777-$ or US-20140275852-$ or US-20170071483-$ or US-20170039358-$ or US-20170011210-$ or US-20160379205-$ or US-20150186609-$ or US-20140366123-$ or US-20140276244-$ or US-20140139486-$ or	(US-PGPUB; USPAT)	OR	ON	ON	2020/05/01 01:38 PM

		US-20130234850-$ or US-20030175993-$ or US-20160313703-$ or US-20160064804-$ or US-20160064800-$ or US-20150085429-$).did. or (US-20130236699-$ or US-20090124062-$ or US-20150124415-$).did. or (US-9848825-$ or US-9737221-$ or US-9737212-$ or US-9704154-$ or US-9629120-$ or US-9622214-$ or US-8738118-$ or US-8727977-$ or US-8630633-$ or US-8617069-$ or US-8527038-$ or US-7674231-$ or US-7474592-$ or US-6694158-$ or US-5722397-$ or US-6443906-$ or US-9288836-$ or US-9423418-$ or US-9091715-$ or US-6431455-$ or US-6350055-$ or US-6255951-$ or US-6158884-$ or US-9781984-$ or US-9575591-$ or US-D727198-$).did. or (US-D728624-$ or US-D737159-$ or US-D741726-$ or US-D752044-$ or US-D758219-$ or US-D758363-$ or US-9459781-$ or US-D768634-$ or US-9507459-$ or US-9547425-$ or US-D790517-$ or US-9288294-$ or US-8596860-$ or US-9791833-$ or US-9591913-$ or US-9680205-$ or US-7654732-$ or US-7682070-$ or US-4903253-$ or US-8766805-$ or US-D578922-$ or US-D647107-$ or US-					

		3577876-$ or US-9300344-$ or US-9615476-$ or US-9625944-$ or US-9627163-$).did. or (US-7286063-$).did.					
L190	278	("10001817"|"10018966"|"10019097"|"10037006"|"10048802"|"10061399"|"10092203"|"10114342"|"10145711"|"10175652"|"10209148"|"10216147"|"10222756"|"10222909"|"10234828"|"10296125"|"10331081"|"10331082"|"10379629"|"10509486"|"2237860"|"2288215"|"2497935"|"2771734"|"2788236"|"2797592"|"3040514"|"3056030"|"3130539"|"3355873"|"3362154"|"3410247"|"3495398"|"3577876"|"3621649"|"3662618"|"3733803"|"4007347"|"4031341"|"4037068"|"4077200"|"4133404"|"4170104"|"4258096"|"4287400"|"4289400"|"4311026"|"4311990"|"4324956"|"4345119"|"4364674"|"4379642"|"4395134"|"4396298"|"4417824"|"4520306"|"4581509"|"4600316"|"4617461"|"4634861"|"4641026"|"4670737"|"4766642"|"4783772"|"4884073"|"4914831"|"4922070"|"4931794"|"4952799"|"4980685"|"4987299"|"5034602"|"5177355"|"5214278"|"5258592"|"5288993"|"5347123"|"5383166"|"5471054"|"5477508"|"5509174"|"5572314"|"5583560"|"5631881"|"5726645"|"5748111"|"5825353"|"5841050"|"5847335"|"5867082"|"5943233"|"5953001"|"5960366"|"5963332"|"5999168"|"6069567"|"6134189"|"6154201"|"6175679"|"6241684"|"6246050"|"6252825"|"6304247"|"6355891"|"6361502"|"6377239"|"6392640"|"6396006"|"6	(US-PGPUB; USPAT)	OR	ON	ON	2020/05/01 02:00 PM

		422740"|"6477117"|"65 02982"|"6525278"|"655 6222"|"6575618"|"6587 400"|"6646635"|"66614 38"|"6672758"|"679499 2"|"6809275"|"6834430" |"6846998"|"6882596"|" 6888076"|"6896403"|"6 909378"|"6914551"|"69 61099"|"6963039"|"696 7903"|"6977868"|"6982 930"|"6985107"|"69875 68"|"6998553"|"701626 3"|"7021442"|"7034237" |"7081905"|"7102626"|" 7111365"|"7113450"|"7 119289"|"7135673"|"71 67083"|"7244927"|"725 5473"|"7265336"|"7274 303"|"7285738"|"72860 63"|"7292741"|"735848 1"|"7369308"|"7371745" |"7385874"|"7404667"|" 7465917"|"7468036"|"7 506269"|"7520664"|"75 28824"|"7545367"|"759 1582"|"7593755"|"7605 846"|"7634263"|"76466 77"|"7655874"|"768207 0"|"7708457"|"7710456" |"7732724"|"7761246"|" 7763819"|"7772507"|"7 778115"|"7781726"|"77 91588"|"7791597"|"782 2469"|"7856255"|"7858 583"|"7865324"|"78949 57"|"7946758"|"806389 2"|"8138488"|"8143981" |"8167126"|"8169402"|" 8188989"|"8195313"|"8 229535"|"8248815"|"82 63886"|"8263889"|"827 5327"|"8294670"|"8312 495"|"8368677"|"83717 45"|"8373661"|"841097 1"|"8432368"|"8439559" |"8441450"|"8446713"|" 8456430"|"8477118"|"8 493190"|"8508511"|"85 25777"|"8562489"|"856 8313"|"8576044"|"8593 598"|"8607662"|"86148 81"|"8666682"|"867728 5"|"8704787"|"8711093" |"8724087"|"8730167"|" 8743088"|"8783944"|"8 804993"|"8816962"|"88 24245"|"8847741"|"885						

		9971"|"8860674"|"8863219"|"8878657"|"8885856"|"8895911"|"8905631"|"8908477"|"8920022"|"8922399"|"8928452"|"8954135"|"8975543"|"8994827"|"9001625"|"9024733"|"9028134"|"9030446"|"9034666"|"9039614"|"9041663"|"9042971"|"9052696"|"9086717"|"9086738"|"9101184"|"9105413"|"9123483"|"9141087"|"9176577"|"9176598"|"9202372"|"9213409"|"9223296"|"9241635"|"9244438"|"9256209"|"9277156"|"9350850"|"9386932"|"9426275"|"9430042"|"9437357"|"9449770"|"9501044"|"9520100"|"9532723").PN.					
L191	33	("9542016"|"9545541"|"9552023"|"9599964"|"9607505"|"9620312"|"9627163"|"9632318"|"9638587"|"9651922"|"9659482"|"9680831"|"9709956"|"9753436"|"9800717"|"9836025"|"9873711"|"9874945"|"9886006"|"9891590"|"9891651"|"9898032"|"9927902"|"9939923"|"9946297"|"9952558"|"9952682"|"9971305"|"9971405"|"9979426"|"D717679"|"D800172"|"RE41637").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2020/05/01 02:00 PM
L192	4	(20150186609|20140107493|D647107|7474592).pn.	(US-PGPUB; USPAT)	OR	ON	ON	2020/05/01 02:11 PM
L193	18	("20030099459" | "4736196" | "5537102" | "5883576" | "5936530" | "6158884" | "6255951" | "6350055" | "6396403" | "6431455" | "7133843").PN. OR ("7474592").URPN.	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2020/05/01 02:37 PM
L194	83	(US-20160350514-$ or US-20160274726-$ or US-20150313542-$ or US-20160367987-$ or US-20160198996-$ or US-20160091965-$ or US-20140278139-$ or	(US-PGPUB; USPAT)	OR	ON	ON	2020/05/06 04:20 PM

		US-20140107493-$ or US-20110003665-$ or US-20150026647-$ or US-20140378777-$ or US-20140275852-$ or US-20170071483-$ or US-20170039358-$ or US-20170011210-$ or US-20160379205-$ or US-20150186609-$ or US-20140366123-$ or US-20140276244-$ or US-20140139486-$ or US-20130234850-$ or US-20030175993-$ or US-20160313703-$ or US-20160064804-$ or US-20160064800-$ or US-20150085429-$).did. or (US-20130236699-$ or US-20090124062-$ or US-20150124415-$).did. or (US-9848825-$ or US-9737221-$ or US-9737212-$ or US-9704154-$ or US-9629120-$ or US-9622214-$ or US-8738118-$ or US-8727977-$ or US-8630633-$ or US-8617069-$ or US-8527038-$ or US-7674231-$ or US-7474592-$ or US-6694158-$ or US-5722397-$ or US-6443906-$ or US-9288836-$ or US-9423418-$ or US-9091715-$ or US-6431455-$ or US-6350055-$ or US-6255951-$ or US-6158884-$ or US-9781984-$ or US-9575591-$ or US-D727198-$).did. or (US-D728624-$ or US-D737159-$ or US-D741726-$ or US-D752044-$ or US-D758219-$ or US-D758363-$ or US-9459781-$ or US-D768634-$ or US-9507459-$ or US-					

		9547425-$ or US-D790517-$ or US-9288294-$ or US-8596860-$ or US-9791833-$ or US-9591913-$ or US-9680205-$ or US-7654732-$ or US-7682070-$ or US-4903253-$ or US-8766805-$ or US-D578922-$ or US-D647107-$ or US-3577876-$ or US-9300344-$ or US-9615476-$ or US-9625944-$ or US-9627163-$).did. or (US-7286063-$).did.					
L195	112037	("ECG" OR "EKG" OR electrocardiogra$4)	(US-PGPUB; USPAT)	OR	ON	ON	2020/05/06 04:43 PM
L196	23	L194 AND L195	(US-PGPUB; USPAT)	OR	ON	ON	2020/05/06 04:43 PM
L197	278	("10001817"|"10018966"|"10019097"|"10037006"|"10048802"|"10061399"|"10092203"|"10114342"|"10145711"|"10175652"|"10209148"|"10216147"|"10222756"|"10222909"|"10234828"|"10296125"|"10331081"|"10331082"|"10379629"|"10509486"|"2237860"|"2288215"|"2497935"|"2771734"|"2788236"|"2797592"|"3040514"|"3056030"|"3130539"|"3355873"|"3362154"|"3410247"|"3495398"|"3577876"|"3621649"|"3662618"|"3733803"|"4007347"|"4031341"|"4037068"|"4077200"|"4133404"|"4170104"|"4258096"|"4287400"|"4289400"|"4311026"|"4311990"|"4324956"|"4345119"|"4364674"|"4379642"|"4395134"|"4396298"|"4417824"|"4520306"|"4581509"|"4600316"|"4617461"|"4634861"|"4641026"|"4670737"|"4766642"|"4783772"|"4884073"|"4914831"|"4922070"|"4931794"|"4952799"|"4980685"	(US-PGPUB; USPAT)	OR	ON	ON	2020/05/06 04:57 PM

		|"4987299"|"5034602"|"5177355"|"5214278"|"5258592"|"5288993"|"5347123"|"5383166"|"5471054"|"5477508"|"5509174"|"5572314"|"5583560"|"5631881"|"5726645"|"5748111"|"5825353"|"5841050"|"5847335"|"5867082"|"5943233"|"5953001"|"5960366"|"5963332"|"5999168"|"6069567"|"6134189"|"6154201"|"6175679"|"6241684"|"6246050"|"6252825"|"6304247"|"6355891"|"6361502"|"6377239"|"6392640"|"6396006"|"6422740"|"6477117"|"6502982"|"6525278"|"6556222"|"6575618"|"6587400"|"6646635"|"6661438"|"6672758"|"6794992"|"6809275"|"6834430"|"6846998"|"6882596"|"6888076"|"6896403"|"6909378"|"6914551"|"6961099"|"6963039"|"6967903"|"6977868"|"6982930"|"6985107"|"6987568"|"6998553"|"7016263"|"7021442"|"7034237"|"7081905"|"7102626"|"7111365"|"7113450"|"7119289"|"7135673"|"7167083"|"7244927"|"7255473"|"7265336"|"7274303"|"7285738"|"7286063"|"7292741"|"7358481"|"7369308"|"7371745"|"7385874"|"7404667"|"7465917"|"7468036"|"7506269"|"7520664"|"7528824"|"7545367"|"7591582"|"7593755"|"7605846"|"7634263"|"7646677"|"7655874"|"7682070"|"7708457"|"7710456"|"7732724"|"7761246"|"7763819"|"7772507"|"7778115"|"7781726"|"7791588"|"7791597"|"7822469"|"7856255"|"7858583"|"7865324"|"7894957"|"7946758"|"8063892"|"8138488"|"8143981"|"8167126"|"8169402"|"8188989"|"8195313"|"8					

		229535"|"8248815"|"8263886"|"8263889"|"8275327"|"8294670"|"8312495"|"8368677"|"8371745"|"8373661"|"8410971"|"8432368"|"8439559"|"8441450"|"8446713"|"8456430"|"8477118"|"8493190"|"8508511"|"8525777"|"8562489"|"8568313"|"8576044"|"8593598"|"8607662"|"8614881"|"8666682"|"8677285"|"8704787"|"8711093"|"8724087"|"8730167"|"8743088"|"8783944"|"8804993"|"8816962"|"8824245"|"8847741"|"8859971"|"8860674"|"8863219"|"8878657"|"8885856"|"8895911"|"8905631"|"8908477"|"8920022"|"8922399"|"8928452"|"8954135"|"8975543"|"8994827"|"9001625"|"9024733"|"9028134"|"9030446"|"9034666"|"9039614"|"9041663"|"9042971"|"9052696"|"9086717"|"9086738"|"9101184"|"9105413"|"9123483"|"9141087"|"9176577"|"9176598"|"9202372"|"9213409"|"9223296"|"9241635"|"9244438"|"9256209"|"9277156"|"9350850"|"9386932"|"9426275"|"9430042"|"9437357"|"9449770"|"9501044"|"9520100"|"9532723").PN.					
L198	13	L195 AND L197	(US-PGPUB; USPAT)	OR	ON	ON	2020/05/06 04:57 PM
L199	33	("9542016"|"9545541"|"9552023"|"9599964"|"9607505"|"9620312"|"9627163"|"9632318"|"9638587"|"9651922"|"9659482"|"9680831"|"9709956"|"9753436"|"9800717"|"9836025"|"9873711"|"9874945"|"9886006"|"9891590"|"9891651"|"9898032"|"9927902"|"9939923"|"9946297"|"9952558"|"9952682"|"9971305"|"9971405"|"99794	(US-PGPUB; USPAT)	OR	ON	ON	2020/05/06 05:04 PM

		26"|"D717679"|"D800172"|"RE41637").PN.					
L200	7	L199 AND L195	(US-PGPUB; USPAT)	OR	ON	ON	2020/05/06 05:04 PM
L201	83	(US-20160350514-$ or US-20160274726-$ or US-20150313542-$ or US-20160367987-$ or US-20160198996-$ or US-20160091965-$ or US-20140278139-$ or US-20140107493-$ or US-20110003665-$ or US-20150026647-$ or US-20140378777-$ or US-20140275852-$ or US-20170071483-$ or US-20170039358-$ or US-20170011210-$ or US-20160379205-$ or US-20150186609-$ or US-20140366123-$ or US-20140276244-$ or US-20140139486-$ or US-20130234850-$ or US-20030175993-$ or US-20160313703-$ or US-20160064804-$ or US-20160064800-$ or US-20150085429-$).did. or (US-20130236699-$ or US-20090124062-$ or US-20150124415-$).did. or (US-9848825-$ or US-9737221-$ or US-9737212-$ or US-9704154-$ or US-9629120-$ or US-9622214-$ or US-8738118-$ or US-8727977-$ or US-8630633-$ or US-8617069-$ or US-8527038-$ or US-7674231-$ or US-7474592-$ or US-6694158-$ or US-5722397-$ or US-6443906-$ or US-9288836-$ or US-9423418-$ or US-9091715-$ or US-6431455-$ or US-6350055-$ or US-6255951-$ or US-6158884-$ or US-	(US-PGPUB; USPAT)	OR	ON	ON	2020/05/08 10:45 AM

		9781984-$ or US-9575591-$ or US-D727198-$).did. or (US-D728624-$ or US-D737159-$ or US-D741726-$ or US-D752044-$ or US-D758219-$ or US-D758363-$ or US-9459781-$ or US-D768634-$ or US-9507459-$ or US-9547425-$ or US-D790517-$ or US-9288294-$ or US-8596860-$ or US-9791833-$ or US-9591913-$ or US-9680205-$ or US-7654732-$ or US-7682070-$ or US-4903253-$ or US-8766805-$ or US-D578922-$ or US-D647107-$ or US-3577876-$ or US-9300344-$ or US-9615476-$ or US-9625944-$ or US-9627163-$).did. or (US-7286063-$).did.					
L202	4081	(((wrist NEAR watch) OR (wristwatch)) AND ("ECG" OR "EKG" OR electrocardiogra$4))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2020/05/08 10:46 AM
L203	4144877	electrode	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2020/05/08 10:47 AM
L204	2474	L202 AND L203	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2020/05/08 10:47 AM
L205	939	(((wrist NEAR watch) OR (wristwatch)) SAME ("ECG" OR "EKG" OR electrocardiogra$4))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2020/05/08 10:48 AM
L206	760	L204 AND L205	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2020/05/08 10:48 AM
L207	84	(US-20160350514-$ or US-20160274726-$ or US-20150313542-$ or US-20160367987-$ or US-20160198996-$ or US-20160091965-$ or US-20140278139-$ or US-20140107493-$ or	(US-PGPUB; USPAT)	OR	ON	ON	2020/05/08 10:56 AM

		US-20110003665-$ or US-20150026647-$ or US-20140378777-$ or US-20140275852-$ or US-20170071483-$ or US-20170039358-$ or US-20170011210-$ or US-20160379205-$ or US-20150186609-$ or US-20140366123-$ or US-20140276244-$ or US-20140139486-$ or US-20130234850-$ or US-20030175993-$ or US-20160313703-$ or US-20160064804-$ or US-20160064800-$ or US-20150085429-$).did. or (US-20130236699-$ or US-20090124062-$ or US-20150124415-$).did. or (US-9848825-$ or US-9737221-$ or US-9737212-$ or US-9704154-$ or US-9629120-$ or US-9622214-$ or US-8738118-$ or US-8727977-$ or US-8630633-$ or US-8617069-$ or US-8527038-$ or US-7674231-$ or US-7474592-$ or US-6694158-$ or US-5722397-$ or US-6443906-$ or US-9288836-$ or US-9423418-$ or US-9091715-$ or US-6431455-$ or US-6350055-$ or US-6255951-$ or US-6158884-$ or US-9781984-$ or US-9575591-$ or US-D727198-$).did. or (US-D728624-$ or US-D737159-$ or US-D741726-$ or US-D752044-$ or US-D758219-$ or US-D758363-$ or US-9459781-$ or US-D768634-$ or US-9507459-$ or US-9547425-$ or US-					

		D790517-$ or US-9288294-$ or US-8596860-$ or US-9791833-$ or US-9591913-$ or US-9680205-$ or US-7654732-$ or US-7682070-$ or US-4903253-$ or US-8766805-$ or US-D578922-$ or US-D647107-$ or US-3577876-$ or US-9300344-$ or US-9615476-$ or US-9625944-$ or US-9627163-$).did. or (US-7286063-$ or US-4448199-$).did.					
L208	919589	dielectric OR ceraminc	(US-PGPUB; USPAT)	OR	ON	ON	2020/05/08 11:06 AM
L209	1700627	dielectric OR ceramic	(US-PGPUB; USPAT)	OR	ON	ON	2020/05/08 11:06 AM
L210	20	L207 AND L209	(US-PGPUB; USPAT)	OR	ON	ON	2020/05/08 11:06 AM
L211	0	"16826130"	(US-PGPUB; USPAT)	OR	ON	ON	2020/05/08 11:11 AM
L212	1	"10613485".pn.	(US-PGPUB; USPAT)	OR	ON	ON	2020/05/08 11:11 AM
L213	1178366	coil	(US-PGPUB; USPAT)	OR	ON	ON	2020/05/08 11:25 AM
L214	15	L207 AND L213	(US-PGPUB; USPAT)	OR	ON	ON	2020/05/08 11:27 AM
L215	126	(wireless SAME recharg$4 SAME (coil OR antenna) SAME magnet)	(US-PGPUB; USPAT)	OR	ON	ON	2020/05/08 12:42 PM
L216	70511	(((wrist NEAR watch) OR (wristwatch)))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2020/05/08 12:42 PM
L217	24	L216 AND L215	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2020/05/08 12:42 PM
L218	28998	wireless NEAR charg$4	(US-PGPUB; USPAT)	OR	ON	ON	2020/05/08 01:18 PM
L219	83	(US-20160350514-$ or US-20160274726-$ or US-20150313542-$ or US-20160367987-$ or US-20160198996-$ or US-20160091965-$ or US-20140278139-$ or US-20140107493-$ or US-20110003665-$ or	(US-PGPUB; USPAT)	OR	ON	ON	2020/05/08 01:19 PM

		US-20150026647-$ or US-20140378777-$ or US-20140275852-$ or US-20170071483-$ or US-20170039358-$ or US-20170011210-$ or US-20160379205-$ or US-20150186609-$ or US-20140366123-$ or US-20140276244-$ or US-20140139486-$ or US-20130234850-$ or US-20030175993-$ or US-20160313703-$ or US-20160064804-$ or US-20160064800-$ or US-20150085429-$).did. or (US-20130236699-$ or US-20090124062-$ or US-20150124415-$).did. or (US-9848825-$ or US-9737221-$ or US-9737212-$ or US-9704154-$ or US-9629120-$ or US-9622214-$ or US-8738118-$ or US-8727977-$ or US-8630633-$ or US-8617069-$ or US-8527038-$ or US-7674231-$ or US-7474592-$ or US-6694158-$ or US-5722397-$ or US-6443906-$ or US-9288836-$ or US-9423418-$ or US-9091715-$ or US-6431455-$ or US-6350055-$ or US-6255951-$ or US-6158884-$ or US-9781984-$ or US-9575591-$ or US-D727198-$).did. or (US-D728624-$ or US-D737159-$ or US-D741726-$ or US-D752044-$ or US-D758219-$ or US-D758363-$ or US-9459781-$ or US-D768634-$ or US-9507459-$ or US-9547425-$ or US-D790517-$ or US-					

		9288294-$ or US-8596860-$ or US-9791833-$ or US-9591913-$ or US-9680205-$ or US-7654732-$ or US-7682070-$ or US-4903253-$ or US-8766805-$ or US-D578922-$ or US-D647107-$ or US-3577876-$ or US-9300344-$ or US-9615476-$ or US-9625944-$ or US-9627163-$).did. or (US-7286063-$).did.					
L220	5	L218 AND L219	(US-PGPUB; USPAT)	OR	ON	ON	2020/05/08 01:19 PM
L221	278	("10001817"|"10018966"|"10019097"|"10037006"|"10048802"|"10061399"|"10092203"|"10114342"|"10145711"|"10175652"|"10209148"|"10216147"|"10222756"|"10222909"|"10234828"|"10296125"|"10331081"|"10331082"|"10379629"|"10509486"|"2237860"|"2288215"|"2497935"|"2771734"|"2788236"|"2797592"|"3040514"|"3056030"|"3130539"|"3355873"|"3362154"|"3410247"|"3495398"|"3577876"|"3621649"|"3662618"|"3733803"|"4007347"|"4031341"|"4037068"|"4077200"|"4133404"|"4170104"|"4258096"|"4287400"|"4289400"|"4311026"|"4311990"|"4324956"|"4345119"|"4364674"|"4379642"|"4395134"|"4396298"|"4417824"|"4520306"|"4581509"|"4600316"|"4617461"|"4634861"|"4641026"|"4670737"|"4766642"|"4783772"|"4884073"|"4914831"|"4922070"|"4931794"|"4952799"|"4980685"|"4987299"|"5034602"|"5177355"|"5214278"|"5258592"|"5288993"|"5347123"|"5383166"|"547	(US-PGPUB; USPAT)	OR	ON	ON	2020/05/08 01:22 PM

		1054"|"5477508"|"5509 174"|"5572314"|"55835 60"|"5631881"|"572664 5"|"5748111"|"5825353" |"5841050"|"5847335"|" 5867082"|"5943233"|"5 953001"|"5960366"|"59 63332"|"5999168"|"606 9567"|"6134189"|"6154 201"|"6175679"|"62416 84"|"6246050"|"625282 5"|"6304247"|"6355891" |"6361502"|"6377239"|" 6392640"|"6396006"|"6 422740"|"6477117"|"65 02982"|"6525278"|"655 6222"|"6575618"|"6587 400"|"6646635"|"66614 38"|"6672758"|"679499 2"|"6809275"|"6834430" |"6846998"|"6882596"|" 6888076"|"6896403"|"6 909378"|"6914551"|"69 61099"|"6963039"|"696 7903"|"6977868"|"6982 930"|"6985107"|"69875 68"|"6998553"|"701626 3"|"7021442"|"7034237" |"7081905"|"7102626"|" 7111365"|"7113450"|"7 119289"|"7135673"|"71 67083"|"7244927"|"725 5473"|"7265336"|"7274 303"|"7285738"|"72860 63"|"7292741"|"735848 1"|"7369308"|"7371745" |"7385874"|"7404667"|" 7465917"|"7468036"|"7 506269"|"7520664"|"75 28824"|"7545367"|"759 1582"|"7593755"|"7605 846"|"7634263"|"76466 77"|"7655874"|"768207 0"|"7708457"|"7710456" |"7732724"|"7761246"|" 7763819"|"7772507"|"7 778115"|"7781726"|"77 91588"|"7791597"|"782 2469"|"7856255"|"7858 583"|"7865324"|"78949 57"|"7946758"|"806389 2"|"8138488"|"8143981" |"8167126"|"8169402"|" 8188989"|"8195313"|"8 229535"|"8248815"|"82 63886"|"8263889"|"827 5327"|"8294670"|"8312 495"|"8368677"|"83717					

		45"|"8373661"|"8410971"|"8432368"|"8439559"|"8441450"|"8446713"|"8456430"|"8477118"|"8493190"|"8508511"|"8525777"|"8562489"|"8568313"|"8576044"|"8593598"|"8607662"|"8614881"|"8666682"|"8677285"|"8704787"|"8711093"|"8724087"|"8730167"|"8743088"|"8783944"|"8804993"|"8816962"|"8824245"|"8847741"|"8859971"|"8860674"|"8863219"|"8878657"|"8885856"|"8895911"|"8905631"|"8908477"|"8920022"|"8922399"|"8928452"|"8954135"|"8975543"|"8994827"|"9001625"|"9024733"|"9028134"|"9030446"|"9034666"|"9039614"|"9041663"|"9042971"|"9052696"|"9086717"|"9086738"|"9101184"|"9105413"|"9123483"|"9141087"|"9176577"|"9176598"|"9202372"|"9213409"|"9223296"|"9241635"|"9244438"|"9256209"|"9277156"|"9350850"|"9386932"|"9426275"|"9430042"|"9437357"|"9449770"|"9501044"|"9520100"|"9532723").PN.					
L222	6	L218 AND L221	(US-PGPUB; USPAT)	OR	ON	ON	2020/05/08 01:22 PM
L223	33	("9542016"|"9545541"|"9552023"|"9599964"|"9607505"|"9620312"|"9627163"|"9632318"|"9638587"|"9651922"|"9659482"|"9680831"|"9709956"|"9753436"|"9800717"|"9836025"|"9873711"|"9874945"|"9886006"|"9891590"|"9891651"|"9898032"|"9927902"|"9939923"|"9946297"|"9952558"|"9952682"|"9971305"|"9971405"|"9979426"|"D717679"|"D800172"|"RE41637").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2020/05/08 01:23 PM
L224	4	L218 AND L223	(US-PGPUB; USPAT)	OR	ON	ON	2020/05/08 01:23 PM

L225	33	("9542016"|"9545541"|"9552023"|"9599964"|"9607505"|"9620312"|"9627163"|"9632318"|"9638587"|"9651922"|"9659482"|"9680831"|"9709956"|"9753436"|"9800717"|"9836025"|"9873711"|"9874945"|"9886006"|"9891590"|"9891651"|"9898032"|"9927902"|"9939923"|"9946297"|"9952558"|"9952682"|"9971305"|"9971405"|"9979426"|"D717679"|"D800172"|"RE41637").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2020/05/08 01:24 PM
L226	4	L218 AND L225	(US-PGPUB; USPAT)	OR	ON	ON	2020/05/08 01:24 PM
L227	5	L218 AND L201	(US-PGPUB; USPAT)	OR	ON	ON	2020/05/08 01:24 PM
L228	16	("0052020"|"10012550"|"10241593"|"10353487"|"10551798"|"20070182708"|"20140009397"|"20140045547"|"20200041962"|"20200073339"|"20200110473"|"6128006"|"6203190"|"6636197"|"8318340"|"8797153").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2020/10/22 02:58 PM
L229	216	(coil SAME (recharg$4 OR charg$4) SAME cover SAME dielectric)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2020/10/22 03:03 PM
L230	0	L228 AND L229	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2020/10/22 03:03 PM
L231	27643	(coil AND (recharg$4 OR charg$4) AND cover AND dielectric)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2020/10/22 03:06 PM
L232	1	L228 AND L231	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2020/10/22 03:06 PM
L233	58	(watch AND housing AND cover AND (touch NEAr display) AND dielectric AND optical AND coil AND wireless AND (heart NEAR rate) AND (electrocardiog$4 OR "ECG" OR "EKG"))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2020/10/22 03:16 PM
L235	358	((("Rothkopf") near3 ("Fletcher") near3 ("R"))).INV.	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2020/10/29 09:55 AM
L236	527578	watch	(US-PGPUB; USPAT; USOCR; FPRS; EPO;	OR	ON	ON	2020/10/29 09:56 AM

			JPO)				
L237	127	L235 AND L236	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2020/10/29 09:56 AM
L238	1031	Watch AND band AND (wireless SAME coil SAME inductive)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2020/10/29 10:35 AM
L239	1459613	dielectric	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2020/10/29 10:35 AM
L240	308	L238 AND L239	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2020/10/29 10:36 AM
L241	293	(housing AND watch AND (band OR strap) AND cover AND dielectric AND coil AND charg$4 AND surface AND electrode AND (heart NEAr rate))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2020/10/29 01:39 PM
L243	2	(9134807|10474194).pn.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2021/01/13 01:19 PM
L244	275	("0000005"|"0000055"|"0000072"|"0000073"|"0000078"|"0000555"|"0000726"|"0000728"|"0000786"|"0022019"|"0022020"|"0032019"|"0032020"|"0042020"|"0052019"|"0052020"|"0052585"|"0062019"|"0072019"|"0078949"|"0079467"|"0082019"|"0082020"|"0112019"|"0122019"|"10001817"|"10012550"|"10018966"|"10019097"|"10037006"|"10048802"|"10061399"|"10092203"|"10114342"|"10145711"|"10175652"|"20030174590"|"20040047244"|"20040082414"|"20040130971"|"20040264301"|"20050075558"|"20050088417"|"20060250377"|"2237860"|"2288215"|"2497935"|"2771734"|"2788236"|"2797592"|"3040514"|"3056030"|"3130539"|"3355873"|"3362154"|"3410247"|"3495398"|"3577876"|"3621649"|"3662618"|"3733803"|"4007347"|"4031341"|"4037068"|"4077200"|"41	(US-PGPUB; USPAT)	OR	ON	ON	2021/05/04 11:05 AM

		33404"|"4170104"|"425 8096"|"4287400"|"4289 400"|"4311026"|"43119 90"|"4324956"|"434511 9"|"4364674"|"4379642" |"4395134"|"4396298"|" 4417824"|"4448199"|"4 520306"|"4581509"|"46 00316"|"4617461"|"463 4861"|"4641026"|"4670 737"|"4766642"|"47837 72"|"4884073"|"491483 1"|"4922070"|"4931794" |"4952799"|"4980685"|" 4987299"|"5034602"|"5 177355"|"5214278"|"52 88993"|"5631881"|"584 1050"|"5847335"|"5867 082"|"5943233"|"59530 01"|"5960366"|"596333 2"|"5999168"|"6069567" |"6128006"|"6134189"|" 6154201"|"6175679"|"6 203190"|"6241684"|"62 46050"|"6252825"|"630 4247"|"6355891"|"6361 502"|"6377239"|"63926 40"|"6396006"|"642274 0"|"6477117"|"6502982" |"6525278"|"6556222"|" 6575618"|"6587400"|"6 636197"|"6646635"|"66 61438"|"6672758"|"679 4992"|"6809275"|"6834 430"|"6846998"|"68825 96"|"6888076"|"689640 3"|"6909378"|"6914551" |"6961099"|"6963039"|" 6967903"|"6977868"|"6 982930"|"6985107"|"69 87568"|"6998553"|"701 6263"|"7021442"|"7031 228"|"7034237"|"70819 05"|"7102626"|"711136 5"|"7113450"|"7119289" |"7135673"|"7167083"|" 7244927"|"7274303"|"7 286063"|"7292741"|"73 69308"|"7371745"|"738 5874"|"7404667"|"7465 917"|"7468036"|"75062 69"|"7520664"|"752882 4"|"7545367"|"7591582" |"7593755"|"7605846"|" 7634263"|"7646677"|"7 655874"|"7682070"|"77 08457"|"7710456"|"773 2724"|"7761246"|"7763					

		819"|"7772507"|"77781 15"|"7781726"|"779158 8"|"7791597"|"7822469" |"8063892"|"8138488"|" 8143981"|"8167126"|"8 169402"|"8188989"|"81 95313"|"8229535"|"824 8815"|"8263886"|"8263 889"|"8275327"|"82946 70"|"8312495"|"831834 0"|"8368677"|"8371745" |"8373661"|"8410971"|" 8432368"|"8439559"|"8 441450"|"8446713"|"84 56430"|"8477118"|"849 3190"|"8508511"|"8525 777"|"8562489"|"85683 13"|"8576044"|"859359 8"|"8607662"|"8614881" |"8666682"|"8677285"|" 8704787"|"8711093"|"8 724087"|"8730167"|"87 43088"|"8783944"|"879 7153"|"8804993"|"8816 962"|"8824245"|"88477 41"|"8859971"|"886067 4"|"8863219"|"8878657" |"8885856"|"8895911"|" 8905631"|"8908477"|"8 920022"|"8922399"|"89 28452"|"8948832"|"895 4135"|"8975543"|"8994 827"|"9001625"|"90247 33"|"9028134"|"903044 6"|"9034666"|"9039614" |"9041663"|"9042971"|" 9049998"|"9052696"|"9 086717"|"9086738"|"91 00493"|"9101184"|"910 5413"|"9123483"|"9134 807"|"9141087").PN.					
L245	52	("9176577"|"9176598"|" 9202372"|"9213409"|"9 223296"|"9241635"|"92 44438"|"9256209"|"927 7156"|"9350850"|"9386 932"|"9426275"|"94300 42"|"9437357"|"944977 0"|"9501044"|"9520100" |"9532723"|"9542016"|" 9545541"|"9552023"|"9 599964"|"9607505"|"96 20312"|"9627163"|"963 2318"|"9638587"|"9651 922"|"9659482"|"96808 31"|"9709956"|"975343 6"|"9800717"|"9836025" |"9873711"|"9874945"|	(US-PGPUB; USPAT)	OR	ON	ON	2021/05/04 11:05 AM

		9886006"|"9891590"|"9891651"|"9898032"|"9927902"|"9939923"|"9946297"|"9952558"|"9952682"|"9971305"|"9971405"|"9971407"|"9979426"|"D717679"|"D800172"|"RE41637").PN.					
L246	341583	crown	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2021/05/04 11:06 AM
L247	16	L245 AND L246	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2021/05/04 11:06 AM
L248	86	(US-20160350514-$ or US-20160274726-$ or US-20150313542-$ or US-20160367987-$ or US-20160198996-$ or US-20160091965-$ or US-20140278139-$ or US-20140107493-$ or US-20110003665-$ or US-20150026647-$ or US-20140378777-$ or US-20140275852-$ or US-20170071483-$ or US-20170039358-$ or US-20170011210-$ or US-20160379205-$ or US-20150186609-$ or US-20140366123-$ or US-20140276244-$ or US-20140139486-$ or US-20130234850-$ or US-20030175993-$ or US-20160313703-$ or US-20160064804-$ or US-20160064800-$ or US-20150085429-$).did. or (US-20130236699-$ or US-20090124062-$ or US-20150124415-$ or US-20150351690-$).did. or (US-9848825-$ or US-9737221-$ or US-9737212-$ or US-9704154-$ or US-9629120-$ or US-9622214-$ or US-8738118-$ or US-8727977-$ or US-8630633-$ or US-8617069-$ or US-8527038-$ or US-7674231-$ or US-	(US-PGPUB; USPAT)	OR	ON	ON	2021/05/04 11:09 AM

		7474592-$ or US-6694158-$ or US-5722397-$ or US-6443906-$ or US-9288836-$ or US-9423418-$ or US-9091715-$ or US-6431455-$ or US-6350055-$ or US-6255951-$ or US-6158884-$ or US-9781984-$ or US-9575591-$ or US-D727198-$).did. or (US-D728624-$ or US-D737159-$ or US-D741726-$ or US-D752044-$ or US-D758219-$ or US-D758363-$ or US-9459781-$ or US-D768634-$ or US-9507459-$ or US-9547425-$ or US-D790517-$ or US-9288294-$ or US-8596860-$ or US-9791833-$ or US-9591913-$ or US-9680205-$ or US-7654732-$ or US-7682070-$ or US-4903253-$ or US-8766805-$ or US-D578922-$ or US-D647107-$ or US-3577876-$ or US-9300344-$ or US-9615476-$ or US-9625944-$ or US-9627163-$).did. or (US-7286063-$ or US-4448199-$ or US-5738104-$).did.					
L249	9	L246 AND L248	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2021/05/04 11:09 AM
L250	4	(10942491|10613485|10620591|10599101).pn.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2021/05/04 11:14 AM
L251	49	L244 AND L246	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2021/05/04 11:20 AM
L252	6361313	sensor	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2021/05/04 12:06 PM

L253	23	L251 AND L252	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2021/05/04 12:06 PM
L254	403796	(tactile OR haptic)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2021/05/04 12:44 PM
L255	30	L245 AND L254	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2021/05/04 12:44 PM
L256	63	L244 AND L254	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2021/05/04 12:51 PM
L259	6581094	optical	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2021/05/04 02:50 PM
L260	92	(US-20160350514-$ or US-20160274726-$ or US-20150313542-$ or US-20160367987-$ or US-20160198996-$ or US-20160091965-$ or US-20140278139-$ or US-20140107493-$ or US-20110003665-$ or US-20150026647-$ or US-20140378777-$ or US-20140275852-$ or US-20170071483-$ or US-20170039358-$ or US-20170011210-$ or US-20160379205-$ or US-20150186609-$ or US-20140366123-$ or US-20140276244-$ or US-20140139486-$ or US-20130234850-$ or US-20030175993-$ or US-20160313703-$ or US-20160064804-$ or US-20160064800-$ or US-20150085429-$).did. or (US-20130236699-$ or US-20090124062-$ or US-20150124415-$ or US-20150351690-$ or US-20030174590-$).did. or (US-9848825-$ or US-9737221-$ or US-9737212-$ or US-9704154-$ or US-9629120-$ or US-9622214-$ or US-8738118-$ or US-8727977-$ or US-8630633-$ or US-	(US-PGPUB; USPAT)	OR	ON	ON	2021/05/04 02:50 PM

		8617069-$ or US-8527038-$ or US-7674231-$ or US-7474592-$ or US-6694158-$ or US-5722397-$ or US-6443906-$ or US-9288836-$ or US-9423418-$ or US-9091715-$ or US-6431455-$ or US-6350055-$ or US-6255951-$ or US-6158884-$ or US-9781984-$ or US-9575591-$ or US-D727198-$).did. or (US-D728624-$ or US-D737159-$ or US-D741726-$ or US-D752044-$ or US-D758219-$ or US-D758363-$ or US-9459781-$ or US-D768634-$ or US-9507459-$ or US-9547425-$ or US-D790517-$ or US-9288294-$ or US-8596860-$ or US-9791833-$ or US-9591913-$ or US-9680205-$ or US-7654732-$ or US-7682070-$ or US-4903253-$ or US-8766805-$ or US-D578922-$ or US-D647107-$ or US-3577876-$ or US-9300344-$ or US-9615476-$ or US-9625944-$ or US-9627163-$).did. or (US-7286063-$ or US-4448199-$ or US-5738104-$ or US-8908477-$ or US-7034237-$ or US-6882596-$ or US-9971405-$ or US-9651922-$).did.					
L261	59	L259 AND L260	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2021/05/04 02:50 PM
L262	4	(20140275852|4448199).pn.	(US-PGPUB; USPAT; USOCR; FPRS; EPO;	OR	ON	ON	2021/05/04 03:01 PM

			JPO)				
L263	92	(US-20160350514-$ or US-20160274726-$ or US-20150313542-$ or US-20160367987-$ or US-20160198996-$ or US-20160091965-$ or US-20140278139-$ or US-20140107493-$ or US-20110003665-$ or US-20150026647-$ or US-20140378777-$ or US-20140275852-$ or US-20170071483-$ or US-20170039358-$ or US-20170011210-$ or US-20160379205-$ or US-20150186609-$ or US-20140366123-$ or US-20140276244-$ or US-20140139486-$ or US-20130234850-$ or US-20030175993-$ or US-20160313703-$ or US-20160064804-$ or US-20160064800-$ or US-20150085429-$).did. or (US-20130236699-$ or US-20090124062-$ or US-20150124415-$ or US-20150351690-$ or US-20030174590-$).did. or (US-9848825-$ or US-9737221-$ or US-9737212-$ or US-9704154-$ or US-9629120-$ or US-9622214-$ or US-8738118-$ or US-8727977-$ or US-8630633-$ or US-8617069-$ or US-8527038-$ or US-7674231-$ or US-7474592-$ or US-6694158-$ or US-5722397-$ or US-6443906-$ or US-9288836-$ or US-9423418-$ or US-9091715-$ or US-6431455-$ or US-6350055-$ or US-6255951-$ or US-6158884-$ or US-9781984-$ or US-9575591-$ or US-	(US-PGPUB; USPAT)	OR	ON	ON	2021/05/04 03:02 PM

		D727198-$).did. or (US-D728624-$ or US-D737159-$ or US-D741726-$ or US-D752044-$ or US-D758219-$ or US-D758363-$ or US-9459781-$ or US-D768634-$ or US-9507459-$ or US-9547425-$ or US-D790517-$ or US-9288294-$ or US-8596860-$ or US-9791833-$ or US-9591913-$ or US-9680205-$ or US-7654732-$ or US-7682070-$ or US-4903253-$ or US-8766805-$ or US-D578922-$ or US-D647107-$ or US-3577876-$ or US-9300344-$ or US-9615476-$ or US-9625944-$ or US-9627163-$).did. or (US-7286063-$ or US-4448199-$ or US-5738104-$ or US-8908477-$ or US-7034237-$ or US-6882596-$ or US-9971405-$ or US-9651922-$).did.					
L264	176	ely-colin-m.in.	(US-PGPUB; USPAT)	OR	ON	ON	2021/05/04 03:13 PM
L265	2438	((touch OR force) NEAr sensor) AND crown AND sensor	(US-PGPUB; USPAT)	OR	ON	ON	2021/05/04 03:23 PM
L266	275	("0000005"|"0000055"|"0000072"|"0000073"|"0000078"|"0000555"|"0000726"|"0000728"|"0000786"|"0022019"|"0022020"|"0032019"|"0032020"|"0042020"|"0052019"|"0052020"|"0052585"|"0062019"|"0072019"|"0078949"|"0079467"|"0082019"|"0082020"|"0112019"|"0122019"|"10001817"|"10012550"|"10018966"|"10019097"|"10037006"|"10048802"|"10061399"|"10092203"|	(US-PGPUB; USPAT)	OR	ON	ON	2021/05/04 03:23 PM

		"10114342"|"10145711" |"10175652"|"20030174 590"|"20040047244"|"2 0040082414"|"2004013 0971"|"20040264301"|" 20050075558"|"200500 88417"|"20060250377"| "2237860"|"2288215"|"2 497935"|"2771734"|"27 88236"|"2797592"|"304 0514"|"3056030"|"3130 539"|"3355873"|"33621 54"|"3410247"|"349539 8"|"3577876"|"3621649" |"3662618"|"3733803"|" 4007347"|"4031341"|"4 037068"|"4077200"|"41 33404"|"4170104"|"425 8096"|"4287400"|"4289 400"|"4311026"|"43119 90"|"4324956"|"434511 9"|"4364674"|"4379642" |"4395134"|"4396298"|" 4417824"|"4448199"|"4 520306"|"4581509"|"46 00316"|"4617461"|"463 4861"|"4641026"|"4670 737"|"4766642"|"47837 72"|"4884073"|"491483 1"|"4922070"|"4931794" |"4952799"|"4980685"|" 4987299"|"5034602"|"5 177355"|"5214278"|"52 88993"|"5631881"|"584 1050"|"5847335"|"5867 082"|"5943233"|"59530 01"|"5960366"|"596333 2"|"5999168"|"6069567" |"6128006"|"6134189"|" 6154201"|"6175679"|"6 203190"|"6241684"|"62 46050"|"6252825"|"630 4247"|"6355891"|"6361 502"|"6377239"|"63926 40"|"6396006"|"642274 0"|"6477117"|"6502982" |"6525278"|"6556222"|" 6575618"|"6587400"|"6 636197"|"6646635"|"66 61438"|"6672758"|"679 4992"|"6809275"|"6834 430"|"6846998"|"68825 96"|"6888076"|"689640 3"|"6909378"|"6914551" |"6961099"|"6963039"|" 6967903"|"6977868"|"6 982930"|"6985107"|"69 87568"|"6998553"|"701					

		6263"|"7021442"|"7031 228"|"7034237"|"70819 05"|"7102626"|"711136 5"|"7113450"|"7119289" |"7135673"|"7167083"|" 7244927"|"7274303"|"7 286063"|"7292741"|"73 69308"|"7371745"|"738 5874"|"7404667"|"7465 917"|"7468036"|"75062 69"|"7520664"|"752882 4"|"7545367"|"7591582" |"7593755"|"7605846"|" 7634263"|"7646677"|"7 655874"|"7682070"|"77 08457"|"7710456"|"773 2724"|"7761246"|"7763 819"|"7772507"|"77781 15"|"7781726"|"779158 8"|"7791597"|"7822469" |"8063892"|"8138488"|" 8143981"|"8167126"|"8 169402"|"8188989"|"81 95313"|"8229535"|"824 8815"|"8263886"|"8263 889"|"8275327"|"82946 70"|"8312495"|"831834 0"|"8368677"|"8371745" |"8373661"|"8410971"|" 8432368"|"8439559"|"8 441450"|"8446713"|"84 56430"|"8477118"|"849 3190"|"8508511"|"8525 777"|"8562489"|"85683 13"|"8576044"|"859359 8"|"8607662"|"8614881" |"8666682"|"8677285"|" 8704787"|"8711093"|"8 724087"|"8730167"|"87 43088"|"8783944"|"879 7153"|"8804993"|"8816 962"|"8824245"|"88477 41"|"8859971"|"886067 4"|"8863219"|"8878657" |"8885856"|"8895911"|" 8905631"|"8908477"|"8 920022"|"8922399"|"89 28452"|"8948832"|"895 4135"|"8975543"|"8994 827"|"9001625"|"90247 33"|"9028134"|"903044 6"|"9034666"|"9039614" |"9041663"|"9042971"|" 9049998"|"9052696"|"9 086717"|"9086738"|"91 00493"|"9101184"|"910 5413"|"9123483"|"9134 807"|"9141087").PN.					

L267	5	L265 AND L266	(US-PGPUB; USPAT)	OR	ON	ON	2021/05/04 03:23 PM
L268	52	("9176577"|"9176598"|"9202372"|"9213409"|"9223296"|"9241635"|"9244438"|"9256209"|"9277156"|"9350850"|"9386932"|"9426275"|"9430042"|"9437357"|"9449770"|"9501044"|"9520100"|"9532723"|"9542016"|"9545541"|"9552023"|"9599964"|"9607505"|"9620312"|"9627163"|"9632318"|"9638587"|"9651922"|"9659482"|"9680831"|"9709956"|"9753436"|"9800717"|"9836025"|"9873711"|"9874945"|"9886006"|"9891590"|"9891651"|"9898032"|"9927902"|"9939923"|"9946297"|"9952558"|"9952682"|"9971305"|"9971405"|"9979426"|"D717679"|"D800172"|"RE41637").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2021/05/04 03:24 PM
L269	11	L265 AND L268	(US-PGPUB; USPAT)	OR	ON	ON	2021/05/04 03:24 PM
L270	1038	(((touch OR force) NEAr sensor) WITH (screen OR display)) AND crown AND sensor	(US-PGPUB; USPAT)	OR	ON	ON	2021/05/04 03:41 PM
L271	412793	watch	(US-PGPUB; USPAT)	OR	ON	ON	2021/05/04 03:41 PM
L272	744	L270 AND L271	(US-PGPUB; USPAT)	OR	ON	ON	2021/05/04 03:42 PM
L273	82705	(biosensor)	(US-PGPUB; USPAT)	OR	ON	ON	2021/05/04 03:42 PM
L274	33	L272 AND L273	(US-PGPUB; USPAT)	OR	ON	ON	2021/05/04 03:42 PM
L275	25	(10942491|10613485|11620591|10627783|10599101).pn.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/09 10:10 AM
L276	5	(10942491|10613485|11620591|10627783|10599101).pn.	(USPAT)	OR	ON	ON	2022/11/09 10:12 AM
L277	5	(10942491|10613485|10620591|10627783|10599101).pn.	(USPAT)	OR	ON	ON	2022/11/09 10:31 AM

L278	1	"11474483".pn.	(USPAT)	OR	ON	ON	2022/11/09 11:03 AM
L279	250	("0000002" OR "0012021" OR "0012022" OR "0032020" OR "0032021" OR "0042020" OR "0042021" OR "0052020" OR "0052021" OR "0062021" OR "0062022" OR "0072022" OR "0082020" OR "0102022" OR "0112020" OR "0112021" OR "0122020" OR "0122021" OR "10001817" OR "10012550" OR "10018966" OR "10019097" OR "10037006" OR "10037081" OR "10048802" OR "10061399" OR "10066970" OR "10092203" OR "10108016" OR "10114342" OR "10145711" OR "10175652" OR "10190891" OR "10203662" OR "10209148" OR "10216147" OR "10222755" OR "10222756" OR "10222909" OR "10234828" OR "10241593" OR "10296125" OR "10331081" OR "10331082" OR "10332111" OR "10353487" OR "10379629" OR "10386940" OR "10401961" OR "10429959" OR "10474194" OR "10503258" OR "10509486" OR "10524671" OR "10534320" OR "10534900" OR	(US-PGPUB; USPAT)	OR	ON	ON	2022/12/14 01:49 PM

		"10551798" OR "10572053" OR "10579090" OR "10593617" OR "20020101457" OR "20030174590" OR "20040047244" OR "20040082414" OR "20040130971" OR "20040264301" OR "20050075558" OR "20050088417" OR "20060250377" OR "20070013775" OR "20070050054" OR "20070182708" OR "20070211042" OR "20070222756" OR "20070229671" OR "20070247421" OR "20080130914" OR "20090051649" OR "20090073119" OR "20090122656" OR "20090146975" OR "20090152452" OR "20090217207" OR "20090285443" OR "20090312051" OR "20090312655" OR "20100033430" OR "20100053468" OR "20100081375" OR "20100149099" OR "20110007468" OR "20110090148" OR "20110158057" OR "20110242064" OR "20110270358" OR "20120067711" OR "20120068857" OR "20120075082" OR "20120112859" OR "20120113044" OR "20120206248" OR "20120272784" OR "20130037396" OR "20130087443" OR "20130191220" OR "20130235704" OR "20130261405" OR "20130335196" OR "20140009397" OR "20140045547" OR "20140071098" OR "20140073486" OR "20140132516" OR "20140197936" OR					

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PE2E SEARCH - Search History (Interference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	British Equivalents	Time Stamp
N153	0	(wearable AND housing AND band AND display AND (touch NEAR sensor) AND crown AND (rotatable OR rotational OR rotat$4) AND switch AND haptic).clm.	(US-PGPUB; USPAT)	OR	ON	ON	2018/12/12 07:07 AM
N154	0	(wearable AND housing AND band AND display AND (touch NEAR sensor) AND crown AND (rotatable OR rotational OR rotat$4) AND switch AND vibrat$4).clm.	(US-PGPUB; USPAT)	OR	ON	ON	2018/12/12 07:08 AM
N234	0	(watch AND housing AND cover AND (touch NEAr display) AND dielectric AND optical AND coil AND wireless AND (heart NEAR rate) AND (electrocardiog$4 OR "ECG" OR "EKG")).clm.	(US-PGPUB; USPAT)	OR	ON	ON	2020/10/22 03:24 PM
N242	1	(housing AND watch AND (band OR strap) AND cover AND dielectric AND coil AND charg$4 AND surface AND electrode AND (heart NEAr rate)).clm.	(US-PGPUB; USPAT)	OR	ON	ON	2020/10/29 01:39 PM

Bibliographic Data

Application No: 17/951,973

Foreign Priority claimed: ○ Yes ◉ No

35 USC 119 (a-d) conditions met: ☐ Yes ☐ No ☐ Met After Allowance

Verified and Acknowledged: /BRIAN T GEDEON/ Examiner's Signature | Initials

Title: WEARABLE ELECTRONIC DEVICE

FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
09/23/2022	368	3792	P22914USC10
RULE			

APPLICANTS

Apple Inc., Cupertino, CA, UNITED STATES

INVENTORS

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Julian Hoenig, San Francisco, CA, UNITED STATES

Rico Zorkendorfer, San Francisco, CA, UNITED STATES

CONTINUING DATA

This application is a CON of 17899498 08/30/2022

This application is a CON of 17672653 02/15/2022 PAT 11474483

17672653 is a CON of 17188966 03/01/2021

This application is a CON of 17188966 03/01/2021

17672653 is a CON of 17188995 03/01/2021

This application is a CON of 17188995 03/01/2021

17188966 is a CON of 16826130 03/20/2020 PAT 10942491

17188995 is a CON of 16826130 03/20/2020 PAT 10942491

16826130 is a CON of 15261917 09/10/2016 PAT 10627783

16826130 is a CON of 15261912 09/10/2016 PAT 10620591

16826130 is a CON of 15261914 09/10/2016 PAT 10613485

15261914 is a CON of 14842617 09/01/2015 PAT 10599101

15261912 is a CON of 14842617 09/01/2015 PAT 10599101

16826130 is a CON of 14842617 09/01/2015 PAT 10599101

15261917 is a CON of 14842617 09/01/2015 PAT 10599101

14842617 has PRO of 62044974 09/02/2014

FOREIGN APPLICATIONS

IF REQUIRED, FOREIGN LICENSE GRANTED**

10/20/2022

STATE OR COUNTRY

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FILING FEE RECEIVED

$6,160

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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
17/951,973	09/23/2022	Fletcher R. Rothkopf	P22914USC10

CONFIRMATION NO. 5622

62579
APPLE INC./BROWNSTEIN
c/o Brownstein Hyatt Farber Schreck, LLP
410 Seventeenth Street
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PUBLICATION NOTICE



Title:WEARABLE ELECTRONIC DEVICE

Publication No.US-2023-0028554-A1
Publication Date:01/26/2023

NOTICE OF PUBLICATION OF APPLICATION

The above-identified application will be electronically published as a patent application publication pursuant to 37 CFR 1.211, et seq. The patent application publication number and publication date are set forth above.

The publication may be accessed through the USPTO's publically available Searchable Databases via the Internet at www.uspto.gov. The direct link to access the publication is currently http://www.uspto.gov/patft/.

The publication process established by the Office does not provide for mailing a copy of the publication to applicant. A copy of the publication may be obtained from the Office upon payment of the appropriate fee set forth in 37 CFR 1.19(a)(1). Orders for copies of patent application publications are handled by the USPTO's Public Records Division. The Public Records Division can be reached by telephone at (571) 272-3150 or (800) 972-6382, by facsimile at (571) 273-3250, by mail addressed to the United States Patent and Trademark Office, Public Records Division, Alexandria, VA 22313-1450 or via the Internet.

In addition, information on the status of the application, including the mailing date of Office actions and the dates of receipt of correspondence filed in the Office, may also be accessed via the Internet through the Patent Electronic Business Center at www.uspto.gov using the public side of the Patent Application Information and Retrieval (PAIR) system. The direct link to access this status information is currently https://portal.uspto.gov/pair/PublicPair. Prior to publication, such status information is confidential and may only be obtained by applicant using the private side of PAIR.

Further assistance in electronically accessing the publication, or about PAIR, is available by calling the Patent Electronic Business Center at 1-866-217-9197.

Office of Data Managment, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:

Inventor(s):	Fletcher R. Rothkopf et al.		
App. No.:	17/951,973	Con. No.:	5622
Filed:	September 23, 2022	Art Unit:	3792
Title:	WEARABLE ELECTRONIC DEVICE	Examiner:	Brain T. Gedeon

AMENDMENT AND RESPONSE TO OFFICE ACTION

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

In response to the Office action dated December 22, 2022, please consider the following remarks and amend the above-identified application as follows:

Amendments to the Specification begin on page 2 of this paper.

Remarks begin on page 3 of this paper.

Amendments to the Specification:

Please replace paragraphs [0106] and [0156] with the following paragraphs, marked to show changes:

[0106] As another example, electronic devices 100, 420, 430 may communicate with one another as part of the overall ecosystem. Data may be passed from one device 420 to another device 100. This may be useful if the user 410 is wearing one electronic device 100 but is not near another device 430 that wishes to notify the user or interact with the user in some fashion. Continuing the example, the computer 430 may transmit a reminder or message to the wearable device 100 to gain the user's attention. As another example, the computer 430 (or any other electronic device in the ecosystem) may transmit a state of an application or even the device itself to the wearable device 100. Thus, for example, if an application operating on the computer needs the user's attention, it may be gained through an alert issued by the wearable device.

[0156] The geometry of the receiving features may be located with respect to other features or components of the device. In the example depicted in FIG. 8, at least a portion of the groove of the receiving features 623, 624 may be disposed underneath the cover (item 609 of FIGs. 6-7). With respect to FIG. 6, the groove of the receiving features 623, 624 is located underneath the opening for the cover, which is defined by the sealing ledge 810 and flange 812 formed in the upper portion of the housing 601. In some embodiments, the length of the groove extends further than the width of the opening configured to receive the cover (and thus the cover, when assembled). In some embodiments, the grooves are formed at an angle relative to the centerline of the housing. In some cases, the angle is approximately 5 degrees. In some embodiments, the groove is located underneath the centerline of the housing 601. In some embodiments, the groove is angled upward toward the top of the housing 601 and inward toward the center of the housing 601. The groove [[601]] may angle upward and cross the centerline of the housing. In some cases, the groove crosses the vertical centerline of the housing 601.

REMARKS

This paper is submitted in response to the Office action mailed on December 22, 2022. This paper amends paragraphs 106 and 156 of the specification to correct minor typographical errors. No claims are amended.

After entry of this Amendment and Response, claims 21-31 will be pending.

I. Priority

The Priority section in the Office action appears to recite the priority claim differently than what was included with the application as filed and what is shown in the filing receipt mailed on October 21, 2022. For consistency and completeness, the priority claim that was included in the as-filed Application Data Sheet and specification (and which is reflected in the Filing Receipt mailed on October 21, 2022) is provided below:

> This application is a continuation patent application of U.S. Patent Application No. 17/672,653, filed February 15, 2022, and titled "Wearable Electronic Device," which is a continuation patent application of U.S. Patent Application No. 17/188,966, filed March 1, 2021, and titled "Wearable Electronic Device," which is a continuation patent application of U.S. Patent Application No. 16/826,130, filed March 20, 2020, and titled "Wearable Electronic Device," now U.S. Patent No. 10,942,491, issued March 9, 2021, which is a continuation patent application of U.S. Patent Application No. 14/842,617, filed September 1, 2015, and titled "Wearable Electronic Device," now U.S. Patent No. 10,599,101, issued March 24, 2020, which is a nonprovisional patent application of and claims the benefit of U.S. Provisional Patent Application No. 62/044,974, filed September 2, 2014, the disclosures of which are hereby incorporated herein by reference in their entireties. U.S. Patent Application No. 16/826,130, filed March 20, 2020, and titled "Wearable Electronic Device," now U.S. Patent No. 10,942,491, issued March 9, 2021 is also a continuation patent application of U.S. Patent Application No. 15/261,917, filed September 10, 2016, and titled "Wearable Electronic Device," now U.S. Patent No. 10,627,783, issued April 21, 2020, which is a continuation application of U.S. Patent Application No. 14/842,617, filed September 1, 2015, and titled "Wearable Electronic Device," now U.S. Patent No. 10,599,101, issued March 24, 2020, which is a nonprovisional patent application of and claims the benefit of U.S. Provisional Patent

Application No. 62/044,974, filed September 2, 2014, the disclosures of which are hereby incorporated herein by reference in their entireties. U.S. Patent Application No. 16/826,130, filed March 20, 2020, and titled "Wearable Electronic Device," now U.S. Patent No. 10,942,491, issued March 9, 2021 is also a continuation patent application of U.S. Patent Application No. 15/261,914, filed September 10, 2016, and titled "Wearable Electronic Device," now U.S. Patent No. 10,613,485, issued April 7, 2020, which is a continuation patent application of U.S. Patent Application No. 14/842,617, filed September 1, 2015, and titled "Wearable Electronic Device," now U.S. Patent No. 10,599,101, issued March 24, 2020, which is a nonprovisional patent application of and claims the benefit of U.S. Provisional Patent Application No. 62/044,974, filed September 2, 2014, the disclosures of which are hereby incorporated herein by reference in their entireties. U.S. Patent Application No. 16/826,130, filed March 20, 2020, and titled "Wearable Electronic Device," now U.S. Patent No. 10,942,491, issued March 9, 2021 is also a continuation patent application of U.S. Patent Application No. 15/261,912, filed September 10, 2016, and titled "Wearable Electronic Device," now U.S. Patent No. 10,620,591, issued April 14, 2020, which is a continuation patent application of U.S. Patent Application No. 14/842,617, filed September 1, 2015, and titled "Wearable Electronic Device," now U.S. Patent No. 10,599,101, issued March 24, 2020, which is a nonprovisional patent application of and claims the benefit of U.S. Provisional Patent Application No. 62/044,974, filed September 2, 2014, the disclosures of which are hereby incorporated herein by reference in their entireties. U.S. Patent Application No. 17/672,653, filed February 15, 2022, and titled "Wearable Electronic Device," is also a continuation patent application of U.S. Patent Application No. 17/188,995, filed March 1, 2021, and titled "Wearable Electronic Device," which is a continuation patent application of U.S. Patent Application No. 16/826,130, filed March 20, 2020, and titled "Wearable Electronic Device," now U.S. Patent No. 10,942,491, issued March 9, 2021, which is a continuation patent application of U.S. Patent Application No. 14/842,617, filed September 1, 2015, and titled "Wearable Electronic Device," now U.S. Patent No. 10,599,101, issued March 24, 2020, which is a nonprovisional patent application of and claims the benefit of U.S. Provisional Patent Application No. 62/044,974, filed September 2, 2014, the disclosures of which are hereby incorporated herein by reference in their entireties. U.S. Patent Application No. 16/826,130, filed March 20, 2020, and titled "Wearable Electronic Device," now U.S. Patent No. 10,942,491, issued March 9, 2021 is also a continuation patent application of U.S. Patent Application

No. 15/261,917, filed September 10, 2016, and titled "Wearable Electronic Device," now U.S. Patent No. 10,627,783, issued April 21, 2020, which is a continuation application of U.S. Patent Application No. 14/842,617, filed September 1, 2015, and titled "Wearable Electronic Device," now U.S. Patent No. 10,599,101, issued March 24, 2020, which is a nonprovisional patent application of and claims the benefit of U.S. Provisional Patent Application No. 62/044,974, filed September 2, 2014, the disclosures of which are hereby incorporated herein by reference in their entireties. U.S. Patent Application No. 16/826,130, filed March 20, 2020, and titled "Wearable Electronic Device," now U.S. Patent No. 10,942,491, issued March 9, 2021 is also a continuation patent application of U.S. Patent Application No. 15/261,914, filed September 10, 2016, and titled "Wearable Electronic Device," now U.S. Patent No. 10,613,485, issued April 7, 2020, which is a continuation patent application of U.S. Patent Application No. 14/842,617, filed September 1, 2015, and titled "Wearable Electronic Device," now U.S. Patent No. 10,599,101, issued March 24, 2020, which is a nonprovisional patent application of and claims the benefit of U.S. Provisional Patent Application No. 62/044,974, filed September 2, 2014, the disclosures of which are hereby incorporated herein by reference in their entireties. U.S. Patent Application No. 16/826,130, filed March 20, 2020, and titled "Wearable Electronic Device," now U.S. Patent No. 10,942,491, issued March 9, 2021 is also a continuation patent application of U.S. Patent Application No. 15/261,912, filed September 10, 2016, and titled "Wearable Electronic Device," now U.S. Patent No. 10,620,591, issued April 14, 2020, which is a continuation patent application of U.S. Patent Application No. 14/842,617, filed September 1, 2015, and titled "Wearable Electronic Device," now U.S. Patent No. 10,599,101, issued March 24, 2020, which is a nonprovisional patent application of and claims the benefit of U.S. Provisional Patent Application No. 62/044,974, filed September 2, 2014, the disclosures of which are hereby incorporated herein by reference in their entireties. This application is also a continuation patent application of U.S. Patent Application No. 17/188,966, filed March 1, 2021, and titled "Wearable Electronic Device." This application is also a continuation patent application of U.S. Patent Application No. 17/188,995, filed March 1, 2021, and titled "Wearable Electronic Device." This application is also a continuation patent application of U.S. Patent Application No. 17/899,498, filed August 30, 2022, and titled "Wearable Electronic Device."

II. Double Patenting

The Examiner has provisionally rejected claims 21-31 on the ground of nonstatutory double patenting as being unpatentable over claims 1-20 of U.S. Patent No. 10,627,783 in view of U.S. Patent No. 10,620,591. Without acquiescing to the propriety of the rejection, the Assignee herewith files a Terminal Disclaimer and submits that the nonstatutory double patenting rejections are rendered moot.

III. Conclusion

The Assignee thanks the Examiner for the thorough review of the application. The Assignee respectfully submits the present application, as amended, is in condition for allowance and respectfully requests the issuance of a Notice of Allowability as soon as practicable.

Submitted with this response is the required Terminal Disclaimer fee. The Assignee believes no further fees or petitions are required. However, should any such fees or petitions be required, please consider this a request therefor and authorization to charge Deposit Account No. 504621 as necessary.

If the Examiner should require any additional information or amendment, please contact the undersigned attorney.

Dated: March 22, 2023.

Respectfully submitted,

/Peter J. Nagle/

Peter J. Nagle, Registration No. 70,361
Attorney for Assignee
USPTO Customer No. 62579

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410 Seventeenth Street
Suite 2200
Denver, Colorado 80202
Phone: 303-223-1100
Fax: 303-223-1111

Electronic Acknowledgement Receipt	
EFS ID:	47728822
Application Number:	17951973
International Application Number:	
Confirmation Number:	5622
Title of Invention:	WEARABLE ELECTRONIC DEVICE
First Named Inventor/Applicant Name:	Fletcher R. Rothkopf
Customer Number:	62579
Filer:	Peter James Nagle/Sonya Domingo
Filer Authorized By:	Peter James Nagle
Attorney Docket Number:	P22914USC10
Receipt Date:	22-MAR-2023
Filing Date:	23-SEP-2022
Time Stamp:	22:19:36
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		P22914USC10_Amendment_and_Response.pdf	38906 ea7bcc32d215ad45967dc19f957dd34a544 6cech	yes	6

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Amendment/Request for Reconsideration-After Non-Final Rejection	1	1
	Specification	2	2
	Applicant Arguments/Remarks Made in an Amendment	3	6
Warnings:			
Information:			
	Total Files Size (in bytes):	38906	

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.
National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.
New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

Doc Code: DIST.E.FILE **Document Description: Electronic Terminal Disclaimer - Filed**	**PTO/SB/26** U.S. Patent and Trademark Office Department of Commerce

Electronic Petition Request	**TERMINAL DISCLAIMER TO OBVIATE A DOUBLE PATENTING REJECTION OVER A "PRIOR" PATENT**
Application Number	17951973
Filing Date	23-Sep-2022
First Named Inventor	Fletcher Rothkopf
Attorney Docket Number	P22914USC10
Title of Invention	WEARABLE ELECTRONIC DEVICE

☒ Filing of terminal disclaimer does not obviate requirement for response under 37 CFR 1.111 to outstanding Office Action

☒ This electronic Terminal Disclaimer is not being used for a Joint Research Agreement.

Owner	Percent Interest
APPLE INC.	100%

The owner(s) with percent interest listed above in the instant application hereby disclaims, except as provided below, the terminal part of the statutory term of any patent granted on the instant application which would extend beyond the expiration date of the full statutory term of prior patent number(s)

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as the term of said prior patent is presently shortened by any terminal disclaimer. The owner hereby agrees that any patent so granted on the instant application shall be enforceable only for and during such period that it and the prior patent are commonly owned. This agreement runs with any patent granted on the instant application and is binding upon the grantee, its successors or assigns.

In making the above disclaimer, the owner does not disclaim the terminal part of the term of any patent granted on the instant application that would extend to the expiration date of the full statutory term of the prior patent, "as the term of said prior patent is presently shortened by any terminal disclaimer," in the event that said prior patent later:
- expires for failure to pay a maintenance fee;
- is held unenforceable;
- is found invalid by a court of competent jurisdiction;
- is statutorily disclaimed in whole or terminally disclaimed under 37 CFR 1.321;
- has all claims canceled by a reexamination certificate;
- is reissued; or
- is in any manner terminated prior to the expiration of its full statutory term as presently shortened by any terminal disclaimer.

◉ Terminal disclaimer fee under 37 CFR 1.20(d) is included with Electronic Terminal Disclaimer request.

○ I certify, in accordance with 37 CFR 1.4(d)(4), that the terminal disclaimer fee under 37 CFR 1.20(d) required for this terminal disclaimer has already been paid in the above-identified application.	
Applicant claims the following fee status: ○ Small Entity ○ Micro Entity ◉ Regular Undiscounted I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.	
THIS PORTION MUST BE COMPLETED BY THE SIGNATORY OR SIGNATORIES I certify, in accordance with 37 CFR 1.4(d)(4) that I am: ◉ An attorney or agent registered to practice before the Patent and Trademark Office who is of record in this application Registration Number 70361 ○ A sole inventor ○ A joint inventor; I certify that I am authorized to sign this submission on behalf of all of the inventors as evidenced by the power of attorney in the application ○ A joint inventor; all of whom are signing this request	
Signature	/Peter J. Nagle/
Name	Peter J. Nagle

*Statement under 37 CFR 3.73(b) is required if terminal disclaimer is signed by the assignee (owner).
Form PTO/SB/96 may be used for making this certification. See MPEP § 324.

Electronic Patent Application Fee Transmittal

Application Number:	17951973
Filing Date:	23-Sep-2022
Title of Invention:	WEARABLE ELECTRONIC DEVICE
First Named Inventor/Applicant Name:	Fletcher R. Rothkopf
Filer:	Peter James Nagle/Sonya Domingo
Attorney Docket Number:	P22914USC10

Filed as Large Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
STATUTORY OR TERMINAL DISCLAIMER	1814	1	170	170
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension-of-Time:				
Miscellaneous:				
			Total in USD ($)	**170**

Doc Code: DISQ.E.FILE
Document Description: Electronic Terminal Disclaimer – Approved

Application No.: 17951973

Filing Date: 23-Sep-2022

Applicant/Patent under Reexamination: Rothkopf

Electronic Terminal Disclaimer filed on March 22, 2023

☒ APPROVED

This patent is subject to a terminal disclaimer

☐ DISAPPROVED

Approved/Disapproved by: Electronic Terminal Disclaimer automatically approved by EFS-Web

U.S. Patent and Trademark Office

Electronic Acknowledgement Receipt	
EFS ID:	47728368
Application Number:	17951973
International Application Number:	
Confirmation Number:	5622
Title of Invention:	WEARABLE ELECTRONIC DEVICE
First Named Inventor/Applicant Name:	Fletcher R. Rothkopf
Customer Number:	62579
Filer:	Peter James Nagle/Sonya Domingo
Filer Authorized By:	Peter James Nagle
Attorney Docket Number:	P22914USC10
Receipt Date:	22-MAR-2023
Filing Date:	23-SEP-2022
Time Stamp:	22:22:10
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$170
RAM confirmation Number	E20233LM22069604
Deposit Account	
Authorized User	
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Terminal Disclaimer-Filed (Electronic)	eTerminal-Disclaimer.pdf	41271 a851299a07710a8a63a96f51a716e2144d1638cf	no	2
Warnings:					
Information:					
2	Fee Worksheet (SB06)	fee-info.pdf	38090 93a5cf9be9886f6de9cc90a1e5031ee50eb25bbd	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	79361		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.
National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.
New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PTO/SB/08A (08-03) U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE Substitute for Form 1449A/PTO **INFORMATION DISCLOSURE STATEMENT BY APPLICANT** *(Use as many sheets as necessary)*	**APPLICATION NO.:** 17/951,973	**FILING DATE:** September 23, 2022
	INVENTOR(S): Fletcher Rothkopf	**ART UNIT:** 5622
	EXAMINER NAME: Brian T Gedeon	**ATTY. DOCKET NO.:** P22914USC10

U.S. PATENT DOCUMENTS

EXAMINER INITIALS*	Cite No.[1]	PATENT NUMBER Number – Kind Code[2] (if known)	ISSUE DATE MM-DD-YYYY	Name of Patentee of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
	A1.	4,129,124	12/12/1978	Thalmann	
	A2.	4,163,447	8/7/1979	Orr	
	A3.	4,224,948	9/30/1980	Cramer et al.	
	A4.	4,248,244	2/3/1981	Charnitski et al.	
	A5.	4,375,219	3/1/1983	Schmid	
	A6.	5,613,008	05/31/1994	Suga et al.	
	A7.	6,075,755	06/13/2000	Zarchan	
	A8.	6,091,530	06/18/2000	Duckworth	
	A9.	6,265,789	7/24/2001	Honda et al.	
	A10.	9,277,880	3/8/2016	Poeze et al.	
	A11.	10,231,629	3/19/2019	Pei et al.	
	A12.	10,060,788	8/28/2018	Fei	

U.S. PUBLICATION DOCUMENTS

EXAMINER INITIALS*	Cite No.[1]	PUBLICATION NUMBER Number – Kind Code[2] (if known)	PUBLICATION DATE MM-DD-YYYY	Name of Inventor(s) of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
	B1.	2001/0056243	12/27/2001	Ohsaki et al.	
	B2.	2005/0116820	6/5/2005	Goldreich	
	B3.	2007/0276270	11/29/2007	Tran	
	B4.	2008/0208009	8/28/2008	Shklarski	
	B5.	2012/0221254	8/30/2012	Kateraas et al.	
	B6.	2014/0135594	5/15/2014	Yuen et al.	
	B7.	2015/0214749	7/30/2015	Park et al.	
	B8.	2015/0355604	12/10/2015	Fraser et al.	
	B9.	2016/0073914	3/17/2016	Lapetina et al.	
	B10.	2016/0228064	8/11/2016	Jung et al.	

FOREIGN PATENT DOCUMENTS						
EXAMINER INITIALS*	Cite No.[1]	DOCUMENT NUMBER Country Code[3] – Number[4] – Kind Code[5] (if known)	PUBLICATION DATE MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear	T[6]
	C1.	WO1982/00088	1/21/1982	Prime Microelectronic Instruments, Inc.		
	C2.	WO2005/092182	10/6/2005	Seiko Instr Inc		
	C3.	WO2012/140559	10/18/2012	Medic4All		
	C4.	WO2015/116111	8/6/2015	Hewlett-Packard Development Co, L.P.		
	C5.	WO2015/150199	10/8/2015	Koninklijke Philips N.V.		
	C6.	WO2017/165532	9/28/2017	Neumitra Inc		
	C7.	JP2005270543	10/6/2005	Seiko Instr Inc		

OTHER PRIOR ART – NON PATENT LITERATURE DOCUMENTS			
EXAMINER INITIALS*	Cite No.[1]	Include name of Author, title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), volume-issue number(s), publisher, page(s) and date.	T[6]
	D1.	ALDINGER, F. and Weberruβ, V.A., "An Introduction to Structures, Properties, Technologies, Methods" (2010) In: Advanced Ceramics and Future Materials 17 pages	
	D2.	BERBARI, E.J., "Principles of Electrocardiology" (2015) In: The Biomedical Engineering Handbook -4th Edition (Eds: J.D. Bronzin & D.R. Peterson) 5 pages	
	D3.	CANFIELD, D., "Drying and Curing Inks and Coatings on Glass" (March 16, 2013) Glass Magazine 5 pages	
	D4.	DOREMUS, R.H., "Structure, Properties, and Processing" (2008) In: Ceramic and Glass Materials (Eds: J.F. Shackelford & R.H. Doremus) 33 pages	
	D5.	FRANCIS, J., "ECG monitoring leads and special leads" (2016) Indian Pacing and Electrophysiology Journal 16:92-95.	
	D6.	KINGERY, W.D., "Introduction to Ceramics" (1960) Eds: John Wiley & Sons, Inc. 23 pages	
	D7.	LOEHMAN, R.E., "Surfaces, Interfaces, Thin Films" (1993) In: Characterization of Ceramics, Materials Characterization Series (Eds: R.E. Loehman, J.E. Fitzpatrick) 13 pages	
	D8.	MENDELSON, Y. et al., "A Wearable Reflectance Pulse Oximeter for Remote Physiological Monitoring" (Aug 30-Sept 3, 2006) Proceedings of the 28th IEEE, EMBS Annual International Conference New York City 4 pages	
	D9.	MENDELSON, Y., "Wearable Wireless Pulse Oximetry for Physiological Monitoring" (Aug 4, 2008) Presentation - PPL Workshop 34 pages	
	D10.	MEZIANE, N. et al. "Dry Electrodes for Electrocardiography" (2013) Physiol. Meas. 34:R47-R69.	
	D11.	SHI, F., "Progress in Modern Ceramics" (2012) In: Ceramic Materials (Ed: Feng Shi) 6 pages	
	D12.	Declaration of R. James Duckworth, Ph.D, Filed February 27, 2023 in Case No. IPR2023-00634, 187 Pages	
	D13.	Defendant Masimo Corporation's Answer To Complaint and Counterclaims, dated December 12, 2022, Filed in District Court Case 1:22-cv-01378-MN, Masimo Corporation and Sound United, LLC vs. Apple Inc., 904 pages	

* EXAMINER: Initial if citation considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant

[1] Applicant's unique citation number (optional). [2] See Kinds Codes of USPTO Patent Documents at www.uspto.gov or MPEP 901.04. [3] Enter Office that issued the document, by the two-letter code (WIPO Standard ST.3). [4] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [5] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [6] Applicant is to place a check mark here if English language Translation is attached.
1.

OTHER PRIOR ART – NON PATENT LITERATURE DOCUMENTS			
	D14.	Complaint For Patent Infringement, dated October 20, 2022, Filed in District Court Case 1:22-cv-01378-UNA, Masimo Corporation and Sound United, LLC vs. Apple Inc., 672 pages	
	D15.	Declaration of Sylvia D. Hall-Ellis, Ph.D., Filed February 27, 2023 in Case No. IPR2023-00634, 40 pages	
	D16.	Declaration of Jamie L. Kringstein In Support Of Plaintiff And Counterclaim-Defendant Apple Inc.'s Motion To Dismiss Masimo Corporation's Counterclaims And Strike Its Inequitable Conduct Affirmative Defense, dated February 21, 2023, Filed in District Court Case 1:22-cv-01378-MN-JLH, *Masimo Corporation and Sound United, LLC vs. Apple Inc.*, 52 pages	
	D17.	Plaintiff And Counterclaim-Defendant Apple Inc.'s Memorandum Of Law In Support Of Its Motion To Dismiss Masimo Corporation's Counterclaims And Strike Its Inequitable Conduct Affirmative Defense, dated February 21, 2023, Filed in District Court Case 1:22-cv-01378-MN, *Masimo Corporation and Sound United, LLC vs. Apple Inc.*, 28 pages	
	D18.	Petition For Inter Partes Review Of U.S. Patent No. 10,627,783, Filed February 27, 2023, in Case No. IPR2023-00634, 124 pages	

EXAMINER	DATE CONSIDERED

EXAMINER: Initial if citation considered, whether or not citation is in conformance with MPEP 609; Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

Electronic Patent Application Fee Transmittal					
Application Number:	17951973				
Filing Date:	23-Sep-2022				
Title of Invention:	WEARABLE ELECTRONIC DEVICE				
First Named Inventor/Applicant Name:	Fletcher R. Rothkopf				
Filer:	Peter James Nagle/Sonya Domingo				
Attorney Docket Number:	P22914USC10				
Filed as Large Entity					
Filing Fees for Utility under 35 USC 111(a)					
Description		**Fee Code**	**Quantity**	**Amount**	**Sub-Total in USD($)**
Basic Filing:					
Pages:					
Claims:					
Miscellaneous-Filing:					
Petition:					
Patent-Appeals-and-Interference:					
Post-Allowance-and-Post-Issuance:					
Extension-of-Time:					

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
SUBMISSION- INFORMATION DISCLOSURE STMT	1806	1	260	260
		Total in USD ($)		**260**

Electronic Acknowledgement Receipt	
EFS ID:	47728855
Application Number:	17951973
International Application Number:	
Confirmation Number:	5622
Title of Invention:	WEARABLE ELECTRONIC DEVICE
First Named Inventor/Applicant Name:	Fletcher R. Rothkopf
Customer Number:	62579
Filer:	Peter James Nagle/Sonya Domingo
Filer Authorized By:	Peter James Nagle
Attorney Docket Number:	P22914USC10
Receipt Date:	22-MAR-2023
Filing Date:	23-SEP-2022
Time Stamp:	22:16:17
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$260
RAM confirmation Number	E20233LM17279306
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1	Transmittal Letter	P22914USC10_IDS_Transmittal.pdf	16537 0fb0d9190b929c69ccfc7ed918ecd758f807f5f5	no	2
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2	Foreign Reference	WO1982000088A1.pdf	3744911 f2d19d518b86e05e9c6d9da0b14da0dfe6d0cd73	no	28
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3	Foreign Reference	WO2005092182.pdf	885621 9a6e3bea797cc41a2bd4f38245a86ac56f3ad635	no	32
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4	Foreign Reference	WO2012140559.pdf	3227809 18e9b9d24d14e049f22efc7b70bcd7e972f449dc	no	32
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5	Foreign Reference	WO2015116111.pdf	2582628 62468d76883230d15849c03a4bea2c2421c08abd	no	21
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6	Foreign Reference	WO2015150199.pdf	3683369 ab038f1ad062371109be184f6e9c97bcdb49d576	no	31
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7	Non Patent Literature	NPL_Aldinger_2010.pdf	24469916 c88f7e4a5a6fc79d40d6602b4d9381e3b597b53b	no	17
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8	Non Patent Literature	NPL_Berbari.pdf	6211276 d093987e7255d996fe7dfd4e80f16ca684cc75c2	no	5
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9	Non Patent Literature	NPL_Canfield.pdf	717939 e5fc4daf1ff23ebc7a656786f19a1f0772a656a2	no	5
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10	Non Patent Literature	NPL_Francis_2016.pdf	711964 e5388aed88f25b8cee52995f888512192850 09cb	no	4
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11	Non Patent Literature	NPL_Loehman_1993.pdf	8036638 ffdd0b5d72f596bd99157706981 3630e078 277c5	no	13
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12	Non Patent Literature	NPL_Mendelson_2006.pdf	700906 8ff0a1ec8296250567703 6c94a32cd7193ce c022	no	4
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13	Non Patent Literature	NPL_Mendelson_2008.pdf	4012122 07913dadce5c379f3043abc1ffadc154515 2a2b4	no	34
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14	Non Patent Literature	NPL_Meziane_2013.pdf	773020 d03c6620b184df6db163a85f4aa5888719c06827e	no	23
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15	Non Patent Literature	NPL_Shi_2012.pdf	4241760 5225e7989fd89abcc40670ac6502f960965c7a05b	no	6
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19	Non Patent Literature	NPL-Complaint_For_Patent_Infringement_672_pgs-part_1.pdf	14390056 87e402a399d7bc6de9b9e180eb306f2ca9cfccdf	no	200
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21	Non Patent Literature	NPL-Complaint_For_Patent_Infringement_672_pgs-part_3.pdf	19501764 17cea3e7ab0a22da8ea7492a7c80b65bbe0e6f03	no	272
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22	Foreign Reference	JP2005270543A.pdf	891984 d41c301fbf413dc1e6788d53a5e6e9c165ded629	no	30
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23	Non Patent Literature	NPL_Doremus_2008.pdf	7338532 dfc8d25e60569baed75d932a8da8b5801961c741	no	33
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24	Non Patent Literature	NPL_Kingery_1960.pdf	4492677 e0a0a456ecf26b0ceebfa7652fc60ef02dd0fbce	no	23
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25	Non Patent Literature	NPL_Declaration_Duckworth.pdf	10439097 1c433ed69161e157bb18e00cc7dff5be18fbbe7	no	187
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28	Non Patent Literature	NPL-Plantiff_and_Counterclaim_28_pgs.pdf	321245 3c2f7c3cff0e79187cac73c76bd856266a7d46e5	no	28
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29	Non Patent Literature	NPL-Petition_for_IPR_124_pages.pdf	15600498 87a86aa68085ed41f75f6ddddcd00317cdb155fc1	no	124
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31	Information Disclosure Statement (IDS) Form (SB08)	P22914USC10_PTO-SB-08.pdf	56065 1c3c89b76bd567da70621383ccb2a4cc70984d6a	no	3
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Docket No. P22914USC10

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the Application of:		
Fletcher Rothkopf et al.	Examiner:	BRIAN T GEDEON
Application No. 17/951,973	Art Unit:	3792
Filed: September 23, 2022	Confirmation No.	5622
For: WEARABLE ELECTRONIC DEVICE		

INFORMATION DISCLOSURE STATEMENT TRANSMITTAL

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

The Examiner is requested to consider the references noted on the enclosed Form PTO/SB/08A and B during examination of the above-identified patent application. These references are submitted for the Examiner's consideration and are submitted pursuant to the duty of disclosure under 37 C.F.R. § 1.56. In submitting these references, no representation is made or implied that the references are or are not material to the examination of the application. The Examiner is requested to review the cited references and is encouraged to make his or her own determination of materiality of the references cited.

Pursuant to the requirements of 37 C.F.R. § 1.98(a)(2)(ii), only copies of the foreign references and non-patent literature documents are provided. Copies of the U.S. patent and U.S. patent application publication references are not provided, unless required by the Office.

In accordance with **37 CFR 1.97(c)**, the information disclosure statement is being filed after the period specified in 37 CFR 1.97(b), but before the mailing date of any of a final action under §1.113, a notice of allowance under §1.311, or an action that otherwise closes prosecution in the application, and is accompanied by the fee set forth in §1.17(p)

FEE AUTHORIZATION

The required fee specified in 37 C.F.R. § 1.17(p), is being paid concurrently herewith by credit card authorization through the USPTO Electronic Filing System. The Director is hereby authorized any fee deficiency or credit any overpayment, to Deposit Account No. 50-4621.

If the Examiner has any questions, please contact the undersigned attorney.

Dated: March 22, 2023

Respectfully submitted,

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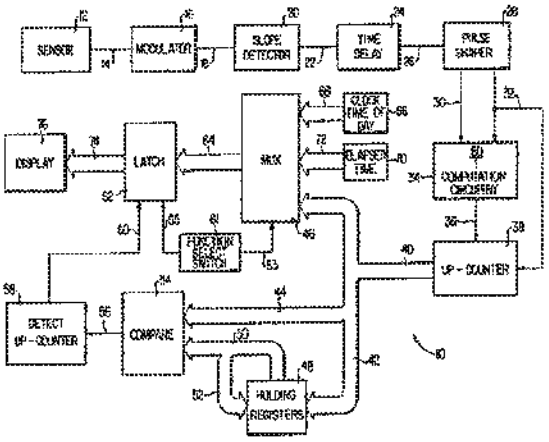
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(54) Title: CARDIOTACHOMETER USING AUTOCORRELATION TECHNIQUES

(57) Abstract

A cardiotachometer for indicating heart rate of a user in beats per minute. The cardiotachometer comprises a sensor (12), placed on the body of the user, for producing an electrical signal indicative of the heart rate of the user. Circuitry (28) is provided for converting the electrical signal into first and second digital signals. 60/t computation circuitry (34) responds to the first and second digital signals and produces a third digital signal having a varying frequency representative of the number of heart beats per minute. An up-counter (38) converts the third digital signal into a plurality of binary number signals, each bit of which is stored in a series of shift registers (48). A compare (54) using a plurality of exclusive OR gates, compares each of the stored binary number signals with the most recent binary number signal, from the up-counter, to determine if a plurality of compared signals are within a predetermined percentage of each other. Finally, a display (76) is provided for displaying the most recent binary number signal, when the plurality of compared signals are within the predetermined percentage of each other. Further provision is made for display of both elapsed time and time of day.



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Description

Cardiotachometer Using Autocorrelation Techniques

Technical Field

The present invention relates to pulse monitors with visual readout, in general, and to a cardiotachometer which performs a comparison between selected heartbeat intervals such that when any plurality of the intervals are within a predetermined percentage of each other, the plurality of intervals are averaged, read out and held in the display until the next update.

Background Art

Heart rate is the basic parameter used to evaluate and determine the condition of the human body. In carrying out its action, the heart produces three wave complexes, designated as P, QRS, and T, each of which corresponds to a particular electrical event within the heart. It has long been known that the R wave produces the greatest electrical activity, and for this reason the R-R interval has been used as a way of measuring the time between heartbeats. By knowing the time between heartbeats, it is easy to determine the number of beats per minute.

The contraction, or period of contraction, of the heart, is referred to as a systole. It coincides with the interval between first and second heart sounds, during which blood is forced into the aorta and the pulmonary trunk. In the same way the R-R interval may be used as a way of measuring the time between heartbeats, the interval between systoles may be used for the same purpose.

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During a systole, the heart contracts and forces blood through the arteries, which respond by expanding. Thus, a systole may be detected by placing an appropriate transducer or sensor against any of the well known pressure points on the human body or in an area where blood flow is occurring.

The transducer may be in the form of a pressure transducer, such as a piezoelectric crystal or a photo-transducer in the form of a light emitting diode and a photocell.

There are any number of prior art pulse monitors which detect the R-R interval or the systolic rate, compute the heart rate in beats per minute and, then, display every update as an instantaneous beat-by-beat readout. An undesirable feature of this procedure is that movements of the transducer by the user are not distinguished from actual heart pulses by the transducer and thus a false reading occurs. Another cause of false readings is the detection by the transducer of normal respiratory fluctuation or psychomotor responses. These readings manifest themselves in a constantly changing display.

To avoid such false readings, electronic pulse rate measuring devices have been designed to average the time interval over 4, 8, 10, or 16 beats to get an average heart beat. Each of these averaging techniques has its own drawback. In the case of the 4 beat average, there is still some jumping of the readout. The problem with the 8, 10 or 16 beat average is the long time interval between updates. Probably the most important drawback found in all averaging systems is that any error occurring during the period under consideration is also averaged into the final readout.

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There is thus a need for a cardiotachometer or a pulse monitor which produces a continuous update and display, and which is not plagued by the problems of inconsistent readout, and the introduction of error from any source, such as, muscle tremor, poor sensor contact, and inappropriate use, to name a few. The present invention is directed toward filling that need.

Disclosure of Invention

In accordance with the subject invention, there is provided a miniature, totally self-contained cardiotachometer to be worn or held by a user for numerically displaying a continuous readout of the user's heart beat rate. The device, which may be housed in a wrist watch or a compact hand-held unit, basically comprises a sensor in the form of a light emitting diode and a photocell which is placed on the finger of the user. The photocell responds to the variations in light intensity reflected off the capillary bed within the finger to produce an analog voltage signal representative of the systolic beats. This signal is received by a slope detector where it is amplified and converted into a digital signal.

The digital signal is delayed for a predetermined time and then fed into a pulse shaper to produce a pair of clean pulse trains. One pulse train is used to reset an up-counter and a 60/t computation block, while the other pulse train is used to latch data within the 60/t computation block.

The 60/t computation circuitry produces an output signal which has a frequency representative of the heart rate in beats per minute. This signal is used to cause an up-counter to produce a binary

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number equal to the number of beats per minute. This number is fed to a latch and held.

The binary number from the up-counter, with the two least significant bits excluded, is simultaneously fed to a comparator and a series of holding registers.

In the preferred embodiment the holding registers typically comprise a plurality of 10-bit shift registers, one being associated with each binary bit from the up-counter. The binary numbers from the up-counter are placed into the holding registers on a first-in first-out (FIFO) basis. Thus, the eleventh number placed into the holding registers will replace the first number previously stored therein. If the bits of the current number from the up-counter are the same as the bits of one of the numbers in the holding registers, a compare signal is issued and fed to a detect up-counter. This comparison continues with the remaining numbers stored in the holding registers. When at least one more valid comparison is made, the detect up-counter is advanced to produce a latch signal. The latch responds to this signal by causing the data stored therein to be transferred to a display where the data is converted into an array of integers in eye readable format.

Provision is also made for an elasped time indicator and a conventional time-of-day clock, each of which have their readout on the same display as the cardiotachometer.

It is thus an object of the present invention to provide a cardiotachometer for producing a numerical indication of pulse rate with an extremely high degree of accuracy.

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It is another object of the present invention to provide a totally unified, self-contained, sensor-electronic-display pulse monitor.

It is still an object of the present invention to provide a simple, inexpensive pulse monitor not plagued by readout error.

It is yet an object of the present invention to provide a pulse monitor not plagued by movements of the sensor at the detection site by the user.

It is a further object of the present invention to provide a pulse monitor in which beat-by-beat read unsteadiness, due to normal respiratory fluctuation or psychomotor responses, is ameliorated.

Additional objects of the present invention will become apparent from a reading of the appended specification and claims in which preferred but not necessarily the only forms of the invention will be described in detail, taken in connection with the drawings accompanying and forming a part of the application.

Brief Description of Drawings

Figure 1 is a functional block diagram for a preferred embodiment of the subject invention;

Figure 2 is block circuit diagram showing examples of the sensor, the modulator and the slope detector;

Figure 3 is a block circuit diagram showing examples of the time delay and the pulse shaper;

Figure 4 is a block circuit diagram showing examples of the 60/t computation circuit and the up-counter;

Figure 5 is a block circuit diagram showing the holding registers and the compare;

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Figure 6 is a perspective view of the hand-held embodiment of the subject cardiotachometer.

Figure 7 is a perspective view of the subject cardiotachometer in the form of a wrist watch.

Figure 8 is a schematic rear view of the cardiotachometer of Figure 7.

Best Mode for Carrying Out the Invention

With reference to Figure 1, the cardiotachometer of the subject invention is generally noted as 10. In a preferred embodiment of the subject invention, the cardiotachometer 10 is a totally self-contained unit in the form of a wrist watch or a hand-held device.

A sensor 12, which may be a conventional pressure transducer or a light emitting diode/photocell combination, measures the systolic beats of the user. In the case of the wrist watch embodiment, the beats are sensed at the wrist of the user in a conventional manner. In the case of the hand held device, the beats are sensed through a finger of the user in a conventional manner. The electrical signal produced by the sensor is fed into a modulator 16 via leads 14. The modulator 16 converts the incoming signal into a digital signal for interpretation by the slope detector 20. The output of the slope detector 20 appears on line 22 and is fed to a time delay 24. The output of the time delay appearing on leads 26 is fed to a pulse shaper 28 which produces two pulse trains on lines 30 and 32.

The signals appearing on lines 30 and 32 are fed into 60/t computation circuitry 34. The signals on lines 30 and 32 cause the 60/t circuit 34 to produce at its output 36, a digital signal having

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a frequency equal to the number of heart beats per minute.

An up-counter 38 responds to the signal on line 36 by producing an output signal 40 which is a digital representation in binary form of the number of beats per minute. The signal appearing on line 32 is used to reset the up-counter 38 between detected beats.

The output of the up-counter is typically a 12-bit number, D11-D0, which is fed to a multiplexer 46. The multiplexer 46 also receives the output of a time of day clock 66 on lines 68, and an elapsed time indicator 70 on lines 72.

At the same time, 6 bits, D7-D2, from the output of the up-counter are fed to holding registers 48 on lines 42 and to a compare 54 via lines 44. The holding registers 48 typically comprise a series of 10-bit shift registers, although shift registers having a capacity for a greater or lesser number of bits can be used. The holding registers are clocked at a rate such that the entire contents of the registers are presented to the compare 54 before the output of the up-counter is changed. The output of the holding registers 48 is also reinserted into the registers on a first-in first-out basis, along with the output of the up-counter so that the oldest piece of data is replaced by the output of the up-counter.

The compare 54 contrasts the data from the up-counter 40, appearing on lines 44, with the data samples contained in the holding registers 48, appearing on lines 50. When the bits on line 44 are the same as the bits on line 50, the compare 54 issues a compare signal on line 56.

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The detect up-counter which is typically a conventional up-counter, is caused to advance or count one unit by the compare signal 56. When the detect up-counter has advanced at least two, but typically three, units, a latch pulse is issued on line 60.

A function select switch 61, which is typically a multiposition switch or a series of push button switches located external to the device, provides a means for selecting between three functions for display, namely, time of day, elapsed time, or heart rate. When heart rate is selected the multiplexer 46 feeds the output of the up-counter 38 to the latch 62. The signal appearing on line 60 from the detect up-counter 58 causes the latch 62 to issue appropriate signals on lines 74 to cause a conventional display 76 to display in eye readable form the heart rate of the user in beats per minute.

When the user wishes to display the time of day or the elapsed time, the function select switch 61 also activates the latch 62 to produce the appropriate display in eye readable format on display 76.

A detailed description of the sensor 12, the modulator 16, and the slope detector 20 will now be presented with reference to Figure 2. The sensor 12 comprises a light emitting diode (LED) 100 in series with a resistor 102 between a source of potential Vcc and ground. There is also provided a photocell in the form of a phototransistor 104 in series with a resistor 106 between a source of potential Vcc and ground. The photocell senses the light from the LED bouncing off the capillary bed within the skin of the wearer as a beam of varying intensity caused by the systolic beats. The photocell

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responds by producing a varying voltage which is fed into the positive term of a comparator 110.

The output of the comparator 110 is fed to the D input of flip-flop 122 via inverters 112 through 114. The flip-flop 122 produces a pulse train at its Q output which is fed back through resistor 118 to the negative input of the comparator 110. A capacitor 120 is connected between the negative input and ground. As the capacitor charges, it will trail the upgoing pulse from the phototransistor. When it catches the pulse, the output of the comparator 110 will be low, otherwise the output will be high. Therefore, the Q output of the flip-flop 122 will produce a series of logic ones when the slope of the output of the phototransistor is positive and will produce a series of logic zeros at all other times.

The Q output of the flip-flop 122 is fed into a 16 bit shift register 126, although shift registers having a greater bit capacity can be used. The outputs of the shift registers are fed into a NAND gate 128 and then inverted by an inverter 134 to produce a signal on line 22. Should any of the outputs of the shift register become a logic zero then the output of the inverter 134 will be a logic zero, thus indicating that a pulse has not been detected. When the shift register is filled with logic ones, the output of the inverter 134 will also be a logic one, thus indicating that a pulse has been detected. The capacity of the shift register 126 as well as the clocking rate for the flip-flop 122 and the shift register 126 is chosen so that base line noise, including 60 and 120 Hz noise, at the sensor is not detected as a pulse. In other words, for a pulse to be detected it must have a

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fairly high slope, such as that caused by a systolic beat.

With reference to Figure 3, the time delay 24 and the pulse shaper 28 will be described in detail. The output of the slope detector 20 appearing on line 22 is fed into a NAND gate 140. The other input to the NAND gate is received from the $\bar{Q}$ output of a flip-flop 142. The output of the NAND gate 140 provides a clock signal to the flip-flop 142 on line 148. The Q output of flip-flop 142 is fed to the D input of an up-counter 144 which has its reset grounded. The up-counter issues a signal every 16th pulse to reset the flip-flop 142. In this way, a time-delayed signal is issued on line 26 and fed into the pulse shaper 28. This time delay serves the purpose of providing a "dead time" interval where no spurious pulses, whether electronic or mechanical in origin, can be counted.

The pulse shaper 28 which is used to provide a pair of synchronized pulses on lines 30 and 32, comprises three flip-flops 150-152. Flip-flop 150 has its D input held high and is clocked by the signal on line 26. The Q output of flip-flop 150 is fed to the D input of flip-flop 151. The Q output of flip-flop 151 is fed to the D input of flip-flop 152 and also provides a signal on line 30. The Q output of the flip-flop 152 provides a signal on line 32 as well as a reset signal for flip-flop 150. Thus, the signals appearing on lines 30 and 32 are synchronized to further provide that no spurious pulses, electronic or mechanical, are allowed into the computation.

With reference to Figure 4, a detailed description of the 60/t circuit 34 and the up-counter 38 will be provided. A conventional 12-bit up-counter

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160 is enabled and reset by the signal on line 32. The output of the up-counter is a 12-bit number chosen to represent the time interval between reset times. This number is fed via lines 162 into a latch 164 which is clocked at a rate determined by the signal on line 30. The latch has its reset high so as to dump it contents into the divide-by-N (÷ N) 168.

The divide-by-N is reset by the signal appearing on line 32 and is appropriately clocked by a signal on line 167 to produce at its output, a digital signal having a frequency equal to the number of heart beats per minute. Thus, it can be seen that the 60/t circuitry takes the time interval between systolic beats, and converts this time interval into a digital signal indicative of the number of heart beats per minute. This signal, which appears on line 36, is used to clock an up-counter 38 which is reset between detected beat intervals by the signal on line 32. The output of the up-counter is a 12-bit binary number, D11 through D0, which appears on lines 40. The output of the up-counter is fed via lines 40 to the multiplexer 46. At the same time bits D7 through D2 from the up-counter are fed into the holding registers 48 and the compare 54.

With reference to Figure 5, the details of the holding registers 48 and the compare 54 will now be described. Bits D7-D2 from the output of the up-counter 38 are simultaneously fed into the inputs A_o through F_o of a multiplexer 180 and a series of exclusive OR gates 190 through 195 via lines 44-1 through 44-6. The outputs, A through F, of the multiplexer 180 are fed into a series of 10-bit shift registers 170 through 175. The outputs of the

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shift registers are fed to inputs of the exclusive OR gates 190 through 195 via lines 51-56, and to the inputs A_1 through F_1 of the multiplexer 180 via lines 52-1 through 52-6.

The shift registers 170 through 175 shift the incoming data received from the multiplexer 180 on a first-in first-out (FIFO) basis. The data is shifted through the shift registers at such a rate so that each of the data samples is presented for comparison by the compare 54 with the selected bits D7 through D2 from the up-counter 38.

The outputs of the exclusive OR gates 190 through 192 are fed to a NOR gate 196 the output of which is fed to the input of a NAND gate 204. The outputs of exclusive OR gates 193 through 195 are fed to the inputs of NAND gate 204 via inverters 198 through 200, respectively.

The exclusive OR gates 190 through 195 each issue a logic 1 when the inputs to those gates are different and issue a logic 0 when the inputs are the same. When the outputs of all of the exclusive OR gates 190 through 195 are low, the output of the NAND gate 204 is high, indicating that a valid comparison has been made. If any of the outputs from the exclusive OR gates is high then the output of the NAND gate 204 will be low, indicating that a valid comparison has not been made.

By way of example, assume that the output from the up-counter 38 is a binary number indicating that the heart rate is 72 beats per minute. The output, D11-D0, of the up-counter 38 in binary notation is 0000, 0100, 1000. As stated before, only bits D7-D2 are fed into the exclusive OR gates. In this case, binary bits 010010 will be fed, respectively, to the inputs 41-1 through 44-6 of the

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exclusive OR gates. Since the two least significant bits of the output from the up-counter 38 have been excluded from the comparison, the output of the up-counter 38 will compare favorably to samples stored in the shift registers which are in the range between 72 and 75 beats per minute. This is due to the fact that the bits D7 through D2 for each of those numbers are the same as bits D7 through D2 for the number 72. A specific comparison range, obtained by excluding the two least significant bits, has been described. It is to be understood that the comparison range as well as the percentage difference between the numbers within the range may be increased by excluding a greater number of least significant bits. Further, the comparison range and the percentage difference may be narrowed by not excluding any least significant bits so that the percentage difference between samples is reduced to zero.

Returning now to Figure 1, the compare signal on line 56 indicates that a valid comparison has been made. This signal provides a pulse to advance the up-counter 58. When the up-counter advances at least two, but typically three, units, it issues a latch signal on line 60 to latch the data previously stored in the latch 62, to appear on display 76. The multiplexer 46 is of conventional design, and may include a series of multiplexers designated as model number 4053 and manufactured by National Semiconductor, Inc., Santa Clara, California. Likewise the latch is of conventional design and may include a number of BCD-to-seven segment conversion devices. One such device is model number 4543, again, manufactured by National Semiconductor, Inc. The display 76 is typically of the type which converts the output of the latch 62 to an eye-readable array

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of integers. One such device is model number 741 manufactured by Beckman Instruments, Inc., Fullerton, California. Although there are numerous variations in the timing scheme used to clock the various components of the subject invention, excellent results have been obtained using the following clock rates:

512 Hz for the flip-flop 122 in the modulator and shift register 126 in the slope detector.

16 Hz to the up-counter 144 in the time delay.

32,768 Hz to the flip-flop 151 in the pulse shaper.

128 Hz to the up-counter 160 and 7680 Hz to the divide-by-N 168 in the 60/T circuit 34.

16,384 Hz to the shift registers 170-175 in the holding registers 48.

With reference to Figure 6, a hand-held version of the unified, self-contained cardiotachometer with digital readout is generally designated as 200. The device comprises a unitized housing 202 shaped for convienent placement within the palm of the user. The light emitting diode 100 and the phototransistor 104 are positioned on the housing so as to receive the thumb of the user. In this way systoles are detected. The cardiotachometer circuitry, described hereinbefore, is mounted within the housing 200. The output of the phototransistor 104 is fed to the cardiotachometer circuitry, wherein it is processed and read out on the display 76 which is positioned on the housing for easy reading by the user.

The cardiotachometer of the subject invention being mounted in a wrist watch is shown in Figures 7 and 8. In this embodiment the cardiotachometer

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circuitry is mounted in a watch housing 210 which is secured to the wrist of the user by straps 212. The sensor, which is a piezoelectric transducer 214, is secured to the back of the housing 210 and detects systoles through the wrist of the user. A push button switch 216 is provided to select the function (heart rate, time of day, or elapsed time) to be displayed on the display 76.

Obviously many modifications and variations of the present invention are possible in light of the above teachings, and it is contemplated that the subject invention may be implemented through the use of discrete components or an integrated circuit chip. It is further contemplated that an integrated circuit chip having complimentary-metal-oxide-silicon (CMOS) circuits may be used to configure the present invention, and that a remote sensor may be contained in a housing separate from that containing the remainder of the device. It is, therefore, to be understood that within the scope of the appended claims, the invention may be practiced otherwise and as specifically described.

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Claims

1. A cardiotachometer for indicating heart rate of a user in beats per minute, said cardiotachometer comprising:

means, responsive to the heart beats of said user for producing a heart rate signal having portions representative of the beats per minute of said user's heart;

means for storing the portions of said heart rate signal;

means for comparing each of said stored portions with the most recent portion of said heart rate signal;

means for issuing a display signal when at least two of the comparisons in said comparing means is made between portions within a predetermined comparison range; and

means, responsive to said display signal, for displaying said most recent portion of said heart rate signal in eye-readable format wherein heart rate in beats per minute is indicated.

2. The cardiotachometer of claim 1, wherein said at least two is three.

3. The cardiotachometer of claim 1 further including time delay means for removing spurious pulses.

4. A cardiotachometer for indicating heart rate of a user in beats per minute, said cardiotachometer comprising:

interval means, responsive to the heart beats of said user, for producing an interval signal having portions indicative of the time interval between said beats;

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means for converting each portion of said interval signal into a heart rate signal having portions representative of the beats per minute of said user's heart;

means for storing the portions of said heart rate signal;

means for comparing each of said stored portions with the most recent portion of said heart rate signal;

means for issuing a display signal when at least two of the comparisons in said comparing means are made between portions within a predetermined percentage of each other; and

means, responsive to said display signal, for displaying said most recent one of said plurality of signals in eye-readable format wherein heart rate in beats per minute is indicated.

5. The cardiotachometer of claim 4, further comprising sensor means, adapted to contact the skin of said user, for producing an electrical signal indicative of the heart beats of said user, and interconnect means for conveying said electrical signal for use by said interval means.

6. The cardiotachometer of claim 4 further including time delay means for removing spurious pulses.

7. The cardiotachometer of claim 4, further comprising means for producing a signal indicative of time-of-day for display by said displaying means.

8. The cardiotachometer of claim 4, further comprising means for producing a signal indicative of elapsed time for display by said displaying means.

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9. A cardiotachometer for indicating heart rate in beats per minute of a user, said cardiotachometer comprising:

sensor means, adapted to contact the skin of said user, for producing an electrical signal indicative of the heart rate of said user;

means for converting said electrical signal into first and second digital signals;

means responsive to said first and second digital signals for producing a third digital signal having a varying frequency representative of the number of heart beats per minute;

converting means for converting said third digital signal into a plurality binary number signals;

storing means for storing each of said binary number signals;

means for comparing each of said stored binary number signals with the most recent binary number signal from said converting means to determine if a plurality of compared signals are within a predetermined comparison range of each other; and

means for displaying said most recent binary number signal when said plurality of compared signals are within said predetermined percentage of each other.

10. The cardiotachometer of claim 9, wherein said comparison range is determined by the number of least significant bits excluded from each of said stored and most recent binary number signals.

11. The cardiotachometer of claim 9, wherein said sensor means comprises a pressure transducer.

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12. The cardiotachometer of claim 9, wherein said sensor means comprises a light source, and a photocell responsive to variations in light intensity reflected off of the capillary bed within the skin of said user, for producing a voltage signal representative of the heart rate of said user.

13. The cardiotachometer of claim 9, wherein said sensor means detects systolic beats in order to produce said electrical signal.

14. The cardiotachometer of claim 9, wherein said third digital signal producing means comprises counting means for producing an interval signal representing the time interval between heart beats, and dividing means responsive to said interval signal for producing said third digital signal.

15. The cardiotachometer of claim 14, wherein said producing means includes a latch for holding said interval signal before it is fed to said dividing means.

16. The cardiotachometer of claim 15, wherein said dividing means is a divide-by-N device.

17. The cardiotachometer of claim 9, wherein said converting means comprises an up-counter.

18. The cardiotachometer of claim 9, wherein said storing means comprises shift register means.

19. The cardiotachometer of claim 9, wherein said plurality of binary number signals each comprises a plurality of bits, and said storing means comprises a plurality of shift registers, each for receiving a particular bit of each binary number signal.

20. The cardiotachometer of claim 9, wherein said comparing means includes an exclusive

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OR gate for receiving said stored binary number signals and said most recent binary number signal.

21. The cardiotachometer of claim 19, wherein said comparing means further includes means for excluding at least one of the least significant bits of each of said binary number signals from being compared.

22. The cardiotachometer of claim 9, wherein said comparing means includes means for issuing a compare signal each time said compared signals are within a predetermined percentage of each other, and wherein said displaying means includes means for issuing a display signal after receiving a plurality of said compare signals.

23. The cardiotachometer of claim 22, wherein said plurality of compare signals is three.

24. The cardiotachometer of claim 9, wherein said displaying means includes latch means for holding said most recent binary number signal prior to display, and means for displaying the contents of said latch means as an array of integers.

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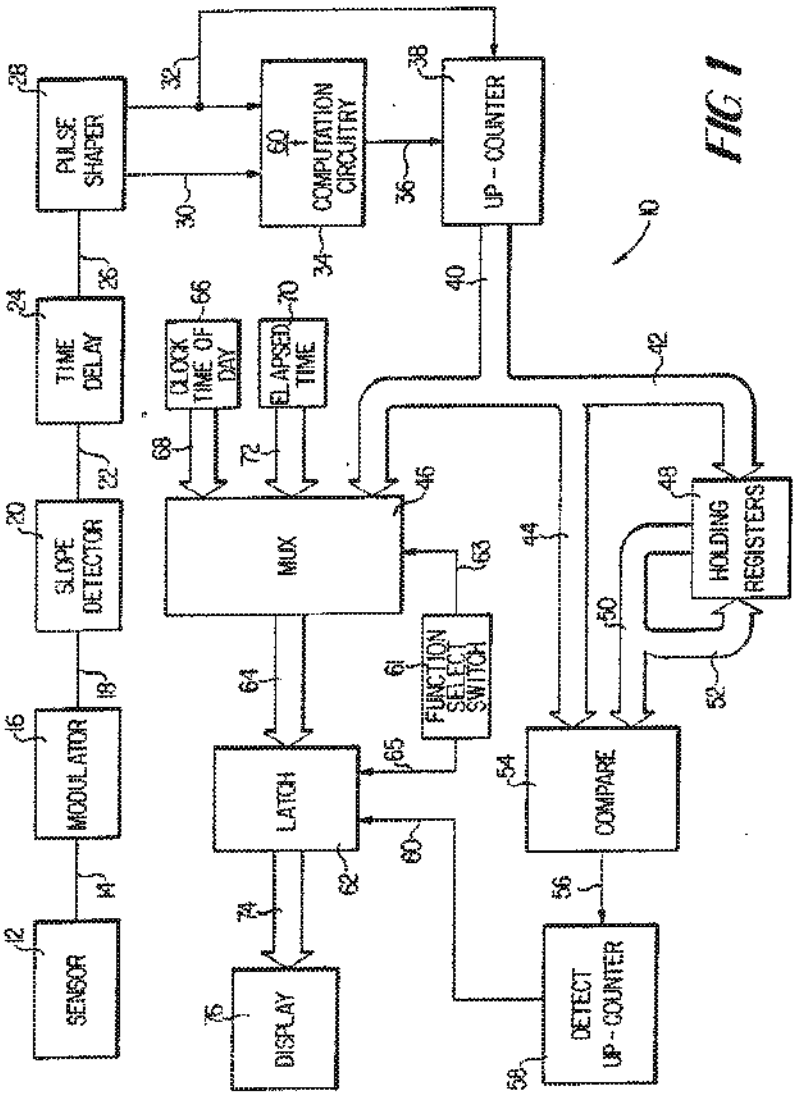


FIG 1

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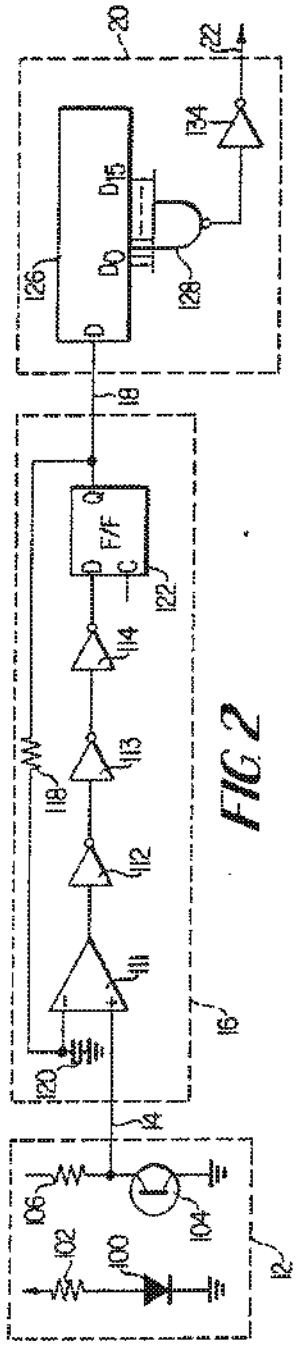


FIG 2

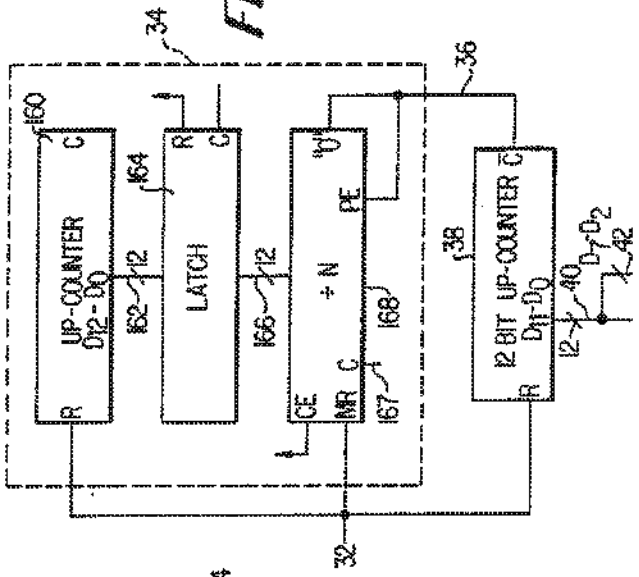


FIG 4

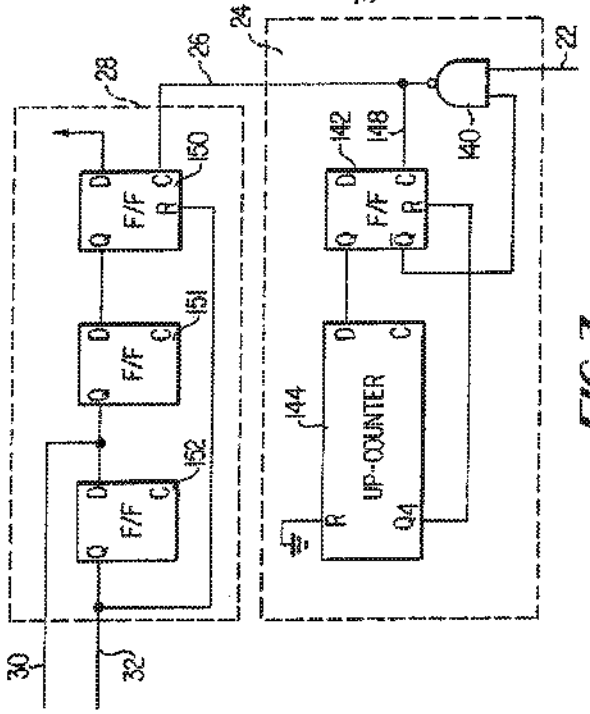


FIG 3

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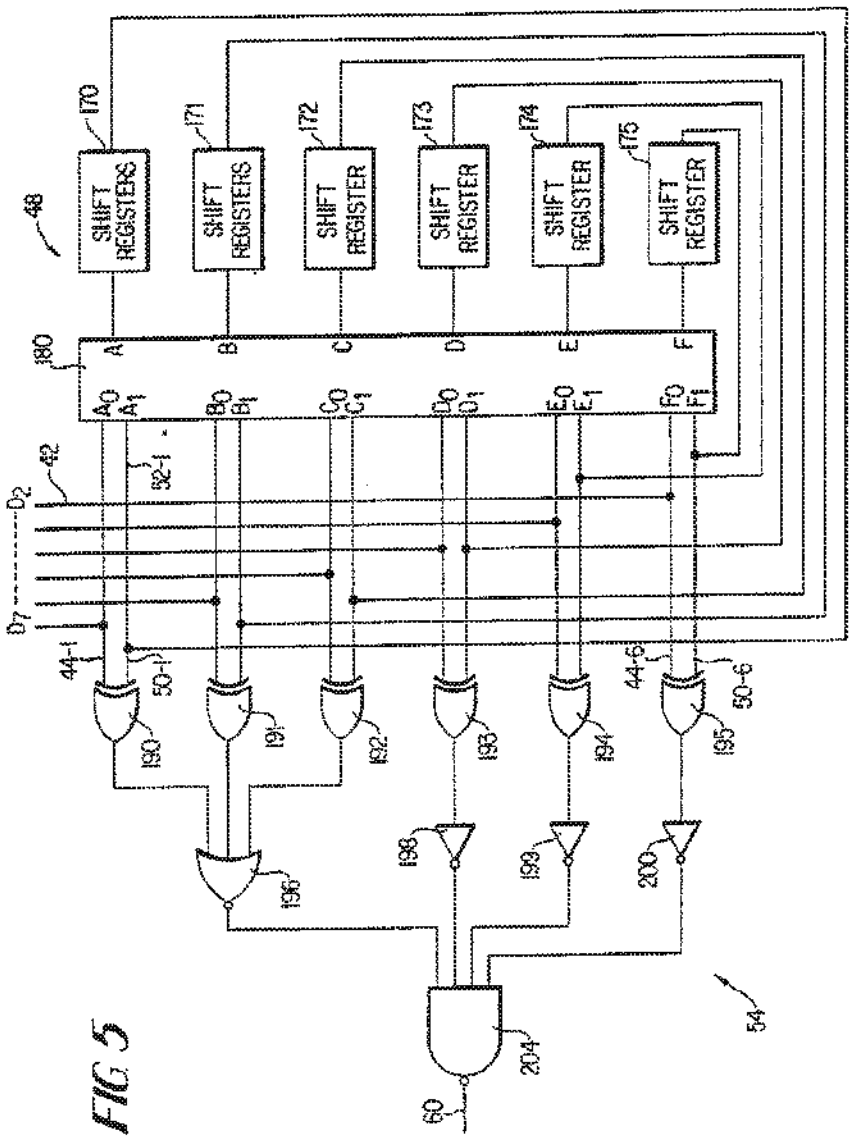


FIG 5

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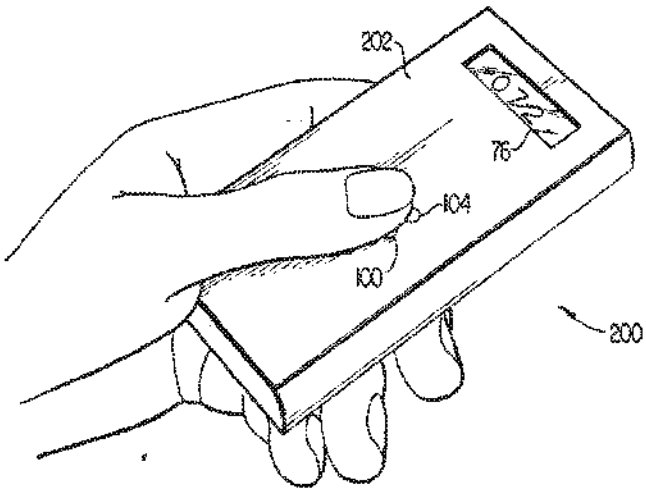


FIG 6

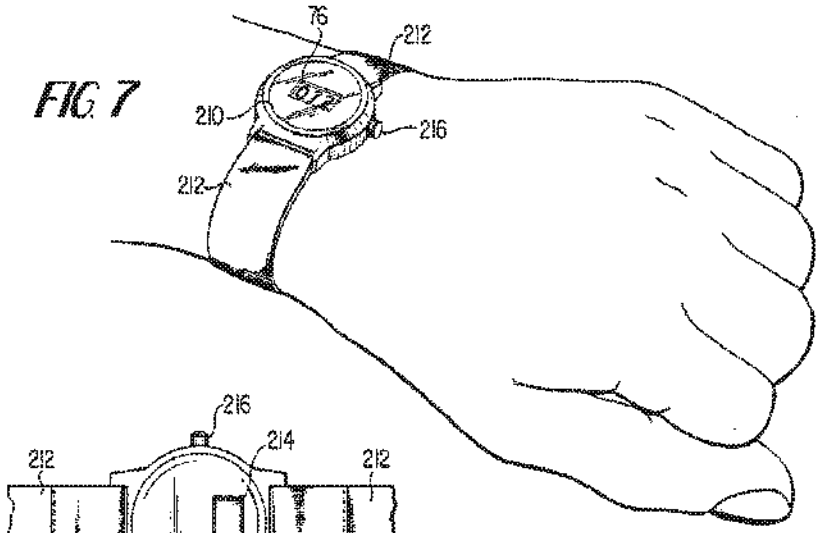


FIG 7

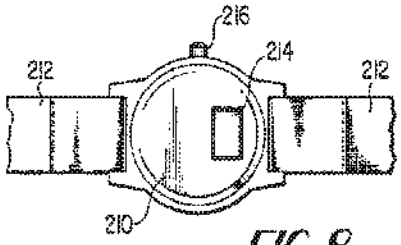


FIG 8

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INTERNATIONAL SEARCH REPORT

International Application No PCT/US80/00839

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC

Int. Cl.[3] A61B 5/02
U.S. Cl. 128/666,690

II. FIELDS SEARCHED

Minimum Documentation Searched [4]

Classification System	Classification Symbols
U.S.	128/666,687,689,690,706,707

Documentation Searched other than Minimum Documentation to the Extent that such Documents are included in the Fields Searched [5]

III. DOCUMENTS CONSIDERED TO BE RELEVANT [14]

Category *	Citation of Document, [15] with indication, where appropriate, of the relevant passages [17]	Relevant to Claim No. [18]
X,E	US,A, 4,248,244 Published February 03, 1981 CHARNITSKI et al	1-2,4-5,9-10 21-24
X	US,A, 3,837,333 Published September 24, 1974 BRUCKHEIM	1-2,4-5,9-10 21-24
X	US,A, 4,022,192 Published May 10, 1977 LAUKIEN	1-2,4-5,9-10 21-24
X	US,A, 4,096,854 Published June 27, 1978 PERICA et al	8,11
X,E	US,A, 4,224,948 Published September 30, 1980 CRAMER, et al	7,8
X	US,A, 4,166,454 Published September 4, 1979 MEIJER	12,13
X	US,A, 3,613,670 Published October 19, 1971 EDENHOFER	3,6
X	US,A, 4,058,118 Published November 15, 1977 STUPAY et al	3,6
X	US,A, 3,908,636 Published September 30, 1975 PAGE	12
X	US,A, 3,858,574 Published January 7, 1975 PAGE	12
X	US,A, 4,030,483 Published June 21, 1977 STEVENS	12
X	US,A, 4,015,595 Published April 5, 1977 BENJAMIN Jr.	12

(Cont. On Suppl. Sheet 2)

* Special categories of cited documents: [16]

"A" document defining the general state of the art

"E" earlier document but published on or after the international filing date

"L" document cited for special reason other than those referred to in the other categories

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but on or after the priority date claimed

"T" later document published on or after the international filing date or priority date and not in conflict with the application, but cited to understand the principle or theory underlying the invention

"X" document of particular relevance

IV. CERTIFICATION

Date of the Actual Completion of the International Search [1]	Date of Mailing of this International Search Report [2]
19 May 1981	02 JUN 1981
International Searching Authority [3]	**Signature of Authorized Officer [20]**
ISA/US	John Hanley

Form PCT/ISA/210 (second sheet) (October 1977)

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FURTHER INFORMATION CONTINUED FROM THE SECOND SHEET

III		
A	US,A, 3,717,140 Published February 20, 1973 GREENWOOD	
A	US,A, 4,018,219 Published April 19, 1977 HOJAIBAN	
A	US,A, 4,120,294 Published October 17, 1978 WOLFE	

V. ☐ OBSERVATIONS WHERE CERTAIN CLAIMS WERE FOUND UNSEARCHABLE [14]

This international search report has not been established in respect of certain claims under Article 17(2) (a) for the following reasons:

1. ☐ Claim numbers ....., because they relate to subject matter [15] not required to be searched by this Authority, namely:

2. ☐ Claim numbers ....., because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out [15], specifically:

VI. ☐ OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING [16]

This International Searching Authority found multiple inventions in this international application as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims of the international application.

2. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims of the international application for which fees were paid, specifically claims:

3. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claim numbers:

Remark on Protest

☐ The additional search fees were accompanied by applicant's protest.

☐ No protest accompanied the payment of additional search fees.

Form PCT/ISA/210 (supplemental sheet (2)) (October 1977)

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October 6, 2005 (10.06.2005)

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(21) International Application Number: PCT/JP2005/002021

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(30) Priority Data:
Japanese Patent Application 2004-09194 March 26, 2004 (03.26.2004) JP

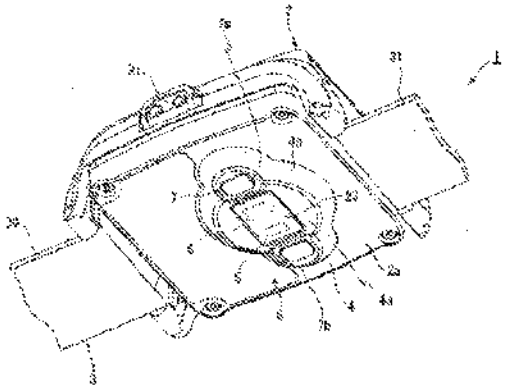
(71) Applicant: SEIKO INSTRUMENTS INC. [JP/JP], 1-8 Nakase, Mihama-ku, Chiba-shi, Chiba 2618507 (JP).

(72) Inventors; and

(75) Inventors/Applicants: KOTANAGI, Susumu [JP/JP]; c/o SEIKO INSTRUMENTS INC., 1-8 Nakase, Mihama-ku, Chiba-shi, Chiba 2618507 (JP). NAKAMURA, Takashi [JP/JP]; c/o SEIKO INSTRUMENTS INC., 1-8 Nakase, Mihama-ku, Chiba-shi, Chiba 2618507 (JP). MAEGAWA, Kazuya [JP/JP]; c/o SEIKO INSTRUMENTS INC., 1-8 Nakase, Mihama-ku, Chiba-shi, Chiba 2618507 (JP). MIYAHARA, Shinichiro [JP/JP]; c/o SEIKO INSTRUMENTS INC., 1-8 Nakase, Mihama-ku, Chiba-shi, Chiba 2618507 (JP). MORIYA, Koichi [JP/JP]; c/o SEIKO INSTRUMENTS INC., 1-8 Nakase, Mihama-ku, Chiba-shi, Chiba 2618507 (JP).

/continued overleaf/

(54) TITLE OF THE INVENTION: BIOLOGICAL INFORMATION MEASURING DEVICE



(57) Abstract: A biological information measuring device comprising a biological sensor section including a body, a protrusion formed on the lower surface of the body, a means for fixing the body to an arm while directing the lower surface of the body toward the surface side of a biological object, a light emitting section for irradiating light toward the biological object while touching the surface of the biological object, a light receiving section for receiving reflection light from the biological object out of the light irradiated from the light emitting section and producing biological information signal corresponding to the quantity of received light, and means for detecting whether or not the light emitting section and the light receiving section are in contact with the surface of the biological object, and a section provided in the body and detecting biological information based on the biological information signal, characterized in that the biological sensor section is arranged on the lower surface of the protrusion. The biometric information measuring device can be fixed for a long time without giving an unpleasant feeling while enhancing tightness.

(57) Abstract: A biological information measuring device comprising: a biological sensor part including: a main body; a protruding part formed so as to protrude from the lower surface of the main body; a fixing means for mounting the main body to an arm while directing the lower surface of the main body toward the living body surface side; a light-emitting part for emitting light toward the living body while in contact with the living body surface; a light-receiving part for receiving reflected light from the living body out of the light emitted by the light-emitting part and generating a biological

[continued overleaf]

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APPLE 1016

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(74) Agent: SHIGA, Masatake et al.; 2-3-1 Yaesu, Chuo-ku, Tokyo 1048453 (JP)

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasia (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), Europe (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Attached Documentation
— **International Search Report**

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

information signal corresponding to the amount of received light; and a contact detection means for detecting whether the light-emitting part and the light-receiving part are in contact with the living body surface; and a biological information detection part which is provided on the main body and detects biological information based on the biological information signal; wherein the biological sensor part is disposed on the lower surface of the protruding part. The biological information measuring device enhances adherence and can be worn for a long time without causing discomfort.

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SPECIFICATION

BIOLOGICAL INFORMATION MEASURING DEVICE

TECHNICAL FIELD

(0001) The present invention relates to a biological information measuring device capable of measuring biological information such as pulse rate while mounted to the wrist (arm).

The present application claims priority based on Japanese Patent Application No. H2004-091942 filed on March 26, 2004, the content of which is incorporated herein.

BACKGROUND ART

(0002) In response to a growing interest in health management in recent years, various biological information measuring devices capable of measuring various biological information such as pulse rate while mounted to the wrist (arm) or the like have been provided (for example, see Patent Document 1).

(0003) A biological information measuring device of this type which detects pulse rate, for example, emits light toward a living body while mounted to the wrist, receives reflected light – that is, a reflected signal – from blood vessels with a pulse sensor or the like, extracts a pulse signal corresponding to the pulse from the reflected signal, and calculates the pulse rate. Since the pulse rate can be measured easily while mounted to the wrist, in particular, the device is easily used by the wearer.

Patent Document 1: Japanese Unexamined Patent Application Publication No. 2001-78973 (paragraph Nos. 0011-0031, FIGS. 1-7)

PROBLEM TO BE SOLVED BY THE INVENTION

(0004) The conventional biological information measuring devices described above are typically used while mounted to the wrist. However, the movement of the user causes muscles to move and changes the thickness (diameter) of the wrist, which leads to the risk that a gap may be formed between the biological information measuring device and the living body surface. This diminishes adherence, which may prevent accurate biological information from being detected. Moreover, since the biological information measuring device is fixed to the wrist, the feeling of pressure on the wrist increases when attached by a band, for example, which makes it difficult to wear for long periods of time.

(0005) The present invention was conceived in light of such circumstances, and an object thereof is to provide a biological information measuring device which enhances adherence and can be worn for

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a long time without causing discomfort.

MEANS FOR SOLVING THE PROBLEM

(0006) The present invention provides the following means for solving the problem described above.

(0007) The biological information measuring device comprises: a biological sensor part including a main body, a protruding part formed so as to protrude from a lower surface of the main body, a fixing means for mounting the main body to an arm while directing the lower surface of the main body toward a living body surface side, a light-emitting part for emitting light toward the living body while in contact with the living body surface, a light-receiving part for receiving reflected light from the living body out of the light emitted by the light-emitting part and generating a biological information signal corresponding to an amount of received light, and a contact detection means for detecting whether the light-emitting part and the light-receiving part are in contact with the living body surface; and a biological information detection part which is provided on the main body and detects biological information based on the biological information signal; wherein the biological sensor part is disposed on a lower surface of the protruding part.

(0008) In the biological information measuring device according to this invention, light is emitted toward the living body from the light-emitting part after the main body is mounted to the wrist (arm) with the fixing means. A portion of the emitted light is absorbed, for example, by hemoglobin in blood vessels, and another portion of the light is reflected by biological tissue. The light-receiving part receives this reflected light and generates a biological information signal such as a pulse signal corresponding to the amount of received light. The biological information detection means then performs prescribed processing on the biological information signal so that biological information such as pulse rate can be detected. In addition, the contact detection means can detect whether the light-emitting part and the light-receiving part are indeed in contact with the living body surface.

(0009) In particular, when the main body is mounted to the wrist by the fixing means, the protruding part protrudes from the lower surface of the main body, which facilitates contact between the living body surface and the lower surface of the protruding part. That is, the adherence of the biological sensor part is enhanced. Therefore, unlike in conventional configurations, it is unnecessary to fix the main body so as to strongly press (so as to compress) the main body against the living body surface with the fixing part. Accordingly, the device does not cause discomfort, even when worn for a long time. Moreover, since the adherence of the biological sensor part is enhanced, the light-emitting part and the light-receiving part can emit and receive light efficiently. Therefore, biological information can be detected with high precision.

(0010) In addition, the biological information measuring device according to the present invention is configured so that, in the biological information measuring device of the present invention de-

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scribed above, ridged parts are formed so as to protrude from the lower surface of the main body at positions a prescribed distance from side surfaces of the protruding part so as to sandwich at least the protruding part, and a distance between a lower surface of each ridged part and the lower surface of the main body part is set to be equal to or greater than a distance between the lower surface of the protruding part and the lower surface of the main body part.

(0011) In the biological information measuring device according to this invention, when the main body is mounted to the arm with the fixing means, the living body surface is in contact with the lower surfaces of the ridged parts and the lower surface of the protruding part. At this time, the ridged parts protrude at positions a prescribed distance from the side surfaces of the protruding part so as to sandwich the protruding part, so gaps are formed between the protruding part and the ridged parts. As a result, the living body is in contact with the lower surfaces of the protruding part and the ridged parts while temporarily filling the gaps on both sides sandwiching the protruding part. Accordingly, the adherence between the living body surface and the biological sensor part can be secured more reliably.

(0012) In particular, since the ridged parts protrude from the lower surface of the main body by a height equal to or greater than that of the protruding part, they come into contact with the living body surface simultaneously with or before the protruding part. As a result, the living body surface can be stably brought into contact with the lower surface of the protruding part in the same state, and the contact pressure can be made constant. Accordingly, biological information can be detected stably over a long period of time.

(0013) In addition, the biological information measuring device according to the present invention is configured so that, in the biological information measuring device of the present invention described above, the contact detection part includes at least a pair of electrodes and detects whether the light-emitting part and the light-receiving part are in contact with the living body surface based on a potential difference between the pair of electrodes.

(0014) In the biological information measuring device according to this invention, when the main body is mounted to the arm, the pair of electrodes come into contact with the living body surface so that a discharge occurs through the living body surface. As a result, the potential between the electrodes decreases. By detecting the potential difference between the pair of electrodes, it can be easily and reliably detected whether the light-emitting part and the light-receiving part are indeed in contact with the living body surface. Note that the electrodes need not be a pair, and a plurality of electrodes, for example, may be provided so that contact can be detected based on the potential difference between each of the electrodes.

(0015) In addition, the biological information measuring device according to the present invention is

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configured so that, in the biological information measuring device of the present invention described above, the pair of electrodes are disposed so as to sandwich the light-emitting part and the light-receiving part therebetween.

(0016) In the biological information measuring device according to this invention, the pair of electrodes are disposed so as to sandwich the light-emitting part and the light-receiving part, so it can be detected whether the light-emitting part and the light-receiving part are in contact with the living body surface with high precision.

(0017) In addition, the biological information measuring device according to the present invention is configured so that, in the biological information measuring device of the present invention described above, a flexible board which electrically connects the light-emitting part and the light-receiving part to the biological information detection part is provided; and the flexible board is provided inside the main body so as to push the light-emitting part and the light-receiving part toward the lower surface side of the main body with its own elasticity.

(0018) In the biological information measuring device according to this invention, the light-emitting part and the light-receiving part are always pressed toward the lower surface side of the main body by the elasticity of the flexible board, so when the main body is mounted to the wrist, the light-emitting part and the light-receiving part are in close proximity to the living body surface. Accordingly, it is possible to emit light to and receive light from the living body efficiently, and the detection precision for biological information can be enhanced.

(0019) In addition, the biological information measuring device according to the present invention is configured so that, in the biological information measuring device of the present invention described above, a display part for displaying detected biological information is provided on an upper surface of the main body.

(0020) In the biological information measuring device according to this invention, biological information displayed on the display part can be easily viewed, so it is possible to confirm detected biological information or to confirm whether biological information has been detected properly at any time when necessary, which is use-friendly and convenient.

(0021) In addition, the biological information measuring device according to the present invention is configured so that, in the biological information measuring device of the present invention described above, the fixing means includes first and second bands having base end sides attached to the main body to enable mounting on the arm; and the first and second bands are disposed opposite one another so as to sandwich the main body and are formed from an expandable elastic material.

(0022) In the biological information measuring device according to this invention, the main body can

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be easily and reliably mounted like a wristwatch using the first and second bands. In particular, since both bands are formed from an expandable elastic material, even if the thickness of the wrist changes somewhat due to muscle movement, the amount of change can be absorbed, and gaps or the like can be prevented from forming between the main body and the living body surface. As a result, it is unnecessary to tighten both bands, and the device can be worn for a long time.

(0023) In addition, the biological information measuring device according to the present invention is configured so that, in the biological information measuring device of the present invention described above, the biological sensor part is disposed at a position offset toward the base end side of the first or second band from a center position of the main body.

(0024) In the biological information measuring device according to this invention, when the main body is mounted to the wrist like a wristwatch using the first and second bands, even if there is small amount of play relative to the wrist and the main body shifts due to the gravitational effect as a result of this play (for example, when the main body shifts in a state in which the arm is facing downward (ground side) or when the main body shifts in a state in which the back of the hand is on the inside while the arm is positioned horizontally and the upper surface of the main body is held in front of the eyes), the biological sensor part is disposed at a position offset toward the base end side of the first or second band from the center position of the main body, so it is possible to prevent a reduction in the adherence of the biological sensor part.

(0025) In addition, the biological information measuring device according to the present invention is configured so that, in the biological information measuring device of the present invention described above, a rechargeable battery that can be recharged and a recharging means for recharging the rechargeable battery with power are provided on the main body.

(0026) In the biological information measuring device according to this invention, the rechargeable battery can be recharged with power from an external source via the recharging means, so it is unnecessary to separately prepare an ordinary battery or the like. Accordingly, the cost of maintaining the product can be reduced.

(0027) In addition, the biological information measuring device according to the present invention is configured so that, in the biological information measuring device of the present invention described above, a distance between the lower surface of the protruding part and the lower surface of the main body is set to 2 to 4 mm.

(0028) The biological information measuring device according to this invention is mounted to the wrist while the lower surface of the protruding part protrudes 2 to 4 mm from the lower surface of the main body. As a result, the protruding part can be reliably brought into contact with the living body surface, and the adherence of the biological sensor part can be ensured. That is, when the distance between the lower surface of the protruding part and the lower surface of the main body is

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2 mm or smaller, the level difference is small, and a gap is formed relative to the living body surface so that external light can enter easily. In addition, when the distance between the lower surface of the protruding part and the lower surface of the main body is 4 mm or greater, an oppressive feeling arises when the device is worn, while the height causes instability, and external light can easily enter the space between the device and the living body surface when inclined.

(0029) As described above, setting the distance between the lower surface of the protruding part and the lower surface of the main body to 2 to 4 mm makes it possible to prevent an oppressive feeling and the incidence of external light.

(0030) In addition, the biological information measuring device according to the present invention is configured so that, in the biological information measuring device of the present invention described above, the protruding part is formed so that an outer periphery thereof is circular.

(0031) In the biological information measuring device according to this invention, In the biological information measuring device according to this invention, the protruding part is circular, so when the main body is mounted to the wrist, it is pressed against the living body surface with equal force. Therefore, the adherence is good.

(0032) In addition, the biological information measuring device according to the present invention is configured so that, in the biological information measuring device of the present invention described above, the protruding part is formed so that an outer edge thereof is a curved surface.

(0033) In the biological information measuring device according to this invention, the outer edge of the protruding part is formed with a curved surface, so when the main body is mounted to the wrist, the adherence can be enhanced even further. Moreover, even when worn for a long time, pressure marks are unlikely to form, so the device is comfortable to wear.

(0034) In addition, the biological information measuring device according to the present invention is configured so that, in the biological information measuring device of the present invention described above, the protruding part is formed with a curved surface from a center toward an outer edge of the lower surface thereof.

(0035) In the biological information measuring device according to this invention, the protruding part is formed with a curved surface from the center toward the outer edge of the lower surface thereof, so when the main body is mounted to the wrist, it is mounted in a state in which the living body surface deforms smoothly and the contact pressure of the center part of the lower surface is increased, which further enhances the adherence. Moreover, even when worn for a long time, pressure marks are unlikely to form, so the device is comfortable to wear.

(0036) In addition, the biological information measuring device according to the present invention is configured so that, in the biological information measuring device of the present invention described above, a diameter of the protruding part is set to not greater than 20 mm.

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(0037) In the biological information measuring device according to this invention, the diameter of the protruding part is not greater than 20 mm, so the protruding part can be easily pressed against the living body surface with a light force.

(0038) In addition, the biological information measuring device according to the present invention is configured so that, in the biological information measuring device of the present invention described above, the ridged parts are provided at a position 8 mm from side surfaces of the protruding part, and a distance between the lower surface of each ridged part and the lower surface of the main body is set to 4 mm.

(0039) In the biological information measuring device according to this invention, the ridged parts can be formed in close proximity of 8 mm from the side surfaces of the protruding part and can be kept to a height of 4 mm. Thus, the ridged parts can be formed in a small space, so the size of the main body can be reduced – that is, the size of the entire device can be reduced.

EFFECT OF THE INVENTION

(0040) According to the biological information measuring device according to the present invention, when the main body is mounted to the wrist with the fixing part, the protruding part protrudes from the lower surface of the main body, so the living body surface and the lower surface of the protruding part come into contact reliably, which enhances the adherence of the biological sensor part. Therefore, unlike in conventional configurations, it is unnecessary to fix the main body so as to strongly press (so as to compress) the main body against the living body surface with the fixing part. Accordingly, the device does not cause discomfort, even when worn for a long time. Moreover, since the adherence of the biological sensor part is enhanced, light can be emitted and received efficiently, and biological information can be detected with high precision.

BRIEF DESCRIPTION OF THE DRAWINGS

(0041) FIG. 1 is a front view illustrating an embodiment of the biological information measuring device according to the present invention.

FIG. 2 is a side view illustrating a state in which the biological information measuring device illustrated in FIG. 1 is mounted to the wrist.

FIG. 3 is a side view illustrating a state in which the biological information measuring device illustrated in FIG. 1 is mounted to the wrist, and is a view from the opposite direction as that illustrated in FIG. 2.

FIG. 4 is a perspective view illustrating a state in which the biological information measuring device illustrated in FIG. 1 is viewed diagonally from above.

FIG. 5 is a perspective view illustrating a state in which the biological information measuring device illustrated in FIG. 1 is viewed diagonally from below.

FIG. 6 is a cross-sectional view of the biological information measuring device illustrated in FIG. 4

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along arrows C-C.

FIG. 7 is a cross-sectional view of the biological information measuring device illustrated in FIG. 4 along arrows D-D.

FIG. 8 is a drawing illustrating the shape of another protruding part than that of the biological information measuring device illustrated in FIG. 1, and is a drawing of a case in which the outer periphery of the protruding part is circular.

FIG. 9 is a drawing of a case in which the protruding part illustrated in FIG. 8 is formed so that the outer edge thereof is a curved surface.

FIG. 10 is a drawing of a case in which the protruding part illustrated in FIG. 8 is formed with a curved surface from the center toward the outer edge of the lower surface thereof.

FIG. 11 is a drawing of a case in which the ridged parts are formed so as to sandwich the protruding part illustrated in FIG. 8.

FIG. 12 is a drawing of a case in which the ridged parts are formed so as to sandwich the protruding part illustrated in FIG. 9.

FIG. 13 is a drawing of a case in which the ridged parts are formed so as to sandwich the protruding part illustrated in FIG. 10.

EXPLANATION OF SYMBOLS

(0042) B: Living body surface, 1: biological information measuring device, 2: housing (main body), 2a: lower surface of main body, 2b: upper surface of main body, 3: fixing means, 4: protruding part, 4a: lower surface of protruding part, 4b: side surface of protruding part, 5: LED (light-emitting part), 6: PD (light-receiving part), 7: contact detection means, 7a, 7b: pair of electrodes, 8: biological sensor part, 9: data processing part (biological information detection part), 11: display part, 13: rechargeable battery, 21: external connection terminal (recharging means), 24: flexible board, 30: first band, 31: second band, 40: ridged part, 40a: lower surface of ridged part

BEST MODE FOR CARRYING OUT THE INVENTION

(0043) An embodiment of the biological information measuring device according to the present invention will be described hereinafter with reference to FIGS. 1 to 7.

(0044) As illustrated in FIGS. 1 to 7, a biological information measuring device 1 of this embodiment is a wristwatch-type device which detects pulse rate as a type of biological information while mounted to the wrist (arm) A.

(0045) This biological information measuring device 1 includes a housing (main body) 2 internally equipped with various electrical parts and electronic parts, and a fixing means 3 for mounting the housing 2 to the wrist A while directing the lower surface 2a of the housing 2 toward a surface B side of a living body. In addition, a protruding part 4 which protrudes from the lower surface 2a is formed on the lower surface 2a of the housing 2.

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(0046) A biological sensor part 8, which includes an LED (Light Emitting Diode) (light-emitting part) 5 for emitting light toward the living body while in contact with the living body surface B side, a PD (Photodetector) (light-receiving part) 6 for receiving reflected light from the living body out of the light emitted by the LED 5 and generating a pulse signal (biological information signal) corresponding to the amount of received light, and a contact detection means 7 for detecting whether the LED 5 and the PD 6 are in contact with the living body surface B, is disposed on the lower surface 4a of the protruding part 4.

(0047) In addition, a data processing part (biological information detection part) 9 for detecting pulse rate based on the generated pulse signal is provided inside the housing 2.

(0048) The housing 2 described above is made of plastic or a metal material such as aluminum and is formed with a prescribed thickness into a substantially rectangular shape from a top view, for example. A cover glass 10 with a substantially square shape is fitted into the central portion of the upper surface 2b of the housing 2, and a display part 11 for displaying the aforementioned pulse rate that is detected and various other information is disposed inside the cover glass 10.

(0049) In addition, as illustrated in FIGS. 6 and 7, a main board 12 is provided inside the housing 2, and the data processing part 9, the display part 11, a rechargeable battery 13 that can be recharged, a memory 14 for recording the pulse rate, a sub-board 15, and various other electronic parts are mounted on or electrically connected to the main board 12.

(0050) The data processing part 9 includes IC parts such as a CPU, and has a function of detecting the pulse rate by temporarily amplifying the pulse signal generated by the PD6 with an amplifier, performing prescribed processing such as Fast Fourier Transform processing (FFT processing), and then analyzing the processing results. In addition, the data processing part 9 records the detected pulse rate in the memory 14 and displays the pulse rate on the display part 11 based on input from each button 20 described below. Further, the data processing part 9 has a function of comprehensively controlling other components.

(0051) The display part 11 is a liquid crystal display device such as an LCD (Liquid Crystal Display), for example, and in addition to the pulse rate described above, it has a time display function for displaying the time counted by a crystal resonator (not illustrated), for example, or a function of displaying various other information. For example, the time, date, day of the week, the remaining power of the rechargeable battery 13, or the like can be displayed.

(0052) In addition, as illustrated in FIGS. 1 and 2, various buttons 20 such as three buttons 20 disposed on the upper surface 2b of the housing 2 and below the display part 11 and one button 2 disposed on the side surface of the housing 2, for example, are provided on the housing 2. Various

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operations can be performed by pressing each of these buttons 20. Operations such as starting or stopping the measurement of the pulse rate, switching the display between the pulse rate and time, and sending pulse rate data recorded in the memory 14 to an external device, for example, can be performed.

(0053) Further, an external connection terminal (recharging means) 21 for recharging the rechargeable battery 13 by supplying power from an external device such as a recharger is provided on the side surface of the housing 2. Note that the external connection terminal 21 may be protected by attaching a cover or the like so as to cover the external connection terminal 21. This makes it possible to protect the external connection terminal 21 from water droplets, dust, or the like, which is more preferable. In addition, rather than the external connection terminal 21, a transformer or the like for supplying power to a recharger and to the inside of the housing 2 may be provided so as to recharge the rechargeable battery 13 in a contactless state.

(0054) As illustrated in FIG. 5, the protruding part 4 is formed into a shape combining three circles when viewed from below – that is, a keyhole-like shape formed by combining, with a central circle, two circles having a smaller diameter than the central circle so as to sandwich the central circle from the left and right sides. In addition, the protruding part 4 is formed so that the center position thereof is offset toward the side of a second band 31 described below rather than the center position of the housing 2. As a result, the biological sensor part 8 disposed on the lower surface of the protruding part 4 is similarly disposed at a position offset toward the second band 31 side. In addition, rather than protruding vertically from the lower surface of the housing 2, the protruding part 4 is formed so that the side surface 4b is a sloping surface.

(0055) In addition, as illustrated in FIG. 7, a through-hole 22 passing through the outside and the inside of the housing 2 is formed in the center of the lower surface 4a of the protruding part 4, and a cover glass 23 is fixed to the housing 2 so as to block the through-hole 22. The LED 5 and the PD 6 are disposed adjacent to one another in a direction orthogonal to the longitudinal direction of the housing so as to touch the inside of the glass cover 23. That is, the LED 5 and the PD 6 are configured so as to be dropped into the protruding part 4. As a result, the LED 5 and the PD 6 are as close to the living body surface B as possible.

[0056] At this time, as illustrated in FIG. 6, the LED 5 and the PD 6 are mounted to one end side of a flexible board 24 that is electrically connected to the sub-board 15, and are disposed in a state in which they are pushed toward the lower surface 2a side of the housing 2 by the elasticity of the flexible board 24. This also causes the LED 5 and the PD 6 to be positioned on the lower surface

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4a side of the protruding part 4 as much as possible. That is, the LED 5 and the PD 6 are as close to the living body surface B as possible. Note that the sub-board 15 and the flexible board 24 [sic: corrected from "14"] are formed with an integral structure. In addition, the flexible board to which the LED 5 and the PD 6 are mounted may be fixed to the lower surface 2a side of the housing 2 with a fixing member such as double-sided tape.

(0057) The pulse signal generated by the PD 6 is sent to the data processing part 9 via the flexible board 24, the sub-board 15, and the main board 12.

(0058) The contact detection means 7 has a pair of electrodes 7a and 7b, and the pair of electrodes 7a and 7b are disposed on the lower surface 4a of the protruding part 4 so as to sandwich the LED 5 and the PD 6. That is, the pair of electrodes 7a and 7b, the LED 5, and the PD 6 are disposed in a row in a direction orthogonal to the longitudinal direction of the housing 2. In addition, the pair of electrodes 7a and 7b are provided so that the tips thereof protrude slightly more than lower surface 4a of the protruding part 4 and are provided so that the base end sides are electrically connected to the sub-board 15.

(0059) The pair of electrodes 7a and 7b have a function of detecting whether there is contact with the living body surface B based on the potential difference between the electrodes. The data processing part 9 is set to receive the detection result and, for example, when it is detected that there is contact with the living body surface B, to control the operation of the LED 5 so as to emit light from the LED 5. Note that instead of this configuration, it may also be set so as to forego FFT processing when it is detected that there is no contact with the living body surface B, for example.

(0060) The fixing means 3 has a first band 30 and a second band 31 having base end sides that are attached to the housing 2 to enable mounting to the wrist A. The first band 30 and the second band 31 are provided opposite one another so as to sandwich the housing 2 in the longitudinal direction of the housing 2. In addition, both bands 30 and 31 are made of an expandable elastic material.

(0061) A buckle 30a and a tongue 30b are attached to the end of the first band 30. In addition, a plurality of insertion holes 31a into which the tongue 30b may be inserted are formed in the second band 31 along the longitudinal direction of the second band 31. As a result, the lengths of the first band 30 and the second band 31 can be adjusted in accordance with the thickness of the wrist A of the user.

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(0062) A case in which the pulse rate is detected by the biological information measuring device 1 configured in this way while mounted to the wrist A will be described hereinafter.

(0063) First, as illustrated in FIGS. 2 and 3, both bands 30 and 31 are wrapped around the wrist A of the user, and the tongue 30b of the first band 30 is inserted into the insertion hole 31a of the second band 31 in accordance with the size of the wrist A to mount the housing 2 to the wrist A. When the housing 2 is mounted to the wrist A, the protruding part 4 protrudes more than the lower surface 2a of the housing 2, so the living body surface B and the lower surface 4a of the protruding part 4 are in close contact. Therefore, it is unnecessary to mount the housing 2 so as to constrict the wrist A, and it is only necessary to adjust the lengths of both bands 30 and 31 so that they are tightened with a prescribed amount of force. In particular, since the side surface 4b of the protruding part 4 is a sloping surface, the living body surface B deforms smoothly in accordance with the outer shape of the protruding part 4, which facilitates close contact.

(0064) When the living body surface B and the lower surface 4a of the protruding part 4 are in close contact – that is, when the living body surface B is in contact with the lower surface 4a of the protruding part 4 – the pair of electrodes 7a and 7b come into contact with the living body surface B. In particular, since the pair of electrodes 7a and 7b are disposed so as to protrude slightly more than lower surface 4a of the protruding part 4, they easily come into contact with the living body surface B. When the pair of electrodes 7a and 7b come into contact with the living body surface B, a discharge occurs through the living body surface B so that the voltage between the electrodes drops. Upon receiving this voltage drop (for example, a drop below a given threshold), the data processing part 9 detects that the pair of electrodes 7a and 7b are indeed in contact with the living body surface B. That is, it detects that the biological sensor part 8 including the LED 5 and the PD 6 is indeed in contact with the living body surface B. In particular, since the pair of electrodes 7a and 7b are disposed so as to sandwich the LED 5 and the PD 6, it can be detected with high precision whether the LED 5 and the PD 6 are in contact with the living body surface B.

(0065) Upon detecting that the LED 5 and the PD 6 are in contact with the living body surface B, the data processing part 9 emits light from the LED 5 toward the living body. A portion of the emitted light is absorbed, for example, by hemoglobin in blood vessels, and another portion of the light is reflected by biological tissue. The PD 6 receives this reflected light, generates a pulse signal (biological information signal) corresponding to the amount of received light, and outputs the signal to the data processing part 9. That is, since the amount of reflected light out of the light emitted from the LED 5 varies depending on fluctuations in blood flow within arteries and arterioles in the wrist A (living body), the PD 6 can receive reflected light corresponding to the pulsation of arteries – that is, pulse waves. As a result, the PD 6 can generate a pulse signal.

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(0066) After amplifying the received pulse signal, the data processing part 9 performs prescribed processing such as FFT processing and analyzes the signal to detect the pulse rate. The data processing part 9 then records the detected pulse rate in the memory 14 and displays the signal on the display part 11 based on the operation of each button 20.

(0067) Since the user can easily display and confirm the detected pulse rate on the display part 11 by pressing each button 20 as necessary, the device is convenient to use. In addition, the user can also confirm information other than the pulse rate such as the time or the remaining power of the rechargeable battery 13, for example, with the display part 11 by operating each button, which makes it easy to use.

(0068) Further, as described above, the user mounts the housing 2 to the wrist A by tightening it with a prescribed amount of force using both bands 30 and 31, so even when worn for a long time, the user does not experience an oppressive feeling and therefore does not experience discomfort.

(0069) In addition, when the user holds something in the hand or performs some kind of operation, for example, the thickness (diameter) of the wrist A (arm) changes due to muscle movement. In this case as well, since the biological sensor part 8 is disposed on the lower surface 4a of the protruding part 4 protruding from the lower surface 2a of the housing 2, it is possible to minimize any reduction in contact (adherence) between the biological sensor part 8 and the living body surface B. In particular, the fact that the first band 30 and the second band 31 are expandable and can expand and contract in accordance with changes in the thickness of the wrist A also makes it possible to suppress decreases in adherence.

(0070) Accordingly, even if the thickness of the wrist A changes, it is possible to maintain a state in which the LED 5 and the PD 6 are in contact with the living body surface B, so the accurate pulse rate can always be detected. This makes it possible to enhance the pulse rate detection precision. In addition, the fact that the LED 5 and the PD 6 are dropped into the protruding part 4 and are pushed toward the lower surface 2a side of the housing 2 by the elasticity of the flexible board 24 so that they are as close to the living body surface B as possible also makes it possible to detect the pulse rate with high precision.

(0071) Further, when the display part 11 is held in front of the eyes while the arm is positioned horizontally and the back of the hand is facing inward in order to confirm various information displayed on the display part 11, even if the housing 2 shifts toward the ground side – that is, toward the second band 31 side – due to gravity, the biological sensor part 8 is disposed at a position offset toward the base end side of the second band 31 from the center position of the housing 2, so it is possible to prevent a reduction in contact between the biological sensor part 8 and the living body

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surface B. Note that this is also true in a case in which the arm faces the ground side – that is, the arm is dropped downward.

(0072) In addition, the rechargeable battery 13 can be recharged with power by connecting a recharging cord or the like connected to a recharger to the external connection terminal 21, for example, and it is unnecessary to separately prepare an ordinary battery. Therefore, it is possible to reduce maintenance costs. Note an audio output means such as a buzzer for outputting audio may be provided inside the housing 2 so that when the charged amount of the rechargeable battery 13 drops to nearly "0", a sound is outputted to inform the user of the recharging period (recharging timing).

(0073) As described above, according to the biological information measuring device 1 of this embodiment, when the main body is mounted to the wrist A with the fixing means 3, the protruding part 4 protrudes from the lower surface 2a of the housing 2, so the living body surface B and the lower surface 4a of the protruding part 4 reliably come into contact, which enhances the adherence of the biological sensor part 8. Therefore, unlike in conventional configurations, it is unnecessary to fix the housing 2 so as to strongly press (so as to compress) the housing against the living body surface B with the fixing part 3. Accordingly, the device does not cause discomfort, even when worn for a long time. Moreover, since the adherence of the biological sensor part 8 is enhanced, light can be emitted and received efficiently, which makes it possible to detect the pulse rate with high precision.

(0074) Note that the technical scope of the present invention is not limited to the embodiment described above, and various modifications may be applied within a scope that does not depart from the gist of the present invention.

(0075) For example, in the embodiment described above, the shape of the protruding part 4 was a keyhole-like shape formed by combining three circles, but the protruding part is not limited to this shape and may be any shape as long as it protrudes beyond the lower surface 2a of the housing 2.

(0076) For example, as illustrated in FIG. 8, the protruding part 4 may be formed so that the outer periphery is circular. In addition, the diameter of the protruding part 4 illustrated in FIG. 8 is set to 20 mm, and the protruding part is formed so that the lower surface 4a of the protruding part 4 and the lower surface 2a of the housing 2 are 3 mm apart from one another.

(0077) By forming the protruding part 4 into a circle, when the housing 2 is mounted to the wrist A, the protruding part 4 is pressed against the living body surface B with equal force, so there adherence is good. At this time, since the diameter of the protruding part 4 is not greater than 20 mm, the protruding part 4 can be pressed with a light force, which makes it possible to further eliminate any oppressive feeling. Here, the difference between the maximum diameter and the minimum diameter of the wrist is typically 3 mm. Therefore, as illustrated in FIG. 8, by setting the distance

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between the lower surface 4a of the protruding part 4 and the lower surface 2a of the housing 2 to 3 mm, it is possible to accommodate changes in the thickness of the wrist, which makes it possible to enhance adherence without creating a gap between the lower surface 4a of the protruding part 4 and the living body surface B. Accordingly, the adherence of the biological sensor part 8 can be improved.

(0078) Note that although the distance between the lower surface 4a of the protruding part 4 and the lower surface 2a of the housing 2 was set to 3 mm, the distance is not limited to 3 mm and may be set within the range of from 2 mm to 4 mm. When the distance is 2 mm or smaller, the level difference is small, and a gap is formed relative to the living body surface B so that external light can enter easily. In addition, when the distance is 4 mm or greater, an oppressive feeling arises, while the height causes instability, and external light can easily enter the space between the device and the living body surface B when inclined. That is, as illustrated in FIG. 8, setting the distance between the lower surface 4a of the protruding part 4 and the lower surface 2a of the housing 2 to within the range of from 2 mm to 4 mm makes it possible to prevent an oppressive feeling and the incidence of external light.

(0079) In addition, the protruding part 4 illustrated in FIG. 8 may be formed so that the outer edge thereof is a curved surface, as illustrated in FIG. 9. This makes it possible to further enhance the adherence, and even when worn for a long time, pressure marks are unlikely to form, so the device is comfortable to wear.

(0080) Further, a curved surface may be formed from the center toward the outer edge of the lower surface 4a of the protruding part 4, as illustrated in FIG. 10. As a result, the device can be mounted in a state in which the living body surface B deforms smoothly and the contact pressure of the center part of the lower surface 4a is increased, which further enhances adherence. Moreover, pressure marks are unlikely to form, so the device is comfortable to wear.

(0081) In addition, as illustrated in FIG. 11, ridged parts 40 formed so as to protrude from the lower surface 2a of the housing 2 may be provided a prescribed distance – that is, a distance of 8 mm – from the side surfaces 4b of the protruding part 4 so as to sandwich the protruding part 4. Note that the protruding part 4 illustrated in FIG. 11 has the same shape as that illustrated in FIG. 8.

(0082) Further, the distance between the lower surface 40a of each ridged part 40 and the lower surface 2a of the housing 2 is set to 4 mm, which is slightly higher than the distance (3mm) between the lower surface 4a of the protruding part 4 and the lower surface 2a of the housing 2.

(0083) With such a configuration, when the housing 2 is mounted to the wrist A, the living body comes into contact with the lower surface 4a of the protruding part 4 and the lower surfaces 40a of the ridged parts 40 while filling the 8 mm gaps formed between the protruding part 4 and the

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ridged parts 40. At this time, the ridged parts 40 come into contact with the living body on the outside of the protruding part 4 and make contact before the protruding part 4. Accordingly, the living body can be brought into contact with the lower surface 4a of the protruding part 4 in a stable state, and the contact pressure can be made uniform with respect to the lower surface 4a of the protruding part 4. Therefore, the pulse rate can be detected stably over a long period of time. In addition, the ridged parts 40 may be formed in close proximity to the protruding part 4 – that is, in a small space – so the size can be kept small even when the ridged parts 40 are provided.

(0084) Note that, as illustrated in FIGS. 12 and 13, the ridged parts may also be configured in combination with the protruding part 4 illustrated in FIGS. 9 and 10 described above. In addition, the ridged parts may be formed so as to enclose the perimeter of the protruding part at positions a prescribed distance from the side surfaces of the protruding part.

(0085) Further, in the embodiment described above, pulse rate was given as an example of biological information, but the present invention is not limited to pulse rate as long as biological information is used.

(0086) In addition, although the contact detection means has a pair of electrode, it is not limited to a pair and may also have a plurality of electrodes. In this case, the contact detection means should be set to detect whether there is contact based on the potential difference between each of the electrodes.

(0087) Further, the biological sensor part was configured to be offset toward the base end side of the second band from the center position of the housing, but it may also be formed so as to be offset toward the base end side of the first band side. That is, the design should be made in consideration of the relationship between both bands and the display part.

(0088) In addition, the housing may be provided with an additional function such as a wireless communication means for enabling wireless communication with other electronic devices. This makes it possible to transmit pulse rate data recorded in the memory to an external electronic device and to acquire various information into the memory by means of wireless communication such as Bluetooth.

INDUSTRIAL APPLICABILITY

(0089) According to the present invention, when the main body is mounted to the wrist with the fixing means, the protruding part protrudes from the lower surface of the main body, so the living body surface and the lower surface of the protruding part reliably come into contact, which enhances the adherence of the biological sensor part. Therefore, unlike in conventional configurations, it is unnecessary to fix the main body so as to strongly press (so as to compress) the main body against the living body surface with the fixing part. Accordingly, the device does not cause discomfort, even when worn for a long time. Moreover, since the adherence of the biological sensor part is enhanced,

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light can be emitted and received efficiently, and biological information can be detected with high precision.

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CLAIMS

(1) A biological information measuring device comprising:

a biological sensor part including:

a main body;

a protruding part formed so as to protrude from a lower surface of the main body;

a fixing means for mounting the main body to an arm while directing the lower surface of the main body toward a living body surface side;

a light-emitting part for emitting light toward the living body while in contact with the living body surface;

a light-receiving part for receiving reflected light from the living body out of the light emitted by the light-emitting part and generating a biological information signal corresponding to an amount of received light; and

a contact detection means for detecting whether the light-emitting part and the light-receiving part are in contact with the living body surface; and

a biological information detection part which is provided on the main body and detects biological information based on the biological information signal;

wherein the biological sensor part is disposed on a lower surface of the protruding part.

(2) The biological information measuring device according to Claim 1,

wherein ridged parts are formed so as to protrude from the lower surface of the main body at positions a prescribed distance from side surfaces of the protruding part so as to sandwich at least the protruding part; and

a distance between a lower surface of each ridged part and the lower surface of the main body part is set to be equal to or greater than a distance between the lower surface of the protruding part and the lower surface of the main body part.

(3) The biological information measuring device according to Claim 1 or 2,

wherein the contact detection part includes at least a pair of electrodes and detects whether the light-emitting part and the light-receiving part are in contact with the living body surface based on a potential difference between the pair of electrodes.

(4) The biological information measuring device according to Claim 3,

wherein the pair of electrodes are disposed so as to sandwich the light-emitting part and the light-receiving part therebetween.

(5) The biological information measuring device according to any one of Claims 1 to 4,

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wherein a flexible board which electrically connects the light-emitting part and the light-receiving part to the biological information detection part is provided; and

the flexible board is provided inside the main body so as to push the light-emitting part and the light-receiving part toward the lower surface side of the main body with its own elasticity.

(6) The biological information measuring device according to any one of Claims 1 to 5,

wherein a display part for displaying detected biological information is provided on an upper surface of the main body.

(7) The biological information measuring device according to any one of Claims 1 to 6,

wherein the fixing means includes first and second bands having base end sides attached to the main body to enable mounting on the arm; and

the first and second bands are disposed opposite one another so as to sandwich the main body and are formed from an expandable elastic material.

(8) The biological information measuring device according to Claim 7,

wherein the biological sensor part is disposed at a position offset toward the base end side of the first or second band from a center position of the main body.

(9) The biological information measuring device according to any one of Claims 1 to 8,

wherein a rechargeable battery that can be recharged and a recharging means for recharging the rechargeable battery with power are provided on the main body.

(10) The biological information measuring device according to any one of Claims 1 to 9,

wherein a distance between the lower surface of the protruding part and the lower surface of the main body is set to 2 to 4 mm.

(11) The biological information measuring device according to any one of Claims 1 to 10,

wherein the protruding part is formed so that an outer periphery thereof is circular.

(12) The biological information measuring device according to Claim 11,

wherein the protruding part is formed so that an outer edge thereof is a curved surface.

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(13) The biological information measuring device according to Claim 11,

wherein the protruding part is formed with a curved surface from a center toward an outer edge of the lower surface thereof.

(14) The biological information measuring device according to any one of Claims 11 to 13,

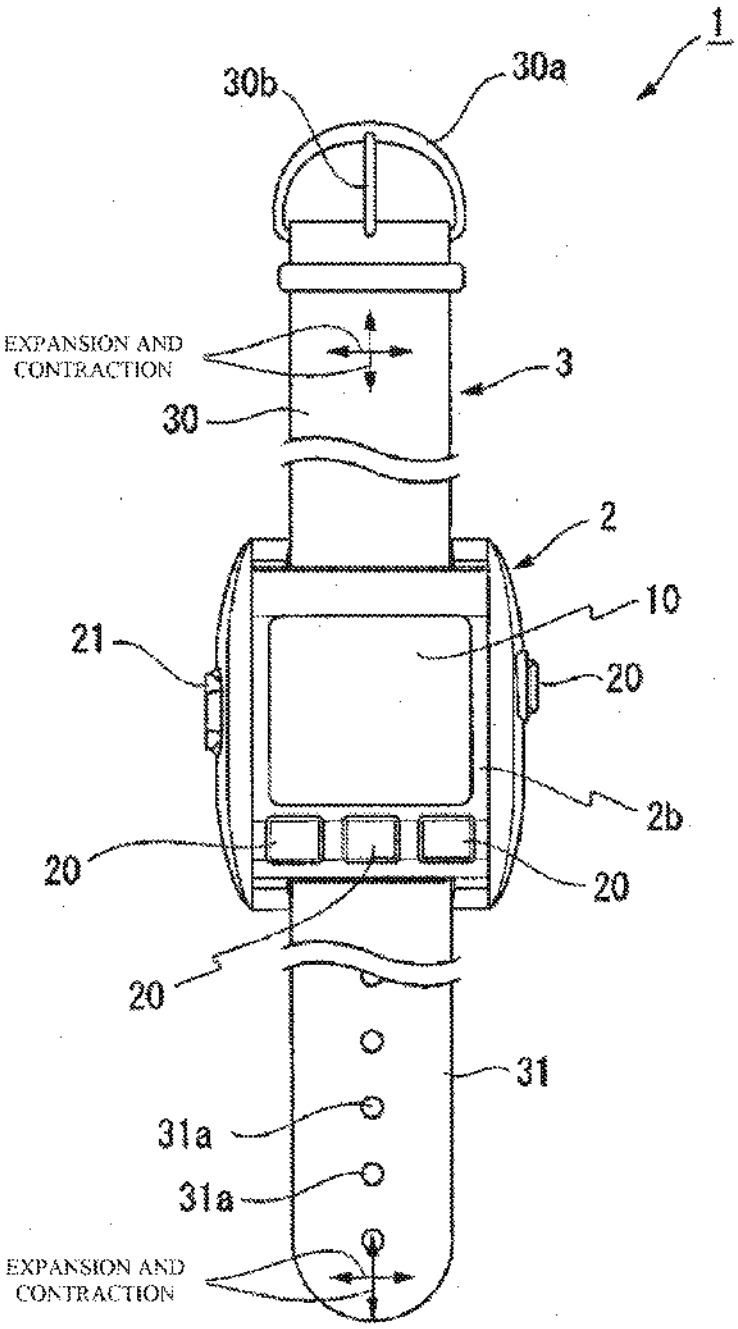
wherein a diameter of the protruding part is set to not greater than 20 mm.

(15) The biological information measuring device according to any one of Claims 2 to 14,

wherein the ridged parts are provided at a positions 8 mm from side surfaces of the protruding part, and a distance between the lower surface of each ridged part and the lower surface of the main body is set to 4 mm.

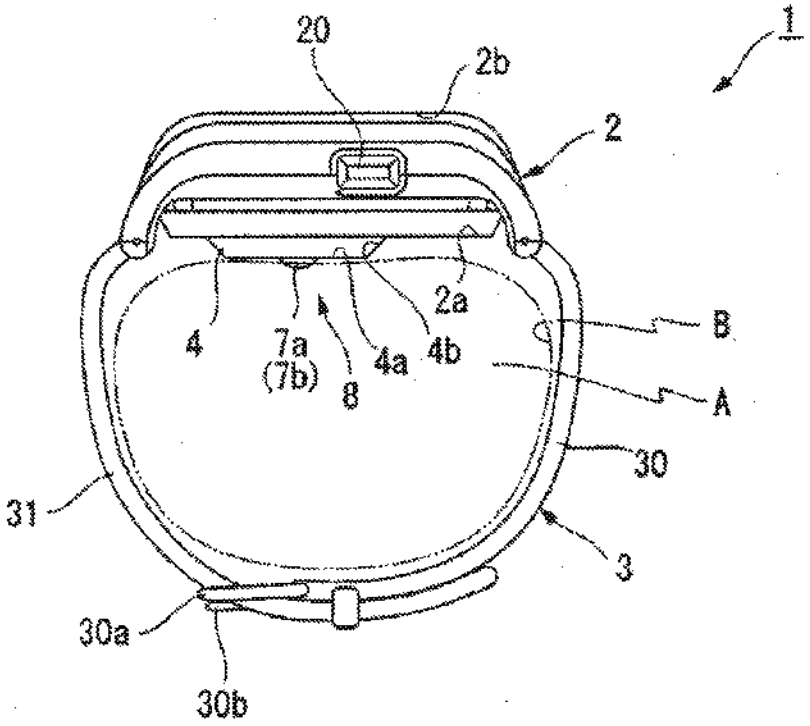
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[FIG. 1]

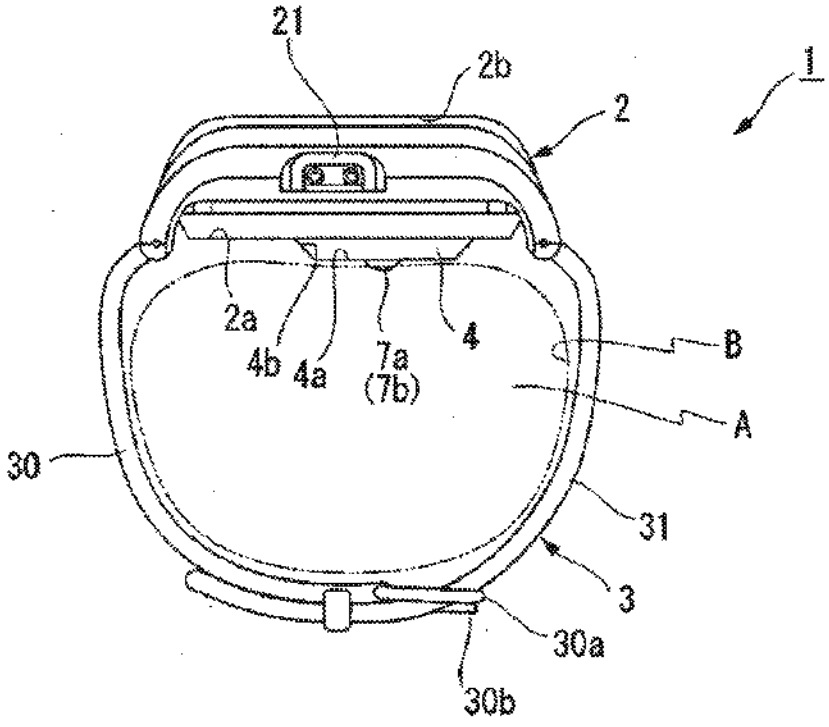


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[FIG. 2]



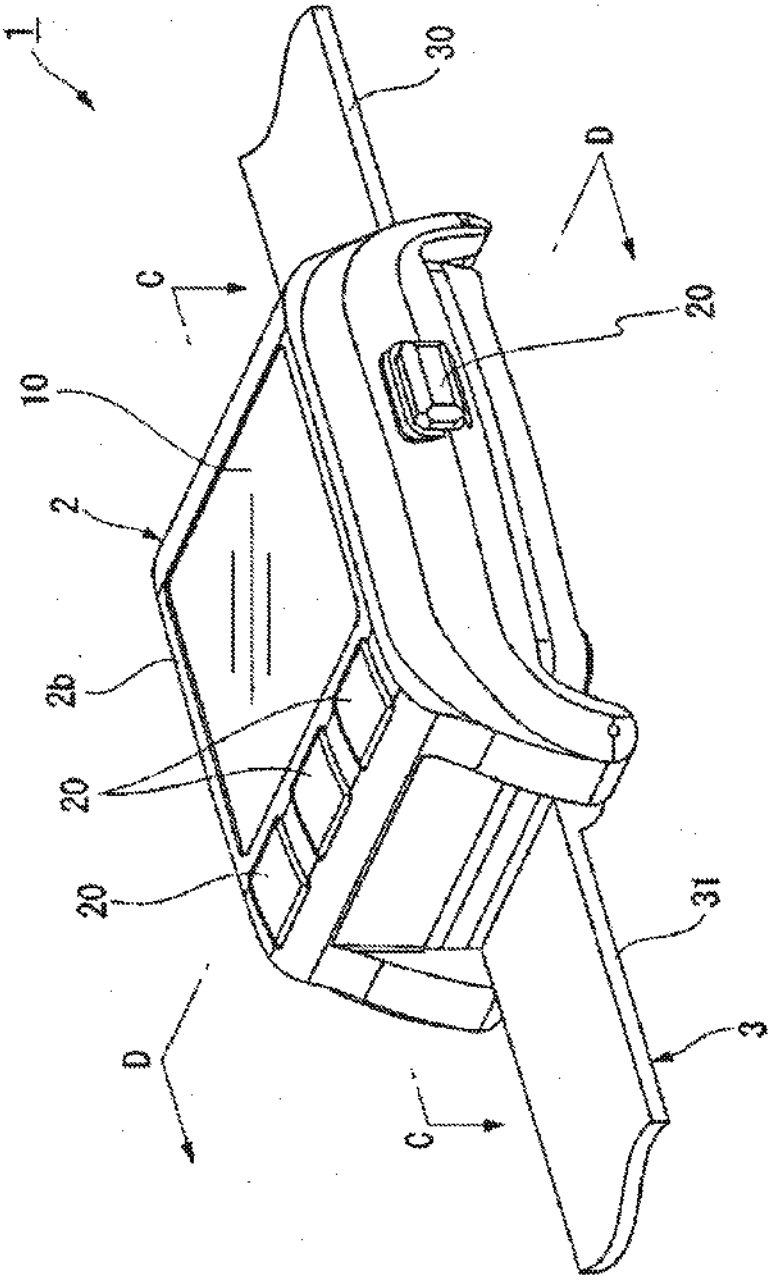
[FIG. 3]



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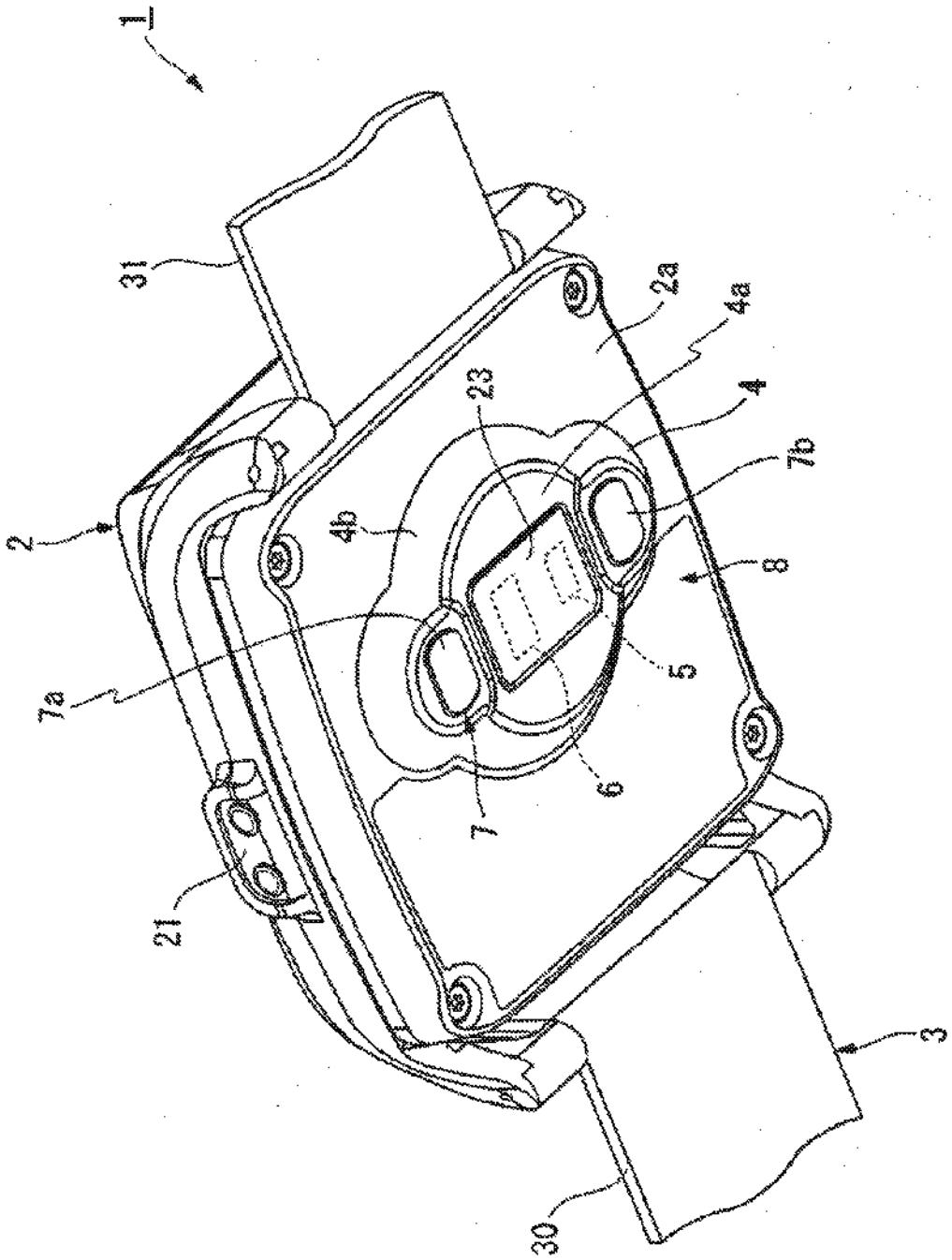
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[FIG. 4]

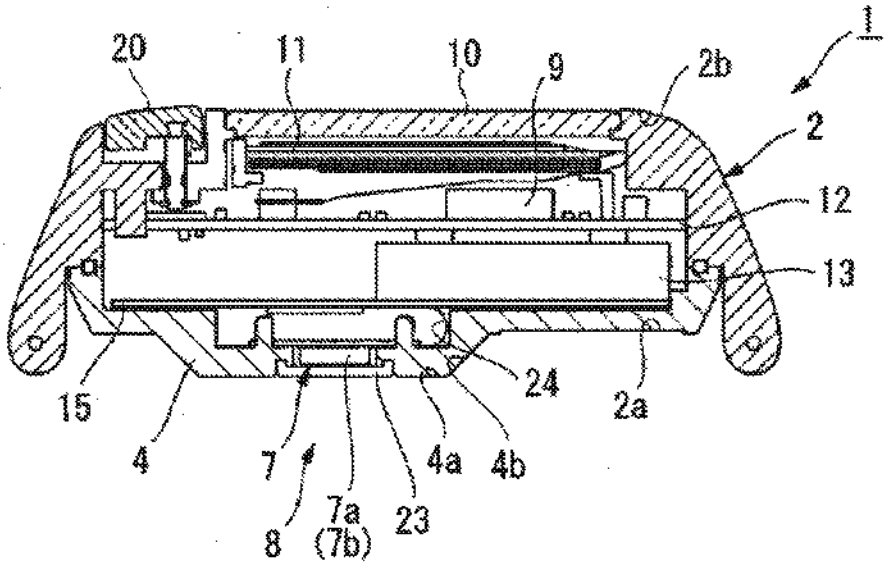


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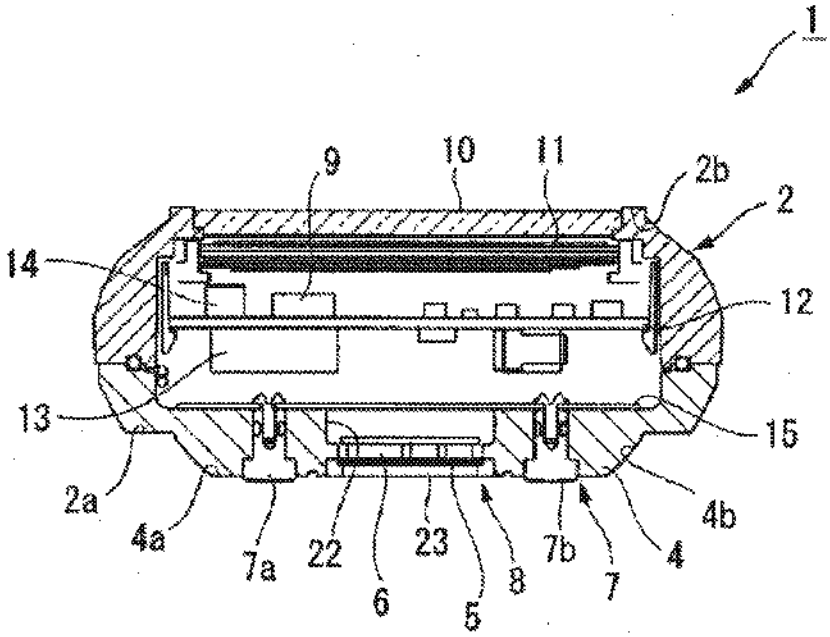
[FIG. 5]



[FIG. 6]

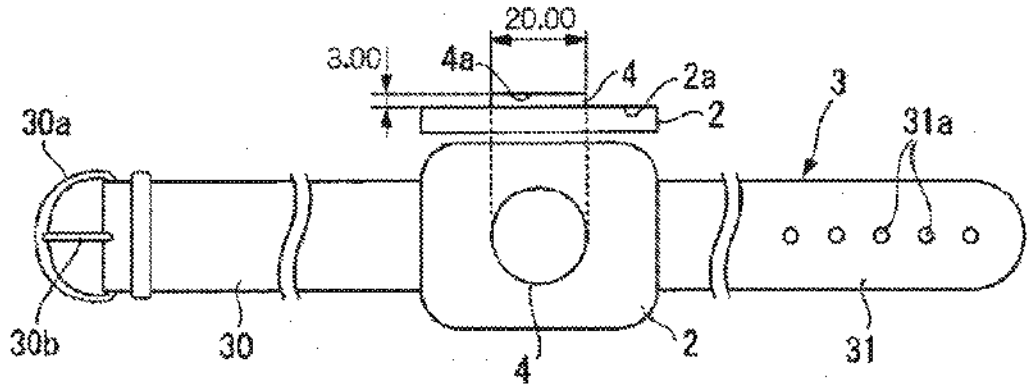


[FIG. 7]

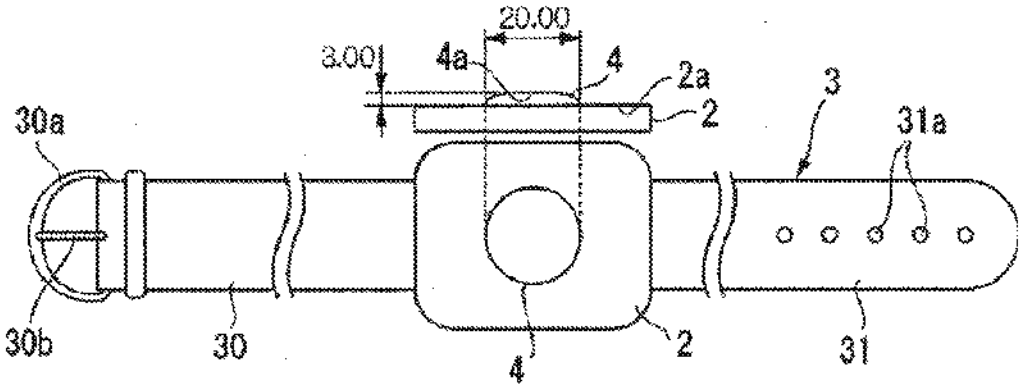


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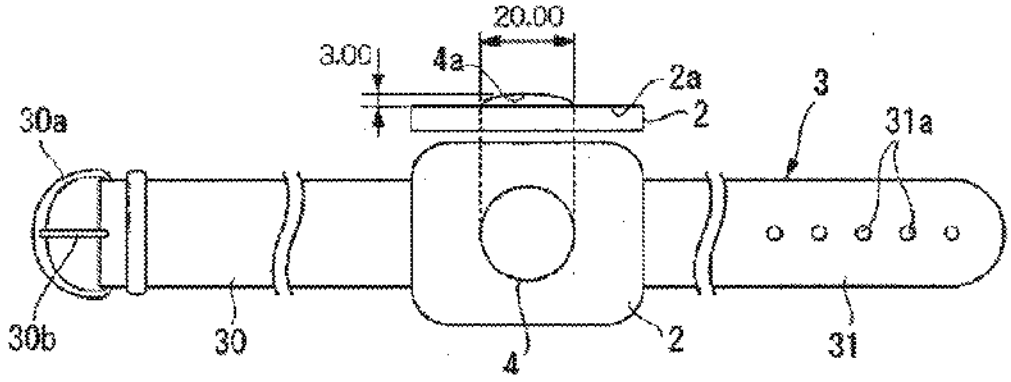
[FIG. 8]



[FIG. 9]

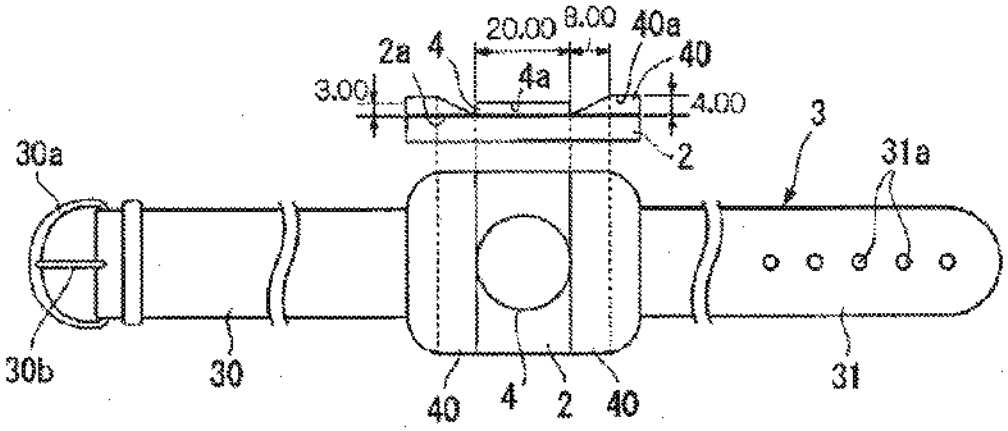


[FIG. 10]

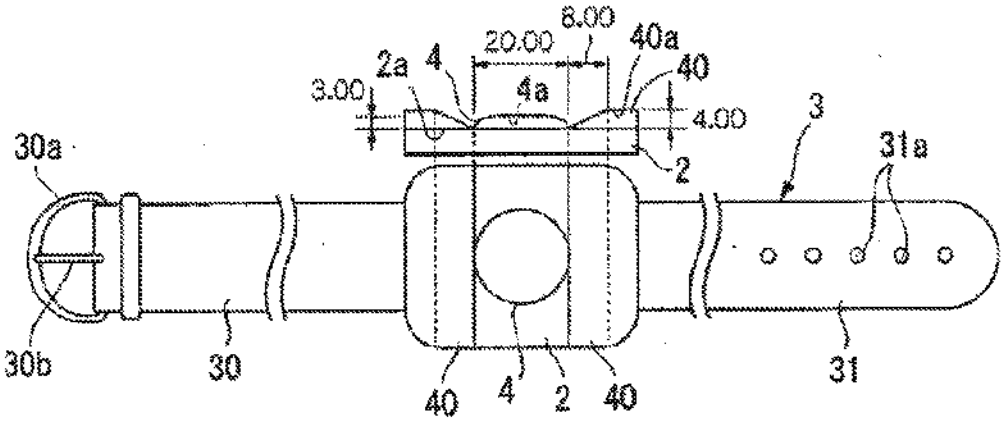


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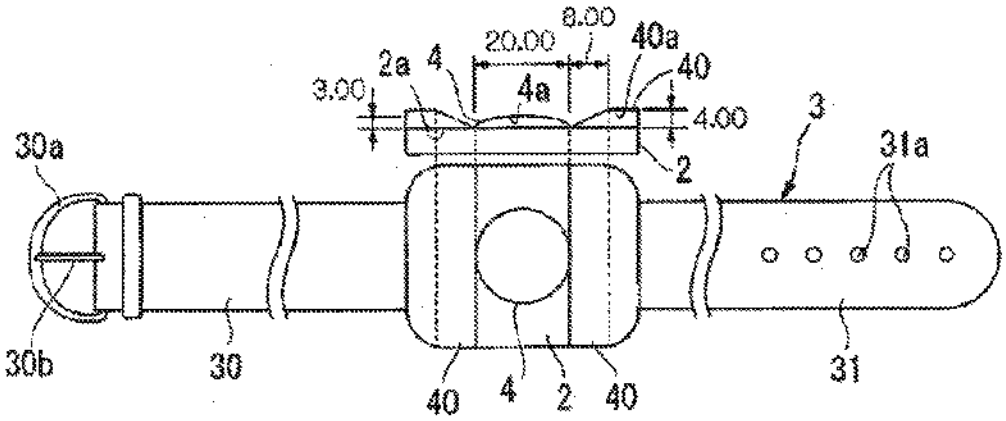
[FIG. 11]



[FIG. 12]



[FIG. 13]



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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2005/002021

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl[7] A61B5/0245

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)
Int.Cl[7] A61B5/0245

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Toroku Jitsuyo Shinan Koho 1994-2005
Kokai Jitsuyo Shinan Koho 1971-2005 Jitsuyo Shinan Toroku Koho 1996-2005

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y A	JP 11-235320 A (Seiko Epson Corp.), 31 August, 1999 (31.08.99), Full text; all drawings (Family: none)	1-4,6,7,9,11 5,8,10,12-15
Y A	JP 2003-70767 A (Seiko Instruments Inc.), 11 March, 2003 (11.03.03), Par. Nos. [0021] to [0027]; Figs. 2, 3 & EP 1290975 A1 & US 2003/45802 A1	1-4,6,7,9,11 5,8,10,12-15
Y	JP 2002-159457 A (Seiko Instruments Inc.), 04 June, 2002 (04.06.02), Par. Nos. [0013] to [0027]; Figs. 4 to 16 (Family: none)	2

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
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"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
02 March, 2005 (02.03.05)	22 March, 2005 (22.03.05)

Name and mailing address of the ISA/ Japan Patent Office (ISA/JP) 3-4-3 Kasumigaseki, Chiyoda-ku, Tokyo 100-8915 Facsimile No.	Authorized officer Kosen Ito Telephone No. 03-3581-1101 Ext. 3290	PW 9604

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INTERNATIONAL SEARCH REPORT

International application No
PCT/JP2005/002021

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2000-342547 A (Kawasaki Heavy Industries, Ltd., The New Industry Research Organization), 12 December, 2000 (12.12.00) Par. Nos. [0012] to [0013]; Figs. 1 to 4 (Family: none)	9

Form PCT/ISA/210 (continuation of second sheet) (January 2004)

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TRANSPERFECT

Translation Certificate

I, Brian Toth, hereby certify that the attached English translation is, to the best of my knowledge, a true and accurate translation of WO2005092182A1. The translated text reflects the content, meaning, and style of the original text and constitutes a true and accurate translation of the original document.

I acknowledge that willful false statements and the like are punishable by fine or imprisonment, or both under 18 U.S.C. 1001.

All statements made of my own knowledge are true and all statements made on information and belief are believed to be true.

Brian Toth

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(74) Agent: **SWIRSKY, Daniel J.**; AlphaPatent Associates Ltd., 55 Reuven St., 99544 Beit Shemesh (IL).

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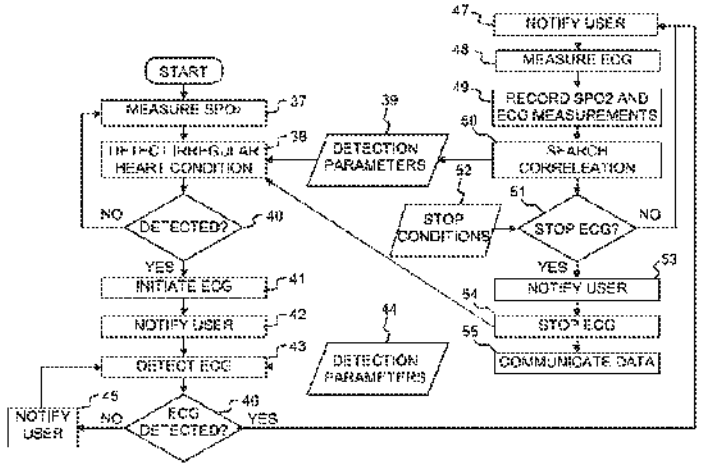
Published:

— *with international search report (Art. 21(3))*

— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

(54) Title: PULSE OXIMETRY MEASUREMENT TRIGGERING ECG MEASUREMENT

Fig. 7



(57) Abstract: A method and a system for triggering the measurement of electrocardiogram (ECG) signal of a user. The system includes a SpO_2 measuring unit and an ECG measuring unit both embedded in a wrist-mounted device worn by the user. The method including the steps of: continuously measuring SpO_2 at the wrist of the user, detecting an irregular heart condition from the SpO_2 measurement, notifying the user to perform an ECG measurement, and initiating the ECG measurement at least partially at the wrist.

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PULSE OXIMETRY MEASUREMENT TRIGGERING ECG MEASUREMENT

Cross-Reference to Related Applications

This application claims the priority benefit of U.S. Provisional Patent Application No. 61473821 filed April 11, 2011, which is incorporated herein by reference.

Field of the Invention

The present invention relates to systems and methods for patient monitoring and, more particularly but not exclusively, to systems and methods for monitoring heart-related events using electrocardiogram (ECG).

Background of the Invention

Various heart diseases require the monitoring of events associated with electrical activity of the heart. The electrical activity is typically monitored by measuring an electrocardiogram (ECG). Some heart diseases are reflected in permanent irregularities of the ECG signal. Other heart diseases are reflected in transient, very short-time, irregularities of the ECG signal. Some heart diseases are reflected in events of irregular ECG signal.

Measuring ECG typically requires connecting the patient to an ECG measuring device via a plurality of wires connected to the patient in predefined places of the body. If the heart-related event is short enough the patient does not have the time to find an ECG device, to properly wire the device to the body and then take the ECG measurement.

One common solution is a telemetry ECG device that is wired to the patient and transmits the ECG signal to a near-by telemetry station. Such devices are used in hospitals where it is important to monitor the patients at all time and also enable them mobility within the hospital ward. However, this solution has the disadvantage of the communication range of the ECG monitoring device.

Another common solution is a Holter device, which is practically a small ECG device connected to the patient for typically 24 hours, recording the ECG signal. Hopefully, the heart-related event occurs during the recording time. The Holter does not limit the mobility range of the patient but has a time limit of its operation. For events that

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are not sufficiently frequent this solution does not work. Also important and highly disadvantageous is the Holter device uses electric contacts at the end of electric cables. Thus, the patient has to be constantly wired to the Holter device.

All such solutions require uncomfortable fixed wiring of the patient to the ECG device at all time. Solutions require uncomfortable fixed wiring are therefore inappropriate for monitoring infrequent events of irregular ECG. There is thus a widely recognized need for, and it would be highly advantageous to have, a method and a system for measuring the ECG signal associated with an intermittent irregular heart-related event, devoid of the above limitations.

The following patents and patent applications are believed to represent the most relevant prior art: US patents 5,176,137, 7,598,878, and 7650176; US patent applications 20020095092, 20030229276, 20070038050, 20090247848, and 20090326356; and PCT applications WO2001017420, and WO2009074985.

Summary of the Invention

According to one aspect of the present invention there is provided a method for triggering measurement of electrocardiogram (ECG) signal of a subject, the method including the steps of: continuously measuring SpO2 at least one of a wrist and a finger of the subject, detecting an irregular heart condition from the SpO2 measurement, notifying the subject to perform an ECG measurement, and initiating ECG measurement at least partially at the wrist.

According to another aspect of the present invention there is provided a method for triggering ECG measurement where the step of notifying the subject to perform an ECG measurement includes at least one of the acts of: notifying the subject to perform an ECG measurement repeatedly until the ECG measurement detects an ECG signal, stopping the notification to the subject to perform an ECG measurement when the ECG measurement detects an ECG signal, notifying the subject when the ECG signal is first detected, notifying the subject that the ECG signal is being detected, notifying the subject as long as the ECG signal is detected, and notifying the subject that the ECG measurement has stopped.

According to still another aspect of the present invention there is provided a method for triggering ECG measurement additionally including the steps of: performing

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the SpO2 measurement while performing the ECG measurement, identifying a correlation between the SpO2 measurement and the ECG measurement, and using the correlation in the step of detecting an irregular heart condition from the SpO2 measurement.

Yet according to another aspect of the present invention there is provided a method for triggering ECG measurement where the correlation is particular to the subject.

Also according to another aspect of the present invention there is provided a method for triggering ECG measurement where the ECG measurement is stopped upon detecting at least one of the conditions of: the irregular heart condition stopped, heart condition returned to normal, a predefined period elapsed, and a predefined number of heart beats counted.

Further according to another aspect of the present invention there is provided a method for triggering ECG measurement where the SpO2 measurement includes using reflective SpO2 measurement.

Yet further according to another aspect of the present invention there is provided a method for triggering ECG measurement where the ECG measurement additionally includes the steps of: providing at least two separate conductive areas configured to measure electrical activity of the subject, performing at least one of the steps of: contacting a first conductive area to at least a portion of the wrist, and a second conductive area to a finger of a second hand of the subject, contacting a first conductive area to at least a portion of the wrist, and a second and a third conductive areas to two fingers of a second hand of the subject, and contacting a first and a second conductive areas to at least a portion of the first hand and a third conductive area to a second hand of the subject; extracting an ECG signal from the conductive areas by using one conductive area as a reference and amplifying the differential voltage between at least two other conductive areas; and continuously converting the at least one measurement to form medical information.

Still further according to another aspect of the present invention there is provided a method for triggering ECG measurement where the ECG measurement additionally includes the step of: communicating at least one of the SpO2 measurement, the ECG measurement, and the medical information to at least one of a gateway and a remote server.

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According to yet another aspect of the present invention there is provided a wrist-mounted physiological parameters measuring device including: an SpO2 measuring unit attached to a wrist of a subject the SpO2 measuring unit being operative to continuously measure SpO2 at the wrist of the subject, an ECG measuring unit attached to the wrist of the subject for measuring ECG signal at least partially at the wrist, and a processor operative to control both the SpO2 measuring and the ECG measuring unit, where the processor is operative to detect an irregular heart condition from the SpO2 measurement, to notify the subject to perform an ECG measurement upon detecting the irregular heart condition the, and to initiate the ECG measurement.

According to still another aspect of the present invention there is provided a wrist-mounted physiological parameters measuring device where the processor is additionally configured to perform at least one of the procedures selected from the group including of: a procedure for notifying the subject to perform an ECG measurement repeatedly until the ECG measurement detects an ECG signal, a procedure for stopping the notification to the subject to perform an ECG measurement when the ECG measurement detects an ECG signal, a procedure for notifying the subject when the ECG signal is first detected, a procedure for notifying the subject that the ECG signal is being detected, a procedure for notifying the subject as long as the ECG signal is detected, and a procedure for notifying the subject that the ECG measurement has stopped.

Further according to another aspect of the present invention there is provided a wrist-mounted physiological parameters measuring device where the processor is additionally configured to perform at least one of the procedures selected from the group including of: a procedure performing the SpO2 measurement while performing the ECG measurement, a procedure for identifying a correlation between the SpO2 measurement and the ECG measurement, and a procedure for detecting the irregular heart condition from the SpO2 measurement using the correlation.

Still further according to another aspect of the present invention there is provided a wrist-mounted physiological parameters measuring device where the correlation is particular to the subject.

Yet further according to another aspect of the present invention there is provided a wrist-mounted physiological parameters measuring device where the processor is additionally configured to stop the ECG measurement upon detecting at least one of the

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conditions of: the irregular heart condition stopped, heart condition returned to normal, a predefined period elapsed, and a predefined number of heart beats counted.

Even further according to another aspect of the present invention there is provided a wrist-mounted physiological parameters measuring device the SpO2 measuring unit includes reflective SpO2 measurement device.

Additionally according to another aspect of the present invention there is provided a wrist-mounted physiological parameters measuring device where the ECG measurement unit includes at least two separate conductive areas configured to measure electrical activity of the subject, where the at least three conductive areas arranged in one of the following configurations: a first conductive area configured to be in contact with at least a portion of the wrist, and second conductive area configured to be touched by a finger of a second hand of the subject, a first conductive area configured to be in contact with at least a portion of the wrist, and second and third conductive areas configured to be touched by two fingers of a second hand of the subject, and a first and a second conductive areas configured to be in contact with at least a portion of the first hand and a third conductive area configured to be touched by a second hand of the subject, where the ECG signal is extracted from the three conductive areas by using the signal of one conductive area as a reference and amplifying the differential voltage between the other two conductive areas, and where the processor is operative to continuously convert the ECG signal to form medical information.

Also according to yet another aspect of the present invention there is provided a wrist-mounted physiological parameters measuring device additionally including a communication unit operative to communicate at least one of the SpO2 measurement, the ECG measurement, and the medical information to at least one of a gateway and a remote server.

Unless otherwise defined, all technical and scientific terms used herein have the same meaning as commonly understood by one of ordinary skill in the art to which this invention belongs. The materials, methods, and examples provided herein are illustrative only and not intended to be limiting.

Implementation of the method and system of the present invention involves performing or completing certain selected tasks or steps manually, automatically, or a combination thereof. Moreover, according to actual instrumentation and equipment of

preferred embodiments of the method and system of the present invention, several selected steps could be implemented by hardware or by software on any operating system of any firmware or a combination thereof. For example, as hardware, selected steps of the invention could be implemented as a chip or a circuit. As software, selected steps of the invention could be implemented as a plurality of software instructions being executed by a computer using any suitable operating system. In any case, selected steps of the method and system of the invention could be described as being performed by a data processor, such as a computing platform for executing a plurality of instructions.

Brief Description of the Drawings

The invention is herein described, by way of example only, with reference to the accompanying drawings. With specific reference now to the drawings in detail, it is stressed that the particulars shown are by way of example and for purposes of illustrative discussion of the preferred embodiments of the present invention only, and are presented in order to provide what is believed to be the most useful and readily understood description of the principles and conceptual aspects of the invention. In this regard, no attempt is made to show structural details of the invention in more detail than is necessary for a fundamental understanding of the invention, the description taken with the drawings making apparent to those skilled in the art how the several forms of the invention may be embodied in practice.

In the drawings:

Fig. 1A is a simplified illustration of a front view of a wrist-mounted heart monitoring device with two ECG sensors in the front side and one in the back side;

Fig. 1B is a simplified illustration of a back view of a wrist-mounted heart monitoring device with two ECG sensors in the front side and one in the back side;

Fig. 2A is a simplified illustration of a front view of a wrist-mounted heart monitoring device with one ECG sensors in the front side and two in the back side;

Fig. 2B is a simplified illustration of a back view of a wrist-mounted heart monitoring device with one ECG sensors in the front side and two in the back side

Fig. 3 is a simplified illustration of the wrist-mounted heart monitoring device of Figs. 1A and 1B warn and used by a subject;

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Fig. 4 is a simplified illustration of the wrist-mounted heart monitoring device of Figs. 2A and 2B warn and used by a subject;

Fig. 5 is a simplified illustration of the wrist-mounted heart monitoring device having a ring-mounted oximeter sensor warn and used by a subject;

Fig. 6 is a simplified block diagram of the heart monitoring device; and

Fig. 7 is a simplified flow chart of a software program preferably executed by the processor of the wrist-mounted heart monitoring device.

Detailed Description of the Invention

The principles and operation of a combined oximetry and electrocardiogram measuring system and a method according to the present invention may be better understood with reference to the drawings and accompanying description.

Before explaining at least one embodiment of the invention in detail, it is to be understood that the invention is not limited in its application to the details of construction and the arrangement of the components set forth in the following description or illustrated in the drawings. The invention is capable of other embodiments or of being practiced or carried out in various ways. In addition, it is to be understood that the phraseology and terminology employed herein is for the purpose of description and should not be regarded as limiting.

In this document, an element of a drawing that is not described within the scope of the drawing and is labeled with a numeral that has been described in a previous drawing has the same use and description as in the previous drawings. Similarly, an element that is identified in the text by a numeral that does not appear in the drawing described by the text has the same use and description as in the previous drawings where it was described.

In this document, unless otherwise specified, the terms "oxygen saturation in the blood", "blood oxygen saturation", "pulse oximeter", oximetry, SpO_2, and photoplethysmography have the same meaning and may be used interchangeably, except for those places where a difference between such terms is described. Similarly, the terms ECG, EKG, electrocardiogram, and electrocardiograph have the same meaning and may be used interchangeably unless otherwise specified. Additionally, the terms user, subject and patient may refer to the same entity, unless otherwise stated.

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Oximetry and ECG are well known techniques and there are various devices for measuring each. US patent 7650176 (Sarussi) teaches reflective measurement of Oxygen saturation in the blood. Sarussi describes a device mounted on the wrist of a human subject, or on an ankle of a baby with a reflective oximetry sensor mounted at the back side of the device and facing the skin of the subject. US patent application 20020095092 (Kondo) also teaches reflective oximetry at the wrist. Additionally, US patent application 20070038050 (Sarussi) teaches a wrist-worn measuring device with a finger-worn reflective oximetry sensor. PCT application WO2001017420 (Lindberg) teaches a further method of reflective oximetry. None of these teaches the use of ECG measurements with oximetry.

Deriving heart beat rate from oximetry, as well as other artifacts of the heart activity and blood flow, is also known in the art, as can be seen in US patent 5,176,137 (Ericson) and US patent applications 20030229276 (Sarussi) and 20090247848 (Baker).

US patent applications 20100268040 (Ben Oren) and 20090326356 (Kracker) discuss combination of oximetry and ECG measurements. Both documents assume that both the oximetry device and the ECG device are connected to the patient at all times. Thus a combined measurement is possible.

US patent No. 7,598,878 (Goldreich) describes a wrist mounted device equipped with an ECG measuring device and a SpO_2 measuring device. However, Goldreich does not teach interrelated measurements of ECG and SpO_2.

The prior art does not consider a requirement to enable a patient to perform ECG measurement as soon as an irregular heart activity develops and without requiring the ECG to be constantly wired to the patient.

The present invention resolves this problem by providing a combined oximetry and electrocardiogram measuring system and a method in which the oximetry measurement is performed continuously and/or repeatedly, and the ECG measurement is triggered upon detection of an intermittent irregular heart-related event. The present invention preferably performs measurements of intermittent irregular heart-related events without requiring the fixed wiring of the ECG device to the patient.

Reference is now made to Figs. 1A and 1B, which are simplified illustrations of two views of a wrist-mounted heart monitoring device 10 according to a preferred embodiment of the present invention.

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As shown in Fig. 1A, the heart monitoring device 10 preferably includes a monitoring unit 11 and a wearing accoutrement 12 such as a band, a strap or a bracelet, for attaching the monitoring unit 11 to a wrist of the monitored subject. It is appreciated that the accoutrement 12 can be a flexible band or a band equipped with a fastening article such as a hook and loop fastener (Velcro^{TM}) strip or any other type of fastener. It is appreciated that the heart monitoring device 10 can be attached to other parts of the body such as the ankle.

As shown in Figs. 1A and 1B, the heart monitoring device 10 is preferably equipped with two types of sensing devices: and oximetry (SpO_2) measuring unit and an ECG measuring unit. The oximetry measuring unit preferably includes an oximetry sensor 13 mounted in the back side of the monitoring unit 11 and facing the skin of the subject. The ECG measuring unit preferably includes at least three areas 14, each providing electrical contact with the subject. As shown in Figs. 1A and 1B, at least one of the electrical contacts 14 designated by the numeral 15 is mounted in the back side of the monitoring unit 11 and facing the skin of the subject, and at least two electrical contacts 14 designated by the numeral 16 are mounted on the front side of the monitoring unit 11.

It is appreciated that instead of, or in addition to, the oximetry (SpO_2) measuring unit the heart monitoring device may include a unit for measuring CO_2 content in the blood.

It is further appreciated that the oximetry (SpO_2) measuring unit can be mounted on the inner side of a ring or a clip worn on a finger of the hand wearing the heart monitoring device 10.

It is further appreciated that it is possible to measure ECG signals with only two electrical sensors contacting the subject, for example, one contact touching the wrist and the other contact touched by a finger of the other hand.

As shown in Figs. 1A, the heart monitoring device 10 may optionally include a user interface, preferably containing a display 17 and one or more buttons 18 for operating the device, and a sound producing device 19 for providing audible alerts to the user.

Reference is now made to Figs. 2A and 2B, which are simplified illustrations of two views of a different version wrist-mounted heart monitoring device 20 of an alternative configuration according to a preferred embodiment of the present invention.

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As shown in Figs. 2A and 2B, a monitoring unit 21 of the heart monitoring device 20 is similar to the monitoring unit 11 except that it preferably contains one ECG sensing contact 14 designated by the numeral 22 mounted in the front side and two ECG sensing contact 14 designated by the numeral 23 mounted in the back side.

Reference is now made to Figs. 3 and 4, which are simplified illustrations of the wrist-mounted heart monitoring device warn and used by a subject according to a preferred embodiment of the present invention.

As shown in Fig. 3, the heart monitoring device 10 is preferably warren on the wrist of the first hand of the subject. The oximetry sensor 13 (not shown) preferably faces the front side of the hand. One electrical contact (not shown) mounted on the back side of the heart monitoring device 10 touches the skin of the subject at the wrist, and two of the fingers of the second hand of the subject touch the two electrical contacts 14 on the front side of the heart monitoring device 10.

Alternatively, the heart monitoring device 10 may be equipped with two electrical contacts, one electrical contact mounted in the back side of the heart monitoring device 10 facing the wrist and touching the skin of the wrist, and the other electrical contact mounted in the front side of the heart monitoring device 10 to be touched by a finger of the opposite hand.

As shown in Fig. 4, the heart monitoring device 20 is preferably warren on the wrist of the first hand of the subject. The oximetry sensor 13 (not shown) preferably faces the back side of the hand. Two electrical contacts (not shown) mounted on the back side of the heart monitoring device 10 touch the skin of the subject at the wrist, and one of the fingers of the second hand of the subject touches the electrical contact 14 on the front side of the heart monitoring device 10.

It is appreciated that the heart monitoring device 20 can be warren facing the front side of the hand and the heart monitoring device 10 can be warren facing the back side of the hand.

Reference is now made to Fig. 5, which is a simplified illustrations another version of the wrist-mounted heart monitoring device warn and used by a subject according to a preferred embodiment of the present invention.

As seen, the wrist-mounted heart monitoring device 24 of Fig. 5 includes the oximeter (not shown) mounted inside a ring 25 warn on a finger of the hand wearing the

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heart monitoring device 24. The oximeter in the ring 24 is preferably connected to the heart monitoring device 24, preferably by an electrical cable 26.

Independently, the wrist-mounted heart monitoring device 24 includes a single electrical contact (not shown) mounted in the back side and a second electrical contact 14 mounted in the front side of the heart monitoring device 24 and touched by a finger of the other hand.

Reference is now made to Fig. 6, which is a simplified block diagram of the heart monitoring device 10, and/or 20 and/or 24, according to a preferred embodiment of the present invention.

As shown in Fig. 6, the heart monitoring device preferably includes a power supply unit such as a battery 27, a memory unit 28, a processor 29, an oximetry measuring unit 30 with the oximetry sensor 13, an ECG measuring unit 31 with three ECG contact sensors 14, a user interface unit 32 preferably containing output devices such as a display 33 and a sound producing device 34, and a user input device 35 for example including buttons, and optionally a communication unit 36.

The oximetry measuring unit 30 preferably uses reflective oximetry measuring technology. However, it is appreciated that other technologies for measuring SpO_2 such as transmittance oximetry can be used as well.

The memory unit 28 preferably contains software program containing instructions to be executed by the processor 29, operational parameters, oximetry and ECG data collected from the oximetry measuring unit 30 and ECG measuring unit 31, etc.

The software program contained in the memory unit 28 preferably contains various procedures such as:

Procedures for operating the oximetry measuring unit 30 and ECG measuring unit 31 including procedures to continuously measure SpO_2 signal, and procedures to initiate ECG measurements.

Procedures for operating the user-interface unit 32 and for interacting with the user including procedures for notifying the subject to perform an ECG measurement.

Procedures for analyzing oximetry measurements to detect various irregular heart conditions, procedure for identifying correlations between SpO_2 measurement and ECG measurement of a particular subject to detect user-specific irregular heart conditions.

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Using said correlation in said step of detecting an irregular heart condition from said SpO_2 measurement.

Procedures for communicating with a gateway and/or a remote server for exchanging information such as operational parameters and/or SpO_2 and ECG measurements.

Reference is now made to Fig. 7, which is a simplified flow chart of a software program preferably executed by the processor 29 of the wrist-mounted heart monitoring device according to a preferred embodiment of the present invention.

As shown in Fig. 7, the software program starts in element 37 by measuring SpO_2. The element of measuring SpO_2 (e.g. oxygen saturation in the blood). The SpO_2 measurement is preferably executed continuously as long as the heart monitoring device is operative. Preferably, the SpO_2 measurement is executed using the oximetry measuring unit 30 and the oximetry sensor 13.

The software program proceeds to element 38 to derive from the SpO_2 measurement physiological parameters such as pulse rate, pulse amplitude, pulse shape, rate of blood flow, etc. Then, the software program scans the derived physiological parameters to detect various irregularities of the heart condition. The scanning for an irregular heart condition preferably uses heart-irregularity detection parameters (element 39) stored in the memory unit 28. When an irregular heart condition is detected (element 40) the software program continues to element 41. However, the SpO_2 measurement (element 37) preferably continues and optionally also the derivation of physiological parameters as well as the detection of irregular heart conditions (element 38).

In element 41 the software program preferably initiates ECG measurement, preferably by operating ECG measuring unit 31. The software program preferably proceeds to element 42 to notify the user to perform an ECG measurement, preferably making use of the ECG monitoring device as described and illustrated with reference to Figs. 3 and 4. The software program preferably proceeds to element 43 to detect and ECG signal. Preferably, determining that the ECG signal is present and appropriately detected by the ECG measuring unit 31 is made using ECG detection parameters (element 44) stored in the memory unit 28. The user is preferably notified (element 45) until an ECG signal is properly detected (element 46), in which case the software program proceeds to element 47 to notify the user that the ECG signal is detected.

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The user notification features described with reference to elements 42, 45 and 47 includes the following optional but preferable notifications:

Repeatedly notifying the user to perform an ECG measurement until the ECG measurement detects an ECG signal.

Stopping the notification (to perform the ECG measurement) when the ECG measurement detects an ECG signal.

Notifying the user when the ECG signal is first detected.

Notifying the user that the ECG signal is being detected.

Notifying the user as long as the ECG signal is detected.

Then, the software program proceeds to element 48 to perform the ECG measurement and to element 49 to record the SpO_2 and the ECG measurements and preferably store them in the memory unit 28. Preferably, the SpO_2 and the ECG signals are correlated and stamped with a time stamp. The SpO_2 measurement, the ECG measurement and their recordation and storage (elements 37, 47 and 49 respectively) are continued and performed in parallel until a stopping condition is met.

Optionally but preferably the software program proceeds to element 50 to search for correlations between the SpO_2 signal and the ECG signal to produce new detection parameters, or modify existing detection parameters, so as to enhance the detection algorithms of the irregular heart conditions. Searching for correlation (element 50) can be executed in real-time (together with elements 37, 47 and 49) or later after the ECG measurement is concluded.

When the software program detects that a condition for stopping the ECG measurement is met (element 51) using stop conditions (element 52) preferably stored in the memory unit 28 the software program preferably notifies the user that the ECG measurement has stopped (element 53) and stops the ECG measurement (element 54).

Exemplary but preferable conditions for stopping the ECG measurement are:

The irregular heart condition has stopped.

The heart condition returned to normal.

A predefined period elapsed.

A predefined number of heart beats were counted.

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The ECG measurement is preferably performed while performing the SpO_2 measurement (and vice-versa) and until it is stopped upon detecting at least one of the stopping conditions.

The notifications to the user, such as the various notifications to start the ECG measurement (element 42), notifications of ongoing ECG measurement (element 47), and notification that the ECG measurement has stopped (element 53) may be visual and/or audible, and/or graphic, and/or textual, and/or using sound, and/or using speech, and/or using vibration, etc.

After concluding the ECG measurement (element 54) the software program preferably proceeds to element 55 to communicate with a remote server. In this step of the software program the wrist-mounted heart monitoring device preferably transmits to the remote server the collected data, such as the recorded ECG measurement, and/or the recorded concurrent SpO_2 measurement, and/or relevant parameters such as those used to detect the irregular heart condition and to stop the measurement, as well as identification of the subject and/or the wrist-mounted heart monitoring device.

The communication with the remote server may use any type of a variety of communication technologies such as wireline, wireless, cellular, WAN, LAN, PAN, or their combinations.

Alternatively, the wrist-mounted heart monitoring device may communicate with a gateway, such as a mobile gateway, such as a cellular telephone, that relays the data from the wrist-mounted heart monitoring device to the remote server.

The remote server preferably further analyzes the data and distributes it and/or derived medical information to physicians, paramedics, or any other healthcare specialists. This communication procedures may also enable the software program to receive from the remote server (optionally via the gateway) software updates and operational parameters updates, such as new detection algorithms, modified detection parameters, modified conditions for stopping the ECG measurements, etc.

Alternatively, the wrist-mounted heart monitoring device may communicate with the remote server (optionally via the gateway) in real-time, while the ECG and SpO_2 measurements are performed. Such online, real-time or near-real-time communication with the remote server may enable the software program to receive parameters updates while

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the measurements are performed, such as modifications to the conditions for stopping the ECG measurements.

It is expected that during the life of this patent many relevant methods and systems will be developed and the scope of the terms herein, particularly of the term "irregular heart condition" are intended to include all such new technologies a priori.

It is appreciated that certain features of the invention, which are, for clarity, described in the context of separate embodiments, may also be provided in combination in a single embodiment. Conversely, various features of the invention, which are, for brevity, described in the context of a single embodiment, may also be provided separately or in any suitable sub-combination.

Although the invention has been described in conjunction with specific embodiments thereof, it is evident that many alternatives, modifications and variations will be apparent to those skilled in the art. Accordingly, it is intended to embrace all such alternatives, modifications and variations that fall within the spirit and broad scope of the appended claims. All publications, patents and patent applications mentioned in this specification are herein incorporated in their entirety by reference into the specification, to the same extent as if each individual publication, patent or patent application was specifically and individually indicated to be incorporated herein by reference. In addition, citation or identification of any reference in this application shall not be construed as an admission that such reference is available as prior art to the present invention.

Claims

What is claimed is:

1. A method for triggering measurement of electrocardiogram (ECG) signal of a subject, the method comprising the steps of:

continuously measuring SpO_2 at least one of a wrist and a finger of said subject;

detecting an irregular heart condition from said SpO_2 measurement;

notifying said subject to perform an ECG measurement; and

initiating ECG measurement at least partially at said wrist.

2. The method according to claim 1 wherein said step of notifying said subject to perform an ECG measurement comprises at least one of the acts of:

notifying said subject to perform an ECG measurement repeatedly until said ECG measurement detects an ECG signal;

stopping said notification to said subject to perform an ECG measurement when said ECG measurement detects an ECG signal;

notifying said subject when said ECG signal is first detected;

notifying said subject that said ECG signal is being detected;

notifying said subject as long as said ECG signal is detected; and

notifying said subject that said ECG measurement has stopped.

3. The method according to claim 1 additionally comprising the steps of:

performing said SpO_2 measurement while performing said ECG measurement;

identifying a correlation between said SpO_2 measurement and said ECG measurement; and

using said correlation in said step of detecting an irregular heart condition from said SpO_2 measurement.

4. The method according to claim 3 wherein said correlation is particular to said subject.

5. The method according to claim 1 wherein said ECG measurement is stopped upon detecting at least one of the conditions of:

said irregular heart condition stopped;

heart condition returned to normal;

a predefined period elapsed; and

a predefined number of heart beats counted.

6. The method according to claim 1 wherein said SpO_2 measurement comprises using reflective SpO_2 measurement.

7. The method according to claim 1 wherein said ECG measurement additionally comprises the steps of:

providing at least two separate conductive areas configured to measure electrical activity of said subject;

performing at least one of the steps of:

(i) contacting a first conductive area to at least a portion of said wrist, and a second conductive area to a finger of a second hand of the subject;

(ii) contacting a first conductive area to at least a portion of said wrist, and a second and a third conductive areas to two fingers of a second hand of the subject; and

(iii) contacting a first and a second conductive areas to at least a portion of the first hand and a third conductive area to a second hand of said subject.

extracting an ECG signal from said conductive areas by using one conductive area as a reference and amplifying the differential voltage between at least two other conductive areas; and

continuously converting the at least one measurement to form medical information.

8. The method according to any of claims 1 to 7 wherein said ECG measurement additionally comprises the step of:

communicating at least one of said SpO_2 measurement, said ECG measurement, and said medical information to at least one of a gateway and a remote server.

9. A wrist-mounted physiological parameters measuring device comprising of:

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an SpO_2 measuring unit attached to a wrist of a subject said SpO_2 measuring unit being operative to continuously measure SpO_2 at said wrist of said subject;

an ECG measuring unit attached to said wrist of said subject for measuring ECG signal at least partially at said wrist; and

a processor operative to control both said SpO_2 measuring and said ECG measuring unit;

wherein said processor is operative to detect an irregular heart condition from said SpO_2 measurement, to notify said subject to perform an ECG measurement upon detecting said irregular heart condition said, and to initiate said ECG measurement.

10. The device according to claim 9 wherein said processor is additionally configured to perform at least one of the procedures selected from the group comprising of:

a procedure for notifying said subject to perform an ECG measurement repeatedly until said ECG measurement detects an ECG signal;

a procedure for stopping said notification to said subject to perform an ECG measurement when said ECG measurement detects an ECG signal;

a procedure for notifying said subject when said ECG signal is first detected;

a procedure for notifying said subject that said ECG signal is being detected;

a procedure for notifying said subject as long as said ECG signal is detected; and

a procedure for notifying said subject that said ECG measurement has stopped.

11. The device according to claim 9 wherein said processor is additionally configured to perform at least one of the procedures selected from the group comprising of:

a procedure performing said SpO_2 measurement while performing said ECG measurement;

a procedure for identifying a correlation between said SpO_2 measurement and said ECG measurement; and

a procedure for detecting said irregular heart condition from said SpO_2 measurement using said correlation.

12. The device according to claim 9 wherein said correlation is particular to said subject.

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13. The device according to claim 9 wherein said processor is additionally configured to stop said ECG measurement upon detecting at least one of the conditions of:

said irregular heart condition stopped;

heart condition returned to normal;

a predefined period elapsed; and

a predefined number of heart beats counted.

14. The device according to claim 9 wherein said SpO_2 measuring unit comprises reflective SpO_2 measurement device.

15. The device according to claim 9 wherein said ECG measurement unit comprises at least two separate conductive areas configured to measure electrical activity of said subject;

wherein said at least three conductive areas arranged in one of the following configurations:

(i) a first conductive area configured to be in contact with at least a portion of the wrist, and second conductive area configured to be touched by a finger of a second hand of the subject;

(ii) a first conductive area configured to be in contact with at least a portion of the wrist, and second and third conductive areas configured to be touched by two fingers of a second hand of the subject; and

(iii) a first and a second conductive areas configured to be in contact with at least a portion of the first hand and a third conductive area configured to be touched by a second hand of the subject;

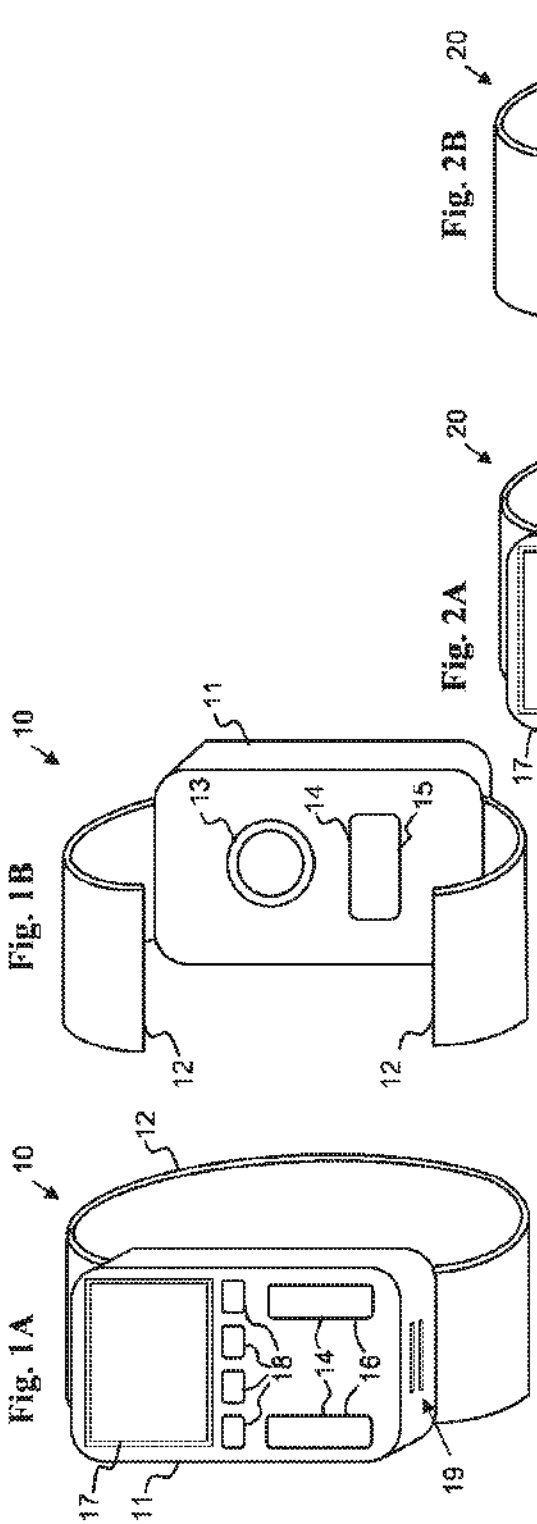
whereby said ECG signal is extracted from said three conductive areas by using the signal of one conductive area as a reference and amplifying the differential voltage between the other two conductive areas; and

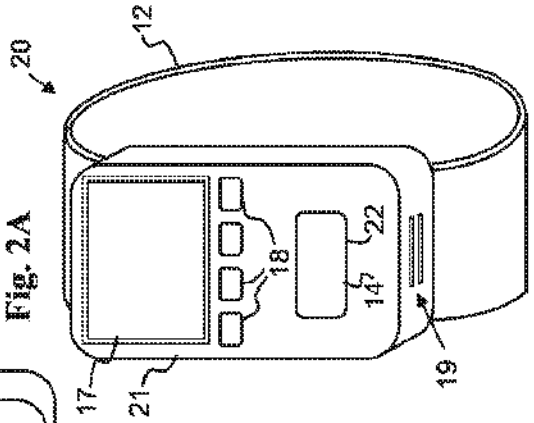
whereby said processor is operative to continuously convert said ECG signal to form medical information.

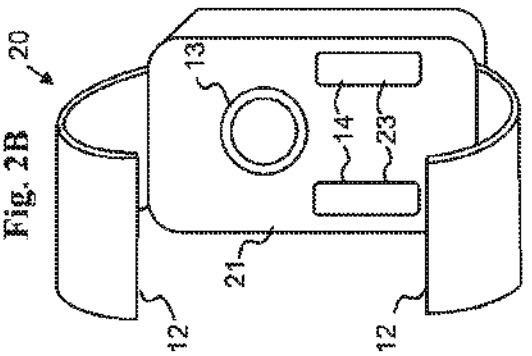
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16. The device according to any of claims 9 to 15 additionally comprising a communication unit operative to communicate at least one of said SpO_2 measurement, said ECG measurement, and said medical information to at least one of a gateway and a remote server.

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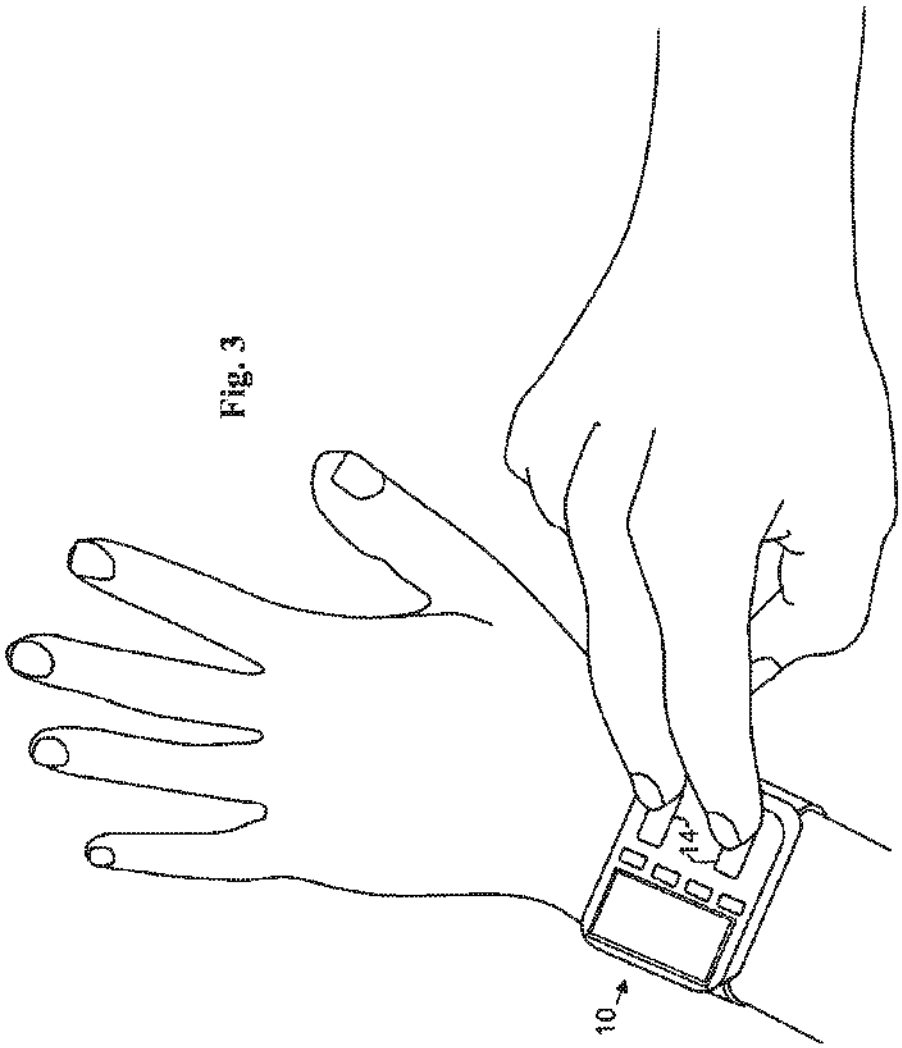






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Fig. 3



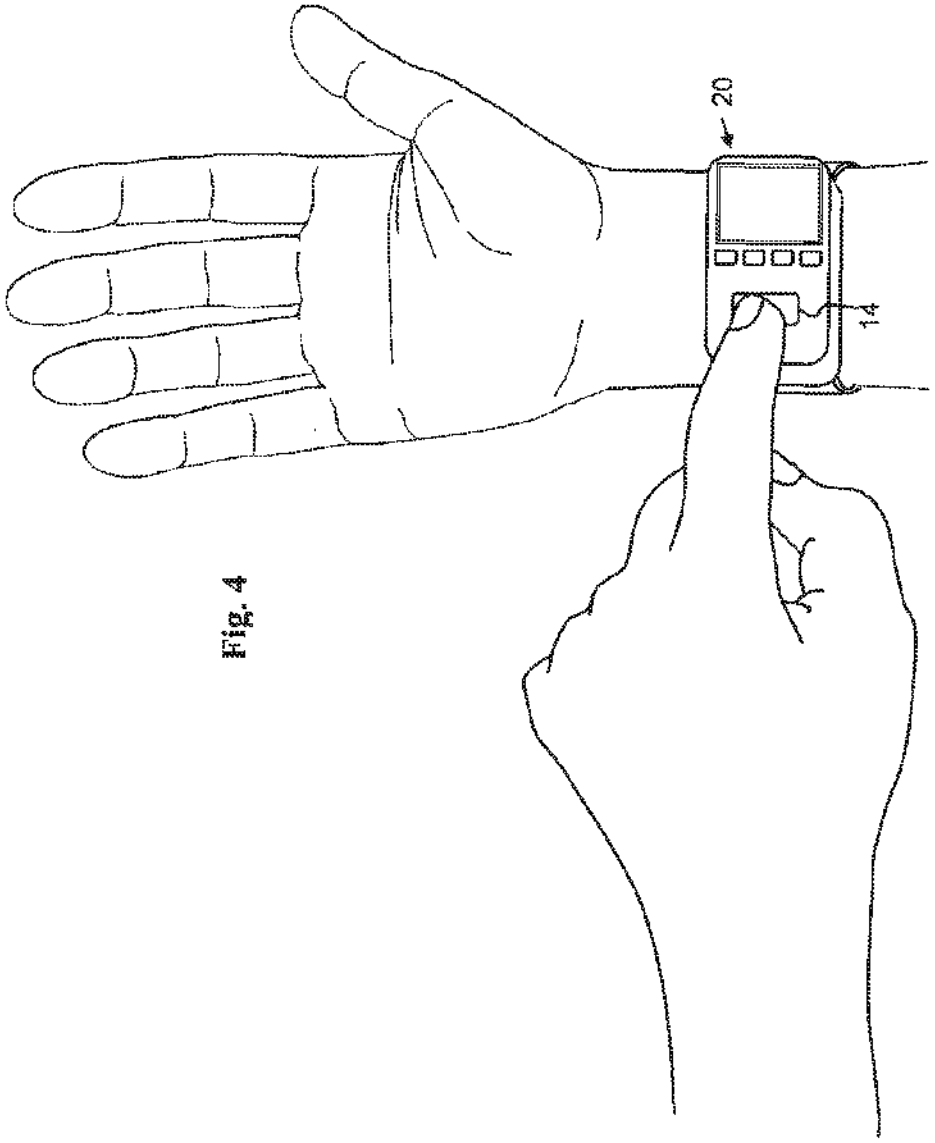
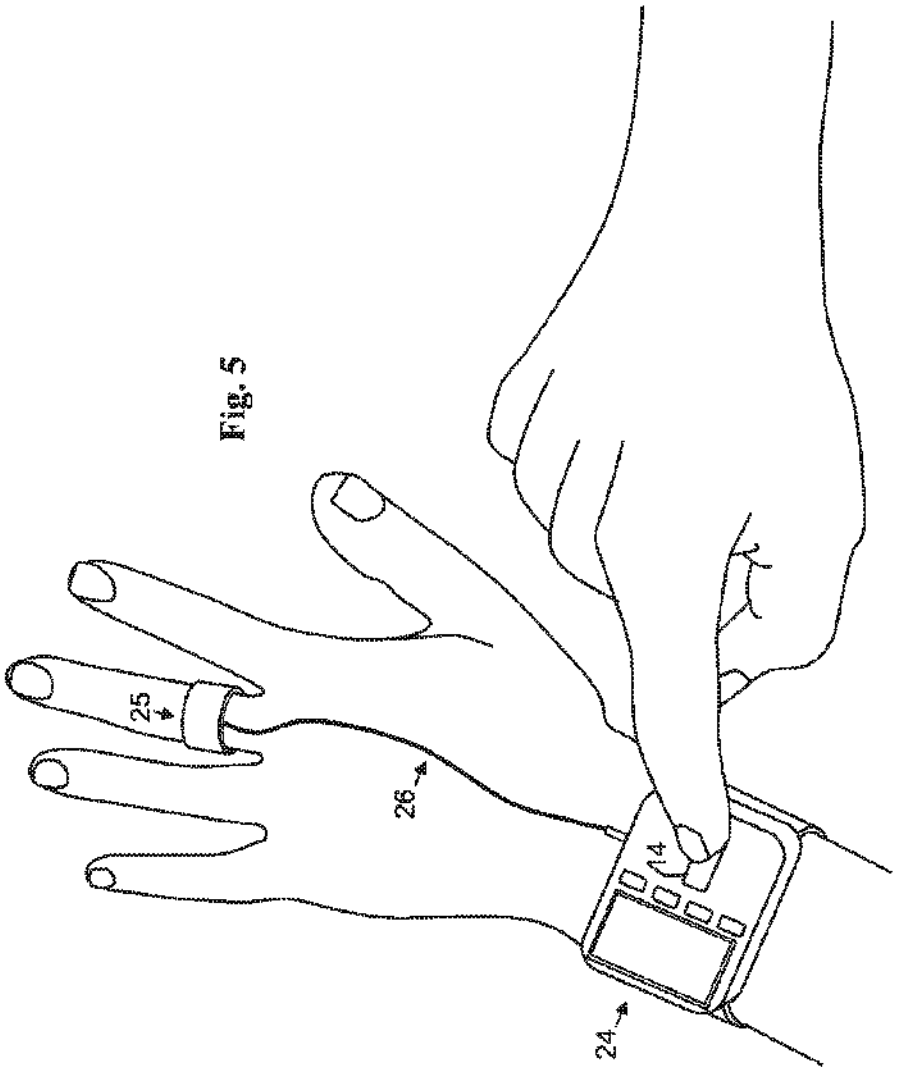


Fig. 4

Fig. 5



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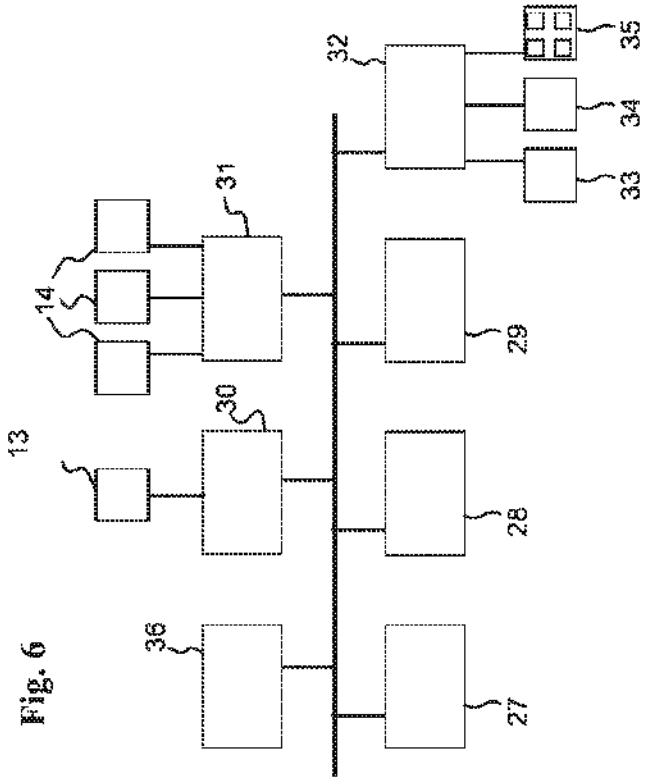


Fig. 6

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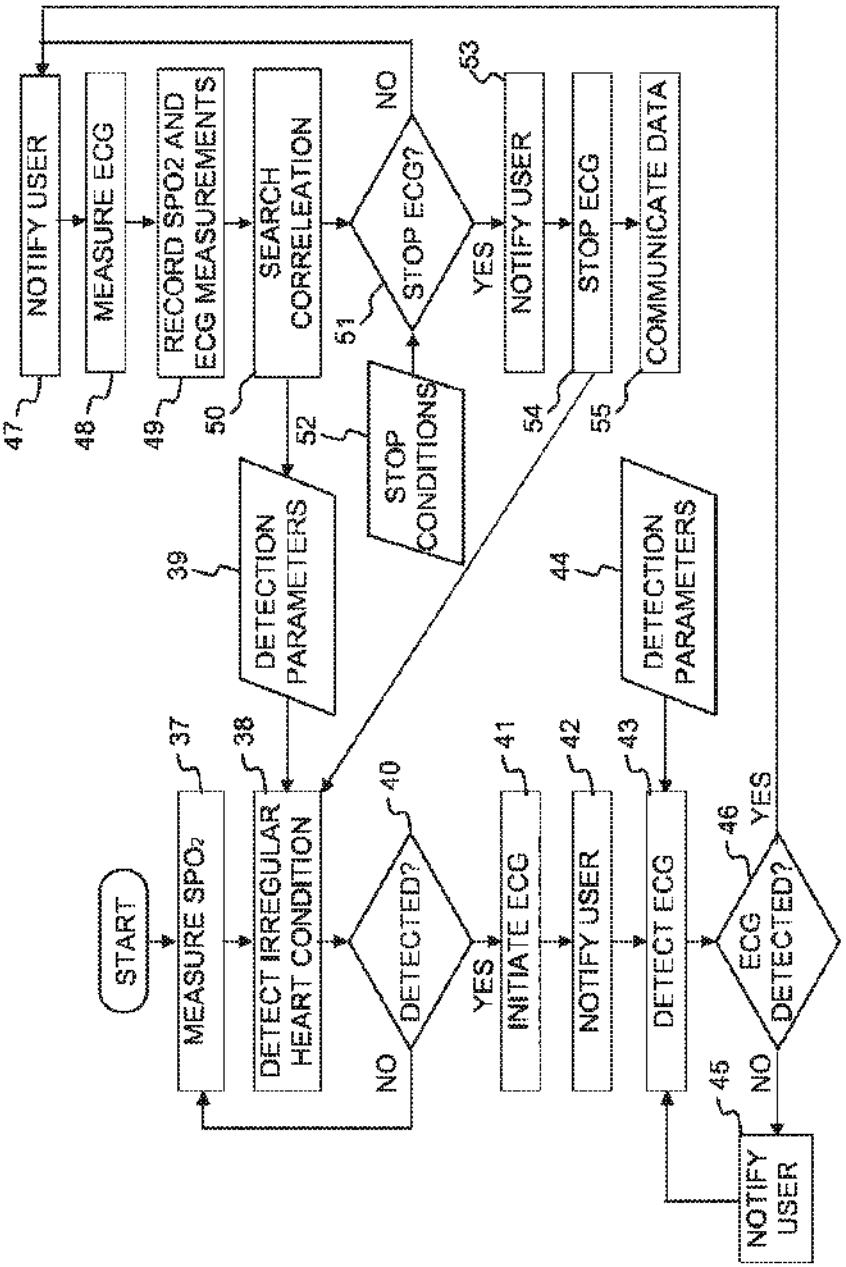


Fig. 7

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2012/051731

A. CLASSIFICATION OF SUBJECT MATTER
INV. A61B5/024 A61B5/0404 A61B5/1455
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

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, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2007/265533 A1 (TRAN BAO [US]) 15 November 2007 (2007-11-15) figure 6A paragraphs [0218] - [0220], [0226] - [0229], [0245] - [0246], [0252] -----	9-16
X	US 2005/177051 A1 (ALMEN ADAM J [US]) 11 August 2005 (2005-08-11) abstract figures 1,2 paragraphs [0052] - [0064], [0072] - [0073], [0081] -----	9-16

-/--

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
2 August 2012	13/08/2012

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	Vanderperren, Yves

Form PCT/ISA/210 (second sheet) (April 2005)

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INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2012/051731

(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No
X	WO 2005/110238 A1 (MEDIC4ALL A G [CH]; GOLDREICH RAMI [IL]) 24 November 2005 (2005-11-24) figures 1,5 page 32, line 3 - line 20 page 33, line 9 - line 18	9-16
A	EP 0 335 357 A2 (NELLCOR INC [US]) 4 October 1989 (1989-10-04) paragraphs [0021], [0022]	11,12

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International application No.
PCT/IB2012/051731

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. [X] Claims Nos.: 1-8
because they relate to subject matter not required to be searched by this Authority, namely:

see FURTHER INFORMATION sheet PCT/ISA/210

2. [ ] Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. [ ] Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. [ ] As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. [ ] As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.

3. [ ] As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. [ ] No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

[ ] The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

[ ] The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

[ ] No protest accompanied the payment of additional search fees.

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FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

Continuation of Box II.1

Claims Nos.: 1-8

Claims 1-8 relate to subject-matter considered by this Authority to be covered by the provisions of Rule 39.1(iv) / 67.1(iv) PCT. A meaningful search is not possible on the basis of claims 1-8 because they are directed to a diagnostic method practised on the human or animal body (Rule 39.1(iv) PCT) The claims comprise - the step of collecting data (claim 1: " continuously measuring SpO2 at least one of a wrist and a finger of said subject ") - the step of comparing these with standard values (claim 1: " detecting an irregular heart condition from said SpO2 measurement "; the feature of a comparison is implicitly and necessarily present in a step of detecting an irregular heart condition) - the step of finding a significant deviation (claim 1: " detecting an irregular heart condition from said SpO2 measurement "; the feature of finding a deviation is implicitly and necessarily present in a step of detecting an irregular heart condition), and - the step of attributing the deviation to a particular clinical picture, i.e., the deductive medical or veterinary decision phase (claim 1: " detecting an irregular heart condition from said SpO2 measurement "). It is pointed out that no unified criteria exist within the PCT contracting states as to what subject-matter is considered to fall under the provisions of Rules 39.1(iv) and 67.1(iv)PCT, in particular what subject-matter may be considered as industrially applicable or not. In the present case, the claimed subject-matter of method-claims 1-8 may during prosecution in the regional and national phase, be considered to be diagnostic and, therefore, not acceptable under the applicable law.

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/IB2012/051731

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2007265533 A1	15-11-2007	US 2007265533 A1	15-11-2007
		US 2009227877 A1	10-09-2009
		US 2012095357 A1	19-04-2012
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		WO 2005110238 A1	24-11-2005
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		JP 3286313 B2	27-05-2002
		JP 2002282243 A	02-10-2002
		US 4911167 A	27-03-1990

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6 August 2015 (06.08.2015)

WIPO | PCT

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(21) International Application Number:
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(22) International Filing Date:
30 January 2014 (30.01.2014)

(25) Filing Language: English

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(72) Inventors: **JABORI, Monji G.**; 11445 Compaq Center Dr W. Houston, Texas 77070 (US). **LIM, Hui Leng**; 11445 Compaq Center Dr W. Houston, Texas 77070 (US). **STANCIL, Charles J.**; 11445 Compaq Center Dr W, Houston, Texas 77070 (US).

(74) Agents: **HABLINSKI, Reed Joseph** et al.; Hewlett-Packard Company, Intellectual Property Administration, 3404 E. Harmony Road, Mail Stop 35, Fort Collins, Colorado 80528 (US).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

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Declarations under Rule 4.17:

— *as to the identity of the inventor (Rule 4.17(i))*

[Continued on next page]

(54) Title: WIRELESS POWER ALIGNMENT

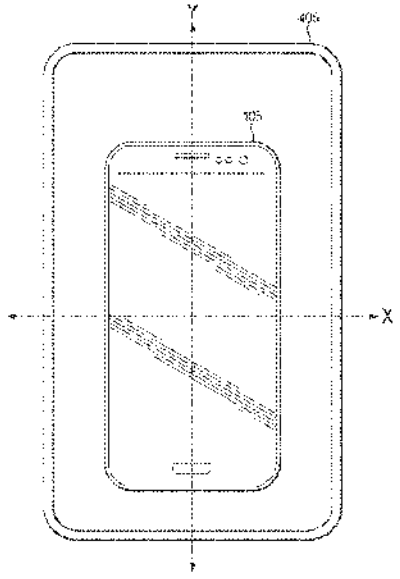


FIG. 6

(57) Abstract: A computing device can include a wireless power module and a haptic module to move the computing device in a direction. A controller in the computing device can detect a misalignment of the wireless power module with a wireless power transmitter. The controller can control the haptic module to move the computing device to be aligned with the wireless power transmitter.

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417

— as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))

Published:

— with international search report (Art. 21(3))

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WIRELESS POWER ALIGNMENT

Background

[0001] Haptic technology is tactile feedback which takes advantage of the sense of touch by applying forces, vibrations, or motions to the user. This mechanical stimulation can be used to assist in the creation of virtual objects in a computer simulation, to control such virtual objects, and to enhance the remote control of machines and devices. Haptic feedback may use electromagnetic technologies such as vibratory motors.

Brief Description Of The Drawings

[0002] Some embodiments of the invention are described with respect to the following figures:

Fig. 1 is a computing device according to an example implementation;

Fig. 2 is a computing device according to an example implementation;

Fig. 3 is a computing device according to an example implementation;

Fig. 4 is a computing device and wireless power transmitter according to an example implementation;

Fig. 5 is a computing device and wireless power transmitter according to an example implementation;

Fig. 6 is a computing device and wireless power transmitter according to an example implementation;

Fig 7 is a flow chart of a method of aligning a wireless power module according to an example implementation;

Fig 8 is a flow chart of a method of aligning a wireless power module according to an example implementation; and

Fig 9 is a computing device according to an example implementation.

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Detailed Description

[0003] Wireless power transfer such as by induction can transfer power from a wireless power transmitter to a wireless power module. The wireless power module may be on a computing device to power the device or transfer power to a storage on the computing device such as a battery.

[0004] The efficiency of transfer of power by induction may be effected by the alignment of the inductive coils. Haptics is a tactile feedback technology which takes advantage of the sense of touch by applying forces, vibrations, or motions to the user. A computing device may include a haptic module, the haptic module may cause the computing device to vibrate. Vibration of the computing device can cause the computing device to move relative to a wireless power transmitter causing the computing device to align with wireless power transmitter to increase the efficiency of the power transfer.

[0005] In one implementation, a computing device can include a wireless power module and a haptic module to move the computing device in a direction. A controller in the computing device can detect a misalignment of the wireless power module with a wireless power transmitter. The controller can control the haptic module to move the computing device to be aligned with the wireless power transmitter.

[0006] In another implementation, a method can include sensing, by a computing device, a wireless power module misaligned with a wireless transmitter. Then a controller can determine if activating a haptic module would align the wireless power module with the wireless power transmitter. If they would align the haptic module can be activated until the wireless power module is aligned with the wireless power transmitter.

[0007] In still another implementation, a computer readable medium can include code that if executed by a controller in a computing device can cause the controller to determine if a wireless power module and a wireless power transmitter are misaligned. The code can then cause the controller to determine if activating a haptic module would align the wireless power module with the wireless power

transmitter. The controller can then activate the haptic module if it is determined that activating the haptic module would align the wireless power module with the wireless power transmitter until the wireless power module is aligned with the wireless power transmitter.

[0008] With reference to the figures, Fig. 1 is a computing device according to an example implementation. A computing device 100 can include an enclosure 105 and a wireless power module 130. The enclosure 105 may be made of a plastic, carbon fiber, metal or another material. If conductive material is used for the enclosure 105, a non-conductive material may be part of the enclosure 105 to allow wireless power to be received through the non-conductive part of the enclosure 105. The material of the enclosure may have a low co-efficient of friction created between the enclosure and another material such as below 0.6.

[0009] A haptic module 110 can move the computing device in a direction by vibrating the computing device 100. The haptic module may be for example an eccentric rotating mass (ERM), a linear resonance actuator (LRA), a piezo actuator or another type of haptic module. The vibrations caused by the haptic module 110 may be linear, periodic, random or transient, the result of the vibrations can be to move the computing device in a direction. A controller 120 can determine how to activate the haptic module 110 to move the computing device 100 in a direction and a distance. For example the direction may be any direction from 0 and 360 degrees. The amount of movement of the computing device 100 provided by activating the haptic module 110 may depend on many factors such as the weight of the computing device 100, the force generated by the haptic module 110 and the coefficient of friction between the computing device 100 and the wireless power transmitter which may be in a docking station for example. The controller 120 can also affect the motion and direction by the type and frequency of the input waveform to the haptic module 110.

[0010] The controller 120 can detect a misalignment of the wireless power module 130 with a wireless power transmitter. The wireless power transmitter can send power to a wireless power module. The wireless power module can receive power

from the wireless power transmitter. The wireless power transmitter may be the primary coil of an electrical transformer and the wireless power module may be the secondary coil of an electrical transformer. The distance that power can be transferred between a primary and secondary coil of an electrical transformer may be short. To extend the distance that power can be transferred between the wireless power transmitter and the wireless power module resonant inductive coupling can be used where the primary and secondary coils are tuned to resonate at the same frequency.

[0011] The detection may be by receiving data from a sensor 135. The sensor 135 may for example detect a magnetic field in the wireless power transmitter and the sensor 135 may detect the magnet's position relative to the sensor. The controller 120 can use the data from the sensor 135 to determine a direction and a distance to move the computing device 100 and therefore the wireless power module 130 relative to the wireless power transmitter. The controller 120 may have a threshold limit on the distance that the computing device 100 can be moved to align the wireless power module 130 with the wireless power transmitter for example a threshold may be 0.5 centimeters although other thresholds can be used. If for example the controller 120 determines that the wireless power module 130 is 0.7 centimeters out of alignment and the threshold is 0.5 centimeters the controller may not activated the haptic module 110, however if the controller determined the wireless power module130 was 0.3 centimeters out of alignment with the wireless power transmitter then the controller may activate the haptic module to start vibrating the computing device 100 causing the wireless power module 130 to become more aligned with the wireless power transmitter.

[0012] A battery 125 can store the energy received from the wireless power module 130. The battery 125 may be a lithium ion, nickel metal hydride or another battery technology. The battery 125 may be charged by receiving current from the wireless power module 130. Other components in the computing device 100 can be powered by the wireless power module 130 by receiving current from the wireless power module 130 or from the battery 125.

[0013] Aligning the wireless power module 130 with a wireless power transmitter can improve the efficiency of the power transfer between the wireless power transmitter and the wireless power module 130. For example if the wireless power module 130 is 0.5 centimeters out of alignment the efficiency may drop over 50% from an aligned wireless power module 130 and a wireless power transmitter. An aligned wireless power module 130 with a wireless power transmitter may be when the wireless power module 130 is within a threshold distance such as 0.1 centimeters from the wireless power transmitter. Although the thresholds have been described as distances the thresholds may be other values such as the electrical current received from the wireless power module 130 or the charging efficiency. For example if the electrical current is below a threshold the computing device 100 may be moved to increase the current received or if the efficiency is below a threshold amount the computing device 100 may be moved. The maximum efficiency may be about 72% for a wireless power module and wireless power transmitter however misalignment can reduce the charging efficiency.

[0014] Fig. 2 is a computing device according to an example implementation. The haptic module may include a first haptic module 110 and a second haptic module 115. The first haptic module 110 and the second haptic module may be oriented in different directions relative to each other to produce movement of the computing device 100 in different directions. For example the second haptic module 115 may be substantially perpendicular to the first haptic module 110. The first haptic module 110 and second haptic module 115 may be controlled to move the computing device 100 in more than one direction. The haptic modules 110 and 115 may have motors or other components that can be operated in for example a forward and reverse direction. Operating the haptic module in forward may cause the computing device to move in a one direction while operating the haptic module in reverse may cause the computing device to move in another direction.

[0015] The haptic modules 110 and 115 can also provide feedback for events. For example the controller 120 may cause the haptic module 110 to vibrate when a phone call, a text message or another event occurs. The controller 120 may operate the haptic modules 110 and 115 in a way that causes the device not to move in a

direction to prevent any event from causing the loss of efficiency of the wireless power module 130. The controller 120 in one example may not operate the haptic modules for indicating an event if wireless charging is occurring to prevent the haptic modules from moving the computing device 100 out of alignment with the wireless power transmitter.

[0016] Fig. 3 is a computing device according to an example implementation. In one example computing device 100 includes multiple haptic modules. The first haptic module 110, the second haptic module 115, the third haptic module 140 and the fourth haptic module 145 are shows as being toward the corners of the computing device 100 but may be in other configurations. The controller 120 can cause the haptic modules 110, 115, 140, and 145 to operate in coordination to move the computing device 100. For example when operated each haptic module may pull the device in the direction leading with that corner. If haptic modules on the same side such as haptic modules 115 and 145 are activated the computing device may move to the side. The haptic modules 110, 115, 140, and 145 may also cause the computing device to rotate for example.

[0017] Fig. 4-5 are a computing device and wireless power transmitter according to an example implementation. In some examples the enclosure 105 and a docking station 405 may have a shape that promotes the alignment caused by the haptic modules to align the wireless power transmitter 455 with the wireless power module 130. One example of such a shape is the computing device enclosure 105 has a convex shape and the docking station 405 includes concave shape. In one example the computing device enclosure 105 and the docking station can be shaped so that the computing device enclosure 105 can settle into an aligned position by activating the haptic module when the computing device detects that it is out of alignment with the docking station. Although figure 4-5 show a concave and convex shape of the docking station 405 and the computing device 105 other shapes may be used such as alignment protrusions on the computing device enclosure 105 that align with alignment indentations on the docking station 405 when the haptic module is activated. Using alignment features of the enclosure and the docking station may allow the haptic module to be operated when there is misalignment without having to

use the controller to control the direction or distance of movement of the computing device enclosure 105 relative to the docking station 450. For example if the computing device enclosure 105 is in contact with the docking station 405 as shown in Fig. 5 and the wireless power module within the computing device enclosure 105 is not aligned for maximum efficiency the controller can activate the haptic module and the weight of the computing device will cause the computing device to move along the surface of the docking station until the computing device enclosure 105 is aligned with the docking station 405.

[0018] The docking station 405 may provide the wireless power transmitter 455. The docking station 405 may receive power for the wireless power transmitter 455 from an alternating current (AC) to direct current (DC) adapter such as a 5 watt adapter. The DC current may be converted back to AC current that is applied to the wireless power transmitter 455. The wireless power module can generate AC current that is converted to DC current in the computing device for use to charge the battery or power the components of the computing device. The docking station 405 may also have other components for data communication with the computing device 100 such as Bluetooth or wifi wireless data transceivers.

[0019] Fig. 6 is a computing device and wireless power transmitter according to an example implementation. The computing device enclosure 105 is on the docking station 405 and the computing device enclosure 105 is shown moving in the x direction to the middle of the docking station. The haptic modules may also cause the computing device to move in the Y direction.

[0020] Fig 7 is a flow chart of a method of aligning a wireless power module according to an example implementation. The method 700 includes sensing, by a computing device 100, a wireless power module misaligned with a wireless power transmitter at 705. It can be determined from using a controller if activating a haptic module would align the wireless power module with the wireless power transmitter at 710. If it is determined that activating the haptic module would align the wireless power module with the wireless power transmitter then the haptic module can be activated until the wireless power module is aligned with the wireless power

transmitter at 720. If it is determined that activating the haptic module would not align the wireless power module with the wireless power transmitter then the haptic module is not activating at 715. If the haptic module is not activated to align the wireless power module with the wireless power transmitter then the computing device may notify the user that the haptic module cannot align the wireless power module with the wireless power transmitter. The notification may also prompt the user with instructions in how to move the device so that it is within a threshold that the haptic module can be used to align wireless power module with the wireless power transmitter, for example the notification may ask to reposition the device on a docking station, or may have an arrow showing which way to move the computing device.

[0021] In an implementation it may be determined that the wireless power module misalignment is greater than a threshold limit. Other examples may include that the controller determines that there is not enough power to move the computing device at current levels. If for example the current power level is not enough to align the wireless power module with the wireless power transmitter then the controller may delay activating the haptic modules until power in a storage such as a battery has reached sufficient levels to allow then haptic modules to be activated.

[0022] Fig 8 is a flow chart of a method of aligning a wireless power module according to an example implementation. The method 800 includes sensing, by a computing device 100, a wireless power module misaligned with a wireless power transmitter at 805. It can be determined from using a controller if activating a haptic module would align the wireless power module with the wireless power transmitter at 810. If it is determined that activating the haptic module would align the wireless power module with the wireless power transmitter then activating the haptic module until the wireless power module is aligned with the wireless power transmitter at 820. The determination at 820 may include comparing the misalignment to a first threshold.

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[0023] If it is determined that activating the haptic module would not align the wireless power module with the wireless power transmitter then no activating the haptic module at 815.

[0024] A notification generated at 807 may also cause the haptic module to be activated at 820. The notification may be for example a phone call being received, a text message or another notification.

[0025] Fig 9 is a computing device according to an example implementation. The computing device 900 can include an enclosure 905 and a computer readable medium 950. The computer readable medium 950 can include code 955 that if executed by a controller 935 in a computing device 900 causes the controller 935 to determine if a wireless power module 925 and a wireless power transmitter are misaligned. It is determined if activating a haptic module 920 would align the wireless power module with the wireless power transmitter. The controller can then activate the haptic module if it is determined that activating the haptic module would align the wireless power module with the wireless power transmitter until the wireless power module is aligned with the wireless power transmitter. To determine if activating the haptic module would align the wireless power module 925 and a wireless power transmitter the misalignment can be compared to a range between a first threshold and a second threshold.

[0026] The techniques described above may be embodied in a computer-readable medium for configuring a computing system to execute the method. The computer readable media may include, for example and without limitation, any number of the following non-transitive mediums: magnetic storage media including disk and tape storage media; optical storage media such as compact disk media (e.g., CD-ROM, CD-R, etc.) and digital video disk storage media; holographic memory; nonvolatile memory storage media including semiconductor-based memory units such as FLASH memory, EEPROM, EPROM, ROM; ferromagnetic digital memories; volatile storage media including registers, buffers or caches, main memory, RAM, etc.; and the Internet, just to name a few. Other new and various types of computer-readable media may be used to store the software modules discussed herein. Computing

systems may be found in many forms including but not limited to mainframes, minicomputers, servers, workstations, personal computers, notepads, personal digital assistants, various wireless devices and embedded systems, just to name a few.

[0027] The use of "comprising", "including" or "having" are synonymous and variations thereof herein are meant to be inclusive or open-ended and do not exclude additional unrecited elements or method steps. It should also be noted that a plurality of hardware and software based devices, as well as a plurality of different structural components may be used to implement the disclosed methods and systems.

[0028] In the foregoing description, numerous details are set forth to provide an understanding of the present invention. However, it will be understood by those skilled in the art that the present invention may be practiced without these details. While the invention has been disclosed with respect to a limited number of embodiments, those skilled in the art will appreciate numerous modifications and variations therefrom. It is intended that the appended claims cover such modifications and variations as fall within the true spirit and scope of the invention.

What is claimed is:

1. A computing device comprising:
a wireless power module;
a haptic module to move the computing device in a direction; and
a controller to detect a misalignment of the wireless power module with a wireless power transmitter and control the haptic module to move the computing device to be aligned with the wireless power transmitter.

2. The device of claim 1, wherein the controller determines if the misalignment is past a threshold and if past the threshold does not control the haptic module to move the computing device.

3. The device of claim 2, wherein the threshold is a distance.

4. The device of claim 2, wherein the threshold is a charging efficiency.

5. The device of claim 1, further comprising alignment protrusions on the computing device.

6. The device of claim 5, further comprising alignment indentations on the wireless power transmitter.

7. The device of claim 1, wherein the haptic module includes a first haptic module and a second haptic module substantially perpendicular to the first haptic module.

8. The device of claim 1, wherein the computing device has a convex shape and the wireless power transmitter includes concave shape.

9. The device of claim 1, further comprising a sensor to detect misalignment with an object in a wireless power transmitter.

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10. The device of claim 1, wherein the haptic module provides feedback for events.

11. A method comprising:

sensing, by a computing device, a wireless power module misaligned with a wireless power transmitter;

determining, from the sensing using a controller, if activating a haptic module would align the wireless power module with the wireless power transmitter; and

activating the haptic module if it is determined that activating the haptic module would align the wireless power module with the wireless power transmitter until the wireless power module is aligned with the wireless power transmitter.

12. The method of claim 11, wherein determining further comprises comparing the misalignment to a first threshold.

13. The method of claim 12, further comprising activating the haptic module in response to a notification event.

14. A computer readable medium comprising code that if executed by a controller in a computing device causes the controller to:

determine if a wireless power module and a wireless power transmitter are misaligned;

determine if activating a haptic module would align the wireless power module with the wireless power transmitter; and

activate the haptic module if it is determined that activating the haptic module would align the wireless power module with the wireless power transmitter until the wireless power module is aligned with the wireless power transmitter.

15. The computer readable medium of claim 14 further comprising code that if executed causes a computing device to:

compare a misalignment to a range between a first threshold and a second threshold.

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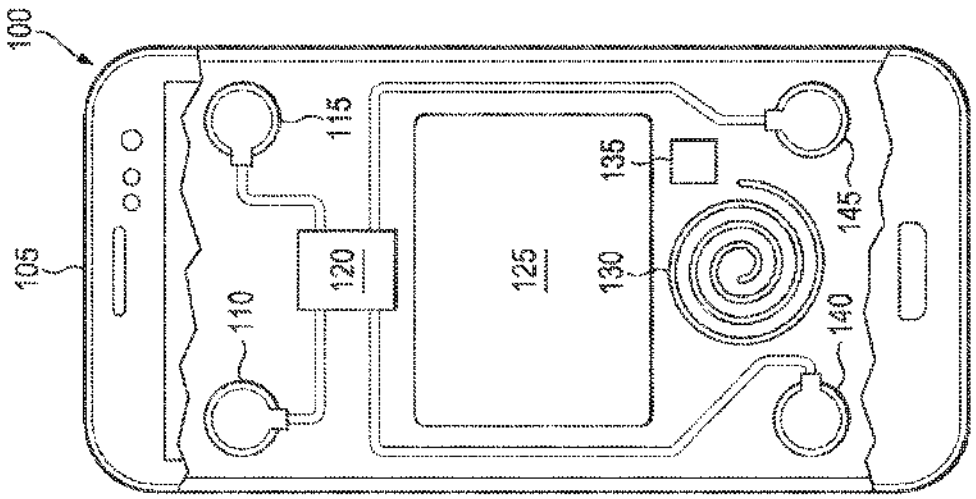


FIG. 3

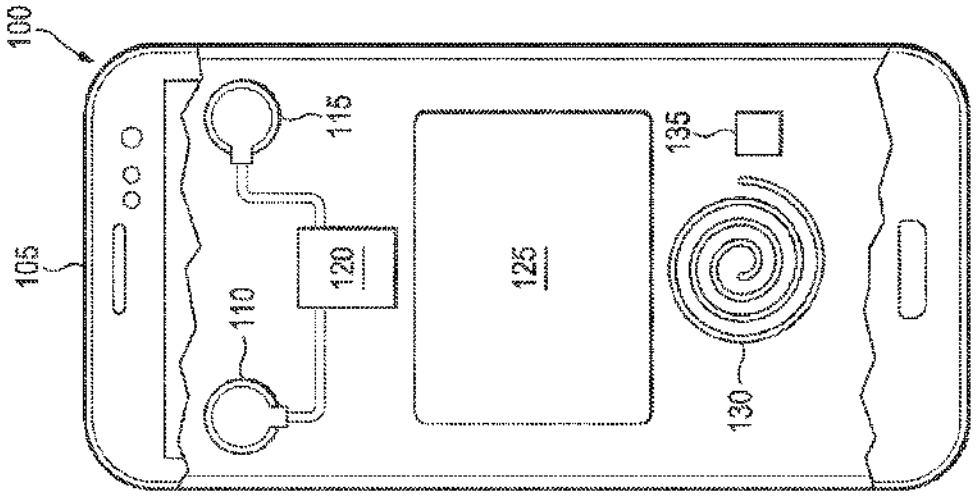


FIG. 2

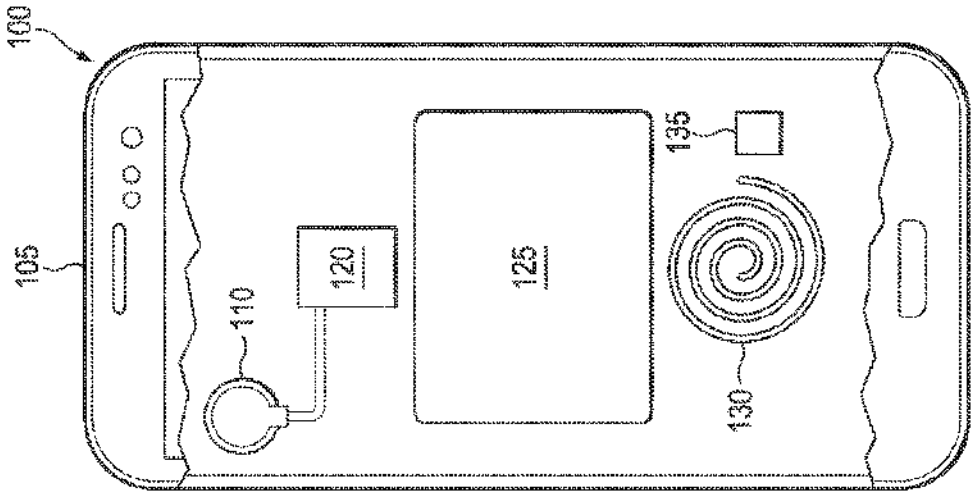


FIG. 1

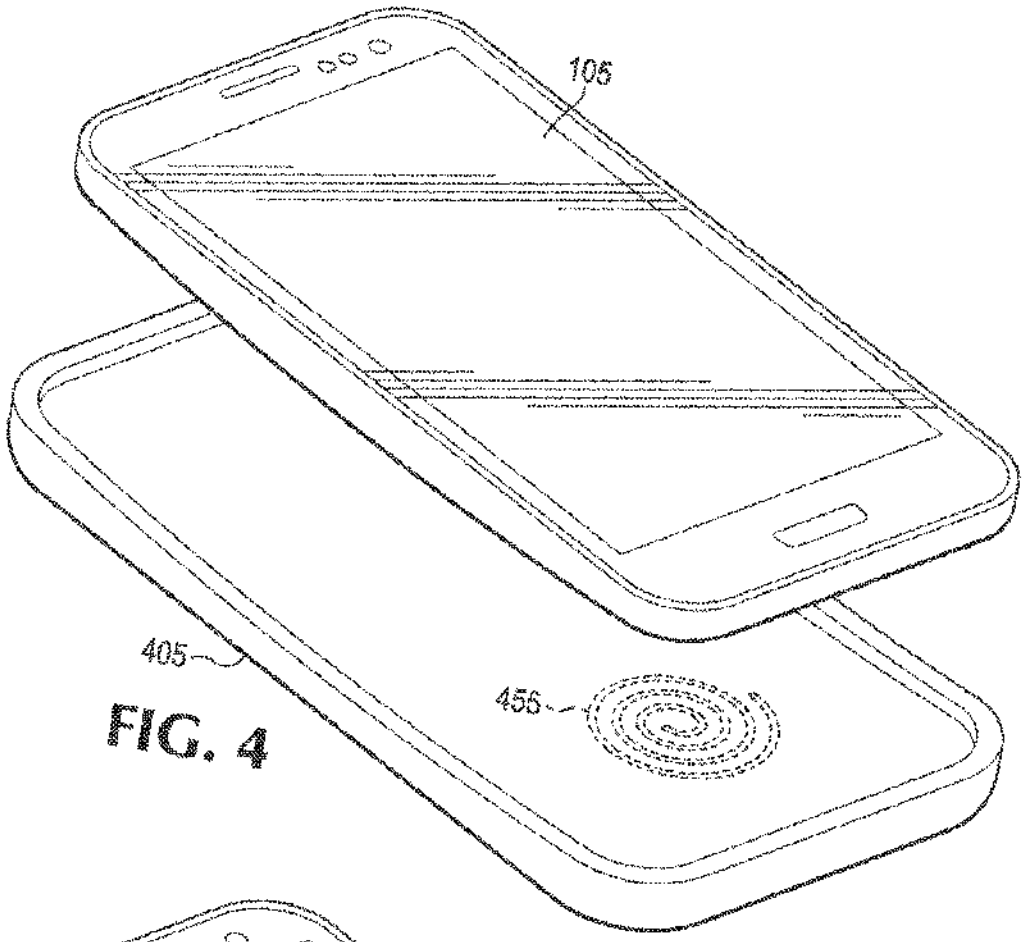


FIG. 4

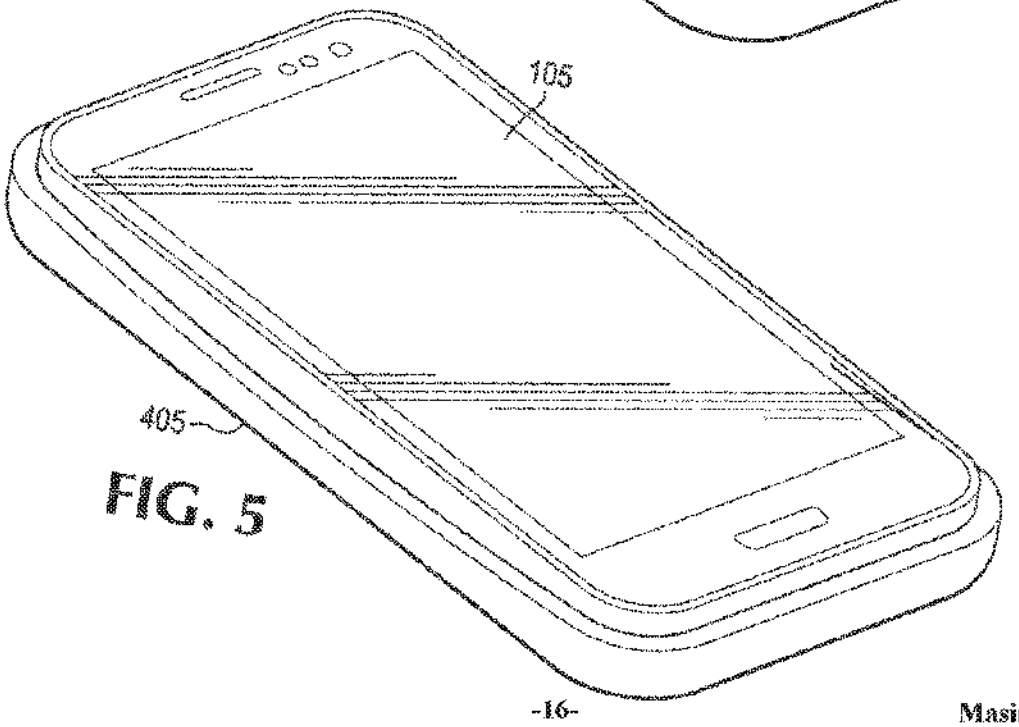


FIG. 5

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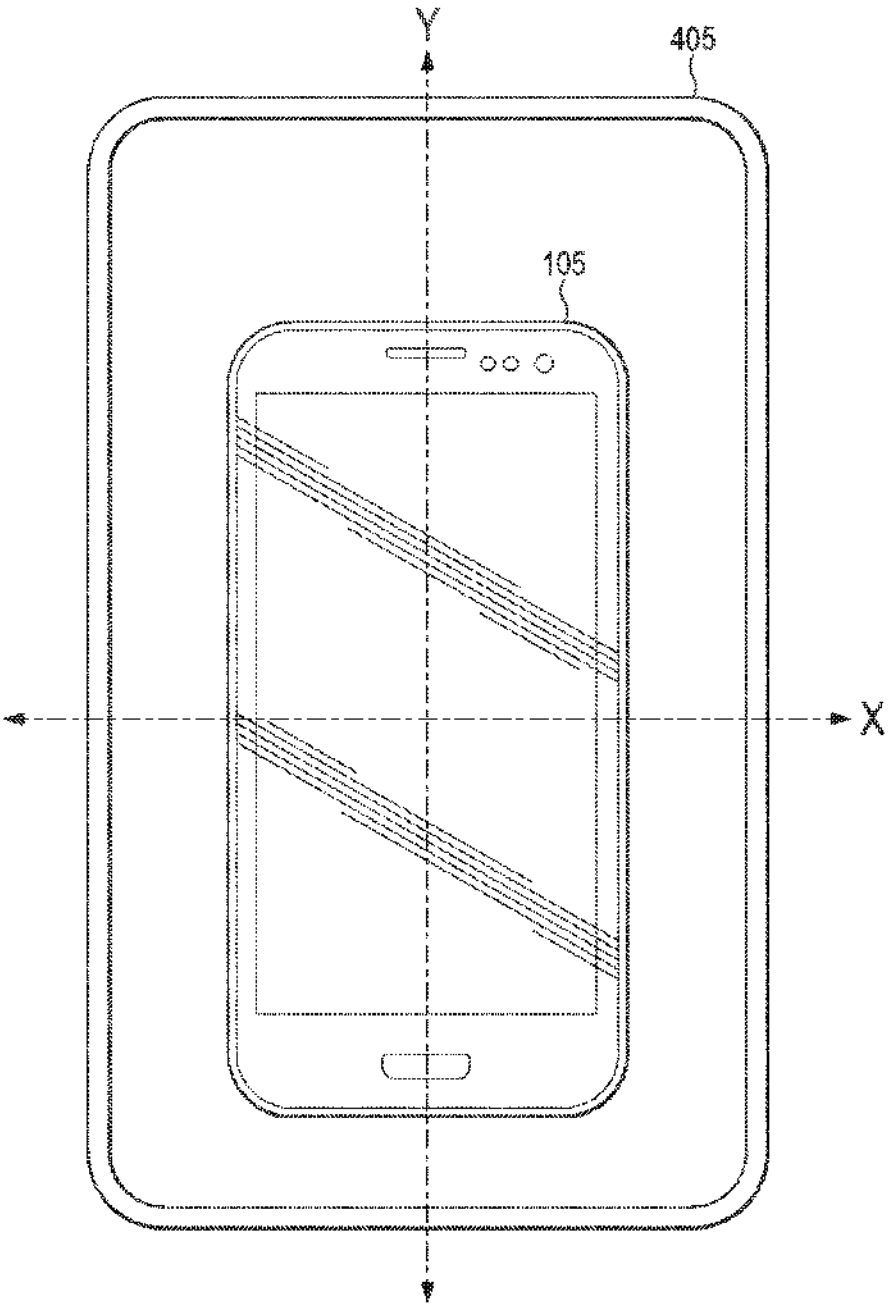


FIG. 6

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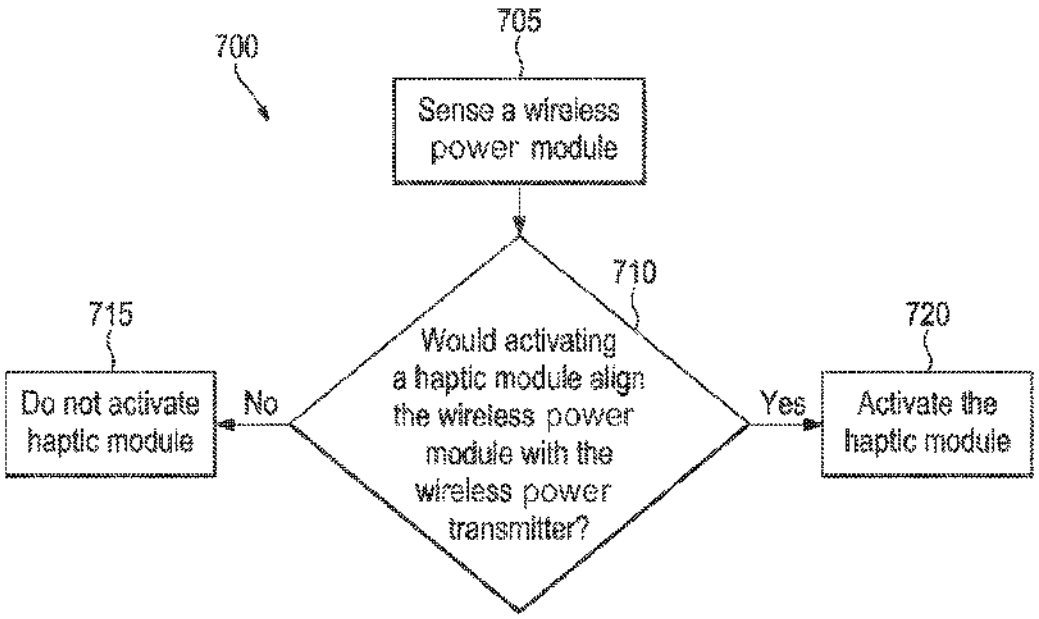


FIG. 7

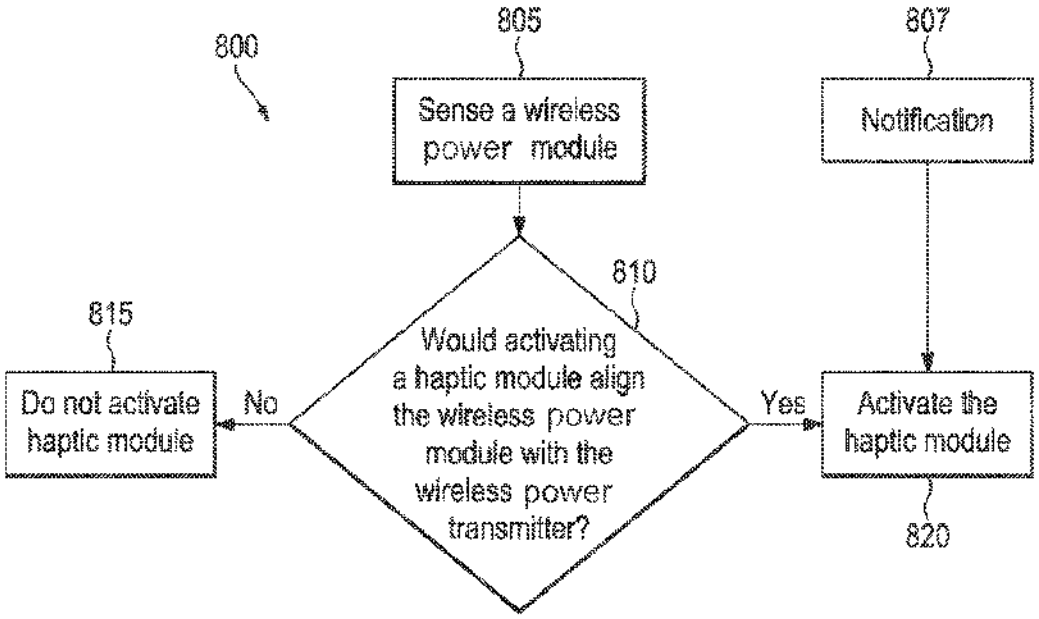


FIG. 8

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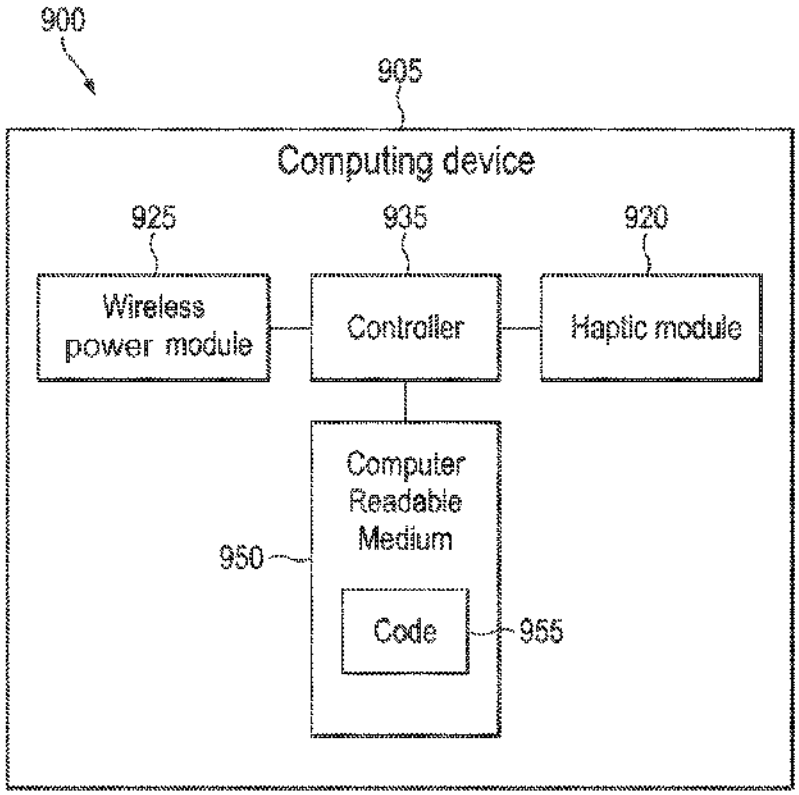


FIG. 9

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2014/013906

A. CLASSIFICATION OF SUBJECT MATTER

H04W 88/02(2009.01)i, H02J 17/00(2006.01)i

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)
H04W 88/02; H04M 1/00; H01F 38/14; H02J 7/00; H02J 7/02; H04B 1/38; H02J 17/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean utility models and applications for utility models
Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKOMPASS(KIPO internal) & Keywords: wireless power charging , alignment , haptic

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2012-0052923 A1 (SEKWON PARK) 01 March 2012 See claims 1-20 and figures 1-9.	1-15
A	US 2013-0278210 A1 (NIGEL P. COOK et al.) 24 October 2013 See claims 1-20 and figures 1-10.	1-15
A	US 2013-0088195 A1 (YOUNG SEOK YOON et al.) 11 April 2013 See claims 1-18 and figures 1-6.	1-15

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents,such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
27 October 2014 (27.10.2014)	**27 October 2014 (27.10.2014)**

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		WO 2010-000078 A1	14/01/2010
US 2013-0086195 A1	11/04/2013	KR 10-2013-0037082 A	15/04/2013

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(74) Agents: **ROCHE, Denis** et al.; Philips IP&S, High Tech Campus 5, NL-5656 AE Eindhoven (NL).

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(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*

Published:

— *with international search report (Art. 21(3))*

(54) Title: SYSTEM AND METHOD FOR DETECTING VARIATION OF HEART RATE OF A USER

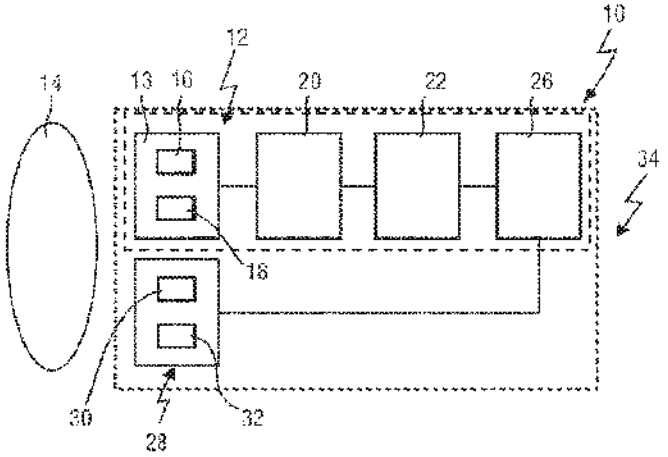


FIG. 2

(57) Abstract: The present invention relates to a system (34) for detecting variation of heart rate, HR, of a user (14), said system comprising an optical sensing unit (12) for measuring a heartbeat-related optical signal of said user (14) over time, a processing unit (20) for deriving an HR-variation signal from said heartbeat-related optical signal, an analyzing unit (22) for comparing said derived HR-variation signal to a reference HR range, and an initiating unit (26) for initiating a process for measuring an informative heartbeat-related signal of said user (14) depending on said comparing of said analyzing unit (22).

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System and method for detecting variation of heart rate of a user

FIELD OF THE INVENTION

The present invention relates to detection of physiological signals of cardiovascular systems. In particular, it relates to a system and method for detecting variation of heart rate of a user. It finds applications in diagnostic investigation of arrhythmias, in particular in the detection of atrial fibrillation. However, it is to be understood that the present invention also finds applications in other fields and is not necessarily limited to the afore-mentioned applications.

BACKGROUND OF THE INVENTION

Cardiovascular diseases are a class of diseases that involve the circulatory system such as the heart, the blood vessels including arteries, capillaries and veins. Cardiovascular diseases include cardiac diseases, vascular diseases of the brain and kidney, and peripheral arterial diseases. Nowadays, cardiovascular diseases have become one of the leading causes of death for human worldwide. It is thus crucial to develop techniques that enable efficient and accurate detection of symptoms characterizing cardiovascular diseases.

One of the most common groups of conditions belonging to cardiovascular diseases is the arrhythmia, which is characterized by abnormal heart rates. A patient having arrhythmia may have a heartbeat that is too fast or too slow, wherein the heartbeat may be regular or irregular. Arrhythmias can occur in the upper chambers of the heart (atria) or in the lower chambers of the heart (ventricles).

To date, there exist several detection techniques for atrial fibrillation (AF). For instance, a Holter monitor can be worn by a patient for a certain time period, generally between one day and two weeks, in order to monitor the heart activity of the patient continuously. The heart activity is usually characterized by the electrocardiography (ECG), which is able to provide information on the cause of arrhythmias. For instance, an ECG signal measured between two consecutive heart beats in a healthy person differs strongly from that of a person experiencing an AF episode. Other conditions such as brain activity, electroencephalography (EEG) or arterial pressure may also be monitored. An alternative technique is also based upon measurement of the ECG, wherein a stick to be held with both hands is applied instead of a Holter monitor.

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The afore-mentioned techniques are afflicted with a number of drawbacks. For instance, the Holter monitor of the first technique usually comprises several electrodes which need to be contacted with several body parts of the patient, rendering this technique rather obtrusive. The second technique, though being less obtrusive compared to the first one, does not provide a continuous detection but only measures the ECG when the patient is holding the stick with both hands. An enforced continuous measurement may cause significant inconveniences to the patient's daily life activities. Since ECG requires a measurement with at least two electrodes, arranged on both sides of the heart, there are no solutions yet for really unobtrusive ECG measurements.

Besides measuring the patient's ECG, optical sensors can also be applied to detect optical signals which allow to deduce whether the patient shows an AF episode. In particular, such optical sensors may be configured to detect photoplethysmography (PPG) signals, thus providing an unobtrusive method to detect arrhythmias. Such optical sensors may be integrated into a device, in particular a wearable device that can be worn on one or more body parts of the patient, thereby combining the unobtrusiveness and continuous detection. This technique is configured to measure the pulse instead of the electrical signal of the heart, thus providing rather limited information on the precise origin of possible arrhythmias, in particular compared to an ECG measurement. Next to that, movement of the patient may lead to motion artifacts in the PPG signal causing usually a lower signal-to-noise ratio than for corresponding ECG measurements. This may lead to an incorrect derivation of heart rate from the PPG signal.

Another optical method to measure heart rate is by laser speckle. This technique suffers from the same drawbacks as mentioned for PPG in the previous paragraph.

US 2012/0310100 A1 discloses systems and methods for detecting and monitoring arrhythmias from a signal, comprising a signal processing system configured to transform a signal using wavelet transformation and analyze changes in features of the transformed signal to detect pulse rhythm abnormalities. In an embodiment, the system disclosed therein may detect pulse rhythm abnormalities by analyzing energy parameters, morphology changes and pattern changes in the scalogram of a photoplethysmography signal.

WO 2012/140559 discloses a method and a system for triggering the measurement of electrocardiogram (ECG) signal of a user. The system includes a S_pO_2 measuring unit and an ECG measuring unit bath embedded in a wrist-mounted device warren by the user. The method including the steps of: continuously measuring S_pO_2 at the wrist of the user, detecting an irregular heart condition from the S_pO_2 measurement, notifying the user

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to perform an ECG measurement, and initiating the ECG measurement at least partially at the wrist.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a system and a method which enable detection of variation of heart rate of a user, which is more accurate, especially when there is doubt on the normalcy of the heart rate, while being user-friendly.

In a first aspect of the present invention, a system for detecting variation of heart rate of a user is presented comprising an optical sensing unit for measuring a heartbeat-related optical signal of said living being over time, a processing unit for deriving an HR-variation signal from said heartbeat-related optical signal, an analyzing unit for comparing said derived HR-variation signal to a reference HR range, and an initiating unit for initiating a process for measuring an informative heartbeat-related signal of said user depending on said comparing of said analyzing unit. The initiating unit is further configured to control the optical sensing unit to switch from a first sensing mode, in which the optical sensing unit has already performed an optical measurement of the user, to a second sensing mode which corresponds to a higher sampling rate than the first sensing mode.

Therefore, the system is suitable for detection of HR-variation in two stages: in a first stage, the detection is based on an optical measurement while in a second stage the detection is based on an electrical measurement. Such a combination of optical with electrical measurement provides a user with both the unobtrusiveness of optical measurements and the high accuracy of electrical measurements capable of providing the user with information of the actual cause of abnormal behaviors appearing in the detection of the first stage. Once the HR-variation signal detected in the first stage indicates a possible AF episode, the second stage may be initiated. In this way, the duration of obtrusive electrical measurements may be reduced to episodes in which the normalcy of the heart rate is suspicious. Furthermore, during the first stage, the optical measurement may result in arrhythmia-suspicious data, which in reality are caused by insufficient measurement accuracy. In this case, the sensitivity of the optical sensing unit is improved by increasing the sampling rate.

The present invention is thus advantageous over a detection technique based solely upon either optical or electrical measurements. In particular, it is advantageous over the optical technique disclosed by the afore-mentioned prior art.

In an embodiment of the invention, the initiating unit is configured to initiate a process to measure an informative heartbeat-related signal when the derived HR-variation

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signal deviates from the reference HR range by a pre-determined amount. The pre-determined amount may depend on at least one of the user's demographic information, the user's medical history, one or more of the user's physiological signals and the activity the user is performing.

In another embodiment, the said informative heartbeat-related signal is an electrocardiography ECG signal. The electrical sensing unit is advantageously an ECG unit. This embodiment initiates and/or changes the setting of the second stage of detection, in an automatic manner, when a pre-determined criterion is fulfilled. Since each user may have his/her individual condition, individually different criteria might be used for the sake of detection accuracy. Hence, this embodiment advantageously allows the operation of the device to be adapted to the individual condition of the user. Advantageously, the initiating unit is configured to activate a setting, in particular a user-specific setting, of the electrical sensing unit based on the optical measurement. In this way, the device is able to cause an accurate electrical measurement.

In another embodiment, the optical sensing unit comprises one or more photoplethysmography sensing unit. Such a PPG sensing unit can either be optimized to measure heart rate, in which case it advantageously uses green light, or it can be optimized to measure S_pO_2 (pulse oximeter oxygen saturation), in which case it advantageously uses red and infrared light. One or more photo detectors catch the light that has travelled from the one or more light sources (advantageously LEDs) through the skin towards the photo detector(s) and in that way produce a signal that has a relation to the heart rate. To correct for motion artifacts, the PPG sensing unit advantageously also contains a sensor for noise cancellation, like an accelerometer and/or the addition of light of a different color measured by either yet another or an already used photo detector. A processing unit derives the interbeat intervals (IBI's, where an IBI is the time in between two consecutive heart beats) from the sensor signals of the PPG sensing unit. The processing unit can either physically be integrated in the same device as the PPG sensing unit, or it can be a separate unit. Apart from deriving the IBI's, it might also derive a quality indicator, which is an indicator for the probability that the derived IBI is correct and is therefore related to the signal-to-noise ratio of the motion-corrected PPG signal.

Additional parameters such as the respiration and/or the hypo- and/or hypervolemia may be detected besides the heartbeat-related optical signal. An elaborate analysis of the user's condition is thus obtainable using one single device.

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In another embodiment, the system further comprises a user interface element. This embodiment advantageously enables interaction between the device and the user, so that an optical measurement and/or an electrical measurement may be conveniently initiated and performed. Advantageously, the user interface element comprises a graphic user interface (GUI), for example in the form of a touch screen, which enables easy device-user-interaction.

In another embodiment, the system comprises an electrical sensing unit to measure a heartbeat-related electrical signal of the user.

Advantageously, the present invention enables an optical measurement and an electrical measurement of HR-variation using one single system, thus combining the advantages of both measurement techniques. These may be chosen depending upon the user's actual need in order to minimize unnecessary obtrusive detection as well as to maximize the accuracy of the HR-variation detection.

In another embodiment, the electrical sensing unit comprises an electrocardiography ECG unit comprising at least a first and a second electrode, the heartbeat-related electrical signal comprising an ECG signal. Advantageously, this embodiment exploits the well-established ECG technique which is able to provide deep insights into the cardiac cycle and information regarding origin of anomalies in the HRV detected optically. In particular, the ECG technique enables a noninvasive method to detect events occurring within the circulatory system such as the heart. Advantageously, the system comprises a PPG unit and an ECG unit. The present embodiment thus is able to combine the afore-mentioned strengths of both PPG and ECG. In order to measure ECG, the first and second electrodes are separately contacted or contactable to two body parts on sides lying opposite one another with respect to the heart of the user.

In another embodiment, the device further comprises a housing wearable on one or more body parts of the user. It is noted that the term "wearable" shall also include the general meaning of the term "portable". The one or more body parts include all body parts of the human body appropriate for wearing or porting the device, such as the arm, the wrist, the waist, the back, the neck, the leg, the foot, etc. Alternatively, the housing of the device may be portable in a pocket of a garment or a hand bag, while the optical sensing unit comprises at least one optical sensor which is in direct contact with one or more body parts of the user. Advantageously, such a device enables continuous detection of the HR-variation, independent upon the location (at home, in a vehicle/train/aircraft, at working place) and activity (working, resting, doing sport, having a meal) of the user. By wearing the device for a long period of time, a long term study of the HR progressing can be realized which may

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provide the surgical person with accurate information about the development of heart diseases including AF and other types of arrhythmias. Besides, AF-episodes might occur on any time of the day; carrying the device continuously thereby makes it possible to detect even unexpected AF-episodes.

Advantageously, the device comprises a wristwatch-like device, the housing being wearable on one wrist or arm of said user, containing both an optical sensing unit and two electrodes for an ECG-measurement, where one of the two electrodes needs to be touched by a finger of the other hand for an actual ECG measurement. This advantageously combines an optical sensing unit such as a PPG unit and an electrical sensing unit such as an ECG unit within one system that can be particularly easily worn. Normally, a user is used to wearing/porting a wristwatch, which has little impact on the user's daily activities. Preferably, the first electrode is arranged on a first surface of the housing in contact with the wrist wearing the housing and the second electrode is arranged on a second surface of the housing or connected to the housing via connection means. In this way, an electrical measurement can be particularly easily carried out, since the first electrode is already in constant contact with one of the user's wrists so that the user wearing the device only needs to bring one finger of his/her second hand into contact with the second electrode. The second surface may be facing the user's face so that it is particularly easy for the user to locate. A second electrode that is connected to the device body via connection means such as a cable provides the possibility of ECG measurements on two body parts distantly spaced from each other, such as the hands and the legs.

In another embodiment, the device comprises a communication device. The communication device includes mobile devices such as smartphones, tablets, laptops, watches capable of communication, navigation systems, mobile medical devices, etc. This embodiment advantageously enables to combine the functionality of a medical device with that of a communication device. The two electrodes may be arranged on a surface of the communication device. For instance, in case of a smartphone an electrical detection of HR-variation can be easily performed by holding the smartphone with two hands. This is of particular importance, since smartphones have become one of the most used devices, so that a user using such a smartphone according to the present invention is able to frequently perform optical and/or electrical measurements of HR. In another embodiment, the mobile communication device being a smartphone cooperates with a software program in the form of an app, which contains instructions how to perform the optical and/or electrical

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measurements as well as how to retrieve user information such as patient history and/or patient specific settings for the afore-mentioned measurements.

In a further aspect of the present invention, method for detecting variation of heart rate of a user is presented comprising measuring a heartbeat-related optical signal of said user over time with an optical sensing unit, deriving an HR-variation signal from the heartbeat-related optical signal, comparing the derived HR-variation signal to a reference HR range, and initiating a process for measuring an informative heartbeat-related signal of said user depending on said comparing. The step of initiating is further adapted to initiate a switch from a first sensing mode, in which the optical sensing unit has already performed an optical measurement of the user, to a second sensing mode which corresponds to a higher sampling rate than the first sensing mode.

In yet further aspects of the present invention, there are provided a computer program which comprises program code means for causing a computer to perform the steps of the method disclosed herein when the computer program is carried out on a computer as well as a non-transitory computer-readable recording medium that stores therein a computer program product, which, when executed by a device, causes the method disclosed herein to be performed.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other aspects of the invention will be apparent from and elucidated with reference to the embodiment(s) described hereinafter. In the following drawings:

Fig. 1 shows a schematic block diagram of a device in accordance with a first embodiment;

Fig. 2 shows a schematic block diagram of a system in accordance with a first embodiment;

Fig. 3 shows a side view of a system in accordance with a second embodiment;

Fig. 4A and Fig. 4B show a front and a back view of the system in accordance with the second embodiment shown in Fig. 3, respectively;

Fig. 5A and Fig. 5B shows a front and a side view of a system in accordance with a third embodiment, respectively

Fig. 6 shows a schematic block diagram of a method in accordance with an embodiment;

Fig. 7 shows a schematic block diagram of a method in accordance with the invention when the optical sensing unit determines an arrhythmia-suspicious period; and

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Fig. 8 is a schematic graph showing how to determine whether the measured instantaneous heart rate is arrhythmia suspicious.

DETAILED DESCRIPTION OF THE INVENTION

With reference to Fig. 1 a schematic block diagram of a device 10 for detecting heart rate variation in accordance with a first embodiment is shown. The device 10 comprises an optical sensing unit 12 such as an optical sensor for measuring a heartbeat-related optical signal of a living being 14 over time, the living being the user of the device 10. Such optical sensor units are known in the art. A possible optical sensor will be briefly described now. Note that other optical sensors are also possible in relation to the invention. As shown in Fig. 1, the optical sensing unit 12 may comprise an emitter 16 (for example an LED) for emitting light to the living being 14 and a photo detector 18 (like a photodiode) to detect the light that has travelled from the emitter 16 through the living body 14 to the photo detector 18. The optical sensing unit 12 may also comprise more than one light emitters 16 and/or more than one photo detectors 18. The light emitters may or may not have the same color. When the optical sensing unit 12 is optimized for heart rate measurements, the one or more light emitters 16 advantageously emit green light. When the optical sensing unit 12 in optimized for pulse oximeter oxygen saturation S_pO_2 measurements, it contains advantageously one or more red light emitters and one or more infrared light emitters. The combination of one or more light emitters 16 and one or more photo detectors 18 meant for measuring the PPG signal together form the optical sensor 13. To correct for motion artifacts, the optical sensing unit may also contains an additional sensor 19 for noise cancellation, like an accelerometer and/or the addition of light of a different color measured by either yet another photo detector or a one or more photo detectors 18 that are also used in the optical sensor 13.

A processing unit 20 such as a processor derives the interbeat intervals (IBI's, where an IBI is the time in between two consecutive heart beats) from the sensor signals of the optical sensor 13 and the noise-cancellation sensor 19 of the optical sensing unit 12. Apart from deriving the IBI's, the processing unit 20 might also derive a quality indicator, which is an indicator for the probability that the derived IBI is correct and is therefore related to the signal-to-noise ratio of the motion-corrected PPG signal. Instead of deriving IBI's (with the unit of time, like seconds or milliseconds), the processing unit 20 may also derive the frequency of heartbeat signals, so that it is a continuous function of time representing the momentary value of heartbeat frequency having unit of hertz (Hz) or kilohertz (kHz). We

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will use the term instantaneous heart rate for this value, although it must be noted that in this case it is derived from the PPG signal and not from the RR-peak in the ECG, as it is normally done. It is not necessarily needed that the processing unit 20 derives the power spectra from the instantaneous heartbeat or the IBI's, as is normally done for heart rate variability (HRV). For this reason, we use the term HR-variation signal instead of HRV to cover a broader range, in which not necessarily the power spectra of the high frequency band, low frequency band and/or ultralow frequency band are calculated, but which also reflects the consecutive IBI's or instantaneous heart rates.

In the embodiment shown in Fig. 1, the device 10 further comprises an analyzing unit 22 such as a comparator for comparing the HR-variation signal derived by the processing unit 20 to a reference HR range. In one embodiment, the reference HR range may be a pre-determined HR range corresponding to the range of IBIs of a healthy person. Alternatively, the analyzing unit 22 may compare the individual IBIs determined from the measured heartbeat-related optical signal of the patient to the individual IBIs of a healthy person, in particular a person without arrhythmia or atrial fibrillation AF but showing the same average HR as the patient.

In the embodiment shown in Fig. 1, the device 10 further comprises an initiating unit 26 such as a controller for initiating an electrical sensing unit 28, said electrical sensing unit 28 being configured to measure a heartbeat-related electrical signal of the living being 14. The electrical sensing unit 28 comprises a first electrode 30 and a second electrode 32, the first and/or the second electrodes 30, 32 being advantageously contactable to the living being 14. The initiating unit 26 may be configured to activate the electrical sensing unit 28 when the HR-variation signal derived by the processing unit 20 deviates from the reference HR range, in particular by a pre-determined amount.

In the embodiment shown in Fig. 1, the electrical sensing unit 28 is a separate unit from the device 10. The electrical sensing unit 28 may be an electrocardiography ECG sensor, the heartbeat-related electrical signal comprising an ECG signal.

In the embodiment shown in Fig. 1, the optical sensing unit 12 is arranged on one side of the living being 14. It is understood that the optical sensing unit 12 may be arranged to be in the vicinity of any other side(s) of the living being 14. In particular, a plurality of optical sensors 13 may be arranged at different positions that are appropriate for performing an optical measurement of the living being 14.

In the embodiment shown in Fig. 1, the electrical sensing unit 28 comprises only two electrodes 30, 32. It is understood that the electrical sensing unit 28 may comprise

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further electrodes and that all the electrodes of the electrical sensing unit 28 may be arranged at least partially at different positions with respect to the living being 14 that are appropriate for performing an electrical measurements of the living being 14.

In the embodiment shown in Fig. 1, the processing unit 20, analyzing unit 22, and initiating unit 26 are integrated in the same device 10 as the optical sensing unit 12. Although the word unit is used, the processing unit 20, analyzing unit 22, and initiating unit 26 need not necessarily to be separate physical entities but can be a single physical entity such as a processor. The processing, analyzing and/or initiating functions can also be in the form of a code which is executed by the same computer program.

In another embodiment, the optical sensing unit 12, the processing unit 20, analyzing unit 22 and /or initiating unit 26 are integrated in one or more different devices, using a wired or wireless connection between each other (the processing unit 20 should at least be in connection with the optical sensing unit 12, the analyzing unit 22 should be in connection with the processing unit 20, and the initiating unit 26 should be in connection with the analyzing unit 22). A possibility is to use a smart phone as separate device, containing one or more processing unit 20, analyzing unit 22, and initiating unit 26.

In another embodiment, the user may wear the optical sensing unit 12 on his/her wrist and an electrical sensing unit 28 in his/her pocket or hand bag. The analyzing unit 22 can be integrated in the same device as the optical sensing unit 12 or the electrical sensing unit 28 ore may be a separate device in wireless connection with (at least) the optical sensing unit 12. If the analyzing unit 22 detects an arrhythmia-suspicious period, the user is warned and thereby asked to take the electrical sensing unit 28 from pocket / hand bag and perform an electrical measurement, e.g. an ECG measurement.

In the embodiment shown in Fig. 1, the initiating unit 26 initiates an electrical measurement. Here the word initiating includes but is not limited to one or more of the following options: automatically start an electrical measurement (irrespective of whether or not the user is already connected to the electrodes), automatically start the recording of the electrical measurement (to enable the user to look back the data later), mark / time stamp the electrical measurement data that are being recorded (to enable the user to easily find back the valuable data), let the user know that he/she should connect to the electrodes to do an ECG measurement (for example with text or images on a display, with a recorded or simulated voice, or with other , visual, auditory or vibrational signs known by the user).

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With reference to Fig. 2, a schematic block diagram of a system 34 in accordance with a first embodiment is shown.

The system 34 comprises a device for detecting HR-variation of a living being, advantageously the device 10 shown in Fig. 1. The system 34 further comprises an electrical sensing unit to measure a heartbeat-related electrical signal of the living being 14. Advantageously, the system 34 comprises the electrical sensing unit 28 described with reference to Fig. 1.

When using the device 10 in Fig. 1 and 2, the emitter 16 emits light which propagates to one or more body parts of the living being 14. Advantageously, the emitter 16 emits light of red light wavelength and IR light wavelength to one or more body parts, for example the skin of the living being 14. The detector 18 detects the light which emanates back from the living being 14 after being emitted by the emitter 16. In this way, the optical sensing unit 12 performs measurement of a heartbeat-related optical signal. The heartbeat-related optical signal measured by the optical sensing unit 12 is then processed by the processing unit 20 to generate an HR-variation signal. In particular, the heartbeat-related optical signal comprises a plurality of heartbeat signals, wherein adjacent heartbeat signals are separated by interbeat intervals (IBI). By measuring the heartbeat-related optical signal for a certain time period, a certain number of heartbeat signals and consequently a certain number of IBI may be measured. The processing unit 20 thus derives an HR-variation signal from the measured heartbeat-related optical signal by calculating the plurality of IBIs.

The analyzing unit 22 then compares the HR-variation signal derived by the processing unit 20 to the reference HR range as described above. If the derived HR-variation resides within the reference HR range, the optical measurement indicates that the living being 14 shows a normal heart rate behavior. If the derived HR-variation signal deviates from the reference HR range by a pre-determined amount, the optical measurement suggests that the living being shows an abnormal heart rate behavior and further investigation of the heart rate condition of the living being 14 may be necessary. In this case, the initiating unit 26 of the device 10 shown in Fig. 1 may activate the electrical sensing unit 28 that is either arranged externally from the device 10 or in combination with the device 10 within the system 34 to perform an electrical measurement for the living being 14. In particular, the initiating unit 26 may activate the ECG unit 28 to measure an ECG signal of the living being 14. Moreover, the initiating unit 26 may control the optical sensing unit 12 to switch from a first sensing mode, in which the optical sensing unit 12 has already performed an optical measurement of the living being 14, to a second sensing mode, wherein the second sensing mode corresponds

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to a higher sensitivity than the first sensing mode. In particular, the second sensing mode corresponds to a higher sample rate than the first sensing mode. The initiating unit 26 may also control an alerting unit (not shown) to send one or more alert signals. The one or more alert signals may be visual and/or acoustical and/or vibrational signals. For instance, the one or more alert signals may comprise a flashing light signal, appearing in the vicinity of at least one electrode of the ECG unit 28, and/or a voice signal indicating that an HR-variation signal deviating from the reference HR range has been detected and an electrical measurement may be performed and/or a vibration of one or more parts of the device 10. In a preferable embodiment, the initiating unit 26 activates the electrical sensing unit 28 after one or more alert signals have been sent by the alerting unit and after the user has input a command to the system 34 and/or the device 10 and/or the electrical sensing unit 28. In another preferable embodiment, the initiating unit 26 switches the optical sensing unit 12 from the first to the second sensing mode after the one or more alert signals have been sent and the user has input a command to the system 34 and/or the device 10 and/or the optical sensing unit 12.

With reference to Fig. 3, a system 34 in accordance with a second embodiment is shown. The system 34 comprises a wearable device 10, wherein the wearable device 10 comprises a housing 36 that can be worn by the living being 14. In particular, the system 34 comprises a wristwatch-like device 36 with a housing 38 wearable on one wrist or arm of the living being 14. The first electrode 30 of the electrical sensing unit 28 is arranged on a first surface 42 of the housing 38, whereas the first surface 42 is not in contact with the wrist or arm 40 of the living being 14. The second electrode 32 of the electrical sensing unit 28 is arranged on a second surface 44 of the housing 38. The second surface 44 may be opposite to the first surface 42 with respect to the housing 38, so that the second electrode 32 may be configured to be in permanent contact with the skin of the wrist or arm 40.

In a preferable embodiment, one or more optical sensors 13, in particular PPG sensors, may be arranged on the second surface 44 so that they may measure a heartbeat-related optical signal, in particular a PPG signal of the living being 14. The PPG signal may be measured directly from the wrist or arm of the living being 14.

In Fig. 4A and B, the wristwatch-like device 36 of Fig. 3 are shown in a front and a back view, respectively. In a preferable embodiment, the wristwatch-like device 36 further comprises a user interface element 46, in particular a graphic user interface (GUI) element 46, which enables an interaction between the system 34 and the user. In particular,

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the GUI element 46 may be configured to show the heartbeat-related optical signal measured by the optical sensing unit 12 and/or the HR-variation signal derived by the processing unit 20 and/or the reference HR range and/or the heartbeat-related electrical signal measured by the electrical sensing unit 28 and/or the one or more alert signals sent by the alerting unit. Also an average heart rate (average over at least several seconds, having the unit beats per minute) could be calculated from the PPG or ECG signal and shown on the GUI element 46. Another option is that the GUI element 46 shows information not related to the measurements of the heart, for instance the time, by which device 36 can be used as a normal watch, or internet, SMS (Short Message Service) etc, by which it can be used as a smart watch. The GUI element 46 may be a cathode ray tube monitor, a flat panel display, a liquid crystal display (LCD), a plasma display or any other type of monitor or display known in the art. The GUI element 46 may cooperate with a GUI program based on Windows, Linux, MS OS, KDE and any suitable GUI program known in the art.

By placing first electrode 30 not on the front side 42, but on the side of the watch or on the strap instead, the GUI element 46 can cover the whole front side 42 of the watch.

The optical measurement of the heartbeat-related optical signal of the living being 14 can be performed once the user has put on the wristwatch-like device 36. It is understood that the wearable device 36 may also be configured to be worn at another body part, such as the forehead, the neck, the waist, the leg and/or the foot of the living being 14. After the optical sensing unit 12 of the wristwatch-like device 36 has detected an HR-variation signal of the living being 14 and that the derived HR-variation signal has been found to deviate from a pre-determined reference HR range, in particular by a pre-determined amount, the GUI element 46 displays an alert signal, advantageously a text message informing the user about the result of the optical measurement and/or instructing the user to start an electrical measurement. Alternatively, the GUI element 46 may display an alert signal comprising a text message instructing the user to stop moving, to attach the device with the optical sensor 13 properly, and/or to increase the sample rate of the optical sensing unit 12. Another possibility is that the device 36 automatically increases the sample rate of the optical sensing unit 12. After a message instructing the user to start an electrical measurement, by placing one or more fingers of the other hand not wearing the wristwatch-like device 36 onto the first electrode 30, an ECG signal will be measured. Advantageously, the data captured by the ECG unit will be stored in a memory unit. In that way, a doctor could examine the data later to make an analysis of the arrhythmia. The memory unit may be

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integrated in the system 34. Alternatively, the system 34 may comprise a data interface with which data can be send to and/or are retrievable from an external data base, such as a network system, a cloud system, the internet, an intranet, a personal computer or a mobile communication device including a smartphone, or any other mobile devices. The data interface may be based on USB, Blue Tooth, optical fiber or other data interface technologies known in the art.

Alternatively, the electrical sensing 28 of the system 34 may comprise a second electrode 32' which is connected to the housing 38 of the wristwatch-like device 36 via connection means 48. In particular, the connection means 48 may comprise a cable 48. The wired second electrode 32' may be brought into contact with a different body part of the living being 14 such as the chest, the neck, the forehead, the face, the arm, the wrist, the back, the leg, the feet, etc. By bringing the wired second electrode 32' to the hand or the arm or the wrist not wearing the wristwatch-like device 36, an electrical measurement of the HR-variation signal may be performed with two body parts on size lying opposite one another with respect to the heart of the living being 14. As an ECG with even more than two electrodes could be valuable, there is also the possibility to have even more electrodes. In a preferable embodiment, it is easy to attach and detach the one or more cables 48 of the one or more electrodes 32' to/from the device to keep the device 36 unobtrusive. When the initiating unit 26 warns the user to do an ECG measurement, he/she should then attach the one or more cables 48 to the device and the one or more electrodes 32' to the desired place(s) on the body. In this embodiment, the electrode 30 on top of the device and/or electrode 32 on the bottom of the device may be absent.

With reference to Fig. 5A a system 34 in accordance with a third embodiment is shown in a front view.

In this embodiment, the device 10 comprises a mobile communication device 50, in particular a smartphone. Alternatively, the mobile communication device 50 may be configured as a tablet, a calculator, a portable media player, a video camera or a navigation device. The first and second electrodes 30, 32 of the electrical sensing unit 28, in particular being an ECG unit, are advantageously arranged on a front surface 52 of the mobile communication device 50. Alternatively, the electrical sensing unit 28 may comprise further electrodes, wherein at least two of all electrodes of the electrical sensing unit 28 are arranged on two different surfaces of the mobile communication device 50. In particular, at least one

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electrode 30, 32 may be arranged on a back surface 54 or a side surface 56, 57, 58, 59, as shown in Fig. 5B.

The optical sensing unit 12 is arranged advantageously on the front surface 52, whereas it can be alternatively arranged on the back surface 54 or one of the side surfaces 56, 57, 58, 59. In a preferable embodiment, the optical sensing unit 12 comprises a plurality of optical sensors 13 which are arranged at least partially on different surfaces 52, 54, 56, 57, 58, 59. Alternatively, the optical sensing unit 12 is a camera. Nowadays, most smart phones already have a standard camera. Together with a dedicated app, the information from the camera can be used to derive the heart rate.

The mobile communication device 50 further comprises a display unit 60, the display unit 60 advantageously comprising a touchscreen. Advantageously, a GUI element such as the GUI element 46 is integrated into or configured to cooperate with the display unit 60 of the mobile communication device 50.

In a preferable embodiment, a computer program such as an app may be configured to cooperate with the mobile communication device 50. After starting the app via the display unit 60, the user may start an optical measurement of the HR-variation signal. When the optical sensing unit 12 detects an HR-variation signal deviating from a reference HR range by a pre-determined amount, the display unit 60 displays an alert message and provides the user with several options containing: increasing the sample rate of the optical sensing unit 12; proceeding with an electrical measurement of the HR-variation signal; consulting a doctor/a surgical person/a care giver, etc. Each of the afore-mentioned options may be associated with a visual button shown on the display unit 60, by clicking of which the chosen option will be processed. For instance, if the user clicks the visual button associated with the option "increasing the sample rate of the optical sensing unit", the display unit 60 displays a visual control panel for the optical sensing unit 12 through which the sample rate of at least one optical sensor 13 of the optical sensing unit 12 may be varied. If the user choses the option "proceeding with an electrical measurement", the display unit 60 displays an guide message for performing an electrical measurement, advantageously with the electrical sensing unit 28 arranged within the system 34. Alternatively, the guide message may be configured for guiding the user to perform an electrical measurement using an external electrical sensing unit 28, advantageously an external ECG unit connectable to the mobile communication device 50 via a communication link known in the art. If the user choses the option "consulting a doctor", the display unit 60 display a list of contact information, advantageously with feed-back information.

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In a preferable embodiment, the optical sensing unit 12 and the electrical sensing unit 28 of the system 34 according to one or more embodiments shown above may be operated simultaneously. In another preferable embodiment, the system 34 and/or the device 10, 36, 50 may communicate with an external database, an external network system such as the internet, an intranet, a cloud system or a PC or another mobile communication device either using a wired communication link or wirelessly.

With reference to Fig. 6, a method for detecting HRV of a living being 14 is shown. In a step 101, a heartbeat-related optical signal of the living being 14 is measured over time. This can be done by using the device 10, 36, 50 according to the afore-mentioned embodiments. The heartbeat-related optical signal is then proceeded to derive an HR-variation signal in step 102. In particular, the heartbeat-related optical signal comprises a plurality of heartbeat signals, wherein a plurality of interbeat intervals (IBI) can be derived. The derived HR-variation signal is then compared to a reference HR range in a step 103, wherein the reference HR range is advantageously a pre-determined HR range based on HR-variation signal measured for a healthy living being. In a step 104, the result of the comparison in the step 103 is provided to the initiating unit 26 for controlling the electrical sensing unit 28, in particular being an ECG unit. In a step 105, the initiating unit 26 activates the electrical sensing unit 28 to perform a measurement of a heartbeat-related electrical signal, once the derived HR-variation signal has been found to deviate from the reference HR range by a pre-determined amount. Alternatively, the electrical sensing unit 28 has already been activated previously at the time of the comparison in step 103, while step 105 can for example be starting recording the ECG data and/or showing the ECG signal on a display. Recording the ECG data (either or not only in a period with arrhythmia-suspicious PPG data) is in any case a desirable function of the device, because then the doctor would be able to look back the shape of the ECG waveform, to make conclusions on the origin of the arrhythmias. To easily find back the point where the PPG data became arrhythmia suspicious, apart from activating the electrical sensing unit and/or starting the ECG recording and/or showing the ECG signal on a display, step 105 could thus also involve marking the trace of ECG data and /or PPG data that are being recorded.

In a preferable embodiment, the method comprises a step 106 in which the initiating unit 26 switches the optical sensing unit 12 from a first to a second sensing mode wherein the second sensing mode corresponds to higher sensitivity than the first sensing mode. In another preferable embodiment, the method comprises a step 107, in which one or

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more alert signals are sent. The alert signals may contain visual acoustic and/or vibrational signals. In a preferable embodiment the alert signals contain a text message for instructing the user to choose between different options as described above with reference to Fig. 5A.

Fig. 7 shows a schematic block diagram of possible steps when the PPG sensing unit determines an arrhythmia-suspicious period. When the PPG sensing unit determines an arrhythmia-suspicious period, the precision of the PPG sensing unit can be increased (e.g. by increasing the sample rate) or the user can be asked (by a text on a display, by an audio-recorded/simulated voice, or by other visual, vibrational, or auditory signs known to the user) to correct a measurement error (e.g. by stop moving or improve the contact of the optical sensor with the skin, for example by tightening or reattaching the device with the optical sensing unit) or to start an electrical measurement. If after correcting the measurement error or increasing the sensitivity mode of the PPG sensing unit, the PPG signal is still arrhythmia suspicious, the user can be asked to start an electrical measurement or directly an alarm can be sent out to a caregiver and/or feedback is given to the user that he/she should consult a doctor and/or the data could be recorded/marked to be looked back later by the doctor. The latter three could also be the next step when the ECG turns out to indicate a period of arrhythmia. If either the error-corrected/increased-precision PPG measurement or the ECG measurement shows a normal heart-rate variation signal, the mode can go back to the normal PPG measurement mode.

Fig. 8 shows a schematic graph of an example of how to determine whether the measured instantaneous heart rate is arrhythmia suspicious. The solid line shows the average heart rate (averaged over at least a couple of seconds) of a person. At a certain time it starts to increase because the person starts to exercise. As boundaries to decide what is a normal heart-rate variation and what is not, the dashed lines are taken. The open squares are the instantaneous heart rates of a healthy person, whereas the dots are the instantaneous heart rates of a person with arrhythmias. The figure shows that all instantaneous heart rates of the healthy person fall inside the boundaries, while for the person with arrhythmias there are dots that fall outside the boundaries. Therefore, a pattern as shown by the dots, if measured by the optical sensing unit 12, would give rise for initiating unit 26 to initiate one of the aforementioned processes, like telling the user to start an electrical measurement. It is also possible to give the user continuous feedback on heart-rate variation OK or heart-rate variation not OK based on whether or not the heart rate falls inside the boundaries. This

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could be the heart rate measured by the optical unit and/or the heart rate measured by the ECG unit. The boundaries could be taken fixed, in the sense that they are always the same amount above and below the average heart rate, or they could be more specific, meaning that the boundaries for example depend on the user's demographic information (like age and gender), on the user's medical history, on one or more of the user's physiological signals (average heart rate, change in average heart rate, S_pO_2, respiration rate, etc.) and/or on the activity the user is performing (sitting, sleeping, walking, running, cycling etc.)

If the device 10 has got the ability to ask the user to stop moving, like in the embodiment of Fig. 8, it might use the signal of the noise-cancellation sensor 19 to determine whether the user is making disturbing movements at all. If the user is indeed making disturbing movements, he/she is asked to stop moving, if not, another option is chosen. Similarly, the device 10 could be made automatic such that the sample rate will not be increased if this is not a limiting factor and/or the user will not be asked to improve the contact of the optical sensor 13 with the skin if the signal-to-noise ratio is already high.

While the invention has been illustrated and described in detail in the drawings and foregoing description, such illustration and description are to be considered illustrative or exemplary and not restrictive; the invention is not limited to the disclosed embodiments. Other variations to the disclosed embodiments can be understood and effected by those skilled in the art in practicing the claimed invention, from a study of the drawings, the disclosure, and the appended claims. For example, although a PPG sensing unit in contact with the skin has been mainly disclosed in the description as being the optical sensing unit, the same invention holds for other optical sensing units, like a laser speckle sensing unit, or optical sensing units not in contact with the skin, like a vital signs camera. Next to that, more than one optical sensing unit may be used.

In the claims, the word "comprising" does not exclude other elements or steps, and the indefinite article "a" or "an" does not exclude a plurality. A single element or other unit may fulfill the functions of several items recited in the claims. The mere fact that certain measures are recited in mutually different dependent claims does not indicate that a combination of these measures cannot be used to advantage.

A computer program may be stored and/or distributed on a suitable medium, such as an optical storage medium or a solid-state medium supplied together with or as part of other hardware, but may also be distributed in other forms, such as via the Internet or other wired or wireless telecommunication systems.

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Any reference signs in the claims should not be construed as limiting the scope.

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CLAIMS:

1. A system (34) for detecting variation of heart rate, HR, of a user (14), comprising:

- an optical sensing unit (12) for measuring a heartbeat-related optical signal of said user (14) over time;
- a processing unit (20) for deriving an HR-variation signal from said heartbeat-related optical signal;
- an analyzing unit (22) for comparing said derived HR-variation signal to a reference HR range; and
- an initiating unit (26) for initiating a process for measuring an ECG signal of said user (14) depending on said comparing of said analyzing unit (22), wherein the initiating unit (26) is further configured to control the optical sensing unit (12) to switch from a first sensing mode, in which the optical sensing unit (12) has already performed an optical measurement of the user (14), to a second sensing mode which corresponds to a higher sampling rate than the first sensing mode.

2. The system (34) according to claim 1, wherein said initiating unit (26) is configured to initiate a process to measure the ECG signal when said derived HR-variation signal deviates from said reference HR range by more than a pre-determined amount.

3. The system (34) according to claim 2, wherein the pre-determined amount depends on at least one of the user's demographic information, the user's medical history, one or more of the user's physiological signals and the activity the user is performing.

4. The system (34) according to claim 1, wherein said optical sensing unit (12) comprises one or more photoplethysmography PPG sensors, said heartbeat-related optical signal comprising a PPG signal.

5. The system (34) according to claim 1, wherein the initiating unit (26) initiates one or more of the following:

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- automatically start an ECG measurement,
  automatically start a recording of the ECG measurement,
- mark the ECG measurement data that are being recorded, -
- inform the user that he/she should connect to electrodes of an ECG unit,
- show the ECG signal on a graphic user interface element (46).

6. The device (10) according to claim 1, further comprising a user interface element (46).

7. A system (34) according to claim 1, comprising an electrical sensing unit (28) to measure a heartbeat-related electrical signal of said user (14).

8. The system (34) according to claim 7, wherein said electrical sensing unit comprises an electrocardiography ECG unit comprising at least a first (30) and a second electrode (32), said heartbeat-related electrical signal comprising an ECG signal.

9. The system (34) according to claim 8, comprising a wristwatch-like device (10), said device (10) comprising a housing (38) being wearable on one wrist or arm of said user (14).

10. The system (34) according to claim 9, wherein said first electrode (30) is arranged on a first surface (42) of said housing (38) in contact with said one wrist or arm wearing said housing (38) and said second electrode is arranged on a second surface (44) of said housing (38) or connected to said housing (38) via connection means (48).

11. The system (34) according to claim 1, wherein said device (10) comprises a communication device (50).

12. A method for detecting variation of heart rate, HR, of a user (14), comprising the steps of:

- measuring a heartbeat-related optical signal of said user (14) over time with an optical sensing unit (12);
- deriving an HR-variation signal from said heartbeat-related optical signal;
- comparing said derived HR-variation signal to a reference HR range; and

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- initiating a process for measuring an ECG signal of said user (14) depending on said comparing, wherein the step of initiating is further adapted to initiate a switch from a first sensing mode, in which the optical sensing unit (12) has already performed an optical measurement of the user (14), to a second sensing mode which corresponds to a higher sampling rate than the first sensing mode.

13. Computer program comprising program code means for causing a computer to carry out the steps of the method as claimed in claim 12 when said computer program is carried out on the computer.

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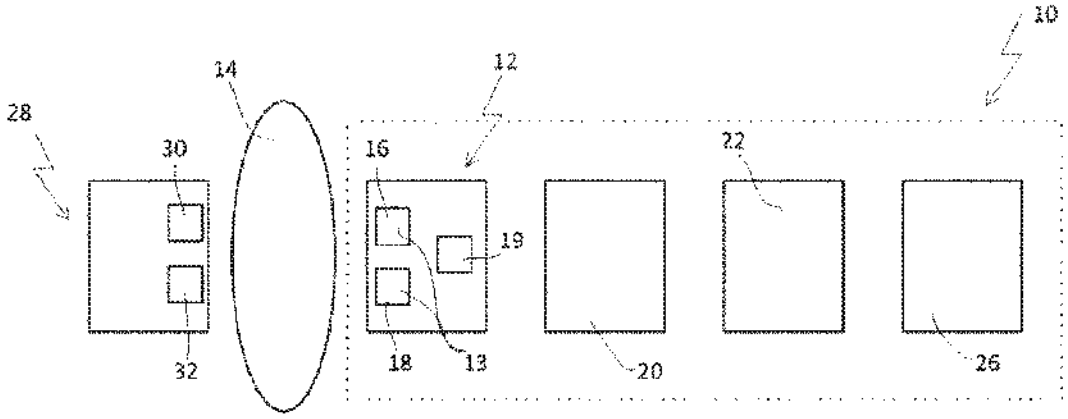


FIG. 1

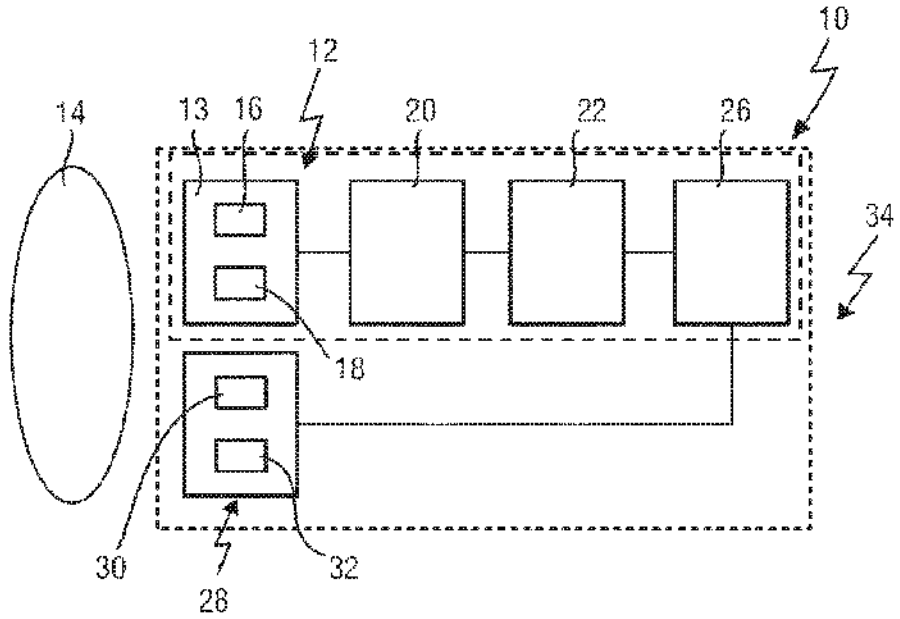


FIG. 2

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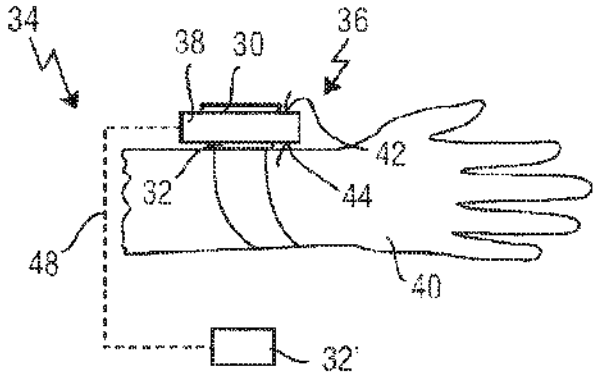


FIG. 3

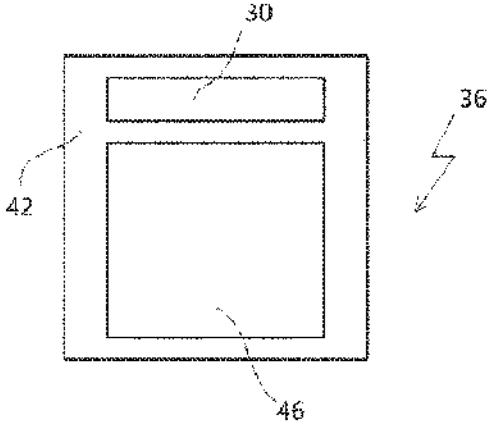


FIG. 4A

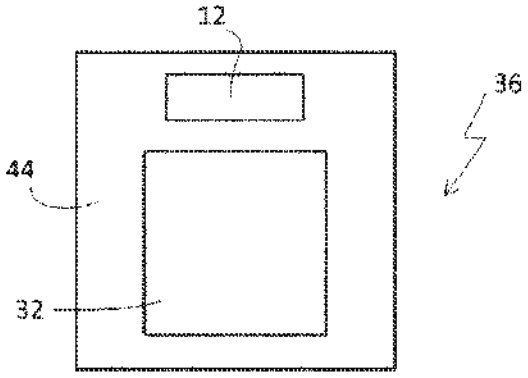


FIG. 4B

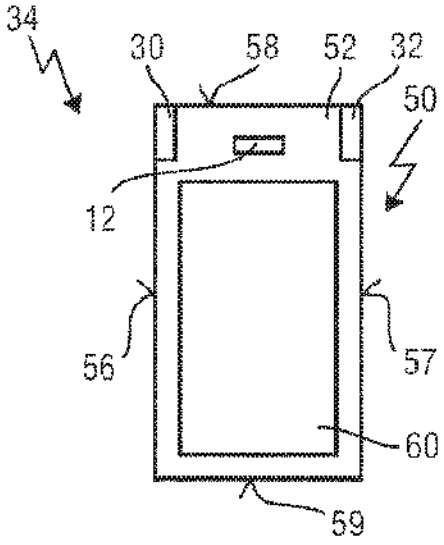


FIG. 5A

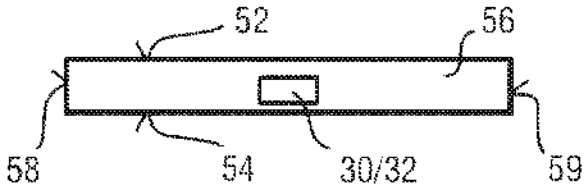


FIG. 5B

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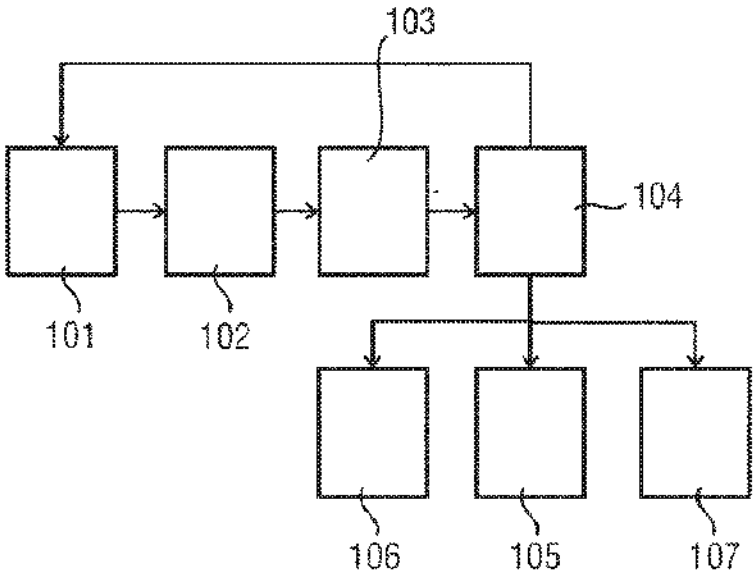


FIG. 6

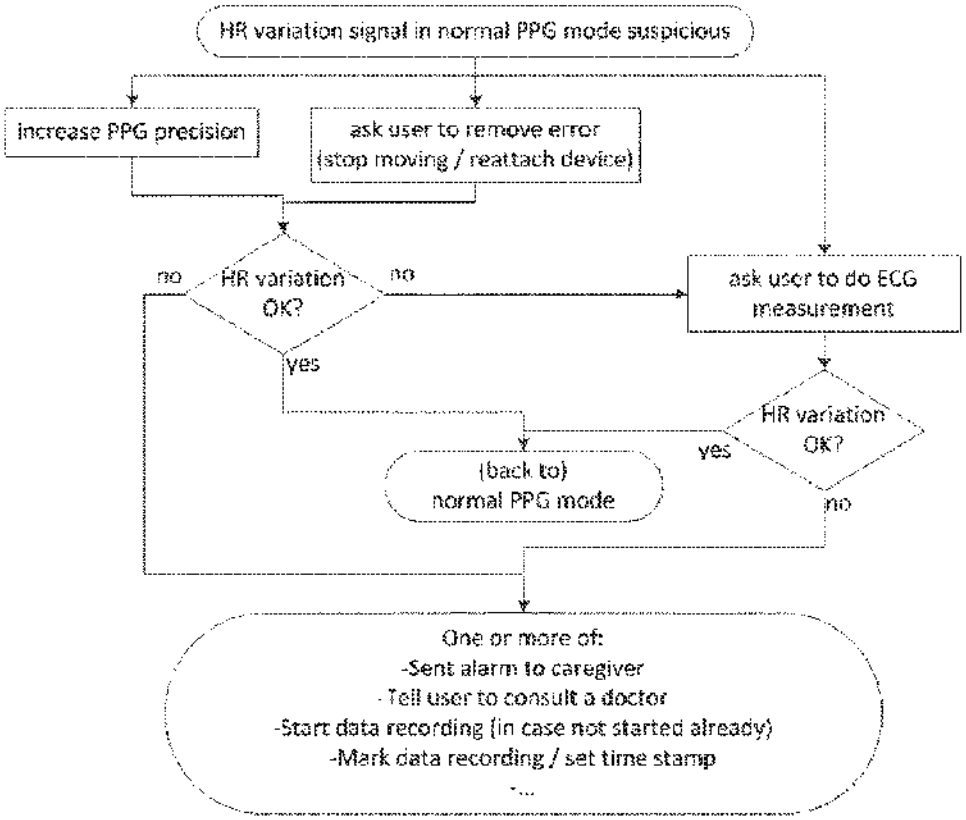


FIG. 7

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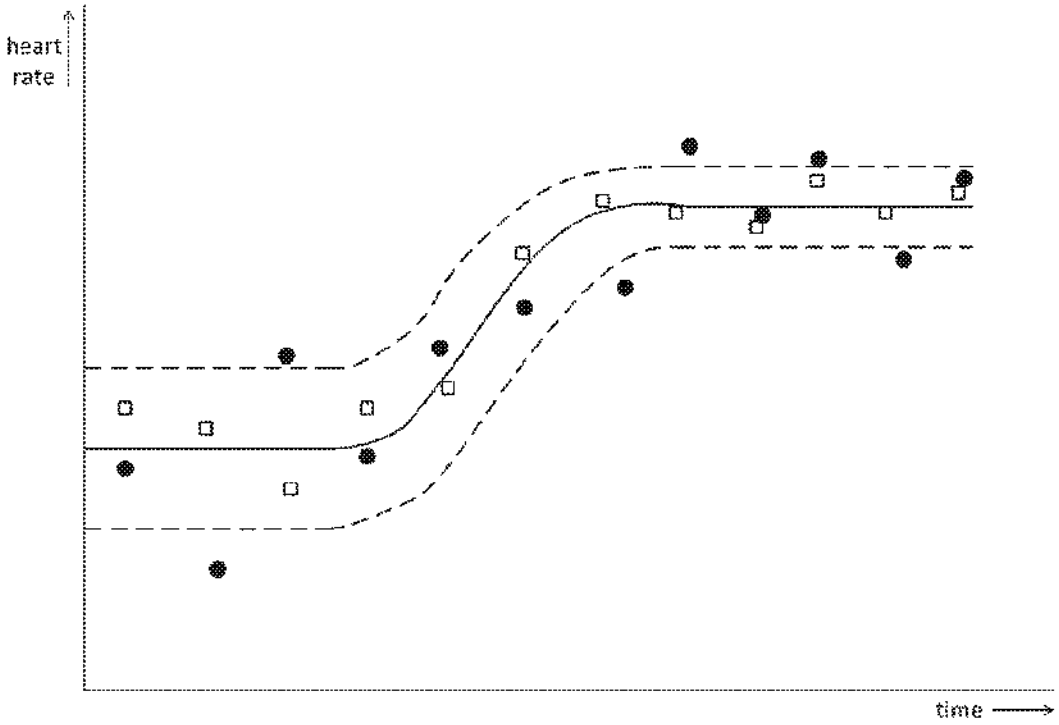


FIG. 8

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2015/056482

A. CLASSIFICATION OF SUBJECT MATTER
INV. A61B5/00 A61B5/024 A61B5/0402
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

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, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 2012/140559 A1 (MEDIC4ALL AG [CH]; SHMUELI RAM [IL]; SANDLERMAN NIMROD [IL]) 18 October 2012 (2012-10-18) abstract; figure 7 page 9, paragraph 1 - page 14, paragraph 3	1-13
Y	US 2009/326356 A1 (KRACKER STEFAN G [DE]) 31 December 2009 (2009-12-31) abstract; claims 6,19; figure 10 paragraphs [0048], [0049], [0051], [0058], [0122], [0128], [0130]	1-13
A	US 2011/245633 A1 (GOLDBERG ROBERT [US] ET AL) 6 October 2011 (2011-10-06) paragraphs [0063] - [0069]	1,12,13

-/--

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
24 June 2015	03/07/2015

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	Daniel, Christian

Form PCT/ISA/210 (second sheet) (April 2005)

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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 7 177 686 B1 (TURCOTT ROBERT [US]) 13 February 2007 (2007-02-13) paragraphs [0085] - [0089]	1,12
A	US 2006/200011 A1 (SUZUKI TAKUJI [JP] ET AL) 7 September 2006 (2006-09-07) paragraphs [0012], [0072] - [0100]	1,12
A	JP H08 71047 A (OMRON TATEISI ELECTRONICS CO) 19 March 1996 (1996-03-19) the whole document	1

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2012140559 A1	18-10-2012	NONE	
US 2009326356 A1	31-12-2009	NONE	
US 2011245633 A1	06-10-2011	EP 2542147 A2	09-01-2013
		KR 20130051922 A	21-05-2013
		US 2011245633 A1	06-10-2011
		WO 2011109716 A2	09-09-2011
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		US 2006200011 A1	07-09-2006
JP H0871047 A	19-03-1996	NONE	

Espacenet

JP2005270543A BIOLOGICAL INFORMATION MEASURING DEVICE

Applicants: SEIKO INSTR INC

Inventors: OTANAGI SUSUMU,NAKAMURA TAKASHI,MAEKAWA KAZUYA,MIYAHARA SHINICHIRO,MORIYA KOICHI

Classifications:
IPC ***A61B5/024; A61B5/0245;*** (IPC1-7): A61B5/0245;

CPC **A61B5/02416 (EP); A61B5/681 (EP);**

Priorities: JP2004091942A 2004-03-26

Application: JP2004091942A 2004-03-26

Publication: JP2005270543A 2005-10-06

Published as: JP2005270543A;**JP4485234B2; WO2005092182A1**

BIOLOGICAL INFORMATION MEASURING DEVICE

Abstract

PROBLEM TO BE SOLVED: To provide a biological information measuring device capable of improving adhesion and being put on for a long period of time without an unpleasant feeling. SOLUTION: The biological information measuring device 1 comprises: a main body 2; a projection part 4 formed by being projected from the lower surface 2a of the main body 2; a fixing means 3 for mounting the main body 2 on an arm in the state of turning the lower surface 2a of the main body 2 to a living body surface side; a living body sensor part 8 provided with a light emitting part 5 for emitting light toward a living body in the state of being in contact with a living body surface, a light receiving part 6 for receiving reflected light from the living body of the light emitted by the light emitting part 5 and generating biological information signals corresponding to a received light quantity and a contact detection means 7 for detecting whether or not the light emitting part 5 and the light receiving part 6 are in contact with the living body surface; and a biological information detection part provided in the main body 2 for detecting biological information on the basis of the biological information signals. The living body sensor part 8 provides the biological information measuring device 1 that is arranged on the lower surface 4a of the projection part 4. COPYRIGHT: (C)2006,JPO&NCIPI

(19)日本国特許庁(JP)　(12)公開特許公報(A)　(11)特許出願公開番号
特開2005-270543
(P2005-270543A)
(43)公開日　平成17年10月6日(2005.10.6)

(51)Int.Cl.[7]	F I	テーマコード（参考）
A61B 5/0245	A61B 5/02 320B	4C017

審査請求 未請求　請求項の数 15　OL　（全 17 頁）

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(22)出願日　平成16年3月26日(2004.3.26)

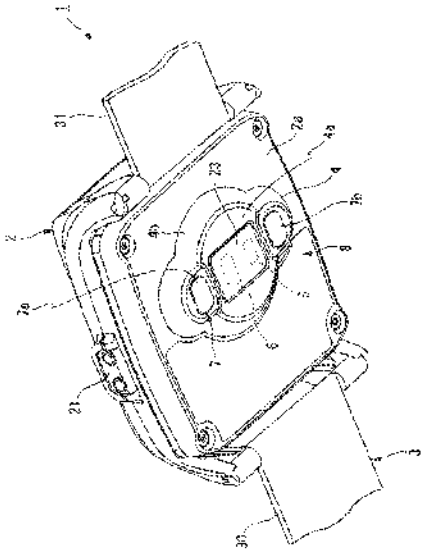
（特許庁注：以下のものは登録商標）
1．Bluetooth

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最終頁に続く

(54)【発明の名称】生体情報計測装置

(57)【要約】
【課題】　密着性が向上すると共に、不快感を感じることなく長時間の装着を行うこと。
【解決手段】　本体２と、該本体２の下面２ａから突出して形成された突出部４と、本体２の下面２ａを生体表面側に向けた状態で該本体２を腕に装着する固定手段３と、生体表面に接触した状態で生体に向けて光を照射する光発光部５と、該光発光部５により照射された光のうち生体からの反射光を受光すると共に受光量に応じた生体情報信号を生成する光受光部６と、光発光部５及び光受光部６が生体表面に接触しているか否かを検出する接触検出手段７とを有する生体センサ部８と、本体２に設けられ、生体情報信号に基づいて生体情報を検出する生体情報検出部とを備え、生体センサ部８は、突出部４の下面４ａに配されている生体情報計測装置１を提供する。
【選択図】　図５



【特許請求の範囲】
【請求項１】
本体と、
該本体の下面から突出して形成された突出部と、
前記本体の下面を生体表面側に向けた状態で該本体を腕に装着する固定手段と、
前記生体表面に接触した状態で生体に向けて光を照射する光発光部と、該光発光部により照射された光のうち前記生体からの反射光を受光すると共に受光量に応じた生体情報信号を生成する光受光部と、光発光部及び光受光部が生体表面に接触しているか否かを検出する接触検出手段とを有する生体センサ部と、
前記本体に設けられ、前記生体情報信号に基づいて生体情報を検出する生体情報検出部とを備え、
前記生体センサ部は、前記突出部の下面に配されていることを特徴とする生体情報計測装置。
【請求項２】
請求項１に記載の生体情報計測装置において、
前記本体の下面には、少なくとも前記突出部を挟むと共に該突出部の側面から所定距離離間した位置に、本体の下面から突出して形成された凸条部が設けられ、
該凸条部の下面と前記本体部の下面との距離は、前記突出部の下面と前記本体部の下面との距離と同一又はそれ以上の距離に設定されていることを特徴とする生体情報計測装置。
【請求項３】
請求項１又は２に記載の生体情報計測装置において、
前記接触検出手段が、少なくとも一対の電極を有し、該一対の電極間の電位差に基づいて、前記光発光部及び前記光受光部が前記生体表面に接触しているか否かを検出することを特徴とする生体情報計測装置。
【請求項４】
請求項３に記載の生体情報計測装置において、
前記一対の電極が、前記光発光部及び前記光受光部を間に挟むように配されていることを特徴とする生体情報計測装置。
【請求項５】
請求項１から４のいずれか１項に記載の生体情報計測装置において、
前記光発光部及び前記光受光部と前記生体情報検出部との間を電気的に接続するフレキシブル基板を備え、
該フレキシブル基板は、前記光発光部及び前記光受光部を自身の弾性により記本体の下面側に向けて押圧するように前記本体内に設けられていることを特徴とする生体情報計測装置。
【請求項６】
請求項１から５のいずれか１項に記載の生体情報計測装置において、
前記本体の上面に、検出された生体情報を表示する表示部を備えていることを特徴とする生体情報計測装置。
【請求項７】
請求項１から６のいずれか１項に記載の生体情報計測装置において、
前記固定手段は、前記本体に基端側が取り付けられて腕に装着可能な第１のバンド及び第２のバンドを備え、
前記第１のバンド及び第２のバンドは、前記本体を挟んで対向するように配されると共に、伸縮自在な弾性材料により形成されていることを特徴とする生体情報計測装置。
【請求項８】
請求項７に記載の生体情報計測装置において、
前記生体センサ部は、前記本体の中心位置から前記第１のバンド又は前記第２のバンドの基端側にずれた位置に配されていることを特徴とする生体情報計測装置。

【請求項９】
請求項１から８のいずれか１項に記載の生体情報計測装置において、
前記本体に、充電可能な充電池と、該充電池に電力を充電する充電手段とを備えていることを特徴とする生体情報計測装置。
【請求項１０】
請求項１から９のいずれか１項に記載の生体情報計測装置において、
前記突出部の下面と前記本体の下面との距離が、２～４ｍｍに設定されていることを特徴とする生体情報計測装置。
【請求項１１】
請求項１から１０のいずれか１項に記載の生体情報計測装置において、
前記突出部は、外周が円形となるように形成されていることを特徴とする生体情報計測装置。
【請求項１２】
請求項１１に記載の生体情報計測装置において、
前記突出部は、外縁が曲面となるように形成されていることを特徴とする生体情報計測装置。
【請求項１３】
請求項１１に記載の生体情報計測装置において、
前記突出部は、下面の中心から外縁に向かって曲面となるように形成されていることを特徴とする生体情報計測装置。
【請求項１４】
請求項１１から１３のいずれか１項に記載の生体情報計測装置において、
前記突出部の直径が、２０ｍｍ以下に設定されていることを特徴とする生体情報計測装置。
【請求項１５】
請求項２から１４のいずれか１項に記載の生体情報計測装置において、
前記凸条部は、前記突出部の側面から８ｍｍ離間した位置に設けられると共に、該凸条部の下面と前記本体の下面との距離が４ｍｍに設定されていることを特徴とする生体情報計測装置。
【発明の詳細な説明】
【技術分野】
【０００１】
本発明は、手首（腕）に装着した状態で脈拍数等の生体情報を測定することができる生体情報計測装置に関するものである。
【背景技術】
【０００２】
近年の健康管理への関心の高まりにより、手首（腕）等に装着したまま脈拍数等の様々な生体情報を計測することができる生体情報計測装置が各種提供されている（例えば、特許文献１参照）。
【０００３】
この種の生体情報計測装置のうち、例えば、脈拍数を検出するものは、手首に装着した状態で、生体に向けて光を照射すると共に、脈拍センサ等により血管からの反射光、即ち、反射信号を受信して、該反射信号から脈拍に相当する脈拍信号を抽出して脈拍数を算出している。特に、手首に装着したまま容易に脈拍数の測定が行えるので、使用者に簡便に使用されている。
【特許文献１】特開２００１－７８９７３号公報（段落番号００１１～００３１、図１～図７）
【発明の開示】
【発明が解決しようとする課題】
【０００４】

上述した従来の生体情報計測装置は、一般的に手首に装着して使用されている。ところが、使用者の動きによっては筋肉が動き手首の太さ（径）が変化してしまい、生体情報計測装置と生体表面との間に隙間が空いてしまう恐れがあった。そのため、密着性が低下し正確な生体情報を検出できない可能性があった。また、生体情報計測装置を確実に手首に固定するため、例えば、バンドにより締め付けた場合には、手首への圧迫感が増し長時間の装着を行うには困難なものであった。

【０００５】

本発明は、このような事情に考慮してなされたもので、その目的は、密着性が向上すると共に、不快感を感じることなく長時間の装着を行うことができる生体情報計測装置を提供することである。

【課題を解決するための手段】

【０００６】

本発明は、前記課題を解決するために以下の手段を提供する。

【０００７】

本発明の生体情報計測装置は、本体と、該本体の下面から突出して形成された突出部と、前記本体の下面を生体表面側に向けた状態で該本体を腕に装着する固定手段と、前記生体表面に接触した状態で生体に向けて光を照射する光発光部と、該光発光部により照射された光のうち前記生体からの反射光を受光すると共に受光量に応じた生体情報信号を生成する光受光部と、光発光部及び光受光部が生体表面に接触しているか否かを検出する接触検出手段とを有する生体センサ部と、前記本体に設けられ、前記生体情報信号に基づいて生体情報を検出する生体情報検出部とを備え、前記生体センサ部は、前記突出部の下面に配されていることを特徴とするものである。

【０００８】

この発明に係る生体情報計測装置においては、固定手段により、本体を手首（腕）に装着した後、光発光部から生体に向けて光を照射する。照射された光は、その一部が、例えば、血管内のヘモグロビン等により吸収され、また、他の光の一部は生体組織にて反射する。光受光部は、この反射された光を受光すると共に、受光量に応じた脈拍信号等の生体情報信号を生成する。そして、生体情報検出手段により、生体情報信号を所定処理して脈拍数等の生体情報の検出を行える。また、接触検出手段により、光発光部及び光受光部が確実に生体表面に接触しているか否かの検出を行える。

【０００９】

特に、固定手段により本体を手首に装着したときに、本体の下面から突出部が突出しているので、生体表面と突出部の下面とが接触し易い状態となる。即ち、生体センサ部の密着性が向上する。そのため、固定手段により、従来のように本体を生体表面に強く押し付けるように（圧迫するように）固定する必要はない。従って、長時間装着したとしても、不快感を感じることはない。また、生体センサ部の密着性が向上しているので、光発光部及び光受光部により、効率良く光の照射及び受光を行うことができる。従って、高精度に生体情報の検出を行うことができる。

【００１０】

また、本発明に係る生体情報計測装置は、上記本発明の生体情報計測装置において、前記本体の下面には、少なくとも前記突出部を挟むと共に該突出部の側面から所定距離離間した位置に、本体の下面から突出して形成された凸条部が設けられ、該凸条部の下面と前記本体部の下面との距離は、前記突出部の下面と前記本体部の下面との距離と同一又はそれ以上の距離に設定されていることを特徴とするものである。

【００１１】

この発明に係る生体情報計測装置においては、固定手段により、本体を腕に装着したときに、生体表面は、凸条部の下面及び突出部の下面に接触している状態となる。この際、凸条部は、突出部を挟むと共に該突出部の側面から所定距離離間した位置に突出しているので、突出部と凸条部との間には、隙間が空いた状態となっている。これにより、生体は、突出部を挟む両側の隙間に一旦入り込んだ状態で、突出部及び凸条部の下面に接触する

。従って、より確実に生体表面と生体センサ部との密着性を確保することができる。

【００１２】

特に、凸条部は突出部に対して本体の下面から同一高さ又はそれ以上の高さだけ突出しているので、突出部と同一又は突出部より先に生体表面に接触する。また、凸条部は、突出部の外側で生体表面に接触する。これにより、生体表面を突出部の下面に同一状態で安定して接触させることができると共に、接触圧力を一定にすることができる。従って、長時間に亘り安定して生体情報を検出することができる。

【００１３】

また、本発明に係る生体情報計測装置は、上記本発明の生体情報計測装置において、前記接触検出手段が、少なくとも一対の電極を有し、該一対の電極間の電位差に基づいて、前記光発光部及び前記光受光部が前記生体表面に接触しているか否かを検出することを特徴とするものである。

【００１４】

この発明に係る生体情報計測装置においては、本体を腕に装着したときに、一対の電極が生体表面に接触し、該生体表面を通して放電が行われる。これにより、電極間の電位が減少する。そして、この一対の電極間の電位差を検出することで、光発光部及び光受光部が確実に生体表面に接触しているか否かを容易且つ確実に検出することができる。なお、電極は一対でなくても良く、例えば、複数の電極を備えて、これら各電極の電位差に基づいて接触しているか否かを検出しても良い。

【００１５】

また、本発明に係る生体情報計測装置は、上記本発明の生体情報計測装置において、前記一対の電極が、前記光発光部及び前記光受光部を間に挟むように配されていることを特徴とするものである。

【００１６】

この発明に係る生体情報計測装置においては、一対の電極が、光発光部及び光受光部を間に挟むように配されているので、高精度に光発光部及び光受光部が生体表面に接触しているか否かを検出ことができる。

【００１７】

また、本発明に係る生体情報計測装置は、上記本発明のいずれか１つの生体情報計測装置において、前記光発光部及び前記光受光部と前記生体情報検出部との間を電気的に接続するフレキシブル基板を備え、該フレキシブル基板は、前記光発光部及び前記光受光部を自身の弾性により前記本体の下面側に向けて押圧するように前記本体内に設けられていることを特徴とするものである。

【００１８】

この発明に係る生体情報計測装置においては、光発光部及び光受光部がフレキシブル基板の弾性により、常に本体の下面側に押圧されているので、本体を手首に装着したときに、光発光部及び光受光部は生体表面に対して近接した状態となる。従って、生体に対してより効率良く光の照射及び受光を行うことができ、生体情報の検出精度を向上することができる。

【００１９】

また、本発明に係る生体情報計測装置は、上記本発明のいずれか１つの生体情報計測装置において、前記本体の上面に、検出された生体情報を表示する表示部を備えていることを特徴とするものである。

【００２０】

この発明に係る生体情報計測装置においては、表示部に表示された生体情報を容易に視認できるので、必要なときにいつでも検出された生体情報を確認したり、生体情報の検出が正しく行なわれているか等を確認することができ、使い易く簡便である。

【００２１】

また、本発明に係る生体情報計測装置は、上記本発明のいずれか１つの生体情報計測装置において、前記固定手段は、前記本体に基端側が取り付けられて腕に装着可能な第１の

バンド及び第２のバンドを備え、前記第１のバンド及び第２のバンドは、前記本体を挟んで対向するように配されると共に、伸縮自在な弾性材料により形成されていることを特徴とするものである。

【００２２】

この発明に係る生体情報計測装置においては、第１のバンド及び第２のバンドにより、本体を手首に腕時計のように容易且つ確実に装着することができる。特に、両バンドは、伸縮自在な弾性材料により形成されているので、筋肉の動きにより多少手首の太さが変化した場合にもその変化量を吸収でき、本体と生体表面との間に隙間等が生じることを防止することができる。よって、両バンドを締め付ける必要がなく、長時間の装着が可能になる。

【００２３】

また、本発明に係る生体情報計測装置は、上記本発明のいずれか１つの生体情報計測装置において、前記生体センサ部は、前記本体の中心位置から前記第１のバンド又は前記第２のバンドの基端側にずれた位置に配されていることを特徴とするものである。

【００２４】

この発明に係る生体情報計測装置においては、第１のバンド及び第２のバンドにより本体を腕時計のように手首に装着したときに、仮に手首との間に若干の遊びがあり、この遊びにより本体が重力作用によりずれた（例えば、腕を下方（地面側）に向けた状態でずれた場合や、手の甲を内側にすると共に腕を水平にして目の前に本体の上面をかざした状態でずれた場合等）としても、生体センサ部は、本体の中心位置から第１のバンド又は第２のバンドの基端側にずれた位置に配されているので、生体センサ部の密着性の低下を防止することができる。

【００２５】

また、本発明に係る生体情報計測装置は、上記本発明のいずれか１つの生体情報計測装置において、前記本体に、充電可能な充電池と、該充電池に電力を充電する充電手段とを備えていることを特徴とするものである。

【００２６】

この発明に係る生体情報計測装置においては、充電手段を介して充電池に外部からの電力を充電できるので、通常の電池等を別個に用意する必要がない。従って、製品の維持に係るコストを低減することができる。

【００２７】

また、本発明に係る生体情報計測装置は、上記本発明のいずれか１つの生体情報計測装置において、前記突出部の下面と前記本体の下面との距離が、２～４ｍｍに設定されていることを特徴とするものである。

【００２８】

この発明に係る生体情報計測装置においては、突出部の下面が本体の下面から２～４ｍｍ突出した状態で手首に装着される。これにより、確実に突出部を生体表面に接触させることができ、生体センサ部の密着性を確保できる。つまり、突出部の下面と本体の下面との距離が２ｍｍ以下の場合には、段差が少なく生体表面との間に隙間ができ外光が入り易い。また、突出部の下面と本体の下面との距離が４ｍｍ以上の場合には、装着時に圧迫感が生じると共に高さがあるので不安定な状態となり、例えば、斜めになった際に生体表面との間に外光が入り易くなってしまう。

【００２９】

上述したように、突出部の下面と前記本体の下面との距離を２～４ｍｍにすることで、圧迫感及び外光の入射を防止することができる。

【００３０】

また、本発明に係る生体情報計測装置は、上記本発明のいずれか１つの生体情報計測装置において、前記突出部は、外周が円形となるように形成されていることを特徴とするものである。

【００３１】

この発明に係る生体情報計測装置においては、突出部が円形であるので、本体を手首に装着したときに、生体表面に均等な力で押し込まれる。従って、密着性が良い。

【００３２】

また、本発明に係る生体情報計測装置は、上記本発明のいずれか１つの生体情報計測装置において、前記突出部は、外縁が曲面となるように形成されていることを特徴とするものである。

【００３３】

この発明に係る生体情報計測装置においては、突出部の外縁が曲面に形成されているので、本体を手首に装着したときに、密着性のさらなる向上を図ることができる。また、長時間装着したとしても、圧迫痕が付き難いので、装着し易い。

【００３４】

また、本発明に係る生体情報計測装置は、上記本発明の生体情報計測装置において、前記突出部は、下面の中心から外縁に向かって曲面となるように形成されていることを特徴とするものである。

【００３５】

この発明に係る生体情報計測装置においては、突出部の下面の中心から外縁に向かって曲面に形成されているので、本体を手首に装着したときに、生体表面が滑らかに変形し、下面の中心部の接触圧力が上昇した状態で装着され、密着性のさらなる向上を図ることができる。また、長時間装着したとしても、圧迫痕が付き難いので、装着し易い。

【００３６】

また、本発明に係る生体情報計測装置は、上記本発明のいずれか１つの生体情報計測装置において、前記突出部の直径が、２０ｍｍ以下に設定されていることを特徴とするものである。

【００３７】

この発明に係る生体情報計測装置においては、突出部の直径が２０ｍｍ以下であるので、軽い力で容易に突出部を生体表面に押し付けることができる。

【００３８】

また、本発明に係る生体情報計測装置は、上記本発明のいずれか１つの生体情報計測装置において、前記凸条部は、前記突出部の側面から８ｍｍ離間した位置に設けられると共に、該凸条部の下面と前記本体の下面との距離が４ｍｍに設定されていることを特徴とするものである。

【００３９】

この発明に係る生体情報計測装置においては、凸条部を突出部の側面から８ｍｍという近傍に形成できると共に、４ｍｍの高さで揃えることができる。このように、小さなスペースで凸条部を形成できるので、本体の小型化、即ち、装置全体の小型化を図ることができる。

【発明の効果】

【００４０】

本発明に係る生体情報計測装置によれば、固定手段により本体を手首に装着したときに、本体の下面から突出部が突出しているので、生体表面と突出部の下面とが確実に接触して、生体センサ部の密着性が向上する。そのため、固定手段により、従来のように本体を生体表面に強く押し付ける（圧迫する）ように固定する必要はない。従って、長時間装着したとしても、不快感を感じることはない。また、生体センサ部の密着性が向上しているので、効率良く光の照射及び受光を行うことができ、高精度に生体情報の検出を行うことができる。

【発明を実施するための最良の形態】

【００４１】

以下、本発明に係る生体情報計測装置の一実施形態を、図１から図７を参照して説明する。

【００４２】

本実施形態の生体情報計測装置１は、図１から図７に示すように、腕時計型であって手首（腕）Ａに装着した状態で、生体情報である脈拍数を検出するものである。

【００４３】

この生体情報計測装置１は、各種の電気部品及び電子部品を内蔵したハウジング（本体）２と、ハウジング２の下面２ａを生体表面Ｂ側に向けた状態でハウジング２を手首Ａに装着する固定手段３とを備えている。また、ハウジング２の下面２ａには、該下面２ａから突出した突出部４が形成されている。

【００４４】

この突出部４の下面４ａには、生体表面Ｂ側に接触した状態で生体に向けて光を照射するＬＥＤ（Light Emitting Diode）（光発光部）５と、該ＬＥＤ５により照射された光のうち生体からの反射光を受光すると共に受光量に応じた脈拍信号（生体情報信号）を生成するＰＤ（Photodetector）（光受光部）６と、ＬＥＤ５及びＰＤ６が生体表面Ｂに接触しているか否かを検出する接触検出手段７とを有する生体センサ部８が配されている。

【００４５】

また、ハウジング２内には、生成された脈拍信号に基づいて脈拍数を検出するデータ処理部（生体情報検出部）９が設けられている。

【００４６】

上記ハウジング２は、プラスチックやアルミニウム等の金属材料からなり、所定の厚みをもって、例えば、上面視略長方形状に形成されている。ハウジング２の上面２ｂの中央部分には、略正方形状のカバーガラス１０が嵌め込まれており、該カバーガラス１０の内側には検出された上記脈拍数やその他各種の情報を表示する表示部１１が配されている。

【００４７】

また、ハウジング２内には、図６及び図７に示すように、メイン基板１２が設けられており、該メイン基板１２に上記データ処理部９、上記表示部１１、充電可能な充電池１３、脈拍数を記録するメモリ１４、サブ基板１５及びその他各種の電子部品が実装又は配線等により電気的に接続されている。

【００４８】

上記データ処理部９は、ＣＰＵ等のＩＣ部品を含むものであり、ＰＤ６により生成された脈拍信号を一旦アンプ等により増幅した後に、高速フーリエ変換処理（ＦＦＴ処理）等の所定処理を行い、その処理結果を解析することにより脈拍数を検出する機能を有している。また、データ処理部９は、検出した脈拍数をメモリ１４に記録すると共に、後述する各ボタン２０からの入力に基づいて表示部１１に表示させるようになっている。更に、データ処理部９は、他の構成品を総合的に制御する機能も有している。

【００４９】

上記表示部１１は、例えば、ＬＣＤ（Liquid Crystal Display）等の液晶表示器であり、上述した脈拍数以外に、例えば、図示しない水晶振動子によりカウントされた時刻を表示する時刻表示機能やその他の各種情報を表示する機能を有している。例えば、時刻、日付、曜日や充電池１３の残電力量等を表示できるようになっている。

【００５０】

また、ハウジング２には、図１及び図２に示すように、複数のボタン２０、例えば、ハウジング２の上面２ｂであって表示部１１の下側に配された３つのボタン２０及びハウジング２の側面に配された１つのボタン２０が設けられている。これら各ボタン２０を押下することで、各種操作ができるようになっている。例えば、脈拍数の計測開始、計測停止や、脈拍数と時刻との表示切替や、メモリ１４内に記録されている脈拍数データを外部の機器にデータ送信する等の操作ができるようになっている。

【００５１】

更に、ハウジング２の側面には、上記充電池１３に充電器等の外部から電力を供給して充電させる外部接続端子（充電手段）２１が設けられている。なお、外部接続端子２１を覆うようにカバー等を取り付けて、外部接続端子２１を保護しても構わない。こうすることで、外部接続端子２１を水滴や埃等から保護することが可能となり、より好適である。

また、外部接続端子２１に限らず、充電器及びハウジング２内にそれぞれ電力を供給するためのトランス等を設け、非接触状態で充電池１３の充電を行うように構成しても構わない。

【００５２】

上記突出部４は、図５に示すように、下面視した際に３つの円を組み合わせた形状、即ち、中央の円形に、該円形より径が小さい２つの円形を左右から挟むように結合した瓢箪のような形状に形成されている。また、突出部４は、その中心位置がハウジング２の中心位置よりも後述する第２のバンド３１側にずれた位置になるように形成されている。これにより、突出部４の下面に配された上記生体センサ部８も同様に、第２のバンド３１側にずれた位置に配されるようになっている。また、突出部４は、ハウジング２の下面から垂直に突出するのではなく、側面４ｂが斜面となるように形成されている。

【００５３】

また、突出部４の下面４ａの中心には、図７に示すように、外部とハウジング２の内部を貫通させる貫通孔２２が形成されており、該貫通孔２２を塞ぐようにカバーガラス２３がハウジング２に固定されている。そして、カバーガラス２３の内側に接するように、上記ＬＥＤ５及びＰＤ６がハウジング２の長手方向に直交する方向に、互いに隣接するように配されている。つまり、ＬＥＤ５及びＰＤ６は、突出部４内に落とし込まれる構成となっている。これにより、ＬＥＤ５及びＰＤ６は、生体表面Ｂに可能な限り近づくようになっている。

【００５４】

この際、ＬＥＤ５及びＰＤ６は、図６に示すように、上記サブ基板１５に電気的に接続されたフレキシブル基板２４の一端側に実装されており、該フレキシブル基板２４の弾性によってハウジング２の下面２ａ側に向けて押圧された状態で配されている。このことからも、ＬＥＤ５及びＰＤ６は、可能な限り突出部４の下面４ａ側に位置するようになっている。即ち、ＬＥＤ５及びＰＤ６は、生体表面Ｂに可能な限り近づくようになっている。なお、サブ基板１５及びフレキシブル基板１４は、一体構造として形成されている。また、ＬＥＤ５及びＰＤ６が実装されているフレキシブル基板の固定は、両面テープ等の固定部材でハウジング２の下面２ａ側に固定してもよい。

【００５５】

上記ＰＤ６により生成された脈拍信号は、フレキシブル基板２４、サブ基板１５及びメイン基板１２を介して、上記データ処理部９に送られるようになっている。

【００５６】

上記接触検出手段７は、一対の電極７ａ、７ｂを有しており、該一対の電極７ａ、７ｂはＬＥＤ５及びＰＤ６を間に挟んだ状態で突出部４の下面４ａに配されている。即ち、一対の電極７ａ、７ｂ、ＬＥＤ５及びＰＤ６は、ハウジング２の長手方向に直交する方向に一列に並ぶように配されている。また、一対の電極７ａ、７ｂは、その先端が突出部４の下面４ａから若干突出するように設けられていると共に、基端側がサブ基板１５に電気的に接続するように設けられている。

【００５７】

この一対の電極７ａ、７ｂは、電極間の電位差に基づいて生体表面Ｂに接触しているか否かを検出する機能を有している。データ処理部９は、この検出結果を受けて、例えば、生体表面Ｂに接触していると検出されたときに、ＬＥＤ５から光を照射するようにＬＥＤ５の作動を制御するように設定されている。なお、この場合だけに限らず、例えば、生体表面Ｂに接触していないことが検出されたときに、ＦＦＴ処理を行なわないように設定しても構わない。

【００５８】

上記固定手段３は、ハウジング２に基端側が取り付けられて手首Ａに装着可能な第１のバンド３０及び第２のバンド３１を有している。第１のバンド３０及び第２のバンド３１は、ハウジング２の長手方向に、該ハウジング２を挟んで対向するように設けられている。また、両バンド３０、３１は、伸縮自在な弾性材料により形成されている。

【００５９】
上記第１のバンド３０には、先端にバックル３０ａ及びタング３０ｂが取り付けられている。また、第２のバンド３１には、上記タング３０ｂが挿入される挿入孔３１ａが該第２のバンド３１の長手方向に沿って複数形成されている。これにより、使用者の手首Ａの太さに応じて第１のバンド３０及び第２のバンド３１の長さを調整することができるようになっている。
【００６０】
このように構成された生体情報計測装置１により、手首Ａに装着した状態で脈拍数を検出する場合について説明する。
【００６１】
まず、図２及び図３に示すように、使用者の手首Ａを巻回するよう両バンド３０、３１を巻き、手首Ａの太さに応じて第１のバンド３０のタング３０ｂを第２のバンド３１の挿入孔３１ａに挿入し、ハウジング２を手首Ａに装着する。ハウジング２が手首Ａに装着されると、突出部４はハウジング２の下面２ａよりも突出しているので、生体表面Ｂと突出部４の下面４ａとが密着した状態となる。従って、手首Ａを締め付けるようにハウジング２を装着する必要はなく、所定の力で締まるように両バンド３０、３１の長さを調整すれば良い。特に、突出部４は、側面４ｂが斜面となっているので、突出部４の外形形状に合わせて生体表面Ｂが滑らかに変形するので、密着し易い。
【００６２】
生体表面Ｂと突出部４の下面４ａとが密着状態、即ち、生体表面Ｂが突出部４の下面４ａに接触すると、一対の電極７ａ，７ｂが生体表面Ｂに接触する。特に、一対の電極７ａ、７ｂは、突出部４の下面４ａよりも若干突出するように配されているので、生体表面Ｂに接触し易い。一対の電極７ａ、７ｂが、生体表面Ｂに接触すると、生体表面Ｂを通して放電が行なわれ両電極間の電圧が低下する。この電圧低下（例えば、ある閾値より低下）を受けて、データ処理部９は、一対の電極７ａ、７ｂが確実に生体表面Ｂに接触していることの検出を行う。即ち、ＬＥＤ５及びＰＤ６を含む生体センサ部８が、確実に生体表面Ｂに接触していることを検出する。特に、一対の電極７ａ、７ｂは、ＬＥＤ５及びＰＤ６を間に挟んで配されているので、ＬＥＤ５及びＰＤ６が生体表面Ｂに接触している否かを高精度に検出することができる。
【００６３】
ＬＥＤ５及びＰＤ６が生体表面Ｂに接触していることを検出すると、データ処理部９は、ＬＥＤ５から生体に向けて光を照射させる。照射された光の一部は、血管内の、例えば、ヘモグロビンによって吸収され、他の光の一部は、生体組織で反射される。ＰＤ６は、この反射光を受光すると共に受光量に応じた脈拍信号（生体情報信号）を生成して、データ処理部９に出力する。つまり、手首Ａ（生体）内部の動脈及び細動脈内の血流変動に応じて、ＬＥＤ５から照射された光の反射光量が変動するので、ＰＤ６は、動脈の脈動、即ち、脈波に応じた反射光の受光が行える。これにより、ＰＤ６は、脈拍信号の生成が行える。
【００６４】
データ処理部９は、送られてきた脈拍信号を増幅した後に、ＦＦＴ処理等の所定処理をした後、解析を行なって脈拍数を検出する。そして、データ処理部９は、検出した脈拍数をメモリ１４に記録すると共に各ボタン２０操作に基づいて表示部１１に表示させる。
【００６５】
使用者は、必要時に各ボタン２０を押下することで、容易に検出された脈拍数を表示部１１に表示させて確認が行えるので、使用に関して簡便である。また、使用者は、各ボタン２０の操作により、脈拍数以外のその他の情報、例えば、時刻や充電池１３の残電力等についても表示部１１により確認することができるので使い易い。
【００６６】
また、上述したように、使用者は、ハウジング２を両バンド３０、３１により所定の力で締め付けて手首Ａに装着しているので、長時間装着したとしても圧迫感を感じることが

ないので、不快に感じることがない。

【００６７】

また、使用者が、例えば、何かを手に持ったり、何らかの作業を行った場合には、筋肉の動きにより、手首Ａ（腕）の太さ（径）が変化する。この場合においても、生体センサ部８は、ハウジング２の下面２ａから突出した突出部４の下面４ａに配されているので、生体センサ部８と生体表面Ｂとの接触性（密着性）が低下することを極力抑えることができる。特に、第１のバンド３０及び第２のバンド３１は、伸縮自在であるので手首Ａの太さの変化に合わせて伸縮できることからも、密着性の低下を抑えることができる。

【００６８】

従って、手首Ａの太さが変化したとしても、ＬＥＤ５及びＰＤ６を生体表面Ｂに接触した状態を維持できるので、常に正確な脈拍数の検出を行える。従って、脈拍数の検出精度の向上を図ることができる。また、ＬＥＤ５及びＰＤ６は、突出部４内に落とし込まれていると共に、フレキシブル基板２４の弾性によって、ハウジング２の下面２ａ側に向けて押圧されて生体表面Ｂに出来るだけ近接していることからも、脈拍数を高精度に検出することができる。

【００６９】

また、使用者が、表示部１１に表示された各種情報を確認するために、手の甲を内側に向けた状態で腕を水平に向けて表示部１１を目の前にかざした場合、仮に、ハウジング２が重力により地面側、即ち、第２のバンド３１側にずれたとしても、生体センサ部８はハウジング２の中心位置よりも第２のバンド３１の基端側に向けてずれた位置に配されているので、生体センサ部８と生体表面Ｂとの接触性が低下することを防止することができる。なお、腕を地面側に向けた、即ち、腕を下に下ろした場合も同様である。

【００７０】

また、充電池１３に電力を充電する場合には、例えば、充電器に接続されている充電コード等を外部接続端子２１に接続することで充電を行うことができ、通常の電池を別個に用意する必要はない。従って、維持経費の削減を図ることができる。なお、ハウジング２内に音声を出力するブザー等の音声出力手段を設けて、充電池１３の充電量が“０”に近くなるまで減少した場合に、音声を出力させて充電時期（充電タイミング）を知らせるように構成しても構わない。

【００７１】

以上説明したように、本実施形態の生体情報計測装置１によれば、固定手段３により本体を手首Ａに装着したときに、ハウジング２の下面２ａから突出部４が突出しているので、生体表面Ｂと突出部４の下面４ａとが確実に接触して、生体センサ部８の密着性が向上する。そのため、固定手段３により、従来のようにハウジング２を生体表面Ｂに強く押し付ける（圧迫する）ように固定する必要はない。従って、長時間装着したとしても、不快感を感じることはない。また、生体センサ部８の密着性が向上しているので、効率良く光の照射及び受光を行うことができ、高精度に脈拍数の検出を行うことができる。

【００７２】

なお、本発明の技術範囲は上記実施の形態に限定されるものではなく、本発明の趣旨を逸脱しない範囲において種々の変更を加えることが可能である。

【００７３】

例えば、上記実施形態においては、突出部４の形状を３つの円形を組み合わせた鍵穴のような形状にしたが、これに限らず、ハウジング２の下面２ａより突出していれば形状は自由に形成して構わない。

【００７４】

例えば、図８に示すように、外周が円形となるように突出部４を形成しても構わない。また、図８に示される突出部４は、その直径が２０ｍｍに設定され、突出部４の下面４ａとハウジング２の下面２ａとが３ｍｍの距離になるように形成されている。

【００７５】

突出部４を円形にすることで、ハウジング２を手首Ａに装着したときに、突出部４が生

体表面Ｂに均等な力で押し込まれるので、密着性が良い。この際、突出部４の直径が２０ｍｍ以下であるので、軽い力で突出部４を押し付けることができ、より圧迫感をなくすことができる。ここで、一般的に手首の最大径と最小径との差は３ｍｍとされている。よって、図８に示すように、突出部４の下面４ａとハウジング２の下面２ａとの距離を３ｍｍに設定することで、手首の太さの変化に対応でき、突出部４の下面４ａと生体表面Ｂとの間に隙間を作ることなく、密着性の向上を図ることができる。従って、生体センサ部８の密着性を良くすることができる。

【００７６】

なお、突出部４の下面４ａとハウジング２の下面２ａとの距離を３ｍｍに設定したが、３ｍｍに限らず、２ｍｍ～４ｍｍの範囲に設定されていれば構わない。仮に、２ｍｍ以下の場合には、段差が少なくなり、生体表面Ｂとの間に隙間ができ、外光が入り易くなってしまう。また、４ｍｍ以上の場合には、圧迫感が生じると共に、高さがあるので不安定となり、斜めになった際にやはり生体表面Ｂとの間に隙間ができ外光が入り易くなってしまう。即ち、図８に示すように、突出部４の下面４ａとハウジング２の下面２ａとの距離を２ｍｍ～４ｍｍの範囲内に設定することで、圧迫感及び外光の入射を防止することができる。

【００７７】

また、図８に示す突出部４を、図９に示すように、外縁が曲面となるように形成しても構わない。こうすることで、密着性のより良くすることができると共に長時間装着したとしても、圧迫痕が付き難いので、装着し易い。

【００７８】

更に、図１０に示すように、突出部４の下面４ａの中心から外縁に向かって曲面となるように形成しても構わない。こうすることで、生体表面Ｂが滑らかに変形し、下面４ａの中心部の接触圧力が上昇した状態で装着でき、密着性のさらなる向上を図ることができると共に、さらに圧迫痕が付き難く装着し易い。

【００７９】

また、図１１に示すように、ハウジング２の下面２ａに、突出部４を挟むと共に突出部４の側面４ｂから所定距離、即ち、８ｍｍ離間した位置に、ハウジング２の下面２ａから突出して形成された凸条部４０を設けても良い。なお、図１１に示す突出部４は、図８に示すものと同一形状である。

【００８０】

また、凸条部４０の下面４０ａとハウジング２の下面２ａとの距離は４ｍｍに設定されており、突出部４の下面４ａとハウジング２の下面２ａとの距離（３ｍｍ）よりも若干高くなっている。

【００８１】

このように構成した場合には、ハウジング２を手首Ａに装着したときに、生体は、突出部４と凸条部４０との間に形成された８ｍｍの隙間に入り込んだ状態で、突出部４の下面４ａ及び凸条部４０の下面４０ａに接触する。この際、凸条部４０は、突出部４の外側で生体に接触すると共に突出部４より先に接触する。従って、生体を安定させた状態で突出部４の下面４ａに接触させることができると共に、突出部４の下面４ａに対して接触圧力を均一にすることができる。よって、長時間に亘り安定して脈拍数の検出を行うことができる。また、凸条部４０を突出部４の近傍、即ち、小さなスペースで形成できるので、凸条部４０を設けたとしても、小型化を図ることができる。

【００８２】

なお、上記凸条部は、図１２及び図１３に示すように、上述した図９及び図１０に示す突出部４と組み合わせて構成しても構わない。また、凸条部は、突出部の側面から所定距離離間した位置に、突出部の周囲を囲むように形成しても構わない。

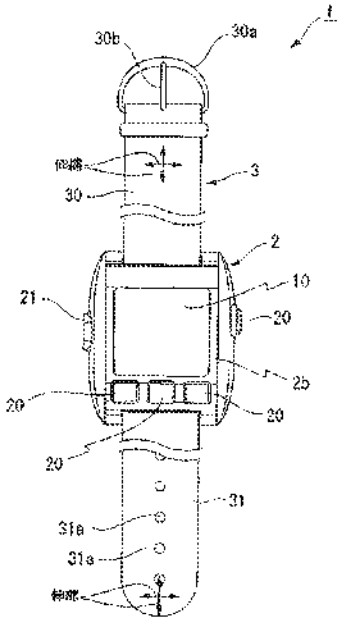
【００８３】

また、上記実施形態においては、生体情報として脈拍数を例にして説明したが、脈拍数に限らず、生体情報であれば構わない。

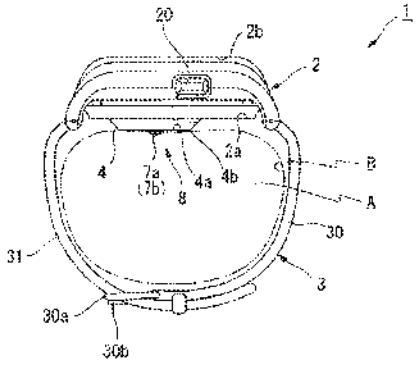
【００８４】
また、接触検出手段は、一対の電極を有したが、一対に限らず、複数の電極を有しても構わない。この場合には、各電極間の電位差に基づいて接触したか否かを検出するように設定すれば良い。
【００８５】
また、生体センサ部は、ハウジングの中心位置より、第２のバンドの基端側にずれるように構成したが、第１のバンド側の基端側にずれるように形成しても構わない。つまり、両バンドと表示部との関係により、設計すれば良い。
【００８６】
また、ハウジングに、他の電子機器との間で無線通信可能な無線通信手段等の機能を付加しても良い、こうすることで、Ｂｌｕｅｔｏｏｔｈ等の無線通信により、メモリに記録した脈拍数を外部の電子機器にデータ送信したり、各種情報をメモリに入手させることができる。
【図面の簡単な説明】
【００８７】
【図１】本発明に係る生体情報計測装置の一実施形態を示す正面図である。
【図２】図１に示す生体情報計測装置を手首に装着した状態を示す側面図である。
【図３】図１に示す生体情報計測装置を手首に装着した状態を示す側面図であり、図２に示す方向とは逆方向から見た図である。
【図４】図１に示す生体情報計測装置を斜め上方から見た状態を示す斜視図である。
【図５】図１に示す生体情報計測装置を斜め下方から見た状態を示す斜視図である。
【図６】図４に示す生体情報計測装置の断面矢視Ｃ－Ｃ図である。
【図７】図４に示す生体情報計測装置の断面矢視Ｄ－Ｄ図である。
【図８】図１に示す生体情報計測装置とは別の突出部の形状を示す図であって、突出部の外周が円形の場合の図である。
【図９】図８に示す突出部を、外縁が曲面となるように形成した場合の図である。
【図１０】図８に示す突出部を、下面の中心から外縁に向けて曲面となるように形成した場合の図である。
【図１１】図８に示す突出部を挟むように、凸条部を形成した場合の図である。
【図１２】図９に示す突出部を挟むように、凸条部を形成した場合の図である。
【図１３】図１０に示す突出部を挟むように、凸条部を形成した場合の図である。
【符号の説明】
【００８８】
Ｂ　生体表面
１　生体上方計測装置
２　ハウジング（本体）
２ａ　本体の下面
２ｂ　本体の上面
３　固定手段
４　突出部
４ａ　突出部の下面
４ｂ　突出部の側面
５　ＬＥＤ（光発光部）
６　ＰＤ（光受光部）
７　接触検出手段
７ａ、７ｂ　一対の電極
８　生体センサ部
９　データ処理部（生体情報検出部）
１１　表示部
１３　充電池

２１　外部接続端子（充電手段）
２４　フレキシブル基板
３０　第１のバンド
３１　第２のバンド
４０　凸条部
４０ａ　凸条部の下面

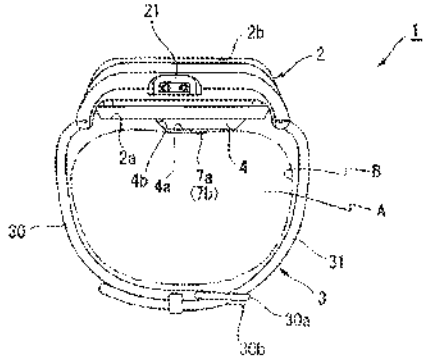
【図１】



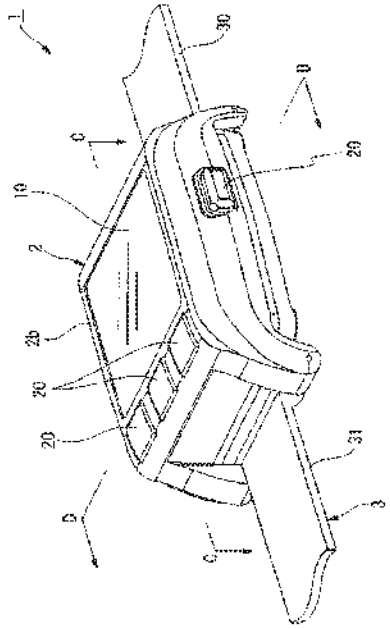
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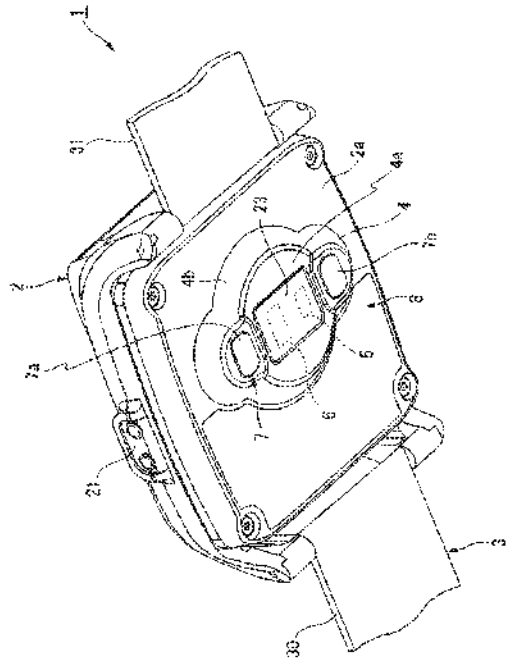
【図３】


21
2b
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2a
4b
4a
7a
(7b)
4
8
A
30
31
3
30a
30b

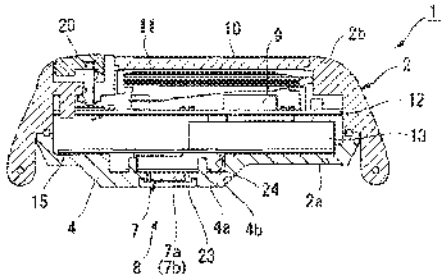
【図４】


1
30
B
B
20
10
2
2b
20
20
31
3
C
C

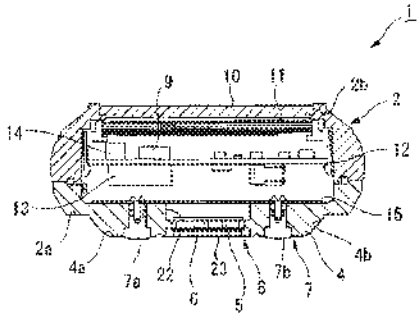
【図５】


1
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2a
4a
4
23
7a
2
4b
6
7a
5
7
6
21
3
30

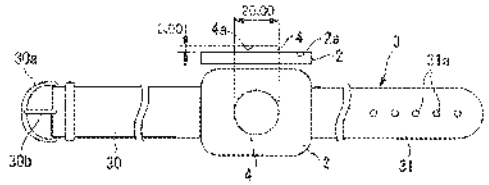
【図６】


20
11
10
9
2b
1
2
12
13
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24
2a
4
7
4a
4b
8
7a
(7b)
23

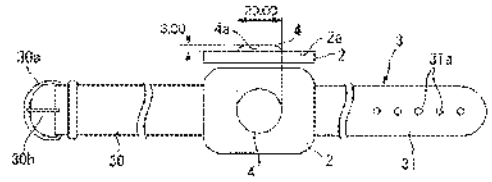
【図７】


1
9
10
11
2b
2
14
12
13
15
2a
4a
4b
7a
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23
6
5
7b
7
4

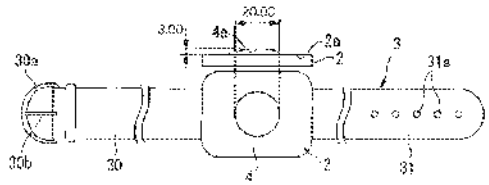
【図８】



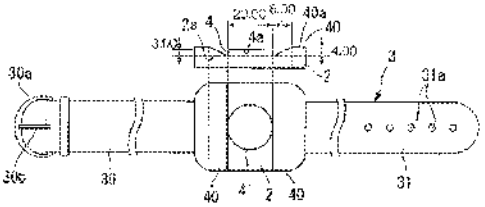
【図９】



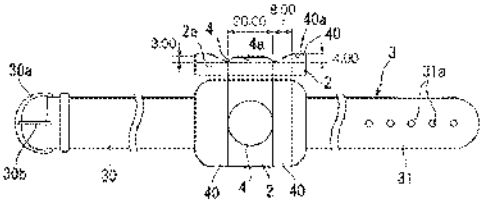
【図１０】



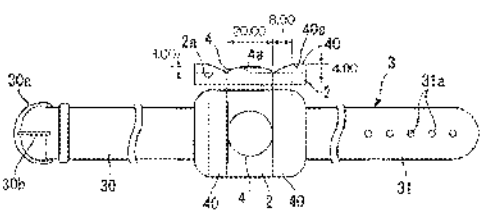
【図１１】



【図１２】



【図１３】



フロントページの続き

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Patents 2005-270543

› JP2005270543A – Biological information measuring device

› AU2005270543A1 – Electroacoustic transducer arrangement for underwater antennas

Biological information measu

Abstract

<P>PROBLEM TO BE SOLVED: To provide a biological information measuring device capable of improving adhesion and being put on for a long period of time without an unpleasant feeling. <P>SOLUTION: The biological information measuring device 1 comprises: a main body 2; a projection part 4 formed by being projected from the lower surface 2a of the main body 2; a fixing means 3 for mounting the main body 2 on an arm in the state of turning the lower surface 2a of the main body 2 to a living body surface side; a living body sensor part 8 provided with a light emitting part 5 for emitting light toward a living body in the state of being in contact with a living body surface, a light receiving part 6 for receiving reflected light from the living body of the light emitted by the light emitting part 5 and generating biological information signals corresponding to a received light quantity and a contact detection means 7 for detecting whether or not the light emitting part 5 and the light receiving part 6 are in contact with the living body surface; and a biological information detection part provided in the main body 2 for detecting biological information on the basis of the biological information signals. The living body sensor part 8 provides the biological information measuring device 1 that is arranged on the lower surface 4a of the projection part 4. <P>COPYRIGHT: (C)2006,JPO&NCIPI

Images (13)



Classifications

› A61B5/681 Wristwatch-type devices

View 1 more classifications

JP2005270543A

Japan

Download PDF Find Prior Art Similar

Other languages: Japanese

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Current Assignee : Seiko Instruments Inc

Worldwide applications

2004 JP 2005 WO

Application JP2004091942A events ⓘ

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2005-03-10	Priority to PCT/JP2005/002921
2005-10-06	Publication of JP2005270543A
2010-06-16	Application granted
2010-06-16	Publication of JP4488234B2
Status	Expired - Fee Related
2024-03-26	Anticipated expiration

Info: Patent citations (5), Cited by (32), Legal events, Similar documents, Priority and Related Applications

External links: Espacenet, Global Dossier, Discuss

Claims (15)

Hide Dependent ^
translated from Japanese

The body,
A protrusion formed to protrude from the lower surface of the main body;
Fixing means for mounting the main body on the arm with the lower surface of the main body facing the surface of the living body,
A light emitting unit that emits light toward the living body in contact with the surface of the living body, and a living body information signal that receives reflected light from the living body among the light irradiated by the light emitting unit and that corresponds to the amount of light received A biosensor unit that includes a light receiving unit that generates a contact detection unit that detects whether the light emitting unit and the light receiving unit are in contact with the biological surface;
A biological information detection unit that is provided in the main body and detects biological information based on the biological information signal;
The biological information measuring device, wherein the biological sensor unit is disposed on a lower surface of the protruding portion. The biological information measuring apparatus according to claim 1,
The lower surface of the main body is provided with a ridge formed to protrude from the lower surface of the main body at a position at least a predetermined distance from the side surface of the protruding portion while sandwiching the protruding portion.
The biological information characterized in that the distance between the lower surface of the ridge portion and the lower surface of the main body portion is set to be equal to or greater than the distance between the lower surface of the protruding portion and the lower surface of the main body portion. Measuring device. The biological information measuring device according to claim 1 or 2,
The contact detection means includes at least a pair of electrodes, and detects whether the light emitting unit and the light receiving unit are in contact with the living body surface based on a potential difference between the pair of electrodes. A biological information measuring device as a feature. The biological information measuring device according to claim 3,
The biological information measuring device, wherein the pair of electrodes are arranged so as to sandwich the light emitting unit and the light receiving unit therebetween. The biological information measuring device according to any one of claims 1 to 4,

A flexible substrate for electrically connecting the light emitting unit and the light receiving unit and the biological information detecting unit;
The biological information measuring apparatus according to claim 1, wherein the flexible substrate is provided in the main body so as to press the light emitting portion and the light receiving portion toward the lower surface side of the main body by its elasticity. In the living body information measuring device according to any one of claims 1 to 5,
A biological information measuring apparatus comprising a display unit for displaying detected biological information on an upper surface of the main body. The biological information measuring apparatus according to any one of claims 1 to 6,
The fixing means includes a first band and a second band that are attached to the arm with a proximal end attached to the main body,
The biological information measuring device, wherein the first band and the second band are arranged so as to face each other with the main body interposed therebetween, and are formed of a stretchable elastic material. The biological information measuring device according to claim 7,
The biological information measuring apparatus, wherein the biological sensor unit is arranged at a position shifted from a central position of the main body toward a proximal end side of the first band or the second band. In the living body information measuring device according to any one of claims 1 to 8,
A biological information measuring apparatus comprising: a rechargeable battery capable of being charged in the main body; and charging means for charging power to the rechargeable battery. The biological information measuring device according to any one of claims 1 to 9,
The biological information measuring device, wherein a distance between the lower surface of the protruding portion and the lower surface of the main body is set to 2 to 4 mm. The biological information measuring apparatus according to any one of claims 1 to 10,
The living body information measuring apparatus according to claim 1, wherein the protrusion is formed so that the outer periphery is circular. The biological information measuring apparatus according to claim 11,
The biological information measuring device, wherein the protruding portion is formed so that an outer edge is a curved surface. The biological information measuring apparatus according to claim 11,
The biological information measuring device, wherein the protruding portion is formed to have a curved surface from the center of the lower surface toward the outer edge. The biological information measuring device according to any one of claims 11 to 13,
The biological information measuring device, wherein a diameter of the protruding portion is set to 20 mm or less. The biological information measuring device according to any one of claims 2 to 14,
The ridge portion is provided at a position 8 mm away from the side surface of the protruding portion, and the distance between the lower surface of the ridge portion and the lower surface of the main body is set to 4 mm. apparatus.

Description

(translated from Japanese)

The present invention relates to a biological information measuring apparatus capable of measuring biological information such as a pulse rate while being worn on a wrist (arm).

Due to the recent increase in interest in health management, various biological information measuring devices capable of measuring various biological information such as pulse rate while being worn on the wrist (arm) or the like have been provided (for example, Patent Document 1). reference).

Among this type of biological information measuring device, for example, a device that detects a pulse rate irradiates light toward a living body while being worn on the wrist, and reflects light from a blood vessel by a pulse sensor or the like, that is, reflected light. A signal is received, a pulse signal corresponding to a pulse is extracted from the reflected signal, and a pulse rate is calculated. In particular, since the pulse rate can be easily measured while wearing on the wrist, it is easily used by the user.
JP 2001-78973 A (paragraph numbers 0011-0031, FIG. 1 to FIG. 7)

The above-described conventional biological information measuring apparatus is generally used by being worn on the wrist. However, depending on the movement of the user, the muscle moves and the thickness (diameter) of the wrist changes, which may cause a gap between the biological information measuring device and the biological surface. For this reason, there is a possibility that the adhesiveness is lowered and accurate biological information cannot be detected. Further, in order to securely fix the biological information measuring device to the wrist, for example, when it is tightened with a band, a feeling of pressure on the wrist increases and it is difficult to perform wearing for a long time.

The present invention has been made in view of such circumstances, and an object of the present invention is to provide a biological information measuring device that can be worn for a long time without feeling uncomfortable while improving adhesion. That is.

The present invention provides the following means in order to solve the above problems.

The biological information measuring device of the present invention includes a main body, a protruding portion formed to protrude from the lower surface of the main body, and a fixing means for attaching the main body to the arm with the lower surface of the main body facing the biological surface side, A light emitting unit that emits light toward the living body in contact with the surface of the living body, and a living body information signal that receives reflected light from the living body among the light irradiated by the light emitting unit and that corresponds to the amount of light received A living body sensor section having a light receiving section for generating a light, a contact detecting means for detecting whether the light emitting section and the light receiving section are in contact with the surface of the living body, and the body information signal. And a biological information detection unit that detects biological information based on the biological sensor unit, wherein the biological sensor unit is disposed on a lower surface of the protruding portion.

In the biological information measuring apparatus according to the present invention, the fixing means irradiates light from the light emitting unit toward the living body after the body is mounted on the wrist (arm). A part of the irradiated light is absorbed by, for example, hemoglobin in the blood vessel, and a part of the other light is reflected by the living tissue. The light receiving unit receives the reflected light and generates a biological information signal such as a pulse signal corresponding to the amount of received light. Then, the biological information detection means can perform predetermined processing on the biological information signal to detect biological information such as the pulse rate. In addition, it is possible to detect whether or not the light emitting unit and the light receiving unit are reliably in contact with the living body surface by the contact detection means.

In particular, when the main body is attached to the wrist by the fixing means, since the protruding portion protrudes from the lower surface of the main body, the living body surface and the lower surface of the protruding portion are easily brought into contact with each other. That is, the adhesion of the biosensor unit is improved. Therefore, it is not necessary to fix the main body so that it is strongly pressed against the surface of the living body (to be

pressed) by the fixing means. Therefore, even if it is worn for a long time, there is no discomfort. Moreover, since the adhesiveness of the biosensor unit is improved, the light emitting unit and the light receiving unit can efficiently irradiate and receive light. Therefore, it is possible to detect biological information with high accuracy.

Further, the biological information measuring apparatus according to the present invention is the biological information measuring apparatus according to the present invention, wherein the main body is located at a position spaced at least a predetermined distance from the side surface of the protruding portion while sandwiching at least the protruding portion on the lower surface of the main body. And a distance between the lower surface of the protrusion and the lower surface of the main body is the same as or the distance between the lower surface of the protrusion and the lower surface of the main body. The above distance is set.

In the biological information measuring apparatus according to the present invention, when the main body is attached to the arm by the fixing means, the biological surface is in contact with the lower surface of the protruding portion and the lower surface of the protruding portion. At this time, since the protruding portion protrudes at a predetermined distance from the side surface of the protruding portion while sandwiching the protruding portion, there is a gap between the protruding portion and the protruding portion. Yes. Thereby, the living body comes into contact with the lower surface of the protruding portion and the protruding strip portion in a state where the living body once enters the gap on both sides sandwiching the protruding portion. Therefore, the adhesion between the living body surface and the living body sensor unit can be ensured more reliably.

In particular, since the protruding portion protrudes from the lower surface of the main body by the same height or higher than the protruding portion, the protruding portion contacts the living body surface at the same height as the protruding portion or before the protruding portion. Further, the ridge portion contacts the living body surface outside the protruding portion. Thereby, the living body surface can be stably brought into contact with the lower surface of the protruding portion in the same state, and the contact pressure can be made constant. Therefore, it is possible to detect biological information stably for a long time

The biological information measuring apparatus according to the present invention is the biological information measuring apparatus according to the present invention, wherein the contact detecting means has at least a pair of electrodes, and the light emission based on a potential difference between the pair of electrodes. It is detected whether the part and the light receiving part are in contact with the surface of the living body.

In the biological information measuring apparatus according to the present invention, when the main body is attached to the arm, the pair of electrodes come into contact with the surface of the living body, and discharge is performed through the surface of the living body. Thereby, the electric potential between electrodes decreases. By detecting the potential difference between the pair of electrodes, it can be easily and reliably detected whether or not the light emitting unit and the light receiving unit are reliably in contact with the surface of the living body. Note that the electrodes do not have to be a pair. For example, a plurality of electrodes may be provided, and whether or not they are in contact may be detected based on a potential difference between these electrodes.

Moreover, the biological information measuring device according to the present invention is characterized in that, in the biological information measuring device according to the present invention, the pair of electrodes are arranged so as to sandwich the light emitting unit and the light receiving unit therebetween. It is what.

In the biological information measuring apparatus according to the present invention, the pair of electrodes are arranged so as to sandwich the light emitting unit and the light receiving unit therebetween, so that the light emitting unit and the light receiving unit contact the surface of the living body with high accuracy. It is possible to detect whether or not

Moreover, the biological information measuring device according to the present invention electrically connects the light emitting unit, the light receiving unit, and the biological information detecting unit in any one of the biological information measuring devices of the present invention. A flexible substrate is provided, and the flexible substrate is provided in the main body so as to press the light emitting portion and the light receiving portion toward the lower surface side of the main body by its own elasticity. It is.

In the biological information measuring apparatus according to the present invention, since the light emitting unit and the light receiving unit are always pressed against the lower surface side of the main body due to the elasticity of the flexible substrate, when the main body is attached to the wrist, The light receiving part is in a state of being close to the surface of the living body. Therefore, it is possible to more efficiently irradiate and receive light with respect to the living body, and improve detection accuracy of living body information.

Moreover, the biological information measuring device according to the present invention is characterized in that, in any one of the biological information measuring devices according to the present invention, a display unit for displaying detected biological information is provided on the upper surface of the main body. To do.

In the biological information measuring apparatus according to the present invention, since the biological information displayed on the display unit can be easily visually confirmed, the detected biological information can be confirmed whenever necessary, or the biological information is correctly detected. It is easy to use and simple.

Further, the biological information measuring apparatus according to the present invention is the biological information measuring apparatus according to any one of the present invention described above, wherein the fixing means includes a first band that is attached to the arm and has a proximal and attached to the main body. A second band is provided, and the first band and the second band are arranged so as to face each other with the main body interposed therebetween, and are formed of a stretchable elastic material. Is there.

In the biological information measuring apparatus according to the present invention, the main body can be easily and reliably attached to the wrist like a wristwatch by the first band and the second band. In particular, since both bands are made of elastic material that can be stretched, even if the thickness of the wrist changes slightly due to muscle movement, the amount of change can be absorbed. Can be prevented. Therefore, it is not necessary to tighten both bands, and long-time wearing is possible.

Moreover, the biological information measuring device according to the present invention is the biological information measuring device according to any one of the present invention described above, wherein the biological sensor unit is connected to the first band or the second band from the center position of

the main body. It is arranged at a position shifted to the base end side.

In the biological information measuring apparatus according to the present invention, when the main body is attached to the wrist like a wristwatch by the first band and the second band, there is some play between the wrist and the main body due to this play. Shifted due to gravity (for example, when the arm is shifted downward (ground side), or when the upper surface of the main body is held in front of the eyes with the back of the hand inside and the arm horizontal) In this case, the biosensor unit is disposed at a position shifted from the center position of the main body to the base end side of the first band or the second band, so that the adhesion of the biosensor unit is reduced. Can be prevented.

Moreover, the biological information measuring device according to the present invention is the biological information measuring device according to any one of the present invention, wherein the main body includes a rechargeable battery that can be charged, and a charging unit that charges the rechargeable battery with electric power. It is characterized by that.

In the biological information measuring apparatus according to the present invention, since the external battery can be charged with the rechargeable battery via the charging means, it is not necessary to prepare a normal battery or the like separately. Therefore, the cost for maintaining the product can be reduced.

In the biological information measuring device according to the present invention, in any one of the biological information measuring devices according to the present invention, a distance between the lower surface of the protruding portion and the lower surface of the main body is set to 2 to 4 mm. It is characterized by.

In the biological information measuring apparatus according to the present invention, the protrusion is attached to the wrist with the lower surface of the protrusion protruding from the lower surface of the main body by 2 to 4 mm. Thereby, a protrusion part can be made to contact a biological body surface reliably, and the adhesiveness of a biosensor part can be ensured. That is, when the distance between the lower surface of the protrusion and the lower surface of the main body is 2 mm or less, there are few steps and a gap is formed between the living body surface and external light is likely to enter. In addition, when the distance between the lower surface of the protruding portion and the lower surface of the main body is 4 mm or more, a feeling of pressure is generated between the attachments and there is a height, so that the state becomes unstable. It becomes easy for outside light to enter between.

As described above, by making the distance between the lower surface of the protruding portion and the lower surface of the main body 2 to 4 mm, it is possible to prevent a feeling of pressure and the incidence of external light.

Moreover, the biological information measuring device according to the present invention is characterized in that, in any one of the biological information measuring devices according to the present invention, the projecting portion is formed so as to have a circular outer periphery. .

In the biological information measuring apparatus according to the present invention, since the protruding portion is circular, when the main body is attached to the wrist, it is pushed into the surface of the biological body with an equal force. Therefore, the adhesion is good.

Moreover, the biological information measuring device according to the present invention is characterized in that, in any one of the biological information measuring devices according to the present invention, the protruding portion is formed such that an outer edge is a curved surface. .

In the biological information measuring apparatus according to the present invention, since the outer edge of the projecting portion is formed in a curved surface, the adhesion can be further improved when the main body is attached to the wrist. Moreover, even if it is worn for a long time, it is easy to wear because it is difficult to have a compression mark.

The biological information measuring apparatus according to the present invention is characterized in that, in the biological information measuring apparatus according to the present invention, the projecting portion is formed to be a curved surface from the center of the lower surface toward the outer edge. It is.

In the biological information measuring apparatus according to the present invention, since the curved surface is formed from the center of the lower surface of the projecting portion toward the outer edge, the biological surface is smoothly deformed when the body is attached to the wrist, and the center of the lower surface It is mounted in a state where the contact pressure of the part is increased, and the adhesion can be further improved. Moreover, even if it is worn for a long time, it is easy to wear because it is difficult to have a compression mark.

Moreover, the biological information measuring device according to the present invention is characterized in that, in any one of the biological information measuring devices according to the present invention, a diameter of the protruding portion is set to 20 mm or less.

In the biological information measuring device according to the present invention, since the diameter of the protrusion is 20 mm or less, the protrusion can be easily pressed against the surface of the living body with a light force.

Moreover, the biological information measuring device according to the present invention is the biological information measuring device according to any one of the present invention described above, wherein the protruding portion is provided at a position spaced 8 mm from the side surface of the protruding portion. The distance between the lower surface of the part and the lower surface of the main body is set to 4 mm.

In the biological information measuring apparatus according to the present invention, the ridge portion can be formed in the vicinity of 8 mm from the side surface of the protruding portion, and can be suppressed to a height of 4 mm. As described above, since the ridges can be formed in a small space, the main body can be downsized, that is, the entire apparatus can be downsized.

According to the biological information measuring apparatus of the present invention, when the main body is attached to the wrist by the fixing means, the protruding portion protrudes from the lower surface of the main body, so that the living body surface and the lower surface of the protruding portion are reliably in contact with each other. The adhesion of the biosensor unit is improved. Therefore, it is not necessary to fix the main body so as to strongly press (squeeze) the body against the surface of the living body as in the prior art. Therefore, even if it is worn for a long time, there is no discomfort. Moreover, since the adhesiveness of the biosensor unit is improved, light irradiation and light reception can be performed efficiently, and biometric information can be detected with high accuracy.

Hereinafter, an embodiment of a biological information measuring apparatus according to the present invention will be described with reference to FIGS.

As shown in FIGS. 1 to 7, the biological information measuring apparatus 1 according to the present embodiment is a wristwatch type and detects a pulse rate which is biological information in a state of being worn on a wrist (arm) A.

The biological information measuring apparatus 1 includes a housing (main body) 2 containing various electric parts and electronic parts, and fixing means for attaching the housing 2 to the wrist A with the lower surface 2a of the housing 2 facing the biological surface B side. 3 is provided. Further, the lower surface 2a of the housing 2 is formed with a protruding portion 4 protruding from the lower surface 2a.

An LED (Light Emitting Diode) 5 that irradiates light toward the living body while being in contact with the surface B of the living body, and the light emitted by the LED 5 Whether PD (Photodetector) (light receiving unit) 6 that receives reflected light from the living body and generates a pulse signal (biological information signal) corresponding to the amount of light received, and LED 5 and PD6 are in contact with living body surface B A biosensor unit 8 having a contact detection means 7 for detecting the above is disposed.

In the housing 2, a data processing unit (biological information detection unit) 9 that detects the pulse rate based on the generated pulse signal is provided.

The housing 2 is made of a metal material such as plastic or aluminum, and has a predetermined thickness, for example, a substantially rectangular shape when viewed from above. A cover glass 10 having a substantially square shape is fitted in a central portion of the upper surface 2b of the housing 2, and a display unit 11 for displaying the detected pulse rate and other various information is provided inside the cover glass 10. It is arranged.

Further, as shown in FIGS. 6 and 7, a main board 12 is provided in the housing 2, and the data processing unit 9, the display unit 11, the rechargeable battery 13, The memory 14 for recording the pulse rate, the sub-board 15 and other various electronic components are electrically connected by mounting or wiring.

The data processing unit 9 includes an IC component such as a CPU, and after the pulse signal generated by the PD 6 is once amplified by an amplifier or the like, a predetermined process such as a fast Fourier transform process (FFT process) is performed. It has a function of detecting the pulse rate by analyzing the processing result. The data processing unit 9 records the detected pulse rate in the memory 14 and displays it on the display unit 11 based on input from each button 20 described later. Further, the data processing unit 9 has a function of comprehensively controlling other components.

The display unit 11 is a liquid crystal display such as an LCD (Liquid Crystal Display), for example. In addition to the above-described pulse rate, for example, a time display function for displaying a time counted by a crystal resonator (not shown) or other It has a function to display various information. For example, the time, date, day of the week, remaining power amount of the rechargeable battery 13 and the like can be displayed.

1 and 2, the housing 2 includes a plurality of buttons 20, for example, three buttons 20 disposed on the upper surface 2 b of the housing 2 and below the display unit 11, and the housing 2. One button 20 arranged on the side surface is provided. Various operations can be performed by pressing these buttons 20. For example, operations such as starting measurement of pulse rate, stopping measurement, switching display of pulse rate and time, and transmitting pulse rate data recorded in memory 14 to an external device can be performed. Yes.

Furthermore, an external connection terminal (charging means) 21 is provided on the side surface of the housing 2 to supply power to the rechargeable battery 13 from outside such as a charger. A cover or the like may be attached to cover the external connection terminal 21 to protect the external connection terminal 21. By doing so, it is possible to protect the external connection terminal 21 from water drops, dust, and the like, which is more preferable. Further, not only the external connection terminal 21, but also a charger and a transformer for supplying power to the housing 2 may be provided, and the rechargeable battery 13 may be charged in a non-contact state.

As shown in FIG. 5, the protrusion 4 is formed by combining three circles when viewed from below, that is, a central circle, and two circles having a diameter smaller than the circle are sandwiched between the left and right sides. It is formed in a shape like a keyhole. Further, the protruding portion 4 is formed so that the center position thereof is shifted to the second band 31 side described later than the center position of the housing 2. Thereby, the said biosensor part 8 distribute | arranged to the lower surface of the protrusion part 4 is similarly arrange | positioned in the position shifted | deviated to the 2nd band 31 side. Further, the protruding portion 4 does not protrude perpendicularly from the lower surface of the housing 2 but is formed so that the side surface 4b is an inclined surface.

Further, as shown in FIG. 7, a through hole 22 that penetrates the outside and the inside of the housing 2 is formed at the center of the lower surface 4 a of the protruding portion 4, and a cover glass 23 is formed so as to close the through hole 22. It is fixed to the housing 2. The LED 5 and the PD 6 are arranged adjacent to each other in a direction perpendicular to the longitudinal direction of the housing 2 so as to contact the inside of the cover glass 23. That is, the LED 5 and the PD 6 are configured to be dropped into the protruding portion 4. As a result, the LED 5 and the PD 6 are as close as possible to the biological surface B.

At this time, as shown in FIG. 6, the LED 5 and the PD 6 are mounted on one end side of the flexible board 24 electrically connected to the sub-board 15, and the lower surface 2 a of the housing 2 is caused by the elasticity of the flexible board 24. It is arranged in a state pressed toward the side. Also from this, LED5 and PD6 are located in the lower surface 4a side of the protrusion part 4 as much as possible. That is, the LED 5 and the PD 6 are as close to the living body surface B as possible. The sub board 15 and the flexible board 14 are formed as an integral structure. The flexible substrate on which the LED 5 and the PD 6 are mounted may be fixed to the lower surface 2a side of the housing 2 with a fixing member such as a double-sided tape.

The pulse signal generated by the PD 6 is sent to the data processing unit 9 via the flexible substrate 24, the sub substrate 15, and the main substrate 12.

The contact detection means 7 has a pair of electrodes 7a and 7b, and the pair of electrodes 7a and 7b are arranged on the lower surface 4a of the protruding portion 4 with the LED 5 and the PD 6 interposed therebetween. In other words, the pair of electrodes 7 a and 7 b, the LED 5, and the PD 6 are arranged in a line in a direction orthogonal to the longitudinal direction of the housing 2. The pair of electrodes 7 a and 7 b are provided so that the distal ends thereof slightly protrude from the lower surface 4 a of the protrusion 4, and the base end side is provided so as to be electrically connected to the sub-substrate 15.

The pair of electrodes 7a and 7b has a function of detecting whether or not the living body surface B is in contact based on a potential difference between the electrodes. The data processing unit 9 is set so as to control the operation of the LED 5 so as to irradiate light from the LED 5 when, for example, it is

detected that it is in contact with the living body surface B in response to the detection result. . In addition to this case, for example, when it is detected that the living body surface B is not touched, the FFT processing may be set not to be performed.

The fixing means 3 has a first band 30 and a second band 31 that are attached to the wrist A with the base end side attached to the housing 2. The first band 30 and the second band 31 are provided in the longitudinal direction of the housing 2 so as to face each other with the housing 2 interposed therebetween. Moreover, both the bands 30 and 31 are formed with the elastic material which can be expanded-contracted.

A buckle 30a and a tongue 30b are attached to the tip of the first band 30. The second band 31 has a plurality of insertion holes 31 a into which the tongue 30 b is inserted along the longitudinal direction of the second band 31. Thereby, the lengths of the first band 30 and the second band 31 can be adjusted according to the thickness of the wrist A of the user.

A case will be described in which the pulse rate is detected while wearing the wrist A by the biological information measuring apparatus 1 configured as described above.

First, as shown in FIGS. 2 and 3, the bands 30 and 31 are wound so as to wind the wrist A of the user, and the tongue 30b of the first band 30 is set to the second according to the size of the wrist A. The housing 2 is attached to the wrist A by being inserted into the insertion hole 31 a of the band 31. When the housing 2 is attached to the wrist A, the protruding portion 4 protrudes from the lower surface 2a of the housing 2, so that the living body surface B and the lower surface 4a of the protruding portion 4 are in close contact with each other. Therefore, it is not necessary to mount the housing 2 so as to tighten the wrist A, and the lengths of both bands 30 and 31 may be adjusted so as to be tightened with a predetermined force. In particular, since the protrusion 4 has the side surface 4b as an inclined surface, the living body surface B is smoothly deformed in accordance with the outer shape of the protrusion 4, and thus is easily adhered.

When the biological surface B and the lower surface 4a of the protruding portion 4 are in close contact, that is, when the biological surface B comes into contact with the lower surface 4a of the protruding portion 4, the pair of electrodes 7a and 7b come into contact with the biological surface B. In particular, the pair of electrodes 7 a and 7 b are arranged so as to protrude slightly from the lower surface 4 a of the protruding portion 4, and therefore easily contact the biological surface B. When the pair of electrodes 7a and 7b come into contact with the living body surface B, discharge is performed through the living body surface B, and the voltage between both electrodes decreases. In response to this voltage drop (for example, lower than a certain threshold), the data processing unit 9 detects that the pair of electrodes 7a and 7b are in contact with the biological surface B reliably. That is, it is detected that the biological sensor unit 8 including the LED 5 and the PD 6 is in contact with the biological surface B reliably. In particular, since the pair of electrodes 7a and 7b are arranged with the LED 5 and the PD 6 interposed therebetween, it is possible to detect with high accuracy whether or not the LED 5 and the PD 6 are in contact with the biological surface B.

When detecting that the LED 5 and the PD 6 are in contact with the living body surface B, the data processing unit 9 irradiates light from the LED 5 toward the living body. A part of the irradiated light is absorbed by, for example, hemoglobin in the blood vessel, and a part of the other light is reflected by the living tissue. The PD 6 receives the reflected light and generates a pulse signal (biological information signal) corresponding to the amount of received light and outputs the pulse signal to the data processing unit 9. That is, the amount of reflected light of the light emitted from the LED 5 varies according to the blood flow variation in the arteries and arterioles in the wrist A (living body), so the PD 6 responds to the pulsation of the artery, that is, the pulse wave. Receives reflected light. Thereby, the PD 6 can generate a pulse signal.

The data processing unit 9 amplifies the transmitted pulse signal, performs predetermined processing such as FFT processing, etc., and then performs analysis to detect the pulse rate. Then, the data processing unit 9 records the detected pulse rate in the memory 14 and displays it on the display unit 11 based on the operation of each button 20.

Since the user can confirm the pulse rate easily detected on the display unit 11 by pressing each button 20 when necessary, it is convenient for use. In addition, the user can easily check other information other than the pulse rate, for example, the time and the remaining power of the rechargeable battery 13 by the operation of each button 20.

In addition, as described above, the user fastens the housing 2 with a predetermined force with both the bands 30 and 31 and attaches it to the wrist A, so even if it is worn for a long time, it does not feel a sense of pressure. I do not feel uncomfortable.

For example, when the user holds something in his hand or performs some work, the thickness (diameter) of the wrist A (arm) changes due to the movement of the muscle. Even in this case, the biosensor unit 8 is disposed on the lower surface 4a of the projecting portion 4 projecting from the lower surface 2a of the housing 2, so that the contact (adhesion) between the biosensor unit 8 and the biosurface B is reduced. Can be suppressed as much as possible. In particular, since the first band 30 and the second band 31 can be expanded and contracted, the first band 30 and the second band 31 can be expanded and contracted in accordance with the change in the thickness of the wrist A.

Accordingly, even if the thickness of the wrist A changes, the state in which the LED 5 and the PD 6 are in contact with the living body surface B can be maintained, so that an accurate pulse rate can always be detected. Therefore, the pulse rate detection accuracy can be improved. Further, the LED 5 and the PD 6 are dropped into the protruding portion 4 and are pressed toward the lower surface 2a side of the housing 2 by the elasticity of the flexible substrate 24 so that they are as close as possible to the living body surface B. In addition, the pulse rate can be detected with high accuracy.

In addition, when the user holds the display unit 11 in front of his / her eyes with the back of the hand facing inward in order to check various information displayed on the display unit 11, the housing is temporarily 2 is shifted to the ground side, that is, the second band 31 side due to gravity, the biosensor unit 8 is arranged at a position shifted toward the proximal end side of the second band 31 from the center position of the housing 2. Therefore, it is possible to prevent the contact between the biological sensor unit 8 and the biological surface B from being lowered. The same applies when the arm is directed to the ground side, that is, when the arm is lowered.

In addition, when charging the rechargeable battery 13, for example, charging can be performed by connecting a charging cord or the like connected to a charger to the external connection terminal 21, and a normal battery is separately prepared. do not have to. Therefore, the maintenance cost can be reduced. It should be noted that a sound output means such as a buzzer for outputting sound is provided in the housing 2, and when the charge amount of the

rechargeable battery 13 decreases to near "0", the sound is output and the charging time (charging timing) is reached. You may comprise so that it may notify.

As described above, according to the biological information measuring apparatus 1 of the present embodiment, when the main body is attached to the wrist A by the fixing means 3, the protruding portion 4 protrudes from the lower surface 2 a of the housing 2. B and the lower surface 4a of the protrusion 4 are reliably in contact with each other, and the adhesion of the biosensor unit 8 is improved. Therefore, it is not necessary to fix the housing 2 so as to strongly press (squeeze) the housing 2 against the living body surface B as in the prior art. Therefore, even if it is worn for a long time, there is no discomfort. Moreover, since the adhesiveness of the biosensor unit 8 is improved, it is possible to efficiently irradiate and receive light, and to detect the pulse rate with high accuracy.

The technical scope of the present invention is not limited to the above embodiment, and various modifications can be made without departing from the spirit of the present invention.

For example, in the above-described embodiment, the shape of the protruding portion 4 is a keyhole shape combining three circles. However, the shape is not limited to this, and the shape can be freely formed as long as it protrudes from the lower surface 2a of the housing 2. It doesn't matter.

For example, as shown in FIG. 8, the protrusion 4 may be formed so that the outer periphery is circular. Further, the protrusion 4 shown in FIG. 8 has a diameter of 20 mm, and is formed such that the lower surface 4a of the protrusion 4 and the lower surface 2a of the housing 2 have a distance of 3 mm.

By making the protruding portion 4 circular, when the housing 2 is attached to the wrist A, the protruding portion 4 is pushed into the living body surface B with an equal force, so that the adhesion is good. At this time, since the diameter of the protruding portion 4 is 20 mm or less, the protruding portion 4 can be pressed with a light force, and the feeling of pressure can be further eliminated. Here, generally, the difference between the maximum diameter and the minimum diameter of the wrist is 3 mm. Therefore, as shown in FIG. 8, by setting the distance between the lower surface 4a of the protruding portion 4 and the lower surface 2a of the housing 2 to 3 mm, it is possible to cope with a change in the thickness of the wrist, and the lower surface 4a of the protruding portion 4 and the living body Adhesion can be improved without creating a gap with the surface B. Therefore, the adhesion of the biosensor unit 8 can be improved.

In addition, although the distance of the lower surface 4a of the protrusion part 4 and the lower surface 2a of the housing 2 was set to 3 mm, not only 3 mm but what is necessary is just set to the range of 2 mm-4 mm. If it is 2 mm or less, the level difference is reduced, a gap is formed between the living body surface B, and external light easily enters. In the case of 4 mm or more, a feeling of pressure is generated and the height is unstable, so that it becomes unstable, and when it is inclined, a gap is formed between the living body surface B and external light easily enters. That is, as shown in FIG. 8, by setting the distance between the lower surface 4a of the protrusion 4 and the lower surface 2a of the housing 2 within a range of 2 mm to 4 mm, it is possible to prevent a feeling of pressure and the incidence of external light. .

Moreover, you may form the protrusion part 4 shown in FIG. 8 so that an outer edge may become a curved surface, as shown in FIG. By doing so, it is possible to improve the adhesion, and even if it is worn for a long time, it is difficult to have a compression mark, so it is easy to wear.

Furthermore, as shown in FIG. 10, you may form so that it may become a curved surface from the center of the lower surface 4a of the protrusion part 4 toward an outer edge. By doing so, the living body surface B can be smoothly deformed and mounted in a state where the contact pressure at the center of the lower surface 4a is increased, so that the adhesion can be further improved, and further, it is difficult to have a compression mark. easy.

Further, as shown in FIG. 11, the protrusion 2 is formed on the lower surface 2a of the housing 2 so as to protrude from the lower surface 2a of the housing 2 at a predetermined distance, that is, 8 mm away from the side surface 4b of the protrusion 4. The protruding ridge 40 may be provided. In addition, the protrusion part 4 shown in FIG. 11 is the same shape as what is shown in FIG.

The distance between the lower surface 40a of the ridge 40 and the lower surface 2a of the housing 2 is set to 4 mm, which is slightly higher than the distance (3 mm) between the lower surface 4a of the protrusion 4 and the lower surface 2a of the housing 2. Yes.

In such a configuration, when the housing 2 is attached to the wrist A, the living body enters the 8 mm gap formed between the protruding portion 4 and the protruding strip portion 40, and the protruding portion 4 The lower surface 4a of the ridge and the lower surface 40a of the ridge 40 are in contact. Under the present circumstances, the protruding item | line part 40 contacts a biological body on the outer side of the protrusion part 4, and contacts the protrusion part 4 ahead. Therefore, the living body can be brought into contact with the lower surface 4a of the protruding portion 4 in a stable state, and the contact pressure can be made uniform with respect to the lower surface 4a of the protruding portion 4. Therefore, the pulse rate can be detected stably for a long time. Moreover, since the protruding line part 40 can be formed in the vicinity of the protruding part 4, that is, in a small space, even if the protruding line part 40 is provided, the size can be reduced.

In addition, you may comprise the said protruding item | line part in combination with the protrusion part 4 shown in FIG.9 and FIG.10 mentioned above, as shown in FIG.12 and FIG.13. Moreover, you may form a protruding item | line part so that the circumference | surroundings of a protrusion part may be enclosed in the position spaced apart from the side surface of the protrusion part by predetermined distance.

Moreover, in the said embodiment, although demonstrated using the pulse rate as an example as biometric information, not only a pulse rate but biometric information may be sufficient.

Moreover, although the contact detection means has a pair of electrodes, it is not limited to a pair and may have a plurality of electrodes. In this case, it may be set to detect whether or not the contact is made based on the potential difference between the electrodes.

In addition, the biosensor unit is configured to be displaced toward the proximal end side of the second band from the center position of the housing, but may be formed to be displaced toward the proximal end side of the first band side. That is, the design may be performed according to the relationship between both bands and the display unit.

Moreover, you may add functions, such as a radio | wireless communication means which can be communicated by radio | wireless with another electronic device, to a housing. In this way, the pulse rate recorded in the memory can be transmitted to an external electronic device or various information can be

obtained in the memory by wireless communication such as Bluetooth.

It is a front view which shows one Embodiment of the biological information measuring device which concerns on this invention. It is a side view which shows the state which mounted | wore the wrist with the biological information measuring device shown in FIG. it is a side view which shows the state with which the biological information measuring device shown in FIG. 1 was mounted | worn on the wrist, and is the figure seen from the direction opposite to the direction shown in FIG. It is a perspective view which shows the state which looked at the biological information measuring device shown in FIG. 1 from diagonally upward. It is a perspective view which shows the state which looked at the biological information measuring device shown in FIG. 1 from diagonally downward. It is a cross-sectional arrow CC figure of the biological information measuring device shown in FIG. It is a cross-sectional arrow DD figure of the biological information measuring device shown in FIG. It is a figure which shows the shape of the protrusion part different from the biological information measuring device shown in FIG. 1, Comprising: It is a figure in case the outer periphery of a protrusion part is circular. It is a figure at the time of forming the protrusion part shown in FIG. 8 so that an outer edge may become a curved surface. It is a figure at the time of forming the protrusion part shown in FIG. 8 so that it may become a curved surface toward the outer edge from the center of a lower surface. It is a figure at the time of forming a protruding item | line part so that the protrusion part shown in FIG. 9 may be pinched | interposed. It is a figure at the time of forming a protruding item | line part so that the protrusion part shown in FIG. 9 may be pinched | interposed. It is a figure at the time of forming a protruding item | line part so that the protrusion part shown in FIG. 10 may be pinched | interposed.

Explanation of symbols

B Living body surface 1 Living body upper measuring device 2 Housing (main body)
2a Lower surface of main body 2b Upper surface of main body 3 Fixing means 4 Protruding portion 4a Lower surface of protruding portion 4b Side surface of protruding portion 5 LED (light emitting portion)
6 PD (light receiving part)
7 Contact detection means 7a, 7b A pair of electrodes 8 Biosensor unit 9 Data processing unit (biological information detection unit)
DESCRIPTION OF SYMBOLS 11 Display part 13 Rechargeable battery 21 External connection terminal (charging means)
24 flexible substrate 30 first band 31 second band 40 ridge 40a lower surface of ridge

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JP2018175022A	2018-11-15	Biological information measuring device

Priority And Related Applications

Priority Applications (2)

Application	Priority date	Filing date	Title
JP2004091942A	2004-03-26	2004-03-26	Biological information measuring device
PCT/JP2005/002021	2004-03-26	2005-02-10	Biological information measuring device

Applications Claiming Priority (1)

Application	Filing date	Title
JP2004091942A	2004-03-26	Biological information measuring device

Legal Events

Date	Code	Title	Description
2006-12-12	A621	Written request for application examination	**Free format text:** JAPANESE INTERMEDIATE CODE: A621 **Effective date:** 20061211

2009-11-06	R001	Notification of change of attorney	**Free format text**: JAPANESE INTERMEDIATE CODE: A7421 **Effective date**: 20091105
2009-11-13	R001	Notification of change of attorney	**Free format text**: JAPANESE INTERMEDIATE CODE: A7421 **Effective date**: 20091112
2009-12-09	A131	Notification of reasons for refusal	**Free format text**: JAPANESE INTERMEDIATE CODE: A131 **Effective date**: 20091208
2010-01-14	A521	Written amendment	**Free format text**: JAPANESE INTERMEDIATE CODE: A523 **Effective date**: 20100113
2010-02-03	A131	Notification of reasons for refusal	**Free format text**: JAPANESE INTERMEDIATE CODE: A131 **Effective date**: 20100202
2010-02-26	A521	Written amendment	**Free format text**: JAPANESE INTERMEDIATE CODE: A523 **Effective date**: 20100225
2010-03-15	TRDD	Decision of grant or rejection written	
2010-03-24	A01	Written decision to grant a patent or to grant a registration (utility model)	**Free format text**: JAPANESE INTERMEDIATE CODE: A01 **Effective date**: 20100323
2010-03-25	A01	Written decision to grant a patent or to grant a registration (utility model)	**Free format text**: JAPANESE INTERMEDIATE CODE: A01
2010-04-01	A61	First payment of annual fees (during grant procedure)	**Free format text**: JAPANESE INTERMEDIATE CODE: A61 **Effective date**: 20100324
2010-04-02	R150	Certificate of patent or registration of utility model	**Ref document number**: 4485234 **Country of ref document**: JP **Free format text**: JAPANESE INTERMEDIATE CODE: R150 **Free format text**: JAPANESE INTERMEDIATE CODE: R150
2010-04-05	FPAY	Renewal fee payment (event date is renewal date of database)	**Free format text**: PAYMENT UNTIL: 20130402 **Year of fee payment**: 3
2013-03-12	FPAY	Renewal fee payment (event date is renewal date of database)	**Free format text**: PAYMENT UNTIL: 20140402 **Year of fee payment**: 4
2018-03-20	R250	Receipt of annual fees	**Free format text**: JAPANESE INTERMEDIATE CODE: R250
2019-04-02	LAPS	Cancellation because of no payment of annual fees	

Concepts

machine-extracted

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Name	Image	Sections	Count	Query match
detection method		claims,abstract,description	17	0.000
substrate		claims,description	12	0.000
material		claims,description	4	0.000

≫ corresponding	abstract,description	5	0.000
Show all concepts from the description section			

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PTO/SB/08A (08-03) U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE Substitute for Form 1449A/PTO **INFORMATION DISCLOSURE STATEMENT BY APPLICANT** *(Use as many sheets as necessary)*	**APPLICATION NO.:** 17/951,973	**FILING DATE:** September 23, 2022
	INVENTOR(S): Fletcher Rothkopf	**ART UNIT:** 5622
	EXAMINER NAME: Brian T Gedeon	**ATTY. DOCKET NO.:** P22914USC10

U.S. PATENT DOCUMENTS

EXAMINER INITIALS*	Cite No.[1]	PATENT NUMBER Number – Kind Code[2] (if known)	ISSUE DATE MM-DD-YYYY	Name of Patentee of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
	A1.	6,721,540	04/2004	Motomu Hayakawa	
	A2.	8,810,514	08/2014	Zhao et al.	
	A3.	11,531,306	12/2022	Ely et al.	

U.S. PUBLICATION DOCUMENTS

EXAMINER INITIALS*	Cite No.[1]	PUBLICATION NUMBER Number – Kind Code[2] (if known)	PUBLICATION DATE MM-DD-YYYY	Name of Inventor(s) of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
	B1.	2019/0025940	07/2018	Shim et al.	
	B2.	2021/0353226	11/2021	Hiemstra	
	B3.	2023/0013283	01/2023	Antonio F. Herrera	
	B4.	2023/0012897	01/2023	Tyler S. Atura Bushnell	
	B5.	2023/0028554	01/2023	Fletcher R. Rothkopf	
	B6.	2023/0077241	03/01/2023	Pandya et al.	

FOREIGN PATENT DOCUMENTS

EXAMINER INITIALS*	Cite No.[1]	DOCUMENT NUMBER Country Code[3] – Number[4] – Kind Code[5] (if known)	PUBLICATION DATE MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear	T[6]
	C1.	CN103919536	07/2014	FITBIT Inc		
	C2.	CN114220694	03/2022	NOOER SCIENCE AND TECH CO LTD		
	C3.	JP2017219448	12/2017	Casio Computer Co. Ltd.		

OTHER PRIOR ART – NON PATENT LITERATURE DOCUMENTS

EXAMINER INITIALS*	Cite No.[1]	Include name of Author, title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), volume-issue number(s), publisher, page(s) and date.	T[6]

* EXAMINER: Initial if citation considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant

[1] Applicant's unique citation number (optional). [2] See Kinds Codes of USPTO Patent Documents at www.uspto.gov or MPEP 901.04 [3] Enter Office that issued the document, by the two-letter code (WIPO Standard ST.3). [4] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [5] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible [6] Applicant is to place a check mark here if English language Translation is attached.
1.

OTHER PRIOR ART – NON PATENT LITERATURE DOCUMENTS	
EXAMINER	**DATE CONSIDERED**
EXAMINER: Initial if citation considered, whether or not citation is in conformance with MPEP 609; Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.	

Espacenet

Bibliographic data: CN103919536 (A) — 2014-07-16

Portable Biometric Monitoring Devices And Methods Of Operating Same

Inventor(s): YUEN SHELTEN GEE JAO; MARTINEZ MARK MANUEL; AXLEY ANDREW COLE; FRIEDMAN ERIC NATHAN; PARK JAMES ± (YUEN, SHELTEN GEE JAO, ; MARTINEZ, MARK MANUEL, ; AXLEY, ANDREW COLE, ; FRIEDMAN, ERIC NATHAN, ; PARK, JAMES, ; 谢尔顿·杰骄·袁, ; 马克·玛努尔·马丁内兹, ; 安德鲁·科尔·阿克斯利, ; 埃里克·内森·弗里德曼, ; 詹姆斯·帕克)

Applicant(s): FITBIT INC ± (FITBIT, INC, ; 飞比特公司)

Classification: **- international:** ***A61B5/00; A61B5/0205***
- cooperative:

Application number: CN20141018701 20140115 Global Dossier

Priority number(s): US201313924784 20130624 ; US201361752826P 20130115

Also published as: CN103919536 (B) CN108903920 (A)

Abstract of CN103919536 (A)

The present inventions, in one aspect, are directed to portable biometric monitoring device including a housing having a physical size and shape that is adapted to couple to the user's body, at least one band to secure the monitoring device to the user, a physiological sensor, disposed in the housing, to generate data which is representative of a physiological condition of the user data. The physiological sensor may include a light source to generate and output light having at least a first wavelength, and a photodetector to detect scattered light (e.g., from the user). A light pipe is disposed in the housing and optically coupled to the light source directs/transmits light therefrom along a predetermined path to an outer surface of the housing. Processing circuitry calculates a heart rate of the user using data which is representative of the scattered light.

(19)中华人民共和国国家知识产权局

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代理人 林彦

(51)Int.Cl.
A61B 5/0205(2006.01)
A61B 5/00(2006.01)

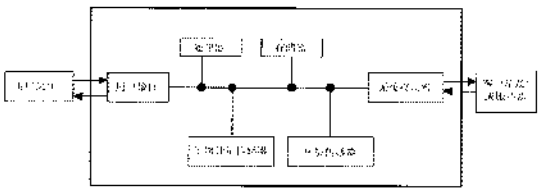
权利要求书3页 说明书29页 附图28页

(54)发明名称

便携式生物计量监测装置及其操作方法

(57)摘要

本申请案针对于便携式生物计量监测装置及其操作方法。在一个方面中，本发明针对于便携式生物计量监测装置，其包含：壳体，其具有适于耦合到用户的身体的物理大小及形状；至少一个带，其用以将所述监测装置紧固到所述用户；生理传感器，其安置于所述壳体中以产生表示用户数据的生理条件的数据。所述生理传感器可包含：光源，其用以产生且输出具有至少第一波长的光；及光电检测器，其用以检测（例如，来自所述用户的）所散射光。光管安置于所述壳体中且光学耦合到所述光源以沿预定路径将光从所述光源引导/透射到所述壳体的外表面。处理电路使用表示所述所散射光的数据来计算所述用户的心率。



CN 103919536 A

1. 一种便携式生物计量监测装置，其包括：

壳体，其具有适于耦合到用户的身体的物理大小及形状；

至少一个带，其耦合到所述壳体以将所述便携式生物计量监测装置紧固到所述用户；

生理传感器，其安置于所述壳体中以产生表示用户数据的生理条件的数据，所述生理传感器包含：

第一光源，其安置于所述壳体中以产生且输出具有至少第一波长的光，及

光电检测器，其安置于所述壳体中以检测所散射光；

第一光管，其安置于所述壳体中且光学耦合到所述第一光源以沿预定路径将光从所述第一光源引导或透射到所述壳体的外表面；及

处理电路，其安置于所述壳体中以使用表示所述所散射光的数据来计算所述用户的心率。

2. 根据权利要求 1 所述的便携式生物计量监测装置，其中所述第一光管包含光学滤波材料以选择性地透射具有所述至少第一波长的光。

3. 根据权利要求 2 所述的便携式生物计量监测装置，其中具有所述至少第一波长的所述光是对应于绿色光谱的光。

4. 根据权利要求 3 所述的便携式生物计量监测装置，其中具有所述至少第一波长的所述光是对应于红外光谱的光。

5. 根据权利要求 1 所述的便携式生物计量监测装置，其中所述壳体包含窗，其中所述窗包含具有第一光学性质的第一部分及具有第二光学性质的第二部分，其中所述第一光管为所述第一部分。

6. 根据权利要求 1 所述的便携式生物计量监测装置，其中所述壳体包含提供所述便携式生物计量监测装置的外表面且经配置以啮合或接触所述用户的皮肤的窗，其中所述窗包含具有第一光学性质的第一部分及具有第二光学性质的第二部分，其中所述第一光管安置于所述第一部分中或为所述第一部分的一部分。

7. 根据权利要求 6 所述的便携式生物计量监测装置，其中所述窗的所述第二部分至少对具有所述至少第一波长的光是光学上不透明的。

8. 根据权利要求 6 所述的便携式生物计量监测装置，其中所述窗对可见光谱中的光是光学上不透明的。

9. 根据权利要求 6 所述的便携式生物计量监测装置，其进一步包含第二光管，所述第二光管安置于所述壳体中且光学耦合到所述光电检测器以沿预定路径将光从所述壳体的外表面引导或透射到所述光电检测器。

10. 根据权利要求 9 所述的便携式生物计量监测装置，其中所述窗进一步包含具有第三光学性质的第三部分，其中所述第二光管安置于所述第三部分中或为所述第三部分的一部分。

11. 根据权利要求 9 所述的便携式生物计量监测装置，其中所述窗的所述第一部分及所述窗的所述第三部分由所述窗的第二部分间隔开及分离。

12. 根据权利要求 1 所述的便携式生物计量监测装置，其中所述壳体包含具有弯曲外表面的窗，其中所述窗的所述弯曲外表面安置于所述装置的内部或皮肤侧上，且其中所述装置的所述内部或皮肤侧经配置以啮合或接触所述用户的所述皮肤。

13. 根据权利要求 1 所述的便携式生物计量监测装置，其中所述壳体包含所述装置的内部或皮肤侧的外表面上的多个隆起或凹陷区域，其中所述装置的所述内部或皮肤侧经配置以啮合或接触所述用户的所述皮肤。

14. 根据权利要求 1 所述的便携式生物计量监测装置，其中所述壳体包含所述装置的内部或皮肤侧的外表面上的摩擦增强材料，其中所述装置的所述内部或皮肤侧经配置以啮合或接触所述用户的所述皮肤。

15. 根据权利要求 1 所述的便携式生物计量监测装置，其中所述壳体包含位于所述装置的内部或皮肤侧的外表面上的顺应部分，所述顺应部分经配置以啮合或接触所述用户的所述皮肤，其中所述顺应部分经配置以使其形状符合所述生物计量监测装置在操作期间耦合或附接到的所述用户的身体部分的形状。

16. 一种便携式生物计量监测装置，其包括：

壳体，其具有适于耦合到用户的身体的物理大小及形状，其中所述壳体的皮肤或内部侧包含突出部分，所述突出部分 (i) 经配置以啮合或接触所述用户的皮肤且 (ii) 包含弯曲外部表面；

至少一个带，其耦合到所述壳体以将所述便携式生物计量监测装置紧固到所述用户；

生理传感器，其安置于所述壳体中以产生表示用户数据的生理条件的数据，所述生理传感器包含：

第一光源，其安置于所述壳体中以产生且输出具有至少第一波长的光，及

光电检测器，其安置于所述壳体中以检测所散射光；

第一光管，其安置于所述壳体的所述突出部分中且光学耦合到所述第一光源以沿预定路径将光从所述第一光源引导或透射到所述壳体的所述皮肤或内部侧的外表面；及

处理电路，其安置于所述壳体中以使用表示所述所散射光的数据来计算所述用户的心率。

17. 根据权利要求 16 所述的便携式生物计量监测装置，其中所述壳体的所述突出部分包含提供所述壳体的外表面的窗，其中所述窗包含具有第一光学性质的第一部分及具有第二光学性质的第二部分，其中所述第一光管安置于所述第一部分中或为所述第一部分的一部分。

18. 根据权利要求 17 所述的便携式生物计量监测装置，其中所述窗的所述第二部分至少对具有所述第一波长的光是光学上不透明的。

19. 根据权利要求 17 所述的便携式生物计量监测装置，其中所述窗对可见光谱中的光是光学上不透明的。

20. 根据权利要求 16 所述的便携式生物计量监测装置，其进一步包含第二光管，所述第二光管安置于所述壳体的所述突出部分中且光学耦合到所述光电检测器以沿预定路径将光从所述壳体的外表面引导或透射到所述光电检测器。

21. 根据权利要求 20 所述的便携式生物计量监测装置，其中所述窗进一步包含具有第三光学性质的第三部分，其中所述第二光管安置于所述第三部分中或为所述第三部分的一部分。

22. 根据权利要求 16 所述的便携式生物计量监测装置，其中所述壳体的所述突出部分包含所述装置的内部或皮肤侧上的多个隆起或凹陷区域，其中所述装置的所述内部或皮肤

侧经配置以啮合或接触所述用户的所述皮肤。

23. 根据权利要求 16 所述的便携式生物计量监测装置，其进一步包含垫圈，所述垫圈与所述突出部分的端部分并置且与所述突出部分的端部分压缩在一起。

24. 一种便携式生物计量监测装置，其包括：

壳体，其具有适于耦合到用户的身体的物理大小及形状，所述壳体包含装置主体及经配置以啮合或接触所述用户的皮肤的突出部分，其中所述突出部分啮合垫圈；

至少一个带，其耦合到所述壳体以将所述便携式生物计量监测装置紧固到所述用户；

生理传感器，其安置于所述壳体中以产生表示用户数据的生理条件的数据，所述生理传感器包含：

光源，其安置于所述壳体中以产生且输出具有至少第一波长的光，及

光电检测器，其安置于所述壳体中以检测所散射光；

其中所述突出部分包含所述壳体的皮肤或内部侧的外表面以借此啮合或接触所述用户的所述皮肤，其中所述突出部分包含具有第一光学性质的第一部分及具有第二光学性质的第二部分，且其中所述突出部分的所述第一部分光学耦合到所述光源以沿预定路径将光从所述光源引导或透射到所述壳体的所述皮肤或内部侧的所述外表面；及

处理电路，其安置于所述壳体中以使用表示所述所散射光的数据来计算所述用户的心率。

25. 根据权利要求 24 所述的便携式生物计量监测装置，其中所述突出部分的所述第二部分至少对具有所述第一波长的光是光学上不透明的。

26. 根据权利要求 24 所述的便携式生物计量监测装置，其中所述突出部分对可见光谱中的光是光学上不透明的。

27. 根据权利要求 24 所述的便携式生物计量监测装置，其中所述突出部分进一步包含第三部分，所述第三部分光学耦合到所述光电检测器以沿预定路径将光从所述壳体的外表面引导或透射到所述光电检测器。

28. 根据权利要求 27 所述的便携式生物计量监测装置，其中所述壳体的所述突出部分经由粘合剂附接到所述装置主体，且其中所述垫圈及所述粘合剂提供不透液密封。

29. 根据权利要求 24 所述的便携式生物计量监测装置，其中提供所述壳体的所述皮肤或内部侧的所述外表面的突出部分包含弯曲外部表面。

30. 根据权利要求 24 所述的便携式生物计量监测装置，其中所述装置主体包含安置于其上的硬涂漆层、硬浸涂层或抗反射光学涂层。

便携式生物计量监测装置及其操作方法

技术领域

[0001] 本发明针对于一种生物计量监测装置以及用以从嵌入式或常驻传感器及/或外部装置收集一种或一种以上类型的生理及/或环境数据并将此信息传递或转送到其它装置或其它因特网可视源的方法及技术。(参见,举例来说,图1)。

背景技术

[0002] 当用户正佩戴或操纵生物计量监测装置时,所述装置可经由一个或多个传感器检测到生理度量中的一个生理度量或许多生理度量,包含但不限于用户的心率。

[0003] 所述装置可具有直接在所述装置上的用户接口,所述用户接口指示可获得及/或正跟踪/获取的数据类型中的一者或一者以上的状态。所述用户接口还可用于显示来自其它装置或因特网源的数据。

[0004] 所述装置可实施无线通信,使得当用户及装置进入无线基站或接入点的范围内时,所存储数据自动上传到因特网可视源,例如网站。

发明内容

[0005] 在一个实施例中,一种便携式生物计量监测装置包括:壳体,其具有适于耦合到用户的身体的物理大小及形状;至少一个带,其耦合到所述壳体以将所述便携式生物计量监测装置紧固到所述用户;生理传感器,其安置于所述壳体中以产生表示用户数据的生理条件的数据,所述生理传感器包含:第一光源,其安置于所述壳体中以产生且输出具有至少第一波长的光,及光电检测器,其安置于所述壳体中以检测所散射光;第一光管,其安置于所述壳体中且光学耦合到所述第一光源以沿预定路径将光从所述第一光源引导或透射到所述壳体的外表面;及处理电路,其安置于所述壳体中以使用表示所述所散射光的数据来计算所述用户的心率。

[0006] 在另一实施例中,一种便携式生物计量监测装置包括:壳体,其具有适于耦合到用户的身体的物理大小及形状,其中所述壳体的皮肤或内部侧包含突出部分,所述突出部分(i)经配置以啮合或接触所述用户的皮肤且(ii)包含弯曲外部表面;至少一个带,其耦合到所述壳体以将所述便携式生物计量监测装置紧固到所述用户;生理传感器,其安置于所述壳体中以产生表示用户数据的生理条件的数据,所述生理传感器包含:第一光源,其安置于所述壳体中以产生且输出具有至少第一波长的光,及光电检测器,其安置于所述壳体中以检测所散射光;第一光管,其安置于所述壳体的所述突出部分中且光学耦合到所述第一光源以沿预定路径将光从所述第一光源引导或透射到所述壳体的所述皮肤或内部侧的外表面;及处理电路,其安置于所述壳体中以使用表示所述所散射光的数据来计算所述用户的心率。

[0007] 在又一实施例中,一种便携式生物计量监测装置包括:壳体,其具有适于耦合到用户的身体的物理大小及形状,所述壳体包含装置主体及经配置以啮合或接触所述用户的皮肤的突出部分,其中所述突出部分啮合垫圈;至少一个带,其耦合到所述壳体以将所述便携

式生物计量监测装置紧固到所述用户；生理传感器，其安置于所述壳体中以产生表示用户数据的生理条件的数据，所述生理传感器包含：光源，其安置于所述壳体中以产生且输出具有至少第一波长的光，及光电检测器，其安置于所述壳体中以检测所散射光；其中所述突出部分包含所述壳体的皮肤或内部侧的外表面以借此啮合或接触所述用户的所述皮肤，其中所述突出部分包含具有第一光学性质的第一部分及具有第二光学性质的第二部分，且其中所述突出部分的所述第一部分光学耦合到所述光源以沿预定路径将光从所述光源引导或透射到所述壳体的所述皮肤或内部侧的所述外表面；及处理电路，其安置于所述壳体中以使用表示所述所散射光的数据来计算所述用户的心率。

附图说明

[0008] 在以下详细说明的过程中，将参考附图。这些图式展示本发明的不同方面，且在适当的情况下，类似地标记图解说明不同图中的相似结构、组件、材料及／或元件的元件符号。在附图中的各图中以实例方式且不以限制方式图解说明本文中所揭示的各种实施例，且其中相似元件符号是指相同及／或类似结构／组件／特征／元件。应理解，结构、组件、特征及／或元件的各种组合（特定展示的那些组合除外）均涵盖于本发明的范围内。

[0009] 此外，本文中描述及图解说明许多发明。本发明既不限于本发明的任何单一方面或实施例，也不限于此些方面及／或实施例的任何组合及／或置换。此外，可单独地或结合本发明的其它方面及／或其实施例中的一者或一者以上一起采用本发明的方面及／或其实施例中的每一者。为简洁起见，本文中未分别论述及／或图解说明特定置换及组合。

[0010] 在附图中的各图中以实例方式且不以限制方式图解说明本文中所揭示的各种实施例，且其中相似元件符号是指类似元件，且其中：

[0011] 图 1 图解说明经由用户接口而实现用户交互的示范性便携式监测装置，其中便携式监测装置可具有用户接口、处理器、生物计量传感器、存储器、环境传感器及／或可与外部装置（举例来说，客户端及／或服务器）通信的无线收发器；

[0012] 图 2 图解说明可经由带的使用而紧固到用户的示范性便携式生物计量监测装置；所述示范性便携式生物计量监测装置可具有显示器、按钮、电子封装及／或带或附接带；明显地，采用所述带或附接带来将便携式生物计量监测装置（举例来说）经由钩与环（例如，维可牢 (Velcro)）、卡环及／或具有带形状记忆的带（例如，经由（举例来说）弹簧金属带、弹性带、“橡胶”带及／或手表样带的使用）紧固到用户，举例来说，用户的附肢；

[0013] 图 3 图解说明（举例来说）图 2 的便携式生物计量监测装置的面向皮肤的部分的视图；明显地，在此实施例中，所述便携式监测装置包含用于配合充电器及／或数据传输电缆的传感器突出部及凹部；明显地，所述突出部可较稳固地维持传感器与用户的皮肤接触（举例来说，与用户的皮肤的预定或固定关系接触）；

[0014] 图 4 图解说明示范性便携式生物计量监测装置的（穿过电子封装的）横截面图；

[0015] 图 5 图解说明示范性便携式生物计量监测装置的传感器突出部的横截面图；明显地，两个光源（例如 LED）可位于光电检测器的一个或一个以上侧（举例来说，光电检测器的任一侧或相对侧）上以实现光电容积描记法 (PPG) 感测，其中光阻挡材料可放置于光源与光电检测器之间以防止来自光源的任何光通过装置主体及被光电检测器检测到（在一个实施例中，光源及光电检测器放置于柔性 PCB 上）；柔性透明层可放置于传感器突出部的

下表面上以形成密封，其中所述透明层可提供（例如）防止液体进入安置或放置光源或光电检测器的装置的其它功能；明显地，所述透明层可经由模内贴标或“IML”而形成；

[0016] 图 6 图解说明示范性便携式生物计量监测装置的传感器突出部的横截面图；明显地，所述突出部类似于图 5 的示范性便携式生物计量监测装置中所图解说明的突出部；然而，光源及光电检测器放置于扁平及 / 或刚性 PCB 上；

[0017] 图 7 图解说明 PPG 传感器的另一横截面图，其中在此实施例中，所述 PPG 传感器不包含突出部；此外，可采用垫圈及 / 或压敏粘合剂来抵抗、抑制及 / 或防止液体进入装置的主体；

[0018] 图 8 图解说明 PPG 光源及光电检测器的示范性几何形状，其中在此实施例中，两个光源放置于光电检测器的任一侧上；明显地，所述光源及光电检测器可安置于或位于还可操作为智能手表的便携式生物计量监测装置的背部（面向用户的皮肤的侧）上的突出部中；

[0019] 图 9 图解说明具有可安置于或位于具有突出部的便携式生物计量监测装置中的一个光电检测器及两个 LED 光源的示范性 PPG 传感器；明显地，在此实施例中，光管将 LED 及光电检测器光学连接到用户的皮肤的表面，其中在操作中，来自光源的光从身体中的血液散射 / 反射，所述光中的一些光经由光管到达光电检测器；明显地，光管优先地沿（举例来说）由光管的几何形状及 / 或材料界定的预定路径来引导或透射光；

[0020] 图 10 图解说明具有突出部的示范性 PPG 检测器，所述突出部具有弯曲侧以减小用户在操作期间及 / 或较稳固地维持传感器与用户的皮肤接触（举例来说，与用户的皮肤的预定或固定关系接触）的任何不适及 / 或使所述不适最小化；在此实施例中，光管的表面将光电检测器及 LED 连接到用户的皮肤且经轮廓化以增强 LED 及光电检测器到光管之间的光通量耦合及 / 或使所述光通量耦合最大化；明显地，还可将光管面向用户的皮肤的端部轮廓化，其中此轮廓可提供聚焦或散焦以增强及 / 或优化 PPG 信号（举例来说，所述轮廓可将光聚焦到与可能发生血液流动的区一致的特定深度及位置）；另外，这些焦点的顶点重叠或极紧密地靠在一起，使得光电检测器可接收（举例来说）最大可能量的所散射 / 所反射光；

[0021] 图 11 图解说明具有带及安置于其中的光学传感器及光发射器的示范性便携式生物计量监测装置；

[0022] 图 12 图解说明具有显示器及腕带的便携式生物计量监测装置；光学 PPG（例如心率）检测传感器及 / 或发射器可安置于或位于所述装置的侧上；明显地，在一个实施例中，所述传感器及 / 或发射器安置于或位于安装于所述装置的侧上的按钮中；

[0023] 图 13 图解说明通过按压便携式生物计量监测装置的侧而输入用户输入的用户，其中作为响应，所述装置从侧装式光学心率检测传感器获得心率测量；所述装置的显示器此后可显示是否已检测心率及 / 或显示用户的心率；

[0024] 图 14 图解说明便携式生物计量监测装置智能报警特征的功能性，其中在此实施例中，所述监测装置可能够检测可检测用户的睡眠阶段或状态（例如轻度睡眠或深度睡眠）的装置或可与所述装置通信；所述用户可设定其想要醒来的时间窗（例如 6:15am 到 6:45am）；所述智能报警可在报警窗期间通过用户进入轻度睡眠状态而触发；

[0025] 图 15 以流程图形式图解说明便携式生物计量监测装置基于装置正经历的移动的

多少而改变装置检测用户的心率的方式的操作；在此实施例中，（例如经由加速度计的使用）检测到运动，所述用户可被认识是活动的且可发生高取样速率心率检测以减小心率测量中的运动伪影；所述数据可被保存及/或显示；明显地，在用户不移动的情况下，低取样心率检测（其不消耗太多的电力）可足以测量心率；

[0026] 图16图解说明具有自行车应用（常驻于自行车上）的示范性便携式监测装置，除其它度量外，所述示范性便携式监测装置还可显示速度及/或节奏；无论何时监测装置接近于无源或有源NFC标签，所述应用均可被激活，所述无源或有源NFC标签可附接到自行车或安置于自行车上，举例来说，自行车车把、车架及/或踏板；

[0027] 图17图解说明具有光源、光检测器、ADC、处理器、DAC/GPIO以及光源强度及接通/关断控制的示范性PPG传感器；

[0028] 图18图解说明类似于图17中所图解说明的实施例的示范性PPG传感器；然而，在此实施例中，传感器采用取样与保持电路以及模拟信号调节；

[0029] 图19图解说明类似于图17中所图解说明的实施例的示范性PPG传感器；然而，在此实施例中，传感器采用取样与保持电路（且在一个实施例中，对信号进行过取样）；

[0030] 图20图解说明具有多个可切换光源及检测器、光源强度及接通/关断控制以及信号调节电路的示范性PPG传感器；

[0031] 图21图解说明使用同步检测的示范性PPG传感器；明显地，在此实施例中，采用解调器来检测/恢复信号；

[0032] 图22图解说明类似于图17中所图解说明的实施例的示范性PPG传感器；然而，在此实施例中，传感器在信号检测路径中采用差分放大器；

[0033] 图23图解说明具有图17到22中所图解说明的许多特征/电路的示范性PPG传感器；

[0034] 图24图解说明具有连接到处理器的心率或PPG传感器、运动传感器、显示器、振打电机/振动电机及通信电路的示范性便携式生物计量监测装置的特定电路/元件；

[0035] 图25图解说明具有连接到处理器的心率或PPG传感器、运动传感器、显示器、振打电机/振动电机、位置传感器、海拔传感器、皮肤电导/湿传感器及通信电路的示范性便携式生物计量监测装置的特定电路/元件；

[0036] 图26图解说明具有连接到处理器的生理传感器、环境传感器及/或位置传感器的示范性便携式监测装置的特定电路/元件；

[0037] 图27以框图形式图解说明用于测量用户的心率的运动信号及光学PPG信号的示范性信号流；

[0038] 图28以框图形式图解说明用于测量用户的心率的运动信号及光学PPG信号的示范性信号流；

[0039] 图29图解说明具有到传感器处理器的模拟连接的传感器，所述传感器处理器又具有到应用处理器的数字连接；

[0040] 图30图解说明具有连接到应用处理器的一个或多个传感器的传感器装置；且

[0041] 图31图解说明具有连接到传感器处理器的一个或多个传感器的传感器装置，所述传感器处理器又连接到应用处理器。

[0042] 再次，本文中描述及图解说明许多发明。本发明既不限于本发明的任何单一方面

或实施例，也不限于此些方面及／或实施例的任何组合及／或置换。可单独地或结合本发明的其它方面及／或其实施例中的一者或一者以上一起采用本发明的方面及／或其实施例中的每一者。为简洁起见，本文中未分别论述那些组合及置换中的许多组合及置换。

[0043] 此外，依据以下说明、图解及权利要求书将明了可不同于及／或类似于图式中所图解说明的方面、发明及实施例的许多其它方面、发明及实施例。另外，尽管各种特征及属性已在图式中图解说明及／依据图式而明了，但应理解，此些特征及属性以及其优点无论在本发明的实施例中的一个实施例、一些实施例还是全部实施例中均不是必需的，且实际上，未必存在于本发明的实施例中的任一者中。

具体实施方式

[0044] 起初，应注意，本文中描述及图解说明许多发明。本发明既不限于本发明的任何单一方面或实施例，也不限于此些方面及／或实施例的任何组合及／或置换。此外，可单独地或结合本发明的其它方面及／或其实施例中的一者或一者以上一起采用本发明的方面及／或其实施例中的每一者。为简洁起见，本文中将不分别论述那些置换及组合中的许多置换及组合。

[0045] 此外，在描述及图解说明本发明的过程中，陈述各种电路、架构、结构、组件、功能及／或元件以及其组合及／或置换。应理解，电路、架构、结构、组件、功能及／或元件（特定描述及图解说明的那些除外）以及其组合及／或置换均涵盖于且在本发明的范围内。

[0046] 生理传感器

[0047] 本发明的便携式生物计量监测装置可使用以下传感器中的一个传感器、一些传感器或全部传感器来获取生理数据，包含下表中所概述的生理数据。生理传感器及／或生理数据的所有组合及置换均打算归属于本发明的范围内。本发明的便携式生物计量监测装置可包含但不限于以下类型；下文指定用以获取对应生理数据的传感器中的一个传感器、一些传感器或全部传感器；实际上，可采用其它类型的传感器来获取对应生理数据，所述其它类型的传感器打算归属于本发明的范围内。另外，所述装置可从对应传感器输出数据导出所述生理数据，但不限于可从所述传感器导出的生理数据的数目及类型。

[0048]

生理传感器	所获取的生理数据

[0049]

光学反射计	心率、心率变异性
可能实施例：	SpO2 (血氧饱和度)
-光发射器及接收器	呼吸
-多个或单个 LED 及光电二极管布置	应激
-针对特定生理信号而调谐的波长	血压
-同步检测/振幅调制	动脉僵硬度
	血糖水平
	血量
	心率恢复
	心脏健康
运动检测器	活动水平检测
可能实施例：	坐/站检测
-惯性、陀螺仪或加速度计	跌倒检测
- GPS	
皮肤温度	应激
EMG	肌张力
EKG	心率、心率变异性、心率恢复
可能实施例：	应激
- 1 导联	心脏健康
- 2 导联	
磁力计	基于旋转的活动水平
激光多普勒	
功率计	
超声波	血流量
音频	心率、心率变异性、心率恢复
	笑检测
	呼吸
	呼吸类型-打鼾、喘气、喘气问题
	用户的语音
应变计	心率、心率变异性

[0050]

可能实施例：	应激
-在腕带中	
湿传感器	应激
可能实施例：	游泳检测
-皮电反应	淋浴检测

[0051] 在一个示范性实施例中，便携式生物计量监测装置包含光学传感器以检测、感测、取样及／或产生可用于确定表示（举例来说）用户的应激（或其水平）、血压及／或心率的信息的数据。（参见，举例来说，图2到7及17到23）。在此实施例中，生物计量监测装置包含光学传感器，所述光学传感器具有用以将光发射或输出到用户的身体中的一个或一个以上光源（LED、激光等）及／或用以取样、测量及／或检测响应或反射且提供用于确定表示用户的应激（或其水平）、血压及／或心率的数据（例如，使用光电容积描记法，即“PPG”）的数据的光检测器（光电二极管、光电晶体管等）。

[0052] 在一个示范性实施例中，用户的心率测量可由一个或一个以上传感器（或连接到其的处理电路）确定的准则触发。举例来说，当来自运动传感器的数据指示静止或极少运动的周期时，生物计量监测装置可触发、获取及／或获得心率测量或数据。（参见，举例来说，图15、24及25）。在一个实施例中，当运动传感器指示用户活动或运动（举例来说，不适合或适宜触发、获取及／或获得所要心率测量或数据（举例来说，用于确定用户的静息心率的数据）的运动）时，用于获取及／或获得所要心率测量或数据的生物计量监测装置及／或传感器可置于或保持处于低功率状态中。明显地，在运动期间采取的测量可为不可靠的且可被运动伪影（举例来说，传感器与用户之间的相对运动）损坏。

[0053] 在另一实施例中，本发明的生物计量监测装置可采用指示用户活动或运动的数据（举例来说，来自一个或一个以上运动传感器）来调整或修改触发、获取及／或获得所要心率测量或数据的特性（举例来说，以改进运动伪影的稳健性）。举例来说，可采用指示用户活动或运动的数据来调整或修改获取心率数据的传感器的取样速率及／或分辨率模式（举例来说，在用户运动量超出特定阈值的情况下，生物计量监测装置可增加用于获取心率测量或数据的传感器的取样速率及／或增加所述传感器的取样分辨率模式）。此外，生物计量监测装置可调整或修改运动传感器在用户活动或运动的此些周期（举例来说，用户运动量超出特定阈值的周期）期间的取样速率及／或分辨率模式。以此方式，当生物计量监测装置确定或检测到此用户活动或运动时，运动传感器可置于较高取样速率及／或较高取样分辨率模式中以（举例来说）实现对心率信号的较准确自适应滤波。（参见，举例来说，图15）。

[0054] 明显地，在生物计量监测装置采用光学技术来获取心率测量或数据（例如，光电容积描记法）的情况下，可采用运动信号来确定或建立用以数据获取或测量（例如，同步检测，而非非振幅调制的方法或技术）及／或其分析的特定方法或技术。（参见，举例来说，图21）。以此方式，指示用户运动或活动量的数据建立或调整通过光学心率数据获取传感器的数据获取或测量的类型或技术。

[0055] 举例来说，在一个优选实施例中，当运动检测器电路检测到或确定用户的运动低

于阈值（举例来说，生物计量监测装置确定用户正静坐或睡着）时，本发明的生物计量监测装置及技术可调整及／或减小光学心率取样的取样速率。（参见，举例来说，图 15）。以此方式，生物计量监测装置可控制其功率消耗（举例来说，通过减小取样速率而减小功率消耗），举例来说，生物计量监测装置可每 10 分钟一次或每 1 分钟 10 秒地对心率（经由心率传感器）进行取样。明显地，除此之外或代替此，生物计量监测装置可根据运动检测经由控制数据处理电路分析及／或数据分析技术而控制功率消耗。因此，用户的运动可影响心率数据获取参数及／或其数据分析或处理。

[0056] 在又一实施例中，当装置确定用户（举例来说）静坐或睡着时，生物计量监测装置可采用传感器来计算心率变异性。此处，装置可以较高速率取样模式（相对于非静坐周期或超出预定阈值的用户活动周期）操作传感器以计算心率变异性。生物计量监测装置（或外部装置）可采用心率变异性作为心脏健康或应激的指示符。

[0057] 实际上，在优选实施例中，当用户静坐及／或睡着（举例来说，如由生物计量监测装置所检测到及／或确定（举例来说，自动地））时，生物计量监测装置测量及／或确定用户的应激水平及／或心脏健康。本发明的生物计量监测装置可使用指示心率变异性、皮电反应、皮肤温度、身体温度及／或心率的传感器数据来确定用户的应激水平、健康状态（例如，发烧或感冒的风险、开始或恶化）及／或心脏健康。以此方式，生物计量监测装置的处理电路可确定及／或跟踪用户随时间的“基线”应激水平及／或随时间的心脏“健康”。在另一实施例中，装置测量用户在用户不运动（或用户的运动低于预定阈值）、坐着、半躺、睡着或处于特定睡眠阶段（例如，深度睡眠）中的一个或一个以上周期期间的生理参数。此数据还可用作应激相关参数、健康相关参数（例如，发烧或感冒的风险或开始）、心脏健康、心率变异性、皮电反应、皮肤温度、身体温度及／或心率的“基线”。

[0058] 明显地，在一个实施例中，生物计量监测装置可自动检测或确定用户何时正试图去睡觉、进入睡眠、睡着及／或从睡眠周期醒来。在此实施例中，生物计量监测装置可采用生理传感器来获取生理数据（如本文中所描述的类型且以如本文中所描述的方式），其中数据处理电路使心率、心率变异性、呼吸速率、皮电反应、运动及／或皮肤及／或身体温度感测的组合相关以检测或确定用户是否正试图去睡觉、进入睡眠、睡着及／或从睡眠周期醒来。作为响应，生物计量监测装置可（举例来说）获取生理数据及／或确定用户的生理条件（如本文中所描述的类型且以如本文中所描述的方式）。举例来说，与用户心率的减小及／或心率变异性的改变组合的用户运动的减少或停止可指示用户已睡着。心率变异性的后续改变及皮电反应可用于确定用户的睡眠状态及／或两个或两个以上睡眠阶段（举例来说，进入轻度及／或深度睡眠阶段）之间的转变。用户的运动及／或经提升心率及／或心率变异性的改变可用于确定用户已醒来。

[0059] 在一个实施例中，生物计量监测装置是用于监测睡眠的系统的一个组件，其中所述系统包括能够与生物计量监测装置通信且适于接近睡眠者放置的辅助装置（例如，闹钟）。所述辅助装置可具有用以接受生物计量监测装置的形状以及机械及／或磁性接口以用于安全保护、通信及／或充电。明显地，生物计量监测装置与辅助装置之间的通信可经由无线通信技术／方法及协议（例如蓝牙、蓝牙 4.0、RFID、NFC 或 WLAN）而提供。所述辅助装置可包括传感器以帮助睡眠或环境监测，例如，举例来说，测量周围光、噪音及／或声音（例如，以检测打鼾）、温度、湿度及空气质量（粉、尘、CO2 等）的传感器。在一个实施例中，

辅助装置可与外部服务（例如www.fitbit.com或服务器（例如，个人计算机））通信。通信可经由有线（例如，以太网、USB）或无线（例如，WLAN、蓝牙、RFID、NFC、蜂窝）电路及协议而实现以将数据传送到辅助装置及/或从辅助装置传送数据。所述辅助装置还可充当继电器以将数据传送到生物计量监测装置及/或将数据从生物计量监测装置传送到外部服务，例如www.fitbit.com或其它服务（例如，新闻、社交网络更新、电子邮件、日历通知）或服务器（例如，个人计算机、移动电话、平板计算机）。可使用来自一个或两个装置的数据对一个或两个装置或外部服务（例如，云服务器）执行用户的睡眠数据的计算。

[0060] 所述辅助装置可配备有显示器以输出由辅助装置获得的数据或由生物计量监测装置、外部服务传送到其的数据或者来自生物计量监测装置、辅助装置及/或外部服务的数据的组合。举例来说，辅助装置可显示指示用户的心率、当日的总步数、活动及/或睡眠目标实现、当日的天气（由辅助装置所测量或由外部服务针对位置所报告）等的数据。在另一实例中，辅助装置可显示（例如）在用户活动（举例来说，每周总步数计数）的情境中与所述用户相对于其它用户的排名有关的数据。在又一实施例中，所述生物计量监测装置可配备有显示器以显示由生物计量监测装置、辅助装置、外部服务或三个源的组合获得的数据。在其中第一装置配备有唤醒报警（例如，振打电机/振动电机、扬声器）的实施例中，辅助装置可充当备份报警（例如，使用音频扬声器）。辅助装置还可具有接口（例如，显示器及按钮或触摸屏）以形成、删除、修改或实现第一装置及/或辅助装置上的报警。

[0061] 在另一实施例中，生物计量监测装置可自动检测或确定其是否附接到用户、安置于用户上及/或被用户佩戴。响应于检测到或确定生物计量监测装置未附接到用户、未安置于用户上及/或未被用户佩戴，生物计量监测装置（或其选定部分）可实施低功率操作模式或置于低功率操作模式中，举例来说，光学心率传感器及/或电路可置于关断或停用状态或者较低功率或睡眠模式中。举例来说，在一个实施例中，生物计量监测装置包含一个或一个以上光检测器（光电二极管、光电晶体管等），其中如果在给定光强度设定下，一个或一个以上光检测器提供低返回信号，那么生物计量监测装置可解释数据指示未被佩戴的装置。在此确定后，装置可即刻减小其功率消耗，举例来说，“停用”或调整应激及/或心率检测传感器及/或电路的操作条件（举例来说，减小光源及/或检测器的工作循环或停用光源及/或检测器及/或停用或衰减其相关联电路或部分）。另外，生物计量监测装置可周期性地确定（例如，每秒一次）是否应将应激及/或心率检测传感器及/或相关联电路的操作条件还原到正常操作条件（举例来说，光源、检测器及/或相关联电路应返回到用于心率检测的正常操作模式）。在另一实施例中，生物计量监测装置在检测到可触发事件后（举例来说，在检测到装置的运动（举例来说，基于来自一个或一个以上运动传感器的数据）及/或检测到经由用户接口（举例来说，轻敲、碰撞或猛击）的用户输入后）即刻还原应激及/或心率检测传感器及/或相关联电路的操作条件。在相关实施例中，出于电力节省目的，生物计量监测装置可在用户并非高度活动时将其心率测量收集的速率减小到（举例来说）每分钟一次测量。在一个实施例中，用户可（举例来说）经由接口（例如通过推动按钮）将装置放入到按需产生测量或以较快速率（例如，每秒一次）产生测量的操作模式中。

[0062] 在一个实施例中，光学传感器（源及/或检测器）可安置于生物计量监测装置的内部或皮肤侧（即，装置的表面接触、触碰及/或面向用户的皮肤的侧（下文中“皮肤侧”））

上。(参见,举例来说,图2到7)。在另一实施例中,光学传感器可安置于装置的一个或一个以上侧上,包含皮肤侧及装置面向或暴露于周围环境的一个或一个以上侧(环境侧)。(参见,举例来说,图11到13)。明显地,来自此些光学传感器的数据可表示生理数据及/或环境数据。实际上,在一个实施例中,无论光学传感器是否安置于多个侧中的一者或一者以上上,所述传感器均提供、获取及/或检测来自生物计量监测装置的多个侧的信息。举例来说,光学传感器可获得与环境的周围光条件有关的数据。

[0063] 在光学传感器安置或布置于生物计量监测装置的皮肤侧上的情况下,在操作中,光源将光发射于用户的皮肤上,且作为响应,光检测器取样、获取及/或检测来自皮肤(及/或来自身体内)的反应或所散射/所反射光。所述一个或一个以上源及检测器可以增强或优化SNR及/或减小光源及检测器的功率消耗或使所述功率消耗最小化的阵列或型式布置。所述光学检测器取样、获取及/或检测生理数据,所述生理数据可接着(举例来说,由常驻处理电路)处理或分析以获得表示(举例来说)用户的心率、呼吸、心率变异性、氧饱和度(SpO2)、血量、血糖、皮肤水分及/或皮肤色素水平的数据。

[0064] 所述源可发射具有将收集的生理数据的类型所特有或与所述类型相关的一个或一个以上波长的光。所述光学检测器可取样、测量及/或检测将收集的生理数据的类型及将评估或确定的(用户的)生理参数所特有或与所述生理数据的类型及所述生理参数相关的一个或一个以上波长。举例来说,在一个实施例中,发射具有绿色光谱中的波长的光的光源(举例来说,发射具有对应于绿色光谱的波长的光的LED)及经定位以取样、测量及/或检测响应或反射的光电二极管可提供用于确定或检测心率的数据。相比之下,发射具有红色光谱中的波长的光的光源(举例来说,发射具有对应于红色光谱的波长的光的LED)及发射具有红外光谱中的波长的光的光源(举例来说,发射具有对应于IR光谱的波长的光的LED)及经定位以取样、测量及/或检测响应或反射的光电二极管可提供用于确定或检测SpO2的数据。

[0065] 实际上,在一个实施例中,可根据被获取的预定类型的生理数据或操作条件而修改、调整及/或控制由LED(或一组LED)发射的光的色彩或波长。此处,调整及/或控制由LED发射的光的波长以优化及/或增强由检测器获得及/或进行取样的生理数据的"质量"。举例来说,由LED发射的光的色彩可在用户的皮肤温度或周围温度较凉时从红外线切换到绿色以便增强对应于心脏活动的信号。(参见,举例来说,图20)。

[0066] 在一个实施例中,生物计量监测装置在壳体中包含窗(举例来说,视觉上不透明的窗)以促进光学传感器与用户之间的光学传输。此处,所述窗可准许光(举例来说,选定波长的实质部分)由(举例来说)一个或一个以上LED发射到用户的皮肤上且准许传递到壳体中的响应或反射由(举例来说)一个或一个以上光电二极管进行取样、测量及/或检测。在一个实施例中,与发射及接收光有关的电路可安置于装置壳体的内部中且在(举例来说,涂有红外线油墨的)塑料或玻璃层或准许红外线光而非人可见光谱中的光通过的红外线透镜下方。以此方式,光透射对于人眼是不可见的。

[0067] 在一个实施例中,生物计量监测装置可采用光管或其它透光结构。(参见,举例来说,图8到10)。就此来说,在一个实施例中,将光经由光管或其它透光结构从光源引导到用户的皮肤。来自用户的身体的所散射或所反射光可经由相同或类似结构被往回引导到光学电路且由所述光学电路检测。实际上,透射结构可采用材料及/或光学设计来促进低光

损失（举例来说，透镜），借此改进光电检测器的 SNR 及 / 或减小光发射器及 / 或光检测器的功率消耗。在一个实施例中，光管或其它透光结构可包含比其它材料更高效率地选择性透射具有一个或一个以上特定或预定波长的光的材料，借此充当带通滤波器。此带通滤波器可经调谐以改进特定生理数据类型的信号。举例来说，在一个实施例中，可实施模内贴标或“IML”透光结构，其中所述结构使用具有预定或所要光学特性的材料来形成特定带通特性（举例来说）以使红外线光比其它波长的光（举例来说，具有人可见光谱中的波长的光）更高效率地通过。

[0068] 在另一实施例中，生物计量监测装置可采用具有光学上不透明的部分（包含特定光学性质）及光学上透明的部分（包含不同于光学上不透明的部分的光学性质）的透光结构。此结构可经由双射或两步模制处理而提供，其中注入光学上不透明的材料且注入光学上透明的材料。取决于行进穿过所述结构的光的方向，实施此透光结构的生物计量监测装置针对不同波长可包含不同透射性质。举例来说，在一个实施例中，光学上不透明的材料可包含对特定波长范围具反射性的性质以便较高效地将光从光发射器及从用户的身体往回传输到检测器（其相对于所发射光的波长可具有不同波长）且由所述检测器检测。

[0069] 在实施透光结构（举例来说，经由 IML 而产生或形成的结构）的另一实施例中，此些结构可包含由限制光源及 / 或检测器中的一个光源及 / 或检测器、一些光源及 / 或检测器或全部光源及 / 或检测器的孔口的不透明的材料组成的掩模。以此方式，透光结构选择性地“定义”光被发射到其中及 / 或从其检测到的主体的优先体积。明显地，可结合本文中所描述及 / 或所图解说明的发明一起采用或实施其它掩模配置；用以（举例来说）改进光电容积描记法信号且结合本文中所描述及 / 或所图解说明的发明一起实施的所有此些掩模配置均打算归属于本发明的范围内。

[0070] 在本文中所描述的透光结构中的任一者中，光学器件的表面或装置主体可包含硬涂漆层、硬浸涂层或光学涂层（例如抗反射）、抗划伤性、防雾及 / 或波长带块（例如阻挡紫外线光）。此些特性或材料可改进生物计量监测装置的操作、准确性及 / 或寿命。

[0071] 在一个实施例中，生物计量监测装置在装置的皮肤侧上包含凹形或凸形形状以在皮肤中以特定深度朝向特定体积聚焦光且增加将光从所述点收集到光电检测器中的效率。（参见，举例来说，图 8 到 10）。在此生物计量监测装置还采用光管来选择性地且可控制地路由光的情况下，将所述光管的端部塑形为具有一定程度的圆柱度（举例来说，而非径向对称）可是有利的。此配置可通过增加将光从发射器传送到用户的皮肤上或中的效率同时减少由光电检测器检测到或收集的“杂散”光而改进 SNR。以此方式，由光电检测器进行取样、测量及 / 或检测的信号由较少杂散光及较多用户对此所发射光的反应（表示对所发射光的反应的信号或数据）组成。

[0072] 在一个实施例中，光学传感器的组件定位于装置的皮肤侧上且经布置或定位以减小 (i) 光源及 / 或相关联检测器与 (ii) 用户的皮肤之间的距离或使所述距离最小化。（参见，举例来说，图 5）。此配置可改进光学传感器的组件与用户的身体之间的光通量耦合的效率。举例来说，在一个实施例中，光源及 / 或相关联检测器安置于柔性或柔韧衬底上，此促进装置的皮肤侧符合（举例来说，在不具有额外处理的情况下）或能够经塑形（或顺应）以符合生物计量监测装置在正常操作期间耦合或附接到的用户的身体部分（举例来说，手腕、手臂、踝及 / 或腿）的形状，使得光源及 / 或相关联检测器靠近于用户的皮肤（即，装置

的皮肤侧与用户的皮肤的并置表面之间几乎没有间隙）。（参见，图 11）。在一个实施例中，光源及 / 或相关联检测器安置于扁平柔性电缆或“FFC”或者柔性 PCB 上。在此实施例中，柔性或柔韧衬底（举例来说，FFC 或柔性 PCB）可连接到装置内的其上安置有其它组件（举例来说，数据处理电路）的第二衬底（举例来说，PCB）。不同高度的光学组件可被安装到柔性衬底的不同“指状物”且被按压或紧固到壳体表面，使得光学组件与所述壳体表面齐平。在一个实施例中，第二衬底可为固定于装置内的其上安置有其它电路及组件（无源及 / 或有源）的相对非柔性或非柔韧衬底。

[0073] 生物计量监测装置经调适（举例来说，包含大小及形状）以被佩戴或装戴于用户的身体（举例来说，手臂、手腕、腿及 / 或踝）上。在包含光学心率监测器的优选实施例中，所述装置可为腕戴式或臂装式附件，例如手表或手镯。（参见，举例来说，图 2 到 13）。在一个实施例中，当生物计量监测装置为腕装式时，光学心率监测器的光学元件安置于或位于所述生物计量监测装置（举例来说，面向手腕的顶部）的内部或皮肤侧上（即，将光学心率监测器与手腕并置）。（参见，举例来说，图 2 到 7）。

[0074] 在另一实施例中，光学心率监测器安置于或位于生物计量监测装置的一个或一个以上外部或环境侧表面上。（参见，举例来说，图 12 到 13）。在此实施例中，用户可用另一只手的手指触摸光学窗（光学心率监测器的光学元件位于其后面）以起始心率测量（及 / 或与心率有关的其它度量，例如心率变异性）及 / 或收集可用于确定用户的心率（及 / 或与心率有关的其它度量）的数据。（参见，举例来说，图 12）。在一个实施例中，举例来说，当用户的手指放置于光学窗上方时，生物计量监测装置可通过检测光电二极管上的入射光的（突然）下降而触发或起始测量。除此之外或代替此，心率测量（或其它此度量）可由基于 IR 的接近检测器及 / 或电容性触摸 / 接近检测器（其可与其它检测器分离）触发。此基于 IR 的接近检测器及 / 或电容性触摸 / 接近检测器可安置于光学窗中或上及 / 或功能性地耦合、电耦合及 / 或物理耦合到所述光学窗以检测或确定（举例来说）用户的手指的存在。

[0075] 在又一实施例中，生物计量监测装置可包含在按下时触发或起始心率测量（及 / 或与心率有关的其它度量）的一个或一个以上按钮。所述按钮可紧接近于光学窗而安置以促进用户在将手指安置于光学窗上时按压按钮。（参见，举例来说，图 13）。在一个实施例中，光学窗可嵌入推动按钮中。因此，当用户按压所述按钮时，其可经由用户啮合及按下所述按钮的手指而触发测量。实际上，所述按钮可被赋予增强或优化抵抗手指的压力量变曲线的形状及 / 或对按压的阻力以在测量或数据获取期间提供高 SNR。在其它实施例（未图解说明）中，生物计量监测装置可采取适于佩戴于身体上、夹持或安装到衣物、放置于衣服（例如，口袋）中或放置于附件（例如，手提包）中的夹子、光滑物件、挂件、踝套、腰带等的形式。

[0076] 在一个特定实施例中，生物计量监测装置在装置的皮肤或内部侧上包含突出部。（参见，图 2 到 11）。当耦合到用户时，突出部以比周围装置主体大的力啮合皮肤。在此实施例中，光学窗或透光结构（上文详细论述了两者）可形成突出部的一部分或并入突出部的一部分中。光学传感器的光发射器及 / 或检测器可安置或布置于与窗或透光结构并置的突出部中。（参见，举例来说，图 3 及 11）。因此，当附接到用户的身体时，生物计量监测装置的突出部的窗部分以比周围装置主体大的力啮合用户的皮肤，借此提供用户的皮肤与光

学窗之间的较紧固物理连接。即，突出部改进生物计量监测装置与用户的皮肤（举例来说，用户的身体的预定部分的皮肤）之间的持续及/或固定接触，此可减小由光电检测器测量的杂散光的量、减少生物计量监测装置与用户之间的运动及/或提供对用户的皮肤的改进的局部压力；此全部可增加所关注的心脏信号的质量。明显地，突出部可含有受益于紧接近于用户的皮肤及/或紧固接触用户的皮肤的其它传感器。除心率传感器之外或代替心率传感器，这些传感器可被包含且包含例如皮肤温度传感器（例如，利用与到突出部的外表面的热环氧树脂结合的光学窗或热敏电阻的非接触性热电堆）、脉动血氧计、血压传感器、EMG或皮电反应传感器的传感器。

[0077] 除此之外或代替此，生物计量监测装置的皮肤侧的一部分可包含摩擦增强机构或材料。举例来说，生物计量监测装置的皮肤侧可包含多个隆起或凹陷区域部分（举例来说，小凸块、脊、凹槽及/或凹坑）。此外，摩擦增强材料（举例来说，凝胶类材料，例如硅酮）可安置于皮肤侧上。实际上，由凝胶制成的装置背部也可提供摩擦，同时还改进用户舒适度及防止杂散光进入。如上所述，摩擦增强机构或材料可单独使用或连同具有如本文中所描述的突出部的生物计量监测装置一起使用。就此来说，生物计量监测装置在装置的突出部分中或上可包含多个隆起或凹陷区域部分（举例来说，小凸块、脊、凹槽及/或凹坑）。实际上，此些隆起或凹陷区域部分可并入/嵌入突出部的窗部分中或上。除此之外或代替此，突出部分可由摩擦增强材料（举例来说，凝胶类材料，例如硅酮）组成或涂覆有所述摩擦增强材料。明显地，突出部及/或摩擦的使用可通过减小传感器在操作期间（尤其在用户运动时）相对于用户的皮肤的运动而改进对应于特定参数（例如，心率、心率变异性、皮电反应、皮肤温度、皮肤颜色、热通量、血压、血糖等）的数据获取的测量准确性。

[0078] 生物计量监测装置的壳体的内部或皮肤侧中的一些或全部还可由金属材料（举例来说，钢、不锈钢、铝、镁或钛）组成。此配置可提供结构刚性。（参见，举例来说，图3）。在此实施例中，经由低变应原“无镍”不锈钢的使用，装置主体可经设计为低变应原的。明显地，采用（至少在特定位置中）为含铁性质的金属类型（举例来说，含铁的不锈钢等级）可是有利的。在此情况下，便携式生物计量监测装置（在其包含可再充电能源（举例来说，可再充电电池）的情况下）可使用磁性性质与充电器互连以紧固到所述充电器。另外，便携式生物计量监测装置还可啮合使用此磁性性质的坞或坞站以促进数据传送。此外，此壳体可提供将增强光学心率传感器及数据获取处理/操作的完整性及可靠性的增强型电磁屏蔽。此外，皮肤温度传感器可物理耦合及热耦合（举例来说，借助热环氧树脂）到金属主体以检测或感测用户的温度。在包含突出部的实施例中，传感器可定位在所述突出部附近或中以提供到用户的皮肤的紧固接触及集中热耦合。

[0079] 在优选实施例中，光学传感器的一个或一个以上组件（在一个实施例中，其可位于突出部中，及/或在另一实施例中，其可经安置或经放置与装置的表面齐平）经由不透液密封（即，防止液体进入到生物计量监测装置的主体中的方法/机构）而附接、固定、包含及/或紧固到便携式生物计量监测装置。举例来说，在一个实施例中，由金属（包含但不限于不锈钢、铝、镁或钛）或刚性塑料制成的装置背部可提供足够坚硬以在容纳用于传感器封装的防水密封时维持装置的结构完整性的结构。（参见，图3到7）。

[0080] 在优选实施例中，光学传感器的封装或模块将连接到具有压敏粘合剂及液体垫圈的装置。（参见，图7）。举例来说，如果光学传感器封装/模块与装置主体之间需要较强

或较耐久性连接，那么还可使用螺钉、铆钉等等。明显地，本发明还可使用防水胶、疏水膜（例如戈尔特斯 (Gore-Tex)）、O 型环、密封剂、脂膏或环氧树脂来紧固或附接光学传感器封装 / 模块及装置主体。

[0081] 如上文所暗示，便携式生物计量监测装置可包含安置于皮肤或内部侧上的包含高反射特性的材料，举例来说，经抛光的不锈钢、反射涂料及经抛光的塑料。以此方式，从装置的皮肤侧所散射 / 所反射的光可被往回散射 / 反射到皮肤中以便（举例来说）改进 SNR。实际上，与为非反射性的装置主体背部相比，此有效地增加输入光信号。明显地，在一个实施例中，选择生物计量监测装置的皮肤或内部侧的色彩来提供特定光学特性（举例来说，反射特定或预定波长的光）以便改进特定生理数据类型的信号。举例来说，在生物计量监测的皮肤或内部侧为绿色的情况下，心率的测量可因对应于绿色光谱的波长的光的优先发射而增强。在生物计量监测的皮肤或内部侧为红色的情况下，SpO2 的测量可因对应于红色光谱的波长的光的优先发射而增强。在一个实施例中，可根据被获取的预定类型的生理数据而修改、调整及 / 或控制生物计量监测装置的皮肤或内部侧的色彩。

[0082] 图 17 描绘光学传感器的示范性示意性框图，其中从光源朝向用户的皮肤发射光且由光检测器感测反射，其中随后由模 / 数转换器 (ADC) 将检测器的输出数字化。可修改（例如，经由光源强度控制模块）光源的强度以维持所要所散射 / 所反射强度信号。举例来说，可减小光源的输出的强度以避免来自光检测器的输出信号的饱和。作为另一实例，可增加光源强度以将来自光检测器的输出信号维持在输出值的所要范围内。明显地，传感器装置的有源控制可经由线性或非线性控制方法（例如比例积分微分 (PID) 控制、固定步长控制、预测控制、神经网络、滞后等等）而实现，且还可采用从装置中的其它传感器导出的信息，例如运动、皮电反应等。图 17 是出于图解说明目的而提供且就此来说，并不将此系统的实施方案限制于（举例来说）集成于 MCU 内的 ADC 或 MCU 的使用。其它可能实施方案包含一个或一个以上内部或外部 ADC、FPGA、ASIC 等的使用。

[0083] 在另一实施例中，传感器装置可并入有取样与保持电路（或等效物）的使用以在关断或衰减光源以节省电力时维持光检测器的输出。在其中光检测器输出的相对改变是最重要（例如，心率测量）的本发明的实施例中，取样与保持电路可不必维持光检测器的输出的准确拷贝。在此些情形中，取样与保持电路可（举例来说）为二极管（例如，肖特基 (Schottky) 二极管）及电容器。取样与保持的输出可呈现给模拟信号调节电路（例如，萨伦 - 凯 (Sallen-Key) 带通滤波器、电平移位器及 / 或增益电路）以调节及放大所关注的频带（例如，对于心脏或呼吸功能为 0.1Hz 到 10Hz）内的信号，所述信号接着被 ADC 数字化。（参见，举例来说，图 18）。

[0084] 在操作中，此移除信号的 DC 及低频率分量且帮助解决与心率及 / 或呼吸有关的 AC 分量。此实施例还可包含用于可变增益设定的模拟信号调节电路（未图解说明），所述模拟信号调节电路可经控制以提供适合信号（例如，不饱和的）。光源、光检测器及 / 或取样与保持的性能特性（例如，转换速率及 / 或增益带宽乘积）及功率消耗可显著高于模拟信号调节电路以实现光源的快速工作循环。在一个实施例中，可与提供到模拟信号调节电路的电力分开地控制提供到光源及光检测器的电力以提供额外电力节省。在另一实施例中，举例来说，当模拟信号调节电路在对光强度设定进行改变之后尚不稳定时，除模拟信号调节电路之外或代替模拟信号调节电路，光检测器及 / 或取样与保持的输出可由 ADC 获取

或取样以控制光源的光强度或测量所关注的生理参数。明显地，由于所关注的生理信号相对于ADC的固有分辨率通常较小，因此在一些实施例中，可调整ADC的参考电压及/或增益以增强信号质量，或可对ADC进行过取样。在又一实施例中，装置可通过（举例来说）过取样、调整ADC的参考电压及/或增益或使用高分辨率ADC而将仅取样与保持电路的输出数字化。（参见，举例来说，图19）。

[0085] 在另一实施例中，传感器装置可并入有差分放大器以放大光检测器输出中的输出的相对改变。（参见，举例来说，图22）。在一个实施例中，数字平均或数字低通滤波信号被从光检测器输出中的输出减去且在其由ADC数字化之前被放大。在另一实施例中，模拟平均或模拟低通滤波信号经由（举例来说）取样与保持电路及模拟信号调节电路的使用而被从光检测器的输出减去。可与提供到模拟信号调节电路的电力分开地控制提供到光源、光检测器及差分放大器的电力以改进电力节省。

[0086] 在一个实施例中，光检测器模块可并入有具有可变增益的跨阻抗放大器级。此配置可避免来自光源的亮周围光及/或亮所发射光的饱和或使所述饱和最小化。举例来说，在跨阻抗放大器的负反馈路径中可借助可变电阻器及/或一组多路复用电阻器来自动调整及/或减小跨阻抗放大器的增益。在本发明的实施例中，装置可通过对光源的强度进行振幅调制及对光检测器（例如，同步检测）的输出进行解调而几乎不并入对周围光的光学屏蔽。（参见，举例来说，图21）。在其它方面，如果周围光具有足以获得心率信号的亮度，那么光源可减小亮度及/或完全关断。

[0087] 在又一实施例中，可以组合形式使用前述处理技术以光学测量用户的生理参数。（参见，举例来说，图23）。此拓扑可允许传感器装置以低功率测量状态及电路拓扑（适用时）操作且如需要，适于较高功率测量状态及电路拓扑。举例来说，传感器装置可在用户不动或静坐时使用模拟信号调节电路来测量所关注的生理参数（例如，心率）以减小功率消耗，但在用户活动时直接切换到光检测器输出的过取样取样。

[0088] 本文中在生理传感器/检测器的上下文中描述及图解说明许多发明。虽然已描述及图解说明本发明的特定实施例、特征、属性及优点，但应理解，本发明的许多其它以及不同及/或类似实施例、特征、属性及优点依据说明及图解变得显而易见。因此，本发明的上述实施例仅是示范性的。其不打算为穷尽性的或将本发明限制于所揭示的确切形式、技术、材料及/或配置。根据本发明可做出许多修改及变化。

[0089] 举例来说，在其中装置包含心率监测器的实施例中，用以获得心率测量的信号的处理可包括滤波及/或信号调节，例如带通滤波（例如，巴特沃斯(Butterworth)滤波器）。为抵消信号中可能发生的大瞬变及/或为改进所述滤波的收敛，可采用非线性方法，例如神经网络或转换速率限制。可使用来自便携式生物计量监测装置上的传感器中的一者或一者以上的数据（例如对应于运动、皮电反应、皮肤温度等的数据）来调整及/或确定由装置实施的信号调节方法。在特定操作条件下，用户的心率可通过计数时间窗内的信号峰值的数目或利用信号的基本频率或第二谐波（例如，经由快速傅里叶变换(FFT)）而测量。在其它情形（例如运动）中，可对信号及所提取的频谱峰值执行FFT，所述频谱峰值随后由开始、继续、合并及删除频谱的轨迹的多个目标跟踪器处理。

[0090] 在一个实施例中，对运动信号执行一组类似操作且使用输出来进行活动鉴别（例如，静坐、行走、跑步、睡觉、半躺、坐着、骑自行车、打字、椭圆训练、举重训练），此用于辅助

多个目标跟踪器。举例来说，可确定用户曾是静止的及已开始移动，且此信息可用于优先地使轨迹延续偏向增加的频率。类似地，活动鉴别器可确定用户已停止跑动或正较缓慢地跑动，且此信息可用于优先地使轨迹延续偏向减小的频率。跟踪可借助单扫描或多扫描多目标跟踪器拓扑而实现，例如联合概率数据互联跟踪器、多个假设跟踪、最近邻等。跟踪器中的估计及预测可经由卡尔曼（Kalman）滤波器、样条回归、粒子滤波器、交互式多个模型滤波器等进行。轨迹选择器模块使用来自多频谱跟踪器的输出轨迹且估计用户的心率。所述估计可被认为是最大似然轨迹、轨迹对其为心率的概率的加权和等。此外，活动鉴别器可影响得到心率估计的选择及/或融合。举例来说，如果用户正睡觉、坐着、平躺或静坐，那么先验概率可朝向40bpm到80bpm范围中的心率偏斜；而如果用户正跑步、慢跑或做其它剧烈锻炼，那么先验概率可朝向90bpm到180bpm范围中的经提升心率偏斜。活动鉴别器的影响可基于用户的速度。当用户不移动时，所述估计可朝向信号的基本频率移位（或全部通过信号的基本频率获得）。对应于用户的心率的轨迹可基于指示活动改变的准则而选择，举例来说，如果用户从静止开始行走，那么可优先地选择图解说明朝向较高频率的移位的轨迹。

[0091] 良好心率信号的获取可经由生物计量监测装置上的显示器或与生物计量监测装置通信（举例来说，有线或无线通信（例如，配备蓝牙低功耗的移动电话））的另一装置指示给用户。在优选实施例中，生物计量监测装置包含由用户可视的LED的脉冲表示的信号强度指示符。所述脉冲可被定时为或关联为与用户的心跳一致。可修改或调整LED的强度、脉冲速率及/或色彩以表明信号强度。举例来说，较亮LED强度可表示较强信号，或在RGB类型LED配置中，绿色的LED可表示较强信号。

[0092] 在优选实施例中，心率信号的强度可通过（举例来说）0.5Hz到4Hz的频带中的信号的能量（例如，平方积累和）而确定。在另一实施例中，本发明的生物计量监测装置可具有可并入到壳体中及/或并入带中或构造成壳体及/或带的应变计、压力传感器及/或力传感器（在那些实施例中，其中生物计量监测装置附接到像手表、手镯及/或臂带的带或安装有像手表、手镯及/或臂带的带，所述带可接着被紧固到用户）。信号质量度量可借助这些接触传感器（单独地或结合来自心率信号的数据一起）而计算。

[0093] 在另一实施例中，生物计量监测装置可经由光电检测器的阵列（例如光电二极管的栅格或CCD摄像机）而以光学方式监测心率。光学装置相对于皮肤的运动可使用加速度计及陀螺仪经由皮肤的特征跟踪及/或自适应运动校正而跟踪。检测器阵列可与皮肤接触或在远离皮肤的小距离处偏移。可有源地控制（例如，借助电机）检测器阵列及其相关联光学器件以维持目标的稳定图像及获取心率信号。此光机械稳定性可使用来自运动传感器（例如，陀螺仪）的信息或图像特征而实现。在一个实施例中，生物计量监测装置可使用用以照射皮肤的相干或不相干光源及光电检测器阵列（其中每一光电检测器与用于比较邻近检测器之间的强度的比较器相关联）来实施相对运动取消，从而获得可使用多种图像跟踪技术跟踪的所谓的斑点图案，例如，举例来说，光流、模板匹配、边缘跟踪等。在此实施例中，用于运动跟踪的光源可不同于光学心率监测器中所使用的光源。

[0094] 在另一实施例中，生物计量监测装置可由沿装置触碰用户的皮肤的表面（即，生物计量监测装置的皮肤侧）分布的多个光电检测器及光发射器组成。（参见，举例来说，图2到11）。在手镯的实例中，举例来说，可存在沿带的内部的周长放置的多个光电检测器及光发射器。（参见，举例来说，图11）。可计算每一站点处的心率信号质量度量以确定用于估

计用户的心率的最佳站点或一组最佳站点。随后，所述站点中的一些站点可被停用或关断以（举例来说）减小功率消耗。装置可在所述站点中的一些站点或全部站点处周期性地检查心率信号质量以（i）选择/启用一个或一个以上传感器及/或检测器及/或（ii）确定一个或一个以上优选传感器/检测器以（举例来说）借此增强、监测及/或优化信号及/或功率效率。

[0095] 在另一实施例中，本发明的生物计量监测装置可包含包含多个传感器（例如光学、声学、压力、电（例如，EKG）及运动）的心率监测系统并融合来自这些传感器中的两者或两者以上的信息以提供心率的估计及/或减轻从运动诱发的噪声。

[0096] 除心率监测（或其它生物计量监测）之外或代替心率监测（或其它生物计量监测），在一个实施例中，生物计量监测装置包含光学传感器以跟踪或检测紫外线曝光的时间及持续时间、总室外曝光、光源类型以及所述光源（荧光灯曝光、白炽灯泡曝光、卤素灯等）的持续时间及强度、暴露于电视（基于灯类型及闪烁速率）（无论用户在室内还是在室外）、当日时间及基于光条件的位置。在一个实施例中，紫外线检测传感器可由作为光检测器驱动的反向偏置的 LED 发射器组成。由此检测器产生的光电流可通过（举例来说）测量 LED 的电容（或者，并联电容器）放电所花费的时间来表征。

[0097] 所有光学传感器均可连同其它传感器一起使用以改进上文所描述的数据的检测或用于扩增其它类型的生理或环境数据的检测。

[0098] 在生物计量监测装置包含音频或无源声传感器的情况下，所述装置可含有一个或一个以上无源声传感器，所述无源声传感器检测声音及压力且可包含但不限于麦克风、压电薄膜等。所述声传感器可安置于所述装置的一个或一个以上侧上，包含触碰或面向皮肤的侧（皮肤侧）及面向环境的侧（环境侧）。

[0099] 本发明的生物计量监测装置还可包含皮电反应 (GSR) 电路以测量用户的皮肤对情绪及物理刺激或生理改变（例如，睡眠阶段的转变）的反应。在一个实施例中，本发明是并入有由导电橡胶或织物构成的带的腕或臂装式装置，使得皮电反应电极可隐藏于带中。由于皮电反应电路可经受改变的温度及环境条件，因此其还可包含启用自动校准的电路，例如与允许已知电阻器的实时测量以表征皮电反应电路的响应的人皮肤/电极路径并联或串联的两个或两个以上可切换参考电阻器。参考电阻器可切换到测量路径中和外，使得其独立地及/或与人皮肤同时地测量。

[0100] 皮肤侧传感器将检测经由身体传输的任何类型的声音，且传感器可布置成优化 SNR 及功率消耗两者的阵列或型式。这些传感器可检测呼吸（通过听肺）、呼吸声音（喘气、打鼾）及问题、心率（听心跳）、用户的语音（经由从身体内的声带所传输的声音）。

[0101] 环境传感器

[0102] 本发明的监测装置可使用以下环境传感器中的一个环境传感器、一些环境传感器或全部环境传感器来（举例来说）获取环境数据，包含下表中所概述的环境数据。所述监测装置不限于下文指定的传感器的数目或类型，而可采用获取下表中所概述的环境数据的其它传感器。环境传感器及/或环境数据的所有组合及置换均打算归属于本发明的范围内。另外，所述装置可从对应传感器输出数据导出环境数据，但不限于可从所述传感器导出的环境数据的类型。

[0103] 明显地，本发明的监测装置可为本文中所描述的环境传感器中的一者或一者以上

或者全部环境传感器及本文中所描述的生理传感器中的一者或一者以上或者全部生理传感器。实际上，生物计量监测装置可使用现在已知或稍后开发的任何传感器来获取本文中所描述的环境数据及生理数据中的任何或全部环境数据及生理数据，所有环境数据及生理数据均打算归属于本发明的范围内。

[0104]

环境传感器	所获取的环境数据

[0105]

运动检测器	位置
可能实施例：	
-惯性、陀螺仪或加速度计	
- GPS	
压力/高度计传感器	高程
周围温度	温度
光传感器	室内对室外
	看 TV (光谱/闪烁速率检测)
	光学数据传送-起始、QR 码等
	紫外线曝光
音频	室内对室外
指南针	位置
可能实施例：	
-三轴指南针	

[0106] 在一个实施例中，举例来说，监测装置可包含安置于或位于装置壳体的内部中的高度计传感器。(参见，举例来说，图 25 及 26)。在此情形中，装置壳体可具有允许装置的内部测量、检测、取样及 / 或经历外部压力的任何改变的通气孔。在一个实施例中，所述通气孔防止水进入装置同时促进经由高度计传感器对压力的改变进行测量、检测及 / 或取样。举例来说，生物计量监测装置的外部表面可包含通气孔类型配置或架构 (例如，Gore™ 通气孔)，此允许周围空气进出装置的壳体 (此允许高度计传感器测量、检测及 / 或取样压力的改变)，但减小、防止到装置壳体中的水及其它液体渗透及 / 或使所述渗透最小化。

[0107] 在一个实施例中，高度计传感器可填充有凝胶，此允许传感器在凝胶外侧经历压力改变。凝胶填充的高度计的使用可在具有或不具有环境密封的通气孔的情况下赋予装置较高水平的环境保护。所述装置可借助凝胶填充的高度计在以下位置中具有较高耐受率，所述位置包含但不限于具有高湿度的那些位置、洗衣机、洗碗机、干衣机、蒸汽房、淋浴室、

游泳池及所述装置可能暴露于水分、暴露于液体或浸没于液体中的任何位置。

[0108] 传感器集成 / 信号处理

[0109] 本发明的生物计量监测装置可使用来自两个或两个以上传感器的数据来计算对应生理或环境数据，如在下表中可见（举例来说，来自以组合形式使用的两个或两个以上传感器的数据）。所述装置可包含但不限于下文指定的传感器的数目、类型或组合。另外，所述装置可从对应传感器组合导出所包含的数据，但不限于可依据对应传感器组合计算的数据的数目或类型。

[0110]

传感器集成	从多个传感器的信号处理导出的数据
皮肤温度及周围温度	热通量
心率及运动	高程增益
运动检测器及其它用户的运动检测器	接近的用户
运动、任何心率传感器、皮电反应	坐/站检测
任何心率、心率变异性传感器、呼吸、运动	睡眠相位检测
	睡眠呼吸暂停检测
任何心率传感器及/或湿度传感器、及/或运动检测器	静息心率
	活动心率
	睡着时的心率
	静坐时的心率
任何心率检测器	心脏问题的早期检测：
	-心律失常
	-心跳停止
多个心率检测器	脉搏传导时间
音频及/或应变计	打字检测
GPS 及光电容积描记法(PPG)	位置-应激相关：
	-应激区域的确定
	-低应激区域的确定
	活动特定心率
	-静息心率
	-活动心率
	自动活动分类及活动心率确定
心率、皮电反应、加速度计及呼吸	用户疲劳，举例来说在锻炼时

[0111] 在一个实施例中，装置还可包含近场通信 (NFC) 接收器 / 传输器以检测另一装置的接近，例如移动电话。当使装置紧密或可检测接近于第二装置时，其可触发第二装置上的新功能性的开始（例如，移动电话上的“应用”的开启及生理数据从装置到第二装置的无线电同步）。（参见，举例来说，图 16）。实际上，本发明的生物计量监测装置可实施 2012 年 3 月 5 日提出申请的美国临时专利申请案 61 / 606,559 中所描述及 / 或所图解说明的电路及技术中的任一者，所述美国临时专利申请案标题为“近场通信系统及其操作方法 (Near Field Communication System,and Method of Operating S ame)”，发明人为：詹姆斯帕克

(James Park)(所述美国临时专利申请案的内容以引用的方式并入本文中)。

[0112] 在另一实施例中,生物计量监测装置包含位置传感器(举例来说,GPS 电路)及心率传感器(举例来说,光电容积描记法电路)以分别产生 GPS 或位置相关数据及心率相关数据。(参见,举例来说,图 25 及 26)。所述生物计量监测装置可接着融合、处理及/或组合来自这两个传感器/电路的数据以根据生理数据(举例来说,心率、应激、活动水平、睡眠长短及/或热量摄取)(举例来说)确定、关联及/或"映射"地理区域。以此方式,生物计量监测装置可识别增加或减少可测量用户度量的地理区域,所述可测量用户度量包含但不限于心率、应激、活动水平、睡眠长短及/或热量摄取。

[0113] 除此之外或代替此,生物计量监测装置可采用 GPS 相关数据及光电容积描记法相关数据(明显地,其中的每一者均可认为是数据流)来根据活动水平确定或关联用户的心率,举例来说,如由用户的加速度、速度、位置及/或行进的距离所确定(如由 GPS 所测量及/或依据 GPS 相关数据所确定)。(参见,举例来说,图 25 及 26)。此处,在一个实施例中,可针对用户"标绘"或关联作为速度的函数的心率,或可将数据分解成不同层级,包含但不限于睡觉、休息、静坐、中等活动、活动及高度活动。

[0114] 实际上,生物计量监测装置还可使 GPS 相关数据与针对一组预定条件具有与其相关联的活动的预定地理位置的数据库相关。举例来说,活动确定及对应生理分类(举例来说,心率分类)可包含使对应于锻炼设施、健康俱乐部及/或健身房的位置的用户的 GPS 坐标与生理数据相关。在这些情况下,可自动测量及显示在(举例来说)健身房练习期间的用户的心率。明显地,许多生理分类可是基于 GPS 相关数据的,包含位置、加速度、海拔、距离及/或速度。包含地理数据及生理数据的此数据库可编译、发展及/或存储于生物计量监测装置及/或外部计算装置上。实际上,在一个实施例中,用户可形成其自己的位置数据库或添加或修改位置数据库以较好地对其活动进行分类。

[0115] 在另一实施例中,用户可同时佩戴多个生物计量监测装置(具有本文中所描述的特征中的任一者)。此实施例的装置可使用有线或无线电路彼此通信或与远程装置通信以计算(举例来说)可难以或不准确地以其它方式计算的(举例来说)生物计量或生理质量或数量,例如脉搏传导时间。多个传感器的使用还可将生物计量测量的准确性及/或精确性改进为优于单个传感器的准确性及/或精确性。举例来说,在腰部、手腕及踝上具有装置可将对用户迈步的检测改进为优于那些位置中的仅一者中的单个装置的检测。可以分布式或集中式方法对所述装置执行信号处理以提供优于单个装置的测量的改进的测量。此信号处理还可远程地执行且在处理之后往回传递到装置。

[0116] 处理任务授权

[0117] 生物计量监测装置可包含一个或一个以上处理器。(参见,举例来说,图 29 到 31)。举例来说,独立应用处理器可用于存储及执行利用由一个或一个以上传感器处理器(处理来自生理传感器、环境传感器及/或活动传感器的数据的处理器)获取及处理的传感器数据的应用。在其中存在多个传感器的情形中,还可存在多个传感器处理器。应用处理器还可具有直接连接到其的传感器。传感器及应用处理器可作为单独离散芯片存在或存在于相同经封装芯片(多核心)内。一装置可具有一单个应用处理器,或一应用处理器及传感器处理器,或者多个应用处理器及传感器处理器。

[0118] 在一个实施例中,传感器封装可放置于包含模拟组件的子板上。此板可具有通常

以主 PCB 为基础的电子器件中的一些电子器件，例如但不限于：跨阻抗放大器、滤波电路、电平移位器、取样与保持电路及微控制器单元。此配置可允许子板经由（除任何必需电力或接地连接之外）数字连接而非模拟连接的使用而被连接到主 PCB。数字连接可具有优于模拟子 PCB 连接或主 PCB 连接的多种优点，包含但不限于：噪声的减小及所需电缆的数目的减小。子板可经由柔性电缆或一组电线的使用而连接到主板。

[0119] 多个应用可存储于应用处理器上。应用可由用于所述应用的可执行码及数据组成，但不限于这些可执行码及数据。数据可由执行应用所需的图形或其它信息及 / 或由所述应用产生的信息输出组成。用于所述应用的可执行码及数据两者均可驻存于应用处理器上，或用于所述应用的数据可存储于外部存储器且自外部存储器检索。外部存储器可包含但不限于 NAND 快闪、NOR 快闪、另一处理器上的快闪、其它固态存储装置、机械硬盘或光盘及 / 或 MRAM。

[0120] 用于应用的可执行码还可存储于外部存储器上。当请求执行应用时，应用处理器从外部存储装置检索可执行码及 / 或数据并执行其。可执行码可暂时地或永久地存储于应用处理器的存储器或存储装置上。此允许对下一执行请求较快地执行所述应用，这是因为消除了检索步骤。当请求执行应用时，应用处理器可检索应用的所有可执行码或可执行码的部分。在检索可执行码的部分的情形中，仅检索当时所需的可执行码的一部分。此允许执行大于应用处理器的存储器或存储装置的应用。

[0121] 应用处理器还可具有存储器保护特征以防止应用重写、损坏、中断、阻塞或以其他方式干扰其它应用、传感器系统、应用处理器或系统及 / 或传感器装置的其它组件。

[0122] 应用可经由多种有线、无线、光学、电容性机构（包含但不限于：USB、Wi-Fi、蓝牙、蓝牙低功耗、NFC、RFID 及 Zigbee）加载到应用处理器或任何外部存储装置上。

[0123] 在一个实施例中，应用可与电子签名加密地签订。因此，应用处理器可将应用的执行约束于具有正确签名的那些应用。

[0124] 佩戴装置的方法

[0125] 生物计量监测装置可包含具有在正常操作期间促进将装置固定到用户的身体（或衣服）的大小及形状的壳体，其中当耦合到用户时，所述装置不可测量地或不明显地影响用户的活动。取决于集成到所述装置中的特定传感器封装及用户想要获取的数据，可以不同方式佩戴装置。

[0126] 用户可借助为柔性的且借此易于装配到用户的带的使用将本发明的生物计量监测装置中的一者或一者以上佩戴于其手腕或踝（或于臂或腿）上。所述带可具有可调整周长，从而允许其装配到用户。所述带可由在暴露于热时收缩的材料构造，从而允许用户形成定制装配。所述带可与生物计量监测装置的“电子”部分拆开，且需要时，可替换。

[0127] 在优选实施例中，生物计量监测装置由两个主要组件组成：主体（含有“电子器件”）及带（促进将装置附接到用户）。所述主体可包含壳体（举例来说，由塑料或塑料类材料制成）及从主体突出的扩展突片（举例来说，由金属或金属类材料制成）。（参见，举例来说，图 4 到 7）。所述带（举例来说，由热塑性氨基甲酸乙酯制成）可机械地或粘着地附接到主体。所述带可延伸出用户的手腕的周长一小部分。氨基甲酸乙酯带的远端可与维可牢、钩及 / 或在一侧上以环缠绕 D 形环且接着往回附接到其自身的环形弹性织物带连接。在此实施例中，闭合机构将允许用户进行无限带长度调整（与分度孔及机械扣封不同）。维可牢

或织物可以允许其被替换（举例来说，如果其被磨损或者在装置的有效期或寿命终止之前不想要佩戴）的方式附接到带。在一个实施例中，维可牢或织物将借助螺钉或铆钉及/或胶、粘合剂及/或卡环附接到带。

[0128] 本发明的生物计量监测装置还可集成且佩戴于项链、胸带、胸罩、眼罩、眼镜、耳环或脚带中。所述装置可以此方式构建：生物计量监测装置的传感器封装/部分是可拆卸的且可以任何数目种方式佩戴，包含但不限于上文所列的那些方式。

[0129] 在另一实施例中，本发明的生物计量监测装置可被夹持到衣物或放置于衣服（例如，口袋）或附件（例如，手提包、背包、钱包）中。由于生物计量监测装置可不接近用户的皮肤，因此在包含心率测量的实施例中，所述测量可通过用户手动地将装置至于特定模式（例如，可能在心率传感器嵌入按钮/传感器中的情况下，按下按钮、覆盖电容性触摸传感器等）中或一旦用户抵靠皮肤而放置装置（例如，将手指放到光学心率传感器）便自动地以离散“按需”情境获得。

[0130] 装置的用户接口

[0131] 生物计量监测装置可包含与装置本地或远程地交互的一种或一种以上方法。

[0132] 在一个实施例中，生物计量监测装置可经由数字显示器直观地输送数据。此显示器的物理实施例可使用任何一种或多种显示器技术，包含但不限于：LED、LCD、AMOLED、电子墨水、夏普（Sharp）显示器技术、图形显示器及其它显示器技术（例如 TN、HTN、STN、FSTN、TFT、IPS 及 OLET）中的一者或一者以上。此显示器可展示所述装置上本地所获取或所存储的数据或者可显示其它装置或因特网服务远程所获取的数据。所述装置可使用传感器（举例来说，周围光传感器，即“ALS”）来控制或调整屏幕背光。举例来说，在暗照明情形中，所述显示器可为暗淡的以节约电池寿命，而在亮照明情形中，显示器可增加其亮度，使得其较易于被用户读取。

[0133] 在另一实施例中，装置可使用单色或多色 LED 来指示装置的状态。装置指示的状态可包含但不限于生物计量状态（例如心率）或应用状态（例如已实现目标的传入消息）。这些状态可经由 LED 的色彩、接通、关断、中间强度、脉冲（及/或其速率）及/或从完全关断到最大亮度的光强度的型式而指示。在一个实施例中，LED 可借助用户的心率的相位及频率来调制其强度及/或色彩。

[0134] 在优选实施例中，电子墨水类型显示器或技术的使用将允许显示器保持继续而不会出现非反射显示器的电池耗尽。此“总是接通”功能性可在（举例来说）其中用户可仅瞥一眼装置来看时间的手表应用的情形中提供令人愉快的用户经历。电子墨水显示器总是在不使装置的电池寿命受损的情况下显示内容，从而允许用户就像其带传统手表一样看时间。

[0135] 装置可通过调制以用户的心率的频率发射的光的振幅使用灯（例如 LED）来显示用户的心率。所述装置可根据心率的改变（例如，进度条）经由 LED 的色彩（例如，绿色、红色）或 LED 点亮的顺序而描绘心率区（例如，有氧、无氧）。所述装置可集成或并入到另一装置或结构（举例来说，眼镜或护目镜）中或与眼镜或护目镜通信以将此信息显示给用户。

[0136] 生物计量监测装置还可经由装置的物理运动将信息输送给用户。物理移动装置的方法的一个此实施例是振动诱发电机（举例来说，振打电机/振动电机）的使用。该装置

可单独地或结合多个运动诱发技术一起使用此方法。

[0137] 所述装置可经由音频将信息输送给用户。扬声器可经由音频音调、语音、歌曲或其它声音的使用输送信息。

[0138] 这三个信息通信方法（即，视觉、运动及听觉）可单独地或结合彼此或另一通信方法一起使用以传递以下信息中的任一者或多者：

[0139] • 用户需要在特定时间唤醒

[0140] • 用户应在其处于特定睡眠阶段时唤醒

[0141] • 用户应在特定时间时去睡觉

[0142] • 用户应在其处于特定睡眠阶段及处于由用户希望唤醒的最早及最晚时间限定的预选时间窗中时唤醒。

[0143] • 接收电子邮件

[0144] • 用户已不活动达特定时间周期。明显地，此可与像（举例来说）会议日历或睡眠跟踪应用的其它应用集成在一起以阻拦、减小或调整不活动警告的行为。

[0145] • 用户已活动达特定时间周期

[0146] • 用户具有约定或日历事件

[0147] • 用户已达到特定活动度量

[0148] • 用户已行进特定距离

[0149] • 用户已达到特定英里速度

[0150] • 用户已达到特定速度

[0151] • 用户已积累特定高程增益

[0152] • 用户已进行特定步数

[0153] • 用户近期已得到心率测量

[0154] • 用户的心率已达到特定水平

[0155] • 用户具有特定值的或在特定范围内的正常心率、活动心率或静息心率

[0156] • 用户的心率已进入或超出特定目标范围或训练区

[0157] • 用户具有要实现的新心率“区”目标，如在针对跑步、骑自行车、游泳等活动进行心率区训练的情形中

[0158] • 用户已在游泳池中游了一圈或已完成特定圈数

[0159] • 外部装置具有需要传递到用户的信息，例如呼入电话或以上警告中的任一者

[0160] • 用户已达到特定疲劳目标或极限。在一个实施例中，疲劳可经由心率、皮电反应、运动传感器及/或呼吸数据的组合而确定

[0161] 这些实例是出于图解说明目的而提供且并不打算限制可由装置传递（举例来说，到用户）的信息的范围。注意，可从第一装置及/或一个或一个以上辅助装置获取用于确定是否满足警告的数据。所述装置自身可确定是否已满足警告的准则。或者，与所述装置通信的计算装置（例如服务器及/或移动电话）可确定何时应发生警告。鉴于本发明，所属领域的技术人员可设想装置可传递到用户的其它信息。举例来说，当满足目标时，装置可与用户通信。用于满足此目标的准则可是基于第一装置上的生理、情境及环境传感器及/或来自一个或一个以上辅助装置的其它传感器数据。所述目标可由用户设定或可由装置自身及/或与所述装置通信的另一计算装置（例如服务器）设定。在示范性实施例中，当满

足生物计量目标时，装置可振动。

[0162] 本发明的生物计量监测装置可配备有无线及/或有线通信电路以在辅助装置上实时地显示数据。举例来说，本发明可能够经由蓝牙低功耗与移动电话通信以便向用户给出心率、心率变异性及/或应激的实时反馈。本发明可指导或授用户以缓和应激的特定方式喘气的“点”。应激可经由心率、心率变异性、皮肤温度、运动-活动数据的改变及/或皮电反应而量化或评估。

[0163] 生物计量监测装置可经由一个或一个以上本地或远程输入方法接收来自用户的输入。本地用户输入的一个此实施例可使用一传感器或一组传感器来将用户的移动转变成到装置的命令。此些运动可包含但可不限于轻敲、转动手腕、使一个或一个以上肌肉收缩及游泳。另一用户输入方法可是经由按钮的类型的使用，但不限于以下类型：电容性触摸按钮、电容性屏幕及机械按钮。在一个实施例中，用户接口按钮可由金属制成。在屏幕使用电容性触摸检测的情形中，其可在不具有介入事件（例如推动物理按钮）的情况下总是对任何手势或输入进行取样且易于对任何手势或输入做出响应。所述装置还可经由音频命令的使用而得到输入。所有这些输入方法可在本地集成到装置中或集成到可经由有线或无线连接与所述装置通信的远程装置中。另外，用户还可能够经由远程装置操纵所述装置。在一个实施例中，此远程装置可具有因特网连接。

[0164] 在一个实施例中，本发明的生物计量监测装置可操作为腕装式振动报警以静静地将用户从睡眠中唤醒。生物计量监测装置可经由心率、心率变异性、皮电反应、运动感测（例如，加速度计、陀螺仪、磁力计）及皮肤温度中的一者或其组合跟踪用户的睡眠质量、唤醒周期、入眠时间、睡眠效率、睡眠阶段（例如，深度睡眠对REM）及/或其它睡眠相关度量。用户可指定所要报警时间且本发明可使用睡眠度量中的一者或一者以上来确定唤醒用户的优选时间。在一个实施例中，当振动报警作用时，用户可通过拍打或轻敲装置（举例来说，此经由装置中的运动传感器、压力/力传感器及/或电容性触摸传感器而检测到）而致使其休眠或关断。在一个实施例中，装置可试图通过在报警设定之前的特定用户睡眠阶段或时间开始小振动而在睡眠循环中的最优点处唤起用户。当用户朝向醒觉或朝向报警设定逐渐前进时，其可逐渐增加振动的强度或显著性。（参见，举例来说，图14）。

[0165] 在另一方面中，生物计量监测装置可使用板上光学传感器（例如光学心率监测器中的组件）而配置或通信。

[0166] 无线连接及数据传输

[0167] 本发明的生物计量监测装置可包含用于传输及接收来自因特网及/或其它装置的信息的无线通信手段。所述无线通信可由一个或一个以上手段（例如蓝牙、ANT、WLAN、电力线网络连接及移动电话网络）组成。这些是作为实例而提供且不排除现存或尚未发明的其它无线通信方法。

[0168] 无线连接为两种方式。装置可将其数据传输、传递及/或推动到其它外围装置及/或因特网。装置还可从其它外围装置及/或因特网接收、请求及/或拉动数据。

[0169] 生物计量监测装置可充当继电器以提供其它装置到彼此间或到因特网的通信。举例来说，装置可经由WLAN连接到因特网，但还配备有ANT无线电。ANT装置可与所述装置通信以经由所述装置的WLAN将其数据传输到因特网（且反之亦然）。作为另一实例，所述装置可配备有蓝牙。如果启用蓝牙的智能电话触及装置，那么所述装置可经由智能电话的移

动电话网络将数据传输到因特网或从因特网接收数据。来自另一装置的数据还可被传输到所述装置并被存储（且反之亦然）或在稍后时间进行传输。

[0170] 本发明还可包含流动式接收或传输网页内容以供在生物计量监测装置上显示。以下是典型实例：

[0171] • 由装置测量但远程地存储的心率及 / 或其它数据的历史图表

[0172] • 由其它装置测量及 / 或远程地（例如，fitbit.com）存储的用户活动及 / 或所消耗的食物及 / 或睡眠数据的历史图表

[0173] • 远程地存储的其它跟踪用户的数据的历史图表。实例包含心率、血压、动脉僵硬度、血糖水平、胆固醇、TV 观看持续时间、玩视频游戏的持续时间、情绪等

[0174] • 基于用户的心率、当前体重、体重目标、食物摄取、活动、睡眠及其它数据中的一者或一者以上的指导及 / 或节食数据。

[0175] • 用户朝向心率、体重、活动、睡眠及 / 或其它目标逐渐前进。

[0176] • 用以描述前述数据的概括统计、图形、标志及 / 或度量（例如，“等级”）

[0177] • 借助类似装置及 / 或跟踪方法显示给用户及其“朋友”的前述数据

[0178] • 社交内容，例如推特源（Twitter Feed）、即时消息及 / 或脸谱网（Facebook）更新

[0179] • 其它在线内容，例如报纸文章、星座物语、天气报告、RSS 源、漫画、填字游戏、分类广告、股票报告及网站

[0180] • 电子邮件消息及日程表

[0181] 内容可根据不同情境递送到生物计量监测装置。举例来说，在早晨，可连同用户前一夜的睡眠数据一起显示新闻及天气报告。在晚上，可显示当日活动的每日总结。

[0182] 本发明还可包含 NFC、RFID 或可用于起始其它装置中的功能性的其它短程无线通信电路。举例来说，本发明可配备有 NFC 天线，使得当用户将其放到紧接近于移动电话时，移动电话上自动开启应用。

[0183] 这些实例是出于图解说明目的而提供且并不打算限制可由所述装置传输、接收或显示的数据的范围或在此传送及显示期间可能发生的任何中间处理。鉴于本发明 / 申请案，所属领域的技术人员可设想许多其它数据。

[0184] 充电及数据传输

[0185] 生物计量监测装置可使用有线连接来对内部可再充电电池进行充电及 / 或将数据传送到主机装置，例如膝上型计算机或移动电话。在一个实施例中，所述装置可使用磁铁来帮助用户将装置与坞或电缆对准。坞或电缆中的磁铁及装置自身中的磁铁的磁场策略上可经定向以迫使装置自对准且提供保持装置与坞或电缆对准的力。所述磁铁还可用作用于充电或数据传输的导电触点。在另一实施例中，永久性磁铁仅用于坞或电缆侧中，而不用于装置自身中。此可在生物计量监测装置采用磁力计的情况下改进所述装置的性能。在装置中具有磁铁的情况下，附近永久性磁铁的强场可增加磁力计准确地测量地球磁场的困难。

[0186] 在另一实施例中，所述装置可在装置主体中含有一个或一个以上电磁铁。用于充电及数据传输的充电器或坞还将含有电磁铁及 / 或永久性磁铁。所述装置可仅在其靠近充电器或坞时接通其电磁铁。其可通过使用磁力计寻找充电器或坞中的永久性磁铁的磁场信号而检测坞的接近。或者，其可通过测量来自充电器或坞的无线信号的所接收信号强度指

示或 RSSI 而检测充电器的接近。所述电磁铁可被反向，从而形成在装置不需要充电、同步时或在其已完成同步或充电时从充电电缆或坞排斥所述装置的力。

[0187] 可配置应用功能性

[0188] 在一些实施例中，本发明的生物计量监测装置可包含手表样外观尺寸及 / 或手镯、臂章或踝套外观尺寸且可编程有开启特定功能性及 / 或显示特定信息的“应用”。应用可通过多种手段或技术而开启或关闭，借此在装置内侧形成高度计检测到的压力信号或靠近与一应用或一组应用相关联的 NFC 标签放置装置，所述多种手段或技术包含但不限于按压按钮、使用电容性触摸传感器、执行加速度计检测到的手势、移动到 GPS 或运动传感器检测到的位置、压紧装置主体。应用还可通过特定环境或生理条件自动触发开启或关闭，包含但不限于：高心率、使用湿传感器的对水的检测（举例来说，以开启游泳应用）、当日的特定时间（举例来说，以在晚上开启睡眠跟踪应用）、压力的改变及飞机起飞或降落的运动特性以开启或关闭“飞机”模式应用。应用还可通过同时满足多个条件而开启或关闭。举例来说，如果加速度计检测到用户正跑动且用户按压按钮，那么其可开启计步器应用、高度计数据收集应用及 / 或显示器。在其中加速度计检测到游泳且用户按压相同按钮的另一情形中，其可开启圈计数应用。

[0189] 在一个实施例中，所述装置可具有可通过开始游泳应用而开启的游泳跟踪模式。在此模式中，装置的运动传感器及 / 或磁力计可用于检测游泳姿势、对游泳姿势类型进行分类、检测游泳圈数及其它相关度量，例如姿势效率、单圈时间、速度、距离及卡路里燃烧。由磁力计指示的方向改变可用于检测圈转弯方法的差异。在优选实施例中，来自运动传感器及 / 或压力传感器的数据可用于检测姿势。

[0190] 在另一实施例中，骑自行车应用可通过接近位于自行车上、自行车上的座架上或与自行车相关联的位置（包含但不限于自行车停车架或自行车存放设施）中的 NFC 或 RFID 标签移动装置而开启。（参见，举例来说，图 16）。所开启的应用可使用与通常用于确定包含但不限于燃烧的卡路里、行进的距离及获得的高程的度量不同的算法。所述应用还可在检测到无线自行车传感器（包含但不限于车轮传感器、GPS、节奏传感器或功率计）时被开启。所述装置可接着显示及 / 或记录来自无线自行车传感器或自行车传感器的数据。

[0191] 额外应用包含但不限于可编程或可定制手表面、秒表、音乐播放器控制器（例如，mp3 播放器远程控制）、文字消息及 / 或电子邮件显示器或“通知器”、导航指南针、自行车计算机显示器（当与单独或集成 GPS 装置、车轮传感器或功率计通信时）、举重跟踪器、仰卧起坐代表跟踪器、引体向上代表跟踪器、阻力训练形式 / 练习跟踪器、高尔夫挥杆动作分析器、网球（或其它有球拍运动）挥杆动作 / 发球分析器、网球比赛挥杆动作检测器、棒球挥杆动作分析器、掷球分析器（例如，足球、棒球）、组织的体育活动强度跟踪器（例如，足球、棒球、篮球、排球、英式足球）、飞盘投掷分析器、食物咀嚼检测器、打字分析器、倾斜传感器、睡眠质量跟踪器、闹钟、应力计、应激 / 放松生物反馈游戏（例如，可能与提供听觉及 / 或视觉提示的移动电话组合以在放松锻炼中训练用户喘气）、刷牙跟踪器、吃饭速率跟踪器（例如，以针对食物摄取计数或跟踪将餐具拿到嘴边的速率及持续时间）、醉态或驾驶机动车辆适宜性指示器（例如，经由心率、心率变异性、皮电反应、步伐分析、解谜等等）、过敏跟踪器（例如，使用皮电反应、心率、皮肤温度、花粉感测等等，可能结合来自（举例来说）因特网的外部季节性过敏原跟踪；可能确定用户对特定形式的过敏原（例如，树花粉）的反应

且警告用户此些过敏原的存在（例如，来自季节信息、花粉跟踪数据库或装置中的或用户所采用的本地环境传感器））、发烧跟踪器（例如，测量发烧、感冒或其它病的风险、开始或恶化，可能结合季节数据、疾病数据库、用户位置及／或用户提供的反馈一起来评估关于用户的特定疾病（例如，流感）的传播，且可能作为响应规定或建议工作或活动的节制）、电子游戏、咖啡因影响跟踪器（例如，响应于咖啡、茶、功能饮料及／或其它含咖啡因的饮品的摄取或节制而短期或长期监测例如心率、心率变异性、皮电反应、皮肤温度、血压、应激、睡眠及／或活动的生理反应）、药物影响跟踪器（例如，类似于先前所提及咖啡因跟踪器，但与其它介入有关，无论其它介入是医疗药物还是保健药物，例如酒精、烟草制品等）、耐力运动指导（例如，利用来自（举例来说）历史锻炼活动（例如，长跑、步速）、心率、心率变异性、健康／病症／应激／发烧状态的数据根据用户指定目标（例如马拉松、三项全能或定制目标）而推荐或规定跑步／骑自行车／游泳练习的强度、持续时间或量变曲线，或建议练习的节制或延迟）、体重及／或身体组成、血压、血糖、食物摄取或卡路里平衡跟踪器（例如，通知用户其可消耗多少卡路里以维持或实现体重）、计步器及咬指甲检测器。在一些情形中，所述应用可仅依赖于本发明的处理能力及传感器。在其它情形中，所述应用可融合或仅显示来自一外部装置或一组外部装置的信息，包含但不限于心率带、GPS 距离跟踪器、身体组成比例、血压监测器、血糖监测器、手表、智能手表、移动通信装置（例如智能电话或平板计算机）或服务器。

[0192] 在一个实施例中，所述便携式监测装置可控制辅助装置上的音乐播放器。可控制的音乐播放器的方面包含但不限于音量、音轨选择及／或播放列表、向前跳过或向后跳过、音轨的快进或后退、音轨的节奏及音乐播放器均衡器。音乐播放器的控制可是经由用户输入的或基于生理、环境或情境数据自动的。举例来说，用户可能够通过经由装置上的用户接口选择音轨而选择及播放其智能电话上的音轨。在另一实例中，便携式监测装置可基于用户的活动水平（依据装置传感器数据计算的活动水平）而自动挑选适当音轨。此可用于帮助激励用户维持特定活动水平。举例来说，如果用户继续跑步或希望将其心率保持在特定范围中，那么在其心率低于其为目标的范围的情况下，所述装置可播放上升或较高节奏的音轨。

[0193] 本文中描述及图解说明许多发明。虽然已描述及图解说明本发明的特定实施例、特征、属性及优点，但应理解，本发明的许多其它以及不同及／或类似实施例、特征、属性及优点依据说明及图解变得显而易见。因此，本发明的上述实施例仅是示范性的。其不打算为穷尽性的或将本发明限制于所揭示的确切形式、技术、材料及／或配置。根据本发明可做出许多修改及变化。应理解，可利用其它实施例且可在不背离本发明的范围的情况下做出操作改变。因此，本发明的范围不仅限于上述说明，这是因为已出于图解及说明的目的呈现上述实施例的说明。

[0194] 重要地，本发明既不限于任何单一方面或实施例，也不限于此些方面及／或实施例的任何组合及／或置换。此外，可单独地或结合本发明的其它方面及／或实施例中的一者或一者以上一起采用本发明的方面及／或其实施例中的每一者。为简洁起见，本文中将不再分别详细地论述及／或图解说明那些置换及组合中的许多置换及组合。

[0195] 除其它外，权利要求书中的术语“计算（calculate）”及其它形式（即，计算（calculating、calculated 及 calculation））意指计算（calculate）、评估（assesses）、确

定（determine）及/或估计（estimate）及其等的其它形式。另外，除其它外，权利要求书中的术语“光管”（或其复数形式）意指光管、导光管、光路径或优先地沿预定路径（举例来说，由光管的几何形状及/或材料界定的路径）引导或透射光的其它透光结构。此外，在权利要求书中，除其它外，“经散射”意指经散射及/或经反射。

[0196] 明显地，本文中的术语“第一”、“第二”等等并不表示任何次序、数量或重要性，而是用于区分一个元件与另一元件。此外，在权利要求书中，本文中的术语“一（a及an）”不表示对数量的限制，而是表示存在所提及物项中的至少一者。

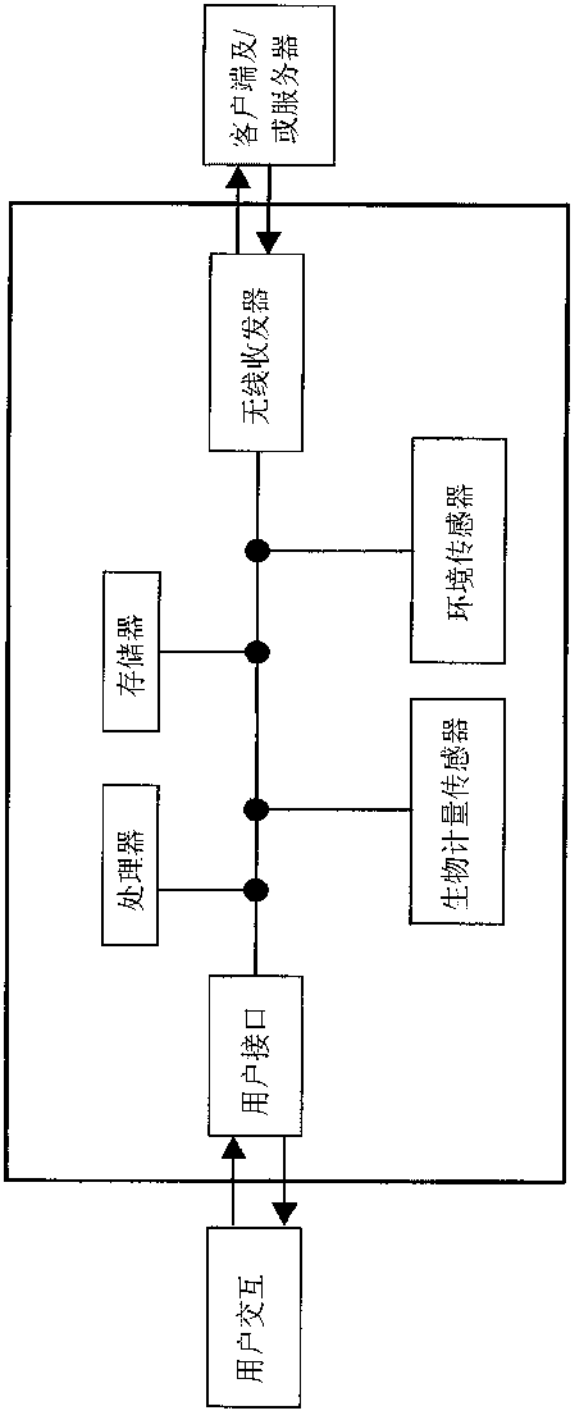


图 1

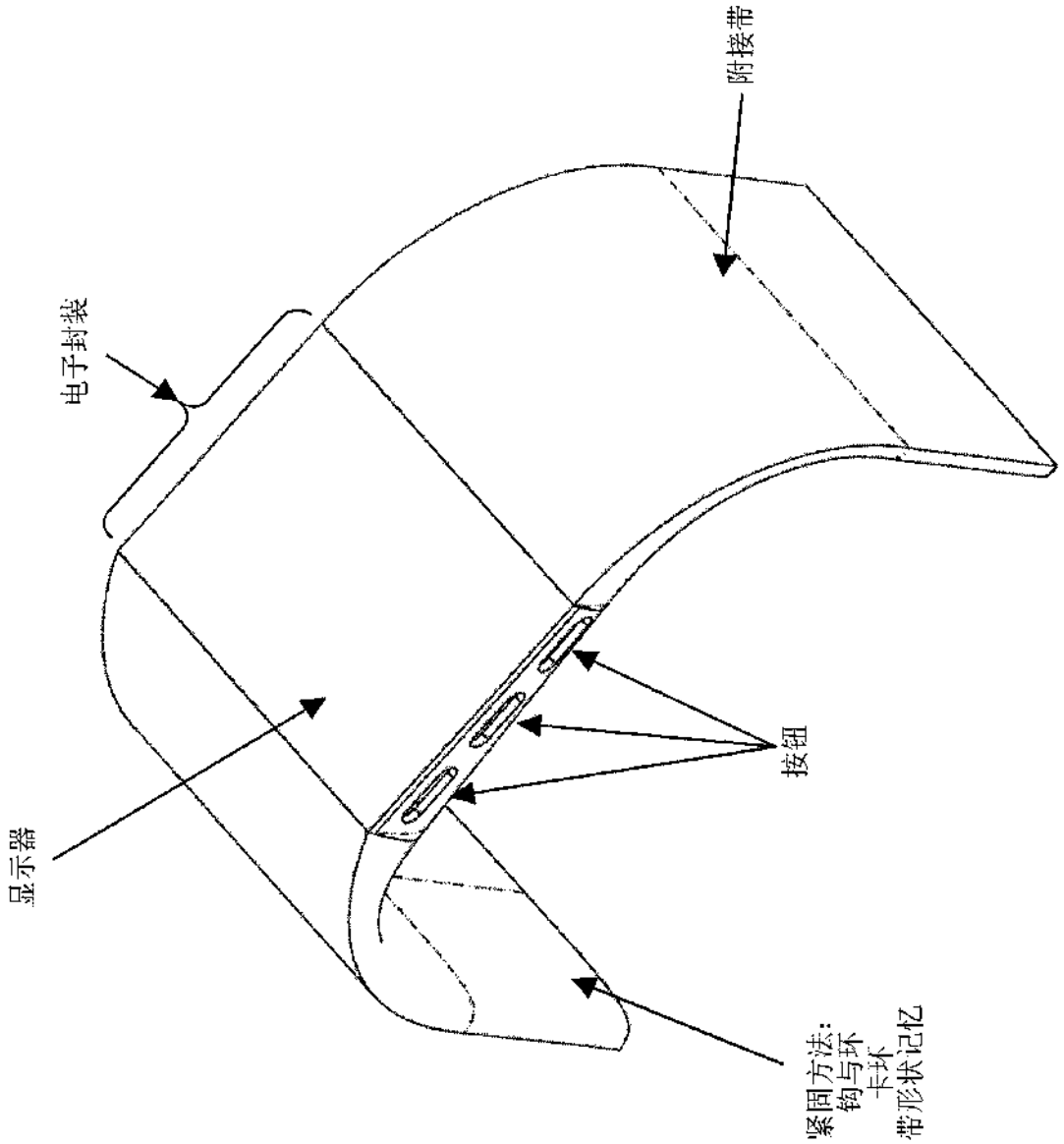


图 2

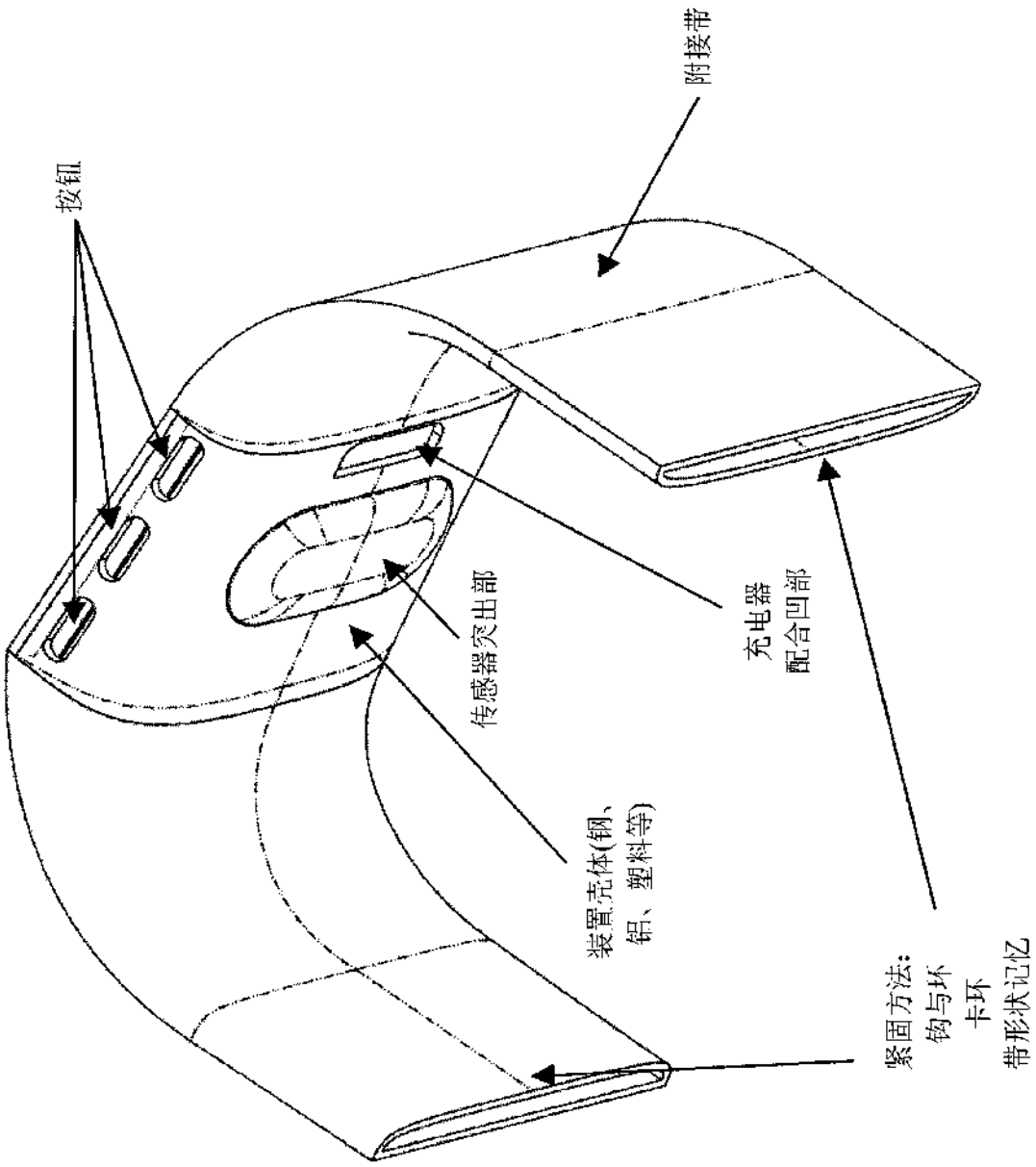


图 3

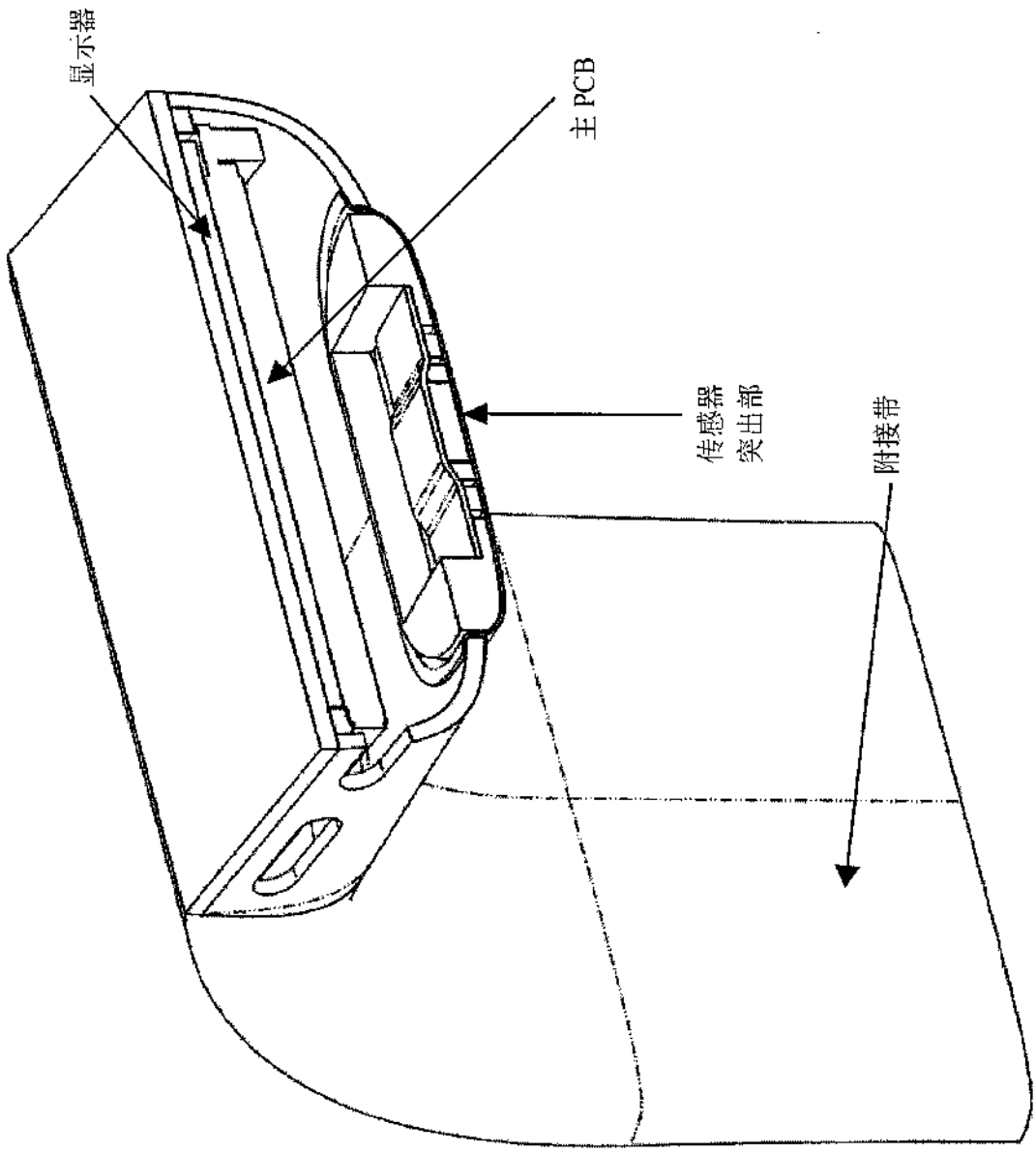


图 4

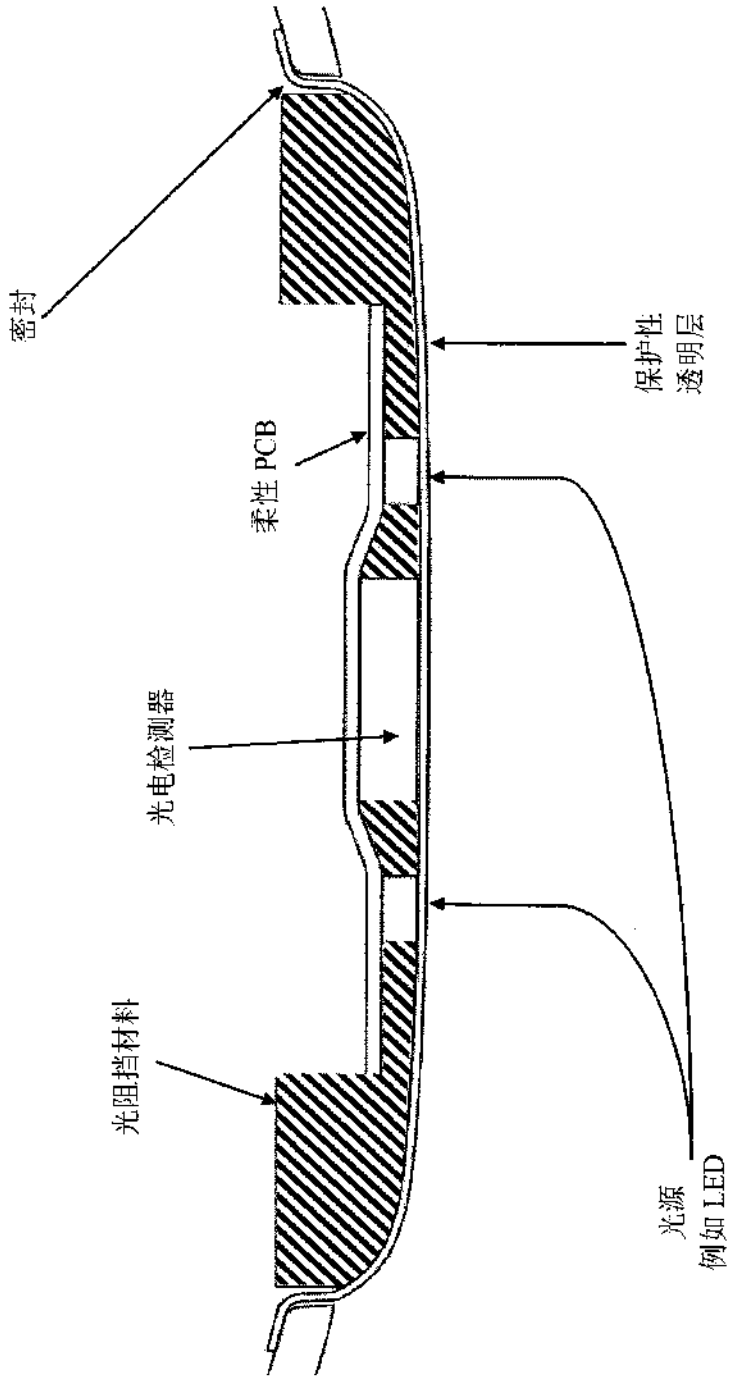


图 5

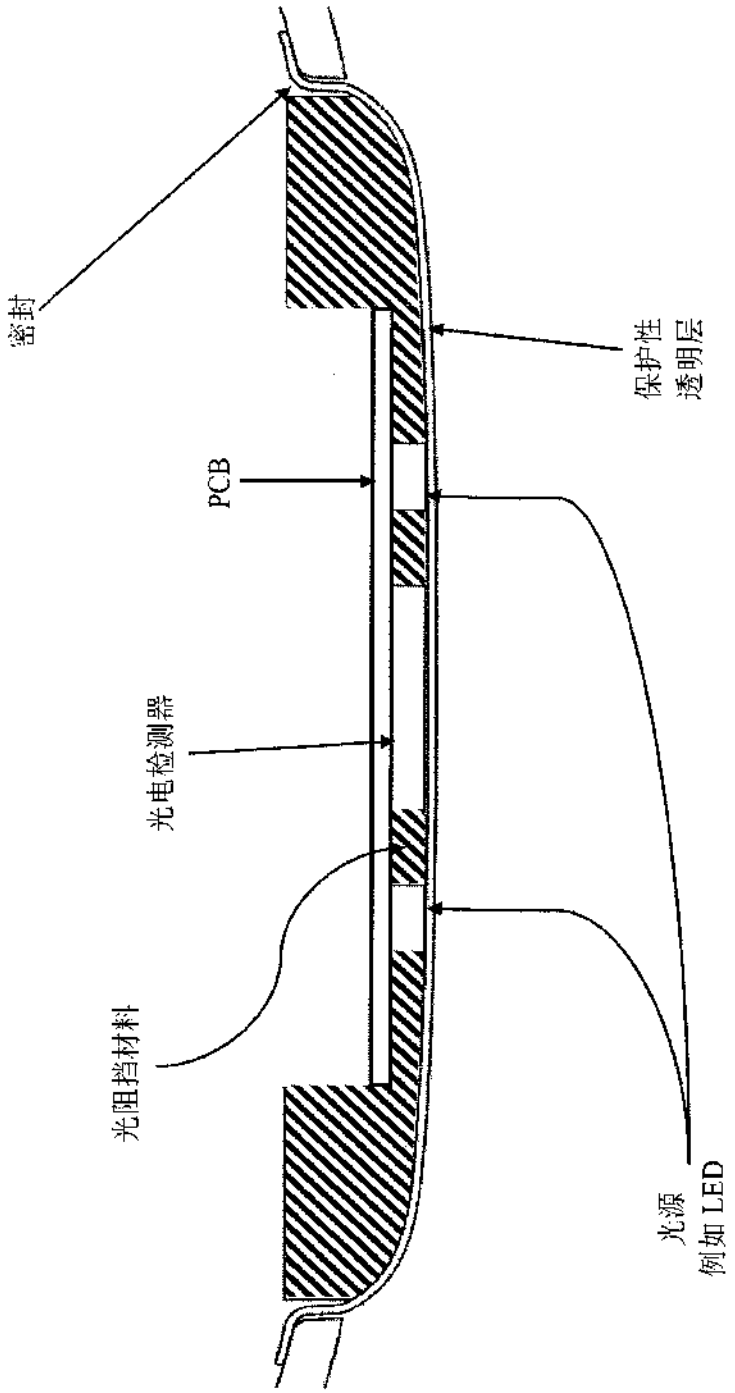


图 6

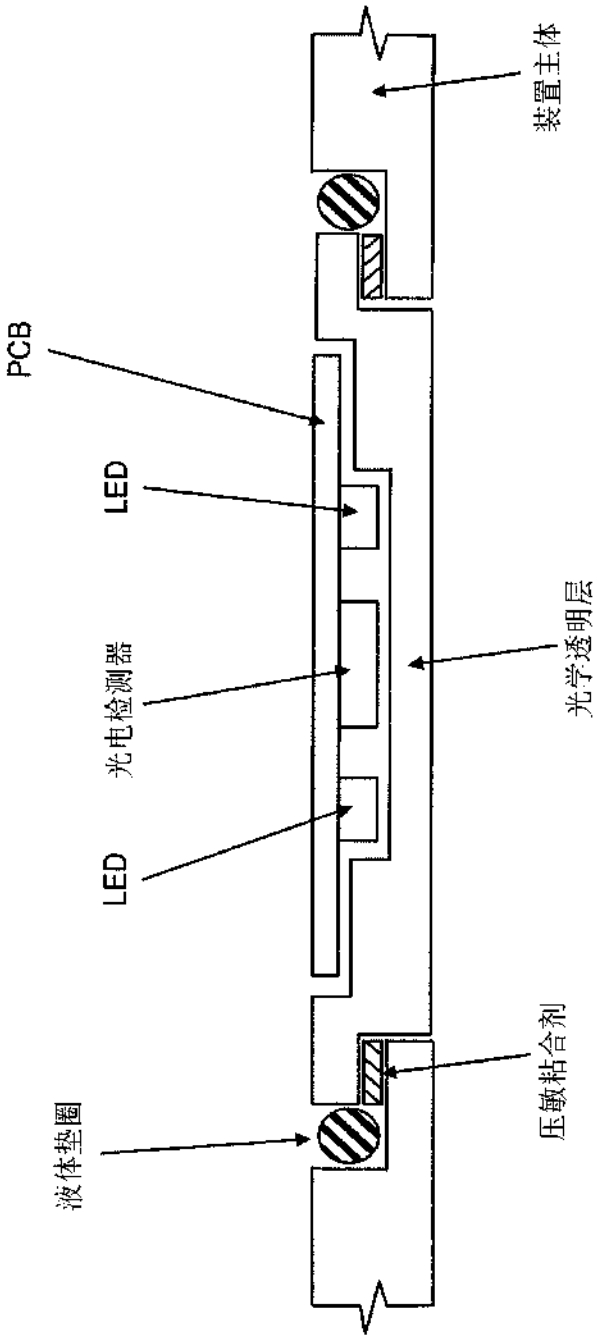


图 7

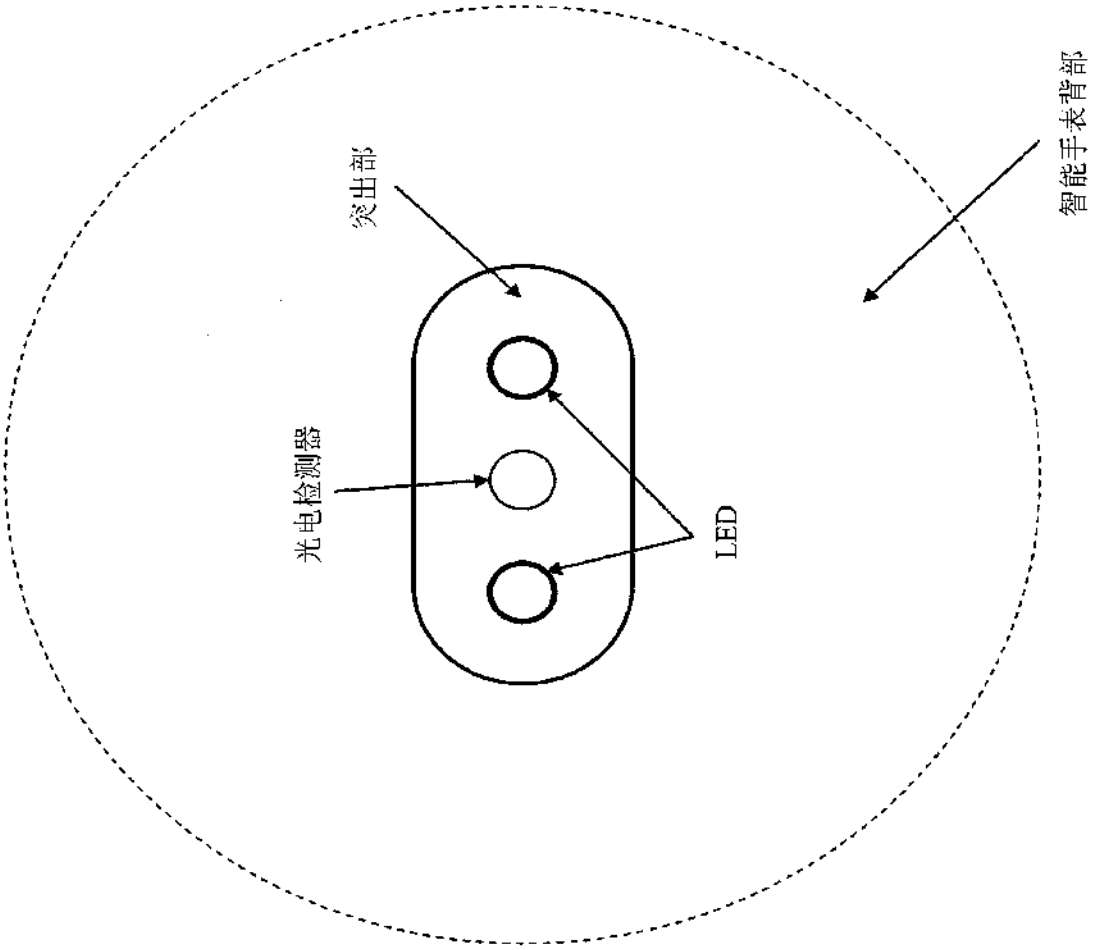


图 8

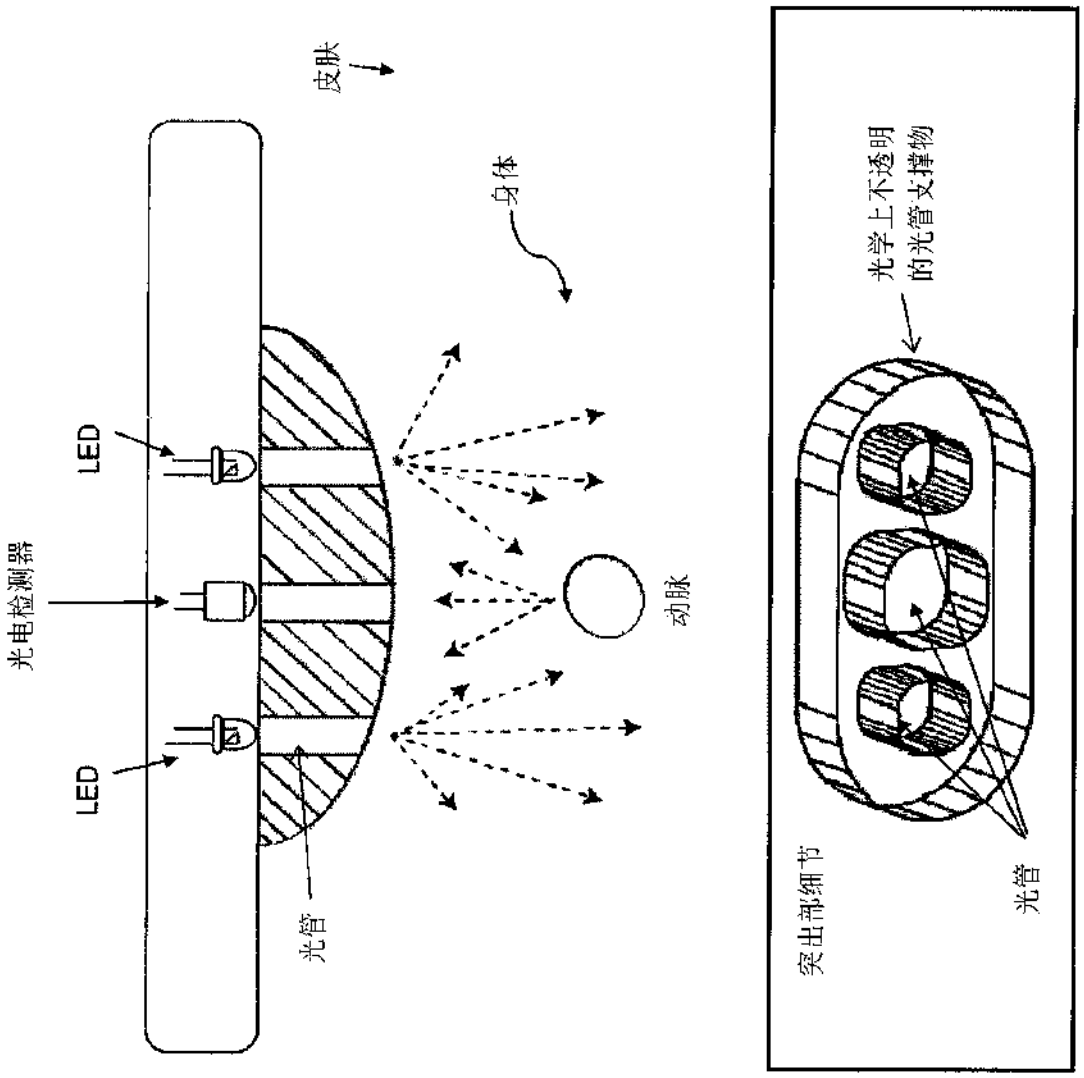


图 9

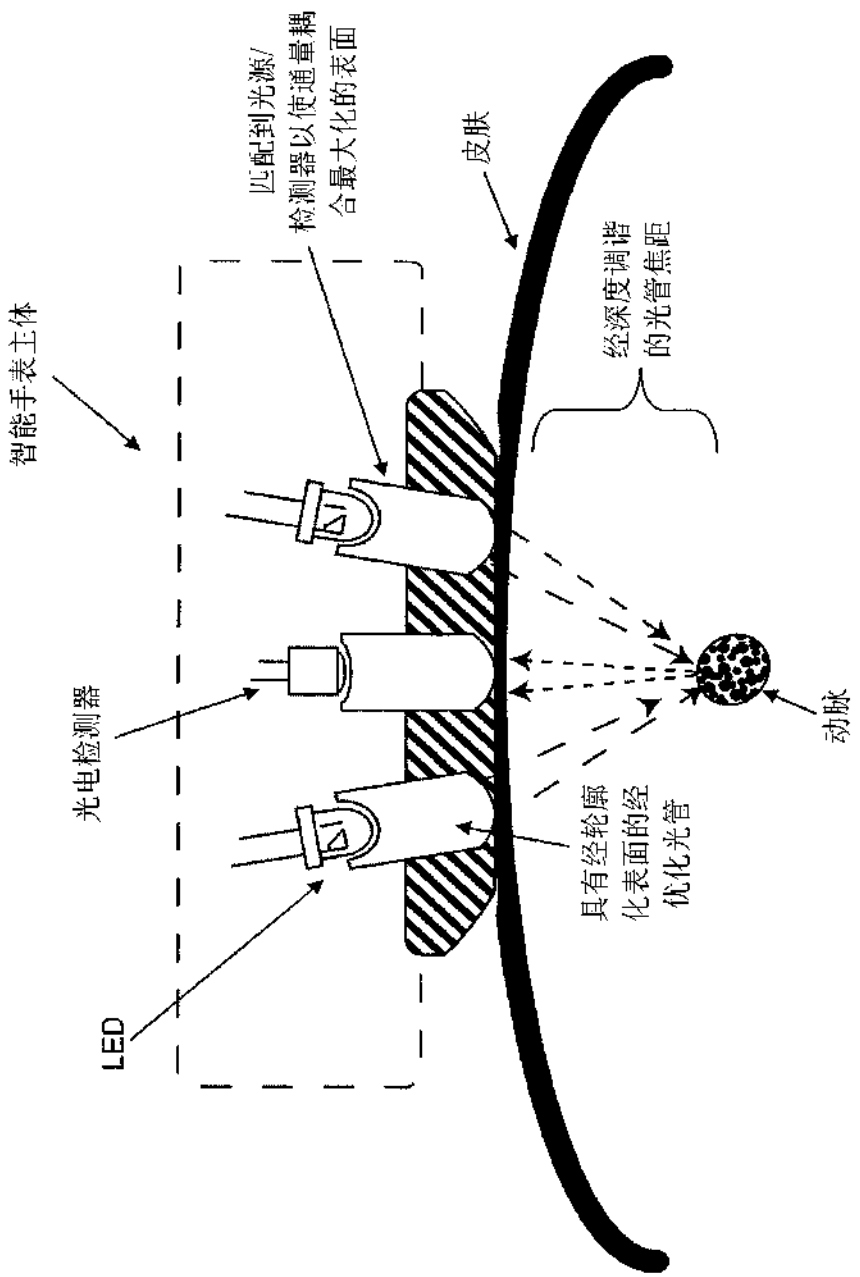

智能手表主体
匹配到光源/
检测器以使通量耦
合最大化的表面
皮肤
经深度调谐
的光管焦距
光电检测器
动脉
具有经轮廓
化表面的经
优化光管
LED

图 10

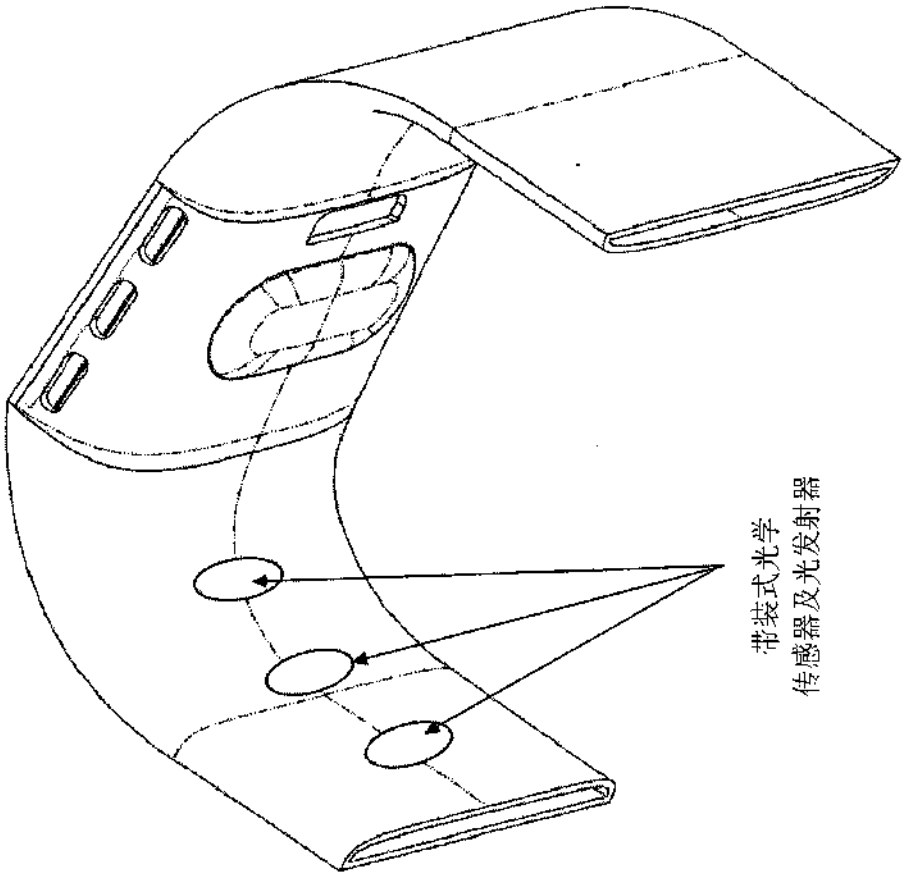


图 11

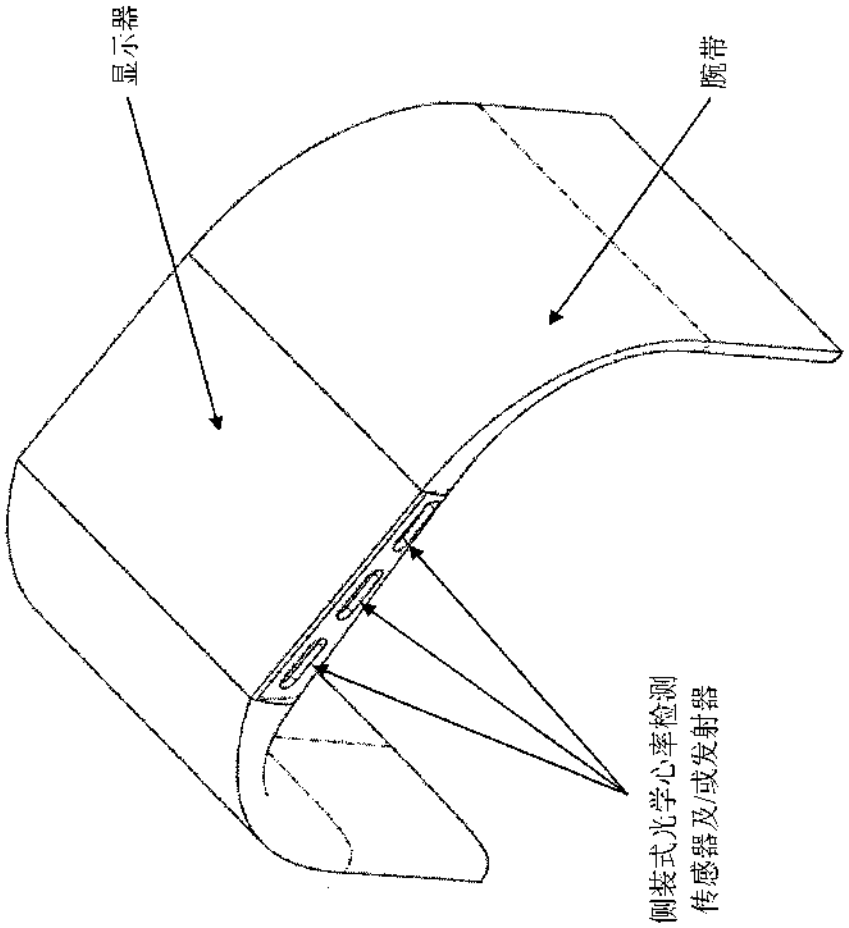


图 12

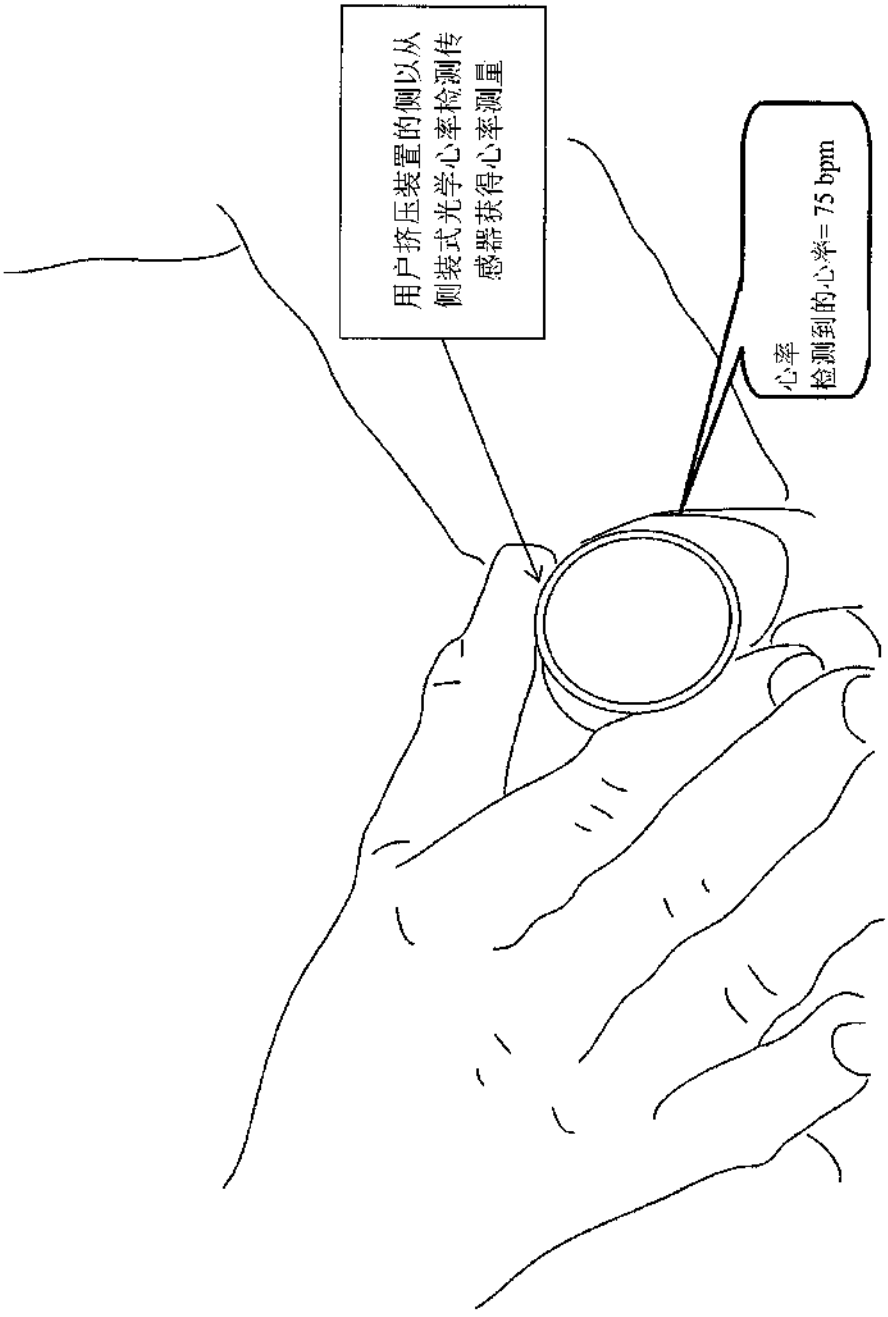


图 13

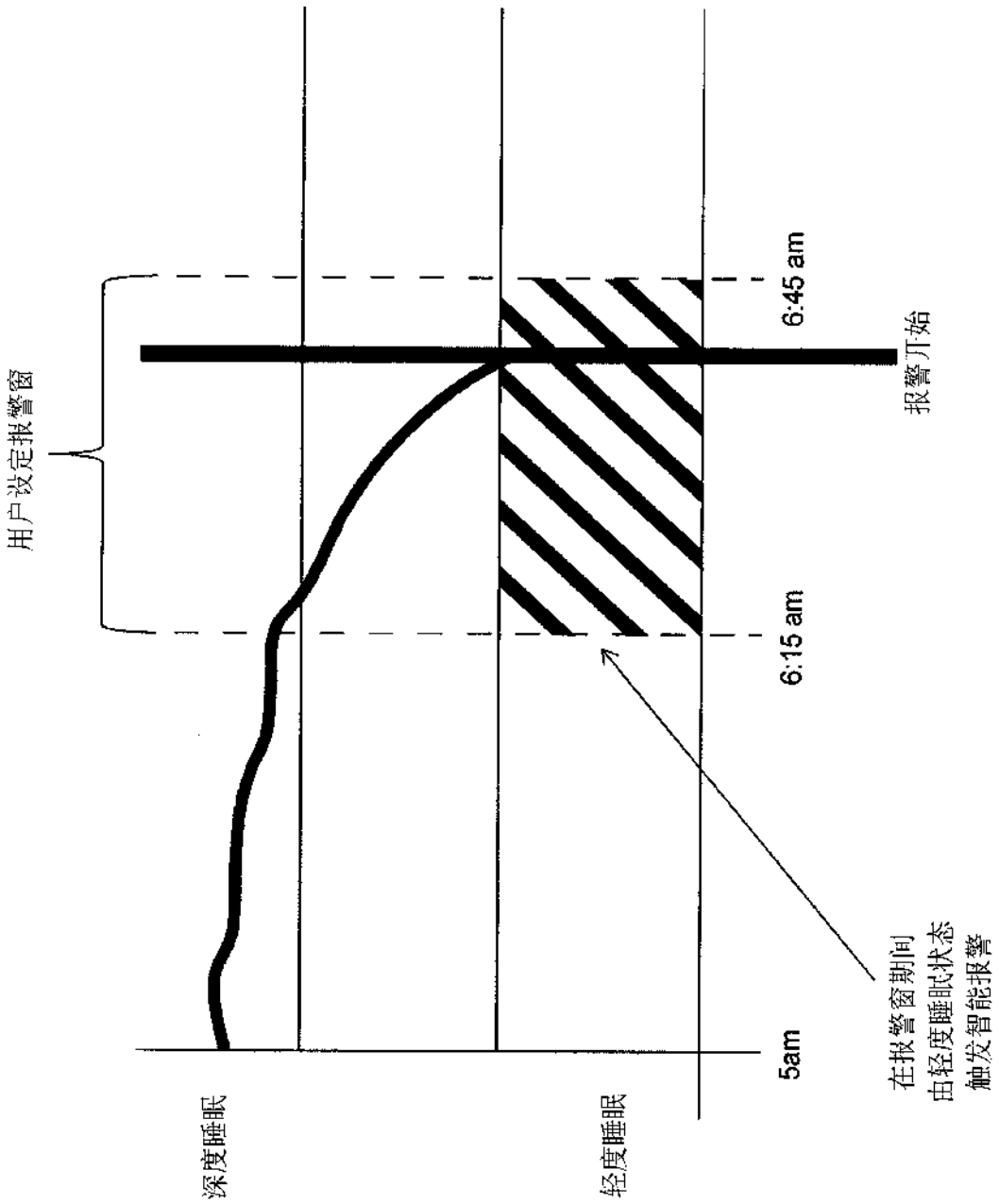

用户设定报警窗
6:45 am
报警开始
6:15 am
5am
深度睡眠
轻度睡眠
在报警窗期间
由轻度睡眠状态
触发智能报警

图 14

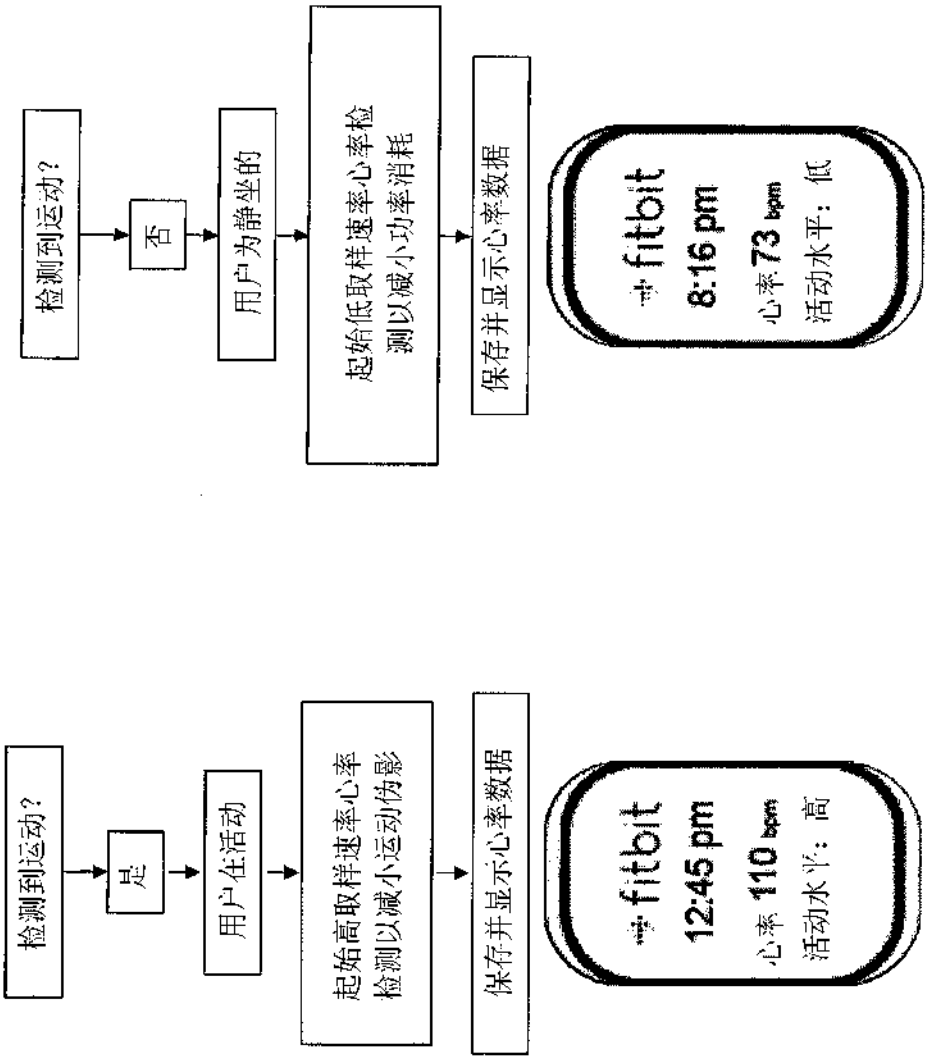

检测到运动?
否
用户为静坐的
起始低取样速率心率检测以减小功率消耗
保存并显示心率数据
fitbit
8:16 pm
心率 73 bpm
活动水平：低
检测到运动?
是
用户在活动
起始高取样速率心率检测以减小运动伪影
保存并显示心率数据
fitbit
12:45 pm
心率 110 bpm
活动水平：高

图 15

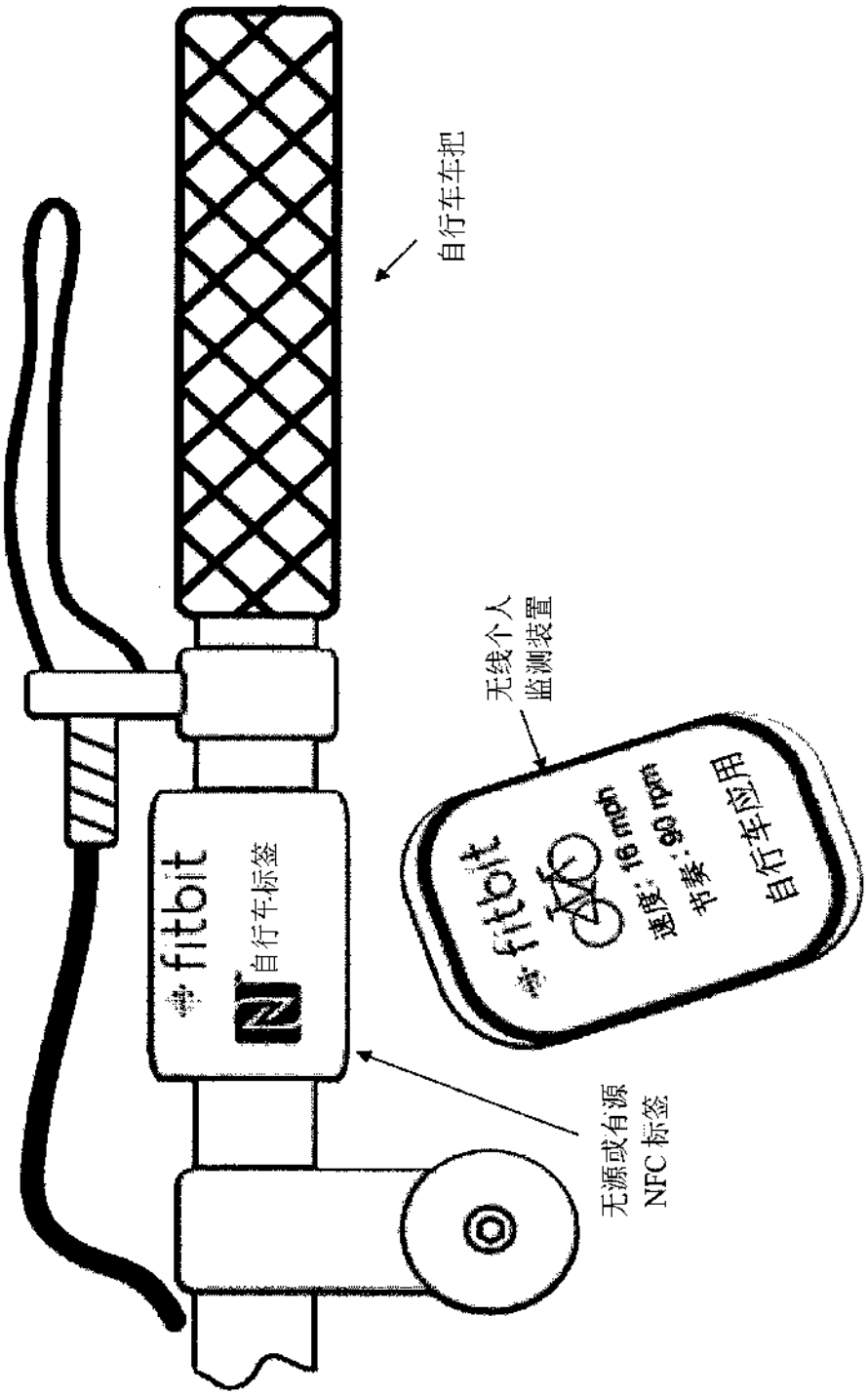

自行车车把
无线个人
监测装置
fitbit
自行车标签
fitbit
速度：19 mph
节奏：90 rpm
自行车应用
无源或有源
NFC 标签

图 16

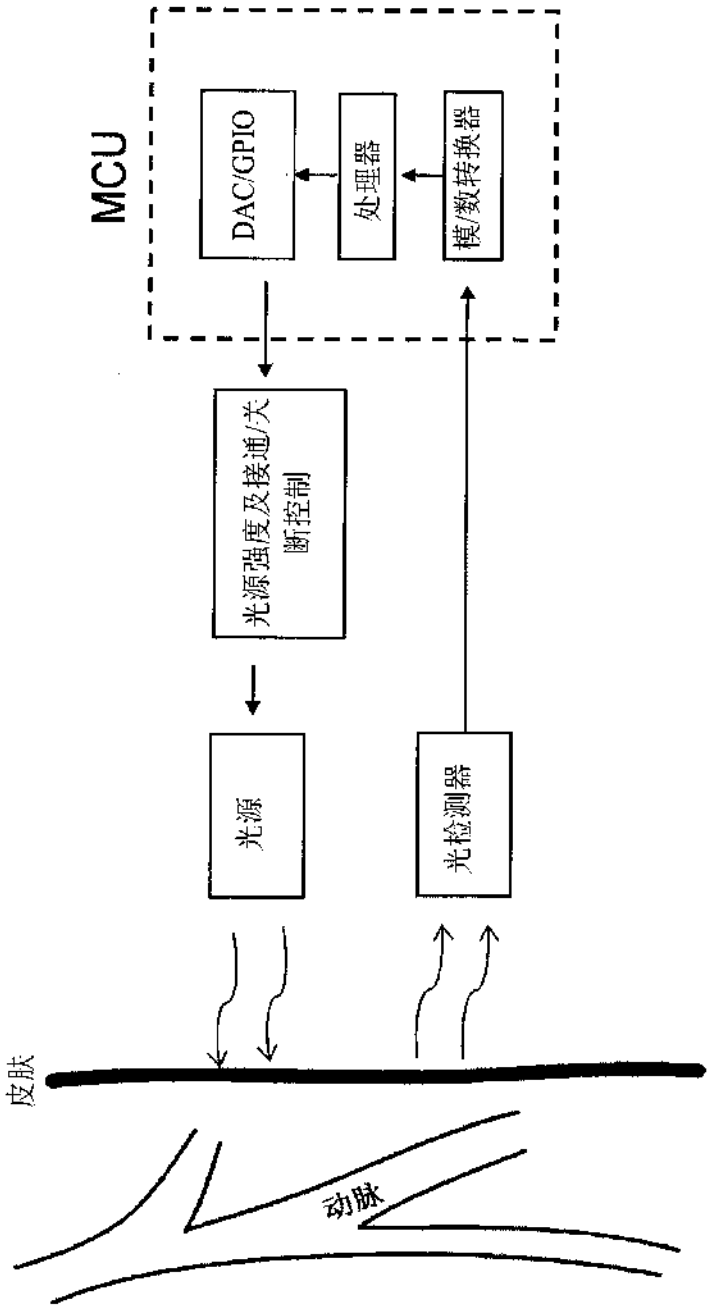


图 17

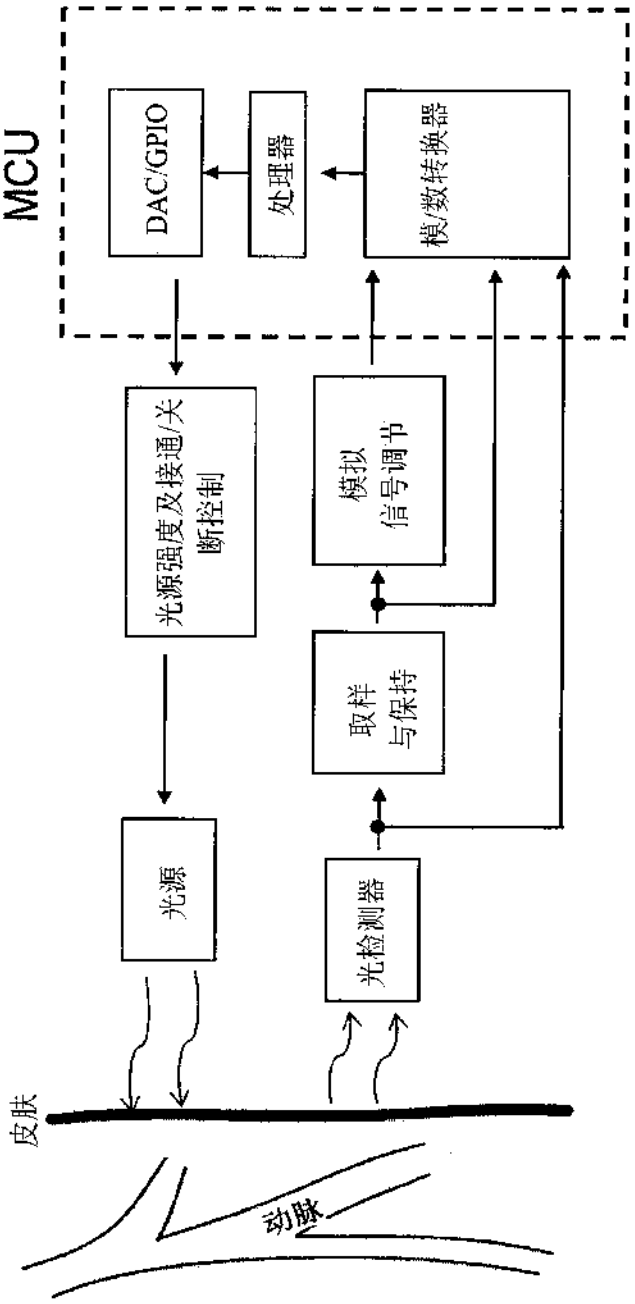

MCU
DAC/GPIO
处理器
模/数转换器
光源强度及接通/关断控制
模拟信号调节
取样与保持
光源
光检测器
皮肤
动脉

图 18

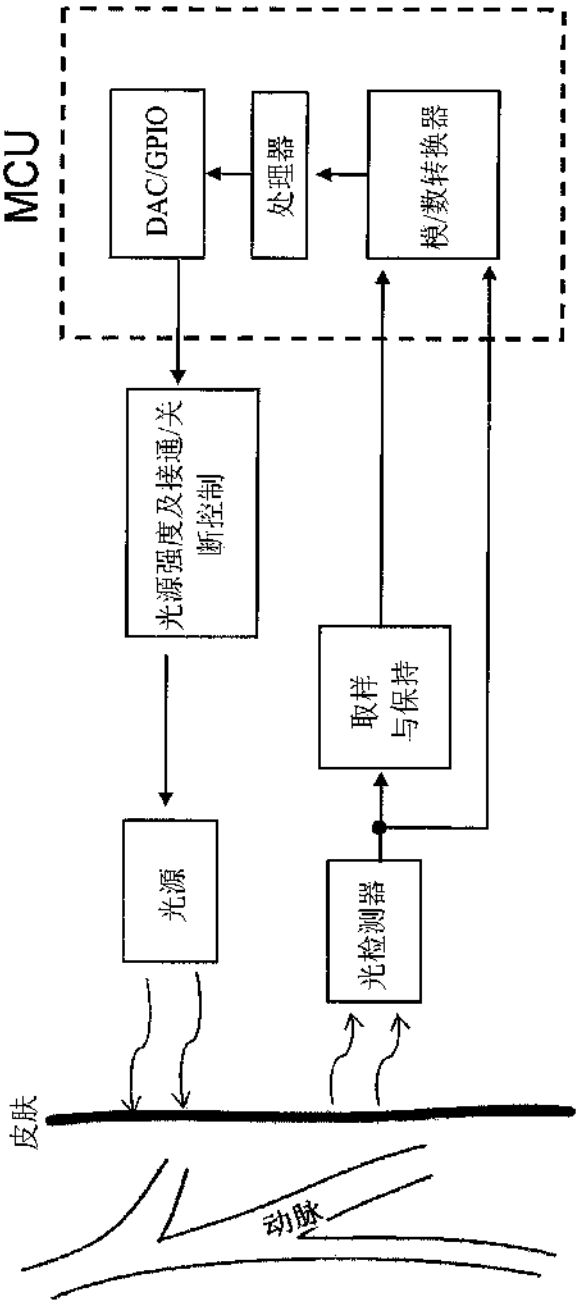


图 19

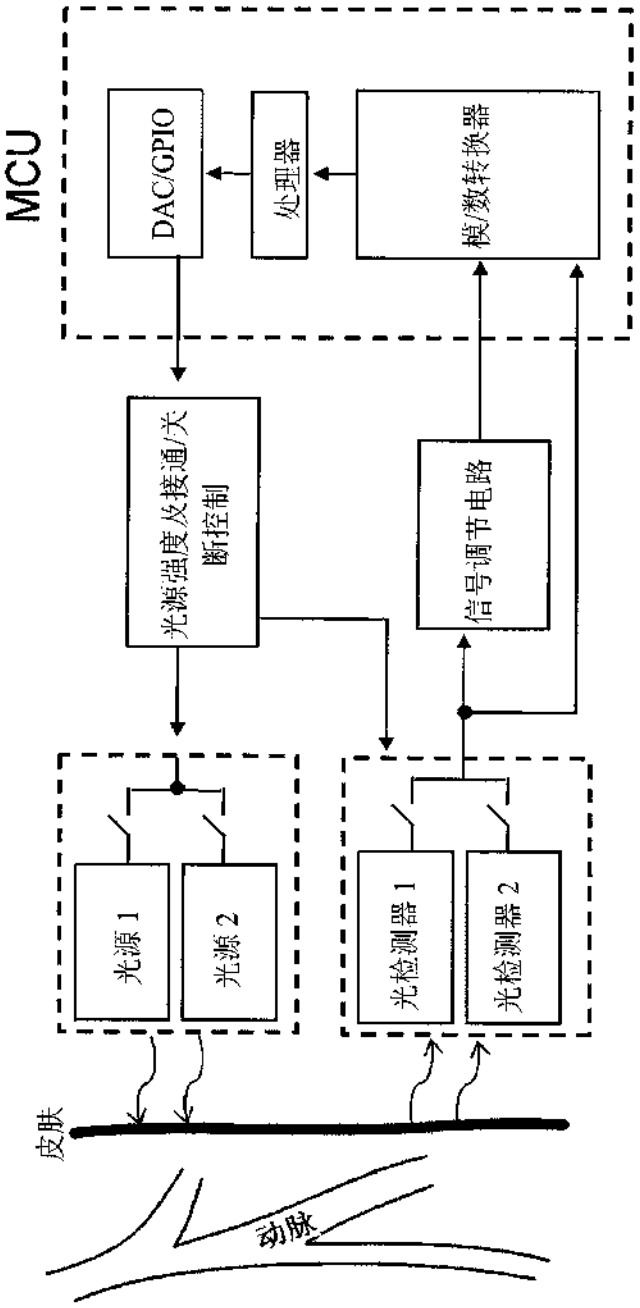

MCU
DAC/GPIO
处理器
模/数转换器
光源强度及接通/关断控制
信号调节电路
光源 1
光源 2
光检测器 1
光检测器 2
皮肤
动脉

图 20

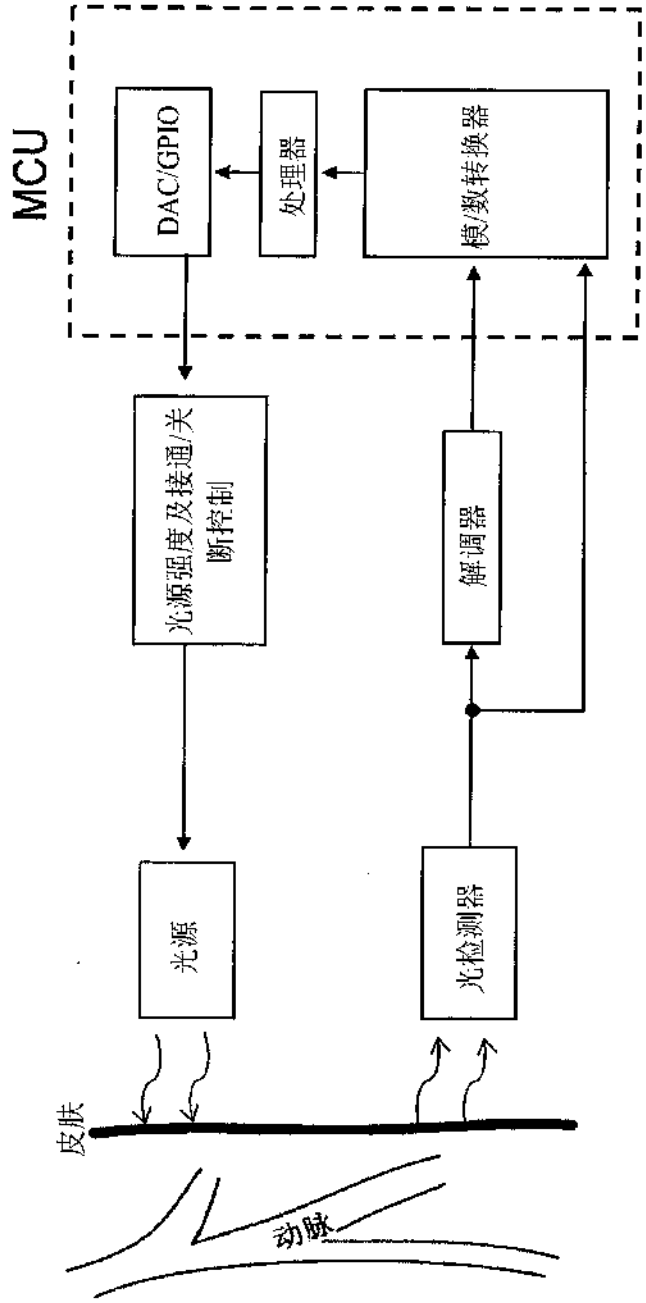


图 21

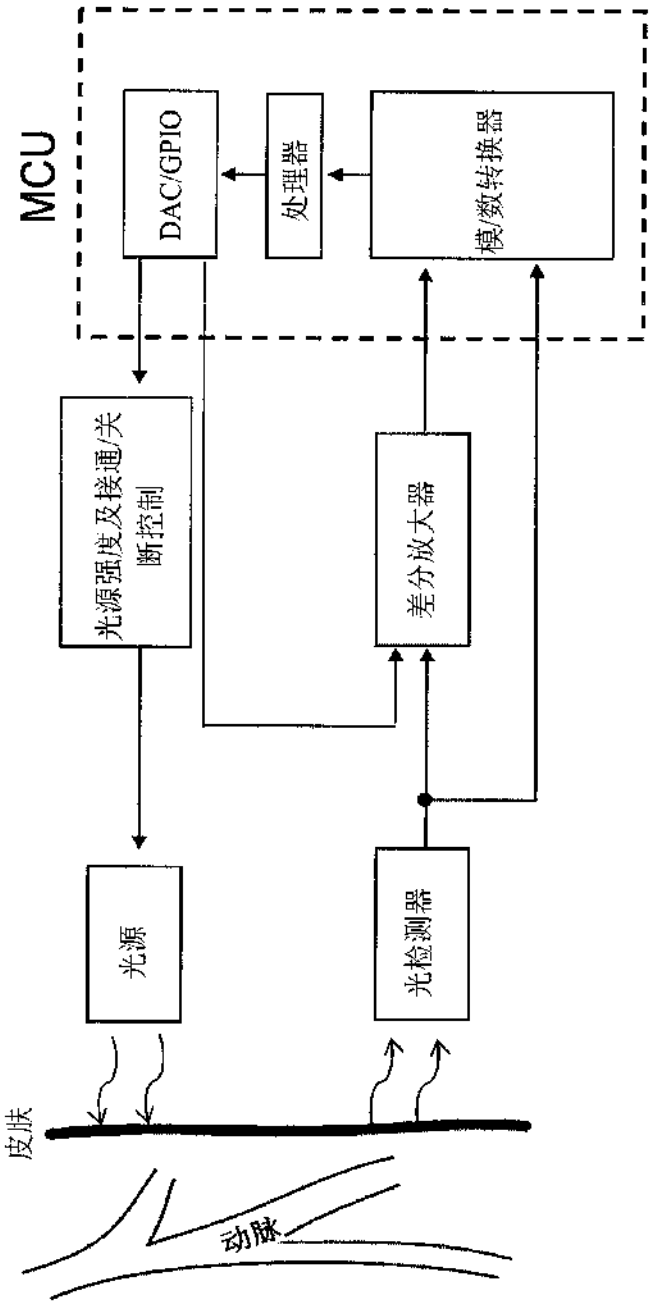


图 22

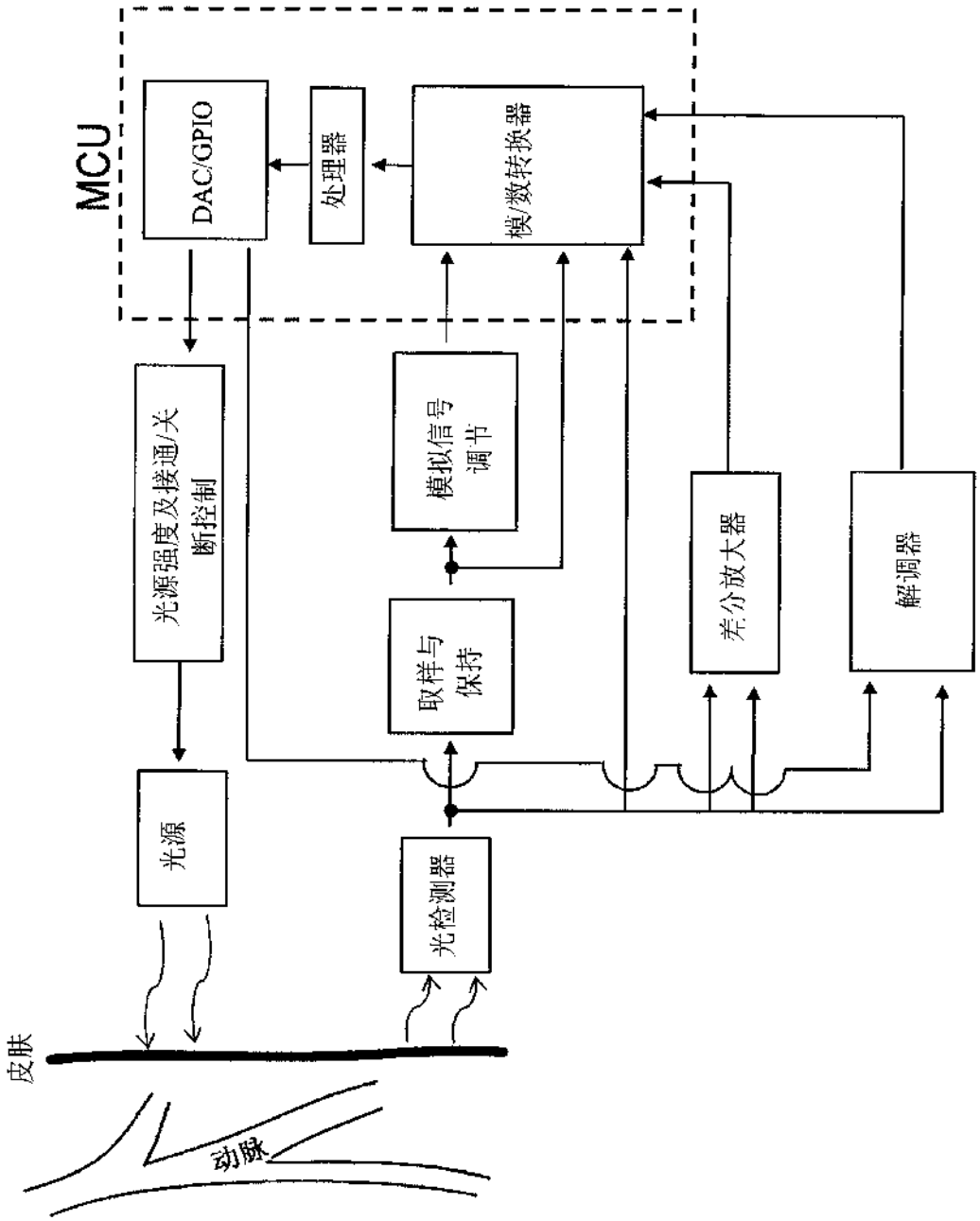

MCU
DAC/GPIO
处理器
模/数转换器
光源强度及接通/关断控制
模拟信号调节
差分放大器
解调器
取样与保持
光源
光检测器
皮肤
动脉

图 23

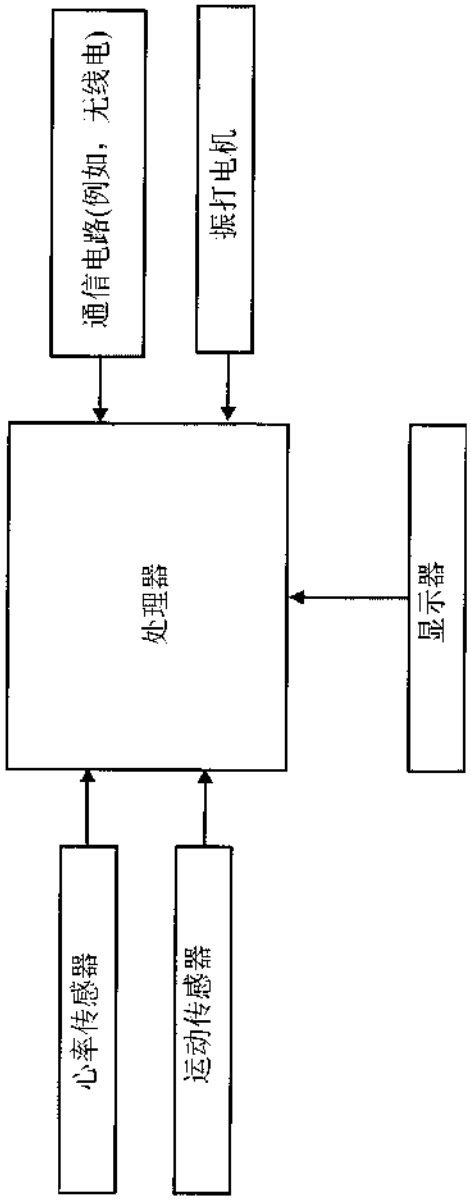


图 24

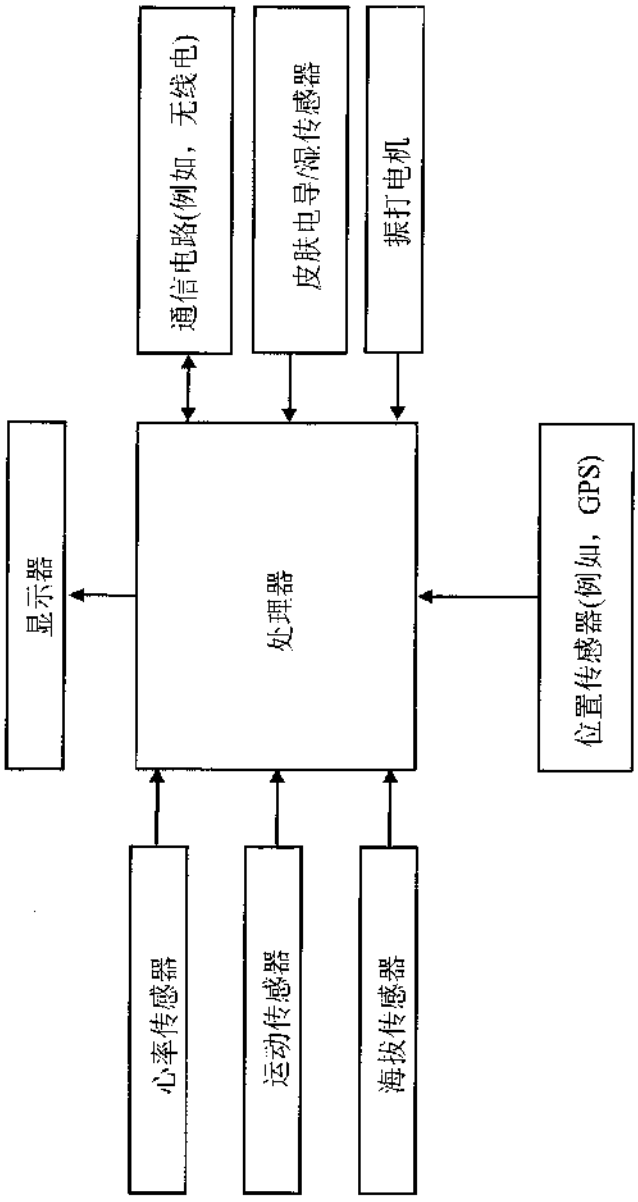

通信电路(例如，无线电)
皮肤电导/湿传感器
振打电机
显示器
处理器
位置传感器(例如，GPS)
心率传感器
运动传感器
海拔传感器

图 25

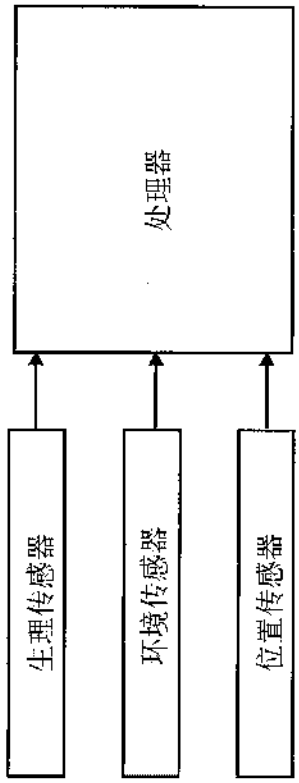

处理器
生理传感器
环境传感器
位置传感器

图 26

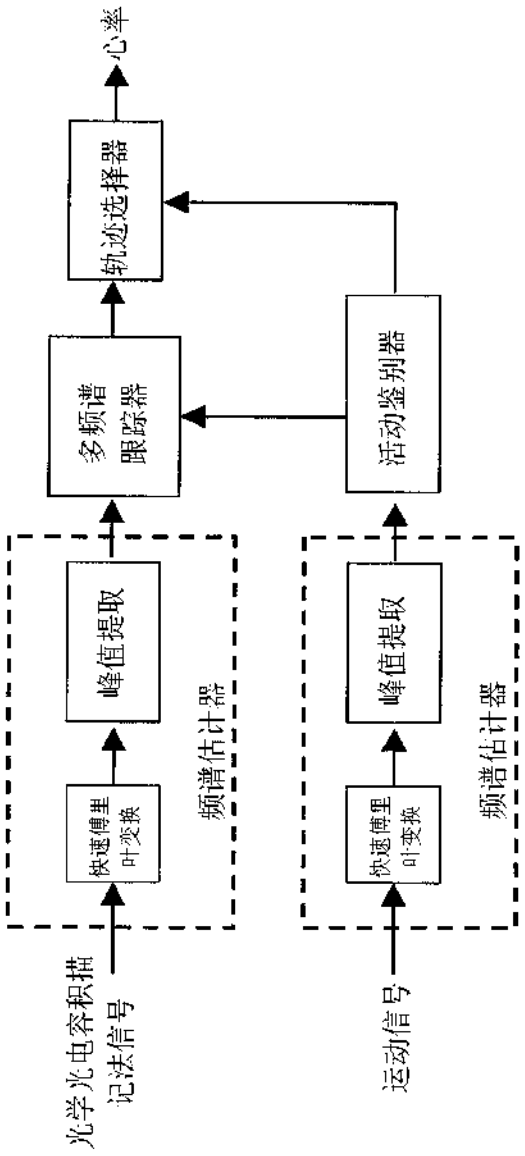

心率
轨迹选择器
多频谱
跟踪器
活动鉴别器
峰值提取
快速傅里
叶变换
频谱估计器
光学光电容积描
记法信号
运动信号

图 27

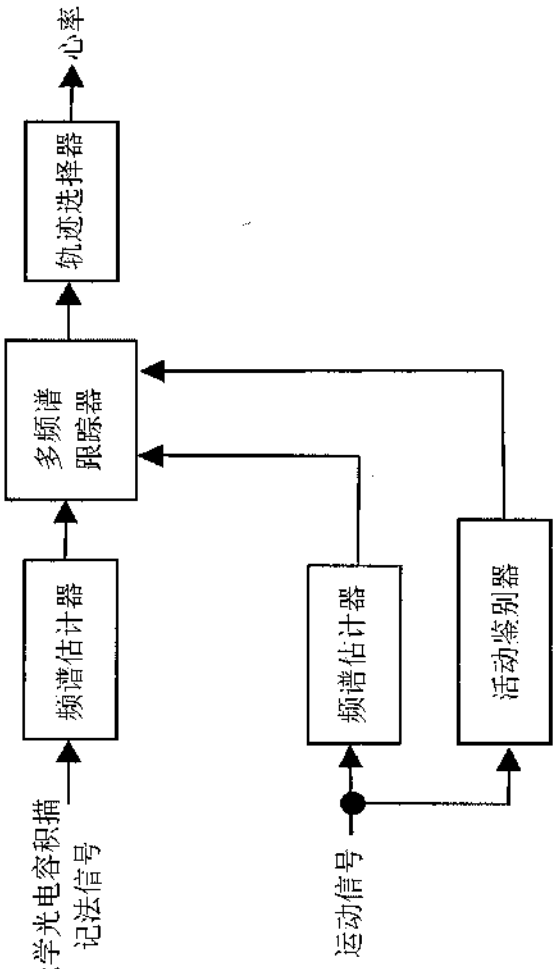

心率
轨迹选择器
多频谱
跟踪器
频谱估计器
活动鉴别器
光学光电容积描
记法信号
运动信号

图 28

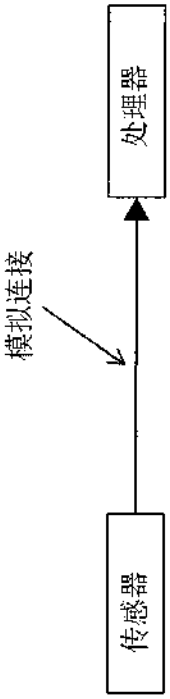
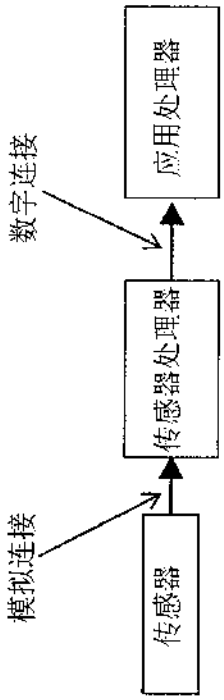

处理器
模拟连接
传感器

图 29


应用处理器
数字连接
传感器处理器
模拟连接
传感器

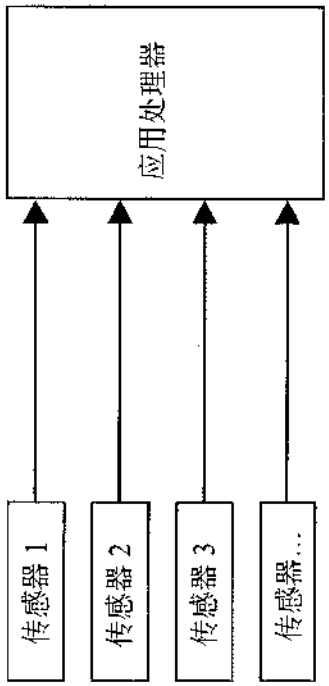

应用处理器
传感器 1
传感器 2
传感器 3
传感器...

图 30

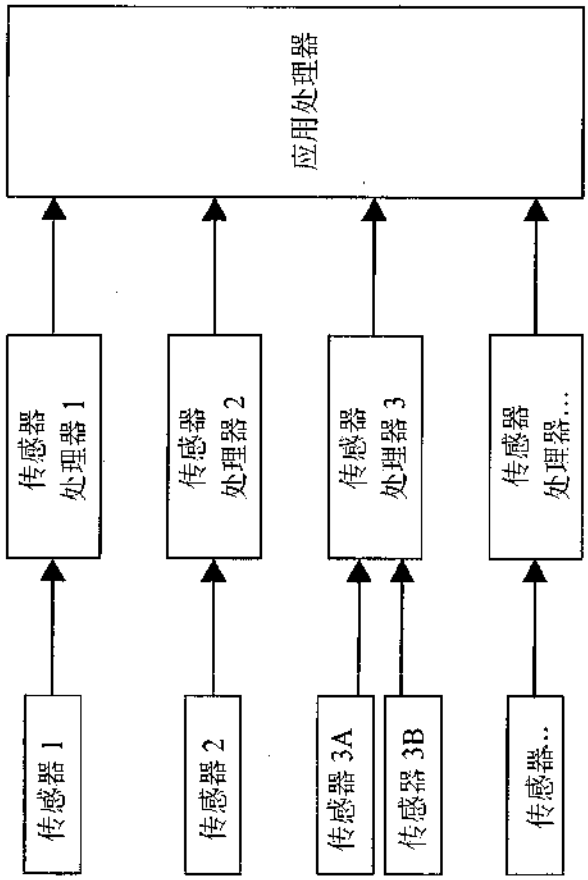

应用处理器
传感器处理器 1
传感器处理器 2
传感器处理器 3
传感器处理器...
传感器 1
传感器 2
传感器 3A
传感器 3B
传感器...

图 31

1 Document

Publication number	Title	Current assignees
CN114220694 A	Key structure and wearable device	GOERTEK

Key structure and wearable device
CN114220694 A

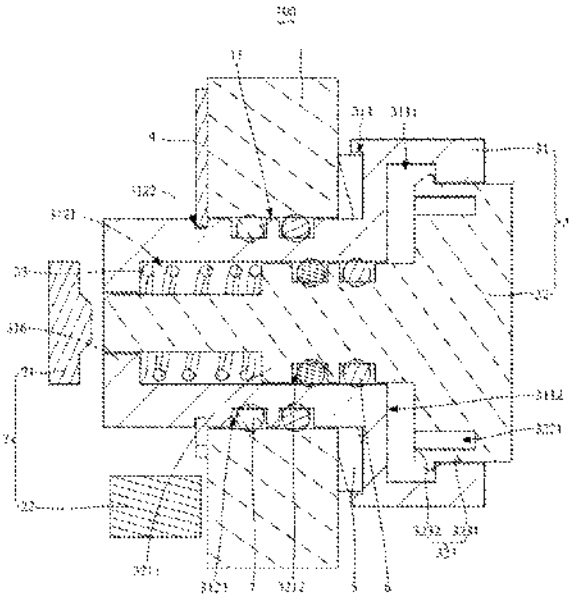
Current assignees	**IPC - International classification**
GOERTEK*	G06F-001/16 H01H-013/06 H01H-013/14
Inventors	H01H-013/28 H01H-019/14 H01H-025/06*
NAN FEIYAN	**CPC - Cooperative classification**
Priority data including date	G06F-001/16/3 H01H-013/06 H01H-013/14
2021CN-1550802 2021-12-17	H01H-013/28/5 H01H-019/14 H01H-025/06/5*

Family

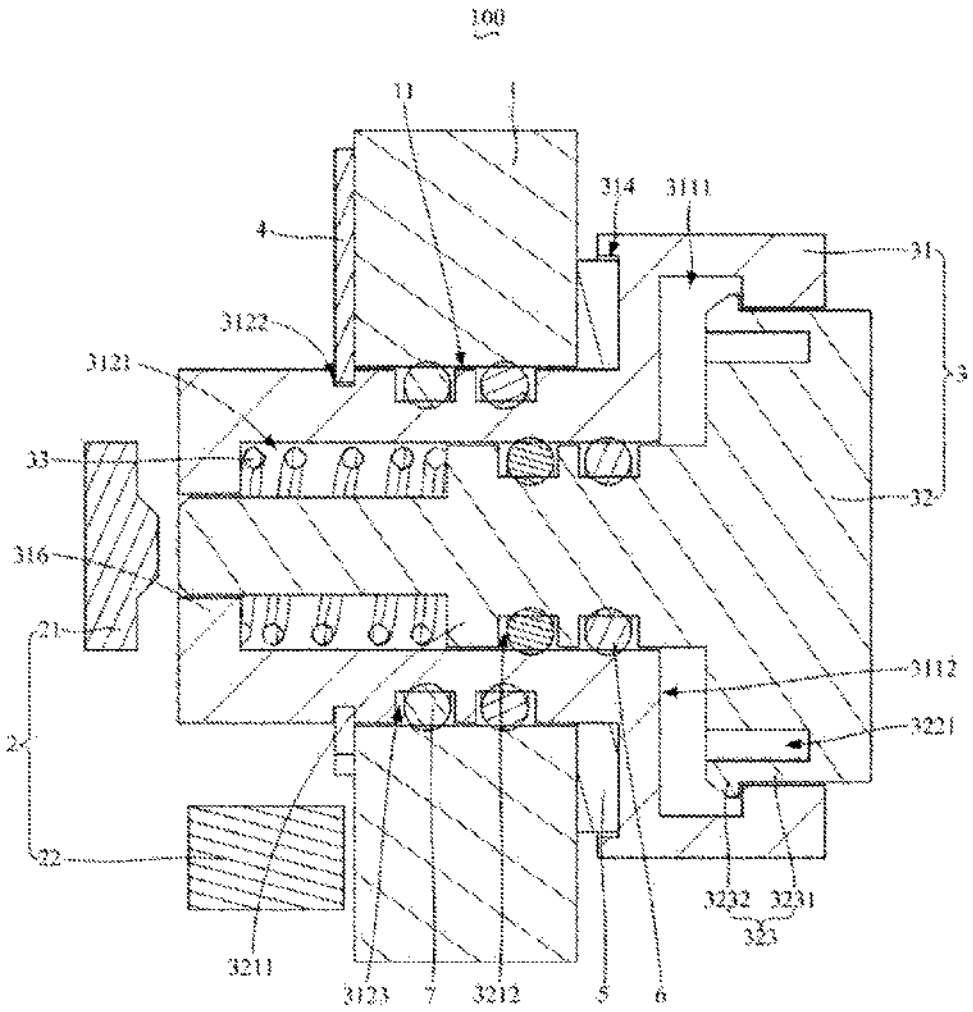
CN114220694 A 2022-03-22

(CN114220694)

The invention discloses a key structure and wearable equipment, the key structure comprises a trigger assembly and a key assembly, the key assembly comprises a rotary crown and a pressing piece, the rotary crown is rotatably arranged in a key hole of a shell in a penetrating manner, a sliding cavity is formed in the rotary crown, and the pressing piece is slidably arranged in the sliding cavity in a penetrating manner; when the pressing piece is pressed, the pressing piece moves along the sliding cavity so as to trigger the triggering assembly; and/or, when the rotary watch crown is rotated, the rotary watch crown drives the pressing piece to rotate so as to trigger the triggering assembly. According to the key structure, the good rotating hand feeling can be guaranteed, the rotating service life of the watch crown is prolonged, the key structure is applied to equipment, the thickness of an equipment shell can be effectively reduced, and the internal space of the equipment is saved.



PR.§1	2021CN-1550802
AP.§1	CN202111550802
PN.PN	CN114220694
FAN	99216558
FAMILY_PN	CN114220694 A 2022-03-22 CN114220694
PRD	2021-12-17
APD	2021-12-17
PN.PD	2022-03-22
TI	Key structure and wearable device
AB	(CN114220694) The invention discloses a key structure and wearable equipment, the key structure comprises a trigger assembly and a key assembly, the key assembly comprises a rotary crown and a pressing piece, the rotary crown is rotatably arranged in a key hole of a shell in a penetrating manner, a sliding cavity is formed in the rotary crown, and the pressing piece is slidably arranged in the sliding cavity in a penetrating manner; when the pressing piece is pressed, the pressing piece moves along the sliding cavity so as to trigger the triggering assembly; and/or, when the rotary watch crown is rotated, the rotary watch crown drives the pressing piece to rotate so as to trigger the triggering assembly. According to the key structure, the good rotating hand feeling can be guaranteed, the rotating service life of the watch crown is prolonged, the key structure is applied to equipment, the thickness of an equipment shell can be effectively reduced, and the internal space of the equipment is saved.
PA	GOERTEK
IN	NAN FEIYAN
RP	(CN114220694) GAO SHA ; CENFO INTELLECTUAL PROPERTY AGENCY Reg. Nb: 44287
IMG	



CLMS (CN114220694)

1. A key structure, comprising:

a trigger component; and

the key assembly comprises a rotary crown and a pressing piece, the rotary crown is rotatably arranged in a key hole of the shell in a penetrating manner, a sliding cavity is arranged in the rotary crown, and the pressing piece is slidably arranged in the sliding cavity in a penetrating manner;

when the pressing piece is pressed, the pressing piece moves along the sliding cavity to trigger the trigger assembly; and/or, when the rotating crown is rotated, the rotating crown drives the pressing piece to rotate so as to trigger the trigger assembly.

2. The key structure of claim 1, wherein the press member comprises a key stem and a key cap connected;

the sliding cavity comprises a first section and a second section which are communicated, the aperture of the second section is larger than that of the first section, the key rod penetrates through the first section in a sliding mode, and part of the key cap protrudes out of one end, far away from the first section, of the second section.

3. The key structure according to claim 2, further comprising at least one first seal ring interposed between said key rod and said first section aperture wall.

4. The key structure according to claim 2, wherein a first clamping member is convexly arranged on the cavity wall of the second section, and a second clamping member which is clamped and matched with the first clamping member is arranged on the outer wall of the key

cap;

the key assembly further comprises an elastic piece arranged in the first section, and the elastic piece is elastically abutted with the key rod;

when the key cap is pressed, the key rod compresses or stretches the elastic piece.

5 The key structure of claim 4, wherein an abutting table is protruded from an outer wall of the key rod, a supporting table is protruded from an inner wall of the first section away from one end of the second section, and two ends of the elastic member are elastically abutted against the abutting table and the supporting table, respectively;

and/or the outer wall of the key cap is provided with an avoidance groove corresponding to the second clamping piece, the second clamping piece comprises an elastic arm and a clamping protrusion, one end of the elastic arm is connected with the outer wall of the key cap, and the clamping protrusion is arranged at the other end of the elastic arm and is positioned on one side of the elastic arm, which is opposite to the avoidance groove;

and/or an abutting surface is formed at the communication position of the first section and the second section, and when the key cap is pressed, the key cap abuts against the abutting surface.

6. The key structure according to any one of claims 1 to 5, wherein the rotary crown includes a rotary part and a rotary part connected to each other, the sliding cavity penetrates through the rotary part and the rotary part, a limiting surface is formed at a connection portion of the rotary part and the rotary part, and the rotary part is rotatably inserted into the key hole, so that the limiting surface is in limiting abutment with an outer wall of the case.

7. The key structure according to claim 6, wherein a snap groove is formed in an outer wall of one end of the rotating shaft portion, which penetrates through the key hole, and the key structure further comprises a snap spring arranged in the housing, and the snap spring is movably snapped in the snap groove.

8. The key structure according to claim 7, wherein the slot is circumferentially disposed along the outer wall of the rotation shaft portion and forms a circular groove, the clamp spring has a clamping portion, the clamping portion is U-shaped, and the clamping portion is movably clamped in the slot.

9. The key structure according to claim 6, further comprising a wear pad, wherein the wear pad is sleeved on the rotation shaft portion and clamped between the limiting surface and the outer wall of the housing.

10. The key structure according to claim 6, further comprising at least one second seal ring interposed between an outer wall of the rotation shaft portion and a wall of the key hole.

11. The key structure of claim 1, wherein the activation component comprises:

the trigger element is arranged in the shell and is opposite to the key hole; and

and the optical sensor is arranged in the shell and is opposite to the side wall of the rotary crown.

12. Wearable device, characterized in that it comprises a device body comprising a housing provided with a key hole and a key structure according to any of claims 1 to 11, said key structure being connected to said housing.

DESC

(CN114220694)

TECHNICAL FIELD

The invention relates to the technical field of intelligent wearable equipment, in particular to a key structure and wearable equipment applying the key structure.

BACKGROUND ART

With the continuous development of material technology, the thickness of the watch case of the watch is thinner and thinner, but the crown needs a certain stroke for pressing, so the further reduction of the thickness of the watch case is limited, the partial thickness of the

crown is thicker, and more internal space of the watch case is occupied. Meanwhile, in the related art, the crown can rub against the spring when rotating, so that the rotating hand feeling is poor, and the rotating service life is short.

DISCLOSURE

Disclosure of Invention

The invention mainly aims to provide a key structure and wearing equipment, aiming at improving the key structure which can ensure good rotating hand feeling and prolong the rotating life of a crown.

In order to achieve the above object, the present invention provides a key structure, including:

a trigger component; and

the key assembly comprises a rotary crown and a pressing piece, the rotary crown is rotatably arranged in a key hole of the shell in a penetrating manner, a sliding cavity is arranged in the rotary crown, and the pressing piece is slidably arranged in the sliding cavity in a penetrating manner;

when the pressing piece is pressed, the pressing piece moves along the sliding cavity to trigger the trigger assembly; and/or, when the rotating crown is rotated, the rotating crown drives the pressing piece to rotate so as to trigger the trigger assembly.

In one embodiment, the pressing piece comprises a key rod and a key cap which are connected;

the sliding cavity comprises a first section and a second section which are communicated, the aperture of the second section is larger than that of the first section, the key rod penetrates through the first section in a sliding mode, and part of the key cap protrudes out of one end, far away from the first section, of the second section.

In an embodiment, the key structure further includes at least one first sealing ring, and the first sealing ring is clamped between the key rod and the hole wall of the first section.

In one embodiment, a first clamping piece is convexly arranged on the cavity wall of the second section, and a second clamping piece in clamping fit with the first clamping piece is arranged on the outer wall of the key cap;

the key assembly further comprises an elastic piece arranged in the first section, and the elastic piece is elastically abutted with the key rod;

when the key cap is pressed, the key rod compresses or stretches the elastic piece.

In one embodiment, a butting table is convexly arranged on the outer wall of the key rod, a supporting table is convexly arranged on the inner wall of the first section, which is far away from one end of the second section, and two ends of the elastic piece are respectively and elastically butted against the butting table and the supporting table;

and/or the outer wall of the key cap is provided with an avoidance groove corresponding to the second clamping piece, the second clamping piece comprises an elastic arm and a clamping protrusion, one end of the elastic arm is connected with the outer wall of the key cap, and the clamping protrusion is arranged at the other end of the elastic arm and is positioned on one side of the elastic arm, which is opposite to the avoidance groove;

and/or an abutting surface is formed at the communication position of the first section and the second section, and when the key cap is pressed, the key cap abuts against the abutting surface.

In one embodiment, the rotating crown comprises a rotating part and a rotating part which are connected, the sliding cavity penetrates through the rotating part and the rotating part, a limiting surface is formed at the joint of the rotating part and the rotating part, and the rotating part is rotatably arranged in the key hole in a penetrating mode so that the limiting surface is in limiting abutting joint with the outer wall of the shell.

In an embodiment, the rotating shaft portion penetrates through an outer wall of one end of the key hole to be provided with a clamping groove, the key structure further comprises a clamp spring arranged in the shell, and the clamp spring is movably clamped in the clamping groove.

In an embodiment, the draw-in groove is followed the outer wall circumference of pivot portion sets up and forms the annular, the jump ring has joint portion, joint portion is the setting of U type, joint portion activity joint in the draw-in groove.

In an embodiment, the key structure further includes a wear pad, and the wear pad is sleeved on the rotating shaft portion and clamped between the limiting surface and the outer wall of the housing.

In an embodiment, the key structure further includes at least one second sealing ring, and the second sealing ring is clamped between the outer wall of the rotation shaft portion and the hole wall of the key hole.

In one embodiment, the trigger component comprises:

the trigger element is arranged in the shell and is opposite to the key hole; and

and the optical sensor is arranged in the shell and is opposite to the side wall of the rotary crown.

The invention further provides wearing equipment which comprises an equipment main body and the key structure, wherein the equipment main body comprises a shell, the shell is provided with a key hole, and the key structure is connected to the shell.

According to the key structure, the rotary crown of the key assembly is rotatably arranged in the key hole of the shell in a penetrating manner, and the sliding cavity is arranged in the rotary crown, so that the pressing piece can be slidably arranged in the sliding cavity in a penetrating manner, and therefore when the pressing piece is pressed, the pressing piece moves along the sliding cavity of the rotary crown, and the trigger assembly is triggered; and/or when the rotating crown is rotated, the rotating crown can drive the pressing piece to rotate so as to trigger the trigger assembly, namely the pressing piece and the rotating crown of the key assembly are arranged in a nested manner, so that the rotating function and the pressing function are separated, the shell does not need to ensure the stroke required by pressing, the thickness of the shell of the equipment can be further reduced, and the internal space of the equipment is saved; meanwhile, the pressing piece can be slidably arranged in the sliding cavity in a penetrating mode, so that the pressing piece can rotate along with the rotating crown when the rotating crown rotates and does not rub against the pressing piece, good rotating hand feeling can be guaranteed, and the rotating life of the crown is prolonged.

DRAWINGS DESCRIPTION

In order to more clearly illustrate the embodiments of the present invention or the technical solutions in the prior art, the drawings used in the description of the embodiments or the prior art will be briefly described below, it is obvious that the drawings in the following description are only some embodiments of the present invention, and for those skilled in the art, other drawings can be obtained according to the structures shown in the drawings without creative efforts.

FIG. 1 is a schematic structural diagram of a key structure according to an embodiment of the present invention;

FIG. 2 is a schematic structural diagram of another view angle of the key structure according to an embodiment of the present invention;

FIG. 3 is an exploded view of a key structure according to an embodiment of the present invention;

FIG. 4 is a schematic cross-sectional view of a key structure according to an embodiment of the present invention;

FIG. 5 is a schematic cross-sectional view of a rotating crown in accordance with an embodiment of the present invention;

fig. 6 is a schematic structural view of a pressing member according to an embodiment of the present invention.

The reference numbers illustrate:

the implementation, functional features and advantages of the objects of the present invention will be further explained with reference to the accompanying drawings.

INVENTION MODE

Detailed Description

The technical solutions in the embodiments of the present invention will be clearly and completely described below with reference to the drawings in the embodiments of the present invention, and it is obvious that the described embodiments are only a part of the embodiments of the present invention, and not all of the embodiments. All other embodiments, which can be derived by a person skilled in the art from the embodiments given herein without making any creative effort, shall fall within the protection scope of the present invention.

It should be noted that all the directional indicators (such as up, down, left, right, front, and rear ... ...) in the embodiment of the present invention are only used to explain the relative position relationship between the components, the movement situation, etc. in a specific posture (as shown in the drawing), and if the specific posture is changed, the directional indicator is changed accordingly.

Also, the meaning of "and/or" and/or "appearing throughout is meant to encompass three scenarios, exemplified by" A and/or B "including scenario A, or scenario B, or scenarios where both A and B are satisfied.

In addition, the descriptions related to "first", "second", etc. in the present invention are only for descriptive purposes and are not to be construed as indicating or implying relative importance or implicitly indicating the number of technical features indicated. Thus, a feature defined as "first" or "second" may explicitly or implicitly include at least one such feature. In addition, technical solutions between various embodiments may be combined with each other, but must be realized by a person skilled in the art, and when the technical solutions are contradictory or cannot be realized, such a combination should not be considered to exist, and is not within the protection scope of the present invention.

With the continuous development of material technology, the thickness of the watch case of the watch is thinner and thinner, but the crown needs a certain stroke for pressing, so the further reduction of the thickness of the watch case is limited, the partial thickness of the crown is thicker, and more internal space of the watch case is occupied. Meanwhile, in the related art, the crown can rub against the spring when rotating, so that the rotating hand feeling is poor, and the rotating service life is short.

Based on the above-mentioned conception and problems, the present invention provides a key structure 100. It is understood that the key structure 100 can be applied to a wearable device, an electronic device or other products using key functions, and is not limited thereto. When key structure 100 is applied to wearing equipment, wearing equipment includes casing 1, and also casing 1 can be wearing equipment's shell, and casing 1 is equipped with button hole 11, and button structure 100 is middle key assembly 3's rotatory table crown 31 and the button hole 11 of the part protrusion casing 1 of pressing piece 32, so can make things convenient for the rotatory table crown 31 and the pressing piece 32 of button assembly 3 to realize respectively rotatory and press the function.

Referring to fig. 1 to 6, in an embodiment of the present invention, the key structure 100 includes a trigger assembly 2 and a key assembly 3, wherein the key assembly 3 includes a

rotating crown 31 and a pressing member 32, the rotating crown 31 is rotatably disposed in the key hole 11 of the casing 1, a sliding cavity 31a is disposed in the rotating crown 31, and the pressing member 32 is slidably disposed in the sliding cavity 31 a; when the pressing piece 32 is pressed, the pressing piece 32 moves along the sliding cavity 31a to trigger the trigger assembly 2; and/or, when the rotating crown 31 is rotated, the rotating crown 31 rotates the pressing member 32 to trigger the trigger assembly 2.

In the present embodiment, the key structure 100 is applied to a device having a key function, the device including a housing 1, the housing 1 being provided with a key hole 11, so that the key structure 100 is fixedly installed by using the housing 1. Of course, the housing 1 may also be a mounting part of the key structure 100 for mounting and fixing the trigger assembly 2, the key assembly 3 and other parts, which is not limited herein. It can be understood that casing 1 provides the installation basis for triggering subassembly 2, button subassembly 3 and other parts, through set up the installation cavity in casing 1 to conveniently utilize the installation cavity installation, fixed trigger subassembly 2, not only realize the protection to triggering subassembly 2, can also play effects such as waterproof.

It can be understood that, through set up the button hole 11 of intercommunication installation cavity on casing 1 to make things convenient for the part of button subassembly 3 to pass through button hole 11 and stretch into the installation cavity, so that button subassembly 3 presses and/or rotatory button subassembly 3 under the exogenic action, so that the pressing member 32 and/or the rotatory crown 31 of button subassembly 3 trigger subassembly 2, in order to realize different button functions.

Optionally, the triggering assembly 2 is used for triggering of a key. The trigger assembly 2 may be a trigger element or an inductive element or a key or a spring piece disposed on the circuit board, and when the pressing piece 32 and/or the rotating crown 31 of the key assembly 3 triggers the trigger assembly 2, the trigger assembly 2 transmits a signal to the circuit board to implement a corresponding control operation, and the like, which is not limited herein.

In this embodiment, the one end of the rotatory crown 31 of button subassembly 3 protrudes in the outside of casing 1, the other end of rotatory crown 31 rotates and wears to locate in key hole 11, thereby convenience of customers realizes the rotation function through convex rotatory crown 31, the one end protrusion of the pressing piece 32 of button subassembly 3 is in the one end of protrusion in the outside rotatory crown 31 of casing 1 simultaneously, also the other end activity of pressing piece 32 wears to locate in sliding cavity 31a, so can convenience of customers realizes pressing the function through convex pressing piece 32.

It can be understood that the rotary crown 31 can be rotatably disposed through the key hole 11 in a damping manner, so that the rotary crown 31 can rotate in the key hole 11 under the condition of applying an external force, and the rotary crown 31 is fixed in the key hole 11 under the condition of not applying the external force. Of course, in other embodiments, the rotating crown 31 can also be installed in the key hole 11 through a seal ring or a damping ring or other structures capable of realizing rotational installation, which is not limited herein.

In the present embodiment, the pressing member 32 is movable along the sliding cavity 31a of the rotary crown 31, for example, the pressing member 32 is slidably disposed in the sliding cavity 31a in a damping manner, so that the pressing member 32 can move in the sliding cavity 31a under the application of an external force, and the pressing member 32 is fixed in the sliding cavity 31a under the non-application of the external force. Of course, in other embodiments, the pressing member 32 may also be configured to perform a pressing return by using a spring or the like, or ensure that the pressing member 32 does not move along the sliding cavity 31a without an external force, and the like, which is not limited herein.

It is understood that the pressing member 32 and the rotating crown 31 are connected into a

whole structure by a detachable connection manner, such as a snap connection, a plug fit, a suction connection, etc., and are not limited herein.

In the key structure 100 of the present invention, the rotating crown 31 of the key assembly 3 is rotatably inserted into the key hole 11 of the casing 1, and the sliding cavity 31a is disposed in the rotating crown 31, so that the pressing member 32 is slidably inserted into the sliding cavity 31a, and thus when the pressing member 32 is pressed, the pressing member 32 moves along the sliding cavity 31a of the rotating crown 31, and the triggering assembly 2 is triggered; and/or, when the rotating crown 31 is rotated, the rotating crown 31 can drive the pressing piece 32 to rotate to trigger the trigger assembly 2, that is, the pressing piece 32 and the rotating crown 31 of the key assembly 3 are arranged in a nested manner, so that the rotating function and the pressing function are separated, therefore, the shell 1 does not need to ensure the stroke required by pressing, the thickness of the shell 1 of the device can be further reduced, and the internal space of the device can be saved; meanwhile, the pressing piece 32 is slidably arranged in the sliding cavity 31a in a penetrating manner, so that the pressing piece 32 can rotate along with the rotating crown 31 without friction with the pressing piece 32 when the rotating crown 31 rotates, good rotating hand feeling can be ensured, and the rotating life of the rotating crown 31 is prolonged.

In one embodiment, the wall of the sliding cavity 31a is convexly provided with a first clamping member 315, and the outer wall of the pressing member 32 is provided with a second clamping member 323 which is in clamping fit with the first clamping member 315; the key assembly 3 further includes an elastic member 33 sleeved on the outer wall of the pressing member 32, and two ends of the elastic member 33 are respectively elastically abutted against the pressing member 32 and the cavity wall of the sliding cavity 31 a.

In the present embodiment, as shown in fig. 3 to 6, by providing the first engaging member 315 on the wall of the sliding cavity 31a of the rotating crown 31 and providing the second engaging member 323 on the outer wall of the pressing member 32, the pressing member 32 is engaged with the rotating crown 31 by the engagement between the second engaging member 323 and the first engaging member 315; meanwhile, through setting up elastic component 33, make elastic component 33 be located the sliding cavity 31a, and the cover is located pressing piece 32 outer wall, make the both ends of elastic component 33 respectively with pressing piece 32 and the chamber wall elasticity butt in sliding cavity 31a, so when pressing piece 32 is connected with rotatory table crown 31 joint through the joint cooperation of second joint piece 323 with first joint piece 315, elastic component 33 is in compression state, thereby utilize the elasticity of elastic component 33 to make pressing piece 32 keep away from trigger subassembly 2, and make pressing piece 32 be connected with rotatory table crown 31 joint through the joint cooperation of second joint piece 323 with first joint piece 315, avoid pressing piece 32 to break away from rotatory table crown 31.

Alternatively, the elastic member 33 is a compression spring, a telescopic spring, or the like, and is not limited herein. It can be understood that, the two ends of the elastic member 33 are elastically abutted against the cavity walls of the pressing member 32 and the sliding cavity 31a, respectively, and a support table or an abutment table may be provided on the outer wall of the pressing member 32 and the cavity wall of the sliding cavity 31a, and the support table or the abutment table does not affect the movement of the pressing member 32 in the sliding cavity 31 a.

In the present embodiment, the rotating crown 31 may be a cylindrical structure with two open ends, that is, the two ends of the sliding cavity 31a have openings, which is not limited herein. The pressing member 32 may be a column or a rod, and the like, but is not limited thereto.

In one embodiment, the press piece 32 includes a key lever 321 and a key cap 322

connected; the sliding cavity 31a includes a first section 3121 and a second section 3111 which are communicated with each other, the aperture of the second section 3111 is larger than that of the first section 3121, the key lever 321 is slidably disposed through the first section 3121, and a portion of the key cap 322 protrudes from an end of the second section 3111 which is far away from the first section 3121.

In an embodiment, as shown in fig. 3 to 6, a first clamping member 315 is convexly disposed on a cavity wall of the second section 3111, and a second clamping member 323 clamped and matched with the first clamping member 315 is disposed on an outer wall of the key cap 322; the key assembly 3 further includes an elastic member 33 disposed in the first section 3121, the elastic member 33 elastically abuts against the key lever 321; when the key cap 322 is pressed, the key rod 321 compresses or stretches the elastic member 33.

In this embodiment, through setting up the pressing piece 32 into button pole 321 and button cap 322, and set up sliding cavity 31a into first section 3121 and second section 3111 that are linked together, make the button pole 321 of pressing piece 32 slide and wear to locate first section 3121, part button cap 322 is located second section 3111 through the cooperation of second joint spare 323 and first joint spare 315, the protruding second section 3111 of part button cap 322 is kept away from the one end of first section 3121, so can make things convenient for the user to press button cap 322, make button cap 322 drive button pole 321 to remove under the exogenic action, in order further to compress elastic component 33, and make button pole 321 support and press trigger component 2.

Alternatively, the first clamping member 315 and the second clamping member 323 may be a matching structure of a clamping platform and a buckle, or a matching structure of a clamping protrusion and a clamping groove, or a matching structure of a clamping protrusion and a clamping hole, which is not limited herein.

Optionally, the elastic element 33 is a spring, and the elastic element 33 is sleeved on an outer wall of the key lever 321. Of course, in other embodiments, the elastic element 33 is a spring, in which case, the elastic element 33 is located in the first section 3121, and the elastic element 33 is elastically connected to the key lever 321 in an abutting manner.

It can be understood that the diameter of the key cap 322 of the press 32 is larger than that of the key bar 321, and optionally, the aperture of the second section 3111 is larger than that of the first section 3121, so that the second section 3111 of the sliding cavity 31a is fitted with the key cap 322, and the first section 3121 of the sliding cavity 31a is fitted with the key bar 321. Of course, in order to avoid the elastic member 33 from affecting the movement of the key lever 321, the diameter of the first section 3121 is slightly larger than that of the elastic member 33.

In the present embodiment, the key rod 321 and the key cap 322 of the pressing member 32 are integrally formed, so that the structural strength of the pressing member 32 can be improved.

In an embodiment, an abutting table 3211 is protruded on an outer wall of the key lever 321, a supporting table 316 is protruded on an inner wall of the first section 3121 away from one end of the second section 3111, and two ends of the elastic member 33 are elastically abutted to the abutting table 3211 and the supporting table 316, respectively.

As shown in fig. 3 to 6, in the present embodiment, the abutting table 3211 is disposed on the outer wall of the key rod 321, and the supporting table 316 is disposed in the cavity wall of the rotating crown 31 adjacent to one end of the trigger assembly 2, so that two ends of the elastic element 33 elastically abut against the abutting table 3211 and the supporting table 316, respectively, thereby ensuring that the elastic element 33 is in a compressed state when the pressing element 32 and the rotating crown 31 are in snap fit through the second snap-fit element 323 and the first snap-fit element 315.

In an embodiment, the key structure 100 further includes at least one first sealing ring 6, and the first sealing ring 6 is sandwiched between the key rod 321 and the hole wall of the first section 3121.

In this embodiment, as shown in fig. 3 and 4, by providing the first sealing ring 6 between the key lever 321 and the hole wall of the first section 3121, the gap between the key lever 321 and the wall of the first section 3121 of the sliding cavity 31a is sealed by the first sealing ring 6, so that the sealing performance and the waterproof performance are improved. Optionally, the material of the first sealing ring 6 is NBR.

It is understood that the first sealing ring 6 includes a plurality of first sealing rings 6, and the plurality of first sealing rings 6 are arranged at intervals along the extending direction of the key lever 321.

In order to avoid the first sealing ring 6 from being displaced during the movement of the key rod 321, in an embodiment, as shown in fig. 3, 4 and 6, at least one of the hole walls of the key rod 321 and the first section 3121 is provided with a first groove 3212, and the first sealing ring 6 is accommodated in the first groove 3212 and partially protrudes from the notch of the first groove 3212.

In this embodiment, the first groove 3212 may be disposed on an outer wall of the key rod 321, or the first groove 3212 may be disposed on a cavity wall of the first segment 3121, or both the outer wall of the key rod 321 and the cavity wall of the first segment 3121 are disposed with the first groove 3212, and are disposed correspondingly, which is not limited herein. As can be appreciated, the first sealing ring 6 has elasticity and sealing performance, and the first sealing ring 6 is accommodated in the first groove 3212 and partially protrudes out of the notch of the first groove 3212, so that the first sealing ring 6 protruding out of the notch of the first groove 3212 can be in sealing abutment with the outer wall of the key lever 321 or the cavity wall of the first segment 3121.

Alternatively, the first groove 3212 may be a U-shaped groove, a wedge-shaped groove, a V-shaped groove, an arc-shaped groove, a semi-circular groove, or the like, which is not limited herein.

In an embodiment, an avoiding groove 3221 is formed in the outer wall of the key cap 322 corresponding to the second clamping member 323, the second clamping member 323 includes a resilient arm 3231 and a clamping protrusion 3232, one end of the resilient arm 3231 is connected to the outer wall of the key cap 322, the clamping protrusion 3232 is protruding from the other end of the resilient arm 3231 and is located on a side of the resilient arm 3231 facing away from the avoiding groove 3221, and the resilient arm 3231 is flush with the outer wall of the key cap 322.

In this embodiment, as shown in fig. 3 to 5, the avoiding groove 3221 is disposed on the outer wall of the key cap 322, so as to facilitate the elastic avoiding position of the second clip member 323, and ensure that the second clip member 323 smoothly extends into the second section 3111 and is clipped with the first clip member 315. It can be understood that, the bullet arm 3231 one end of second joint spare 323 is connected with the outer wall according to key cap 322, and the other end is the free end, and protruding 3232 of card locates the free end of bullet arm 3231 for bullet arm 3231 flushes with the outer wall according to key cap 322, thereby when exerting external force and pressing according to key cap 322, can slide along second section 3111 according to key cap 322, avoids second joint spare 323 to interfere the slip according to key cap 322.

Optionally, the first snap-in member 315 is disposed in an annular boss, that is, the first snap-in member 315 is disposed along the circumferential extension of the inner wall of the second section 3111. Of course, in other embodiments, the first engaging member 315 includes a plurality of boss structures, and the boss structures are spaced along the circumference of

the inner wall of the second section 3111, and each boss structure corresponds to one second engaging member 323.

It can be understood that the second clamping members 323 include a plurality of second clamping members 323, the plurality of second clamping members 323 are circumferentially arranged along the outer wall of the key cap 322 at intervals, and an avoiding groove 3221 is formed in the outer wall of the key cap 322 corresponding to each second clamping member 323, which is not limited herein. In this embodiment, in order to facilitate the protrusion 3232 of the second clip member 323 smoothly extending into the second section 3111 and clipping with the first clip member 315, the protrusion 3232 has a guiding surface 3233, that is, when the pressing member 32 is installed, the first clip member 315 moves along the guiding surface 3233 of the protrusion 3232, so that the protrusion 3232 slides into the second section 3111 and clips with the first clip member 315.

In one embodiment, as shown in fig. 3 to 5, an abutting surface 3112 is formed at a communication portion between the first segment 3121 and the second segment 3111, and when the key cap 322 is pressed, the key cap 322 abuts against the abutting surface 3112. It can be understood, so set up to utilize the extrusion of butt face 3112 restriction external force, avoid external force too big, make press key cap 322 to drive press key rod 321 transition to press and trigger subassembly 2, and then damage trigger subassembly 2. So when exerting external force and pressing button cap 322, the outer wall of button cap 322 slides along first joint spare 315 to with butt joint face 3112 butt joint, button pole 321 just can support to press and trigger subassembly 2 this moment.

In one embodiment, the rotating crown 31 includes a rotating portion 311 and a rotating portion 312 connected to each other, the sliding cavity 31a penetrates through the rotating portion 311 and the rotating portion 312, a limiting surface 313 is formed at a connection position of the rotating portion 311 and the rotating portion 312, and the rotating portion 312 is rotatably inserted into the key hole 11, so that the limiting surface 313 is in limiting contact with the outer wall of the case 1.

In the present embodiment, as shown in fig. 1 to 5, by providing the rotary crown 31 as the rotary portion 311 and the rotary shaft portion 312 connected, the sliding chamber 31a penetrates through the rotary portion 311 and the rotary shaft portion 312, that is, the second section 3111 is formed through the portion of the sliding chamber 31a of the rotary portion 311, and the first section 3121 is formed through the portion of the sliding chamber 31a of the rotary shaft portion 312. Through being formed with spacing face 313 in the outer wall junction of the outer wall of rotating part 311 and pivot portion 312 for pivot portion 312 rotationally wears to locate in the key hole 11, makes spacing face 313 and the spacing butt of casing 1's outer wall, thereby when ensureing to exert external force and press down pressure piece 32, rotatory crown 31 avoids moving along key hole 11 through the spacing butt of face 313 and casing 1's outer wall.

It is understood that the outer diameter of the rotating portion 311 of the rotary crown 31 is larger than the outer diameter of the rotating shaft portion 312. Alternatively, the rotation shaft portion 312 of the rotary crown 31 has a cylindrical structure. In the present embodiment, the rotary portion 311 and the rotary shaft portion 312 of the rotary crown 31 are formed integrally, so that the structural strength of the rotary crown 31 can be improved.

In an embodiment, the rotation shaft portion 312 penetrates through an outer wall of one end of the key hole 11 to be provided with a locking groove 3122, the key structure 100 further includes a snap spring 4 disposed in the housing 1, and the snap spring 4 is movably locked in the locking groove 3122.

In this embodiment, as shown in fig. 2 to 5, by providing the engaging groove 3122 on the rotating shaft portion 312 and providing the snap spring 4, the snap spring 4 is movably

engaged with the engaging groove 3122 and abuts against the inner wall of the housing 1 for limitation, so that the snap spring 4 can be used to further limit the rotating crown 31 in the key hole 11, and when the rotating crown 31 and/or the pressing member 32 of the key assembly 3 are prevented from being pulled out of the key hole 11 by applying an external force to pull the key assembly 3.

It can be understood that, by arranging the snap spring 4, the snap spring 4 is detachably clamped in the clamping groove 3122 of the rotary crown 31, so that the key assembly 3 is convenient to mount and dismount. Of course, in other embodiments, the rotation shaft 312 may be protruded from an outer wall of one end of the key hole 11 to abut against an inner wall of the casing 1, that is, the rotation shaft 312, the rotation part 311 and the rotation part 312 enclose to form an H-shaped limit groove structure, so as to ensure the installation and the limit of the rotation crown 31, which is not limited herein.

In this embodiment, the engaging groove 3122 is circumferentially disposed along the outer wall of the rotating shaft 312 and forms an annular groove, the snap spring 4 has a locking portion 41, the locking portion 41 is disposed in a U shape, and the locking portion 41 is movably locked in the engaging groove 3122. Also jump ring 4 has the installation department of joint portion 41 and connection joint portion 41, and jump ring 4 is spacing through the spacing installation of installation department and casing 1's inner wall or butt, and the joint portion 41 of jump ring 4 is the setting of U type for U type jump ring 4 joint is in rotatory crown 31 in the draw-in groove 3122 of pivot portion 312, can spacing rotatory crown 31 along the axial removal of key hole 11 on the one hand, and on the other hand has and can realize that rotatory crown 31 follows the rotation of key hole 11 circumference.

In an embodiment, as shown in fig. 1 and fig. 3 to fig. 5, the key structure 100 further includes a wear-resistant plate 5, and the wear-resistant plate 5 is sleeved on the rotating shaft portion 312 and clamped between the limiting surface 313 and the outer wall of the housing 1. It will be appreciated that this is so arranged that friction with the outer wall of the case 1 when the rotary crown 31 rotates is reduced by the wear-resistant pieces 5, thereby reducing the rotational damping force. Optionally, the wear-resistant sheet 5 is made of PEEK.

In this embodiment, as shown in fig. 4 and 5, the stopper surface 313 is provided with a stopper groove 314, and a portion of the wear-resistant plate 5 is accommodated in the stopper groove 314. It can be understood that through setting up spacing groove 314 to conveniently utilize spacing groove 314 to realize location and spacing installation to wear pad 5, partial wear pad 5 protrudes the notch of spacing groove 314 simultaneously, so can make wear pad 5 and casing 1's outer wall butt, avoids spacing 313 direct and casing 1's outer wall direct contact, thereby effectively reduces the friction.

In an embodiment, the key structure 100 further includes at least one second sealing ring 7, and the second sealing ring 7 is interposed between the outer wall of the rotation shaft portion 312 and the hole wall of the key hole 11.

In the present embodiment, as shown in fig. 3 to 5, by providing the second seal ring 7, the gap between the rotating shaft portion 312 of the rotary crown 31 and the hole wall of the key hole 11 is sealed by the second seal ring 7, and the sealing performance and the waterproof performance are improved. Optionally, the second sealing ring 7 is made of NBR.

It is understood that the second seal ring 7 is located between the catching groove 3122 of the rotation shaft portion 312 in the rotation crown 31 and the rotation part 311. Optionally, the second sealing ring 7 includes a plurality of second sealing rings 7, and the plurality of second sealing rings 7 are arranged at intervals along the extending direction of the rotating shaft portion 312.

In order to avoid the problem of the displacement of the second sealing ring 7 during the rotation of the rotary crown 31, which may cause the reduction of the sealing performance, in

an embodiment, as shown in fig. 3 to 5, at least one of the outer wall of the rotating shaft portion 312 and the hole wall of the key hole 11 is provided with a second groove 3123, and the second sealing ring 7 is accommodated in the second groove 3123 and partially protrudes out of the notch of the second groove 3123.

It is understood that the second groove 3123 may be disposed on the outer wall of the rotating shaft portion 312 of the rotating crown 31, or the second groove 3123 may be disposed on the hole wall of the key hole 11, or the second groove 3123 is disposed on both the outer wall of the rotating shaft portion 312 and the hole wall of the key hole 11, and in this case, the two second grooves 3123 correspond, which is not limited herein.

In this embodiment, the second sealing ring 7 has elasticity and sealing performance, and the second sealing ring 7 is accommodated in the second groove 3123 and partially protrudes from the notch of the second groove 3123, so that the second sealing ring 7 protruding from the notch of the second groove 3123 can be in sealing abutment with the outer wall of the rotating shaft portion 312 and the hole wall of the key hole 11.

Alternatively, the second groove 3123 may be a U-shaped groove, a wedge-shaped groove, a V-shaped groove, an arc-shaped groove, a semi-circular groove, or the like, which is not limited herein.

In one embodiment, as shown in fig. 1 to 4, the trigger assembly 2 includes a trigger element 21 and an optical sensor 22, wherein the trigger element 21 is disposed in the casing 1 and is opposite to the key hole 11, and the optical sensor 22 is disposed in the casing 1 and is opposite to the sidewall of the rotary crown 31.

In this embodiment, the triggering element 21 is provided with a contact corresponding to the key hole 11, and the contact is opposite to the end of the key rod 321 far away from the key cap 322. It will be understood that the trigger element 21 and the optical sensor 22 are electrically connected to the circuit board, such that the circuit board is configured to receive the trigger signals of the trigger element 21 and the optical sensor 22 for implementing the corresponding control functions of the trigger signals. Optionally, the circuit board is a flexible circuit board or a rigid circuit board, which is not limited herein.

It can be understood that the triggering element 21 can be welded on the flexible circuit board, so that the triggering element 21 is provided with a contact corresponding to the key hole 11, the contact is opposite to one end of the key rod 321 far away from the key cap 322, and thus when an external force is applied to press the key cap 322, the key rod 321 is abutted to the contact and presses the triggering signal.

In the present embodiment, the optical sensor 22 is provided, so that the rotation of the rotating shaft portion 312 is driven to trigger a signal or a function different from the pressing of the trigger triggering member 21 when the user rotates the rotating crown 31 is detected and recognized by the optical sensor 22, which is not limited herein. It will be appreciated that the optical sensor 22 is disposed on the circuit board and adjacent to and spaced from the trigger member 21, and the optical sensor 22 is used for sensing the rotation of the shaft portion 312 of the rotary crown 31 to trigger the trigger assembly 2.

It can be understood that the arrangement is such that the movement stroke of the pressing member 32 is arranged in the rotary crown 31, so that the case 1 does not need to ensure the stroke required for pressing the pressing member 32, the thickness of the case 1 of the device can be further reduced, and the internal space of the device can be saved. Simultaneously, all set up elastic component 33 and pressing member 32 in the slip chamber 31a of rotatory crown 31 to when making rotatory crown 31 rotatory, drive elastic component 33 and pressing member 32 rotatory in the lump, effectively avoided the friction between elastic component 33 and the pressing member 32, improve and to guarantee that good rotatory is felt, improve rotatory crown 31's rotatory life-span.

In the present embodiment, when the key structure 100 is assembled, the elastic member 33, the first sealing ring 6 and the pressing member 32 are assembled, and then the assembled pressing member 32 is installed in the sliding cavity 31a of the rotating crown 31, so that the second fastening member 323 on the key cap 322 is fastened with the first fastening member 315 in the sliding cavity 31a of the rotating crown 31; then the wear-resistant sheet 5 and the second seal ring 7 are arranged at the corresponding positions of the rotary crown 31, the assembled rotary crown 31 is arranged in the key hole 11 of the shell 1, the wear-resistant snap spring 4 is inserted from the inner side of the shell 1, and the snap spring 4 and the shell 1 are welded and fixed. The optical sensor 22 and the triggering element 21 of the triggering assembly 2 are then mounted at corresponding positions inside the housing 1. In the installed key structure 100, since the elastic member 33 is in a pre-compressed state when the key cap 322 is installed, the rotating crown 31 and the key cap 322 are supported with each other, and when the rotating crown 31 rotates, the key rod 321 and the elastic member 33 of the sliding cavity 31a rotate synchronously with the rotating crown 31. The optical sensor 22 installed inside the case 1 receives a rotation signal of the rotary crown 31, thereby realizing the input of the rotation signal; by manually pressing the key cap 322 of the pressing member 32, the key rod 321 is axially moved to trigger the triggering member 21, thereby inputting a switch signal. When the external force is removed and the external force is released, the elastic member 33 rebounds and pushes the key lever 321 to return to the initial position. The second sealing ring 7 and the first sealing ring 6 which are arranged outside the rotating crown 31 and the key rod 321 can ensure 5 ATM-level water resistance while ensuring the movement of the key assembly 3.

It can be understood that, in the key structure 100, since the rotating crown 31 does not move in the axial direction of the key hole 11, the thickness of the case 1 can be reduced, thereby saving the internal space of the case 1 and facilitating the stacking of internal devices; because the rotary crown 31 is not stressed in the axial direction of the key hole 11, the rotary damping is small, the rotary hand feeling is good, the abrasion is not easy to occur, and the service life is prolonged; the key assembly 3 has high part integration level, can assemble materials, and has low material management cost and convenient and fast assembly.

The present invention further provides a wearable device, which includes a device main body and the key structure 100, and the specific structure of the key structure 100 refers to the foregoing embodiments, and since the wearable device adopts all technical solutions of all the foregoing embodiments, the wearable device at least has all beneficial effects brought by the technical solutions of the foregoing embodiments, and details are not repeated herein.

In this embodiment, the device main body includes a housing, the housing is provided with a key hole, and the key structure 100 is connected to the housing. It can be understood that the wearing device can be a watch, a bracelet, a head-mounted display and the like, and when the wearing device is the watch, the shell can be a watch shell of the watch.

The above description is only an alternative embodiment of the present invention, and not intended to limit the scope of the present invention, and all modifications and equivalents of the present invention, which are made by the contents of the present specification and the accompanying drawings, or directly/indirectly applied to other related technical fields, are included in the scope of the present invention.

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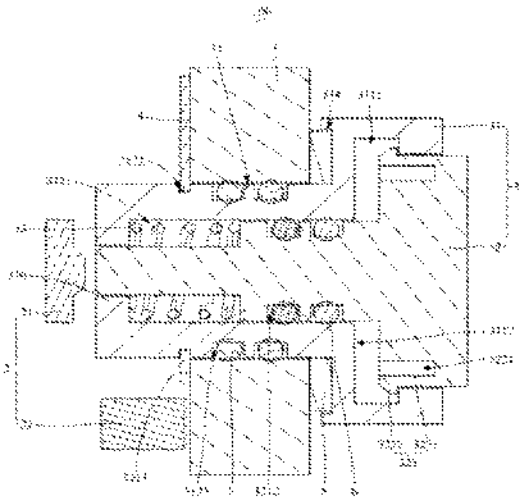
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(54) 发明名称

按键结构和穿戴设备

(57) 摘要

本发明公开一种按键结构和穿戴设备，所述按键结构包括触发组件和按键组件，所述按键组件包括旋转表冠和按压件，所述旋转表冠可转动地穿设于壳体的按键孔内，所述旋转表冠内设有滑动腔，所述按压件可滑动地穿设于所述滑动腔内；其中，按压所述按压件时，所述按压件沿所述滑动腔移动以触发所述触发组件；和/或，旋转所述旋转表冠时，所述旋转表冠带动所述按压件旋转以触发所述触发组件。本发明旨在提高一种能够保证良好的旋转手感，并提高表冠旋转寿命的按键结构，该按键结构应用于设备中，能够有效减薄设备壳体厚度，节省设备内部空间。



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1.一种按键结构，其特征在于，所述按键结构包括：

触发组件；和

按键组件，所述按键组件包括旋转表冠和按压件，所述旋转表冠可转动地穿设于壳体的按键孔内，所述旋转表冠内设有滑动腔，所述按压件可滑动地穿设于所述滑动腔内；

其中，按压所述按压件时，所述按压件沿所述滑动腔移动以触发所述触发组件；和/或，旋转所述旋转表冠时，所述旋转表冠带动所述按压件旋转以触发所述触发组件。

2.根据权利要求1所述的按键结构，其特征在于，所述按压件包括相连接的按键杆和按键帽；

所述滑动腔包括相连通的第一段和第二段，所述第二段的孔径大于所述第一段的孔径，所述按键杆滑动穿设于所述第一段，部分所述按键帽凸出所述第二段远离所述第一段的一端。

3.根据权利要求2所述的按键结构，其特征在于，所述按键结构还包括至少一个第一密封圈，所述第一密封圈夹设于所述按键杆和所述第一段的孔壁之间。

4.根据权利要求2所述的按键结构，其特征在于，所述第二段的腔壁凸设有第一卡接件，所述按键帽的外壁设有与所述第一卡接件卡接配合的第二卡接件；

所述按键组件还包括设于所述第一段内的弹性件，所述弹性件与所述按键杆弹性抵接；

其中，按压所述按键帽时，所述按键杆压缩或拉伸所述弹性件。

5.根据权利要求4所述的按键结构，其特征在于，所述按键杆的外壁凸设有抵接台，所述第一段远离所述第二段一端的内壁凸设有支撑台，所述弹性件的两端分别与所述抵接台和所述支撑台弹性抵接；

且/或，所述按键帽的外壁对应所述第二卡接件设有避让槽，所述第二卡接件包括弹臂和卡凸，所述弹臂的一端与所述按键帽的外壁连接，所述卡凸凸设于所述弹臂的另一端，并位于所述弹臂背向所述避让槽的一侧；

且/或，所述第一段与所述第二段的连通处形成有抵接面，按压所述按键帽时，所述按键帽与所述抵接面抵接。

6.根据权利要求1至5中任一项所述的按键结构，其特征在于，所述旋转表冠包括相连接的旋转部和转轴部，所述滑动腔贯穿所述旋转部和所述转轴部，所述旋转部与所述转轴部的连接处形成有限位面，所述转轴部可转动地穿设于所述按键孔内，使所述限位面与所述壳体的外壁限位抵接。

7.根据权利要求6所述的按键结构，其特征在于，所述转轴部穿过所述按键孔的一端外壁设有卡槽，所述按键结构还包括设于所述壳体内的卡簧，所述卡簧活动卡接于所述卡槽内。

8.根据权利要求7所述的按键结构，其特征在于，所述卡槽沿所述转轴部的外壁周向设置并形成环槽，所述卡簧具有卡接部，所述卡接部呈U型设置，所述卡接部活动卡接于所述卡槽内。

9.根据权利要求6所述的按键结构，其特征在于，所述按键结构还包括耐磨片，所述耐磨片套设于所述转轴部，并夹设于所述限位面和所述壳体的外壁之间。

10.根据权利要求6所述的按键结构，其特征在于，所述按键结构还包括至少一个第二

密封圈，所述第二密封圈夹设于所述转轴部的外壁和所述按键孔的孔壁之间。

11.根据权利要求1所述的按键结构，其特征在于，所述触发组件包括：

触发元件，所述触发元件设于所述壳体内，并与所述按键孔正对设置；和

光学传感器，所述光学传感器设于所述壳体内，并与所述旋转表冠的侧壁正对设置。

12.一种穿戴设备，其特征在于，包括设备主体和如权利要求1至11中任一项所述的按键结构，所述设备主体包括壳体，所述壳体设有按键孔，所述按键结构连接于所述壳体。

按键结构和穿戴设备

技术领域

[0001] 本发明涉及智能穿戴设备技术领域，特别涉及一种按键结构和应用该按键结构的穿戴设备。

背景技术

[0002] 随着材料工艺的不断发展，手表的表壳厚度做的越来越薄，但由于表冠按压需要一定的行程，所以表壳厚度的进一步缩小受到了限制，导致表冠处局部厚度较厚，占用较多的表壳内部空间。同时，相关技术中表冠旋转时会与弹簧摩擦，导致旋转手感较差，旋转寿命较短。

发明内容

[0003] 本发明的主要目的是提供一种按键结构和穿戴设备，旨在提高一种能够保证良好的旋转手感，并提高表冠旋转寿命的按键结构，该按键结构应用于设备中，能够有效减薄设备壳体厚度，节省设备内部空间。

[0004] 为实现上述目的，本发明提出一种按键结构，所述按键结构包括：

[0005] 触发组件；和

[0006] 按键组件，所述按键组件包括旋转表冠和按压件，所述旋转表冠可转动地穿设于壳体的按键孔内，所述旋转表冠内设有滑动腔，所述按压件可滑动地穿设于所述滑动腔内；

[0007] 其中，按压所述按压件时，所述按压件沿所述滑动腔移动以触发所述触发组件；和/或，旋转所述旋转表冠时，所述旋转表冠带动所述按压件旋转以触发所述触发组件。

[0008] 在一实施例中，所述按压件包括相连接的按键杆和按键帽；

[0009] 所述滑动腔包括相连通的第一段和第二段，所述第二段的孔径大于所述第一段的孔径，所述按键杆滑动穿设于所述第一段，部分所述按键帽凸出所述第二段远离所述第一段的一端。

[0010] 在一实施例中，所述按键结构还包括至少一个第一密封圈，所述第一密封圈夹设于所述按键杆和所述第一段的孔壁之间。

[0011] 在一实施例中，所述第二段的腔壁凸设有第一卡接件，所述按键帽的外壁设有与所述第一卡接件卡接配合的第二卡接件；

[0012] 所述按键组件还包括设于所述第一段内的弹性件，所述弹性件与所述按键杆弹性抵接；

[0013] 其中，按压所述按键帽时，所述按键杆压缩或拉伸所述弹性件。

[0014] 在一实施例中，所述按键杆的外壁凸设有抵接台，所述第一段远离所述第二段一端的内壁凸设有支撑台，所述弹性件的两端分别与所述抵接台和所述支撑台弹性抵接；

[0015] 且/或，所述按键帽的外壁对应所述第二卡接件设有避让槽，所述第二卡接件包括弹臂和卡凸，所述弹臂的一端与所述按键帽的外壁连接，所述卡凸凸设于所述弹臂的另一端，并位于所述弹臂背向所述避让槽的一侧；

[0016] 且/或，所述第一段与所述第二段的连通处形成有抵接面，按压所述按键帽时，所述按键帽与所述抵接面抵接。

[0017] 在一实施例中，所述旋转表冠包括相连接的旋转部和转轴部，所述滑动腔贯穿所述旋转部和所述转轴部，所述旋转部与所述转轴部的连接处形成有限位面，所述转轴部可转动地穿设于所述按键孔内，使所述限位面与所述壳体的外壁限位抵接。

[0018] 在一实施例中，所述转轴部穿过所述按键孔的一端外壁设有卡槽，所述按键结构还包括设于所述壳体内的卡簧，所述卡簧活动卡接于所述卡槽内。

[0019] 在一实施例中，所述卡槽沿所述转轴部的外壁周向设置并形成环槽，所述卡簧具有卡接部，所述卡接部呈U型设置，所述卡接部活动卡接于所述卡槽内。

[0020] 在一实施例中，所述按键结构还包括耐磨片，所述耐磨片套设于所述转轴部，并夹设于所述限位面和所述壳体的外壁之间。

[0021] 在一实施例中，所述按键结构还包括至少一个第二密封圈，所述第二密封圈夹设于所述转轴部的外壁和所述按键孔的孔壁之间。

[0022] 在一实施例中，所述触发组件包括：

[0023] 触发元件，所述触发元件设于所述壳体内，并与所述按键孔正对设置；和

[0024] 光学传感器，所述光学传感器设于所述壳体内，并与所述旋转表冠的侧壁正对设置。

[0025] 本发明还提出一种穿戴设备，包括设备主体和上述所述的按键结构，所述设备主体包括壳体，所述壳体设有按键孔，所述按键结构连接于所述壳体。

[0026] 本发明技术方案的按键结构通过将按键组件的旋转表冠可转动地穿设于壳体的按键孔内，并在旋转表冠内设置滑动腔，使得按压件可滑动地穿设于滑动腔内，如此在按压按压件时，按压件沿旋转表冠的滑动腔移动，进而触发触发组件；和/或，旋转旋转表冠时，旋转表冠能够带动按压件旋转以触发触发组件，也即将按键组件的按压件和旋转表冠采用嵌套式设置，使得旋转和按压功能分离，如此壳体不需要保证按压所需要的行程，可使得设备的壳体厚度进一步减薄，节省设备内部空间；同时，按压件可滑动地穿设于滑动腔内，使得旋转表冠旋转时按压件可跟随旋转，不与按压件摩擦，可以保证良好的旋转手感，提高表冠旋转寿命。

附图说明

[0027] 为了更清楚地说明本发明实施例或现有技术中的技术方案，下面将对实施例或现有技术描述中所需要使用的附图作简单地介绍，显而易见地，下面描述中的附图仅仅是本发明的一些实施例，对于本领域普通技术人员来讲，在不付出创造性劳动的前提下，还可以根据这些附图示出的结构获得其他的附图。

[0028] 图1为本发明一实施例中按键结构的结构示意图；

[0029] 图2为本发明一实施例中按键结构另一视角的结构示意图；

[0030] 图3为本发明一实施例中按键结构的分解示意图；

[0031] 图4为本发明一实施例中按键结构的剖面示意图；

[0032] 图5为本发明一实施例中旋转表冠的剖面示意图；

[0033] 图6为本发明一实施例中按压件的结构示意图。

[0034] 附图标号说明：

[0035]

标号	名称	标号	名称
100	按键结构	315	第一卡接件

[0036]

1	壳体	316	支撑台
11	按键孔	32	按压件
2	触发组件	321	按键杆
21	触发元件	3211	抵接台
22	光学传感器	3212	第一凹槽
3	按键组件	322	按键帽
31	旋转表冠	3221	避让槽
31a	滑动腔	323	第二卡接件
311	旋转部	3231	弹臂
3111	第二段	3232	卡爪
3112	抵接面	3233	导向面
312	转轴部	33	弹性件
3121	第一段	4	卡簧
3122	卡槽	41	卡接部
3123	第二凹槽	5	耐磨片
313	限位面	6	第一密封圈
314	限位槽	7	第二密封圈

[0037] 本发明目的的实现、功能特点及优点将结合实施例，参照附图做进一步说明。

具体实施方式

[0038] 下面将结合本发明实施例中的附图，对本发明实施例中的技术方案进行清楚、完整地描述，显然，所描述的实施例仅仅是本发明的一部分实施例，而不是全部的实施例。基于本发明中的实施例，本领域普通技术人员在没有作出创造性劳动前提下所获得的所有其他实施例，都属于本发明保护的范围。

[0039] 需要说明，本发明实施例中所有方向性指示(诸如上、下、左、右、前、后……)仅用于解释在某一特定姿态(如附图所示)下各部件之间的相对位置关系、运动情况等，如果该特定姿态发生改变时，则该方向性指示也相应地随之改变。

[0040] 同时，全文中出现的“和/或”或“且/或”的含义为，包括三个方案，以“A和/或B”为例，包括A方案，或B方案，或A和B同时满足的方案。

[0041] 另外，在本发明中如涉及“第一”、“第二”等的描述仅用于描述目的，而不能理解为指示或暗示其相对重要性或者隐含指明所指示的技术特征的数量。由此，限定有“第一”、“第二”的特征可以明示或者隐含地包括至少一个该特征。另外，各个实施例之间的技术方

案可以相互结合，但是必须是以本领域普通技术人员能够实现为基础，当技术方案的结合出现相互矛盾或无法实现时应当认为这种技术方案的结合不存在，也不在本发明要求的保护范围之内。

[0042] 随着材料工艺的不断发展，手表的表壳厚度做的越来越薄，但由于表冠按压需要一定的行程，所以表壳厚度的进一步缩小受到了限制，导致表冠处局部厚度较厚，占用较多的表壳内部空间。同时，相关技术中表冠旋转时会与弹簧摩擦，导致旋转手感较差，旋转寿命较短。

[0043] 基于上述构思和问题，本发明提出一种按键结构100。可以理解的，按键结构100可应用于穿戴设备、电子设备或其他使用按键功能的产品上，在此不做限定。按键结构100应用于穿戴设备中时，穿戴设备包括壳体1，也即壳体1可以是穿戴设备的外壳，壳体1设有按键孔11，按键结构100中按键组件3的旋转表冠31和按压件32的部分凸出壳体1的按键孔11，如此可方便按键组件3的旋转表冠31和按压件32分别实现旋转和按压功能。

[0044] 请结合参照图1至图6所示，在本发明实施例中，该按键结构100包括触发组件2和按键组件3，其中，按键组件3包括旋转表冠31和按压件32，旋转表冠31可转动地穿设于壳体1的按键孔11内，旋转表冠31内设有滑动腔31a，按压件32可滑动地穿设于滑动腔31a内；其中，按压按压件32时，按压件32沿滑动腔31a移动以触发触发组件2；和/或，旋转旋转表冠31时，旋转表冠31带动按压件32旋转以触发触发组件2。

[0045] 在本实施例中，按键结构100应用于具有按键功能的设备中，该设备包括壳体1，壳体1设有按键孔11，从而利用壳体1安装固定按键结构100。当然，壳体1也可以是按键结构100的安装部件，用于安装和固定触发组件2、按键组件3及其他部件，在此不做限定。可以理解的，壳体1为触发组件2、按键组件3及其他部件提供安装基础，通过在壳体1内设置安装腔，从而方便利用安装腔安装、固定触发组件2，不仅对触发组件2实现保护，还能起到防水等效果。

[0046] 可以理解的，通过在壳体1上设置连通安装腔的按键孔11，从而方便按键组件3的部分穿过按键孔11伸入安装腔，以使得按键组件3在外力作用下按压和/或旋转按键组件3，以使得按键组件3的按压件32和/或旋转表冠31触发触发组件2，以实现不同的按键功能。

[0047] 可选地，触发组件2用于按键的触发。触发组件2可以是设置于电路板上的触发元件或感应元件或按键或弹片等结构，在按键组件3的按压件32和/或旋转表冠31触发触发组件2时，触发组件2将信号传输至电路板以实现相应的控制操作等，在此不做限定。

[0048] 在本实施例中，按键组件3的旋转表冠31的一端凸出在壳体1的外部，旋转表冠31的另一端转动穿设于按键孔11内，从而方便用户通过凸出的旋转表冠31实现旋转功能，同时按键组件3的按压件32的一端凸出在凸出于壳体1外部的旋转表冠31的一端，也即按压件32的另一端活动穿设于滑动腔31a内，如此可方便用户通过凸出的按压件32实现按压功能。

[0049] 可以理解的，旋转表冠31可通过阻尼方式可转动地穿设于按键孔11内，如此可使得旋转表冠31在施加外力的情况下能够在按键孔11内转动，在不施加外力的作用下，旋转表冠31固定在按键孔11内。当然，在其他实施例中，旋转表冠31还可通过密封圈或阻尼环或采用其他能够实现转动安装的结构装设于按键孔11内，在此不做限定。

[0050] 在本实施例中，按压件32能够沿旋转表冠31的滑动腔31a移动，例如按压件32可通过阻尼方式滑动设于滑动腔31a内，如此可使得按压件32在施加外力的情况下能够在滑动

腔31a内移动，在不施加外力的作用下，按压件32固定在滑动腔31a内。当然，在其他实施例中，按压件32还可通过采用弹簧等结构实现按压复位，或确保按压件32在无外力的作用下不沿滑动腔31a内移动等，在此不做限定。

[0051] 可以理解的，按压件32与旋转表冠31采用可拆卸连接方式连接为一体结构，例如采用卡扣连接、插接配合、吸合连接等，在此不做限定。

[0052] 本发明的按键结构100通过将按键组件3的旋转表冠31可转动地穿设于壳体1的按键孔11内，并在旋转表冠31内设置滑动腔31a，使得按压件32可滑动地穿设于滑动腔31a内，如此在按压按压件32时，按压件32沿旋转表冠31的滑动腔31a移动，进而触发触发组件2；和/或，旋转旋转表冠31时，旋转表冠31能够带动按压件32旋转以触发触发组件2，也即将按键组件3的按压件32和旋转表冠31采用嵌套式设置，使得旋转和按压功能分离，如此壳体1不需要保证按压所需要的行程，可使得设备的壳体1厚度进一步减薄，节省设备内部空间；同时，按压件32可滑动地穿设于滑动腔31a内，使得旋转表冠31旋转时按压件32可跟随旋转，不与按压件32摩擦，可以保证良好的旋转手感，提高旋转表冠31的旋转寿命。

[0053] 在一实施例中，滑动腔31a的腔壁凸设有第一卡接件315，按压件32的外壁设有与第一卡接件315卡接配合的第二卡接件323；按键组件3还包括套设于按压件32外壁的弹性件33，弹性件33的两端分别与按压件32和滑动腔31a的腔壁弹性抵接。

[0054] 在本实施例中，如图3至图6所示，通过在旋转表冠31的滑动腔31a腔壁设置第一卡接件315，并在按压件32的外壁设置第二卡接件323，使得按压件32通过第二卡接件323和第一卡接件315的卡接配合与旋转表冠31卡接连接；同时，通过设置弹性件33，使得弹性件33位于滑动腔31a内，并套设于按压件32外壁，使得弹性件33的两端分别与按压件32和滑动腔31a的腔壁弹性抵接，如此在按压件32通过第二卡接件323与第一卡接件315的卡接配合与旋转表冠31卡接连接时，弹性件33处于压缩状态，从而利用弹性件33的弹力使得按压件32远离触发组件2，且使得按压件32通过第二卡接件323与第一卡接件315的卡接配合与旋转表冠31卡接连接，避免按压件32脱离旋转表冠31。

[0055] 可选地，弹性件33为压缩弹簧或伸缩弹簧等，在此不做限定。可以理解的，弹性件33的两端分别与按压件32和滑动腔31a的腔壁弹性抵接，可以通过在按压件32的外壁和滑动腔31a的腔壁设置支撑台或抵接台，且支撑台或抵接台不影响按压件32在滑动腔31a内的移动。

[0056] 在本实施例中，旋转表冠31可选为呈两端开口的筒状结构，也即滑动腔31a的两端具有开口，在此不做限定。按压件32可选为柱状或杆状结构等，在此不做限定。

[0057] 在一实施例中，按压件32包括相连接的按键杆321和按键帽322；滑动腔31a包括相连通的第一段3121和第二段3111，第二段3111的孔径大于第一段3121的孔径，按键杆321滑动穿设于第一段3121，部分按键帽322凸出第二段3111远离第一段3121的一端。

[0058] 在一实施例中，如图3至图6所示，第二段3111的腔壁凸设有第一卡接件315，按键帽322的外壁设有与第一卡接件315卡接配合的第二卡接件323；按键组件3还包括设于第一段3121内的弹性件33，弹性件33与按键杆321弹性抵接；其中，按压按键帽322时，按键杆321压缩或拉伸弹性件33。

[0059] 在本实施例中，通过将按压件32设置为按键杆321和按键帽322，并将滑动腔31a设置为相连通的第一段3121和第二段3111，使得按压件32的按键杆321滑动穿设于第一段

3121，部分按键帽322通过第二卡接件323和第一卡接件315的配合位于第二段3111内，部分按键帽322凸出第二段3111远离第一段3121的一端，如此可方便用户按压按键帽322，使得按键帽322在外力作用下带动按键杆321移动，以进一步压缩弹性件33，并使得按键杆321抵压触发组件2。

[0060] 可选地，第一卡接件315和第二卡接件323可以是卡台和卡扣的配合结构或卡凸和卡槽的配合结构或卡凸和卡孔的配合结构，在此不做限定。

[0061] 可选地，弹性件33为弹簧，弹性件33套设于按键杆321的外壁。当然，在其他实施例中，弹性件33为弹片，此时，弹性件33位于第一段3121内，且弹性件33与按键杆321弹性抵接连接。

[0062] 可以理解的，按压件32的按键帽322的直径大于按键杆321的直径，可选地，第二段3111的孔径大于第一段3121的孔径，使得滑动腔31a的第二段3111与按键帽322相适配，滑动腔31a的第一段3121与按键杆321相适配。当然，为了避免弹性件33影响按键杆321的移动，第一段3121的直径略大于弹性件33的直径。

[0063] 在本实施例中，按压件32的按键杆321和按键帽322为一体成型结构，如此可提高按压件32的结构强度。

[0064] 在一实施例中，按键杆321的外壁凸设有抵接台3211，第一段3121远离第二段3111一端的内壁凸设有支撑台316，弹性件33的两端分别与抵接台3211和支撑台316弹性抵接。

[0065] 如图3至图6所示，在本实施例中，通过在按键杆321的外壁设置抵接台3211，并在旋转表冠31邻近触发组件2一端的腔壁内设置支撑台316，使得弹性件33的两端分别与抵接台3211和支撑台316弹性抵接，从而确保弹性件33在按压件32与旋转表冠31通过第二卡接件323和第一卡接件315卡接配合时处于压缩状态。

[0066] 在一实施例中，按键结构100还包括至少一个第一密封圈6，第一密封圈6夹设于按键杆321和第一段3121的孔壁之间。

[0067] 在本实施例中，如图3和图4所示，通过在按键杆321和第一段3121的孔壁之间设置第一密封圈6，从而利用第一密封圈6密封按键杆321和滑动腔31a的第一段3121腔壁之间的缝隙，提高密封性能和防水性能。可选地，第一密封圈6的材质为NBR。

[0068] 可以理解的，第一密封圈6包括多个，多个第一密封圈6沿按键杆321的延长方向间隔排布。

[0069] 为了避免按键杆321移动过程中，第一密封圈6发生移位等现象，在一实施例中，如图3、图4和图6所示，按键杆321和第一段3121的孔壁中至少一个设有第一凹槽3212，第一密封圈6容纳于第一凹槽3212内，并部分凸出第一凹槽3212的槽口。

[0070] 在本实施例中，第一凹槽3212可设置于按键杆321的外壁，或者第一凹槽3212可设置于第一段3121的腔壁，或者按键杆321的外壁和第一段3121的腔壁上均设有第一凹槽3212，且呈对应设置，在此不做限定。可以理解的，第一密封圈6具有弹性和密封性，第一密封圈6容纳于第一凹槽3212内，并部分凸出第一凹槽3212的槽口，使得凸出第一凹槽3212的槽口的第一密封圈6能够与按键杆321的外壁或第一段3121的腔壁密封抵接。

[0071] 可选地，第一凹槽3212可以使U型凹槽、楔形槽、V型槽、弧形槽、半圆型槽等，在此不做限定。

[0072] 在一实施例中，按键帽322的外壁对应第二卡接件323设有避让槽3221，第二卡接

件323包括弹臂3231和卡凸3232，弹臂3231的一端与按键帽322的外壁连接，卡凸3232凸设于弹臂3231的另一端，并位于弹臂3231背向避让槽3221的一侧，弹臂3231与按键帽322的外壁齐平。

[0073] 在本实施例中，如图3至图5所示，通过在按键帽322的外壁设置避让槽3221，从而方便第二卡接件323的弹性避位，确保第二卡接件323顺利伸入第二段3111内并与第一卡接件315卡接。可以理解的，第二卡接件323的弹臂3231一端与按键帽322的外壁连接，另一端为自由端，卡凸3232凸设于弹臂3231的自由端，使得弹臂3231与按键帽322的外壁齐平，从而在施加外力按压按键帽322时，按键帽322能够沿第二段3111滑动，避免第二卡接件323干涉按键帽322的滑动。

[0074] 可选地，第一卡接件315呈环形凸台设置，也即第一卡接件315沿第二段3111内壁的周向延伸设置。当然，在其他实施例中，第一卡接件315包括多个凸台结构，多个凸台结构沿第二段3111内壁的周向间隔设置，此时每一凸台结构与一第二卡接件323对应。

[0075] 可以理解的，第二卡接件323包括多个，多个第二卡接件323沿按键帽322的外壁周向间隔设置，按键帽322的外壁对应每一第二卡接件323设有一避让槽3221，在此不做限定。在本实施例中，为了方便第二卡接件323的卡凸3232顺利伸入第二段3111内并与第一卡接件315卡接，卡凸3232设有导向面3233，也即在安装按压件32时，第一卡接件315沿卡凸3232的导向面3233移动，以使得卡凸3232滑入第二段3111，并与第一卡接件315卡接。

[0076] 在一实施例中，如图3至图5所示，第一段3121与第二段3111的连通处形成有抵接面3112，按压按键帽322时，按键帽322与抵接面3112抵接。可以理解的，如此设置，从而利用抵接面3112限制外力的挤压，避免外力过大，使得按键帽322带动按键杆321过渡抵压触发组件2，进而损坏触发组件2。如此在施加外力按压按键帽322时，按键帽322的外壁沿第一卡接件315滑动，并与抵接面3112抵接，此时按键杆321刚好可以抵压触发触发组件2。

[0077] 在一实施例中，旋转表冠31包括相连接的旋转部311和转轴部312，滑动腔31a贯穿旋转部311和转轴部312，旋转部311与转轴部312的连接处形成有限位面313，转轴部312可转动地穿设于按键孔11内，使限位面313与壳体1的外壁限位抵接。

[0078] 在本实施例中，如图1至图5所示，通过将旋转表冠31设置为相连接的旋转部311和转轴部312，使得滑动腔31a贯穿旋转部311和转轴部312，也即贯穿旋转部311的滑动腔31a部分形成第二段3111，贯穿转轴部312的滑动腔31a部分形成第一段3121。通过在旋转部311的外壁与转轴部312的外壁连接处形成有限位面313，使得转轴部312可转动地穿设于按键孔11内，使限位面313与壳体1的外壁限位抵接，从而确保施加外力按压按压件32时，旋转表冠31通过限位面313与壳体1的外壁限位抵接，避免沿按键孔11移动。

[0079] 可以理解的，旋转表冠31的旋转部311外径大于转轴部312的外径。可选地，旋转表冠31的转轴部312呈圆柱状的筒形结构。在本实施例中，旋转表冠31的旋转部311和转轴部312为一体成型结构，如此可提高旋转表冠31的结构强度。

[0080] 在一实施例中，转轴部312穿过按键孔11的一端外壁设有卡槽3122，按键结构100还包括设于壳体1内的卡簧4，卡簧4活动卡接于卡槽3122内。

[0081] 在本实施例中，如图2至图5所示，通过在转轴部312上设置卡槽3122，并设置卡簧4，利用卡簧4活动卡接于卡槽3122内，并与壳体1的内壁抵接限位，如此可利用卡簧4进一步将旋转表冠31限定于按键孔11内，避免施加外力拉动按键组件3的旋转表冠31和/或按压件

32时，避免将按键组件3从按键孔11内拉出。

[0082] 可以理解的，通过设置卡簧4，使得卡簧4可拆卸地卡接于旋转表冠31的卡槽3122内，从而方便按键组件3的安装与拆卸。当然，在其他实施例中，也可通过在转轴部312穿过按键孔11的一端外壁凸设限位台，使得限位台与壳体1的内壁限位抵接，也即限位台、转轴部312及旋转部311围合形成H型限位槽结构，从而确保旋转表冠31的安装和限位，在此不做限定。

[0083] 在本实施例中，卡槽3122沿转轴部312的外壁周向设置并形成环槽，卡簧4具有卡接部41，卡接部41呈U型设置，卡接部41活动卡接于卡槽3122内。也即卡簧4具有卡接部41和连接卡接部41的安装部，卡簧4通过安装部与壳体1的内壁限位安装或抵接限位，卡簧4的卡接部41呈L型设置，使得U型卡簧4卡接于旋转表冠31中转轴部312的卡槽3122内，一方面能够限位旋转表冠31沿按键孔11轴向的移动，另一方面有可以实现旋转表冠31沿按键孔11周向的转动。

[0084] 在一实施例中，如图1、图3至图5所示，按键结构100还包括耐磨片5，耐磨片5套设于转轴部312，并夹设于限位面313和壳体1的外壁之间。可以理解的，如此设置，从而利用耐磨片5降低旋转表冠31旋转时与壳体1外壁的摩擦，从而降低旋转阻尼力。可选地，耐磨片5的材质为PEEK材质。

[0085] 在本实施例中，如图4和图5所示，限位面313设有限位槽314，耐磨片5的部分容纳于限位槽314内。可以理解的，通过设置限位槽314，从而方便利用限位槽314对耐磨片5实现定位和限位安装，同时部分耐磨片5凸出限位槽314的槽口，如此可使得耐磨片5与壳体1的外壁抵接，避免限位面313直接与壳体1的外壁直接接触，从而有效降低摩擦。

[0086] 在一实施例中，按键结构100还包括至少一个第二密封圈7，第二密封圈7夹设于转轴部312的外壁和按键孔11的孔壁之间。

[0087] 在本实施例中，如图3至图5所示，通过设置第二密封圈7，从而利用第二密封圈7密封旋转表冠31的转轴部312和按键孔11的孔壁之间的缝隙，提高密封性能和防水性能。可选地，第二密封圈7的材质为NBR。

[0088] 可以理解的，第二密封圈7位于旋转表冠31中的转轴部312的卡槽3122和旋转部311之间。可选地，第二密封圈7包括多个，多个第二密封圈7沿转轴部312的延长方向间隔排布。

[0089] 为了避免旋转表冠31旋转过程中第二密封圈7发生移位现象，导致密封性降低等问题，在一实施例中，如图3至图5所示，转轴部312的外壁和按键孔11的孔壁中至少一个设有第二凹槽3123，第二密封圈7容纳于第二凹槽3123内，并部分凸出第二凹槽3123的槽口。

[0090] 可以理解的，第二凹槽3123可设置于旋转表冠31的转轴部312的外壁，或者第二凹槽3123可设于按键孔11的孔壁，或者第二凹槽3123同时设置于转轴部312的外壁和按键孔11的孔壁，此时两个第二凹槽3123对应，在此不做限定。

[0091] 在本实施例中，第二密封圈7具有弹性和密封性，第二密封圈7容纳于第二凹槽3123内，并部分凸出第二凹槽3123的槽口，使得凸出第二凹槽3123的槽口的第二密封圈7能够与转轴部312的外壁和按键孔11的孔壁密封抵接。

[0092] 可选地，第二凹槽3123可以使U型凹槽、楔形槽、V型槽、弧形槽、半圆型槽等，在此不做限定。

[0093] 在一实施例中，如图1至图4所示，触发组件2包括触发元件21和光学传感器22，其中，触发元件21设于壳体1内，并与按键孔11正对设置，光学传感器22设于壳体1内，并与旋转表冠31的侧壁正对设置。

[0094] 在本实施例中，触发元件21对应按键孔11设有触片，触片与按键杆321远离按键帽322的一端正对。可以理解的，触发元件21和光学传感器22与电路板电连接，从而使得电路板用于接收触发元件21和光学传感器22的触发信号，用于实现触发信号相应的控制功能。可选地，电路板为柔性电路板或硬质电路板，在此不做限定。

[0095] 可以理解的，触发元件21可焊接于柔性电路板上，以使得触发元件21对应按键孔11设有触片，触片与按键杆321远离按键帽322的一端正对，如此在施加外力按压按键帽322时，按键杆321与触片抵接并按压触发信号。

[0096] 在本实施例中，通过设置光学传感器22，从而利用光学传感器22检测和识别用户旋转旋转表冠31时带动转轴部312旋转，以触发不同于按压触发触发元件21的信号或功能，在此不做限定。可以理解的，光学传感器22设于电路板，并与触发元件21相邻且间隔设置，光学传感器22用于感应旋转表冠31的转轴部312旋转，以触发触发组件2。

[0097] 可以理解的，如此设置，使得按压按压件32的移动行程设置在旋转表冠31内，如此可使得壳体1不需要保证按压按压件32所需要的行程，可使得设备的壳体1厚度进一步减薄，节省设备内部空间。同时，将弹性件33和按压件32均设置于旋转表冠31的滑动腔31a内，从而使得旋转表冠31旋转时，一并带动弹性件33和按压件32旋转，有效避免了弹性件33与按压件32之间的摩擦，提高可以保证良好的旋转手感，提高旋转表冠31的旋转寿命。

[0098] 本实施例中按键结构100组装时，将弹性件33和第一密封圈6与按压件32组装，再将组装好的按压件32装入旋转表冠31的滑动腔31a内，使按键帽322上的第二卡接件323与旋转表冠31滑动腔31a内的第一卡接件315扣合；再将耐磨片5、第二密封圈7安装于旋转表冠31的相依相应位置，将组装好的旋转表冠31安装于壳体1的按键孔11内，从壳体1内侧插入耐磨卡簧4，再将卡簧4与壳体1焊接固定。再将触发组件2的光学传感器22和触发元件21安装于壳体1内部相应位置。

[0099] 安装后的按键结构100中，由于按键帽322安装时弹性件33处于预压缩状态，旋转表冠31与按键帽322相互支撑，旋转表冠31转动时，其滑动腔31a的按键杆321和弹性件33会与旋转表冠31同步转动。安装于壳体1内部的光学传感器22接受旋转表冠31的旋转信号，从而实现旋转信号输入；手动按压按压件32的按键帽322，按键杆321轴向运动，触发触发元件21，从而输入开关信号。撤去外力松开后，弹性件33回弹，并推动按键杆321复位到初始位置。安装在旋转表冠31和按键杆321外侧的第二密封圈7和第一密封圈6在保证按键组件3运动的同时，可保证了5ATM级别的防水。

[0100] 可以理解的，按键结构100由于旋转表冠31在按键孔11轴向不运动，所以壳体1的厚度可减小，从而节省壳体1内部空间，有利于内部器件堆叠；由于旋转表冠31在按键孔11的轴向不受力，所以旋转阻尼小，旋转手感较好，并且不易磨损，使用寿命提高；按键组件3零件集成度高，可组件化来料，物料管理成本低，组装便捷。

[0101] 本发明还提出一种穿戴设备，该穿戴设备包括设备主体和上述的按键结构100，该按键结构100的具体结构参照前述实施例，由于本穿戴设备采用了前述所有实施例的全部技术方案，因此至少具有前述实施例的技术方案所带来的所有有益效果，在此不再一一赘

述。

[0102] 在本实施例中，设备主体包括壳体，壳体设有按键孔，按键结构100连接于壳体。可以理解的，穿戴设备可以是手表、手环、头戴显示器等，穿戴设备为手表时，壳体可以是手表的表壳。

[0103] 以上所述仅为本发明的可选实施例，并非因此限制本发明的专利范围，凡是在本发明的构思下，利用本发明说明书及附图内容所作的等效结构变换，或直接/间接运用在其他相关的技术领域均包括在本发明的专利保护范围内。

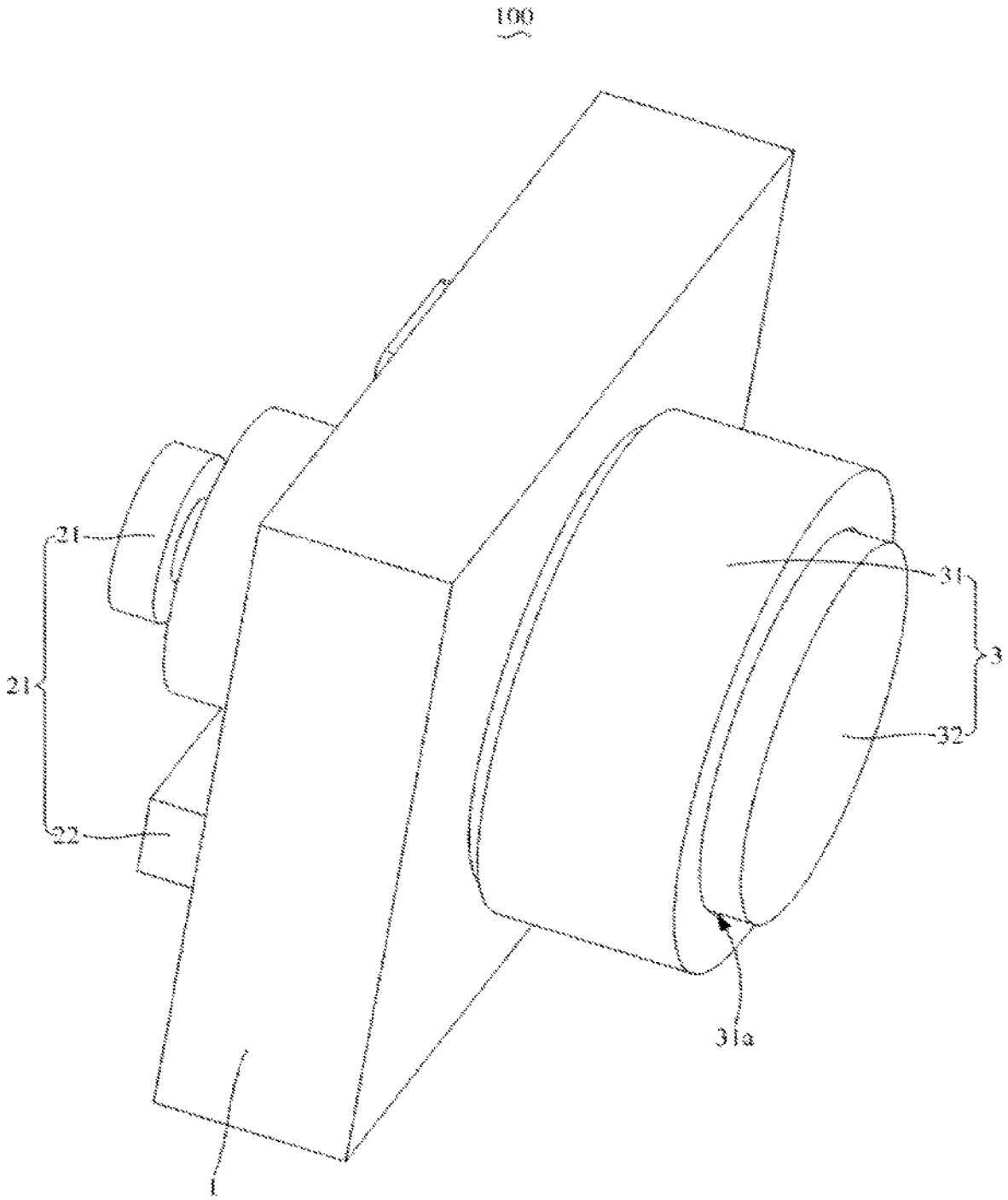


图1

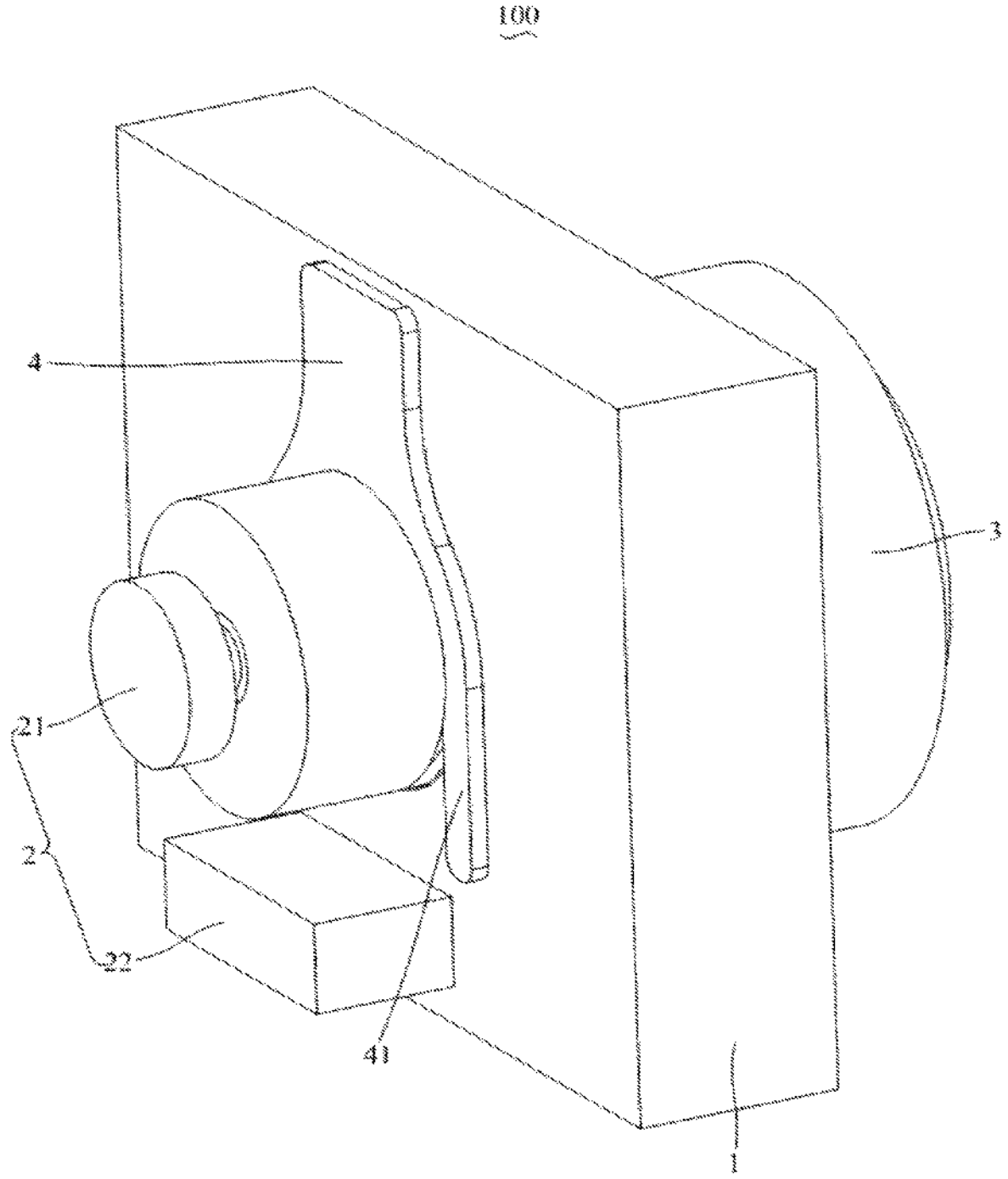


图2

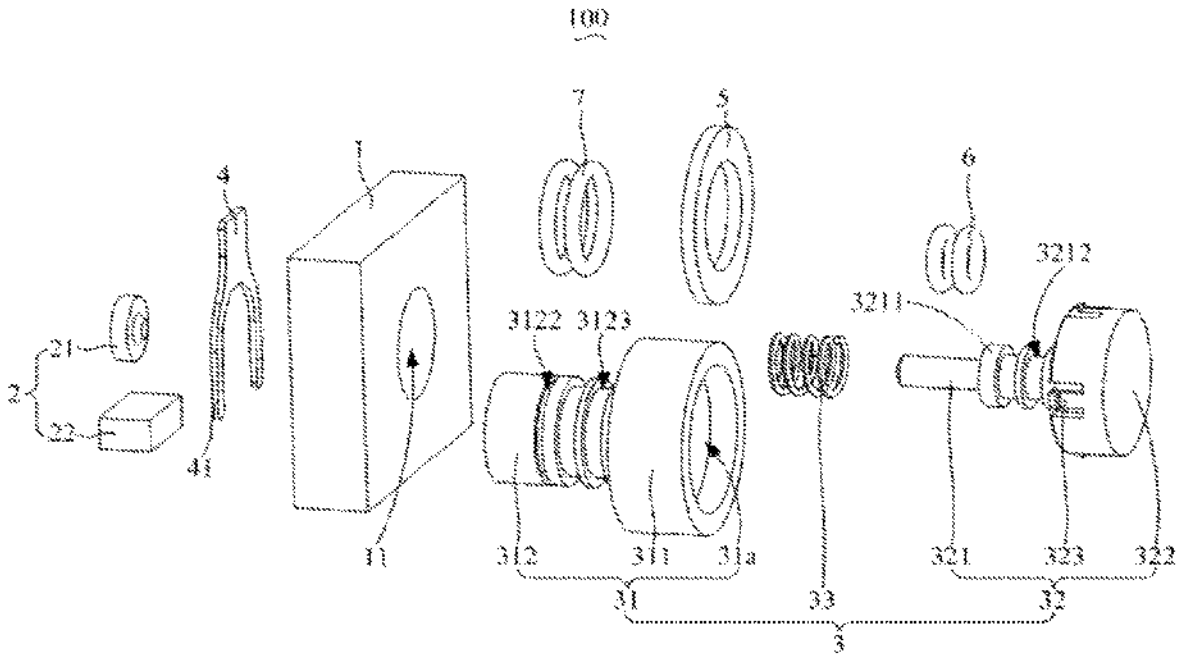

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3211
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22
3122
3123
41
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312
311
31a
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323
322
31
33
32
3

图3

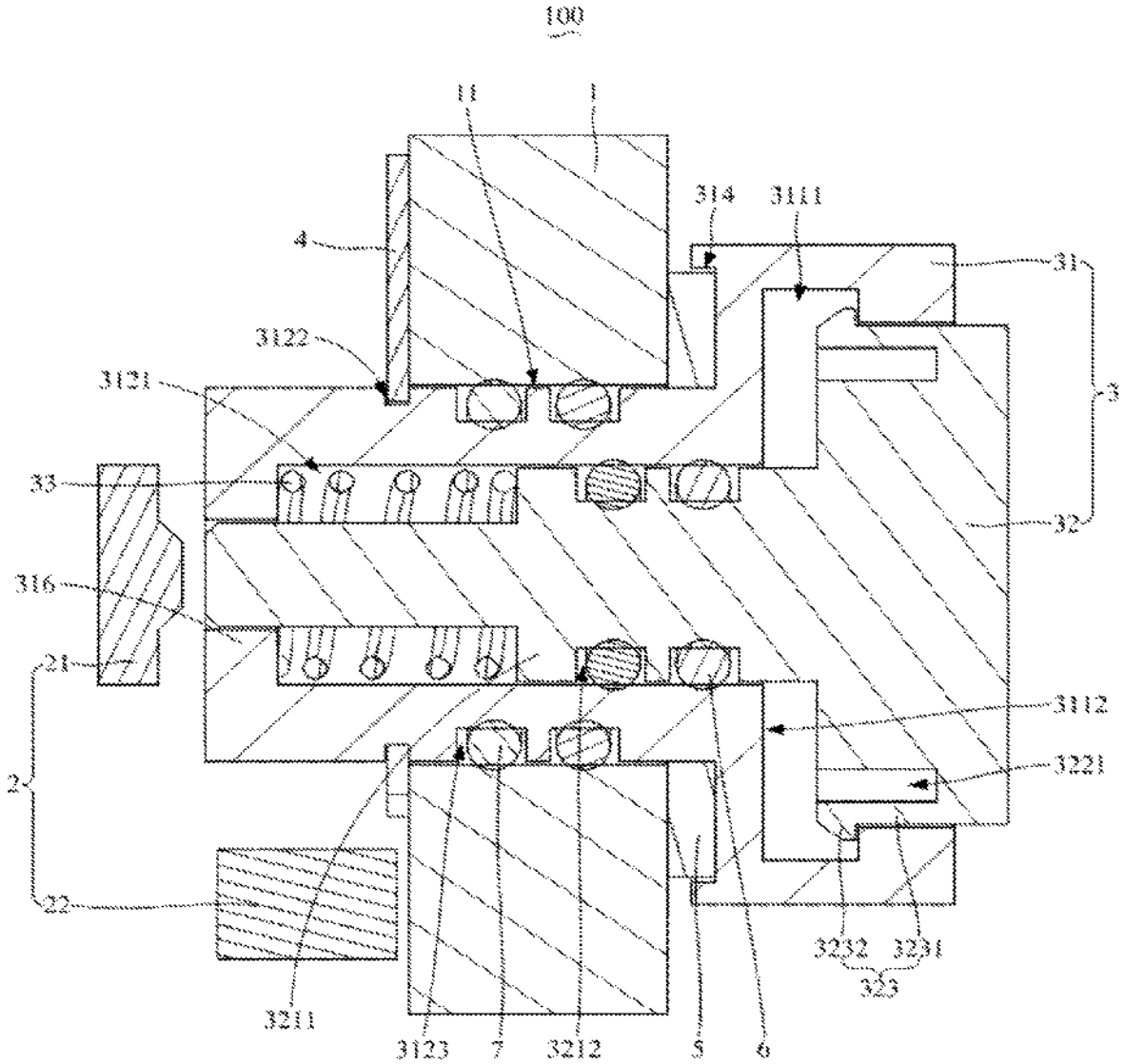

100
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图4

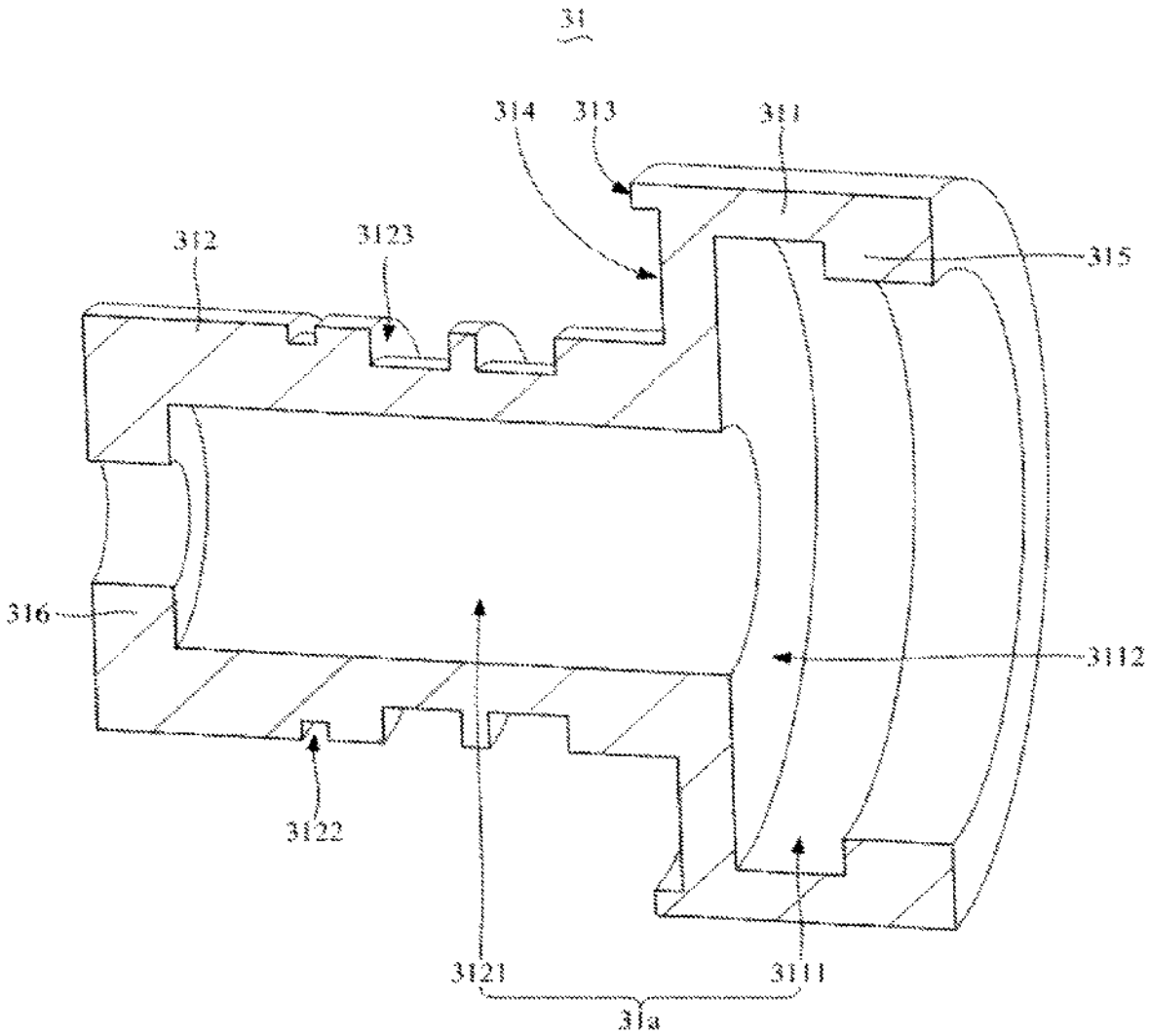


图5

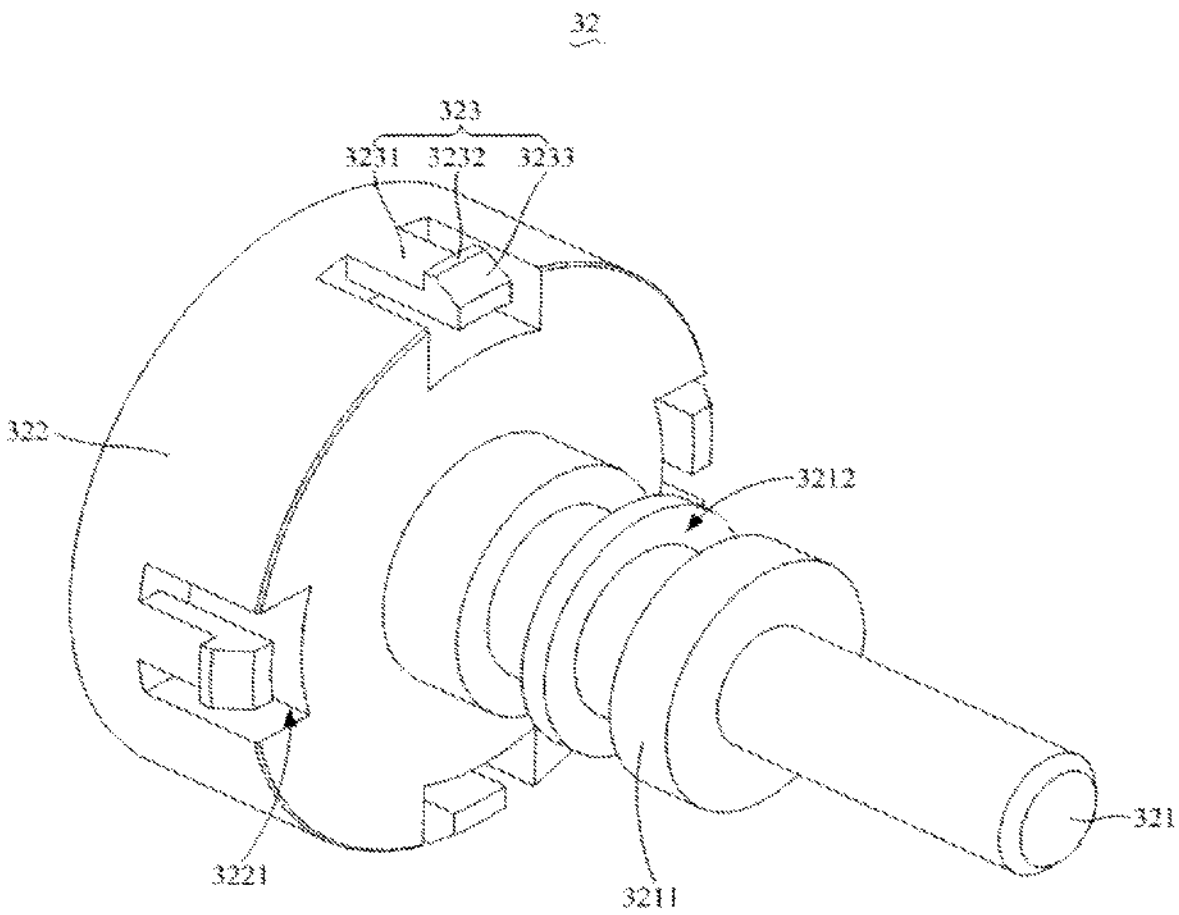


图6

Espacenet

Bibliographic data: JP2017219448 (A) — 2017-12-14

SWITCH DEVICE AND WATCH

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Applicant(s): CASIO COMPUTER CO LTD ± (カシオ計算機株式会社)

Classification: - international: ***G04B3/04; G04B43/00; G04G21/00; H01H13/12***

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Priority number(s): JP20160114613 20160608

Also published as: JP6818228 (B2)

Abstract of JP2017219448 (A)

PROBLEM TO BE SOLVED: To provide a switch device and a watch which have good operability and can secure impact resistance.SOLUTION: A switch device has: a shaft portion 18 provided so as to slid with respect to a through hole 11 of a body case 2; an operation member 14 having a head portion 19 which is provided on the outer end portion of the shaft portion 18 and is arranged outside of the body case 2; and a cushioning protective member 15 provided on the body case 2 so as to slid in a slide direction of the operation member 14 in a state of covering the outer periphery of the head portion 19 of the operation member 14. Accordingly, when the operation member 14 is pushed in, the cushioning protective member 15 is slid together with the head portion 19, and only the operation member 14 can be slid and pushed in, and accordingly operability of the operation member 14 is good, and when the cushioning protective member 15 receives impact from the outside, the cushioning protective member 15 is slid together with the operation member 14 and the impact can be cushioned.SELECTED DRAWING: Figure 2

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H01H 13/12	(2006.01)	H01H	13/12		

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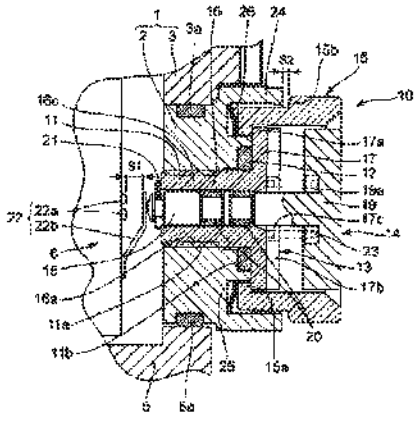
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CS01N CS11H CS11N GS02 GS06
KS16 KS40 NS07

(54)【発明の名称】スイッチ装置および時計

(57)【要約】
【課題】　操作性が良く、かつ耐衝撃性を確保できるスイッチ装置および時計を提供する。
【解決手段】　本体ケース２の貫通孔１１に対してスライド可能に設けられた軸部１８、およびこの軸部１８の外端部に設けられて本体ケース２の外部に配置された頭部１９を備えた操作部材１４と、この操作部材１４の頭部１９の外周を覆った状態で、本体ケース２に、操作部材１４のスライド方向にスライド可能に設けられた緩衝保護部材１５と、を備えている。従って、操作部材１４を押し込む際に、緩衝保護部材１５を頭部１９と共にスライドさせた上、操作部材１４のみをスライドさせて押し込むことができるので、操作部材１４の操作性が良く、また緩衝保護部材１５が外部から衝撃を受けた際に、緩衝保護部材１５を操作部材１４と共にスライドさせて、衝撃を緩衝できる。
【選択図】　図2



【特許請求の範囲】
【請求項１】
貫通孔が設けられたケースと、
前記ケースの前記貫通孔に対してスライド可能に設けられた軸部、および前記軸部の外端部に設けられて前記ケースの外部に配置された頭部を備えた操作部材と、
前記操作部材の前記頭部の外周を覆った状態で、前記ケースに、前記操作部材のスライド方向にスライド可能に設けられた緩衝保護部材と、
を備えていることを特徴とするスイッチ装置。
【請求項２】
請求項１に記載のスイッチ装置において、前記緩衝保護部材のスライドの長さが前記操作部材のスライドの長さよりも短く設定されていることを特徴とするスイッチ装置。
【請求項３】
請求項１または請求項２に記載のスイッチ装置において、前記ケースには、前記緩衝保護部材の外周に位置した状態で、前記緩衝保護部材をスライド可能に保持する保持筒部が、前記ケースの外部に突出して設けられていることを特徴とするスイッチ装置。
【請求項４】
請求項３に記載のスイッチ装置において、前記保持筒部は、前記緩衝保護部材の軸方向の長さの半分ぐらいまで延出して設けられていることを特徴とするスイッチ装置。
【請求項５】
請求項１～請求項４のいずれかに記載のスイッチ装置において、前記操作部材を前記ケースの外部に向けて付勢する第１の付勢部材と、前記緩衝保護部材を前記ケースの外部に向けて付勢する第２の付勢部材と、を備えていることを特徴とするスイッチ装置。
【請求項６】
請求項５に記載のスイッチ装置において、前記第２の付勢部材は、ばね部材であることを特徴とするスイッチ装置。
【請求項７】
請求項５に記載のスイッチ装置において、前記第２の付勢部材は、弾力性を有する弾性部材であることを特徴とするスイッチ装置。
【請求項８】
請求項１～請求項７のいずれかに記載のスイッチ装置において、前記緩衝保護部材は、前記ケースの外部に前記操作部材と共に押し出された際に、前記緩衝保護部材の外端面と前記操作部材の外端面とがほぼ同一面上に位置することを特徴とするスイッチ装置。
【請求項９】
請求項１～請求項８のいずれかに記載のスイッチ装置において、前記ケース内に設けられて、前記操作部材が前記緩衝保護部材のスライド長さよりも長いスライド長さで押し込まれた際に、オン状態になるスイッチ部を備えていることを特徴とするスイッチ装置。
【請求項１０】
請求項９に記載のスイッチ装置において、前記操作部材のスライド長さは、前記操作部材が押し出された第１の位置と前記操作部材が押し込まれて前記スイッチ部がオン状態になった第２の位置との間の長さに設定され、前記緩衝保護部材のスライド長さは、前記緩衝保護部材が押し出されてその外端部と前記操作部材の外端面とがほぼ同一面上に位置する前記第１の位置と前記緩衝保護部材が前記操作部材と共に押し込まれても前記スイッチ部がオン状態にならない第３の位置との間の長さに設定されていることを特徴とするスイッチ装置。
【請求項１１】
請求項１～請求項１０のいずれかに記載されたスイッチ装置を備えていることを特徴とする時計。

【発明の詳細な説明】
【技術分野】
【０００１】
この発明は、腕時計や携帯電話機、携帯情報端末機などの電子機器に用いられるスイッチ装置およびそれを備えた時計に関する。
【背景技術】
【０００２】
例えば、腕時計においては、特許文献１に記載されているように、腕時計ケースに取り付けられて外部に突出した竜頭などの釦頭部の外端部を覆って保護する釦保護装置を備えた構成のものが知られている。
【先行技術文献】
【特許文献】
【０００３】
【特許文献１】特開２０１２－１６３３４０号公報
【０００４】
この種の釦保護装置は、釦頭部の両側に位置する腕時計ケースの外面に２つの保護突起部を釦頭部よりも突出させて設け、この保護突起部の一方に可動保護部の一端部を回転可能に取り付け、この可動保護部の他端部を他方向の保護突起部に着脱可能に取り付けることにより、これら２つの保護突起部と可動保護部とで釦嵌部の外周を覆って保護するように構成されている。
【発明の概要】
【発明が解決しようとする課題】
【０００５】
このような腕時計の釦保護装置では、腕時計ケースの外部に突出する釦頭部の両側に２つの保護突起部を釦頭部よりも突出させて設け、これら２つの保護突起部に可動保護部を架渡す構成であるから、釦頭部を操作する際に、一方の保護突起部に対して可動保護部を回転させて、釦頭部を開放させなければ、釦頭部を操作することができないため、操作性が悪いという問題がある。
【０００６】
この発明が解決しようとする課題は、操作性が良く、かつ耐衝撃性を確保することができるスイッチ装置およびそれを備えた時計を提供することである。
【課題を解決するための手段】
【０００７】
この発明は、貫通孔が設けられたケースと、前記ケースの前記貫通孔に対してスライド可能に設けられた軸部、および前記軸部の外端部に設けられて前記ケースの外部に配置された頭部を備えた操作部材と、前記操作部材の前記頭部の外周を覆った状態で、前記ケースに、前記操作部材のスライド方向にスライド可能に設けられた緩衝保護部材と、を備えていることを特徴とするスイッチ装置である。
【発明の効果】
【０００８】
この発明によれば、操作部材の頭部を押し込む際に、緩衝保護部材を操作部材の頭部と共にスライドさせた上、操作部材のみをスライドさせて押し込むことができるので、操作部材の押し込み感覚が良く、操作部材の操作性を向上させることができ、また緩衝保護部材が外部から衝撃を受けた際に、緩衝保護部材を操作部材の頭部と共にスライドさせることができるので、緩衝保護部材によって衝撃を緩衝することができると共に、操作部材の頭部を保護することができ、これにより耐衝撃性を確保することができる。
【図面の簡単な説明】
【０００９】
【図１】この発明を腕時計に適用した一実施形態を示した拡大正面図である。
【図２】図１に示された腕時計のＡ－Ａ矢視における要部を示した拡大断面図である。

【図３】図２に示されたスイッチ装置の緩衝保護部材が外部から衝撃を受けた状態を示した要部の拡大断面図である。
【図４】図３に示されたスイッチ装置の操作部材が更に押し込まれてスイッチ部をオン動作させた状態を示した要部の拡大断面図である。
【図５】この発明のスイッチ装置における第２の付勢部材の変形例を示した要部の拡大断面図である。
【発明を実施するための形態】
【００１０】
以下、図１～図４を参照して、この発明を腕時計に適用した一実施形態について説明する。
この腕時計は、図１および図２に示すように、腕時計ケース１を備えている。この腕時計ケース１は、本体ケース２と外装ケース３とで構成されている。
【００１１】
この場合、本体ケース２は、図２に示すように、金属または硬質の合成樹脂で形成されている。外装ケース３は、合成樹脂で形成され、本体ケース２の上部外周に防水パッキン３ａを介して取り付けられている。腕時計ケース１の上部開口部、つまり外装ケース３の上部開口部には、図１に示すように、時計ガラス４が取り付けられている。また、この腕時計ケース１の下部、つまり本体ケース２の下部には、図２に示すように、裏蓋５が防水リング５ａを介して取り付けられている。
【００１２】
この腕時計ケース１の内部、つまり本体ケース２の内部には、図２に示すように、時計モジュール６が配置されている。この時計モジュール６は、指針６ａを駆動するための時計ムーブメントや、時刻などの情報を電気光学的に表示する表示パネル、これらを電気的に駆動するための回路部などの時計機能に必要な各種の部品（いずれも図示せず）を備えている。この場合、時計モジュール６は、図１に示すように、その上部に文字板６ｂが配置され、この文字板６ｂの上方を指針６ａが運針するように構成されている。
【００１３】
一方、腕時計ケース１の１２時側と６時側との各側部には、図１に示すように、バンド取付部８がそれぞれ外部に突出して設けられている。これらバンド取付部８には、時計バンド７がそれぞれ取り付けられている。また、この腕時計ケース１の２時側、３時側、４時側、８時側、および１０時側の各側部には、スイッチ装置１０がそれぞれ設けられている。
【００１４】
これらスイッチ装置１０のうち、例えば２時側に位置するスイッチ装置１０は、図２～図４に示すように、腕時計ケース１の本体ケース２に設けられた貫通孔１１に防水リング１２を介して取り付けられた筒状部材１３と、この筒状部材１３にスライド可能に挿入されて腕時計ケース１の外部に突出する操作部材１４と、腕時計ケース１にスライド可能に取り付けられて操作部材１４の外端部を覆って保護する緩衝保護部材１５と、を備えている。
【００１５】
この場合、貫通孔１１は、図２～図４に示すように、本体ケース２にその内部と外部とに貫通して設けられている。この貫通孔１１の内周部には、雌ねじ部１１ａが設けられている。また、この貫通孔１１の外端部における縁部には、防水リング１２が配置される切欠き溝１１ｂが環状に設けられている。
【００１６】
筒状部材１３は、図２～図４に示すように、本体ケース２の貫通孔１１内に取り付けられる筒状部１６と、本体ケース２の外面に配置される鍔状部１７と、を備え、これらが金属や硬質の合成樹脂で一体に形成されている。筒状部１６は、その外径が本体ケース２の貫通孔１１の内径と同じ大きさで、その軸方向の長さが貫通孔１１の軸方向の長さとほぼ同じ長さに形成されている。また、この筒状部１６の外周部には、貫通孔１１の雌ねじ部

１１ａに螺合する雄ねじ部１６ａが設けられている。

【００１７】

これにより、筒状部１６は、図２～図４に示すように、本体ケース２の貫通孔１１内に挿入されて、雄ねじ部１６ａが貫通孔１１の雌ねじ部１１ａに螺合して締め付けられることにより、本体ケース２の貫通孔１１内に取り付けられるように構成されている。この場合、筒状部１６は、その軸方向の内端部が本体ケース２の内周面とほぼ同一面上に位置し、また軸方向の外端部が本体ケース２の外面とほぼ同一面上に位置するように形成されている。

【００１８】

また、鍔状部１７は、図２～図４に示すように、筒状部１６の軸方向に位置する外端部にリング状に形成された板部であり、その軸方向の内端面が本体ケース２の外面に配置されるように構成されている。この場合、鍔状部１７は、その内径が筒状部１６の内径と同じ大きさで、外径が貫通孔１１の切欠き溝１１ｂの外周側の内径よりも大きく形成されている。この場合、鍔状部１７の軸方向の外端面には、ドライバなどの工具が挿入する締付溝１７ｂが設けられている。

【００１９】

これにより、鍔状部１７は、図２～図４に示すように、筒状部１６の雄ねじ部１６ａが本体ケース２の貫通孔１１に設けられた雌ねじ部１１ａに螺合した状態で、締付溝１７ｂにドライバなどの工具を挿入させて、筒状部１６の雄ねじ部１６ａを貫通孔１１の雌ねじ部１１ａに締め付けることにより、鍔状部１７の内端面が本体ケース２の外面に押し当てられて、防水リング１２を本体ケース２の切欠き溝１１ｂ内に押し付けるように構成されている。

【００２０】

一方、操作部材１４は、図２～図４に示すように、筒状部材１３の筒状部１６内にスライド可能に挿入される軸部１８と、この軸部１８の外端部に設けられて筒状部材１３の鍔状部１７の外部側、つまり本体ケース２の外部に配置される頭部１９と、を備えている。軸部１８は、その外径が筒状部１６の軸挿入孔１６ｃの内径とほぼ同じ大きさで、軸方向の長さが筒状部材１３の軸方向の長さよりも長く形成されている。

【００２１】

これにより、軸部１８は、図２～図４に示すように、筒状部１６の軸挿入孔１６ｃ内に挿入された際に、その内端部が本体ケース２の内部に突出し、外端部が筒状部材１３の鍔状部１７から本体ケース２の外部に突出するように構成されている。この場合、軸部１８の外周部には、複数の防水リング２０が設けられている。これら複数の防水リング２０は、その外周部が筒状部材１３の筒状部１６の内周面に圧接した状態で摺動することにより、軸部１８の外周面と筒状部１６の内周面との間の防水を図るように構成されている。

【００２２】

また、本体ケース２の内部に突出する軸部１８の内端部には、図２～図４に示すように、Ｅリングなどの抜止め部材２１が取り付けられている。これにより、軸部１８は、抜止め部材２１が本体ケース２の貫通孔１１内に取り付けられた筒状部１６の内端部に接離可能に当接することにより、本体ケース２の外部に抜け出さないように構成されている。

【００２３】

さらに、この軸部１８は、図２～図４に示すように、その内端部が本体ケース２内の時計モジュール６に設けられたスイッチ部２２に接離可能に対応するように構成されている。この場合、スイッチ部２２は、時計モジュール６の外周部に設けられた接点部２２ａと、軸部１８の内端部で押されて接点部２２ａに接離可能に接触する接点ばね２２ｂと、を備えている。この接点ばね２２ｂは、板ばねであり、その一端部が時計モジュール６の外周部に設けられ、可変側の他端部が常に軸部１８の内端部に弾接するように構成されている。

【００２４】

これにより、スイッチ部２２は、図２～図４に示すように、操作部材１４が押されて軸

部１８の内端部が本体ケース２内に押し込まれた際に、軸部１８の内端部によって接点ばね２２ｂが押されて接点部２２ａに押し付けられることにより、オン動作するように構成されている。また、このスイッチ部２２は、操作部材１４が押し出されて軸部１８の内端部が接点部２２ａから離れた際に、接点ばね２２ｂが軸部１８の内端部に接触した状態で弾性復帰して接点部２２ａから離れることにより、オフ状態になるように構成されている。

【００２５】

一方、操作部材１４の頭部１９は、図２～図４に示すように、筒状部材１３の鍔状部１７から本体ケース２の外部に突出した軸部１８の外端部に設けられている。この頭部１９は、その外径が筒状部材１３の鍔状部１７の外径とほぼ同じ大きさで、全体が円板状に形成されている。また、この頭部１９は、筒状部材１３の鍔状部１７から本体ケース２の外部に向けて所定間隔（Ｓ１）だけ離れて配置されるように構成されている。

【００２６】

すなわち、この頭部１９は、図２～図４に示すように、軸部１８の内端部に設けられた抜止め部材２１が本体ケース２の内周面に位置する筒状部材１３の筒状部１６の内端面に当接した状態のときに、操作部材１４のスライド長さＳ１だけ、筒状部材１３の鍔状部１７から本体ケース２の外部に向けて離れるように構成されている。

【００２７】

この場合、操作部材１４のスライド長さＳ１は、図２～図４に示すように、操作部材１４が押し出された第１の位置（図２に示す位置）と操作部材１４が押し込まれて時計モジュール６のスイッチ部２２がオン状態になった第２の位置（図４に示す位置）との間の長さに設定されている。すなわち、この操作部材１４のスライド長さＳ１は、軸部１８の内端部に弾接する接点ばね２２ｂの可変側の端部からスイッチ部２２の接点部２２ａまでの長さである。

【００２８】

また、この操作部材１４は、図２～図４に示すように、第１の付勢部材である第１ばね部材２３によって本体ケース２の外部に向けて押し出される方向に付勢されるように構成されている。すなわち、この第１ばね部材２３は、コイルばねであり、軸部１８の外周に配置されている。

【００２９】

この場合、第１ばね部材２３は、図２～図４に示すように、その内端部が筒状部材１３の鍔状部１７の外面に環状に設けられた凹部１７ｃ内に配置されて弾接し、外端部が頭部１９の内端面に環状に設けられた凹部１９ａ内に配置されて弾接することにより、頭部１９を本体ケース２の外部に向けて押し出す方向に付勢するように構成されている。

【００３０】

これにより、操作部材１４は、図２に示すように、通常状態のときに、第１ばね部材２３のばね力によって頭部１９が本体ケース２の外部に向けて押し出されて、第１の位置に配置された際に、軸部１８の内端部の抜止め部材２１が本体ケース２内に位置する筒状部１６の内端面に当接して、軸部１８の内端部が時計モジュール６のスイッチ部２２の接点部２２ａから離れることにより、スイッチ部２２をオフ状態にするように構成されている。

【００３１】

また、この操作部材１４は、図４に示すように、第１ばね部材２３のばね力に抗して頭部１９が本体ケース２の内部に向けて押し込まれ、軸部１８の内端部の抜止め部材２１が本体ケース２内に位置する筒状部１６の内端面から離れて、軸部１８の内端部が本体ケース２の内部に向けて突出した際に、この突出した軸部１８の内端部が時計モジュール６のスイッチ部２２の接点ばね２２ｂを押圧して接点部２２ａに接触させた第２の位置に配置されることにより、スイッチ部２２をオン動作させるように構成されている。

【００３２】

ところで、緩衝保護部材１５は、図２～図４に示すように、操作部材１４の頭部１９の

外周を覆った状態で、本体ケース２に対してスライド可能に設けられている。すなわち、この緩衝保護部材１５は、ほぼ円筒状に形成され、その内部に操作部材１４の頭部１９がスライド可能に配置され、この状態で本体ケース２に設けられた保持筒部２４内にスライド可能に取り付けられるように構成されている。

【００３３】

この場合、保持筒部２４は、図２～図４に示すように、ほぼ円筒状をなし、本体ケース２にその外部に突出して設けられている。また、保持筒部２４は、緩衝保護部材１５の軸方向の長さの半分ぐらいまで延出して設けられている。すなわち、この保持筒部２４は、その内径が緩衝保護部材１５の外径とほぼ同じ大きさで、軸方向の長さが緩衝保護部材１５の軸方向の長さよりも短く、かつ筒状部材１３の鍔状部１７の軸方向の長さ（厚み）とほぼ同じ長さで形成されている。

【００３４】

また、この保持筒部２４内に位置する本体ケース２の外面には、図２～図４に示すように、緩衝保護部材１５の内端部が挿入する保持溝２５が、保持筒部２４の内周に沿って環状に設けられている。この保持溝２５は、その軸方向の長さ（深さ）が筒状部材１３の鍔状部１７の軸方向の長さ（厚み）とほぼ同じ長さに形成されている。これにより、緩衝保護部材１５は、その軸方向の長さにおける半分程度の部分が、保持筒部２４内に配置されてガイドされるように構成されている。

【００３５】

この場合、保持溝２５は、図２～図４に示すように、その径方向における外周側の内径が保持筒部２４の内径と同じ大きさで、径方向における内周側の内径が筒状部材１３の鍔状部１７の外径よりも小さく形成されている。このため、筒状部材１３の鍔状部１７は、その外周部１７ａが保持溝２５の内周側から外周側に位置する保持筒部２４に向けてストッパ部として突出するように構成されている。

【００３６】

一方、緩衝保護部材１５は、図２～図４に示すように、ほぼ円筒状に形成され、その外径が本体ケース２の保持筒部２４の内径とほぼ同じ大きさで、内径が操作部材１４の頭部１９の外径および筒状部材１３の鍔状部１７の外径とほぼ同じ大きさに形成されている。これにより、緩衝保護部材１５は、本体ケース２の保持筒部２４内にその軸方向にスライド可能に配置され、この状態で内部に操作部材１４の頭部１９がその軸方向にスライド可能に配置されるように構成されている。

【００３７】

また、この緩衝保護部材１５は、図２～図４に示すように、その軸方向の長さが、操作部材１４の頭部１９が押し出された第１の位置（図２に示す位置）の状態で、その頭部１９の外端面から筒状部材１３の鍔状部１７の内端面までの長さよりも長く、かつ頭部１９の外端面から本体ケース２の保持溝２５における軸方向の内端面（底面）までの長さよりも短い長さで形成されている。これにより、保持筒部２４の保持溝２５は、その内部に緩衝保護部材１５の内端部がスライドするための隙間が設けられるように構成されている。

【００３８】

この場合、緩衝保護部材１５の内端部には、図２～図４に示すように、本体ケース２の保持溝２５内にスライド可能に配置された状態で、筒状部材１３の鍔状部１７の外周部１７ａに接離可能に当接する当接部１５ａが、緩衝保護部材１５の中心軸側に向けて突出して設けられている。また、この緩衝保護部材１５の外周部には、本体ケース２の保持筒部２４の外端部に接離可能に当接する位置規制部１５ｂが設けられている。

【００３９】

これにより、緩衝保護部材１５は、図２に示すように、その内端部および当接部１５ａが本体ケース２の保持溝２５内にスライド可能に配置された状態で、本体ケース２の保持筒部２４から外部に向けて押し出されて、その内端部に設けられた当接部１５ａの外側面が鍔状部１７の外周部１７ａの内側面に当接した際に、緩衝保護部材１５の外周部の位置規制部１５ｂが本体ケース２の保持筒部２４の外端部から軸方向に所定間隔（Ｓ２）だけ

離れるように構成されている。

【００４０】

また、この緩衝保護部材１５は、図４に示すように、本体ケース２の保持筒部２４内に押し込まれて、その外周部の位置規制部１５ｂが本体ケース２の保持筒部２４の外端部に当接した際に、緩衝保護部材１５の内端部に設けられた当接部１５ａの外側面が鍔状部１７の外周部１７ａの内側面から軸方向に所定間隔（Ｓ２）だけ離れるように構成されている。

【００４１】

この場合、緩衝保護部材１５は、図２～図４に示すように、第２の付勢部材である第２ばね部材２６によって本体ケース２の保持筒部２４内から外部に向けて押し出される方向に付勢されるように構成されている。すなわち、この第２ばね部材２６は、リング形状の皿ばねであり、本体ケース２の保持溝２５内に配置されるように構成されている。

【００４２】

この場合、第２ばね部材２６は、図２～図４に示すように、その外周側の縁部が保持溝２５内における軸方向の内面（底面）に弾接し、第２ばね部材２６の内周側の縁部が緩衝保護部材１５の内端部に設けられた当接部１５ａの内端面に弾接することにより、緩衝保護部材１５を本体ケース２の保持筒部２４内から外部に向けて押し出す方向に付勢するように構成されている。

【００４３】

これにより、緩衝保護部材１５は、図２～図４に示すように、通常状態のときに、第２ばね部材２６のばね力によって本体ケース２の保持筒部２４内から外部に向けて押し出され、また第２ばね部材２６のばね力に抗して保持筒部２４の内部に向けて押し込まれるように構成されている。

【００４４】

この場合、第２ばね部材２６は、図２～図４に示すように、そのばね力が第１ばね部材２３のばね力とほぼ同じ強さに設定されていても良いが、第１ばね部材２３のばね力よりも強く設定されていることが望ましい。すなわち、この第２ばね部材２６は、緩衝保護部材１５が外部から衝撃を受けた際に、その衝撃に応じて緩衝保護部材１５がスライドして圧縮されることにより、衝撃を緩衝するために、第１ばね部材２３のばね力よりも強く設定されている。

【００４５】

また、この緩衝保護部材１５は、図２～図４に示すように、そのスライド長さＳ２が操作部材１４のスライド長さＳ１よりも短く（Ｓ２＜Ｓ１）設定されている。すなわち、緩衝保護部材１５のスライド長さＳ２は、緩衝保護部材１５の内端部に設けられた当接部１５ａが鍔状部１７の外周部１７ａに当接した第１の位置（図２に示す位置）と、緩衝保護部材１５の外周部の位置規制部１５ｂが本体ケース２の保持筒部２４の外端部に当接した第３の位置（図３に示す位置）との間の長さに設定されている。

【００４６】

この場合、第１の位置は、図２に示すように、緩衝保護部材１５の内端部に設けられた当接部１５ａが鍔状部１７の外周部１７ａに当接した状態で、操作部材１４が第１ばね部材２３によって押し出され、操作部材１４の軸部１８の内端部に設けられた抜止め部材２１が筒状部材１３の筒状部１６の内端面に当接したときに、緩衝保護部材１５の外端面と操作部材１４の頭部１９の外端面とがほぼ同一面上に配置される位置である。

【００４７】

また、第３の位置は、図３に示すように、緩衝保護部材１５が操作部材１４の頭部１９と共に本体ケース２に向けて押し込まれて、緩衝保護部材１５の外周部の位置規制部１５ｂが本体ケース２の保持筒部２４の外端部に当接した状態で、緩衝保護部材１５の外端面と操作部材１４の頭部１９の外端面とがほぼ同一面上に配置されたときに、操作部材１４の軸部１８の内端部が本体ケース２の内部に突出しても、スイッチ部２２がオン状態にならない位置である。

【００４８】
次に、このような腕時計のスイッチ装置１０の作用について説明する。
このスイッチ装置１０を組み立てる場合には、予め、本体ケース２の上部外周に防水パッキン３ａを介して外装ケース３を取り付ける。そして、この本体ケース２の保持筒部２４内に位置する保持溝２５内に第２ばね部材２６を配置し、この状態で緩衝保護部材１５を本体ケース２の保持筒部２４内に挿入させて、緩衝保護部材１５の内端部および当接部１５ａを本体ケース２の保持溝２５内に配置する。
【００４９】
この状態では、緩衝保護部材１５の内端部と本体ケース２の保持溝２５における軸方向の内端面（底面）との間に第２ばね部材２６が挟まれる。この状態で、本体ケース２の切欠き溝１１ｂ内に防水リング１２を配置して、本体ケース２の貫通孔１１内に筒状部材１３の筒状部１６を取り付ける。このときには、筒状部材１３の筒状部１６を本体ケース２の貫通孔１１内に挿入すると共に、筒状部材１３の鍔状部１７を緩衝保護部材１５の内部に配置する。
【００５０】
この状態で、鍔状部１７の締付溝１７ｂにドライバなどの工具を挿入させて、鍔状部１７を回転させることにより、筒状部１６の雄ねじ部１６ａを貫通孔１１の雌ねじ部１１ａに螺合させて締め付ける。これにより、筒状部１６が貫通孔１１に取り付けられると共に、鍔状部１７が防水リング１２を切欠き溝１１ｂ内に押し付ける。
【００５１】
また、このときには、鍔状部１７の外周部１７ａの内側面が緩衝保護部材１５の当接部１５ａの外側面に当接して、第２ばね部材２６を緩衝保護部材１５の内端部と本体ケース２の保持溝２５における軸方向の内端面（底面）との間に弾力的に挟み付ける。これにより、緩衝保護部材１５が本体ケース２の保持筒部２４内にスライド可能な状態で取り付けられる。
【００５２】
この場合には、緩衝保護部材１５が第２ばね部材２６のばね力によって本体ケース２の外部に向けて押し出されることにより、緩衝保護部材１５の内端部に設けられた当接部１５ａの外側面が鍔状部１７の外周部１７ａの内側面に当接し、緩衝保護部材１５の外周部の位置規制部１５ｂが本体ケース２の保持筒部２４の外端部から軸方向に所定間隔（Ｓ２）だけ離れた状態で配置される。
【００５３】
そして、操作部材１４を筒状部材１３に取り付ける。このときには、予め、操作部材１４の軸部１８の外周部に複数の防水リング２０を取り付けると共に、軸部１８の外周に第１ばね部材２３を配置する。この状態で、操作部材１４の軸部１８を本体ケース２の保持筒部２４側から筒状部材１３の筒状部１６内に挿入させて、軸部１８の内端部を本体ケース２内に突出させると共に、操作部材１４の頭部１９を緩衝保護部材１５内に挿入させる。
【００５４】
この状態で、本体ケース２内に突出した軸部１８の内端部に抜止め部材２１を取り付ける。これにより、軸部１８の複数の防水リング２０が筒状部材１３の筒状部１６の内周面に摺動可能な状態で圧接することにより、軸部１８の外周面と筒状部１６の内周面との間の防水が図られる。
【００５５】
また、このときには、第１ばね部材２３のばね力によって頭部１９が緩衝保護部材１５内から外部に向けて押し出されることにより、軸部１８の内端部の抜止め部材２１が本体ケース２の内周面に位置する筒状部材１３の筒状部１６の内端面に当接する。この状態では、頭部１９の外端面と緩衝保護部材１５の外端面とが同一面上に配置される。
【００５６】
この状態で、本体ケース２内に時計モジュール６を組み込む。このときには、時計モジ

ュール６に設けられたスイッチ部２２を操作部材１４の軸部１８の内端部に対応させる。この場合には、予め、時計モジュール６の外周部にスイッチ部２２の接点部２２ａを設け、この接点部２２ａの近傍に位置する時計モジュール６の外周部にスイッチ部２２の接点ばね２２ｂの一端部を設け、この接点ばね２２ｂの可変部の他端部を接点部２２ａに接離可能に対応させる。これにより、時計モジュール６にスイッチ部２２が取り付けられる。

【００５７】

この状態で、時計モジュール６を本体ケース２内に組み込む際には、スイッチ部２２の接点ばね２２ｂを、本体ケース２内に突出した操作部材１４の軸部１８の内端部に弾接させた状態で配置する。これにより、スイッチ装置１０が腕時計ケース１に組み付けられる。この後は、本体ケース２の下面に裏蓋５を取り付ければ良い。

【００５８】

次に、このスイッチ装置１０を使用する場合について説明する。

このスイッチ装置１０では、通常状態のときに、図２に示すように、緩衝保護部材１５が第２ばね部材２６のばね力によって本体ケース２の保持筒部２４内から外部に向けて押し出される。また、このときには、操作部材１４の頭部１９が第１ばね部材２３のばね力によって本体ケース２の外部に向けて押し出されて、第１の位置に配置される。

【００５９】

すなわち、緩衝保護部材１５が第２ばね部材２６のばね力によって押し出された際には、図２に示すように、緩衝保護部材１５の内端部における当接部１５ａの外側面が筒状部材１３の筒状部１７における外周部１７ａの内側面に当接し、緩衝保護部材１５の外周部に設けられた位置規制部１５ｂが本体ケース２の保持筒部２４の外端部から所定間隔（Ｓ２）だけ離れた位置に配置される。

【００６０】

また、操作部材１４の頭部１９が第１ばね部材２３のばね力によって押し出された際には、図２に示すように、操作部材１４の軸部１８の内端部に設けられた抜止め部材２１が本体ケース２内に位置する筒状部１６の内端面に当接して、この軸部１８の内端部が時計モジュール６のスイッチ部２２の接点部２２ａから離れる。これにより、スイッチ部２２がオフ状態になる。この状態では、緩衝保護部材１５の外端部と操作部材１４の頭部１９の外端面とがほぼ同一面上に配置される。

【００６１】

そして、操作部材１４の頭部１９を押圧する際には、頭部１９よりも外径の大きい緩衝保護部材１５が頭部１９と共に押圧される。このときには、第２ばね部材２６のばね力が第１ばね部材２３のばね力よりも強く設定されていることにより、第２ばね部材２６のばね力に抗して緩衝保護部材１５を操作部材１４の頭部１９と共に押圧する。

【００６２】

これにより、図３に示すように、操作部材１４の頭部１９よりも外径の大きい緩衝保護部材１５と共に操作部材１４の頭部１９がスライドすることで、操作部材１４の押し込み感覚が向上する。このため、緩衝保護部材１５が保持筒部２４でガイドされながら本体ケース２側に向けてスライドし、緩衝保護部材１５の位置規制部１５ｂが保持筒部２４の外端部に当接して位置規制される。

【００６３】

これと同時に、操作部材１４の頭部１９が緩衝保護部材１５と共に本体ケース２内に向けてスライドする。このときには、図３に示すように、操作部材１４の軸部１８が筒状部材１３の筒状部１６内をスライドし、軸部１８の内端部が本体ケース２内に突出して、時計モジュール６のスイッチ部２２の接点ばね２２ｂを接点部２２ａに向けて押圧するが、緩衝保護部材１５のスライド長さＳ２が操作部材１４のスライド長さＳ１よりも短いため、軸部１８の内端部が本体ケース２内に突出しても、スイッチ部２２がオンすることはない。

【００６４】

この状態で、操作部材１４の頭部１９を第１ばね部材２３のばね力に抗して押圧する。このときには、図４に示すように、緩衝保護部材１５はスライドせず、操作部材１４のみがスライドし、頭部１９が第１ばね部材２３を圧縮させて筒状部材１３の鍔状部１７に接近すると共に、軸部１８の内端部が更に本体ケース２内に突出して、スイッチ部２２の接点ばね２２ｂを接点部２２ａに押し付けて接触させる。これにより、スイッチ部２２がオン状態になる。

【００６５】

一方、スイッチ装置１０が通常状態のときに、緩衝保護部材１５が外部から衝撃を受けた際には、その衝撃に応じて緩衝保護部材１５が操作部材１４の頭部１９と共にスライドして、第２ばね部材２６を圧縮すると共に、頭部１９が第１ばね部材２３を圧縮する。これにより、衝撃が緩衝されると共に、緩衝保護部材１５によって操作部材１４の頭部１９が保護される。

【００６６】

また、緩衝保護部材１５が外部から衝撃（緩衝保護部材１５の軸方向に対して垂直方向や斜め方向からの衝撃）を受けた際には、保持筒部２４が、ほぼ円筒状をなし、緩衝保護部材１５の軸方向の長さの半分ぐらいまで延出して設けられているので、緩衝保護部材１５が軸方向に対してねじれることなく、緩衝保護部材１５によって操作部材１４の頭部１９が保護される。

【００６７】

この場合、外部からの衝撃を緩衝しきれないときには、図３に示すように、緩衝保護部材１５が更にスライドして、緩衝保護部材１５の位置規制部１５ｂが保持筒部２４の外端部に当接して位置規制される。これにより、外部の衝撃を緩衝保護部材１５によって確実に受け止めて、スイッチ部２２が不用意にオンするのを確実に防ぐと共に、緩衝保護部材１５によって操作部材１４の頭部１９を確実にかつ良好に保護する。

【００６８】

また、このときには、操作部材１４の軸部１８が緩衝保護部材１５と共にスライドして、軸部１８の内端部が本体ケース２内に突出するが、図３に示すように、時計モジュール６のスイッチ部２２がオン状態になることはない。このため、外部からの衝撃を受けても、軸部１８の内端部によってスイッチ部２２が誤動作したり破損したりすることがなく、スイッチ部２２および時計モジュール６を良好に保護することができる。

【００６９】

このように、この腕時計のスイッチ装置１０によれば、貫通孔１１が設けられた腕時計ケース１の本体ケース２と、この本体ケース２の貫通孔１１に対してスライド可能に設けられた軸部１８、およびこの軸部１８の外端部に設けられて本体ケース２の外部に配置された頭部１９を備えた操作部材１４と、この操作部材１４の頭部１９の外周を覆った状態で、本体ケース２にスライド可能に設けられ、かつそのスライド長さＳ２が操作部材１４のスライド長Ｓ１さよりも短く設定された緩衝保護部材１５と、を備えていることにより、操作部材１４の操作性を向上させ、かつ耐衝撃性を確保することができる。

【００７０】

すなわち、この腕時計のスイッチ装置１０では、操作部材１４の頭部１９を押し込む際に、操作部材１４の頭部１９と共に緩衝保護部材１５をスライドさせた上、操作部材１４のみをスライドさせて押し込むことができるので、操作部材１４の頭部１９の外径よりも大きい外径の緩衝保護部材１５を操作部材１４の頭部１９と共にスライドさせることができ、これにより操作部材１４の押し込み感覚を向上させることができるので、操作部材１４の操作性を向上させることができる。

【００７１】

また、この腕時計のスイッチ装置１０では、緩衝保護部材１５が外部から衝撃を受けた際に、緩衝保護部材１５が操作部材１４の頭部１９を覆った状態で、緩衝保護部材１５を頭部１９と共にスライドさせることができるので、緩衝保護部材１５によって衝撃を緩衝することができると共に、操作部材１４の頭部１９を良好に保護することができ、これに

より耐衝撃性を確保することができる。

【００７２】

この場合、本体ケース２は、その貫通孔１１に設けられた筒状部材１３と、緩衝保護部材１５がスライド可能に配置される保持筒部２４と、を備えていることにより、貫通孔１１に設けられた筒状部材１３によって操作部材１４を本体ケース２の貫通孔１１に対して確実にかつ良好に取り付けることができると共に、保持筒部２４によって緩衝保護部材１５をスライド可能な状態で本体ケース２に対して確実にかつ良好に取り付けることができる。

【００７３】

すなわち、筒状部材１３は、本体ケース２の貫通孔１１内に固定された筒状部１６と、本体ケース２の外面に配置された鍔状部１７と、を備えているので、筒状部１６内に操作部材１４の軸部１８をスライド可能な状態で確実にかつ良好に取り付けることができる。また、保持筒部２４は、緩衝保護部材１５の外周に位置した状態で、本体ケース２にその外部に突出して設けられているので、保持筒部２４の内部に緩衝保護部材１５をスライド可能な状態で確実にかつ良好に取り付けることができる。

【００７４】

この場合、緩衝保護部材１５は、その内端部に筒状部材１３の鍔状部１７の外周部１７ａに接離可能に当接する当接部１５ａが設けられ、外周部に保持筒部２４の外端部に接離可能に当接する位置規制部１５ｂが設けられていることにより、緩衝保護部材１５のスライド長さＳ２を精度良く正確に設定することができる。

【００７５】

すなわち、緩衝保護部材１５は、本体ケース２の外部に向けて押し出された際に、当接部１５ａが鍔状部１７の外周部１７ａに当接して、位置規制部１５ｂが保持筒部２４の外端部から所定間隔（Ｓ２）だけ離れ、本体ケース２の内部に向けて押し込まれた際に、位置規制部１５ｂが保持筒部２４の外端部に当接し、当接部１５ａが鍔状部１７の外周部１７ａから所定間隔（Ｓ２）だけ離れることにより、緩衝保護部材１５のスライド長さＳ２を精度良く正確に設定することができる。

【００７６】

また、このスイッチ装置１０では、操作部材１４を本体ケース２の外部に向けて付勢する第１の付勢部材である第１ばね部材２３と、緩衝保護部材１５を本体ケース２の外部に向けて付勢する第２の付勢部材である第２ばね部材２６と、を備えていることにより、第１ばね部材２３のばね力によって操作部材１４を本体ケース２の外部に向けて押し出すことができ、また第２ばね部材２６のばね力によって緩衝保護部材１５を本体ケース２の外部に向けて押し出すことができる。

【００７７】

このため、このスイッチ装置１０では、緩衝保護部材１５が外部から衝撃を受けた際に、緩衝保護部材１５がスライドしながら第２ばね部材２６を圧縮させると共に、緩衝保護部材１５のスライドに伴って操作部材１４の頭部１９がスライドして第１ばね部材２３を圧縮させるので、衝撃を良好に緩衝することができると共に、操作部材１４の頭部１９を確実にかつ良好に保護することができる。

【００７８】

また、このスイッチ装置１０では、操作部材１４の頭部１９を押し込む際に、第２ばね部材２６のばね力に抗して緩衝保護部材１５を押し込むことにより、この緩衝保護部材１５と共に操作部材１４の頭部１９を押し込むことができ、これにより緩衝保護部材１５の位置規制部１５ｂが保持筒部２４の外端部に当接して、緩衝保護部材１５のスライドを停止させた状態で、頭部１９を第１ばね部材２３のばね力に抗して更に押し込むことができるので、操作部材１４の押し込み感覚を向上させることができ、これにより操作部材１４の操作性を向上させることができる。

【００７９】

この場合、第２ばね部材２６は、そのばね力が第１ばね部材２３のばね力よりも強く設

定されていることにより、第２ばね部材２６のばね力に抗して緩衝保護部材１５を操作部材１４の頭部１９と共に押圧すると、緩衝保護部材１５のスライドに伴って操作部材１４の頭部１９を確実にかつ良好にスライドさせることができ、緩衝保護部材１５のスライドが停止した状態で、第２ばね部材２６のばね力よりも軽い力で頭部１９を更に押し込むことができるので、操作部材１４の押し込み感覚を更に向上させることができ、これにより操作部材１４の操作性を、より一層、向上させることができる。

【００８０】

また、第２ばね部材２６は、リング形状の皿ばねであることにより、構造が簡単で、低価格を図ることができると共に、設置スペースのコンパクト化を図ることができ、これにより緩衝保護部材１５の内端部とこれに対応する本体ケース２の保持溝２５内における軸方向の内端面との間の僅かな隙間に効率良く良好に設置することができる。

【００８１】

また、このスイッチ装置１０では、緩衝保護部材１５が本体ケース２の外部に押し出された際に、その外端面と操作部材１４の頭部１９の外端面とがほぼ同一面上に位置することにより、外部からの衝撃を、操作部材１４の頭部１９が受けることがなく、緩衝保護部材１５で受け止めることができるので、この緩衝保護部材１５によって操作部材１４を確実にかつ良好に保護することができる。

【００８２】

さらに、このスイッチ装置１０では、本体ケース２内に設けられて、操作部材１４が緩衝保護部材１５のスライド長さＳ２よりも長いスライド長さＳ１で押し込まれた際に、オン動作するスイッチ部２２を備えていることにより、外部から衝撃を受けて緩衝保護部材１５が操作部材１４と共にスライドして押し込まれても、操作部材１４がスイッチ部２２をオン状態にさせないようにすることができ、これにより外部からの衝撃によるスイッチ部２２の誤動作およびスイッチ部２２の破損を確実に防ぐことができる。

【００８３】

また、このスイッチ装置１０における操作部材１４のスライド長さＳ１は、操作部材１４が押し出された第１の位置と操作部材１４が押し込まれてスイッチ部２２がオン状態になった第２の位置との間の長さに設定され、緩衝保護部材１５のスライド長さＳ２は、緩衝保護部材１５が押し出されてその外端部と操作部材１４の外端面とがほぼ同一面上に位置する第１の位置と緩衝保護部材１５が操作部材１４と共に押し込まれてスイッチ部２２がオン状態にならない第３の位置との間の長さに設定されていることにより、操作部材１４の操作性が良く、かつ外部からの衝撃によるスイッチ部２２の誤動作およびスイッチ部２２の破損を確実に防ぐことができる。

【００８４】

すなわち、このスイッチ装置１０では、緩衝保護部材１５のスライド長さＳ２が操作部材１４のスライド長さＳ１よりも短いため、外部から衝撃を受けて緩衝保護部材１５が操作部材１４と共にスライドして押し込まれても、操作部材１４がスイッチ部２２をオン状態にさせないようにすることができ、これにより外部からの衝撃によるスイッチ部２２の誤動作およびスイッチ部２２の破損を確実に防ぐことができる。

【００８５】

また、このスイッチ装置１０では、操作部材１４によってスイッチ部２２をオン動作させる際に、まず、緩衝保護部材１５を操作部材１４と共に押し込んで、操作部材１４の軸部１８の内端部をスイッチ部２２に接近させ、この状態で操作部材１４のみを更に押し込んで、スイッチ部２２をオン動作させることができるので、操作部材１４の押し込み感覚を向上させることができ、これにより操作部材１４の操作性が良く、確実にかつ良好にスイッチ部２２をオン動作させることができる。

【００８６】

なお、上述した実施形態では、第２の付勢部材であるばね部材２６が皿ばねである場合について述べたが、この発明はこれに限らず、例えばスプリングワッシャなどの板状のばねであっても良い。

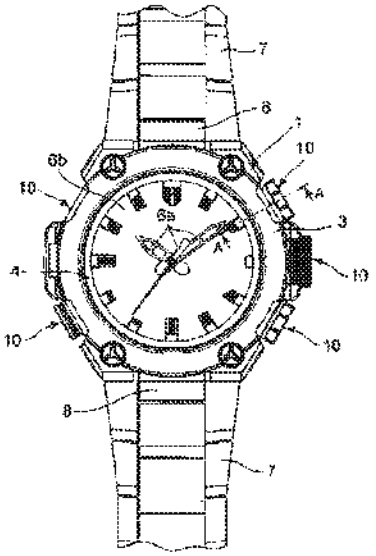
【００８７】
また、上述した実施形態では、第２の付勢部材として、ばね部材２６を用いた場合について述べたが、この発明はこれに限らず、例えば図５に示す変形例のように、第２の付勢部材として弾性部材３０を用いても良い。この場合、弾性部材３０は、ウレタンゴム、シリコーンゴム、エラストマなどの弾力性を有する合成樹脂、または衝撃吸収性を有するゲル状の樹脂などである。
【００８８】
また、上述した実施形態では、スイッチ部２２が接点部２２ａと接点ばね２２ｂとを備えた構成である場合について述べたが、この発明はこれに限らず、マイクロスイッチや近接スイッチなどのスイッチ部であっても良い。
【００８９】
さらに、上述した実施形態では、緩衝保護部材１５の内端部に当接部１５ａを緩衝保護部材１５の中心軸側に向けて突出させて設けた場合について述べたが、この発明はこれに限らず、例えば、緩衝保護部材１５の内端部に当接部を緩衝保護部材１５の径方向における外周側に向けて突出させて設けた構成であっても良い。
【００９０】
この場合には、本体ケース２に設けられた保持筒部２４の内周面に緩衝保護部材１５の当接部がスライド可能に挿入するガイド溝を設け、このガイド溝の軸方向における本体ケース２の外部側に位置する内端面に緩衝保護部材１５の当接部が接離可能に当接することにより、緩衝保護部材１５が外部に向けて押し出された際の位置を規制するように構成すれば良い。
【００９１】
なおまた、上述した実施形態では、腕時計に適用した場合について述べたが、必ずしも腕時計である必要はなく、例えばトラベルウオッチ、目覚まし時計、置き時計、掛け時計などの各種の時計に適用することができる。また、この発明は必ずしも時計である必要はなく、例えば、携帯電話機や携帯情報端末機などの電子機器にも適用することができる。
【００９２】
以上、この発明の一実施形態について説明したが、この発明は、これに限られるものではなく、特許請求の範囲に記載された発明とその均等の範囲を含むものである。
以下に、本願の特許請求の範囲に記載された発明を付記する。
【００９３】
（付記）
請求項１に記載の発明は、貫通孔が設けられたケースと、前記ケースの前記貫通孔に対してスライド可能に設けられた軸部、および前記軸部の外端部に設けられて前記ケースの外部に配置された頭部を備えた操作部材と、前記操作部材の前記頭部の外周を覆った状態で、前記ケースに、前記操作部材のスライド方向にスライド可能に設けられた緩衝保護部材と、を備えていることを特徴とするスイッチ装置である。
【００９４】
請求項２に記載の発明は、請求項１に記載のスイッチ装置において、前記緩衝保護部材のスライドの長さが前記操作部材のスライドの長さよりも短く設定されていることを特徴とするスイッチ装置である。
【００９５】
請求項３に記載の発明は、請求項１または請求項２に記載のスイッチ装置において、前記ケースには、前記緩衝保護部材の外周に位置した状態で、前記緩衝保護部材をスライド可能に保持する保持筒部が、前記ケースの外部に突出して設けられていることを特徴とするスイッチ装置である。
【００９６】
請求項４に記載の発明は、請求項３に記載のスイッチ装置において、前記保持筒部は、前記緩衝保護部材の軸方向の長さの半分ぐらいまで延出して設けられていることを特徴とするスイッチ装置である。

【００９７】
請求項５に記載の発明は、請求項１～請求項４のいずれかに記載のスイッチ装置において、前記操作部材を前記ケースの外部に向けて付勢する第１の付勢部材と、前記緩衝保護部材を前記ケースの外部に向けて付勢する第２の付勢部材と、を備えていることを特徴とするスイッチ装置である。
【００９８】
請求項６に記載の発明は、請求項５に記載のスイッチ装置において、前記第２の付勢部材は、ばね部材であることを特徴とするスイッチ装置である。
【００９９】
請求項７に記載の発明は、請求項５に記載のスイッチ装置において、前記第２の付勢部材は、弾力性を有する弾性部材であることを特徴とするスイッチ装置である。
【０１００】
請求項８に記載の発明は、請求項１～請求項７のいずれかに記載のスイッチ装置において、前記緩衝保護部材は、前記ケースの外部に前記操作部材と共に押し出された際に、前記緩衝保護部材の外端面と前記操作部材の外端面とがほぼ同一面上に位置することを特徴とするスイッチ装置である。
【０１０１】
請求項９に記載の発明は、請求項１～請求項８のいずれかに記載のスイッチ装置において、前記ケース内に設けられて、前記操作部材が前記緩衝保護部材のスライド長さよりも長いスライド長さで押し込まれた際に、オン状態になるスイッチ部を備えていることを特徴とするスイッチ装置である。
【０１０２】
請求項１０記載の発明は、請求項９に記載のスイッチ装置において、前記操作部材のスライド長さは、前記操作部材が押し出された第１の位置と前記操作部材が押し込まれて前記スイッチ部がオン状態になった第２の位置との間の長さに設定され、前記緩衝保護部材のスライド長さは、前記緩衝保護部材が押し出されてその外端部と前記操作部材の外端面とがほぼ同一面上に位置する前記第１の位置と前記緩衝保護部材が前記操作部材と共に押し込まれても前記スイッチ部がオン状態にならない第３の位置との間の長さに設定されていることを特徴とするスイッチ装置である。
【０１０３】
請求項１１に記載の発明は、請求項１～請求項１０のいずれかに記載されたスイッチ装置を備えていることを特徴とする時計である。
【符号の説明】
【０１０４】
１　腕時計ケース
２　本体ケース
３　外装ケース
６　時計モジュール
１０　スイッチ装置
１１　貫通孔
１１ａ　雌ねじ部
１３　筒状部材
１４　操作部材
１５　緩衝保護部材
１６　筒状部
１６ａ　雄ねじ部
１７　鍔状部
１８　軸部
１９　頭部
２０　防水リング

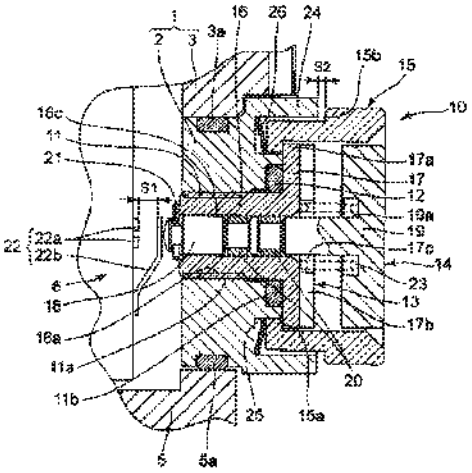
２１　抜止め部材
２２　スイッチ部
２３　第１ばね部材
２４　保持筒部
２５　保持溝
２６　第２ばね部材
３０　弾性部材
Ｓ１　操作部材のスライド長さ
Ｓ２　緩衝保護部材のスライド長さ

10

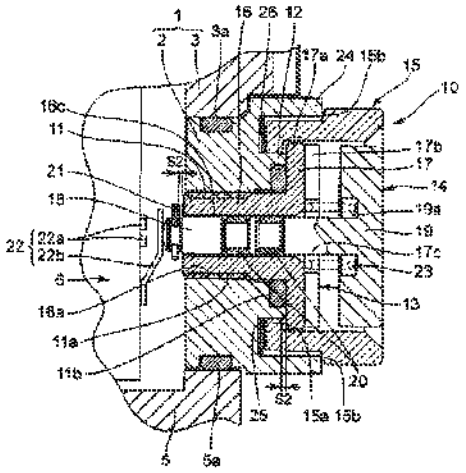
【図１】



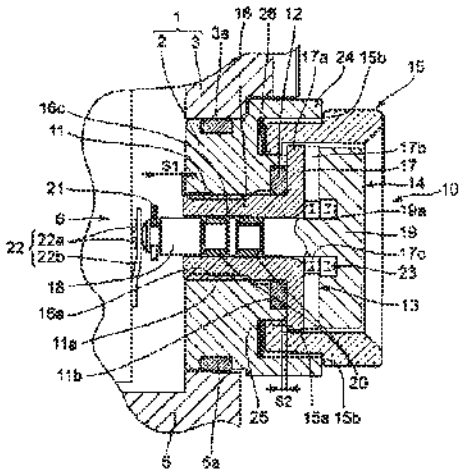
【図２】



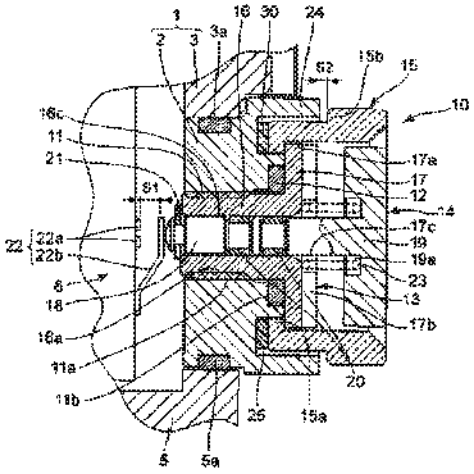
【図３】


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17a
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15b
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16c
11
S2
17b
17
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19a
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22a
22b
17c
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16a
11a
11b
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5a

【図４】


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17b
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11b
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S2
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【図５】


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16c
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S1
17c
22
22a
22b
19
19a
6
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17b
16a
11a
11b
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15a
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5a

Electronic Patent Application Fee Transmittal					
Application Number:	17951973				
Filing Date:	23-Sep-2022				
Title of Invention:	WEARABLE ELECTRONIC DEVICE				
First Named Inventor/Applicant Name:	Fletcher R. Rothkopf				
Filer:	Peter James Nagle/Sonya Domingo				
Attorney Docket Number:	P22914USC10				
Filed as Large Entity					
Filing Fees for Utility under 35 USC 111(a)					
Description		**Fee Code**	**Quantity**	**Amount**	**Sub-Total in USD($)**
Basic Filing:					
Pages:					
Claims:					
Miscellaneous-Filing:					
Petition:					
Patent-Appeals-and-Interference:					
Post-Allowance-and-Post-Issuance:					
Extension-of-Time:					

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
SUBMISSION- INFORMATION DISCLOSURE STMT	1806	1	260	260
		Total in USD ($)		**260**

Electronic Acknowledgement Receipt	
EFS ID:	47815625
Application Number:	17951973
International Application Number:	
Confirmation Number:	5622
Title of Invention:	WEARABLE ELECTRONIC DEVICE
First Named Inventor/Applicant Name:	Fletcher R. Rothkopf
Customer Number:	62579
Filer:	Peter James Nagle/Sonya Domingo
Filer Authorized By:	Peter James Nagle
Attorney Docket Number:	P22914USC10
Receipt Date:	10-APR-2023
Filing Date:	23-SEP-2022
Time Stamp:	12:50:22
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$260
RAM confirmation Number	E202340C50459463
Deposit Account	
Authorized User	
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Transmittal Letter	P22914USC10_IDS_Transmittal.pdf	19262 022337d2b3c0d1a350770e4038f68d05ae301633	no	2
Warnings:					
Information:					
2	Information Disclosure Statement (IDS) Form (SB08)	P22914USC10_PTO-SB-08.pdf	33723 7a731e8b50c4520164dec84ee9eef7495745fec8	no	2
Warnings:					
Information:					
This is not an USPTO supplied IDS fillable form					
3	Foreign Reference	CN103919536.pdf	3822739 0a6aac4735dc25f02b6e76ee9cd33ef072102d812	no	62
Warnings:					
Information:					
4	Foreign Reference	CN114220694A_w_Translation.pdf	1366924 5f1234d3fb3881d4323d9b436e9d31c8449f48a9d	no	35
Warnings:					
Information:					
5	Foreign Reference	JP2017219448A.pdf	1812204 2e5dae3da51d1378770712c7604d627e788604a6	no	18
Warnings:					
Information:					
6	Fee Worksheet (SB06)	fee-info.pdf	38269 edd4f1ce30cd65e27a5cead33f6290008c6402d0	no	2
Warnings:					

Information:	
Total Files Size (in bytes):	7093121

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.
National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.
New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

Docket No. P22914USC10

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the Application of:		
Fletcher Rothkopf et al.	Examiner:	BRIAN T GEDEON
Application No. 17/951,973	Art Unit:	3792
Filed: September 23, 2022	Confirmation No.	5622
For: WEARABLE ELECTRONIC DEVICE		

INFORMATION DISCLOSURE STATEMENT TRANSMITTAL

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

The Examiner is requested to consider the references noted on the enclosed Form PTO/SB/08A and B during examination of the above-identified patent application. These references are submitted for the Examiner's consideration and are submitted pursuant to the duty of disclosure under 37 C.F.R. § 1.56. In submitting these references, no representation is made or implied that the references are or are not material to the examination of the application. The Examiner is requested to review the cited references and is encouraged to make his or her own determination of materiality of the references cited.

Pursuant to the requirements of 37 C.F.R. § 1.98(a)(2)(ii), only copies of the foreign references and non-patent literature documents are provided. Copies of the U.S. patent and U.S. patent application publication references are not provided, unless required by the Office.

In accordance with **37 CFR 1.97(c)**, the information disclosure statement is being filed after the period specified in 37 CFR 1.97(b), but before the mailing date of any of a final action under §1.113, a notice of allowance under §1.311, or an action that otherwise closes prosecution in the application, and is accompanied by the fee set forth in §1.17(p).

STATEMENT OF RELATEDNESS UNDER M.P.E.P. § 2001.06(b)

In satisfaction of the duty of disclosure under 37 C.F.R. § 1.56, and as required by M.P.E.P §2001.06(b), the Examiner is requested to consider the pending application(s) listed below which are owned by the Assignee of the present application. The pending application(s) may include subject matter similar to that of the present application.

- U.S. Patent Application Serial No. 18/074,358; filed December 2, 2022; pending
- U.S. Patent Application Serial No. 18/075,253; filed December 5, 2022; pending
- U.S. Patent Application Serial No. 18/094,930; filed January 9, 2023; pending
- U.S. Patent Application Serial No. 18/106,912; filed February 7, 2023; pending
- U.S. Patent Application Serial No. 18/119,175; filed March 8, 2023; pending

FEE AUTHORIZATION

The required fee specified in 37 C.F.R. § 1.17(p), is being paid concurrently herewith by credit card authorization through the USPTO Electronic Filing System. The Director is hereby authorized any fee deficiency or credit any overpayment, to Deposit Account No. 50-4621.

If the Examiner has any questions, please contact the undersigned attorney.

Dated: April 10, 2023

Respectfully submitted,

/Peter J. Nagle/

Peter J. Nagle, Registration No. 70,361
Attorney for Assignee
USPTO Customer No. 62579

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/951,973	09/23/2022	Fletcher R. Rothkopf	P22914USC10	5622

62579 7590 04/24/2023

APPLE INC./BROWNSTEIN
c/o Brownstein Hyatt Farber Schreck, LLP
410 Seventeenth Street
Suite 2200
Denver, CO 80202

EXAMINER	
GEDEON, BRIAN T	

ART UNIT	PAPER NUMBER
3792	

NOTIFICATION DATE	DELIVERY MODE
04/24/2023	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

patentdocket@bhfs.com

Office Action Summary	Application No. 17/951,973	Applicant(s) Rothkopf et al.	
	Examiner BRIAN T GEDEON	Art Unit 3792	AIA (FITF) Status Yes

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☑ Responsive to communication(s) filed on 22 March 2023.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2a)☑ This action is **FINAL.** 2b) ☐ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

5) ☑ Claim(s) 21-31 is/are pending in the application.

5a) Of the above claim(s) _____ is/are withdrawn from consideration.

6) ☐ Claim(s) _____ is/are allowed.

7) ☑ Claim(s) 21-31 is/are rejected.

8) ☐ Claim(s) _____ is/are objected to.

9) ☐ Claim(s) _____ are subject to restriction and/or election requirement

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to **PPHfeedback@uspto.gov.**

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

a)☐ All b)☐ Some** c)☐ None of the:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)

2) ☑ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) Paper No(s)/Mail Date _____.

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date _____.

4) ☐ Other: _____.

DETAILED ACTION

Response to Amendment

1. This action is in response to the amendment after non-final filed 22 March 2023. Claims 21-31 are pending.

Double Patenting

2. The terminal disclaimer filed 22 March 2023 has been approved. In view of this, the non-statutory double patenting rejection has been withdrawn.

Information Disclosure Statement

3. The information disclosure statements filed 10 April 2023 (2) and 22 March 2023 have been considered.

4. Upon review, certain references disclosed by Applicant are considered pertinent to the present claim set. The references are deemed read on the present claims, thus the finality of the previous Office action has been withdrawn in view of newly discovered references disclosed by Applicant. A new grounds of rejection has been formulated using Applicant's newly disclosed references to Honda et al. (US Patent no. 6,265,789) and Kotangi et al. (Seiko Instruments Inc. WO 2005/092182).

Claim Rejections - 35 USC § 112

5. The following is a quotation of the first paragraph of 35 U.S.C. 112(a):

> (a) IN GENERAL.—The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same, and shall set forth the best mode contemplated by the inventor or joint inventor of carrying out the invention.

The following is a quotation of the first paragraph of pre-AIA 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same, and shall set forth the best mode contemplated by the inventor of carrying out his invention.

6. Claim 26 is rejected under 35 U.S.C. 112(a) or 35 U.S.C. 112 (pre-AIA), first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor or a joint inventor, or for applications subject to pre-AIA 35 U.S.C. 112, the inventor(s), at the time the application was filed, had possession of the claimed invention. The prior art fails to provide any description concerning the shape of the cover being a disk, nor for the relative diameters of the cover with respect to the second opening.

7. Claim 27 is rejected under 35 U.S.C. 112(a) or 35 U.S.C. 112 (pre-AIA), first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor or a joint inventor, or for applications subject to pre-AIA 35 U.S.C. 112, the inventor(s), at the time the application was filed, had possession of the claimed invention. The prior art fails to provide any description concerning the relative diameters of the charging receiver coil with respect to the second opening.

8. Claim 30 is rejected under 35 U.S.C. 112(a) or 35 U.S.C. 112 (pre-AIA), first paragraph, as failing to comply with the written description requirement. The claim(s)

contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor or a joint inventor, or for applications subject to pre-AIA 35 U.S.C. 112, the inventor(s), at the time the application was filed, had possession of the claimed invention. The prior art fails to provide any description concerning the relative diameters of the charging receive coil and the biosensor, nor for the layout of the coil with respect to the biosensor.

Claim Rejections - 35 USC § 103

9. In the event the determination of the status of the application as subject to AIA 35 U.S.C. 102 and 103 (or as subject to pre-AIA 35 U.S.C. 102 and 103) is incorrect, any correction of the statutory basis for the rejection will not be considered a new ground of rejection if the prior art relied upon, and the rationale supporting the rejection, would be the same under either status.

10. The following is a quotation of 35 U.S.C. 103 which forms the basis for all obviousness rejections set forth in this Office action:

> A patent for a claimed invention may not be obtained, notwithstanding that the claimed invention is not identically disclosed as set forth in section 102, if the differences between the claimed invention and the prior art are such that the claimed invention as a whole would have been obvious before the effective filing date of the claimed invention to a person having ordinary skill in the art to which the claimed invention pertains. Patentability shall not be negated by the manner in which the invention was made.

11. Claim(s) 21-31 is/are rejected under 35 U.S.C. 103 as being unpatentable over Honda et al. (US Patent no. 6,265,789 – disclosed by Applicant) in view of Kotangi et al. (Seiko Instruments Inc. WO 2005/092182 – disclosed by Applicant).

In regard to claims 21 and 31, the reference to Honda et al. describes a wearable electronic apparatus that may be embodied as an electronic wrist watch (fig. 1, col 6

lines 4-6). Figure 1 shows that the wearable device includes a housing 201 and band 202 attached to housing 201. Figure 2 (reproduced below) shows that the housing 201

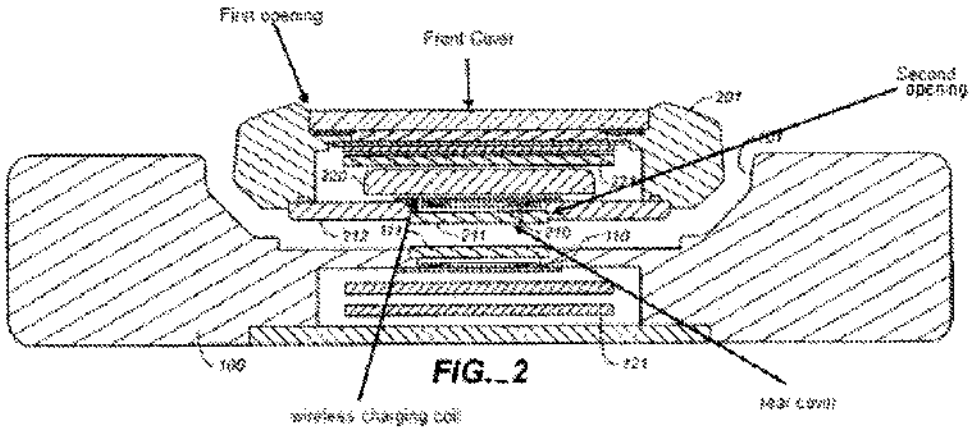
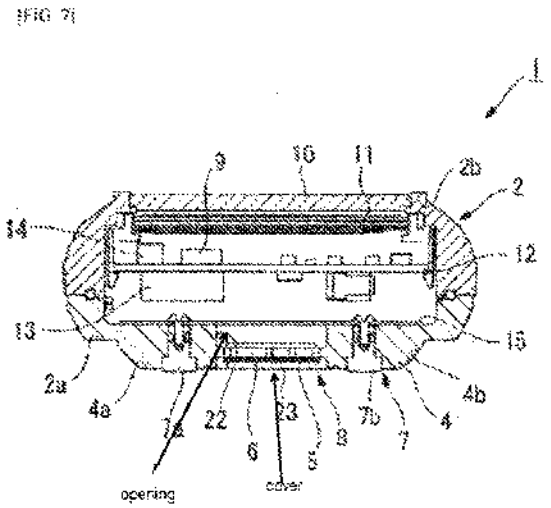


FIG._2

includes a first opening opposite to a second opening (shown annotated), wherein a display 204 is positioned in the first opening (col 6 lines 14-16). The second opening includes a cover glass 211 that forms a portion of the exterior surface 212, and a wireless charging receive coil 210 (i.e., referred to as watch side coil) aligned with the second opening and cover glass 211. The cover glass 211 is configured to pass wireless power from an external wireless charging device 100 (i.e., figure 2 shows the wearable device mated with a charging station 100) supplied by charging coil 110 of the charging station (col 6 lines 21-49). Additionally, coil 210 is configured to provide wireless transmission of data to and from the wearable device. In this manner, the coil 210 is considered similar to the claimed antenna (here Honda et al. performs this data transmission by magnetic induction which is considered to comprise a suitable alternative equivalent in wireless communication technology). Lastly, Honda et al. teaches that the wearable electronic wrist watch is configured to detect biological

information such as a pulse rate or a heart rate, however, Honda et al. does not describe the structure, operation, nor location of the sensor for detecting biological information with respect to the second opening of the housing (col 6 lines 17-20).

Kotangi et al. also describes a wearable electronic device in the form of a wrist watch. The device of Kotangi et al. is configured to be worn on a user and detect biological information from a biosensor disposed within an opening of the wearable housing and below a cover. Figure 1 of Kotangi et al. shows the wearable device comprising a sensor housing 2 and a band attached to the housing 2. Figure 7 of Kotangi et al. (reproduced below), shows that like Honda et al., the housing includes



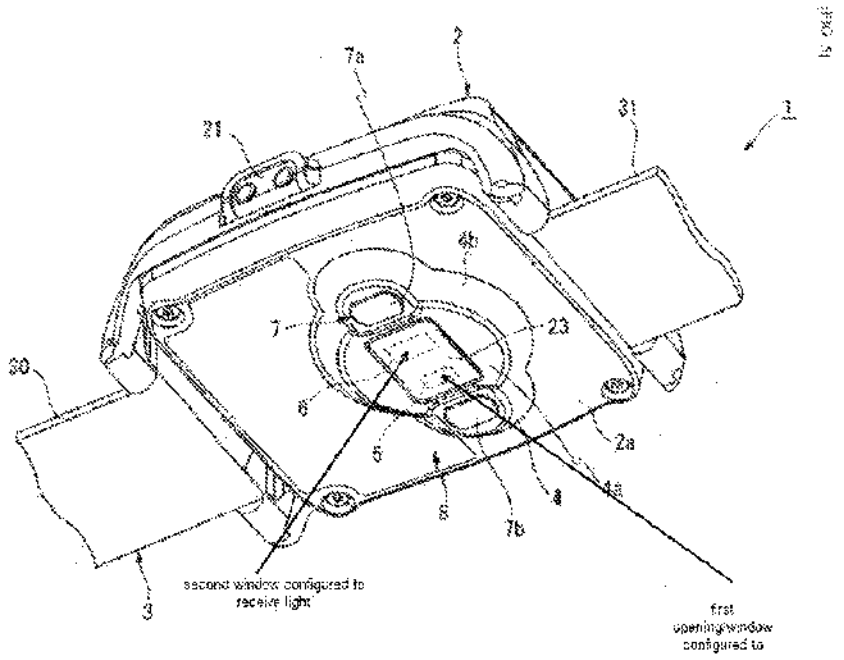
an opening 22 located along the rear side of the housing similar the second opening in Honda et al., wherein the opening includes a cover 23 disposed within the opening and forming an exterior surface. Disposed about the opening and below the cover 23 is a biosensor consisting of a light source 5 and light detector 6. The cover is configured to pass optical signals generated by elements 5 and 6 of the biosensor 8 (see para 54 and 55).

Honda et al. and Kotangi et al. are considered to constitute analogous prior art in the same field of endeavor pertaining to wrist wearable devices that include sensors to detect biological information. In view of this and of the disclosed features of each reference, modification of Honda et al. to include a light source 5 and light detector 6 of Kotangi et al. as a biosensor within the housing 201 is considered to have been obvious to one of ordinary skill in the art at the time of the invention since 1. Honda et al. explicitly suggests that a biosensor is incorporated therein and elements 5 and 6 constitute suitable structure for that element of Honda et al., and 2. Kotangi et al. demonstrates that is known in the art for a biosensor to be aligned with an opening and rear cover, and 3. the modification pertains to the substitution of a known element for another to yield predictable results (i.e., elements 5 and 6 of Kotangi et al.. for the biosensor of Honda et al.; elements 5 and 6 known in the art to measure pulse rate and heart rate). The modification would provide structure necessary for acquiring the pulse rate or heart rate obtained by Honda et al., wherein one of ordinary skill in the art is considered to have had a reasonable expectation of success substituting the elements.

In regard to claim 22, in Kotangi et al. the biosensor include a light source 5 (i.e., configured to emit light toward skin of the user) and a light detector 6 (i.e., configured to receive reflected light from the skin of the user) (para 56 and 65).

In regard to claim 23, figure 5 of Kotangi et al. (below) shows that the light source 5 and photodetector 6 appear to have separate openings/windows within the cover 23

for emitting and receiving light.



In regard to claim 24, the biosensor 8 of Kotangi et al. is configured to utilize emitted and reflected light to measure changes in absorption in order to measure changes in light absorption by the region of the skin and compute a health metric (i.e., heart rate or pulse rate) (para 65). This is similar in scope and intent of the sensor suggested by Honda et al.

In regard to claim 25, the sensors taught and suggested by Honda et al. and Kotangi et al. are considered to be recognized by one of ordinary skill in the art as equivalents to a photoplethysmogram sensor.

In regard to claim 26, from figure 2 of Honda et al., as best as can be interpreted from this illustration, the cover 211 is a disk with a disk diameter that is greater than the diameter of the second opening. Additionally, the seal formed by the disk and housing

is considered water-tight, wherein seal is considered to have been obvious in order to protect interior electronics and circuits from ingress of sweat and other fluid.

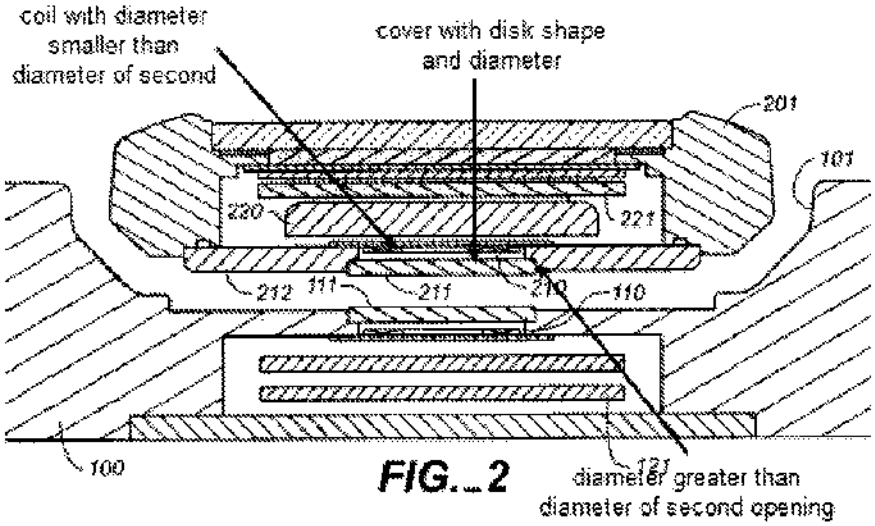


FIG._2

Further in regard to claim 26, the present disclosure fails to provide any disclosure or criticality for such feature. Therefore the feature is considered only to comprise a matter of choice in design.

In regard to claim 27, from figure 2 of Honda et al., as best as can be interpreted from this illustration, the coil 210 has a diameter that is smaller than the diameter of the second opening. The coil 210 configured to receive power and data from coil 110 of station through the second opening and cover 211.

In regard to claim 28, the external biosensor 8 of Kotangi et al. configured for passing optical signals generated by the biosensor is shown and described to have a protruding convex shape (see figures 5 and 7 element 4 referred to as protruding part, para 54). The convex shape serves a different intended use as claimed, namely that of ensuring intimate contact with the user's wrist. The convex nature of the device to serve a different intended use is considered to comprise a matter of choice in design.

In regard to claim 29, Honda et al. teaches that power transmission for charging happens through magnetic coupling of coils 210 and 110 of figure 2 (col 6 lines 36-39). This coupling is considered to occur through the cover 211.

In regard to claim 30, the present disclosure lacks description and criticality for the location of the biosensor with respect to the wireless charging receiver coil. Therefore, it is considered that the positioning is dictated by choice in design and constrained by the limited real estate provided within the watch housing.

Conclusion

9. Applicant's submission of an information disclosure statement under 37 CFR 1.97(c) with the fee set forth in 37 CFR 1.17(p) on 10 April 2023 prompted the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 609.04(b). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

10. Any inquiry concerning this communication or earlier communications from the examiner should be directed to BRIAN T GEDEON whose telephone number is (571)272-3447. The examiner can normally be reached M-F 8:00 am to 5:30 PM ET.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at http://www.uspto.gov/interviewpractice.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, David E. Hamaoui, can be reached on 571-270-5625. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of published or unpublished applications may be obtained from Patent Center. Unpublished application information in Patent Center is available to registered users. To file and manage patent submissions in Patent Center, visit: https://patentcenter.uspto.gov. Visit https://www.uspto.gov/patents/apply/patent-center for more information about Patent Center and https://www.uspto.gov/patents/docx for information about filing in DOCX format. For additional questions, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/BRIAN T GEDEON/
Primary Examiner, Art Unit 3792
19 April 2023

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/951,973	Rothkopf et al.
	Examiner	Art Unit
	BRIAN T GEDEON	3792

CPC - Searched*		
Symbol	Date	Examiner
A61B 5/02,28,308,318,346,349	12/17/2022	BTG

CPC Combination Sets - Searched*		
Symbol	Date	Examiner

US Classification - Searched*			
Class	Subclass	Date	Examiner

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes		
Search Notes	Date	Examiner
Detailed SEARCH history attached.	12/17/2022	BTG
Inventor name search.	12/17/2022	BTG
CPC search limited by keyword search.	12/17/2022	BTG
IDS's considered.	04/19/2023	BTG
IPR2023-00634 petition for Inter Partes Review of US application no. 15/261917	04/19/2023	BTG
IPR2023-00734 petition for Inter Partes Review of US application no. 16/826130	04/19/2023	BTG
IPR2023-00807 petition for Inter Partes Review of US application no. 17/672653	04/19/2023	BTG

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/951,973	Rothkopf et al.
	Examiner	Art Unit
	BRIAN T GEDEON	3792

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner
	US PGPUB, USPAT claim text search.	12/17/2022	BTG

Docket No. P22914USC10

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the Application of:		
Fletcher Rothkopf et al.	Examiner:	BRIAN T GEDEON
Application No. 17/951,973	Art Unit:	3792
Filed: September 23, 2022	Confirmation No.	5622
For: WEARABLE ELECTRONIC DEVICE		

INFORMATION DISCLOSURE STATEMENT TRANSMITTAL

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

The Examiner is requested to consider the references noted on the enclosed Form PTO/SB/08A and B during examination of the above-identified patent application. These references are submitted for the Examiner's consideration and are submitted pursuant to the duty of disclosure under 37 C.F.R. § 1.56. In submitting these references, no representation is made or implied that the references are or are not material to the examination of the application. The Examiner is requested to review the cited references and is encouraged to make his or her own determination of materiality of the references cited.

Pursuant to the requirements of 37 C.F.R. § 1.98(a)(2)(ii), only copies of the foreign references and non-patent literature documents are provided. Copies of the U.S. patent and U.S. patent application publication references are not provided, unless required by the Office.

In accordance with **37 CFR 1.97(c)**, the information disclosure statement is being filed after the period specified in 37 CFR 1.97(b), but before the mailing date of any of a final action under §1.113, a notice of allowance under §1.311, or an action that otherwise closes prosecution in the application, and is accompanied by the fee set forth in §1.17(p).

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /B.T.G/

Docket No. P22914USC10

STATEMENT OF RELATEDNESS UNDER M.P.E.P. § 2001.06(b)

In satisfaction of the duty of disclosure under 37 C.F.R. § 1.56, and as required by M.P.E.P §2001.06(b), the Examiner is requested to consider the pending application(s) listed below which are owned by the Assignee of the present application. The pending application(s) may include subject matter similar to that of the present application.

- U.S. Patent Application Serial No. 18/074,358; filed December 2, 2022; pending
- U.S. Patent Application Serial No. 18/075,253; filed December 5, 2022; pending
- U.S. Patent Application Serial No. 18/094,930; filed January 9, 2023; pending
- U.S. Patent Application Serial No. 18/106,912; filed February 7, 2023; pending
- U.S. Patent Application Serial No. 18/119,175; filed March 8, 2023; pending

FEE AUTHORIZATION

The required fee specified in 37 C.F.R. § 1.17(p), is being paid concurrently herewith by credit card authorization through the USPTO Electronic Filing System. The Director is hereby authorized any fee deficiency or credit any overpayment, to Deposit Account No. 50-4621.

If the Examiner has any questions, please contact the undersigned attorney.

Dated: April 10, 2023

Respectfully submitted,

/Peter J. Nagle/
Peter J. Nagle, Registration No. 70,361
Attorney for Assignee
USPTO Customer No. 62579

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/BRIAN T GEDEON/ 04/19/2023

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /B.T.G/

PTO/SB/08A (08-03) U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE Substitute for Form 1449A/PTO **INFORMATION DISCLOSURE STATEMENT BY APPLICANT** *(Use as many sheets as necessary)*	**APPLICATION NO.:** 17/951,973	**FILING DATE:** September 23, 2022
	INVENTOR(S): Fletcher Rothkopf	**ART UNIT:** 5622
	EXAMINER NAME: Brian T Gedeon	**ATTY. DOCKET NO.:** P22914USC10

U.S. PATENT DOCUMENTS

EXAMINER INITIALS*	Cite No.[1]	PATENT NUMBER Number – Kind Code[2] (if known)	ISSUE DATE MM-DD-YYYY	Name of Patentee of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
	A1.	4,129,124	12/12/1978	Thalmann	
	A2.	4,163,447	8/7/1979	Orr	
	A3.	4,224,948	9/30/1980	Cramer et al.	
	A4.	4,248,244	2/3/1981	Charnitski et al.	
	A5.	4,375,219	3/1/1983	Schmid	
	A6.	5,613,008	05/31/1994	Suga et al.	
	A7.	6,075,755	06/13/2000	Zarchan	
	A8.	6,091,530	06/18/2000	Duckworth	
	A9.	6,265,789	7/24/2001	Honda et al.	
	A10.	9,277,880	3/8/2016	Poeze et al.	
	A11.	10,231,629	3/19/2019	Pei et al.	
	A12.	10,060,788	8/28/2018	Fei	

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EXAMINER INITIALS*	Cite No.[1]	PUBLICATION NUMBER Number – Kind Code[2] (if known)	PUBLICATION DATE MM-DD-YYYY	Name of Inventor(s) of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
	B1.	2001/0056243	12/27/2001	Ohsaki et al.	
	B2.	2005/0116820	6/5/2005	Goldreich	
	B3.	2007/0276270	11/29/2007	Tran	
	B4.	2008/0208009	8/28/2008	Shklarski	
	B5.	2012/0221254	8/30/2012	Kateraas et al.	
	B6.	2014/0135594	5/15/2014	Yuen et al.	
	B7.	2015/0214749	7/30/2015	Park et al.	
	B8.	2015/0355604	12/10/2015	Fraser et al.	
	B9.	2016/0073914	3/17/2016	Lapetina et al.	
	B10.	2016/0228064	8/11/2016	Jung et al.	

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /B.T.G/

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EXAMINER INITIALS*	Cite No.[1]	DOCUMENT NUMBER Country Code[3] – Number[4] – Kind Code[5] (if known)	PUBLICATION DATE MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear	T[6]
	C1.	WO1982/00088	1/21/1982	Prime Microelectronic Instruments, Inc.		
	C2.	WO2005/092182	10/6/2005	Seiko Instr Inc		
	C3.	WO2012/140559	10/18/2012	Medic4All		
	C4.	WO2015/116111	8/6/2015	Hewlett-Packard Development Co, L.P.		
	C5.	WO2015/150199	10/8/2015	Koninklijke Philips N.V.		
	C6.	WO2017/165532	9/28/2017	Neumitra Inc		
	C7.	JP2005270543	10/6/2005	Seiko Instr Inc		

OTHER PRIOR ART – NON PATENT LITERATURE DOCUMENTS			
EXAMINER INITIALS*	Cite No.[1]	Include name of Author, title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), volume-issue number(s), publisher, page(s) and date.	T[6]
	D1.	ALDINGER, F. and Weberruβ, V.A., "An Introduction to Structures, Properties, Technologies, Methods" (2010) In: Advanced Ceramics and Future Materials 17 pages	
	D2.	BERBARI, E.J., "Principles of Electrocardiology" (2015) In: The Biomedical Engineering Handbook -4th Edition (Eds: J.D. Bronzin & D.R. Peterson) 5 pages	
	D3.	CANFIELD, D., "Drying and Curing Inks and Coatings on Glass" (March 16, 2013) Glass Magazine 5 pages	
	D4.	DOREMUS, R.H., "Structure, Properties, and Processing" (2008) In: Ceramic and Glass Materials (Eds: J.F. Shackelford & R.H. Doremus) 33 pages	
	D5.	FRANCIS, J., "ECG monitoring leads and special leads" (2016) Indian Pacing and Electrophysiology Journal 16:92-95.	
	D6.	KINGERY, W.D., "Introduction to Ceramics" (1960) Eds: John Wiley & Sons, Inc. 23 pages	
	D7.	LOEHMAN, R.E., "Surfaces, Interfaces, Thin Films" (1993) In: Characterization of Ceramics, Materials Characterization Series (Eds: R.E. Loehman, J.E. Fitzpatrick) 13 pages	
	D8.	MENDELSON, Y. et al., "A Wearable Reflectance Pulse Oximeter for Remote Physiological Monitoring" (Aug 30-Sept 3, 2006) Proceedings of the 28th IEEE, EMBS Annual International Conference New York City 4 pages	
	D9.	MENDELSON, Y., "Wearable Wireless Pulse Oximetry for Physiological Monitoring" (Aug 4, 2008) Presentation - PPL Workshop 34 pages	
	D10.	MEZIANE, N. et al. "Dry Electrodes for Electrocardiography" (2013) Physiol. Meas. 34:R47-R69.	
	D11.	SHI, F., "Progress in Modern Ceramics" (2012) In: Ceramic Materials (Ed: Feng Shi) 6 pages	
	D12.	Declaration of R. James Duckworth, Ph.D, Filed February 27, 2023 in Case No. IPR2023-00634, 187 Pages	
	D13.	Defendant Masimo Corporation's Answer To Complaint and Counterclaims, dated December 12, 2022, Filed in District Court Case 1:22-cv-01378-MN, Masimo Corporation and Sound United, LLC vs. Apple Inc., 904 pages	

* EXAMINER: Initial if citation considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant

[1] Applicant's unique citation number (optional). [2] See Kinds Codes of USPTO Patent Documents at www.uspto.gov or MPEP 901.04. [3] Enter Office that issued the document, by the two-letter code (WIPO Standard ST.3). [4] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [5] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [6] Applicant is to place a check mark here if English language Translation is attached.
1.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /B.T.G/

OTHER PRIOR ART – NON PATENT LITERATURE DOCUMENTS			
	D14.	Complaint For Patent Infringement, dated October 20, 2022, Filed in District Court Case 1:22-cv-01378-UNA, Masimo Corporation and Sound United, LLC vs. Apple Inc., 672 pages	
	D15.	Declaration of Sylvia D. Hall-Ellis, Ph.D., Filed February 27, 2023 in Case No. IPR2023-00634, 40 pages	
	D16.	Declaration of Jamie L. Kringstein In Support Of Plaintiff And Counterclaim-Defendant Apple Inc.'s Motion To Dismiss Masimo Corporation's Counterclaims And Strike Its Inequitable Conduct Affirmative Defense, dated February 21, 2023, Filed in District Court Case 1:22-cv-01378-MN-JLH, *Masimo Corporation and Sound United, LLC vs. Apple Inc.*, 52 pages	
	D17.	Plaintiff And Counterclaim-Defendant Apple Inc.'s Memorandum Of Law In Support Of Its Motion To Dismiss Masimo Corporation's Counterclaims And Strike Its Inequitable Conduct Affirmative Defense, dated February 21, 2023, Filed in District Court Case 1:22-cv-01378-MN, *Masimo Corporation and Sound United, LLC vs. Apple Inc.*, 28 pages	
	D18.	Petition For Inter Partes Review Of U.S. Patent No. 10,627,783, Filed February 27, 2023, in Case No. IPR2023-00634, 124 pages	

EXAMINER	/BRIAN T GEDEON/	DATE CONSIDERED	04/19/2023

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PTO/SB/08A (08-03) U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE Substitute for Form 1449A/PTO **INFORMATION DISCLOSURE STATEMENT BY APPLICANT** *(Use as many sheets as necessary)*	**APPLICATION NO.:** 17/951,973	**FILING DATE:** September 23, 2022
	INVENTOR(S): Fletcher Rothkopf	**ART UNIT:** 5622
	EXAMINER NAME: Brian T Gedeon	**ATTY. DOCKET NO.:** P22914USC10

U.S. PATENT DOCUMENTS

EXAMINER INITIALS*	Cite No.[1]	PATENT NUMBER Number – Kind Code[2] (if known)	ISSUE DATE MM-DD-YYYY	Name of Patentee of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
	A1.	6,721,540	04/2004	Motomu Hayakawa	
	A2.	8,810,514	08/2014	Zhao et al.	
	A3.	11,531,306	12/2022	Ely et al.	

U.S. PUBLICATION DOCUMENTS

EXAMINER INITIALS*	Cite No.[1]	PUBLICATION NUMBER Number – Kind Code[2] (if known)	PUBLICATION DATE MM-DD-YYYY	Name of Inventor(s) of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
	B1.	2019/0025940	07/2018	Shim et al.	
	B2.	2021/0353226	11/2021	Hiemstra	
	B3.	2023/0013283	01/2023	Antonio F. Herrera	
	B4.	2023/0012897	01/2023	Tyler S. Atura Bushnell	
	B5.	2023/0028554	01/2023	Fletcher R. Rothkopf	
	B6.	2023/0077241	03/01/2023	Pandya et al.	

FOREIGN PATENT DOCUMENTS

EXAMINER INITIALS*	Cite No.[1]	DOCUMENT NUMBER Country Code[3] – Number[4] – Kind Code[5] (if known)	PUBLICATION DATE MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear	T[6]
	C1.	CN103919536	07/2014	FITBIT Inc		
	C2.	CN114220694	03/2022	NOOER SCIENCE AND TECH CO LTD		
	C3.	JP2017219448	12/2017	Casio Computer Co. Ltd.		

OTHER PRIOR ART – NON PATENT LITERATURE DOCUMENTS

EXAMINER INITIALS*	Cite No.[1]	Include name of Author, title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), volume-issue number(s), publisher, page(s) and date.	T[6]

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[1] Applicant's unique citation number (optional). [2] See Kinds Codes of USPTO Patent Documents at www.uspto.gov or MPEP 901.04 [3] Enter Office that issued the document, by the two-letter code (WIPO Standard ST.3). [4] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [5] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible [6] Applicant is to place a check mark here if English language Translation is attached.
1.

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OTHER PRIOR ART – NON PATENT LITERATURE DOCUMENTS	
EXAMINER /BRIAN T GEDEON/	DATE CONSIDERED 04/19/2023
EXAMINER: Initial if citation considered, whether or not citation is in conformance with MPEP 609; Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.	

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /B.T.G/

PE2E SEARCH - Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	British Equivalents	Time Stamp
L1	12	(US-4914831-$ | US-6587400-$ | US-6846998-$ | US-7034237-$ | US-7255473-$ | US-7506269-$ | US-8456430-$ | US-8816962-$ | US-9034666-$ | US-9176577-$ | US-9632318-$ | US-9800717-$).DID.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/30 09:07 AM
L2	42	(US-0018026-$ | US-0024683-$ | US-0061863-$ | US-0062623-$ | US-0103985-$ | US-0104902-$ | US-0253487-$ | US-0269715-$ | US-0285404-$ | US-0306446-$ | US-0331869-$ | US-0335196-$ | US-0347289-$ | US-0357465-$ | US-20130335196-$ | US-20140347289-$ | US-20160062623-$ | US-20160103985-$ | US-20160253487-$ | US-20160306446-$ | US-20170061863-$ | US-20170104902-$ | US-20170269715-$ | US-20170285404-$ | US-20170331869-$ | US-20170357465-$ | US-20180018026-$ | US-20180024683-$).DID.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/30 09:07 AM
L3	3	"9836025".pn.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/30 09:07 AM
L4	9	(US-4395134-$ | US-4634861-$ | US-4987299-$ | US-5631881-$ | US-5825353-$ | US-6392640-$ | US-6896403-$ | US-7102626-$ | US-9430042-$).DID.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/30 09:08 AM

L5	12	(US-0069713-$ | US-0109861-$ | US-0248986-$ | US-0307414-$ | US-20160069713-$ | US-20160109861-$ | US-20170248986-$ | US-20170307414-$).DID.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/30 09:08 AM
L6	22	(US-2288215-$ | US-2788236-$ | US-2797592-$ | US-3410247-$ | US-4311026-$ | US-4766642-$ | US-5509174-$ | US-6502982-$ | US-6834430-$ | US-7111365-$ | US-7285738-$ | US-7371745-$ | US-7591582-$ | US-8607662-$ | US-8783944-$ | US-8905631-$ | US-9052696-$ | US-9244438-$).DID.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/30 09:09 AM
L7	12	(US-0116306-$ | US-0122656-$ | US-0130971-$ | US-0272784-$ | US-20040130971-$ | US-20090122656-$ | US-20120272784-$ | US-20160116306-$).DID.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/30 09:09 AM
L8	0	"201700192391".pn.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/30 09:10 AM
L9	0	(20160327911|20170045958).PN.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/30 09:10 AM
L10	1	"20170192391".pn.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/30 09:10 AM
L11	3	(20160327911|20170045958).PN.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/30 09:10 AM
L12	4	(8188989|9947741).PN.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/30 09:11 AM
L13	244	(US-0003655-$ | US-0010751-$ | US-0013775-$ | US-0033430-$ | US-0037396-$ | US-0050054-$ | US-	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/30 09:11 AM

		0051649-$ | US- 0053468-$ | US- 0054813-$ | US- 0058375-$ | US- 0061636-$ | US- 0067711-$ | US- 0068857-$ | US- 0069443-$ | US- 0069444-$ | US- 0069447-$ | US- 0071050-$ | US- 0071098-$ | US- 0073119-$ | US- 0075082-$ | US- 0075558-$ | US- 0081375-$ | US- 0082414-$ | US- 0087443-$ | US- 0090148-$ | US- 0098016-$ | US- 0112859-$ | US- 0113044-$ | US- 0130914-$ | US- 0132516-$ | US- 0146975-$ | US- 0149099-$ | US- 0152452-$ | US- 0168178-$ | US- 0174590-$ | US- 0197936-$ | US- 0206248-$ | US- 0211042-$ | US- 0217207-$ | US- 0221460-$ | US- 0222756-$ | US- 0227217-$ | US- 0229671-$ | US- 0247421-$ | US- 0250377-$ | US- 0258784-$ | US- 0259301-$ | US- 0285443-$ | US- 0306437-$ | US- 0312051-$ | US- 0313703-$ | US- 0327630-$ | US- 0340318-$ | US- 0341031-$ | US- 0378070-$ | US- 0378071-$ | US- 0378072-$ | US- 15483374-$ | US- 2237860-$ | US- 2497935-$ | US- 2771734-$ | US- 20030174590-$ | US- 20040082414-$ | US- 20050075558-$ | US-					

		20060250377-$ | US- 20070013775-$ | US- 20070050054-$ | US- 20070211042-$ | US- 20070222756-$ | US- 20070229671-$ | US- 20070247421-$ | US- 20080130914-$ | US- 20090051649-$ | US- 20090073119-$ | US- 20090146975-$ | US- 20090152452-$ | US- 20090217207-$ | US- 20090285443-$ | US- 20090312051-$ | US- 20100033430-$ | US- 20100053468-$ | US- 20100081375-$ | US- 20100149099-$ | US- 20110090148-$ | US- 20120067711-$ | US- 20120068857-$ | US- 20120075082-$ | US- 20120112859-$ | US- 20120113044-$ | US- 20120206248-$ | US- 20130037396-$ | US- 20130087443-$ | US- 20140071050-$ | US- 20140071098-$ | US- 20140132516-$ | US- 20140197936-$ | US- 20140327630-$ | US- 20140340318-$ | US- 20150221460-$ | US- 20150227217-$ | US- 20150341031-$ | US- 20160054813-$ | US- 20160058375-$ | US- 20160061636-$ | US- 20160098016-$ | US- 20160168178-$ | US- 20160258784-$ | US- 20160259301-$ | US- 20160306437-$ | US- 20160313703-$ | US- 20160378070-$ | US- 20160378071-$ | US- 20160378072-$ | US- 20170003655-$ | US- 20170010751-$ | US- 20170069443-$ | US- 20170069444-$ | US- 20170069447-$ | US- 3040514-$ | US- 3056030-$ | US- 3130539-$ | US- 3495398-$ | US-					

		3621649-$ | US- 4007347-$ | US- 4031341-$ | US- 4037068-$ | US- 4077200-$ | US- 4133404-$ | US- 4170104-$ | US- 4258096-$ | US- 4287400-$ | US- 4289400-$ | US- 4311990-$ | US- 4324956-$ | US- 4345119-$ | US- 4364674-$ | US- 4379642-$ | US- 4417824-$ | US- 4581509-$ | US- 4600316-$ | US- 4617461-$ | US- 4641026-$ | US- 4670737-$ | US- 4783772-$ | US- 4884073-$ | US- 4922070-$ | US- 4931794-$ | US- 4952799-$ | US- 4980685-$ | US- 5034602-$ | US- 5214278-$ | US- 5258592-$ | US- 5288993-$ | US- 5347123-$ | US- 5383166-$ | US- 5471054-$ | US- 5572314-$ | US- 5583560-$ | US- 5726645-$ | US- 5748111-$ | US- 5841050-$ | US- 5847335-$ | US- 5867082-$ | US- 5943233-$ | US- 5953001-$ | US- 5963332-$ | US- 5423873-$ | US- 6069567-$ | US- 6134189-$ | US- 6154201-$ | US- 6175679-$ | US- 6246050-$ | US- 6252825-$ | US- 6304247-$ | US- 6355891-$ | US- 6422740-$ | US- 6477117-$ | US- 6525278-$ | US- 6556222-$ | US- 6646635-$).DID.					

L14	99	(US-6661438-$ | US-6672758-$ | US-6794992-$ | US-6809275-$ | US-6888076-$ | US-6909378-$ | US-6914551-$ | US-6961099-$ | US-6963039-$ | US-6985107-$ | US-6987568-$ | US-6998553-$ | US-7016263-$ | US-7081905-$ | US-7119289-$ | US-7135673-$ | US-7167083-$ | US-7244927-$ | US-7265336-$ | US-7274303-$ | US-7292741-$ | US-7358481-$ | US-7369308-$ | US-7404667-$ | US-7465917-$ | US-7520664-$ | US-7528824-$ | US-7545367-$ | US-7593755-$ | US-7605846-$ | US-7634263-$ | US-7646677-$ | US-7710456-$ | US-7761246-$ | US-7763819-$ | US-7772507-$ | US-7778115-$ | US-7781726-$ | US-7791597-$ | US-7856255-$ | US-7858583-$ | US-7865324-$ | US-8063892-$ | US-8138488-$ | US-8167126-$ | US-8169402-$ | US-8195313-$ | US-8248815-$ | US-8263886-$ | US-8263889-$ | US-8312495-$ | US-8368677-$ | US-8371745-$ | US-8373661-$ | US-8410971-$ | US-8432368-$ | US-8439559-$ | US-8441450-$ | US-	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/30 09:11 AM

		8446713-$ | US-8477118-$ | US-8493190-$ | US-8525777-$ | US-8568313-$ | US-8576044-$ | US-8593598-$ | US-8614881-$ | US-8666682-$ | US-8704787-$ | US-8711093-$ | US-8724087-$ | US-8730167-$ | US-8743088-$ | US-8824245-$ | US-8859971-$ | US-8860674-$ | US-8863219-$ | US-8878657-$ | US-8885856-$ | US-8895911-$ | US-8920022-$ | US-8922399-$ | US-8928452-$ | US-8994827-$ | US-9024733-$ | US-9041663-$ | US-9086738-$ | US-9105413-$ | US-9123483-$ | US-9176598-$ | US-9202372-$ | US-9213409-$ | US-9223296-$ | US-9277156-$ | US-9350850-$ | US-9449770-$ | US-9607505-$ | US-9620312-$ | US-9627163-$ | US-RE41637-$ | US-X6-$).DID.					
L15	7	(3355873|20110007468|20120177237).PN.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/30 09:12 AM
L16	0	rothkoph-fletcher-r.in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/30 09:23 AM
L17	253	((("Rothkopf") near3 ("Fletcher") near3 ("R"))).INV.	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2018/05/30 09:23 AM
L18	850	biosensor AND ((wrist NEAR watch) OR wristwatch)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/30 09:24 AM
L19	4	L17 AND L18	(US-PGPUB; USPAT; USOCR; FPRS; EPO;	OR	ON	ON	2018/05/30 09:24 AM

			JPO)				
L20	1954995	curve	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/30 09:29 AM
L21	244	L18 AND L20	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/30 09:29 AM
L22	8927	smartwatch	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/30 10:23 AM
L23	89438	biosensor	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/30 10:23 AM
L24	218	L22 AND L23	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/30 10:23 AM
L25	21	(US-20160350514-$ or US-20160274726-$ or US-20150313542-$ or US-20160367987-$ or US-20160198996-$ or US-20160091965-$).did. or (US-9848825-$ or US-9737221-$ or US-9737212-$ or US-9704154-$ or US-9629120-$ or US-9622214-$ or US-8738118-$ or US-8727977-$ or US-8630633-$ or US-8617069-$ or US-8527038-$ or US-7674231-$ or US-7474592-$ or US-6694158-$ or US-5722397-$).did.	(US-PGPUB; USPAT)	OR	ON	ON	2018/05/30 10:35 AM
L26	36	("20030176815" | "20050228297" | "20060252999" | "20070049461" | "20070167844" | "20080039731" | "20090216132" | "20100081951" | "20100106029" | "20100292589" | "20110003665" | "20110152637" | "20120244995" | "20130296723" | "20130338460" | "20140073969" | "20140107493" | "20140167973" | "20140249398" |	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2018/05/30 10:37 AM

		"20140257533" | "20140257534" | "20140257535" | "20140274159" | "20140278139" | "20140354527" | "20150374310" | "4830017" | "4893631" | "4987898" | "5243992" | "5617867" | "6371920" | "6443906" | "6475153" | "6723054" | "7539532").PN. OR ("9848825").URPN.					
L27	16	("20010008074" | "20040020856" | "20040152957" | "20070279852" | "20120293323" | "20130222271" | "20140207264" | "20140275852" | "20140378777" | "20150026647" | "20150371516" | "6619835" | "6736759" | "6832109" | "8988349" | "9288836").PN. OR ("9737212").URPN.	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2018/05/30 10:39 AM
L28	49	("20020055117" | "20030165954" | "20030175993" | "20060057707" | "20080022089" | "20080038738" | "20080266546" | "20130146659" | "20130231711" | "20130234850" | "20130346168" | "20140139422" | "20140139486" | "20140139637" | "20140143737" | "20140180595" | "20140239065" | "20140275850" | "20140275852" | "20140275854" | "20140276244" | "20140316305" | "20140366123" | "20150073907" | "20150186609" | "20150196200" | "20150238150" | "20150366518" |	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2018/05/30 10:41 AM

		"20150371215" | "20160036811" | "20160037346" | "20160125600" | "20160162873" | "20160239624" | "20160286210" | "20160328282" | "20160374588" | "20160379205" | "20170011210" | "20170011223" | "20170018150" | "20170031449" | "20170039358" | "20170071483" | "8784271" | "9100493" | "9299238").PN. OR ("9704154").URPN.					
L29	13	("20020167488" | "20040030753" | "20050195805" | "20050272408" | "20060036642" | "20110080289" | "20110234414" | "20120052922" | "20120218101" | "20130002441" | "20130325922" | "20150279168" | "8744113").PN. OR ("9622214").URPN.	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2018/05/30 10:55 AM
L30	17	("20030099459" | "4736196" | "5537102" | "5883576" | "5936530" | "6158884" | "6255951" | "6350055" | "6396403" | "6431455" | "7133843").PN. OR ("7474592").URPN.	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2018/05/30 10:57 AM
L31	45	(US-20160350514-$ or US-20160274726-$ or US-20150313542-$ or US-20160367987-$ or US-20160198996-$ or US-20160091965-$ or US-20140278139-$ or US-20140107493-$ or US-20110003665-$ or US-20150026647-$ or US-20140378777-$ or US-20140275852-$ or US-20170071483-$ or US-20170039358-$ or US-20170011210-$ or US-20160379205-$ or	(US-PGPUB; USPAT)	OR	ON	ON	2018/05/30 12:03 PM

		US-20150186609-$ or US-20140366123-$ or US-20140276244-$ or US-20140139486-$ or US-20130234850-$ or US-20030175993-$).did. or (US-9848825-$ or US-9737221-$ or US-9737212-$ or US-9704154-$ or US-9629120-$ or US-9622214-$ or US-8738118-$ or US-8727977-$ or US-8630633-$ or US-8617069-$ or US-8527038-$ or US-7674231-$ or US-7474592-$ or US-6694158-$ or US-5722397-$ or US-6443906-$ or US-9288836-$ or US-9423418-$ or US-9091715-$ or US-6431455-$ or US-6350055-$ or US-6255951-$ or US-6158884-$).did.					
L32	1	"15261912"	(US-PGPUB; USPAT)	OR	ON	ON	2018/05/30 12:09 PM
L33	33545	(smartwatch) OR (smart NEAR watch)	(US-PGPUB; USPAT)	OR	ON	ON	2018/05/30 12:28 PM
L34	223931	apple	(US-PGPUB; USPAT)	OR	ON	ON	2018/05/30 12:28 PM
L35	8043	L33 AND L34	(US-PGPUB; USPAT)	OR	ON	ON	2018/05/30 12:28 PM
L36	2386928	curve$4	(US-PGPUB; USPAT)	OR	ON	ON	2018/05/30 12:29 PM
L37	1219	L35 AND L36	(US-PGPUB; USPAT)	OR	ON	ON	2018/05/30 12:29 PM
L38	1756218	rectangular	(US-PGPUB; USPAT)	OR	ON	ON	2018/05/30 12:29 PM
L39	345	L37 AND L38	(US-PGPUB; USPAT)	OR	ON	ON	2018/05/30 12:29 PM
L40	18177	((("Apple") near3 ("Inc"))).AS,AANM.	(USPAT)	OR	ON	ON	2018/05/30 02:59 PM
L41	33545	(smartwatch) OR (smart NEAR watch)	(US-PGPUB; USPAT)	OR	ON	ON	2018/05/30 02:59 PM
L42	407	L40 AND L41	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/30 02:59 PM
L43	279935	crown	(US-PGPUB; USPAT; USOCR; FPRS; EPO;	OR	ON	ON	2018/05/30 03:02 PM

			JPO)				
L44	18	L42 AND L43	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/30 03:02 PM
L45	120000	(heart NEAR rate)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/30 03:03 PM
L46	39	L42 AND L45	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/30 03:03 PM
L47	482	"iwatch"	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/30 03:09 PM
L48	23	L40 AND L47	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/30 03:09 PM
L49	1	"15261912"	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/30 03:12 PM
L50	248238	(photosensor OR photodetector)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/30 03:21 PM
L51	16	L42 AND L50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/30 03:21 PM
L52	155606	sapphire	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/30 03:23 PM
L53	16	L42 AND L52	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/30 03:23 PM
L54	58538	(transparent NEAr cover)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/30 03:59 PM
L55	3	L42 AND L54	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/30 03:59 PM
L56	6820268	cover	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/30 04:00 PM
L57	81	L41 AND L54	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/30 04:00 PM
L58	42	("20030197648" | "20050156908" | "20060196849" | "20060273304" | "20080164578" | "20090104409" | "20090124062" | "20100231466" | "20110019123" | "20110072856" |	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2018/05/30 04:04 PM

		"20110223840" | "20120118228" | "20120135177" | "20120299841" | "20130002583" | "20130071601" | "20130140965" | "20130188366" | "20130236699" | "20140178647" | "20150085429" | "20150085432" | "20160058375" | "20160064800" | "20160378069" | "20160378070" | "20160378071" | "3740944" | "3911670" | "4561783" | "5369267" | "5545277" | "6206563" | "6406769" | "6677906" | "7712954" | "8596860" | "8721917" | "8824140" | "9271395" | "9288294" | "9369553").PN. OR ("9977464").URPN.					
L59	850	biosensor AND ((wrist NEAR watch) OR wristwatch)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/30 04:08 PM
L60	719	L AND L59	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2018/05/30 04:08 PM
L61	0	L40 AND L59	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2018/05/30 04:08 PM
L62	58057	((wrist NEAR watch) OR wristwatch)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/30 04:08 PM
L63	967	L40 AND L62	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/30 04:09 PM
L64	48	L45 AND L63	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/30 04:09 PM
L65	68	L52 AND L63	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/30 04:14 PM
L66	5183	L45 AND L62	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/30 04:17 PM
L67	221	L52 AND L66	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/30 04:18 PM
L68	72	(US-20160350514-$ or US-20160274726-$ or US-20150313542-$ or US-20160367987-$ or	(US-PGPUB; USPAT)	OR	ON	ON	2018/05/31 09:38 AM

		US-20160198996-$ or US-20160091965-$ or US-20140278139-$ or US-20140107493-$ or US-20110003665-$ or US-20150026647-$ or US-20140378777-$ or US-20140275852-$ or US-20170071483-$ or US-20170039358-$ or US-20170011210-$ or US-20160379205-$ or US-20150186609-$ or US-20140366123-$ or US-20140276244-$ or US-20140139486-$ or US-20130234850-$ or US-20030175993-$ or US-20160313703-$ or US-20160064804-$ or US-20160064800-$ or US-20150085429-$).did. or (US-20130236699-$ or US-20090124062-$).did. or (US-9848825-$ or US-9737221-$ or US-9737212-$ or US-9704154-$ or US-9629120-$ or US-9622214-$ or US-8738118-$ or US-8727977-$ or US-8630633-$ or US-8617069-$ or US-8527038-$ or US-7674231-$ or US-7474592-$ or US-6694158-$ or US-5722397-$ or US-6443906-$ or US-9288836-$ or US-9423418-$ or US-9091715-$ or US-6431455-$ or US-6350055-$ or US-6255951-$ or US-6158884-$ or US-9781984-$ or US-9575591-$ or US-D727198-$).did. or (US-D728624-$ or US-D737159-$ or US-D741726-$ or US-D752044-$ or US-D758219-$ or US-D758363-$ or US-9459781-$ or US-					

		D768634-$ or US-9507459-$ or US-9547425-$ or US-D790517-$ or US-9288294-$ or US-8596860-$ or US-9791833-$ or US-9591913-$ or US-9680205-$ or US-7654732-$ or US-7682070-$).did.					
L69	40	("20100193972" | "20110186324" | "20110210825" | "20110222248" | "20110241949" | "20120028679" | "20120133597" | "20120223865" | "20130044074" | "20130052947" | "20130078917" | "20130140965" | "20130229362" | "20130234910" | "20130300618" | "20130321216" | "20140080411" | "20140112511" | "20140132462" | "20140133074" | "20140170975" | "20140209691" | "20140213178" | "20140218250" | "20140226291" | "20140232609" | "20150035709" | "20150207913" | "20150311960" | "20150351292" | "5768217" | "6825751" | "7233291" | "7506436" | "7815820" | "8502739" | "8679393" | "8766858" | "8780581" | "8803745").PN. OR ("9680205").URPN.	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2018/05/31 09:53 AM
L70	3	(9242085|20080033504|9011355).pn.	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2018/05/31 09:54 AM
L71	37	("1313644" | "1692079" | "1817475" | "20040025984" | "20070125816" | "20080060224" | "20080086911" | "20120102691" |	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2018/05/31 11:05 AM

		"20140070042" | "20140094728" | "20150135410" | "20160255944" | "20160272458" | "20160345653" | "20160345661" | "3890801" | "4941236" | "5485848" | "6301754" | "6799887" | "7562640" | "7618384" | "7690220" | "7752774" | "8147417" | "8370998" | "8522456" | "8769844" | "9044372" | "9129503" | "9144273" | "9204690" | "9307804" | "9365387").PN. OR ("9781984").URPN.					
L72	4437806	(contour$4 OR round$4 OR curve$4)	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2018/05/31 12:08 PM
L73	58102	((wrist NEAR watch) OR wristwatch)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/31 12:08 PM
L74	15419	L72 AND L73	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2018/05/31 12:08 PM
L75	66	watchface	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2018/05/31 12:08 PM
L76	26	("2225474" | "3469391" | "4034552" | "4167850" | "4194355" | "4417821" | "4506992").PN. OR ("4903253").URPN.	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2018/05/31 12:12 PM
L77	69	("20100061191" | "3640065" | "4903253" | "5265009" | "5386933" | "6655831" | "6712501" | "6970157" | "7004469" | "7106197" | "7708457" | "8647268" | "8766805" | "9060683" | "9551608" | "D287471" | "D439172" | "D496589" | "D513195" | "D528018" | "D528439" | "D528928" | "D558227" | "D563434" | "D569389" | "D572266" | "D574735" | "D578922" | "D584170" | "D586823" | "D589375" | "D596610" | "D616417" | "D637094" | "D637918" | "D650706" | "D651216" | "D666503" | "D681483" |	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2018/05/31 12:12 PM

		"D699701" | "D712870" | "D728624" | "D737156" | "D737157" | "D737158" | "D737159" | "D741726" | "D744356" | "D745421" | "D746707" | "D746868" | "D747288" | "D751070" | "D752044" | "D756357" | "D756824" | "D757819" | "D758363" | "D759011" | "D759725" | "D765655" | "D766752" | "D771035" | "D771504" | "D777163" | "D782537" | "D784326" | "D790517").PN. OR ("D798905").URPN.					
L78	0	akana-joan.in.	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2018/05/31 12:19 PM
L79	717	akana-jody.in.	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2018/05/31 12:19 PM
L80	406132	((wrist NEAR watch) OR wristwatch OR watch)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/31 12:26 PM
L81	18177	((("Apple") near3 ("Inc"))).AS,AANM.	(USPAT)	OR	ON	ON	2018/05/31 12:26 PM
L82	2430	L81 AND L80	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/31 12:26 PM
L83	124655	rectangular AND orthogonal AND (contour$4 OR round$4 OR curve$4 OR curvature)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/31 12:27 PM
L84	71	L82 AND L83	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/31 12:27 PM
L85	76	(US-20160350514-$ or US-20160274726-$ or US-20150313542-$ or US-20160367987-$ or US-20160198996-$ or US-20160091965-$ or US-20140278139-$ or US-20140107493-$ or US-20110003665-$ or US-20150026647-$ or US-20140378777-$ or US-20140275852-$ or US-20170071483-$ or US-20170039358-$ or	(US-PGPUB; USPAT)	OR	ON	ON	2018/05/31 12:42 PM

		US-20170011210-$ or US-20160379205-$ or US-20150186609-$ or US-20140366123-$ or US-20140276244-$ or US-20140139486-$ or US-20130234850-$ or US-20030175993-$ or US-20160313703-$ or US-20160064804-$ or US-20160064800-$ or US-20150085429-$).did. or (US-20130236699-$ or US-20090124062-$).did. or (US-9848825-$ or US-9737221-$ or US-9737212-$ or US-9704154-$ or US-9629120-$ or US-9622214-$ or US-8738118-$ or US-8727977-$ or US-8630633-$ or US-8617069-$ or US-8527038-$ or US-7674231-$ or US-7474592-$ or US-6694158-$ or US-5722397-$ or US-6443906-$ or US-9288836-$ or US-9423418-$ or US-9091715-$ or US-6431455-$ or US-6350055-$ or US-6255951-$ or US-6158884-$ or US-9781984-$ or US-9575591-$ or US-D727198-$).did. or (US-D728624-$ or US-D737159-$ or US-D741726-$ or US-D752044-$ or US-D758219-$ or US-D758363-$ or US-9459781-$ or US-D768634-$ or US-9507459-$ or US-9547425-$ or US-D790517-$ or US-9288294-$ or US-8596860-$ or US-9791833-$ or US-9591913-$ or US-9680205-$ or US-7654732-$ or US-					

		7682070-$ or US-4903253-$ or US-8766805-$ or US-D578922-$ or US-D647107-$).did.					
L86	78	ely-colin-m.in.	(US-PGPUB; USPAT)	OR	ON	ON	2018/05/31 12:43 PM
L87	52	de-jong-erik-g.in.	(US-PGPUB; USPAT)	OR	ON	ON	2018/05/31 12:46 PM
L88	75	memering-dale-n.in..in.	(US-PGPUB; USPAT)	OR	ON	ON	2018/05/31 12:48 PM
L89	75	memering-dale-n.in.	(US-PGPUB; USPAT)	OR	ON	ON	2018/05/31 12:48 PM
L90	4	mylvaganam-jeffrey-c.in.	(US-PGPUB; USPAT)	OR	ON	ON	2018/05/31 12:51 PM
L91	3	("20120169465"|"20120245439"|"20130231574").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2018/05/31 01:00 PM
L92	1	"20150186609".pn.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/31 01:54 PM
L93	908170	convex	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/31 02:15 PM
L94	9	L85 AND L93	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/31 02:15 PM
L95	1304822	mask	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/31 02:18 PM
L96	14	L85 AND L95	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/05/31 02:19 PM
L97	8	(20150186609|20140275852|20140107493|20130236694903253).pn.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/06/01 08:01 AM
L98	3	"14145856"	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/06/01 09:52 AM
L99	1	"14073550"	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/06/01 09:55 AM
L100	17	("20110121449"|"20130072765"|"20140121471"|"20140334083"|"20150065840"|"3515798"|"6500367"|"8591411").PN.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/06/01 09:58 AM
L101	77	(US-20160350514-$ or US-20160274726-$ or US-20150313542-$ or US-20160367987-$ or	(US-PGPUB; USPAT)	OR	ON	ON	2018/06/01 02:39 PM

		US-20160198996-$ or US-20160091965-$ or US-20140278139-$ or US-20140107493-$ or US-20110003665-$ or US-20150026647-$ or US-20140378777-$ or US-20140275852-$ or US-20170071483-$ or US-20170039358-$ or US-20170011210-$ or US-20160379205-$ or US-20150186609-$ or US-20140366123-$ or US-20140276244-$ or US-20140139486-$ or US-20130234850-$ or US-20030175993-$ or US-20160313703-$ or US-20160064804-$ or US-20160064800-$ or US-20150085429-$).did. or (US-20130236699-$ or US-20090124062-$ or US-20150124415-$).did. or (US-9848825-$ or US-9737221-$ or US-9737212-$ or US-9704154-$ or US-9629120-$ or US-9622214-$ or US-8738118-$ or US-8727977-$ or US-8630633-$ or US-8617069-$ or US-8527038-$ or US-7674231-$ or US-7474592-$ or US-6694158-$ or US-5722397-$ or US-6443906-$ or US-9288836-$ or US-9423418-$ or US-9091715-$ or US-6431455-$ or US-6350055-$ or US-6255951-$ or US-6158884-$ or US-9781984-$ or US-9575591-$ or US-D727198-$).did. or (US-D728624-$ or US-D737159-$ or US-D741726-$ or US-D752044-$ or US-D758219-$ or US-D758363-$ or US-					

		9459781-$ or US-D768634-$ or US-9507459-$ or US-9547425-$ or US-D790517-$ or US-9288294-$ or US-8596860-$ or US-9791833-$ or US-9591913-$ or US-9680205-$ or US-7654732-$ or US-7682070-$ or US-4903253-$ or US-8766805-$ or US-D578922-$ or US-D647107-$).did.					
L102	280007	crown	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/06/01 02:39 PM
L103	6	L101 AND L102	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/06/01 02:39 PM
L104	740594	acoustic	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/06/01 02:40 PM
L105	21	L101 AND L104	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/06/01 02:40 PM
L106	2738169	gasket OR seal	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/06/01 02:42 PM
L107	0	L101 AND LL6	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/06/01 02:42 PM
L108	16	L101 AND L106	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/06/01 02:42 PM
L109	1304822	mask	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/06/01 03:06 PM
L110	14	L101 AND L109	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/06/01 03:06 PM
L111	33714	(smartwatch) OR (smart NEAR watch)	(US-PGPUB; USPAT)	OR	ON	ON	2018/06/01 04:33 PM
L112	2738169	gasket OR seal	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/06/01 04:33 PM
L113	2278	L111 AND L112	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/06/01 04:33 PM
L114	180804	ledge	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/06/01 04:33 PM

L115	73	L113 AND L114	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/06/01 04:34 PM
L116	77	(US-20160350514-$ or US-20160274726-$ or US-20150313542-$ or US-20160367987-$ or US-20160198996-$ or US-20160091965-$ or US-20140278139-$ or US-20140107493-$ or US-20110003665-$ or US-20150026647-$ or US-20140378777-$ or US-20140275852-$ or US-20170071483-$ or US-20170039358-$ or US-20170011210-$ or US-20160379205-$ or US-20150186609-$ or US-20140366123-$ or US-20140276244-$ or US-20140139486-$ or US-20130234850-$ or US-20030175993-$ or US-20160313703-$ or US-20160064804-$ or US-20160064800-$ or US-20150085429-$).did. or (US-20130236699-$ or US-20090124062-$ or US-20150124415-$).did. or (US-9848825-$ or US-9737221-$ or US-9737212-$ or US-9704154-$ or US-9629120-$ or US-9622214-$ or US-8738118-$ or US-8727977-$ or US-8630633-$ or US-8617069-$ or US-8527038-$ or US-7674231-$ or US-7474592-$ or US-6694158-$ or US-5722397-$ or US-6443906-$ or US-9288836-$ or US-9423418-$ or US-9091715-$ or US-6431455-$ or US-6350055-$ or US-6255951-$ or US-6158884-$ or US-9781984-$ or US-9575591-$ or US-	(US-PGPUB; USPAT)	OR	ON	ON	2018/06/01 04:36 PM

		D727198-$).did. or (US-D728624-$ or US-D737159-$ or US-D741726-$ or US-D752044-$ or US-D758219-$ or US-D758363-$ or US-9459781-$ or US-D768634-$ or US-9507459-$ or US-9547425-$ or US-D790517-$ or US-9288294-$ or US-8596860-$ or US-9791833-$ or US-9591913-$ or US-9680205-$ or US-7654732-$ or US-7682070-$ or US-4903253-$ or US-8766805-$ or US-D578922-$ or US-D647107-$).did.					
L117	461759	gasket	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/06/01 04:36 PM
L118	5	L116 AND L117	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/06/01 04:36 PM
L119	6	(15261914|15261917|15627321|15870718|15879223|14842617)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/06/04 04:46 PM
L120	77	(US-20160350514-$ or US-20160274726-$ or US-20150313542-$ or US-20160367987-$ or US-20160198996-$ or US-20160091965-$ or US-20140278139-$ or US-20140107493-$ or US-20110003665-$ or US-20150026647-$ or US-20140378777-$ or US-20140275852-$ or US-20170071483-$ or US-20170039358-$ or US-20170011210-$ or US-20160379205-$ or US-20150186609-$ or US-20140366123-$ or US-20140276244-$ or US-20140139486-$ or US-20130234850-$ or US-20030175993-$ or US-20160313703-$ or US-20160064804-$ or US-20160064800-$ or	(US-PGPUB; USPAT)	OR	ON	ON	2018/06/04 06:22 PM

		US-20150085429-$).did. or (US-20130236699-$ or US-20090124062-$ or US-20150124415-$).did. or (US-9848825-$ or US-9737221-$ or US-9737212-$ or US-9704154-$ or US-9629120-$ or US-9622214-$ or US-8738118-$ or US-8727977-$ or US-8630633-$ or US-8617069-$ or US-8527038-$ or US-7674231-$ or US-7474592-$ or US-6694158-$ or US-5722397-$ or US-6443906-$ or US-9288836-$ or US-9423418-$ or US-9091715-$ or US-6431455-$ or US-6350055-$ or US-6255951-$ or US-6158884-$ or US-9781984-$ or US-9575591-$ or US-D727198-$).did. or (US-D728624-$ or US-D737159-$ or US-D741726-$ or US-D752044-$ or US-D758219-$ or US-D758363-$ or US-9459781-$ or US-D768634-$ or US-9507459-$ or US-9547425-$ or US-D790517-$ or US-9288294-$ or US-8596860-$ or US-9791833-$ or US-9591913-$ or US-9680205-$ or US-7654732-$ or US-7682070-$ or US-4903253-$ or US-8766805-$ or US-D578922-$ or US-D647107-$).did.					
L121	132091	sapphire	(US-PGPUB; USPAT)	OR	ON	ON	2018/06/04 07:38 PM
L122	9	L120 AND L121	(US-PGPUB; USPAT)	OR	ON	ON	2018/06/04 07:39 PM

L123	77	(US-20160350514-$ or US-20160274726-$ or US-20150313542-$ or US-20160367987-$ or US-20160198996-$ or US-20160091965-$ or US-20140278139-$ or US-20140107493-$ or US-20110003665-$ or US-20150026647-$ or US-20140378777-$ or US-20140275852-$ or US-20170071483-$ or US-20170039358-$ or US-20170011210-$ or US-20160379205-$ or US-20150186609-$ or US-20140366123-$ or US-20140276244-$ or US-20140139486-$ or US-20130234850-$ or US-20030175993-$ or US-20160313703-$ or US-20160064804-$ or US-20160064800-$ or US-20150085429-$).did. or (US-20130236699-$ or US-20090124062-$ or US-20150124415-$).did. or (US-9848825-$ or US-9737221-$ or US-9737212-$ or US-9704154-$ or US-9629120-$ or US-9622214-$ or US-8738118-$ or US-8727977-$ or US-8630633-$ or US-8617069-$ or US-8527038-$ or US-7674231-$ or US-7474592-$ or US-6694158-$ or US-5722397-$ or US-6443906-$ or US-9288836-$ or US-9423418-$ or US-9091715-$ or US-6431455-$ or US-6350055-$ or US-6255951-$ or US-6158884-$ or US-9781984-$ or US-9575591-$ or US-D727198-$).did. or (US-D728624-$ or US-D737159-$ or US-	(US-PGPUB; USPAT)	OR	ON	ON	2018/06/07 03:23 PM

		D741726-$ or US-D752044-$ or US-D758219-$ or US-D758363-$ or US-9459781-$ or US-D768634-$ or US-9507459-$ or US-9547425-$ or US-D790517-$ or US-9288294-$ or US-8596860-$ or US-9791833-$ or US-9591913-$ or US-9680205-$ or US-7654732-$ or US-7682070-$ or US-4903253-$ or US-8766805-$ or US-D578922-$ or US-D647107-$).did.					
L124	77772	crown AND (rotary OR rotation)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/06/07 03:23 PM
L125	5	L123 AND L124	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/06/07 03:24 PM
L126	33999	(smartwatch) OR (smart NEAR watch)	(US-PGPUB; USPAT)	OR	ON	ON	2018/06/07 03:24 PM
L127	162	L126 AND L124	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/06/07 03:24 PM
L128	406910	(watch OR wristwatch OR (wrist NEAR watch))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/06/07 03:32 PM
L129	3396	L124 AND L128	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/06/07 03:32 PM
L130	2	"20150124415".pn.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/06/07 03:36 PM
L131	1	"15261912"	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/06/07 03:52 PM
L132	14	(speaker SAME (recess OR aperture) SAME fluid SAME (intrusion OR ingress))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/06/07 04:03 PM
L133	299	(waterproof NEAR port)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/06/07 04:04 PM
L134	0	L126 AND L133	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/06/07 04:04 PM
L135	25	L128 AND L133	(US-PGPUB; USPAT;	OR	ON	ON	2018/06/07

			USOCR; FPRS; EPO; JPO)				04:04 PM
L136	319	(waterproof SAME (audio OR acoustic) SAME port)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/06/07 04:09 PM
L137	8	L126 AND L136	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/06/07 04:09 PM
L138	56	L128 AND L136	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/06/07 04:09 PM
L139	81	(US-20160350514-$ or US-20160274726-$ or US-20150313542-$ or US-20160367987-$ or US-20160198996-$ or US-20160091965-$ or US-20140278139-$ or US-20140107493-$ or US-20110003665-$ or US-20150026647-$ or US-20140378777-$ or US-20140275852-$ or US-20170071483-$ or US-20170039358-$ or US-20170011210-$ or US-20160379205-$ or US-20150186609-$ or US-20140366123-$ or US-20140276244-$ or US-20140139486-$ or US-20130234850-$ or US-20030175993-$ or US-20160313703-$ or US-20160064804-$ or US-20160064800-$ or US-20150085429-$).did. or (US-20130236699-$ or US-20090124062-$ or US-20150124415-$).did. or (US-9848825-$ or US-9737221-$ or US-9737212-$ or US-9704154-$ or US-9629120-$ or US-9622214-$ or US-8738118-$ or US-8727977-$ or US-8630633-$ or US-8617069-$ or US-8527038-$ or US-7674231-$ or US-7474592-$ or US-6694158-$ or US-5722397-$ or US-6443906-$ or US-	(US-PGPUB; USPAT)	OR	ON	ON	2018/06/07 04:49 PM

		9288836-$ or US-9423418-$ or US-9091715-$ or US-6431455-$ or US-6350055-$ or US-6255951-$ or US-6158884-$ or US-9781984-$ or US-9575591-$ or US-D727198-$).did. or (US-D728624-$ or US-D737159-$ or US-D741726-$ or US-D752044-$ or US-D758219-$ or US-D758363-$ or US-9459781-$ or US-D768634-$ or US-9507459-$ or US-9547425-$ or US-D790517-$ or US-9288294-$ or US-8596860-$ or US-9791833-$ or US-9591913-$ or US-9680205-$ or US-7654732-$ or US-7682070-$ or US-4903253-$ or US-8766805-$ or US-D578922-$ or US-D647107-$ or US-3577876-$ or US-9300344-$ or US-9615476-$ or US-9625944-$).did.					
L140	1	"8229535".pn.	(US-PGPUB; USPAT)	OR	ON	ON	2018/06/07 04:50 PM
L141	39	("0012016"|"0012017"|"0022016"|"0032012"|"0032017"|"0042018"|"0052010"|"0052011"|"0052015"|"0052018"|"0062008"|"0062010"|"0062017"|"0072015"|"0072016"|"0082013"|"0082015"|"0082016"|"0092016"|"0102017"|"0112014"|"0112016"|"0122005"|"20040264301"|"20110242064"|"20130261405"|"20150098309"|"20160018846"|"20160320583"|"20170011210"|"20170031449"|"20170139489"|"20170216668"|"20170238138"|"20170251561	(US-PGPUB; USPAT)	OR	ON	ON	2018/12/11 05:21 PM

		"|"20170301314"|"2018 0136613"|"2018013668 6"|"4396298").PN.					
L142	1267679	(translation$4)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/12/11 05:22 PM
L143	4	L141 AND L142	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/12/11 05:24 PM
L144	10	("0062016"|"10001817"| "20130191220"|"20160 147432"|"20160170598 "|"20160170608"|"6396 006"|"8294670"|"95520 23"|"9659482").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2018/12/11 05:28 PM
L145	2	("20110158057"|"91410 87").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2018/12/11 05:28 PM
L146	4	("20180239306"|"20180 246469"|"20180299834 "|"9971405").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2018/12/11 05:28 PM
L147	5	("20040047244"|"20150 366098"|"20180307363 "|"5960366"|"9520100"). PN.	(US-PGPUB; USPAT)	OR	ON	ON	2018/12/11 05:29 PM
L148	22	(US-2288215-$ | US-2788236-$ | US-2797592-$ | US-3410247-$ | US-4311026-$ | US-4766642-$ | US-5509174-$ | US-6502982-$ | US-6834430-$ | US-7111365-$ | US-7285738-$ | US-7371745-$ | US-7591582-$ | US-8607662-$ | US-8783944-$ | US-8905631-$ | US-9052696-$ | US-9244438-$).DID.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/12/11 06:07 PM
L149	2	L142 AND L148	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/12/11 06:07 PM
L150	4	"15178089"	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/12/11 06:18 PM
L151	22	(US-2288215-$ | US-2788236-$ | US-2797592-$ | US-3410247-$ | US-4311026-$ | US-4766642-$ | US-5509174-$ | US-	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/12/12 07:10 AM

		6502982-$ | US-6834430-$ | US-7111365-$ | US-7285738-$ | US-7371745-$ | US-7591582-$ | US-8607662-$ | US-8783944-$ | US-8905631-$ | US-9052696-$ | US-9244438-$).DID.					
L152	25	(US-4396298-$ | US-6977868-$ | US-7385874-$ | US-7708457-$ | US-7732724-$ | US-7946758-$ | US-8143981-$ | US-8508511-$ | US-9028134-$ | US-9086717-$ | US-9101184-$ | US-9241635-$ | US-9256209-$ | US-9386932-$ | US-9426275-$ | US-9437357-$ | US-9501044-$ | US-9532723-$ | US-9545541-$ | US-9599964-$ | US-9680831-$ | US-9946297-$ | US-9971305-$ | US-D717679-$ | US-D800172-$).DID.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/12/12 07:19 AM
L155	13	(9836025|9709956|9620312).pn.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/12/12 09:13 AM
L156	4	"14842617"	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/12/12 09:14 AM
L157	49919	crown SAME ((rotary OR rotation OR rotat$4) OR (translat$4 OR translatable))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/12/12 09:20 AM
L158	3	L155 AND L157	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/12/12 09:20 AM
L159	15	"14455375"	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/12/12 09:22 AM
L160	1	"15261914"	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2018/12/12 09:30 AM

L161	1	"8954135".pn.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2019/01/08 09:51 AM
L162	12	(US-10092203-$ | US-5999168-$ | US-6241684-$ | US-6361502-$ | US-6982930-$ | US-7113450-$ | US-7468036-$ | US-7791588-$ | US-9039614-$ | US-9042971-$ | US-9898032-$ | US-9979426-$).DID.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2019/02/15 09:35 AM
L163	2846978	wireless	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2019/02/15 09:38 AM
L164	9	L162 AND L163	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2019/02/15 09:38 AM
L165	25	(US-0049059-$ | US-0196517-$ | US-0235491-$ | US-0270358-$ | US-0320346-$ | US-0338642-$ | US-0368442-$ | US-0375579-$ | US-20110270358-$ | US-20140368442-$ | US-20140375579-$ | US-20150049059-$ | US-20150320346-$ | US-20150338642-$ | US-20160338642-$ | US-20180196517-$ | US-20180235491-$).DID.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2019/02/15 09:44 AM
L166	3	(US-3362154-$ | US-9001625-$).DID.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2019/02/15 09:45 AM
L167	21	(US-0017846-$ | US-0027461-$ | US-0073486-$ | US-0329368-$ | US-0335891-$ | US-0341342-$ | US-0364815-$ | US-20140073486-$ | US-20170027461-$ | US-20180329368-$ | US-20180335891-$ | US-20180341342-$ | US-20180364815-$ | US-20190017846-$).DID.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2019/02/15 09:46 AM
L168	88408	haptic	(US-PGPUB; USPAT;	OR	ON	ON	2019/02/15

			USOCR; FPRS; EPO; JPO)				09:55 AM
L169	5	L165 AND L168	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2019/02/15 09:55 AM
L170	0	L166 AND L168	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2019/02/15 09:56 AM
L171	6	L162 AND L168	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2019/02/15 09:56 AM
L172	9	(7822469|8908477|20170216519).pn.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2019/05/06 10:15 AM
L173	9	(10209148|10114342|8677285|20130235704|20160241688).pn.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2019/05/23 10:39 AM
L174	993	haptic AND crown	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2019/05/23 10:40 AM
L175	0	L173 AND L174	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2019/05/23 10:40 AM
L176	81	(US-20160350514-$ or US-20160274726-$ or US-20150313542-$ or US-20160367987-$ or US-20160198996-$ or US-20160091965-$ or US-20140278139-$ or US-20140107493-$ or US-20110003665-$ or US-20150026647-$ or US-20140378777-$ or US-20140275852-$ or US-20170071483-$ or US-20170039358-$ or US-20170011210-$ or US-20160379205-$ or US-20150186609-$ or US-20140366123-$ or US-20140276244-$ or US-20140139486-$ or US-20130234850-$ or US-20030175993-$ or US-20160313703-$ or US-20160064804-$ or US-20160064800-$ or US-20150085429-$).did. or (US-20130236699-$ or US-20090124062-$ or US-20150124415-$).did. or (US-9848825-$ or US-9737221-$ or US-	(US-PGPUB; USPAT)	OR	ON	ON	2019/05/23 10:49 AM

		9737212-$ or US-9704154-$ or US-9629120-$ or US-9622214-$ or US-8738118-$ or US-8727977-$ or US-8630633-$ or US-8617069-$ or US-8527038-$ or US-7674231-$ or US-7474592-$ or US-6694158-$ or US-5722397-$ or US-6443906-$ or US-9288836-$ or US-9423418-$ or US-9091715-$ or US-6431455-$ or US-6350055-$ or US-6255951-$ or US-6158884-$ or US-9781984-$ or US-9575591-$ or US-D727198-$).did. or (US-D728624-$ or US-D737159-$ or US-D741726-$ or US-D752044-$ or US-D758219-$ or US-D758363-$ or US-9459781-$ or US-D768634-$ or US-9507459-$ or US-9547425-$ or US-D790517-$ or US-9288294-$ or US-8596860-$ or US-9791833-$ or US-9591913-$ or US-9680205-$ or US-7654732-$ or US-7682070-$ or US-4903253-$ or US-8766805-$ or US-D578922-$ or US-D647107-$ or US-3577876-$ or US-9300344-$ or US-9615476-$ or US-9625944-$).did.					
L177	18	L176 AND Haptic	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2019/05/23 10:50 AM
L178	2	("7021442"|"7894957").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2019/07/29 08:05 AM
L179	2	("7021442"|"7894957").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2019/07/29 08:11 AM

L180	2	("7021442"|"7894957").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2019/07/29 08:11 AM
L181	25	(3733803|4520306|6377239|6882596|6967903|7286063|7655874|8975543|9836025|10331082|20080088417|20170090599|20190163324).pn.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2019/07/29 08:13 AM
L182	3	"9627163".pn.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2019/07/29 08:20 AM
L183	3	"9627163".pn.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2019/08/13 07:07 PM
L184	15	("10331082"|"20050088417"|"20170090599"|"20190163324"|"3733803"|"4520306"|"6377239"|"6882596"|"6967903"|"7021442"|"7286063"|"7655874"|"7894957"|"8975543"|"9836025").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2019/08/13 08:09 PM
L185	5	(7021442|7894957).pn.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2019/08/13 08:11 PM
L186	4	("20190250754"|"20190294117"|"20190302902"|"5177355").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2019/11/24 05:25 PM
L187	3	(5477508|8275327).pn.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2020/02/28 01:14 PM
L188	4	(10613485|10620591|10627783|10599101).pn.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2020/05/01 01:23 PM
L189	83	(US-20160350514-$ or US-20160274726-$ or US-20150313542-$ or US-20160367987-$ or US-20160198996-$ or US-20160091965-$ or US-20140278139-$ or US-20140107493-$ or US-20110003665-$ or US-20150026647-$ or US-20140378777-$ or US-20140275852-$ or US-20170071483-$ or US-20170039358-$ or US-20170011210-$ or US-20160379205-$ or US-20150186609-$ or US-20140366123-$ or US-20140276244-$ or US-20140139486-$ or	(US-PGPUB; USPAT)	OR	ON	ON	2020/05/01 01:38 PM

		US-20130234850-$ or US-20030175993-$ or US-20160313703-$ or US-20160064804-$ or US-20160064800-$ or US-20150085429-$).did. or (US-20130236699-$ or US-20090124062-$ or US-20150124415-$).did. or (US-9848825-$ or US-9737221-$ or US-9737212-$ or US-9704154-$ or US-9629120-$ or US-9622214-$ or US-8738118-$ or US-8727977-$ or US-8630633-$ or US-8617069-$ or US-8527038-$ or US-7674231-$ or US-7474592-$ or US-6694158-$ or US-5722397-$ or US-6443906-$ or US-9288836-$ or US-9423418-$ or US-9091715-$ or US-6431455-$ or US-6350055-$ or US-6255951-$ or US-6158884-$ or US-9781984-$ or US-9575591-$ or US-D727198-$).did. or (US-D728624-$ or US-D737159-$ or US-D741726-$ or US-D752044-$ or US-D758219-$ or US-D758363-$ or US-9459781-$ or US-D768634-$ or US-9507459-$ or US-9547425-$ or US-D790517-$ or US-9288294-$ or US-8596860-$ or US-9791833-$ or US-9591913-$ or US-9680205-$ or US-7654732-$ or US-7682070-$ or US-4903253-$ or US-8766805-$ or US-D578922-$ or US-D647107-$ or US-					

		3577876-$ or US-9300344-$ or US-9615476-$ or US-9625944-$ or US-9627163-$).did. or (US-7286063-$).did.					
L190	278	("10001817"|"10018966"|"10019097"|"10037006"|"10048802"|"10061399"|"10092203"|"10114342"|"10145711"|"10175652"|"10209148"|"10216147"|"10222756"|"10222909"|"10234828"|"10296125"|"10331081"|"10331082"|"10379629"|"10509486"|"2237860"|"2288215"|"2497935"|"2771734"|"2788236"|"2797592"|"3040514"|"3056030"|"3130539"|"3355873"|"3362154"|"3410247"|"3495398"|"3577876"|"3621649"|"3662618"|"3733803"|"4007347"|"4031341"|"4037068"|"4077200"|"4133404"|"4170104"|"4258096"|"4287400"|"4289400"|"4311026"|"4311990"|"4324956"|"4345119"|"4364674"|"4379642"|"4395134"|"4396298"|"4417824"|"4520306"|"4581509"|"4600316"|"4617461"|"4634861"|"4641026"|"4670737"|"4766642"|"4783772"|"4884073"|"4914831"|"4922070"|"4931794"|"4952799"|"4980685"|"4987299"|"5034602"|"5177355"|"5214278"|"5258592"|"5288993"|"5347123"|"5383166"|"5471054"|"5477508"|"5509174"|"5572314"|"5583560"|"5631881"|"5726645"|"5748111"|"5825353"|"5841050"|"5847335"|"5867082"|"5943233"|"5953001"|"5960366"|"5963332"|"5999168"|"6069567"|"6134189"|"6154201"|"6175679"|"6241684"|"6246050"|"6252825"|"6304247"|"6355891"|"6361502"|"6377239"|"6392640"|"6396006"|"6	(US-PGPUB; USPAT)	OR	ON	ON	2020/05/01 02:00 PM

		422740"|"6477117"|"65 02982"|"6525278"|"655 6222"|"6575618"|"6587 400"|"6646635"|"66614 38"|"6672758"|"679499 2"|"6809275"|"6834430" |"6846998"|"6882596"|" 6888076"|"6896403"|"6 909378"|"6914551"|"69 61099"|"6963039"|"696 7903"|"6977868"|"6982 930"|"6985107"|"69875 68"|"6998553"|"701626 3"|"7021442"|"7034237" |"7081905"|"7102626"|" 7111365"|"7113450"|"7 119289"|"7135673"|"71 67083"|"7244927"|"725 5473"|"7265336"|"7274 303"|"7285738"|"72860 63"|"7292741"|"735848 1"|"7369308"|"7371745" |"7385874"|"7404667"|" 7465917"|"7468036"|"7 506269"|"7520664"|"75 28824"|"7545367"|"759 1582"|"7593755"|"7605 846"|"7634263"|"76466 77"|"7655874"|"768207 0"|"7708457"|"7710456" |"7732724"|"7761246"|" 7763819"|"7772507"|"7 778115"|"7781726"|"77 91588"|"7791597"|"782 2469"|"7856255"|"7858 583"|"7865324"|"78949 57"|"7946758"|"806389 2"|"8138488"|"8143981" |"8167126"|"8169402"|" 8188989"|"8195313"|"8 229535"|"8248815"|"82 63886"|"8263889"|"827 5327"|"8294670"|"8312 495"|"8368677"|"83717 45"|"8373661"|"841097 1"|"8432368"|"8439559" |"8441450"|"8446713"|" 8456430"|"8477118"|"8 493190"|"8508511"|"85 25777"|"8562489"|"856 8313"|"8576044"|"8593 598"|"8607662"|"86148 81"|"8666682"|"867728 5"|"8704787"|"8711093" |"8724087"|"8730167"|" 8743088"|"8783944"|"8 804993"|"8816962"|"88 24245"|"8847741"|"885					

		9971"|"8860674"|"8863219"|"8878657"|"8885856"|"8895911"|"8905631"|"8908477"|"8920022"|"8922399"|"8928452"|"8954135"|"8975543"|"8994827"|"9001625"|"9024733"|"9028134"|"9030446"|"9034666"|"9039614"|"9041663"|"9042971"|"9052696"|"9086717"|"9086738"|"9101184"|"9105413"|"9123483"|"9141087"|"9176577"|"9176598"|"9202372"|"9213409"|"9223296"|"9241635"|"9244438"|"9256209"|"9277156"|"9350850"|"9386932"|"9426275"|"9430042"|"9437357"|"9449770"|"9501044"|"9520100"|"9532723").PN.					
L191	33	("9542016"|"9545541"|"9552023"|"9599964"|"9607505"|"9620312"|"9627163"|"9632318"|"9638587"|"9651922"|"9659482"|"9680831"|"9709956"|"9753436"|"9800717"|"9836025"|"9873711"|"9874945"|"9886006"|"9891590"|"9891651"|"9898032"|"9927902"|"9939923"|"9946297"|"9952558"|"9952682"|"9971305"|"9971405"|"9979426"|"D717679"|"D800172"|"RE41637").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2020/05/01 02:00 PM
L192	4	(20150186609|20140107493|D647107|7474592).pn.	(US-PGPUB; USPAT)	OR	ON	ON	2020/05/01 02:11 PM
L193	18	("20030099459" | "4736196" | "5537102" | "5883576" | "5936530" | "6158884" | "6255951" | "6350055" | "6396403" | "6431455" | "7133843").PN. OR ("7474592").URPN.	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2020/05/01 02:37 PM
L194	83	(US-20160350514-$ or US-20160274726-$ or US-20150313542-$ or US-20160367987-$ or US-20160198996-$ or US-20160091965-$ or US-20140278139-$ or	(US-PGPUB; USPAT)	OR	ON	ON	2020/05/06 04:20 PM

		US-20140107493-$ or US-20110003665-$ or US-20150026647-$ or US-20140378777-$ or US-20140275852-$ or US-20170071483-$ or US-20170039358-$ or US-20170011210-$ or US-20160379205-$ or US-20150186609-$ or US-20140366123-$ or US-20140276244-$ or US-20140139486-$ or US-20130234850-$ or US-20030175993-$ or US-20160313703-$ or US-20160064804-$ or US-20160064800-$ or US-20150085429-$).did. or (US-20130236699-$ or US-20090124062-$ or US-20150124415-$).did. or (US-9848825-$ or US-9737221-$ or US-9737212-$ or US-9704154-$ or US-9629120-$ or US-9622214-$ or US-8738118-$ or US-8727977-$ or US-8630633-$ or US-8617069-$ or US-8527038-$ or US-7674231-$ or US-7474592-$ or US-6694158-$ or US-5722397-$ or US-6443906-$ or US-9288836-$ or US-9423418-$ or US-9091715-$ or US-6431455-$ or US-6350055-$ or US-6255951-$ or US-6158884-$ or US-9781984-$ or US-9575591-$ or US-D727198-$).did. or (US-D728624-$ or US-D737159-$ or US-D741726-$ or US-D752044-$ or US-D758219-$ or US-D758363-$ or US-9459781-$ or US-D768634-$ or US-9507459-$ or US-					

		9547425-$ or US-D790517-$ or US-9288294-$ or US-8596860-$ or US-9791833-$ or US-9591913-$ or US-9680205-$ or US-7654732-$ or US-7682070-$ or US-4903253-$ or US-8766805-$ or US-D578922-$ or US-D647107-$ or US-3577876-$ or US-9300344-$ or US-9615476-$ or US-9625944-$ or US-9627163-$).did. or (US-7286063-$).did.					
L195	112037	("ECG" OR "EKG" OR electrocardiogra$4)	(US-PGPUB; USPAT)	OR	ON	ON	2020/05/06 04:43 PM
L196	23	L194 AND L195	(US-PGPUB; USPAT)	OR	ON	ON	2020/05/06 04:43 PM
L197	278	("10001817"|"10018966"|"10019097"|"10037006"|"10048802"|"10061399"|"10092203"|"10114342"|"10145711"|"10175652"|"10209148"|"10216147"|"10222756"|"10222909"|"10234828"|"10296125"|"10331081"|"10331082"|"10379629"|"10509486"|"2237860"|"2288215"|"2497935"|"2771734"|"2788236"|"2797592"|"3040514"|"3056030"|"3130539"|"3355873"|"3362154"|"3410247"|"3495398"|"3577876"|"3621649"|"3662618"|"3733803"|"4007347"|"4031341"|"4037068"|"4077200"|"4133404"|"4170104"|"4258096"|"4287400"|"4289400"|"4311026"|"4311990"|"4324956"|"4345119"|"4364674"|"4379642"|"4395134"|"4396298"|"4417824"|"4520306"|"4581509"|"4600316"|"4617461"|"4634861"|"4641026"|"4670737"|"4766642"|"4783772"|"4884073"|"4914831"|"4922070"|"4931794"|"4952799"|"4980685"	(US-PGPUB; USPAT)	OR	ON	ON	2020/05/06 04:57 PM

		|"4987299"|"5034602"|"5177355"|"5214278"|"5258592"|"5288993"|"5347123"|"5383166"|"5471054"|"5477508"|"5509174"|"5572314"|"5583560"|"5631881"|"5726645"|"5748111"|"5825353"|"5841050"|"5847335"|"5867082"|"5943233"|"5953001"|"5960366"|"5963332"|"5999168"|"6069567"|"6134189"|"6154201"|"6175679"|"6241684"|"6246050"|"6252825"|"6304247"|"6355891"|"6361502"|"6377239"|"6392640"|"6396006"|"6422740"|"6477117"|"6502982"|"6525278"|"6556222"|"6575618"|"6587400"|"6646635"|"6661438"|"6672758"|"6794992"|"6809275"|"6834430"|"6846998"|"6882596"|"6888076"|"6896403"|"6909378"|"6914551"|"6961099"|"6963039"|"6967903"|"6977868"|"6982930"|"6985107"|"6987568"|"6998553"|"7016263"|"7021442"|"7034237"|"7081905"|"7102626"|"7111365"|"7113450"|"7119289"|"7135673"|"7167083"|"7244927"|"7255473"|"7265336"|"7274303"|"7285738"|"7286063"|"7292741"|"7358481"|"7369308"|"7371745"|"7385874"|"7404667"|"7465917"|"7468036"|"7506269"|"7520664"|"7528824"|"7545367"|"7591582"|"7593755"|"7605846"|"7634263"|"7646677"|"7655874"|"7682070"|"7708457"|"7710456"|"7732724"|"7761246"|"7763819"|"7772507"|"7778115"|"7781726"|"7791588"|"7791597"|"7822469"|"7856255"|"7858583"|"7865324"|"7894957"|"7946758"|"8063892"|"8138488"|"8143981"|"8167126"|"8169402"|"8188989"|"8195313"|"8					

		229535"|"8248815"|"8263886"|"8263889"|"8275327"|"8294670"|"8312495"|"8368677"|"8371745"|"8373661"|"8410971"|"8432368"|"8439559"|"8441450"|"8446713"|"8456430"|"8477118"|"8493190"|"8508511"|"8525777"|"8562489"|"8568313"|"8576044"|"8593598"|"8607662"|"8614881"|"8666682"|"8677285"|"8704787"|"8711093"|"8724087"|"8730167"|"8743088"|"8783944"|"8804993"|"8816962"|"8824245"|"8847741"|"8859971"|"8860674"|"8863219"|"8878657"|"8885856"|"8895911"|"8905631"|"8908477"|"8920022"|"8922399"|"8928452"|"8954135"|"8975543"|"8994827"|"9001625"|"9024733"|"9028134"|"9030446"|"9034666"|"9039614"|"9041663"|"9042971"|"9052696"|"9086717"|"9086738"|"9101184"|"9105413"|"9123483"|"9141087"|"9176577"|"9176598"|"9202372"|"9213409"|"9223296"|"9241635"|"9244438"|"9256209"|"9277156"|"9350850"|"9386932"|"9426275"|"9430042"|"9437357"|"9449770"|"9501044"|"9520100"|"9532723").PN.					
L198	13	L195 AND L197	(US-PGPUB; USPAT)	OR	ON	ON	2020/05/06 04:57 PM
L199	33	("9542016"|"9545541"|"9552023"|"9599964"|"9607505"|"9620312"|"9627163"|"9632318"|"9638587"|"9651922"|"9659482"|"9680831"|"9709956"|"9753436"|"9800717"|"9836025"|"9873711"|"9874945"|"9886006"|"9891590"|"9891651"|"9898032"|"9927902"|"9939923"|"9946297"|"9952558"|"9952682"|"9971305"|"9971405"|"99794	(US-PGPUB; USPAT)	OR	ON	ON	2020/05/06 05:04 PM

		26"|"D717679"|"D800172"|"RE41637").PN.					
L200	7	L199 AND L195	(US-PGPUB; USPAT)	OR	ON	ON	2020/05/06 05:04 PM
L201	83	(US-20160350514-$ or US-20160274726-$ or US-20150313542-$ or US-20160367987-$ or US-20160198996-$ or US-20160091965-$ or US-20140278139-$ or US-20140107493-$ or US-20110003665-$ or US-20150026647-$ or US-20140378777-$ or US-20140275852-$ or US-20170071483-$ or US-20170039358-$ or US-20170011210-$ or US-20160379205-$ or US-20150186609-$ or US-20140366123-$ or US-20140276244-$ or US-20140139486-$ or US-20130234850-$ or US-20030175993-$ or US-20160313703-$ or US-20160064804-$ or US-20160064800-$ or US-20150085429-$).did. or (US-20130236699-$ or US-20090124062-$ or US-20150124415-$).did. or (US-9848825-$ or US-9737221-$ or US-9737212-$ or US-9704154-$ or US-9629120-$ or US-9622214-$ or US-8738118-$ or US-8727977-$ or US-8630633-$ or US-8617069-$ or US-8527038-$ or US-7674231-$ or US-7474592-$ or US-6694158-$ or US-5722397-$ or US-6443906-$ or US-9288836-$ or US-9423418-$ or US-9091715-$ or US-6431455-$ or US-6350055-$ or US-6255951-$ or US-6158884-$ or US-	(US-PGPUB; USPAT)	OR	ON	ON	2020/05/08 10:45 AM

		9781984-$ or US-9575591-$ or US-D727198-$).did. or (US-D728624-$ or US-D737159-$ or US-D741726-$ or US-D752044-$ or US-D758219-$ or US-D758363-$ or US-9459781-$ or US-D768634-$ or US-9507459-$ or US-9547425-$ or US-D790517-$ or US-9288294-$ or US-8596860-$ or US-9791833-$ or US-9591913-$ or US-9680205-$ or US-7654732-$ or US-7682070-$ or US-4903253-$ or US-8766805-$ or US-D578922-$ or US-D647107-$ or US-3577876-$ or US-9300344-$ or US-9615476-$ or US-9625944-$ or US-9627163-$).did. or (US-7286063-$).did.					
L202	4081	(((wrist NEAR watch) OR (wristwatch)) AND ("ECG" OR "EKG" OR electrocardiogra$4))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2020/05/08 10:46 AM
L203	4144877	electrode	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2020/05/08 10:47 AM
L204	2474	L202 AND L203	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2020/05/08 10:47 AM
L205	939	(((wrist NEAR watch) OR (wristwatch)) SAME ("ECG" OR "EKG" OR electrocardiogra$4))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2020/05/08 10:48 AM
L206	760	L204 AND L205	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2020/05/08 10:48 AM
L207	84	(US-20160350514-$ or US-20160274726-$ or US-20150313542-$ or US-20160367987-$ or US-20160198996-$ or US-20160091965-$ or US-20140278139-$ or US-20140107493-$ or	(US-PGPUB; USPAT)	OR	ON	ON	2020/05/08 10:56 AM

		US-20110003665-$ or US-20150026647-$ or US-20140378777-$ or US-20140275852-$ or US-20170071483-$ or US-20170039358-$ or US-20170011210-$ or US-20160379205-$ or US-20150186609-$ or US-20140366123-$ or US-20140276244-$ or US-20140139486-$ or US-20130234850-$ or US-20030175993-$ or US-20160313703-$ or US-20160064804-$ or US-20160064800-$ or US-20150085429-$).did. or (US-20130236699-$ or US-20090124062-$ or US-20150124415-$).did. or (US-9848825-$ or US-9737221-$ or US-9737212-$ or US-9704154-$ or US-9629120-$ or US-9622214-$ or US-8738118-$ or US-8727977-$ or US-8630633-$ or US-8617069-$ or US-8527038-$ or US-7674231-$ or US-7474592-$ or US-6694158-$ or US-5722397-$ or US-6443906-$ or US-9288836-$ or US-9423418-$ or US-9091715-$ or US-6431455-$ or US-6350055-$ or US-6255951-$ or US-6158884-$ or US-9781984-$ or US-9575591-$ or US-D727198-$).did. or (US-D728624-$ or US-D737159-$ or US-D741726-$ or US-D752044-$ or US-D758219-$ or US-D758363-$ or US-9459781-$ or US-D768634-$ or US-9507459-$ or US-9547425-$ or US-					

		D790517-$ or US-9288294-$ or US-8596860-$ or US-9791833-$ or US-9591913-$ or US-9680205-$ or US-7654732-$ or US-7682070-$ or US-4903253-$ or US-8766805-$ or US-D578922-$ or US-D647107-$ or US-3577876-$ or US-9300344-$ or US-9615476-$ or US-9625944-$ or US-9627163-$).did. or (US-7286063-$ or US-4448199-$).did.					
L208	919589	dielectric OR ceramInc	(US-PGPUB; USPAT)	OR	ON	ON	2020/05/08 11:06 AM
L209	1700627	dielectric OR ceramic	(US-PGPUB; USPAT)	OR	ON	ON	2020/05/08 11:06 AM
L210	20	L207 AND L209	(US-PGPUB; USPAT)	OR	ON	ON	2020/05/08 11:06 AM
L211	0	"16826130"	(US-PGPUB; USPAT)	OR	ON	ON	2020/05/08 11:11 AM
L212	1	"10613485".pn.	(US-PGPUB; USPAT)	OR	ON	ON	2020/05/08 11:11 AM
L213	1178366	coil	(US-PGPUB; USPAT)	OR	ON	ON	2020/05/08 11:25 AM
L214	15	L207 AND L213	(US-PGPUB; USPAT)	OR	ON	ON	2020/05/08 11:27 AM
L215	126	(wireless SAME recharg$4 SAME (coil OR antenna) SAME magnet)	(US-PGPUB; USPAT)	OR	ON	ON	2020/05/08 12:42 PM
L216	70511	(((wrist NEAR watch) OR (wristwatch)))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2020/05/08 12:42 PM
L217	24	L216 AND L215	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2020/05/08 12:42 PM
L218	28998	wireless NEAR charg$4	(US-PGPUB; USPAT)	OR	ON	ON	2020/05/08 01:18 PM
L219	83	(US-20160350514-$ or US-20160274726-$ or US-20150313542-$ or US-20160367987-$ or US-20160198996-$ or US-20160091965-$ or US-20140278139-$ or US-20140107493-$ or US-20110003665-$ or	(US-PGPUB; USPAT)	OR	ON	ON	2020/05/08 01:19 PM

		US-20150026647-$ or US-20140378777-$ or US-20140275852-$ or US-20170071483-$ or US-20170039358-$ or US-20170011210-$ or US-20160379205-$ or US-20150186609-$ or US-20140366123-$ or US-20140276244-$ or US-20140139486-$ or US-20130234850-$ or US-20030175993-$ or US-20160313703-$ or US-20160064804-$ or US-20160064800-$ or US-20150085429-$).did. or (US-20130236699-$ or US-20090124062-$ or US-20150124415-$).did. or (US-9848825-$ or US-9737221-$ or US-9737212-$ or US-9704154-$ or US-9629120-$ or US-9622214-$ or US-8738118-$ or US-8727977-$ or US-8630633-$ or US-8617069-$ or US-8527038-$ or US-7674231-$ or US-7474592-$ or US-6694158-$ or US-5722397-$ or US-6443906-$ or US-9288836-$ or US-9423418-$ or US-9091715-$ or US-6431455-$ or US-6350055-$ or US-6255951-$ or US-6158884-$ or US-9781984-$ or US-9575591-$ or US-D727198-$).did. or (US-D728624-$ or US-D737159-$ or US-D741726-$ or US-D752044-$ or US-D758219-$ or US-D758363-$ or US-9459781-$ or US-D768634-$ or US-9507459-$ or US-9547425-$ or US-D790517-$ or US-					

		9288294-$ or US-8596860-$ or US-9791833-$ or US-9591913-$ or US-9680205-$ or US-7654732-$ or US-7682070-$ or US-4903253-$ or US-8766805-$ or US-D578922-$ or US-D647107-$ or US-3577876-$ or US-9300344-$ or US-9615476-$ or US-9625944-$ or US-9627163-$).did. or (US-7286063-$).did.					
L220	5	L218 AND L219	(US-PGPUB; USPAT)	OR	ON	ON	2020/05/08 01:19 PM
L221	278	("10001817"|"10018966"|"10019097"|"10037006"|"10048802"|"10061399"|"10092203"|"10114342"|"10145711"|"10175652"|"10209148"|"10216147"|"10222756"|"10222909"|"10234828"|"10296125"|"10331081"|"10331082"|"10379629"|"10509486"|"2237860"|"2288215"|"2497935"|"2771734"|"2788236"|"2797592"|"3040514"|"3056030"|"3130539"|"3355873"|"3362154"|"3410247"|"3495398"|"3577876"|"3621649"|"3662618"|"3733803"|"4007347"|"4031341"|"4037068"|"4077200"|"4133404"|"4170104"|"4258096"|"4287400"|"4289400"|"4311026"|"4311990"|"4324956"|"4345119"|"4364674"|"4379642"|"4395134"|"4396298"|"4417824"|"4520306"|"4581509"|"4600316"|"4617461"|"4634861"|"4641026"|"4670737"|"4766642"|"4783772"|"4884073"|"4914831"|"4922070"|"4931794"|"4952799"|"4980685"|"4987299"|"5034602"|"5177355"|"5214278"|"5258592"|"5288993"|"5347123"|"5383166"|"547	(US-PGPUB; USPAT)	OR	ON	ON	2020/05/08 01:22 PM

		1054"|"5477508"|"5509 174"|"5572314"|"55835 60"|"5631881"|"572664 5"|"5748111"|"5825353" |"5841050"|"5847335"|" 5867082"|"5943233"|"5 953001"|"5960366"|"59 63332"|"5999168"|"606 9567"|"6134189"|"6154 201"|"6175679"|"62416 84"|"6246050"|"625282 5"|"6304247"|"6355891" |"6361502"|"6377239"|" 6392640"|"6396006"|"6 422740"|"6477117"|"65 02982"|"6525278"|"655 6222"|"6575618"|"6587 400"|"6646635"|"66614 38"|"6672758"|"679499 2"|"6809275"|"6834430" |"6846998"|"6882596"|" 6888076"|"6896403"|"6 909378"|"6914551"|"69 61099"|"6963039"|"696 7903"|"6977868"|"6982 930"|"6985107"|"69875 68"|"6998553"|"701626 3"|"7021442"|"7034237" |"7081905"|"7102626"|" 7111365"|"7113450"|"7 119289"|"7135673"|"71 67083"|"7244927"|"725 5473"|"7265336"|"7274 303"|"7285738"|"72860 63"|"7292741"|"735848 1"|"7369308"|"7371745" |"7385874"|"7404667"|" 7465917"|"7468036"|"7 506269"|"7520664"|"75 28824"|"7545367"|"759 1582"|"7593755"|"7605 846"|"7634263"|"76466 77"|"7655874"|"768207 0"|"7708457"|"7710456" |"7732724"|"7761246"|" 7763819"|"7772507"|"7 778115"|"7781726"|"77 91588"|"7791597"|"782 2469"|"7856255"|"7858 583"|"7865324"|"78949 57"|"7946758"|"806389 2"|"8138488"|"8143981" |"8167126"|"8169402"|" 8188989"|"8195313"|"8 229535"|"8248815"|"82 63886"|"8263889"|"827 5327"|"8294670"|"8312 495"|"8368677"|"83717					

		45"|"8373661"|"8410971"|"8432368"|"8439559"|"8441450"|"8446713"|"8456430"|"8477118"|"8493190"|"8508511"|"8525777"|"8562489"|"8568313"|"8576044"|"8593598"|"8607662"|"8614881"|"8666682"|"8677285"|"8704787"|"8711093"|"8724087"|"8730167"|"8743088"|"8783944"|"8804993"|"8816962"|"8824245"|"8847741"|"8859971"|"8860674"|"8863219"|"8878657"|"8885856"|"8895911"|"8905631"|"8908477"|"8920022"|"8922399"|"8928452"|"8954135"|"8975543"|"8994827"|"9001625"|"9024733"|"9028134"|"9030446"|"9034666"|"9039614"|"9041663"|"9042971"|"9052696"|"9086717"|"9086738"|"9101184"|"9105413"|"9123483"|"9141087"|"9176577"|"9176598"|"9202372"|"9213409"|"9223296"|"9241635"|"9244438"|"9256209"|"9277156"|"9350850"|"9386932"|"9426275"|"9430042"|"9437357"|"9449770"|"9501044"|"9520100"|"9532723").PN.					
L222	6	L218 AND L221	(US-PGPUB; USPAT)	OR	ON	ON	2020/05/08 01:22 PM
L223	33	("9542016"|"9545541"|"9552023"|"9599964"|"9607505"|"9620312"|"9627163"|"9632318"|"9638587"|"9651922"|"9659482"|"9680831"|"9709956"|"9753436"|"9800717"|"9836025"|"9873711"|"9874945"|"9886006"|"9891590"|"9891651"|"9898032"|"9927902"|"9939923"|"9946297"|"9952558"|"9952682"|"9971305"|"9971405"|"9979426"|"D717679"|"D800172"|"RE41637").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2020/05/08 01:23 PM
L224	4	L218 AND L223	(US-PGPUB; USPAT)	OR	ON	ON	2020/05/08 01:23 PM

L225	33	("9542016"|"9545541"|"9552023"|"9599964"|"9607505"|"9620312"|"9627163"|"9632318"|"9638587"|"9651922"|"9659482"|"9680831"|"9709956"|"9753436"|"9800717"|"9836025"|"9873711"|"9874945"|"9886006"|"9891590"|"9891651"|"9898032"|"9927902"|"9939923"|"9946297"|"9952558"|"9952682"|"9971305"|"9971405"|"9979426"|"D717679"|"D800172"|"RE41637").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2020/05/08 01:24 PM
L226	4	L218 AND L225	(US-PGPUB; USPAT)	OR	ON	ON	2020/05/08 01:24 PM
L227	5	L218 AND L201	(US-PGPUB; USPAT)	OR	ON	ON	2020/05/08 01:24 PM
L228	16	("0052020"|"10012550"|"10241593"|"10353487"|"10551798"|"20070182708"|"20140009397"|"20140045547"|"20200041962"|"20200073339"|"20200110473"|"6128006"|"6203190"|"6636197"|"8318340"|"8797153").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2020/10/22 02:58 PM
L229	216	(coil SAME (recharg$4 OR charg$4) SAME cover SAME dielectric)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2020/10/22 03:03 PM
L230	0	L228 AND L229	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2020/10/22 03:03 PM
L231	27643	(coil AND (recharg$4 OR charg$4) AND cover AND dielectric)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2020/10/22 03:06 PM
L232	1	L228 AND L231	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2020/10/22 03:06 PM
L233	58	(watch AND housing AND cover AND (touch NEAr display) AND dielectric AND optical AND coil AND wireless AND (heart NEAR rate) AND (electrocardiog$4 OR "ECG" OR "EKG"))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2020/10/22 03:16 PM
L235	358	((("Rothkopf") near3 ("Fletcher") near3 ("R"))).INV.	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2020/10/29 09:55 AM
L236	527578	watch	(US-PGPUB; USPAT; USOCR; FPRS; EPO;	OR	ON	ON	2020/10/29 09:56 AM

			JPO)				
L237	127	L235 AND L236	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2020/10/29 09:56 AM
L238	1031	Watch AND band AND (wireless SAME coil SAME inductive)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2020/10/29 10:35 AM
L239	1459613	dielectric	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2020/10/29 10:35 AM
L240	308	L238 AND L239	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2020/10/29 10:36 AM
L241	293	(housing AND watch AND (band OR strap) AND cover AND dielectric AND coil AND charg$4 AND surface AND electrode AND (heart NEAr rate))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2020/10/29 01:39 PM
L243	2	(9134807|10474194).pn.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2021/01/13 01:19 PM
L244	275	("0000005"|"0000055"|"0000072"|"0000073"|"0000078"|"0000555"|"0000726"|"0000728"|"0000786"|"0022019"|"0022020"|"0032019"|"0032020"|"0042020"|"0052019"|"0052020"|"0052585"|"0062019"|"0072019"|"0078949"|"0079467"|"0082019"|"0082020"|"0112019"|"0122019"|"10001817"|"10012550"|"10018966"|"10019097"|"10037006"|"10048802"|"10061399"|"10092203"|"10114342"|"10145711"|"10175652"|"20030174590"|"20040047244"|"20040082414"|"20040130971"|"20040264301"|"20050075558"|"20050088417"|"20060250377"|"2237860"|"2288215"|"2497935"|"2771734"|"2788236"|"2797592"|"3040514"|"3056030"|"3130539"|"3355873"|"3362154"|"3410247"|"3495398"|"3577876"|"3621649"|"3662618"|"3733803"|"4007347"|"4031341"|"4037068"|"4077200"|"41	(US-PGPUB; USPAT)	OR	ON	ON	2021/05/04 11:05 AM

		33404"|"4170104"|"425 8096"|"4287400"|"4289 400"|"4311026"|"43119 90"|"4324956"|"434511 9"|"4364674"|"4379642" |"4395134"|"4396298"|" 4417824"|"4448199"|"4 520306"|"4581509"|"46 00316"|"4617461"|"463 4861"|"4641026"|"4670 737"|"4766642"|"47837 72"|"4884073"|"491483 1"|"4922070"|"4931794" |"4952799"|"4980685"|" 4987299"|"5034602"|"5 177355"|"5214278"|"52 88993"|"5631881"|"584 1050"|"5847335"|"5867 082"|"5943233"|"59530 01"|"5960366"|"596333 2"|"5999168"|"6069567" |"6128006"|"6134189"|" 6154201"|"6175679"|"6 203190"|"6241684"|"62 46050"|"6252825"|"630 4247"|"6355891"|"6361 502"|"6377239"|"63926 40"|"6396006"|"642274 0"|"6477117"|"6502982" |"6525278"|"6556222"|" 6575618"|"6587400"|"6 636197"|"6646635"|"66 61438"|"6672758"|"679 4992"|"6809275"|"6834 430"|"6846998"|"68825 96"|"6888076"|"689640 3"|"6909378"|"6914551" |"6961099"|"6963039"|" 6967903"|"6977868"|"6 982930"|"6985107"|"69 87568"|"6998553"|"701 6263"|"7021442"|"7031 228"|"7034237"|"70819 05"|"7102626"|"711136 5"|"7113450"|"7119289" |"7135673"|"7167083"|" 7244927"|"7274303"|"7 286063"|"7292741"|"73 69308"|"7371745"|"738 5874"|"7404667"|"7465 917"|"7468036"|"75062 69"|"7520664"|"752882 4"|"7545367"|"7591582" |"7593755"|"7605846"|" 7634263"|"7646677"|"7 655874"|"7682070"|"77 08457"|"7710456"|"773 2724"|"7761246"|"7763					

		819"|"7772507"|"77781 15"|"7781726"|"779158 8"|"7791597"|"7822469" |"8063892"|"8138488"|" 8143981"|"8167126"|"8 169402"|"8188989"|"81 95313"|"8229535"|"824 8815"|"8263886"|"8263 889"|"8275327"|"82946 70"|"8312495"|"831834 0"|"8368677"|"8371745" |"8373661"|"8410971"|" 8432368"|"8439559"|"8 441450"|"8446713"|"84 56430"|"8477118"|"849 3190"|"8508511"|"8525 777"|"8562489"|"85683 13"|"8576044"|"859359 8"|"8607662"|"8614881" |"8666682"|"8677285"|" 8704787"|"8711093"|"8 724087"|"8730167"|"87 43088"|"8783944"|"879 7153"|"8804993"|"8816 962"|"8824245"|"88477 41"|"8859971"|"886067 4"|"8863219"|"8878657" |"8885856"|"8895911"|" 8905631"|"8908477"|"8 920022"|"8922399"|"89 28452"|"8948832"|"895 4135"|"8975543"|"8994 827"|"9001625"|"90247 33"|"9028134"|"903044 6"|"9034666"|"9039614" |"9041663"|"9042971"|" 9049998"|"9052696"|"9 086717"|"9086738"|"91 00493"|"9101184"|"910 5413"|"9123483"|"9134 807"|"9141087").PN.					
L245	52	("9176577"|"9176598"|" 9202372"|"9213409"|"9 223296"|"9241635"|"92 44438"|"9256209"|"927 7156"|"9350850"|"9386 932"|"9426275"|"94300 42"|"9437357"|"944977 0"|"9501044"|"9520100" |"9532723"|"9542016"|" 9545541"|"9552023"|"9 599964"|"9607505"|"96 20312"|"9627163"|"963 2318"|"9638587"|"9651 922"|"9659482"|"96808 31"|"9709956"|"975343 6"|"9800717"|"9836025" |"9873711"|"9874945"|	(US-PGPUB; USPAT)	OR	ON	ON	2021/05/04 11:05 AM

		9886006"|"9891590"|"9891651"|"9898032"|"9927902"|"9939923"|"9946297"|"9952558"|"9952682"|"9971305"|"9971405"|"9971407"|"9979426"|"D717679"|"D800172"|"RE41637").PN.					
L246	341583	crown	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2021/05/04 11:06 AM
L247	16	L245 AND L246	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2021/05/04 11:06 AM
L248	86	(US-20160350514-$ or US-20160274726-$ or US-20150313542-$ or US-20160367987-$ or US-20160198996-$ or US-20160091965-$ or US-20140278139-$ or US-20140107493-$ or US-20110003665-$ or US-20150026647-$ or US-20140378777-$ or US-20140275852-$ or US-20170071483-$ or US-20170039358-$ or US-20170011210-$ or US-20160379205-$ or US-20150186609-$ or US-20140366123-$ or US-20140276244-$ or US-20140139486-$ or US-20130234850-$ or US-20030175993-$ or US-20160313703-$ or US-20160064804-$ or US-20160064800-$ or US-20150085429-$).did. or (US-20130236699-$ or US-20090124062-$ or US-20150124415-$ or US-20150351690-$).did. or (US-9848825-$ or US-9737221-$ or US-9737212-$ or US-9704154-$ or US-9629120-$ or US-9622214-$ or US-8738118-$ or US-8727977-$ or US-8630633-$ or US-8617069-$ or US-8527038-$ or US-7674231-$ or US-	(US-PGPUB; USPAT)	OR	ON	ON	2021/05/04 11:09 AM

		7474592-$ or US-6694158-$ or US-5722397-$ or US-6443906-$ or US-9288836-$ or US-9423418-$ or US-9091715-$ or US-6431455-$ or US-6350055-$ or US-6255951-$ or US-6158884-$ or US-9781984-$ or US-9575591-$ or US-D727198-$).did. or (US-D728624-$ or US-D737159-$ or US-D741726-$ or US-D752044-$ or US-D758219-$ or US-D758363-$ or US-9459781-$ or US-D768634-$ or US-9507459-$ or US-9547425-$ or US-D790517-$ or US-9288294-$ or US-8596860-$ or US-9791833-$ or US-9591913-$ or US-9680205-$ or US-7654732-$ or US-7682070-$ or US-4903253-$ or US-8766805-$ or US-D578922-$ or US-D647107-$ or US-3577876-$ or US-9300344-$ or US-9615476-$ or US-9625944-$ or US-9627163-$).did. or (US-7286063-$ or US-4448199-$ or US-5738104-$).did.					
L249	9	L246 AND L248	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2021/05/04 11:09 AM
L250	4	(10942491|10613485|10620591|10599101).pn.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2021/05/04 11:14 AM
L251	49	L244 AND L246	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2021/05/04 11:20 AM
L252	6361313	sensor	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2021/05/04 12:06 PM

L253	23	L251 AND L252	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2021/05/04 12:06 PM
L254	403796	(tactile OR haptic)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2021/05/04 12:44 PM
L255	30	L245 AND L254	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2021/05/04 12:44 PM
L256	63	L244 AND L254	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2021/05/04 12:51 PM
L259	6581094	optical	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2021/05/04 02:50 PM
L260	92	(US-20160350514-$ or US-20160274726-$ or US-20150313542-$ or US-20160367987-$ or US-20160198996-$ or US-20160091965-$ or US-20140278139-$ or US-20140107493-$ or US-20110003665-$ or US-20150026647-$ or US-20140378777-$ or US-20140275852-$ or US-20170071483-$ or US-20170039358-$ or US-20170011210-$ or US-20160379205-$ or US-20150186609-$ or US-20140366123-$ or US-20140276244-$ or US-20140139486-$ or US-20130234850-$ or US-20030175993-$ or US-20160313703-$ or US-20160064804-$ or US-20160064800-$ or US-20150085429-$).did. or (US-20130236699-$ or US-20090124062-$ or US-20150124415-$ or US-20150351690-$ or US-20030174590-$).did. or (US-9848825-$ or US-9737221-$ or US-9737212-$ or US-9704154-$ or US-9629120-$ or US-9622214-$ or US-8738118-$ or US-8727977-$ or US-8630633-$ or US-	(US-PGPUB; USPAT)	OR	ON	ON	2021/05/04 02:50 PM

		8617069-$ or US-8527038-$ or US-7674231-$ or US-7474592-$ or US-6694158-$ or US-5722397-$ or US-6443906-$ or US-9288836-$ or US-9423418-$ or US-9091715-$ or US-6431455-$ or US-6350055-$ or US-6255951-$ or US-6158884-$ or US-9781984-$ or US-9575591-$ or US-D727198-$).did. or (US-D728624-$ or US-D737159-$ or US-D741726-$ or US-D752044-$ or US-D758219-$ or US-D758363-$ or US-9459781-$ or US-D768634-$ or US-9507459-$ or US-9547425-$ or US-D790517-$ or US-9288294-$ or US-8596860-$ or US-9791833-$ or US-9591913-$ or US-9680205-$ or US-7654732-$ or US-7682070-$ or US-4903253-$ or US-8766805-$ or US-D578922-$ or US-D647107-$ or US-3577876-$ or US-9300344-$ or US-9615476-$ or US-9625944-$ or US-9627163-$).did. or (US-7286063-$ or US-4448199-$ or US-5738104-$ or US-8908477-$ or US-7034237-$ or US-6882596-$ or US-9971405-$ or US-9651922-$).did.					
L261	59	L259 AND L260	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO)	OR	ON	ON	2021/05/04 02:50 PM
L262	4	(20140275852|4448199).pn.	(US-PGPUB; USPAT; USOCR; FPRS; EPO;	OR	ON	ON	2021/05/04 03:01 PM

			JPO)				
L263	92	(US-20160350514-$ or US-20160274726-$ or US-20150313542-$ or US-20160367987-$ or US-20160198996-$ or US-20160091965-$ or US-20140278139-$ or US-20140107493-$ or US-20110003665-$ or US-20150026647-$ or US-20140378777-$ or US-20140275852-$ or US-20170071483-$ or US-20170039358-$ or US-20170011210-$ or US-20160379205-$ or US-20150186609-$ or US-20140366123-$ or US-20140276244-$ or US-20140139486-$ or US-20130234850-$ or US-20030175993-$ or US-20160313703-$ or US-20160064804-$ or US-20160064800-$ or US-20150085429-$).did. or (US-20130236699-$ or US-20090124062-$ or US-20150124415-$ or US-20150351690-$ or US-20030174590-$).did. or (US-9848825-$ or US-9737221-$ or US-9737212-$ or US-9704154-$ or US-9629120-$ or US-9622214-$ or US-8738118-$ or US-8727977-$ or US-8630633-$ or US-8617069-$ or US-8527038-$ or US-7674231-$ or US-7474592-$ or US-6694158-$ or US-5722397-$ or US-6443906-$ or US-9288836-$ or US-9423418-$ or US-9091715-$ or US-6431455-$ or US-6350055-$ or US-6255951-$ or US-6158884-$ or US-9781984-$ or US-9575591-$ or US-	(US-PGPUB; USPAT)	OR	ON	ON	2021/05/04 03:02 PM

		D727198-$).did. or (US-D728624-$ or US-D737159-$ or US-D741726-$ or US-D752044-$ or US-D758219-$ or US-D758363-$ or US-9459781-$ or US-D768634-$ or US-9507459-$ or US-9547425-$ or US-D790517-$ or US-9288294-$ or US-8596860-$ or US-9791833-$ or US-9591913-$ or US-9680205-$ or US-7654732-$ or US-7682070-$ or US-4903253-$ or US-8766805-$ or US-D578922-$ or US-D647107-$ or US-3577876-$ or US-9300344-$ or US-9615476-$ or US-9625944-$ or US-9627163-$).did. or (US-7286063-$ or US-4448199-$ or US-5738104-$ or US-8908477-$ or US-7034237-$ or US-6882596-$ or US-9971405-$ or US-9651922-$).did.					
L264	176	ely-colin-m.in.	(US-PGPUB; USPAT)	OR	ON	ON	2021/05/04 03:13 PM
L265	2438	((touch OR force) NEAr sensor) AND crown AND sensor	(US-PGPUB; USPAT)	OR	ON	ON	2021/05/04 03:23 PM
L266	275	("0000005"|"0000055"|"0000072"|"0000073"|"0000078"|"0000555"|"0000726"|"0000728"|"0000786"|"0022019"|"0022020"|"0032019"|"0032020"|"0042020"|"0052019"|"0052020"|"0052585"|"0062019"|"0072019"|"0078949"|"0079467"|"0082019"|"0082020"|"0112019"|"0122019"|"10001817"|"10012550"|"10018966"|"10019097"|"10037006"|"10048802"|"10061399"|"10092203"|	(US-PGPUB; USPAT)	OR	ON	ON	2021/05/04 03:23 PM

		"10114342"|"10145711" |"10175652"|"20030174 590"|"20040047244"|"2 0040082414"|"2004013 0971"|"20040264301"|" 20050075558"|"200500 88417"|"20060250377"| "2237860"|"2288215"|"2 497935"|"2771734"|"27 88236"|"2797592"|"304 0514"|"3056030"|"3130 539"|"3355873"|"33621 54"|"3410247"|"349539 8"|"3577876"|"3621649" |"3662618"|"3733803"|" 4007347"|"4031341"|"4 037068"|"4077200"|"41 33404"|"4170104"|"425 8096"|"4287400"|"4289 400"|"4311026"|"43119 90"|"4324956"|"434511 9"|"4364674"|"4379642" |"4395134"|"4396298"|" 4417824"|"4448199"|"4 520306"|"4581509"|"46 00316"|"4617461"|"463 4861"|"4641026"|"4670 737"|"4766642"|"47837 72"|"4884073"|"491483 1"|"4922070"|"4931794" |"4952799"|"4980685"|" 4987299"|"5034602"|"5 177355"|"5214278"|"52 88993"|"5631881"|"584 1050"|"5847335"|"5867 082"|"5943233"|"59530 01"|"5960366"|"596333 2"|"5999168"|"6069567" |"6128006"|"6134189"|" 6154201"|"6175679"|"6 203190"|"6241684"|"62 46050"|"6252825"|"630 4247"|"6355891"|"6361 502"|"6377239"|"63926 40"|"6396006"|"642274 0"|"6477117"|"6502982" |"6525278"|"6556222"|" 6575618"|"6587400"|"6 636197"|"6646635"|"66 61438"|"6672758"|"679 4992"|"6809275"|"6834 430"|"6846998"|"68825 96"|"6888076"|"689640 3"|"6909378"|"6914551" |"6961099"|"6963039"|" 6967903"|"6977868"|"6 982930"|"6985107"|"69 87568"|"6998553"|"701					

		6263"|"7021442"|"7031 228"|"7034237"|"70819 05"|"7102626"|"711136 5"|"7113450"|"7119289" |"7135673"|"7167083"|" 7244927"|"7274303"|"7 286063"|"7292741"|"73 69308"|"7371745"|"738 5874"|"7404667"|"7465 917"|"7468036"|"75062 69"|"7520664"|"752882 4"|"7545367"|"7591582" |"7593755"|"7605846"|" 7634263"|"7646677"|"7 655874"|"7682070"|"77 08457"|"7710456"|"773 2724"|"7761246"|"7763 819"\1"7772507"|"77781 15"|"7781726"|"779158 8"|"7791597"|"7822469" |"8063892"|"8138488"|" 8143981"|"8167126"|"8 169402"|"8188989"|"81 95313"|"8229535"|"824 8815"|"8263886"|"8263 889"|"8275327"|"82946 70"|"8312495"|"831834 0"|"8368677"|"8371745" |"8373661"|"8410971"|" 8432368"|"8439559"|"8 441450"|"8446713"|"84 56430"|"8477118"|"849 3190"|"8508511"|"8525 777"|"8562489"|"85683 13"|"8576044"|"859359 8"|"8607662"|"8614881" |"8666682"|"8677285"|" 8704787"|"8711093"|"8 724087"|"8730167"|"87 43088"|"8783944"|"879 7153"|"8804993"|"8816 962"|"8824245"|"88477 41"|"8859971"|"886067 4"|"8863219"|"8878657" |"8885856"|"8895911"|" 8905631"|"8908477"|"8 920022"|"8922399"|"89 28452"|"8948832"|"895 4135"|"8975543"|"8994 827"|"9001625"|"90247 33"|"9028134"|"903044 6"|"9034666"|"9039614" |"9041663"|"9042971"|" 9049998"|"9052696"|"9 086717"|"9086738"|"91 00493"|"9101184"|"910 5413"|"9123483"|"9134 807"|"9141087").PN.					

L267	5	L265 AND L266	(US-PGPUB; USPAT)	OR	ON	ON	2021/05/04 03:23 PM
L268	52	("9176577"|"9176598"|"9202372"|"9213409"|"9223296"|"9241635"|"9244438"|"9256209"|"9277156"|"9350850"|"9386932"|"9426275"|"9430042"|"9437357"|"9449770"|"9501044"|"9520100"|"9532723"|"9542016"|"9545541"|"9552023"|"9599964"|"9607505"|"9620312"|"9627163"|"9632318"|"9638587"|"9651922"|"9659482"|"9680831"|"9709956"|"9753436"|"9800717"|"9836025"|"9873711"|"9874945"|"9886006"|"9891590"|"9891651"|"9898032"|"9927902"|"9939923"|"9946297"|"9952558"|"9952682"|"9971305"|"9971405"|"9971407"|"9979426"|"D717679"|"D800172"|"RE41637").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2021/05/04 03:24 PM
L269	11	L265 AND L268	(US-PGPUB; USPAT)	OR	ON	ON	2021/05/04 03:24 PM
L270	1038	(((touch OR force) NEAr sensor) WITH (screen OR display)) AND crown AND sensor	(US-PGPUB; USPAT)	OR	ON	ON	2021/05/04 03:41 PM
L271	412793	watch	(US-PGPUB; USPAT)	OR	ON	ON	2021/05/04 03:41 PM
L272	744	L270 AND L271	(US-PGPUB; USPAT)	OR	ON	ON	2021/05/04 03:42 PM
L273	82705	(biosensor)	(US-PGPUB; USPAT)	OR	ON	ON	2021/05/04 03:42 PM
L274	33	L272 AND L273	(US-PGPUB; USPAT)	OR	ON	ON	2021/05/04 03:42 PM
L275	25	(10942491|10613485|11620591|10627783|10599101).pn.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/09 10:10 AM
L276	5	(10942491|10613485|11620591|10627783|10599101).pn.	(USPAT)	OR	ON	ON	2022/11/09 10:12 AM
L277	5	(10942491|10613485|10620591|10627783|10599101).pn.	(USPAT)	OR	ON	ON	2022/11/09 10:31 AM

L278	1	"11474483".pn.	(USPAT)	OR	ON	ON	2022/11/09 11:03 AM
L279	250	("0000002" OR "0012021" OR "0012022" OR "0032020" OR "0032021" OR "0042020" OR "0042021" OR "0052020" OR "0052021" OR "0062021" OR "0062022" OR "0072022" OR "0082020" OR "0102022" OR "0112020" OR "0112021" OR "0122020" OR "0122021" OR "10001817" OR "10012550" OR "10018966" OR "10019097" OR "10037006" OR "10037081" OR "10048802" OR "10061399" OR "10066970" OR "10092203" OR "10108016" OR "10114342" OR "10145711" OR "10175652" OR "10190891" OR "10203662" OR "10209148" OR "10216147" OR "10222755" OR "10222756" OR "10222909" OR "10234828" OR "10241593" OR "10296125" OR "10331081" OR "10331082" OR "10332111" OR "10353487" OR "10379629" OR "10386940" OR "10401961" OR "10429959" OR "10474194" OR "10503258" OR "10509486" OR "10524671" OR "10534320" OR "10534900" OR	(US-PGPUB; USPAT)	OR	ON	ON	2022/12/14 01:49 PM

		"10551798" OR "10572053" OR "10579090" OR "10593617" OR "20020101457" OR "20030174590" OR "20040047244" OR "20040082414" OR "20040130971" OR "20040264301" OR "20050075558" OR "20050088417" OR "20060250377" OR "20070013775" OR "20070050054" OR "20070182708" OR "20070211042" OR "20070222756" OR "20070229671" OR "20070247421" OR "20080130914" OR "20090051649" OR "20090073119" OR "20090122656" OR "20090146975" OR "20090152452" OR "20090217207" OR "20090285443" OR "20090312051" OR "20090312655" OR "20100033430" OR "20100053468" OR "20100081375" OR "20100149099" OR "20110007468" OR "20110090148" OR "20110158057" OR "20110242064" OR "20110270358" OR "20120067711" OR "20120068857" OR "20120075082" OR "20120112859" OR "20120113044" OR "20120206248" OR "20120272784" OR "20130037396" OR "20130087443" OR "20130191220" OR "20130235704" OR "20130261405" OR "20130335196" OR "20140009397" OR "20140045547" OR "20140071098" OR "20140073486" OR "20140132516" OR "20140197936" OR					

		"20140340318" OR "20140347289" OR "20140368442" OR "20140375579" OR "20150049059" OR "20150098309" OR "20150124415" OR "20150186609" OR "20150221460" OR "20150293592" OR "20150320346" OR "20150338642" OR "20150341031" OR "20150366098" OR "20160018846" OR "20160054813" OR "20160058375" OR "20160061636" OR "20160062623" OR "20160069713" OR "20160109861" OR "20160116306" OR "20160147432" OR "20160170598" OR "20160170608" OR "20160170624" OR "20160241688" OR "20160253487" OR "20160306446" OR "20160320583" OR "20160327911" OR "20160338642" OR "20160378069" OR "20160378070" OR "20160378071" OR "20170011210" OR "20170027461" OR "20170031449" OR "20170045958" OR "20170061863" OR "20170069443" OR "20170069444" OR "20170069447" OR "20170090572" OR "20170090599" OR "20170104902" OR "20170139489" OR "20170216519" OR "20170216668" OR "20170238138" OR "20170251561" OR "20170269715" OR "20170285404" OR "20170301314" OR "20170307414" OR "20170331869" OR "20170357465" OR "20180018026" OR					

		"20180059624" OR "20180136686" OR "20180196517" OR "20180225701" OR "20180235491" OR "20180337551" OR "20180364815" OR "20190017846" OR "20190072911" OR "20190072912" OR "20190088583" OR "20190278232" OR "20190317454" OR "20190391539" OR "20200041962" OR "20200064774" OR "20200064779" OR "20200073339" OR "20200110473" OR "20200159172" OR "20200233380" OR "20200233529" OR "20200271483" OR "20200326659" OR "20210055696" OR "20210096688" OR "20210181682" OR "20210181688" OR "20210181690" OR "20210181691" OR "20210181692" OR "20210181865" OR "20210255590" OR "20210373501" OR "20210405594" OR "2237860" OR "2288215" OR "2497935" OR "2771734" OR "2788236" OR "2797592" OR "3040514" OR "3056030" OR "3130539" OR "3355873" OR "3362154" OR "3410247" OR "3495398" OR "3577876" OR "3621649" OR "3662618" OR "3733803" OR "4007347" OR "4031341" OR "4037068" OR "4077200" OR "4133404" OR "4170104" OR					

		"4258096" OR "4274152" OR "4287400" OR "4289400" OR "4311026" OR "4311990" OR "4324956" OR "4345119" OR "4364674" OR "4379642" OR "4395134" OR "4396298" OR "4417824" OR "4448199" OR "4520306" OR "4581509" OR "4600316" OR "4617461" OR "4634861" OR "4641026").pn.					
L280	250	("4670737" OR "4766642" OR "4783772" OR "4884073" OR "4914831" OR "4922070" OR "4931794" OR "4952799" OR "4980685" OR "4987299" OR "5034602" OR "5177355" OR "5214278" OR "5258592" OR "5288993" OR "5347123" OR "5383166" OR "5471054" OR "5477508" OR "5509174" OR "5559761" OR "5572314" OR "5583560" OR "5631881" OR "5726645" OR "5738104" OR "5748111" OR "5825353" OR "5841050" OR "5847335" OR "5867082" OR "5943233" OR "5953001" OR "5960366" OR "5963332" OR "5999168" OR "6069567" OR "6128006" OR	(US-PGPUB; USPAT)	OR	ON	ON	2022/12/14 01:49 PM

		"6134189" OR "6154201" OR "6175679" OR "6203190" OR "6241684" OR "6246050" OR "6252825" OR "6304247" OR "6355891" OR "6361502" OR "6377239" OR "6392640" OR "6396006" OR "6422740" OR "6477117" OR "6502982" OR "6525278" OR "6556222" OR "6575618" OR "6587400" OR "6636197" OR "6646635" OR "6661438" OR "6672758" OR "6794992" OR "6809275" OR "6834430" OR "6846998" OR "6882596" OR "6888076" OR "6896403" OR "6909378" OR "6914551" OR "6950695" OR "6961099" OR "6963039" OR "6967903" OR "6977868" OR "6982930" OR "6985107" OR "6987568" OR "6998553" OR "7016263" OR "7021442" OR "7031228" OR "7034237" OR "7081905" OR "7102626" OR "7111365" OR "7113450" OR "7119289" OR "7135673" OR "7167083" OR "7187359" OR "7244927" OR "7255473" OR "7265336" OR "7274303" OR					

		"7285738" OR "7286063" OR "7292741" OR "7358481" OR "7369308" OR "7371745" OR "7385874" OR "7404667" OR "7465917" OR "7468036" OR "7506269" OR "7520664" OR "7528824" OR "7545367" OR "7591582" OR "7593755" OR "7605846" OR "7634263" OR "7646677" OR "7655874" OR "7682070" OR "7708457" OR "7710456" OR "7732724" OR "7761246" OR "7763819" OR "7772507" OR "7778115" OR "7781726" OR "7791587" OR "7791588" OR "7791597" OR "7822469" OR "7856255" OR "7858583" OR "7865324" OR "7894957" OR "7946758" OR "8063892" OR "8138488" OR "8143981" OR "8167126" OR "8169402" OR "8188989" OR "8195313" OR "8229535" OR "8248815" OR "8263886" OR "8263889" OR "8275327" OR "8294670" OR "8312495" OR "8318340" OR "8368677" OR "8371745" OR "8373661" OR "8405618" OR "8410971" OR					

		"8432368" OR "8439559" OR "8441450" OR "8446713" OR "8456430" OR "8477118" OR "8493190" OR "8508511" OR "8525777" OR "8562489" OR "8568313" OR "8576044" OR "8593598" OR "8607662" OR "8614881" OR "8666682" OR "8677285" OR "8704787" OR "8711093" OR "8717151" OR "8724087" OR "8730167" OR "8743088" OR "8783944" OR "8797153" OR "8804993" OR "8816962" OR "8824245" OR "8847741" OR "8851372" OR "8859971" OR "8860674" OR "8863219" OR "8878657" OR "8885856" OR "8895911" OR "8905631" OR "8908477" OR "8920022" OR "8922399" OR "8928452" OR "8948832" OR "8954135" OR "8975543" OR "8994827" OR "9001625" OR "9024733" OR "9028134" OR "9030446" OR "9034666" OR "9039614" OR "9041663" OR "9042971" OR "9049998" OR "9052696" OR "9086717" OR "9086738" OR "9091309" OR					

		"9100493" OR "9101184" OR "9105413" OR "9123483" OR "9134807" OR "9141087" OR "9176577" OR "9176598" OR "9202372" OR "9213409" OR "9223296" OR "9241635" OR "9244438" OR "9256209" OR "9277156" OR "9350850" OR "9367146" OR "9386932" OR "9426275" OR "9430042" OR "9437357" OR "9449770" OR "9501044" OR "9520100" OR "9532723" OR "9542016" OR "9545541" OR "9552023" OR "9599964" OR "9600071" OR "9607505" OR "9620312" OR "9627163" OR "9632318" OR "9632537" OR "9638587" OR "9651922" OR "9659482").pn.					
L281	24	("9680831" OR "9709956" OR "9753436" OR "9800717" OR "9836025" OR "9873711" OR "9874945" OR "9886006" OR "9891590" OR "9891651" OR "9898032" OR "9913591" OR "9927902" OR "9939923" OR "9946297" OR "9952558" OR "9952682" OR "9971305" OR "9971405" OR "9971407" OR	(US-PGPUB; USPAT)	OR	ON	ON	2022/12/14 01:49 PM

		"9979426" OR "D717679" OR "D800172" OR "RE41637").pn.					
L282	1339759	coil	(US-PGPUB; USPAT)	OR	ON	ON	2022/12/14 02:20 PM
L283	57	L280 AND L282	(US-PGPUB; USPAT)	OR	ON	ON	2022/12/14 02:20 PM
L284	47	L279 AND L282	(US-PGPUB; USPAT)	OR	ON	ON	2022/12/14 03:06 PM
L285	1098	wristwatch AND (coil SAME wireless)	(US-PGPUB; USPAT)	OR	ON	ON	2022/12/14 03:16 PM
L286	1209770	antenna	(US-PGPUB; USPAT)	OR	ON	ON	2022/12/14 03:16 PM
L287	884	L285 AND L286	(US-PGPUB; USPAT)	OR	ON	ON	2022/12/14 03:16 PM
L288	969891	charging	(US-PGPUB; USPAT)	OR	ON	ON	2022/12/14 03:19 PM
L289	649	L287 AND L288	(US-PGPUB; USPAT)	OR	ON	ON	2022/12/14 03:20 PM
L290	10893332	@ad<="20140902"	(US-PGPUB; USPAT)	OR	ON	ON	2022/12/14 03:22 PM
L291	137	L289 AND L290	(US-PGPUB; USPAT)	OR	ON	ON	2022/12/14 03:22 PM
L292	6	(coil SAME (optical NEAR (window OR cover)) SAME wireless SAME charg$4)	(US-PGPUB; USPAT)	OR	ON	ON	2022/12/14 03:42 PM
L293	1369	(coil SAME ((window OR cover)) SAME wireless SAME charg$4)	(US-PGPUB; USPAT)	OR	ON	ON	2022/12/14 03:43 PM
L294	36905	wristwatch	(US-PGPUB; USPAT)	OR	ON	ON	2022/12/14 03:44 PM
L295	51	L293 AND L294	(US-PGPUB; USPAT)	OR	ON	ON	2022/12/14 03:44 PM
L296	424	((("Rothkopf") near3 ("Fletcher") near3 ("R"))).INV.	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2022/12/14 03:55 PM
L297	424	((("Rothkopf") near3 ("Fletcher") near3 ("R"))).INV.	(US-PGPUB; USPAT)	OR	ON	ON	2022/12/14 03:55 PM
L298	6	(11474483|10942491|10613485|10620591|10627783|10599101).pn.	(US-PGPUB; USPAT)	OR	ON	ON	2022/12/14 04:05 PM
L299	1209770	antenna	(US-PGPUB; USPAT)	OR	ON	ON	2022/12/14 04:25 PM
L300	282172	antenna.clm.	(US-PGPUB; USPAT)	OR	ON	ON	2022/12/14 04:25 PM
L301	1	L298 AND L300	(US-PGPUB; USPAT)	OR	ON	ON	2022/12/14 04:25 PM

L302	35	L297 AND L300	(US-PGPUB; USPAT)	OR	ON	ON	2022/12/14 04:33 PM
L303	207	ely-colin-m.in.	(US-PGPUB; USPAT)	OR	ON	ON	2022/12/14 04:37 PM
L304	14	L300 AND L303	(US-PGPUB; USPAT)	OR	ON	ON	2022/12/14 04:38 PM
L305	42	(4129124|4224948|4375219|6265789|20110056243|20120140556|20120221254|20140135594).pn.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/04/12 09:53 AM
L306	8	(4129124|4224948|4375219|6265789|20110056243|20120140556|20120221254|20140135594).pn.	(US-PGPUB; USPAT)	OR	ON	ON	2023/04/12 09:54 AM
L307	8	(4129124|4224948|4375219|6265789|20010056243|20120140559|20120221254|20140135594).pn.	(US-PGPUB; USPAT)	OR	ON	ON	2023/04/12 09:56 AM
L308	23	("0000002" OR "10060788" OR "10231629" OR "20010056243" OR "20050116820" OR "20070276270" OR "20080208009" OR "20120221254" OR "20140135594" OR "20150214749" OR "20150355604" OR "20160073914" OR "20160228064" OR "4129124" OR "4163447" OR "4224948" OR "4248244" OR "4375219" OR "5613008" OR "6075755" OR "6091530" OR "6265789" OR "9277880").pn.	(US-PGPUB; USPAT)	OR	ON	ON	2023/04/17 01:48 PM
L309	4524664	wo 2005/092182	(US-PGPUB; USPAT)	OR	ON	ON	2023/04/17 02:46 PM
L310	31051966	wo 2005/092182	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO;	OR	ON	ON	2023/04/17 02:46 PM

			JPO; DERWENT; IBM_TDB)				
L311	3	"wo 2005/092182"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/04/17 02:47 PM
L312	104	((US-9507459-B2 OR US-9680205-B2 OR US-9591913-B2 OR US-9791833-B1 OR US-8596860-B2 OR US-9288294-B2 OR US-D790517-S OR US-9547425-B2 OR US-7654732-B2 OR US-D768634-S OR US-9459781-B2 OR US-D758363-S OR US-D758219-S OR US-D752044-S OR US-D741726-S OR US-D737159-S OR US-D728624-S OR US-D727198-S OR US-9575591-B2 OR US-9781984-B2 OR US-9627163-B2 OR US-7932893-B1 OR US-9651922-B2 OR US-9971405-B2 OR US-6882596-B2 OR US-7034237-B2 OR US-8908477-B2 OR US-5738104-A OR US-4448199-A OR US-7286063-B2 OR US-9625944-B2 OR US-9615476-B2 OR US-9300344-B2 OR US-3577876-A OR US-D647107-S OR US-D578922-S OR US-8766805-B2 OR US-4903253-A OR US-7682070-B2 OR US-8630633-B1 OR US-5722397-A OR US-6694158-B2 OR US-7474592-B2 OR US-7674231-B2 OR US-8527038-B2 OR US-8617069-B2 OR US-8727977-B2 OR US-	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/04/17 02:49 PM

		8738118-B2 OR US-9622214-B2 OR US-9629120-B2 OR US-9704154-B2 OR US-9737212-B2 OR US-9737221-B2 OR US-9848825-B2 OR US-6158884-A OR US-6255951-B1 OR US-6350055-B1 OR US-6431455-B1 OR US-9091715-B2 OR US-9423418-B2 OR US-9288836-B1 OR US-6443906-B1 OR US-9386932-B2 OR US-9141087-B2 OR US-9049998-B2 OR US-8948832-B2 OR US-7385874-B2 OR US-11527824-B2 OR US-6825751-B1 OR US-6265789-B1 OR US-11526034-B1).did. AND USPT.dbnm.) OR ((US-20090124062-A1 OR US-20130236699-A1 OR US-20150085429-A1 OR US-20160064800-A1 OR US-20030174590-A1 OR US-20150351690-A1 OR US-20160064804-A1 OR US-20150124415-A1 OR US-20140107493-A1 OR US-20140278139-A1 OR US-20160091965-A1 OR US-20160198996-A1 OR US-20160367987-A1 OR US-20110003665-A1 OR US-20150313542-A1 OR US-20160274726-A1 OR US-20140366123-A1 OR US-20160313703-A1 OR US-20030175993-A1 OR US-20130234850-A1 OR US-20140139486-A1 OR US-20140276244-A1 OR US-20160350514-A1 OR US-20150186609-A1 OR US-20160379205-A1 OR					

		US-20170011210-A1 OR US-20170039358-A1 OR US-20170071483-A1 OR US-20140275852-A1 OR US-20140378777-A1 OR US-20150026647-A1 OR US-20100292599-A1 OR US-20010056243-A1).did. AND PGPB.dbnm.)					
L313	2	"17951973"	(US-PGPUB)	OR	ON	ON	2023/04/17 03:48 PM

PE2E SEARCH - Search History (Interference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	British Equivalents	Time Stamp
N153	0	(wearable AND housing AND band AND display AND (touch NEAR sensor) AND crown AND (rotatable OR rotational OR rotat$4) AND switch AND haptic).clm.	(US-PGPUB; USPAT)	OR	ON	ON	2018/12/12 07:07 AM
N154	0	(wearable AND housing AND band AND display AND (touch NEAR sensor) AND crown AND (rotatable OR rotational OR rotat$4) AND switch AND vibrat$4).clm.	(US-PGPUB; USPAT)	OR	ON	ON	2018/12/12 07:08 AM
N234	0	(watch AND housing AND cover AND (touch NEAr display) AND dielectric AND optical AND coil AND wireless AND (heart NEAR rate) AND (electrocardiog$4 OR "ECG" OR "EKG")).clm.	(US-PGPUB; USPAT)	OR	ON	ON	2020/10/22 03:24 PM
N242	1	(housing AND watch AND (band OR strap) AND cover AND dielectric AND coil AND charg$4 AND surface AND electrode AND (heart NEAr rate)).clm.	(US-PGPUB; USPAT)	OR	ON	ON	2020/10/29 01:39 PM