

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

MASIMO CORPORATION,
Petitioner,

v.

APPLE INC.,
Patent Owner.

Case No. IPR2023-00807
U.S. Patent No. 11,474,483

DECLARATION OF R. JAMES DUCKWORTH, PH.D

I declare that all statements made herein on 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.

I reserve the right to supplement my opinions in the future to respond to any arguments or positions Apple may raise, taking account of new information as it becomes available to me.

Dated: 3/31/2023



R. James Duckworth, Ph.D

TABLE OF CONTENTS

I.	INTRODUCTION	1
II.	INFORMATION AND MATERIALS CONSIDERED.....	1
III.	EXPERIENCE AND QUALIFICATIONS	6
IV.	APPLICABLE LEGAL STANDARDS	15
	A. Claim Construction	15
	B. Anticipation.....	16
	C. Obviousness	17
V.	LEVEL OF ORDINARY SKILL IN THE RELEVANT ART	20
VI.	CLAIM CONSTRUCTION.....	21
	1. “defining an optically transparent window”	22
VII.	SUMMARY OF OPINIONS	24
VIII.	THE ‘483 PATENT	25
	A. Overview of the ‘483 Patent	25
	B. Prosecution History of the ‘483 Patent	28
	C. Priority of the ‘483 Patent.....	31
IX.	BIOSENSING WATCHES THROUGH THE DECADES.....	31
X.	Introduction to Selected Prior Art References	60
	A. Kotanagi (EX1005).....	60
	B. Coppola (EX1009; EX1020).....	63
	C. Status of References as Prior Art	65
XI.	ANALYSIS OF SPECIFIC GROUNDS	71
	A. Ground 1: Claims 1–3, 5–6, 10–14, and 16–20 are unpatentable because they would have been obvious over Kotanagi in view of Coppola.	72
	1. Independent Claim 1	72
	2. Dependent Claim 2	91

3.	Dependent Claims 3 and 5	93
4.	Dependent Claim 6	94
5.	Independent Claim 10	95
6.	Dependent Claim 11	109
7.	Dependent Claim 12	110
8.	Dependent Claim 13	111
9.	Dependent Claim 14	112
10.	Independent Claim 16	113
11.	Dependent Claim 17	123
12.	Dependent Claim 18	123
13.	Dependent Claim 19	124
14.	Dependent Claim 20	125
B.	Ground 2: Claims 1–3, 5–6 and 10–14 are unpatentable because they would have been obvious over Kotanagi in view of Schmid.....	125
C.	Ground 3: Claim 4 is unpatentable because it would have been obvious over Kotanagi in view of Coppola and Tran.....	131
1.	Dependent Claim 4	131
D.	Ground 4: Claim 15 is unpatentable because it would have been obvious over Kotanagi in view of Coppola and further in view of Kateraas.	134
E.	Ground 5: Claim 7 is unpatentable because it would have been obvious over Kotanagi in view of Coppola or Schmid and further in view of Fraser.....	136
1.	Dependent Claim 7	136
F.	Ground 6: Claim 9 is unpatentable because it would have been obvious over Kotanagi, Coppola or Schmid, and further in view of Honda.	140
G.	Ground 7: Claim 8 is unpatentable because it would have been obvious over Kotanagi in view of Coppola or Schmid and further in view of Miller.....	145
1.	Dependent Claim 8	145
XII.	Condensed Summary of Opinions	150
XIII.	LACK OF OBJECTIVE INDICIA OF NONOBVIOUSNESS SUPPORTS INVALIDITY OF THE CHALLENGED CLAIMS	151

XIV. CONCLUSION.....	151
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I. INTRODUCTION

1. I, R. James Duckworth, Ph.D. have been retained by Knobbe, Martens, Olson & Bear, LLP, counsel for Patent Owner Masimo Corporation (“Masimo”). I am making this declaration at the request of Masimo in the matters of *Inter Partes* for claims 1–20 of U.S. Patent No. 11,474,483 (“the ’483 Patent”). I understand that Apple has asserted the ’483 patent against Petitioner in *Apple Inc. v. Masimo Corporation and Sound United, LLC*, U.S. District Court for the District of Delaware, Case No. 1:22-cv-01378-MN (“the Delaware Litigation”). I understand that this Declaration is being submitted as Exhibit 1003.

2. I am being compensated for my work in this matter at my standard hourly rate for expert consulting services. My compensation in no way depends on the outcome of this proceeding. I have no financial interest in any of the parties to these matters.

II. INFORMATION AND MATERIALS CONSIDERED

3. I have been asked to provide technical expert opinions relating to the validity of the claims of the ’483 Patent. In conducting the analyses and forming the opinions set forth in this Declaration, I have reviewed and considered the ’483 Patent’s claims, specification, and file history. I have also reviewed the prior art references relied upon in this Declaration and the Petition submitted herewith. I

have reviewed and considered at least the following materials in preparing this Declaration:

- The '483 Patent, including its claims, specification, and file history;
- The references cited in this Declaration, including but not limited to Kotanagi, Coppola, Schmid, Fraser, Kateraas, Tran, Miller, and Honda;
- Any materials referenced directly or indirectly in my Declaration; and
- The information and materials identified in the following table:

Exhibit No.	Description
1001	U.S. Patent No. 11,474,483 ('483 Patent)
1002	File History of the '483 Patent
1003	Declaration of Professor R. James Duckworth, Ph.D.
1004	<i>Curriculum Vitae</i> of Professor R. James Duckworth, Ph.D.
1005	PCT Publication No. WO 2005/092182 ("Kotanagi")
1006	U.S. Patent No. 6,265,789 to Honda ("Honda")
1007	U.S. Publication No. 2001/0056234 A1 ("Ohsaki")
1008	PCT Publication No. WO 2012/140559 A1 ("Shmueli")
1009	European Patent App. No. EP14163114 ("Coppola EP")
1010	U.S. Provisional Patent App. No. 61/976,388 ("Fei")

Exhibit No.	Description
1011	PCT Publication No. WO 2015/034149 A1 (“Choi”)
1014	US 20120221254 A1 (“Kateraas”)
1016	US 20140135594 (“Yuen”)
1022	U.S. Patent No. 4,129,124 (“Thalmann”)
1023	KR Patent No. 10-2136836 and English Translation (“Choi”)
1025	U.S. Patent No. 4,163,447 (“Orr”)
1026	U.S. Patent No. 4,224,948 (“Cramer”)
1027	U.S. Patent No. 4,248,244 (“Charnitski”)
1028	PCT Publication No. WO 1982000088 A1 (“Steuer”)
1029	U.S. Patent No. 4,375,219 (“Schmid”)
1030	U.S. Patent No. 5,316,008 (“Suga”)
1031	U.S. Patent No. 5,738,104 (“Lo”)
1033	US 20050116820 A1 (“Goldreich”)
1034	US 20070276270 A1 (“Tran”)
1035	US 20080208009 A1 (“Shklarski”)
1036	U.S. Patent No. 6,091,530 (“Duckworth”)
1037	U.S. Patent 6,075,755 (“Zarchan”)
1038	Y. Mendelson, “A Wearable Reflectance Pulse Oximeter for Remote Physiological Monitoring,” Proceedings of the 28th IEEE (2006)

Exhibit No.	Description
1039	Y. Mendelson, “Wearable Wireless Pulse Oximetry for Physiological Monitoring,” PPL Workshop (2008)
1041	US 20150355604 A1 (“Fraser”)
1047	USPTO Memo of April 5, 2018 regarding <i>Dynamic Drinkware</i> and <i>Amgen</i> cases
1048	District of Delaware Statistics, downloaded on February 21, 2023 from https://www.uscourts.gov/sites/default/files/data_tables/fcms_na_distprofile0930.2022.pdf
1049	U.S. Patent No. 8,624,836 (“Miller”)

4. In preparing this Declaration, I have considered my own knowledge and experience, including my work in the fields of electrical and computer engineering; my experience teaching within those subjects; my experience working with others involved in those fields; and the materials identified herein. I understand my analyses and opinions, including my review of any materials cited herein, should be made from the perspective of one of ordinary skill in the art related to the '483 Patent at the relevant time (i.e., a “POSITA”). I define my opinion on what constitutes a POSITA in Section V of this declaration. I understand the relevant time is September 2, 2014. Accordingly, my analyses and opinions are made from that

relevant perspective. My testimony herein refers to the knowledge of a POSITA as of September 2, 2014, unless indicated otherwise.

5. Any figures appearing in this Declaration were prepared with the assistance of counsel and reflect my understanding of the '483 Patent and the materials discussed herein.

III. EXPERIENCE AND QUALIFICATIONS

6. My academic and professional background is in electrical and computer engineering. I obtained a Bachelor of Engineering degree in Electrical and Electronic Engineering from the University of Bradford, England and a Ph.D. degree in Electrical and Electronic Engineering from the University of Nottingham, England. My Ph.D. thesis work concerned increasing the speed of data processing using multiple processing elements to complete computations in parallel and triggering computations based on the availability of data. After completing my Ph.D., I was a lecturer in the university's Computer Science Department for two years.

7. For more than 40 years, I have studied, designed, and worked in these fields. My experience includes over 35 years of teaching and research, including in the fields of pulse oximetry and other physiological monitoring technologies, low powered wireless sensor design, embedded system design, wearable technology, and indoor location tracking for first responders, among others.

8. I have been a professor of electrical and computer engineering at Worcester Polytechnic Institute ("WPI") for over 35 years. I joined WPI in January 1987 as an Assistant Professor of Electrical Engineering and was an Associate Professor of Electrical and Computer Engineering from July 1991 to June 2021. Presently, I am a Professor Emeritus of Electrical and Computer Engineering at WPI.

9. More recently, my research work has centered on Precision Personnel Location (PPL) for First Responders. This project started as a result of a tragic incident in Worcester in 1999, when six firefighters lost their lives in a warehouse fire. The overall goal of the PPL project is to protect the lives of emergency responders and to enhance their ability to accomplish their missions through research and development of systems for personnel location and tracking, movements, physiological and environment status monitoring, and command and control. The PPL project brought together diverse technical capabilities from other centers and laboratories at WPI to address important problems for emergency responders, the most critical of which is precise location and path tracking for each person in a building.

10. For over 30 years, I developed and taught courses at WPI relevant to the technology disclosed in the '483 Patent. The classes I developed and taught included associated laboratory exercises and projects, which I also developed. As reflected in my curriculum vitae (Exhibit 1004), I developed and taught at least the following relevant courses: (1) Microprocessor System Design; (2) Modeling and synthesis of digital system using Verilog and VHDL; (3) VHDL for Modeling and Synthesis; (4) Computer System Design; (5) Multi-processor and Distributed Systems; (6) Advanced Computer System Design; and (7) Advanced Digital System

Design with FPGAs. All of these courses pertain to the technology disclosed in the '483 Patent. For example, the "Advanced Digital System Design with FPGAs" course required students to interface peripheral sensors such as a light sensor with an analog-to-digital converter to read information from the sensors and a digital-to-analog converter to convert sensed data into waveforms for processing.

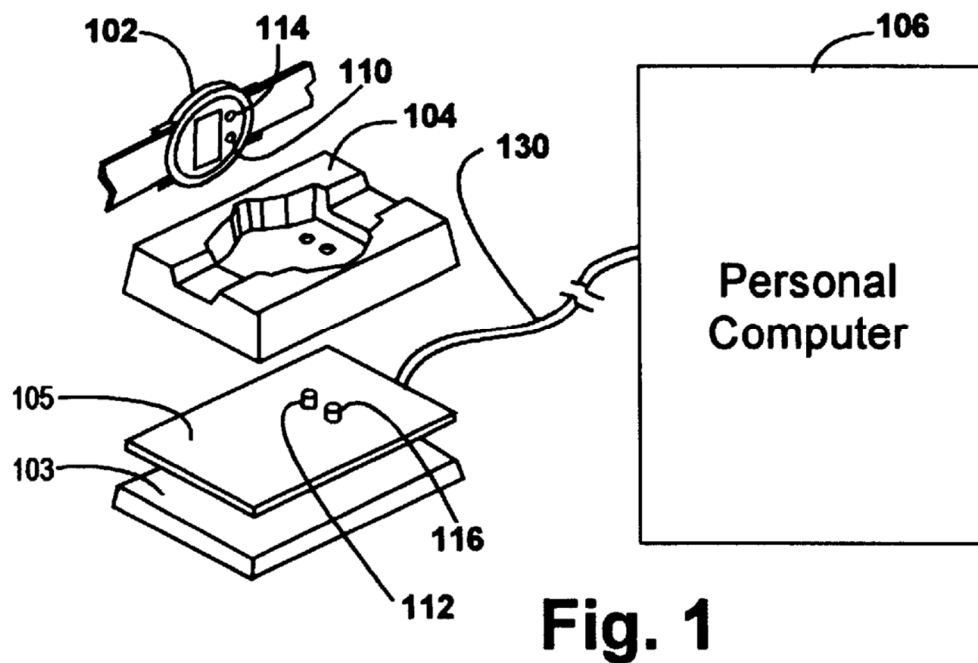
11. In the course of my work at WPI, I have advised hundreds of engineering students in B.S. and M.S. programs and advised or co-advised approximately ten Ph.D. students that have completed Ph.D. degrees.

12. Additionally, I have authored or co-authored dozens of technical papers in refereed journals and conference proceedings and given many conference presentations in the fields I have taught, researched, and worked.

13. Aside from my work at WPI, I have years of experience working with portable, battery powered sensors. During leave in approximately 2000 from WPI, I was the Vice President of Engineering for Adaptive Instruments. At Adaptive Instruments, I was responsible for designing and manufacturing a line of wireless industrial sensors for use in industrial process control. As a consultant, I helped program a small, battery powered device that included a microcontroller and custom LCD and was used to count the number of times an inhaler had been used. Also as a consultant in approximately the year 1997, I helped design and program a wrist-

worn device that reminded the user throughout the day of the medications that needed to be taken. My work on the wrist-worn device led to the patent I obtained on a “Low Power Infrared Communication System,” U.S. Patent No. 6,091,530, included as Exhibit 1036. This wearable electronic device had some similar functionality to the consumer product described in the ’483 patent. It was worn like a watch, provided watch functionality on a display, was battery powered, contained a microcontroller to calculate and display messages, employed an optical data communication system, and incorporated buttons for user control. EX1036 at Abstract, 2:7–17.¹ The system included a cradle shaped complimentary to the watch for data communication: “The cradle housing 104 is preferably shaped configured to receive and align the case of the watch 102 so that, when the watch 102 is placed in the shaped nest provided by 104, the watch IR emitter 110 is thereby aligned in close proximity with the cradle IR detector 112.” EX1036 4:38–42. This device, described in U.S. Patent No. 6,091,530, is shown in Figure 1 reproduced below:

¹ Citations herein containing a colon (“:”) are to columns and lines, where available, or to bates pages and lines (where lines are numbered). Citations to documents having square brackets “[]” for paragraph numbering use brackets instead of paragraph symbols “¶”.



EX1036 at Fig. 1.

14. My technical work also contributed to features in the same device shown in U.S. Patent 6,075,755 titled “Medical Reminder System and Messaging Watch,” included as Exhibit 1037. As with my ’530 patent above, the ’755 device incorporated a display with watch functionality (LCD display 110), was battery powered, contained a microcontroller to calculate and display medication reminder messages, employed an optical data communication system (infrared emitter and detector 116), and incorporated buttons (120, 122, 124, 126) for user control. EX1037 6:28–65. Figure 1 and Figure 4 of the ’755 patent are shown below:

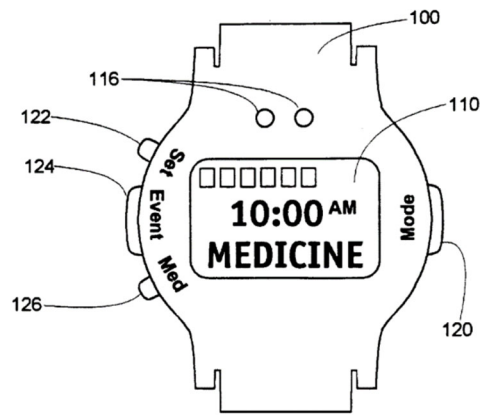


Fig. 1

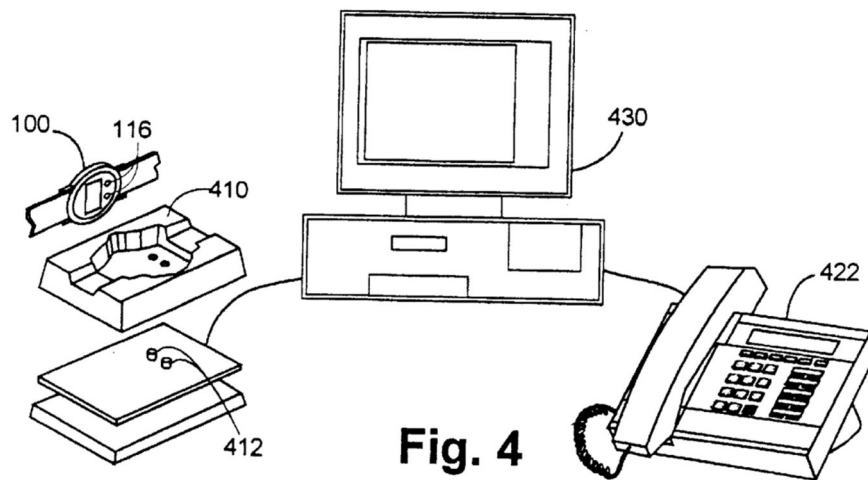
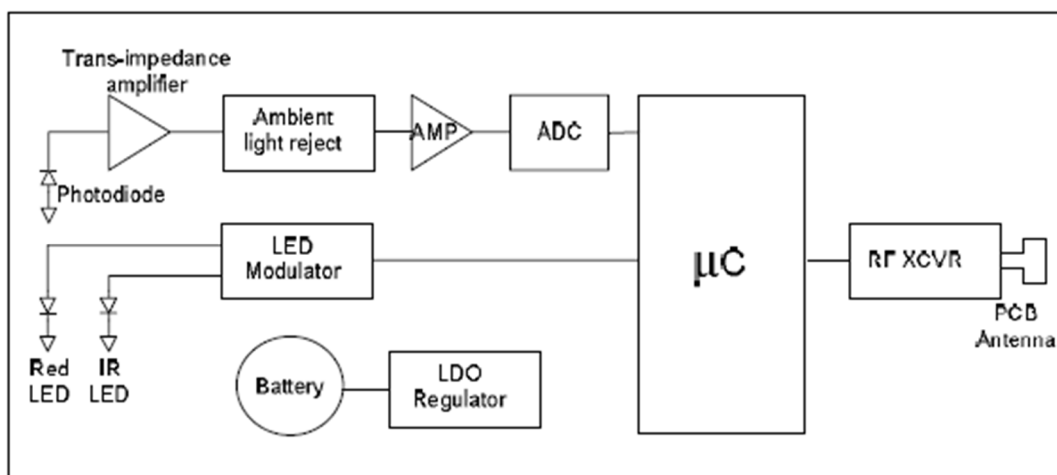
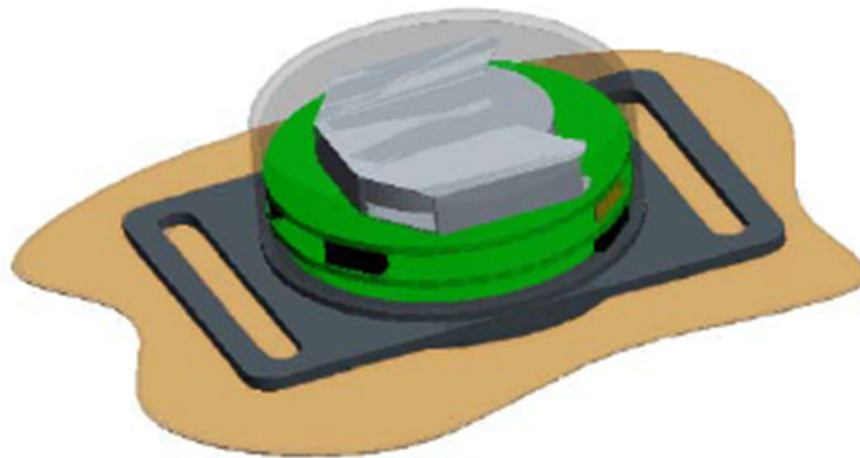


Fig. 4

EX1037 at Figs. 1, 4.

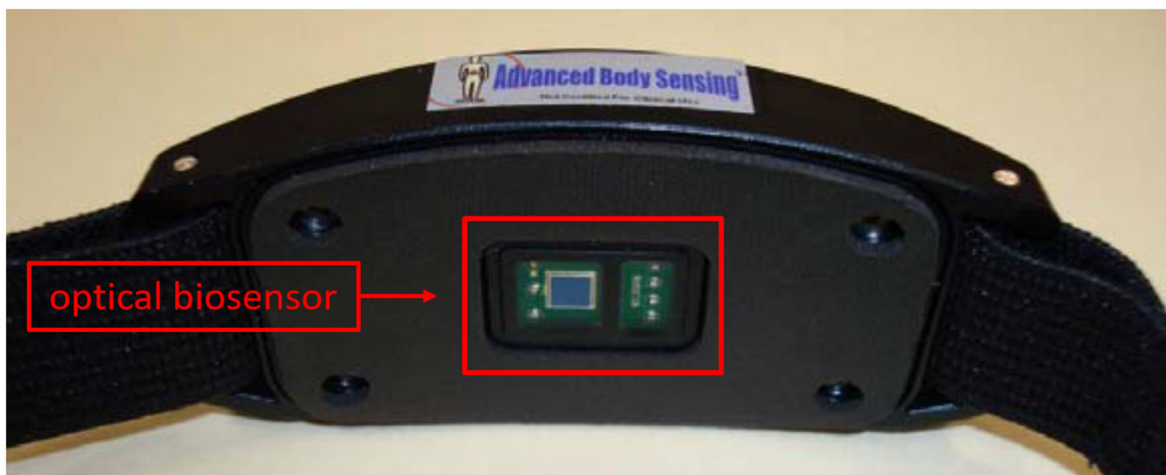
15. From 2005 through 2008, I worked extensively with my colleague at WPI, Professor Yitzhak Mendelson, Ph.D., to research, publish papers about, design, and make, wearable pulse oximetry devices. One publication stemming from this work is titled “A Wearable Reflectance Pulse Oximeter for Remote Physiological Monitoring,” which is included as Exhibit 1038. As stated in the paper, our wearable Pulse Oximeter measured arterial oxygen saturation (SpO_2) and utilized the principle

of photoplethysmography: “Pulse oximetry also relies on the detection of photoplethysmographic (PPG) signals produced by variations in the quantity of arterial blood that is associated with periodic contractions and relaxations of the heart.” EX1038 at 1. As shown below, our Pulse Oximeter incorporated a photodiode, a red LED, and an infrared LED.



EX1038 at 2.

16. Subsequently, in July 2007, Professor Mendelson and I formed a company together called Advanced Body Sensing to design, develop, and build a new, wireless, battery powered, forehead-mounted reflectance pulse oximetry device. To meet these design goals, we had to develop a completely new device, as our prior work concerned prototype devices that required an external power supply and additional instrumentation to operate. Together, Professor Mendelson and I developed a new housing, optical sensor, and associated electronics, including the design and programming of microprocessor and wireless transmission components. Our design and development process led us to the final forehead-mounted pulse oximetry device shown below.



EX1039 at 24 (annotated).

17. Our device included an optical biosensor with two LED's and a photodetector, as highlighted above. Over the course of 2007 and 2008, Advanced

Body Sensing received over \$1,000,000 to develop and build the above pulse oximetry devices for the United States Air Force. The device above was designed to be “integrated into a headband or a helmet” (EX1039 at 2), such as for army use, but the basic principle allows measurements on various skin surfaces of the body. On August 4, 2008, Professor Mendelson presented on our Advanced Body Sensing work, including the above device, at an annual international technology conference held at WPI called the PPL Workshop. His presentation, titled “Wearable Wireless Pulse Oximetry for Physiological Monitoring,” is included as Exhibit 1039.

18. In addition to those listed above, I am a named co-inventor on several patents, including:

- U.S. Patent No. 7,292,189, issued in 2007, titled “Methods and Apparatus for High Resolution Positioning”

- U.S. Patent No. 9,476,963, issued in 2016, titled “Search and Rescue Method and System”

- U.S. Patent No. 9,658,309, issued in 2017, titled “Precision Location Method and System”; and

- U.S. Patent No. 9,846,042, issued in 2017, titled “Gyroscope Assisted Scalable Visual Simultaneous Localization and Mapping.”

19. Above, I have provided a short summary of my education and experience that I believe is most relevant to the analyses and opinions I have expressed in this Declaration. A copy of my curriculum vitae, which describes in further detail my qualifications, responsibilities, employment history, honors, awards, professional associations, presentations, publications, and patents is included as Exhibit 1004.

IV. APPLICABLE LEGAL STANDARDS

20. I am an electrical and computer engineer by training and profession. The opinions I express in this Declaration involve the application of my knowledge and experience to the evaluation of the '483 Patent and certain prior art to the '483 Patent.

21. Although I have been involved as a technical expert in patent matters before, I am not an expert in patent law. Therefore, I have been advised of certain principles of patent law applicable in this matter, which I have used in arriving at my determinations and opinions. The paragraphs below express my understanding of the legal requirements I have used in forming my opinions.

A. Claim Construction

22. I understand that, in assessing the patentability of a patent claim, the Patent Office generally construes claim terms by giving them their ordinary and customary meaning, as they would have been understood by a POSITA at the time

of filing in view of the intrinsic record (patent specification and file history). However, I understand that the inventors may, in the patent specification, expressly define a claim term to have a meaning that differs from the term's ordinary and customary meaning. I also understand that the inventors may disavow or disclaim certain claim scope, thereby departing from the ordinary and customary meaning, when the intrinsic record demonstrates that a clear and unambiguous disavowal or disclaimer has occurred. I understand that extrinsic evidence, such as relevant technical literature and dictionaries, may be useful in ascertaining how a POSITA would have understood a claim term, but the intrinsic record is the primary source for determining the meaning of claim terms. For the purposes of this review, and to the extent necessary, I have interpreted each claim term in accordance with the principles set forth in this paragraph.

23. I understand that the preamble of a claim is limiting where it supplies antecedent basis for a subsequent claim limitation.

B. Anticipation

24. It is my understanding that a claim is unpatentable as "anticipated" under 35 U.S.C. § 102 if a single prior art reference discloses every limitation of the claim, arranged as in the claim. I understand that a prior art reference does not anticipate a claim, however, when it discloses multiple, distinct teachings that a

POSITA might somehow combine to achieve the claimed invention. I understand that anticipation has not been alleged in the grounds of the petition, and, thus, is not at issue.

C. Obviousness

25. I understand that a claim is unpatentable as “obvious” under 35 U.S.C. § 103 if the claimed subject matter as a whole would have been obvious to a POSITA at the time of filing. I also understand that an obviousness analysis takes into account the following factors, which are sometimes referred to as the *Graham* factors: (1) the scope and content of the prior art, (2) the differences between the claimed subject matter and the prior art, (3) the level of ordinary skill in the art at the time of the invention, and (4) “objective indicia of non-obviousness,” also referred to as secondary considerations of non-obviousness. Although it often does not explicitly refer to *Graham* factors (1) and (2), this Declaration addresses each of these factors in great detail, finding that given the scope and content of the prior art, differences between this art and the claimed subject matter are limited—concluding that the claims are not patentable. For factor (4), I understand that these objective indicia include considerations such as whether there was: (i) any unexpected result(s); (ii) skepticism of the invention; (iii) a teaching away from the invention; (iv) failure of others to find the solution(s) provided by the claimed invention; (v) copying by other companies; (vi) commercial success due to the merits of the claimed invention; (vii)

praise by others for the invention; and (viii) a long-felt need in the industry for the claimed invention.

26. In determining the scope and content of the prior art, factor (1), it is my understanding that a reference is considered appropriate prior art if it falls within the field of the inventor's endeavor. In addition, a reference is appropriate prior art if it is reasonably pertinent to the particular problem with which the inventor was involved. A reference is reasonably pertinent if it logically would have commended itself to an inventor's attention in considering his or her problem. If a reference relates to the same problem as the claimed invention, that supports use of the reference as prior art in an obviousness analysis.

27. To assess the differences between prior art and the claimed subject matter, it is my understanding that 35 U.S.C. § 103 requires the claimed invention to be considered as a whole. I understand that this "as a whole" assessment typically involves a showing that a POSITA at the time of filing, confronted by the same problems as the inventor and with no knowledge of the claimed invention, would have selected the elements from the prior art and combined them in the claimed manner.

28. It is my further understanding that the Supreme Court has recognized several rationales for combining references or modifying a reference to show obviousness of claimed subject matter. Some of these rationales include: combining

prior art elements according to known methods to yield predictable results; simple substitution of one known element for another to obtain predictable results; a predictable use of prior art elements according to their established functions; applying a known technique to a known device (method or product) ready for improvement to yield predictable results; choosing from a finite number of identified, predictable solutions, with a reasonable expectation of success; and some teaching, suggestion, or motivation that would have led a POSITA to modify the prior art reference or to combine prior art reference teachings to arrive at the claimed invention. These rationales provide the foundation for all the obviousness combinations discussed in this declaration, whether explicitly recognized or not.

29. I understand that the obviousness analysis must be performed from the perspective of a POSITA, which occurs at the time of the alleged invention. I understand this requirement is to help avoid using hindsight in the analysis. I further understand that the claims of the patent-at-issue must not be used to provide a road map for obviousness; instead, the claims would have been obvious only if a POSITA, without knowledge of the patent-at-issue, would have been motivated to combine the teachings of the prior art to arrive at the claimed invention and had a reasonable expectation of success in doing so.

30. I understand that an assessment of what a reference discloses or teaches—for purposes of an anticipation analysis or an obviousness analysis—is

conducted from the perspective of a POSITA at the time of filing. In other words, a reference discloses or teaches a claim limitation if a POSITA would have, at the relevant time, interpreted the reference as expressly, implicitly, or inherently disclosing the claim limitation. I further understand that a reference does not need to use the exact language of the claim to disclose a claim limitation. I also understand that something is only “inherent in,” and therefore taught by the prior art if it necessarily flows from the explicit disclosure of the prior art. I understand that even if a certain result or characteristic may be present in the prior art, that is not always sufficient to establish inherency.

31. I understand that the obviousness analysis also must show that the prior art, taken as a whole, enables a POSITA to make and use the claimed invention.

32. Applying these legal standards to Claims 1–20 of the ‘483 Patent, I believe Claims 1–20 would have been obvious to a POSITA based on the grounds discussed below.

V. LEVEL OF ORDINARY SKILL IN THE RELEVANT ART

33. The field of art relevant to the ‘483 Patent is biosensing watches and personal electronic devices, and the problems addressed were for arrangement of optical and electrical biosensors on such devices.

34. I understand that the level of ordinary skill in the art for the ‘483 Patent is determined as of September 2, 2014, which is the earliest alleged effective filing

date of the patent. I also understand that Apple has not alleged that the '483 Patent is entitled to an effective filing date other than September 2, 2014.

35. A POSITA of the '483 patent would have had at least a bachelor's degree in a discipline related to electrical engineering, mechanical engineering, physics, industrial design, or equivalent, and at least three years of experience working with or developing electronic medical or consumer devices.

36. I understand the capabilities of a POSITA as of September 2014. Indeed, I possessed at least those capabilities myself before, during, and after that time. As a professor of electrical and computer engineering for over three decades, I have taught many such persons and understand the level of knowledge and skill that persons with such academic experience would have possessed in September 2014. Through my education and decades of experience, such as teaching relevant engineering courses, I am familiar with what a POSITA would have understood in September 2014 and qualified to provide opinions from the perspective of a POSITA at the relevant time.

VI. CLAIM CONSTRUCTION

37. I have interpreted claim terms in accordance with the claim construction principles set forth above.

38. Numerous claim terms are construed based on their ordinary meanings or otherwise in the context of the invalidity analysis in this Declaration, consistent

with the law as it has been explained to me—such as *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005). Construction of an example phrase is also discussed here for convenience.

1. “defining an optically transparent window”

39. Claims 1 and 10 recite that a cover “defines” an optically transparent window. The ’483 patent does not provide a special definition for “window,” although the ’483 patent often recites “windows or apertures.” EX1001 28:38–29.² The ’483 patent refers to the windows in the following context:

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. . . . [T]he 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.

* * *

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

² Citations containing a colon (“:”) are to columns and lines, where available, or to bates pages and lines, where lines are numbered. Citations to documents having square brackets “[]” for paragraph numbering use brackets instead of paragraph symbols “¶”.

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.

EX1001 26:12–19. *Id.* 40:46–67.

40. Accordingly, the '483 patent describes a single sheet of material (rear cover 608) positioned within a single opening in a housing (opening 601). In Figure 16, this sheet defines multiple windows or apertures (EX1001 42:28–35), where the detector and light sources are positioned immediately behind that sheet.

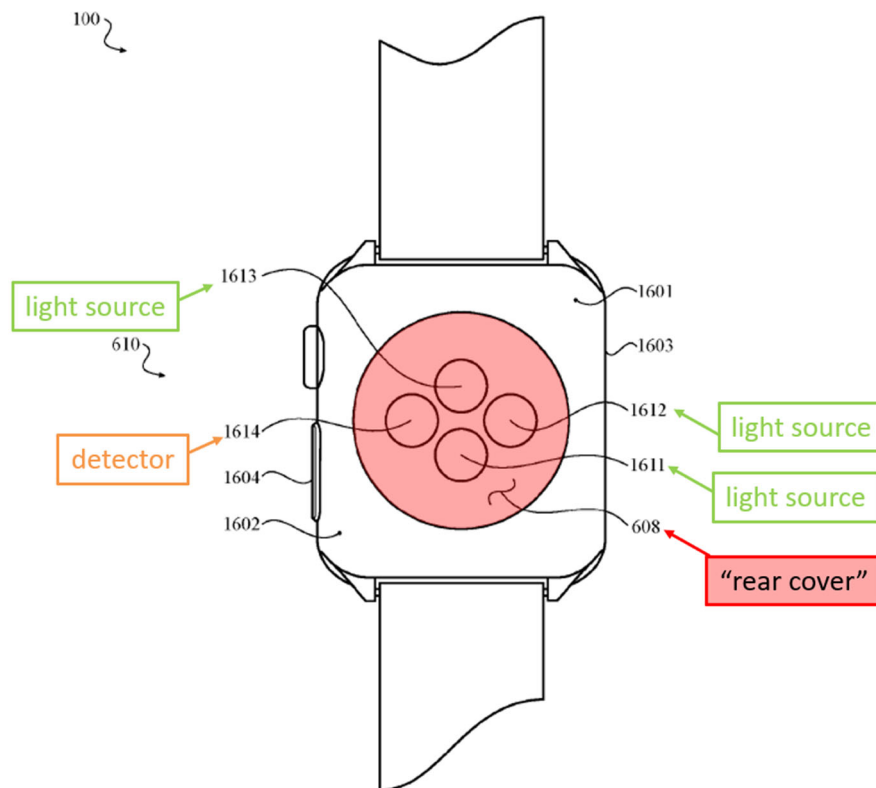


FIG. 16

See EX1001 at 22.

41. Thus, for a cover to “define” an optically transparent window simply means to allow passage of light to a relevant component through an opening and optically transparent window. In the ’483 patent, the single rear cover 608 “defines” multiple openings by allowing passage of light through the round portions labeled 1611–1614 in Fig. 16.

VII. SUMMARY OF OPINIONS

42. I have conducted analyses leading to the opinions expressed in this Declaration. To summarize those opinions, it is my conclusion, from a technical point of view, that Claims 1-20 of the ’483 Patent would not have been obvious to a POSITA based on the teachings of the prior art.

43. It is my opinion that:

- Ground 1: Claims 1–3, 5–6, 10–14, and 16–20 of the ’483 Patent would have been obvious to a POSITA based on Kotanagi in view of Coppola.
- Ground 2: Claims 1–3, 5–6, and 10–14 of the ’483 Patent would have been obvious to a POSITA based on Kotanagi in view of Schmid.
- Ground 3: Claim 4 of the ’483 Patent would have been obvious to a POSITA based on Kotanagi in view of Coppola and Tran.

- Ground 4: Claim 15 of the '483 Patent would have been obvious to a POSITA based on Kotanagi in view of Coppola and Kateraas.
- Ground 5: Claim 7 of the '483 Patent would have been obvious to a POSITA based on Kotanagi in view of Coppola or Schmid, and Fraser.
- Ground 6: Claim 9 of the '483 Patent would have been obvious to a POSITA based on Kotanagi in view of Coppola or Schmid, and Honda.
- Ground 7: Claim 8 of the '483 Patent would have been obvious to a POSITA based on Kotanagi in view of Coppola or Schmid, and Miller.

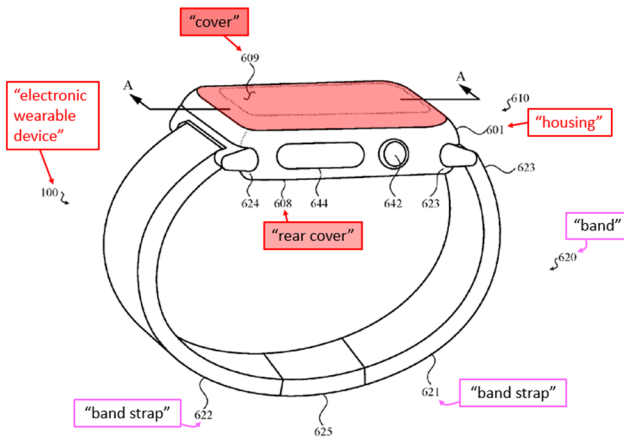
44. Below, I provide the complete analyses supporting my opinions.

VIII. THE '483 PATENT

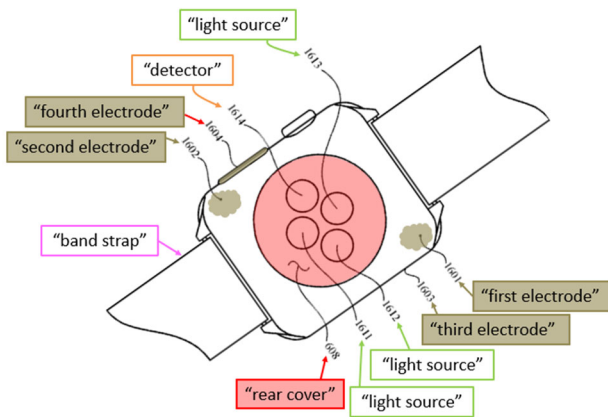
A. Overview of the '483 Patent

45. Apple's '483 patent purports to claim novel improvements to health-monitoring smart watches. However, in my opinion the challenged claims recite features that were well known prior to the '483 Patent. Their combinations in the claims provided no results or benefits that would have been unexpected to a POSITA. Some of those features are shown in the annotated figures below comparing the '483 Patent to figures from a 2005 patent to Kotanagi:

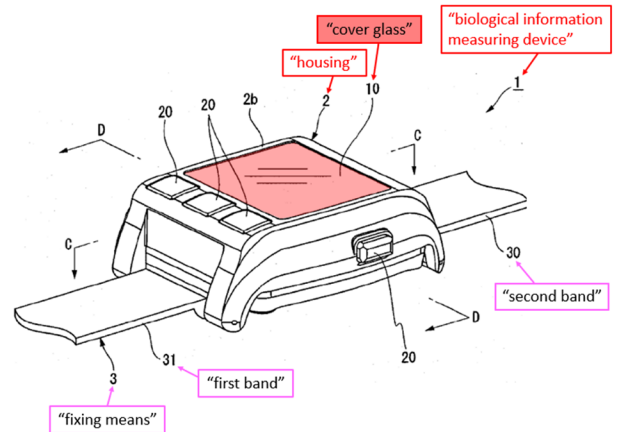
'483 Patent



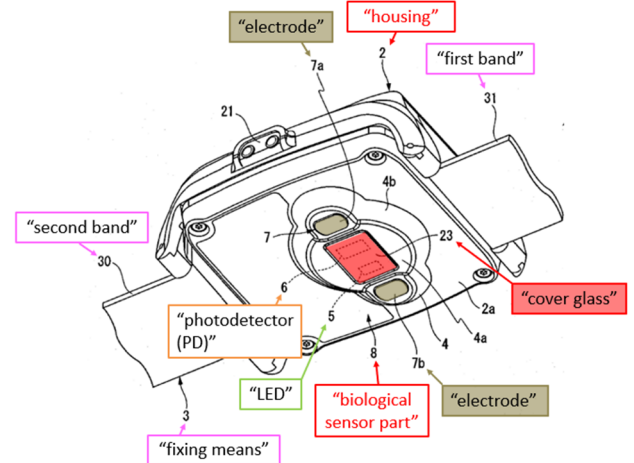
'483 Patent



Prior Art – Kotanagi



Prior Art - Kotanagi



*See*³ EX1001 at 12, 22 (Figs. 6 and 16); *see* EX1005 at 25–26 (Figs. 4 and 5).

3

³ In this Declaration, color feature labels and color shadings are added for convenience and do not come from the cited patent drawings themselves.

46. Kotanagi was a material oversight in the examination of the ‘483 patent, as its teachings in combination with other references make obvious the limitations recited in the ‘483 patent. For example, prior to allowance Claim 21 (allowed Claim 1) and independent Claim 28 (allowed Claim 10) were amended to recite two electrodes on the “rear exterior surface” of the watch prior to allowance. EX1002 at 138–142. However, as shown in the figure above, Kotanagi plainly teaches two electrodes, 7a and 7b, positioned on the rear of an optical biosensing watch.

47. Additionally, all of the independent claims of the ‘483 patent were amended to recite a “third electrode” positioned along the “side” of the device. EX1002 at 138–142. With this amendment, Apple argued that “skin-contacting electrodes[] cannot simply be moved to another location without incurring significant engineering challenges” and that one would not expect that “the modification could be performed successfully without impacting the operation of the device.” EX1002 at 144.

48. However, Kotanagi teaches its “electrodes need not be a pair, and a plurality of electrodes, for example, may be provided.” EX1005 ¶14. *See Id.* ¶86. As explained further below, secondary reference Coppola teaches a biosensing watch with multiple electrodes and that “[b]y 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.” EX1009 at 16:21–23; EX1020 at 14:14–16.

Coppola further teaches that the placement of electrodes is not limited and “at least two of all electrodes of the electrical sensing unit 28 are arranged on two different surfaces” of the device. EX1009 18:5–6; EX1020 15:32–33.

49. These and other limitations were known in the prior art, as will be explained further below.

B. Prosecution History of the '483 Patent

50. I have reviewed Exhibit 1002, the prosecution history of the '483 patent, to help form my opinion in this matter. The following highlights only some portions of that file history.

51. The Examiner rejected the pending Claims 21–40 in a single Non-Final Rejection. EX1002 at 700–702. The Non-Final Rejection cited Hong and Lo prior art references. Although Hong had electrodes in different locations, the Examiner placed little weight on the electrode location:

Hong et al. teaches that skin conductance electrodes may be mounted on the strap. However, **this difference merely pertains to the location of the electrode sensors, not to the function.** The function of the sensors is independent of [sic] location, whether in the housing or on the band the sensors would function in the same manner and provide the same data. Thus, **the location of the sensor, as long as it contacts**

the skin, does not affect or influence the operation of the sensor and presents little critical structure... since the modification would pertain to rearranging the location of working elements, wherein the **rearranged location would continue to provide similar measurements from such sensors.**

EX1002 at 704–705 (emphasis supplied).

52. In response to the Non-Final Rejection, Apple argued and emphasized that “skin-contacting electrodes[] cannot simply be moved to another location without incurring significant engineering challenges.” *Id.* at 144; *see also id.* at 145 (asserting “significant engineering challenges” with rearrangement). Apple argued over primary reference Hong, which taught electrodes in the band of a biosensing watch, and secondary reference Lo (EX1031), which taught two ECG electrodes on the front of the housing of a biosensing watch and one ECG electrode on the back of the housing of the watch. *Id.* at 144–145. Apple argued that Lo does not describe any electrical contacts “positioned along a side of the wearable electronic device” and that one would not “rearrange Lo’s electrodes . . . without encountering significant engineering challenges.” *Id.* at 145. No expert testimony or affidavit was provided to establish any of the facts presented in Apple’s arguments regarding rearranging electrodes. *See id.* generally.

53. Apple amended the claims in the same response to recite the position of the three electrodes on the device, each independent claim now reciting a “third electrode positioned along a side” of the device. EX1002 at 138–142. It appears the Examiner was persuaded by Apple’s assertions and thereafter issued a Notice of Allowance. This stated the claims were allowable because “the prior art fails to describe the configuration of the electrodes as presently recited *with respect to the locations on the housing*.” EX1002 at 40 (emphasis added). However, the Examiner did not consider, and Applicant did not cite, any of the references that are relied upon in the grounds of this Declaration. *See generally* EX1002. These references teach what the Applicant alleged was missing from the prior art: a wearable electronic device with electrical contacts “positioned along a side.” EX1002 at 145 EX1009 at 16:21–23; EX1020 at 14:14–16.

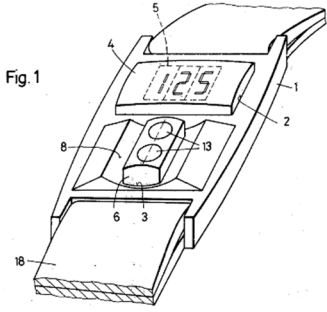
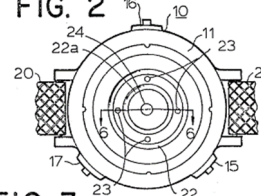
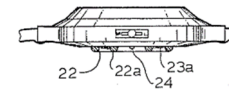
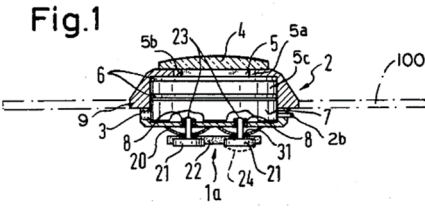
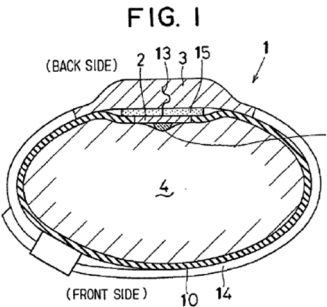
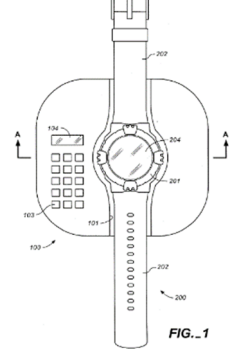
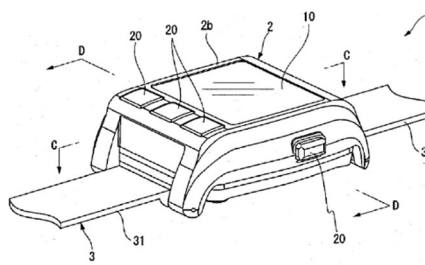
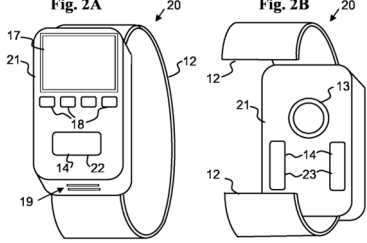
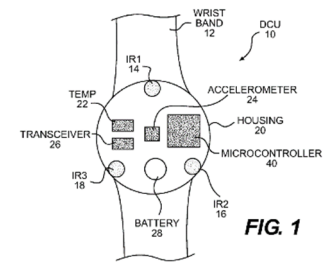
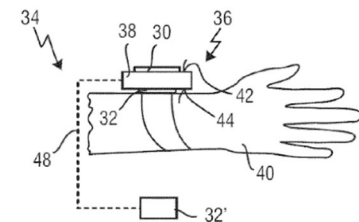
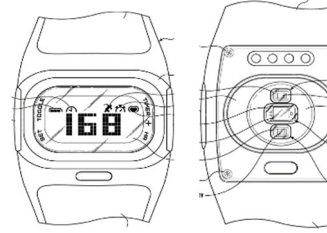
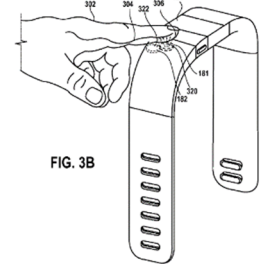
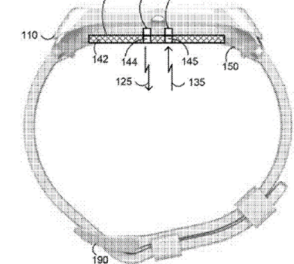
54. Additionally, Coppola teaches what Apple alleged would cause “significant engineering challenges”: rearranging electrodes. Coppola teaches an embodiment with an electrode on the front, but then goes on to refer to rearranging from front, to side: “By placing first electrode 30 *not on the front side* 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.” EX1009 at 16:21–23; EX1020 at 14:14–16 (emphasis added).

C. Priority of the '483 Patent

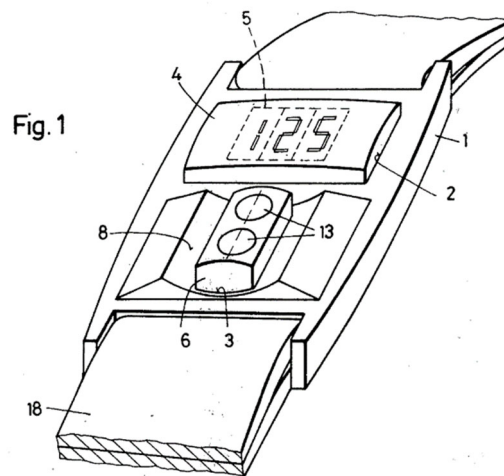
55. The '483 patent was filed February 15, 2022, which is a continuation of U.S. Application No. 17/188,966, filed on March 1, 2021 and U.S. Application No. 17/188,995, filed on March 1, 2021, both of which are continuations of U.S. Application No. 16,826,130, filed on March 20, 2020 which Claims priority to U.S. Application Nos. 15/261,912, 15/261,914, and 15/261,917, all filed on September 10, 2016. EX1002 at 900–903. Applications 15/261,912, 15/261,914, and 15/261,917 are all continuations of U.S. Application No. 14/842,617, filed September 1, 2015, which Claims priority to provisional application 62/044,974, filed September 2, 2014. EX1002 at 900–903. Thus, the earliest alleged priority date of the '483 Patent is September 2, 2014. EX1001 at 1.

IX. BIOSENSING WATCHES THROUGH THE DECADES

56. Biosensing wristwatches were known for decades prior to the earliest September 2014 filing of Apple's patent. A graphical overview of some of these devices is shown in the table below.

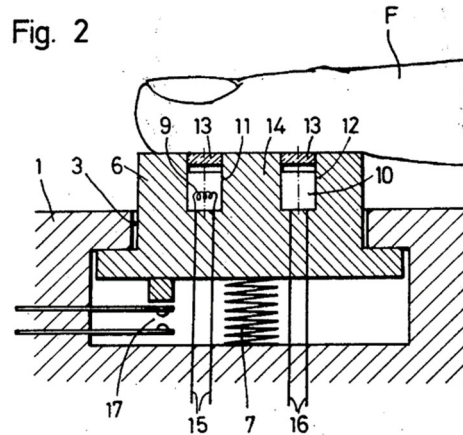
 Thalmann (EX1022) - 1978 US Pat. 4,129,124	  Cramer (EX1026)-1980 US Pat. 4,224,948	 Schmid (EX1029) - 1980 US Pat. 4,375,219
 Ohsaki (EX1007) - 2001 PCT Pub. 2001/0056243	 Honda (EX1006) - 2001 US Pat. 6,265,789	 Kotanagi (EX1005) - 2005 PCT Pub. WO2005/092182
 Shmueli (EX1008) - 2012 PCT Pub. 2012/140559	 Kateraas (EX1014)-2012 US Pub 2012/0221254	 Coppola (EX1020) - 2014 EP App. 141631147
 Fei (EX1010) - 2014 US Prov. App. 61/976388	 Yuen (EX1016) - 2014 US Pub 2014/0135594	 Fraser (EX1041)-Filed 2014 US Pub 2015/0355604

57. One of the earliest patents showing an optical pulse-rate sensor incorporated into a wristwatch device was U.S. Patent 4,129,124 in 1978 to Thalmann (“Thalmann,” EX1022). Thalmann constructed a wristwatch device having an optical pulse-rate sensor incorporated on the upper surface of the device, as shown below:



EX1022, Fig. 1.

58. In Thalmann’s device a user would place their finger on the upper surface of pushbutton 6, which contains translucent plugs 13. *Id.* 1:35–44. Below translucent plugs 13 are light source 9 and photosensitive element 10, as shown below:

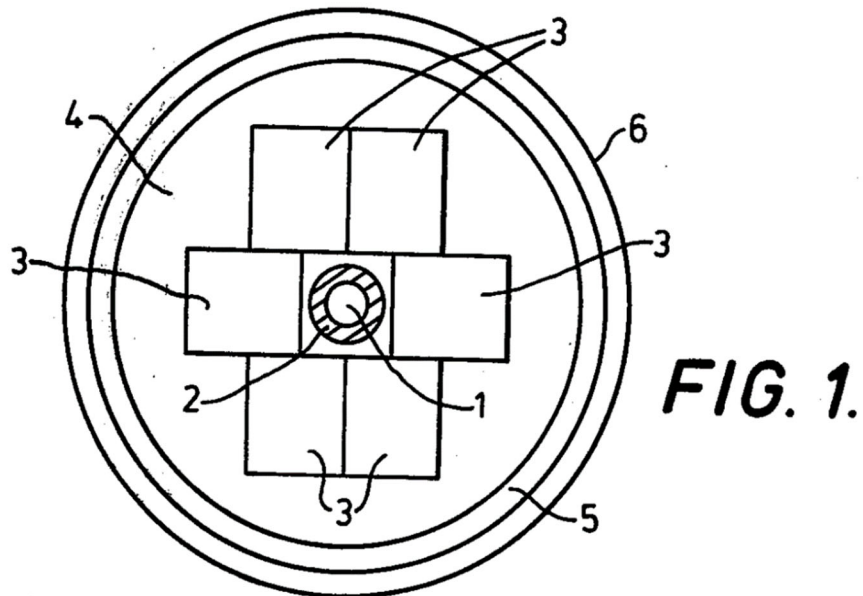


Id., Fig. 2.

59. Thalmann describes that “light source 9 emits light upon being supplied with electric current over connecting wires 15, and finger F is placed upon pushbutton 6, light penetrates into finger F” as a result of the reflected light “[t]he intensity of the light incident upon element 10 is dependent upon the perfusion of blood in finger F placed upon pushbutton 6. The perfusion of blood in finger F is influenced by the pulse.” *Id.* 2:17–25. Thus, Thalmann teaches a wristwatch device for pulse detection.

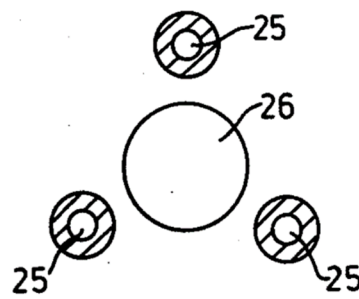
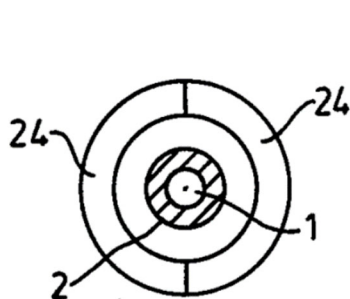
60. Following Thalmann, inventors experimented with placing light emitting components and photodetecting sensors on the back side of a wristwatch. Orr, U.S. Patent 4,163,447 (“Orr,” EX1025) granted in 1979, is one early example of this. As shown below, Orr demonstrated a configuration with “light emitting diode 1 and the photodiodes 3 disposed on the rear surface of a wristwatch casing 6” in

order to detect a pulse signal. EX1025 3:34–36. This particular configuration is shown below:



Id., Fig. 1.

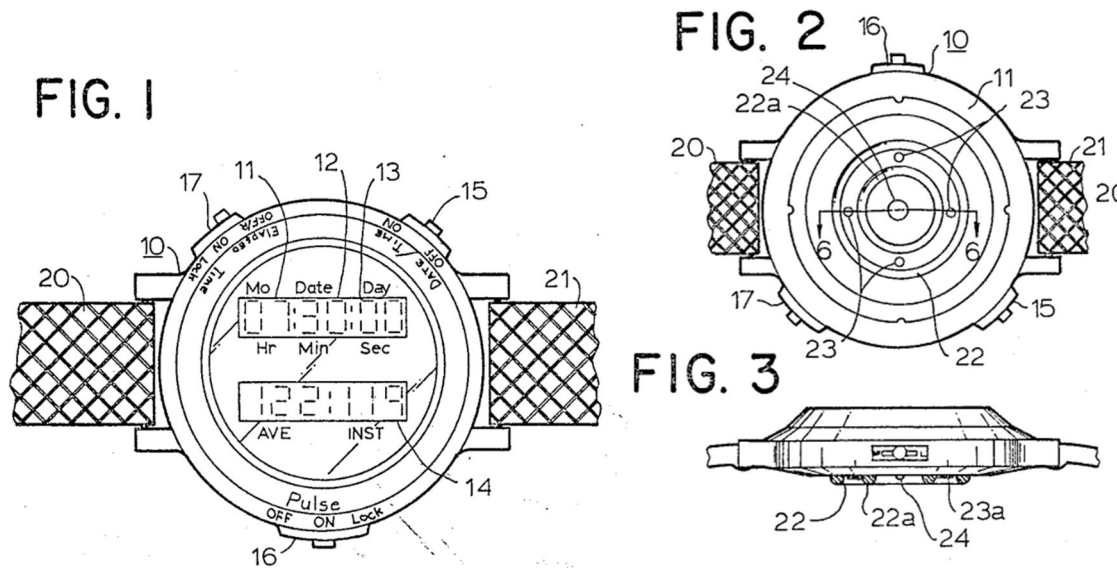
61. Orr teaches in other embodiments that the placement of the photodiodes and LED's on the back of a biosensing watch could vary. This is shown below in Figures 4 and 5:



Id., Figs. 4, 5.

62. Orr additionally teaches that its wristwatch may be provided with a rechargeable battery and that the “battery is recharged with current derived from a semiconductor detector which is also alternatively used to produce a signal in dependence on the heartbeat rate.” EX1025 1:36–39. Thus, Orr teaches a wristwatch with a form of “wireless” charging via light incident on the photodetector on the rear side of Orr’s watch.

63. Orr was followed by further innovations in biosensing watches. In 1980 Cramer was granted U.S. Patent 4,224,948 (“Cramer,” EX1026) titled “Wrist borne pulse meter/chronometer.” EX1026 at 1. Like Orr, Cramer placed optical elements for pulse detection on the back side of a wristwatch. In the picture below, “infra-red source 24” is surrounded by a “detector array 23” as an optical biosensor. EX1026 5:41–42.



Id., Figs. 1,2.

64. Instead of the opaque regions in Orr, Cramer placed ridges or “boss 22” and “boss 22a” between the light and the detectors in order to “prevent[] direct transmission of light between source 24 and detectors 23.” EX1026 5:45–48. Thus, from Orr and Cramer a POSITA would have known that additional light source and detector configurations on the back of a wristwatch are possible.

65. In the following year, 1981, U.S. Patent 4,248,244 was granted to Charnitski (“Charnitski,” EX1027) which incorporated an “electrode section 11” comprising “capacitive plate” 13 and 17 on the top and bottom of the watch with “insulating surfaces 15 and 19” over the capacitive plates and an “electrode 21” in the form of the wrist band of the watch, shown below. EX1027 5:10–15; 2:52.

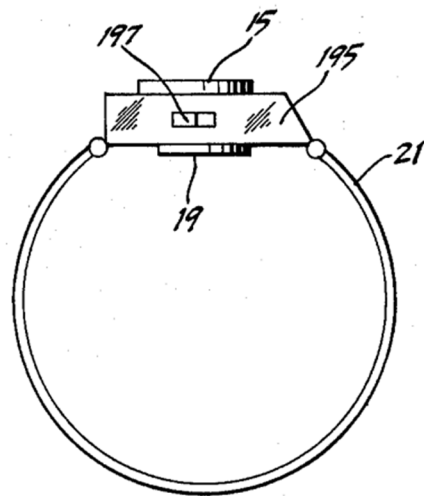


Fig. 2

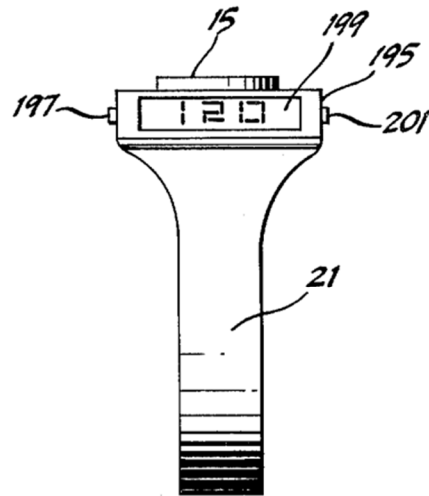
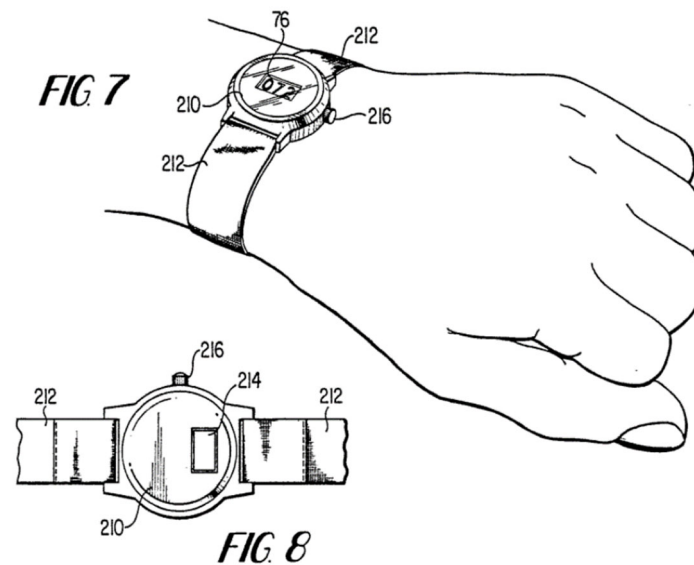


Fig. 3

Id., Figs. 2,3.

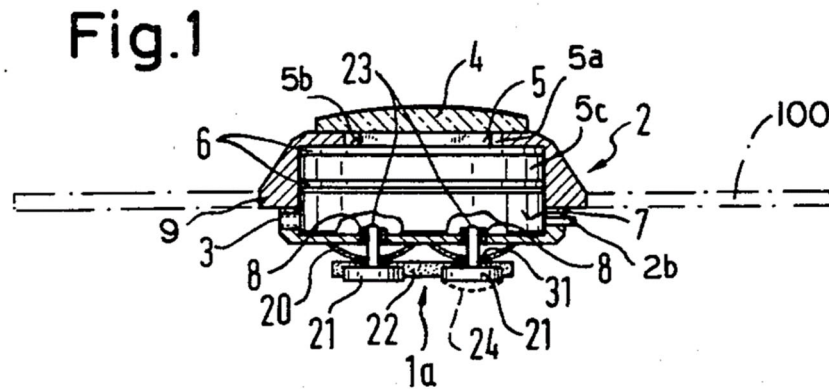
66. Charnitski notes that its watch is superior to the prior art because “electrodes of electrode section 11 have the ability to produce an ECG signal without the necessity of preparing the skin of a living subject with a material such as a conductive gel to accept the electrodes.” EX1027 7:5–8.

67. In the following year of 1982, WO 1982000088 A1 was published by Steuer (“Steuer,” EX1028). Steuer teaches “A sensor 12, which may be a conventional pressure transducer or a light emitting diode/photocell combination, [which] 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.” EX1028 6:15–20. These sensors function as a cardiometer by measuring systolic heartbeats. EX1028 1. Steuer’s system is shown below:



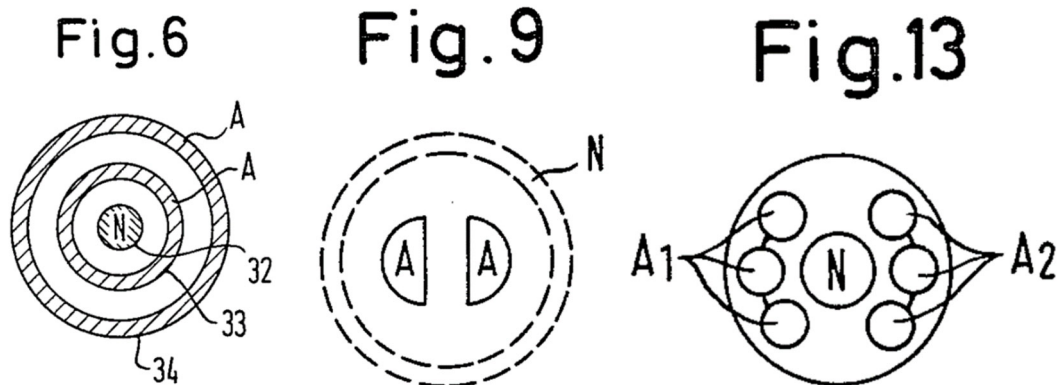
Id., Fig. 8.

68. In the following year, U.S. Patent 4,375,219 was granted to Schmid (“Schmid,” EX1029) relating to ECG/EKG measurements with a biosensing watch. In particular, Schmid modified the design of Charnitski to show that “electrodes 21” may be placed on the rear side of a watch, and the “armband 100 and/or the housing 2 can form the neutral or reference electrode.” EX1029 5:20–22. Schmid’s general watch structure is shown below with “watch-face window 4” in the front side and “electrodes 21” on the rear side. EX1029 5: 35, 48.



Id., Fig. 1.

69. Schmid further showed that an ECG electrode structure is not particularly limited and that active electrodes (“A”) and a reference electrode (“N” which does not contact the skin) may be arranged in “various configurations” (EX1029 6:36), some of which are shown below:



Id., Figs. 6, 9, 13.

70. Like Charnitski, Schmid explains that its biosensing watch is advantageous because it “provide[s] an electrode assembly for EKG and other bioelectrical purposes, which can operate without an electrode gel or other contact

element.” EX1029 1:52–54. Schmid also teaches that its configuration allows the EKG sensors to be in “close proximity” and are “at least as precise as the electrodes heretofore used for EKG measurements inspite [sic] of the many times greater spacing employed with the conventional electrodes.” EX1029 4:17–22.

71. In 1991, Suga (U.S. Patent 5,316,008, “Suga,” EX1030) showed that a biosensing watch could combine the ECG and optical sensors of the prior art into a single watch. As described by Suga, “In the present embodiment, both the detection of ECG waves and the detection of changes in blood flow in a fingertip are used for detection of sphygmus.” EX1030 6:5–7. As stated in Suga, this configuration is advantageous over the prior art because “the invention allows sphygmus and electrocardiographic R waves to be precisely sensed and further generates accurate cardiac data such as sphygmus data, blood pressure data, blood flow rate data and the like for promotion of health.” EX1030 2:33–38.

72. Suga’s watch shows “ECG wave detecting electrodes 4a, 4b” with one electrode on the front of the watch and one on the rear surface of the watch. EX1030 5:46. Embedded within the front electrode 4a is the optical sensor composed of “LED 7” and “photo-transistor 5.” EX1030 3:46–47. These are shown below:

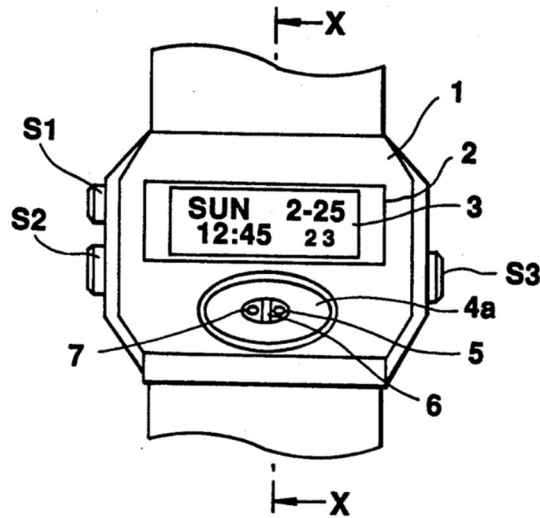


FIG. 1

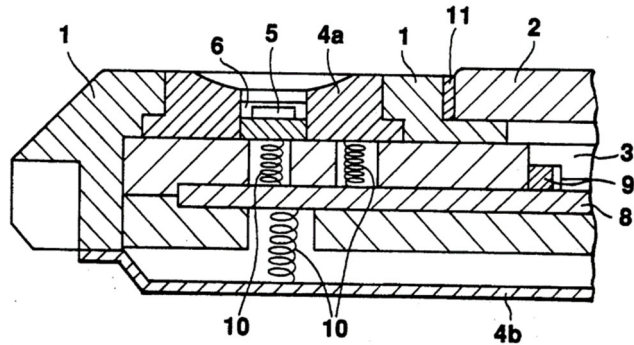


FIG. 2

Id., Figs. 1, 2.

73. Thus, in Suga's device an ECG is calculated with a user's "right fingertip being in contact with the ECG wave detecting electrode 4a while his left wrist being in contact with the ECG wave detecting electrode 4b." EX1030 4:31–33. At the same time "[t]he sphygmus detecting section 15b is connected with the photo transistor 5 and LED 7 of FIG. 1, and senses pulsating flow of blood in a blood vessel in his right fingertip, detecting sphygmus and supplies the sphygmus data to the control section 14." EX1030 4:35–40. Therefore, it was known from the disclosure in Suga in 1991 to incorporate ECG and pulse detection into a single biosensing watch.

74. Several years later in 1998 a patent to Lo (U.S. Patent No. 5,738,104, "Lo," EX1031) disclosed a "digital wrist watch for the EKG type heart rate monitor."

EX1031 7:26–27. The watch has “Two electrical contacts 14 and 16 [] placed on the front of the watch for the user to place his or her fingers on when the pulse mode is entered. A third electrical contact is located on the back side of the watch and is indicated in phantom at 18.” EX1031 7:34–38. This is shown below:

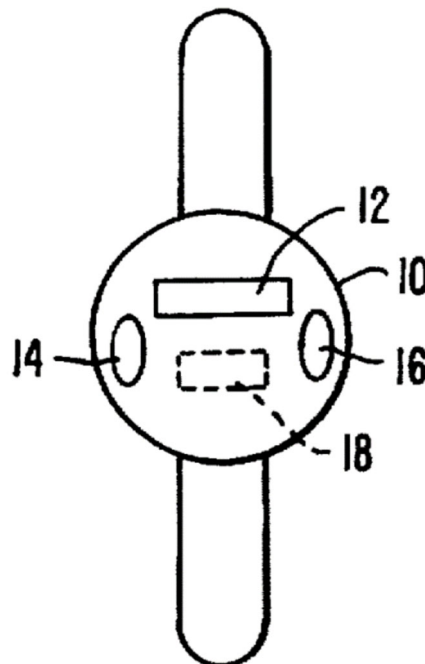
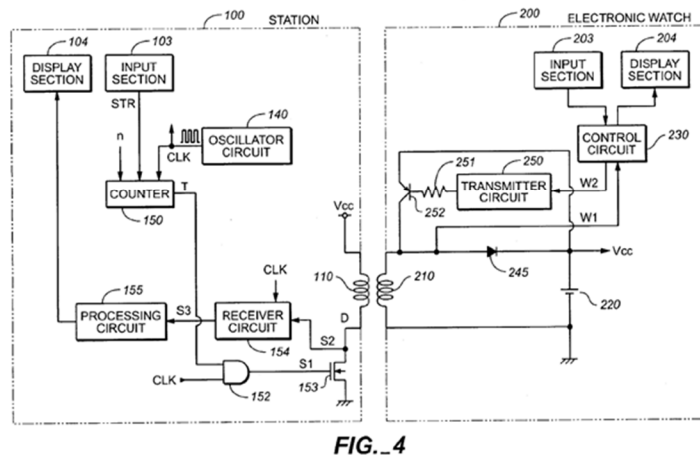
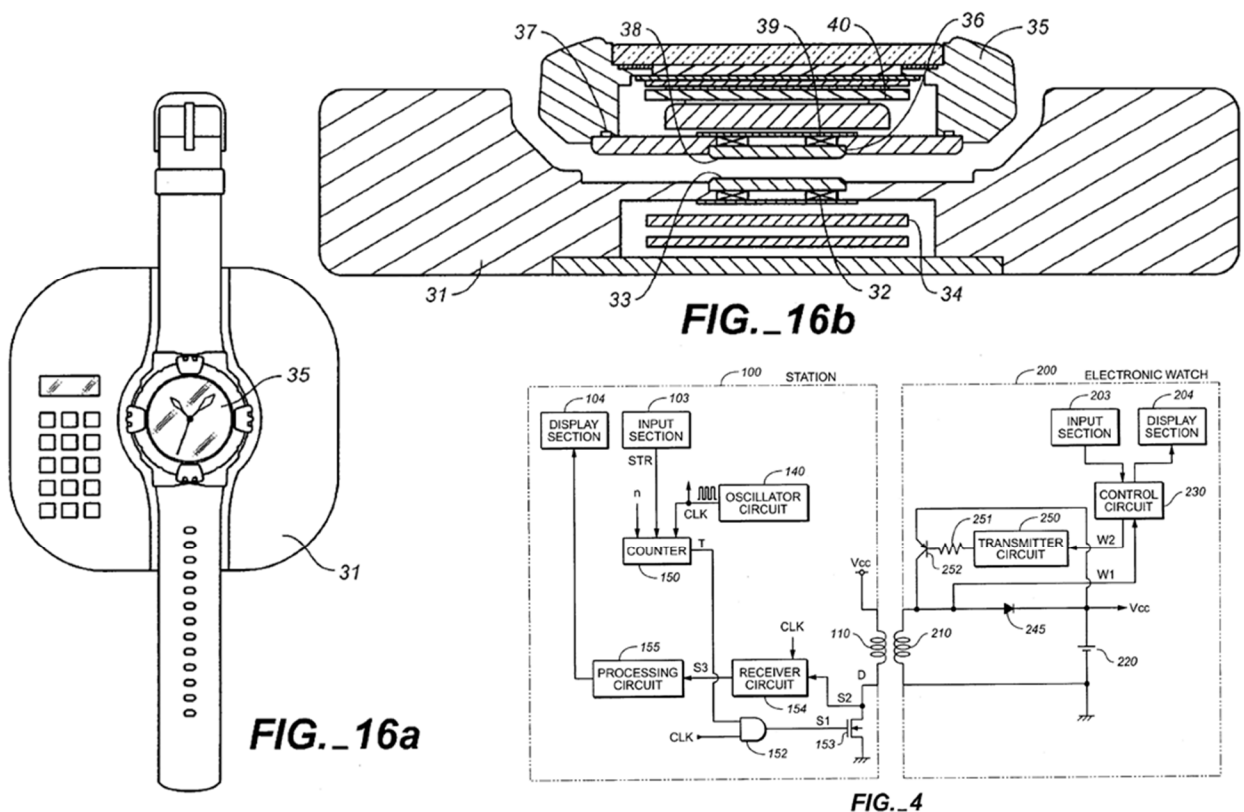


FIG. 1.

Id., Fig. 1.

75. Lo teaches that “[t]he digital watch embodiment uses a three contact approach to help eliminate noise.” EX1031 7:33–34. Thus, a person having ordinary skill in the art would have known in 1995 that three or more electrodes on a watch would have reduced noise in an ECG measurement.

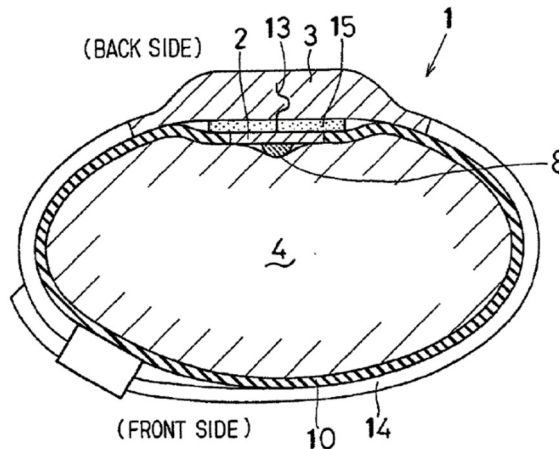
76. In the year 2001, Honda was granted patent 6,265,789 (“Honda,” EX1006). Honda describes and illustrates a portable electronic device in the form of a wristwatch and teaches wireless charging of such devices using a wireless charging “station.” EX1006 6:7. The watch gathers “biological information of the body, such as the pulse rate or heart rate,” which it can transmit to the station. EX1006 8:40–42.



Id., Figs. 4, 16a, 16b.

77. Therefore, a POSITA would have known from Honda’s disclosure that a biosensing watch may be wirelessly charged via magnetic coupling through a rear cover in a charging station.

78. In the same year, Ohsaki (EX1007) was published as US 2001/0056243 A1 with an optical heart rate sensor embedded in a protrusion on the back side of a watch as shown below:



EX1007 at 2.

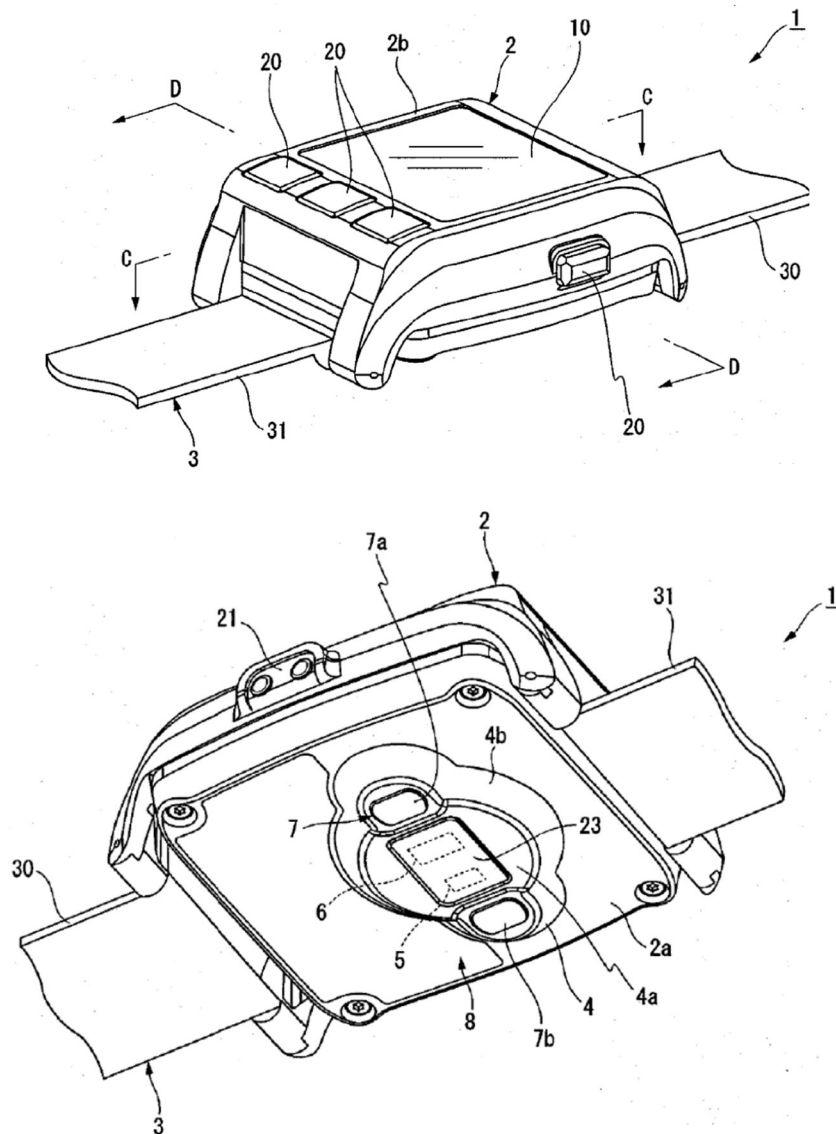
79. In the year 2005 Kotanagi was published as WO 2005092182 (“Kotanagi,” EX1007). Kotanagi describes and illustrates a wristwatch as a “biological information measuring device.” EX1005 at Abstract. Kotanagi describes its biological sensor, at least in part, as:

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.

EX1005 ¶46.

80. Kotanagi's device is shown in Figures 4 and 5 below:



EX1005, Figs. 4, 5.

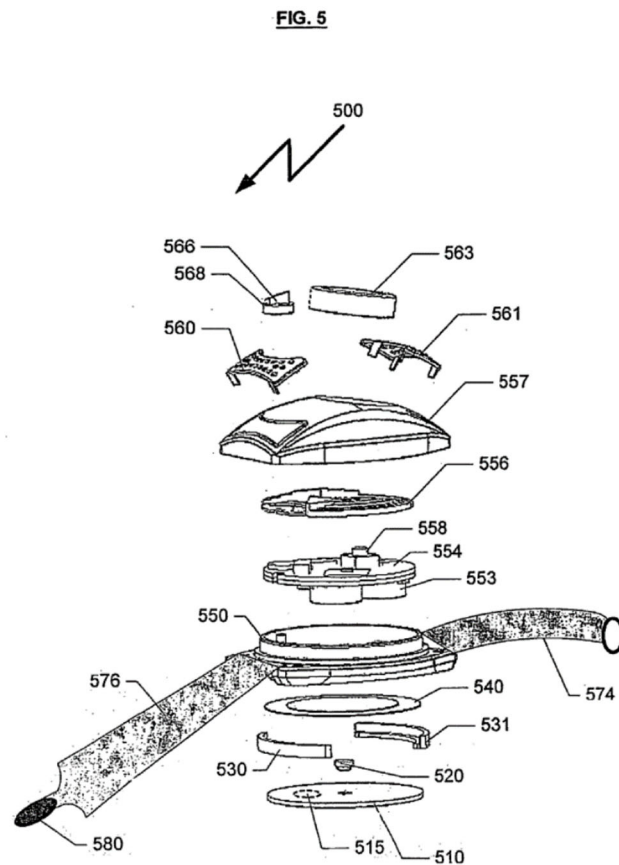
81. In the same year, 2005, Goldreich was published as US 20050116820 A1 (“Goldreich,” EX1033). Goldreich disclosed a wristwatch device which may display “medical information to the user on a local LCD display, such that the user is optionally and preferably able to read the result locally.” EX1033 [0015].

Goldreich provides a list of medical information that the watch may extract and provide:

Examples of medical information which may be extracted from the measured physiological parameter or parameters include, but are not limited to: heart rate; regularity in heart rate; breathing rate; arrhythmia of the heart (if any), as well as the general rhythm and functioning of the heart; blood pressure; presence of abnormal body movements such as convulsions for example; body position; general body movements; body temperature; presence and level of sweat; oxygen saturation in the blood; and glucose levels in the blood.

EX1033 [0015]; see also *id.* [0104] (teaching “device 500 may optionally measure other activities of the body including but not limited to ECG”).

82. Goldreich’s device shows “conductive areas 560 and 561” on the upper sides the watch, and “conductive area 515” on the lower side of the watch such that 515 would be in contact with the wrist. EX1033 [0118]. Goldreich also teaches a “temperature sensor 580” in the wrist of the watch, and an “SpO2 sensor 566” which “preferably has two light sources, optionally by two LEDs (light Emitting Diode) and a photoelectric detector.” EX1033 [0124]. Goldreich’s device is shown below:



Id., Fig. 5.

83. From Goldreich's disclosure a POSITA would have known that a watch could measure a variety of physiological parameters with an optical sensor, a temperature sensor, or three or more electrodes.

84. In the year 2007 a biosensing watch was published in US 20070276270 A1 ("Tran," EX1034), which also included optical sensors and ECG electrodes like Goldreich. Tran teaches that the "back of the device is a conductive metal electrode 1381 that in conjunction with a second electrode 1383 mounted on the wrist band 1374, enables differential EKG or ECG to be measured." EX1034 [0237]. Tran also

teaches an optical sensor embedded in the wrist band and that a “light source and the photo-detector are slidably adjustable and can be moved along the wrist band to optimize beam transmission and pick up. As the heart pumps blood through the patient’s finger, blood cells absorb and transmit varying amounts of the red and infrared radiation depending on how much oxygen binds to the cells’ hemoglobin.” EX1034 [0244]. Tran’s watch, showing electrode 1381, electrode 1383, and wrist band 1374, is below.

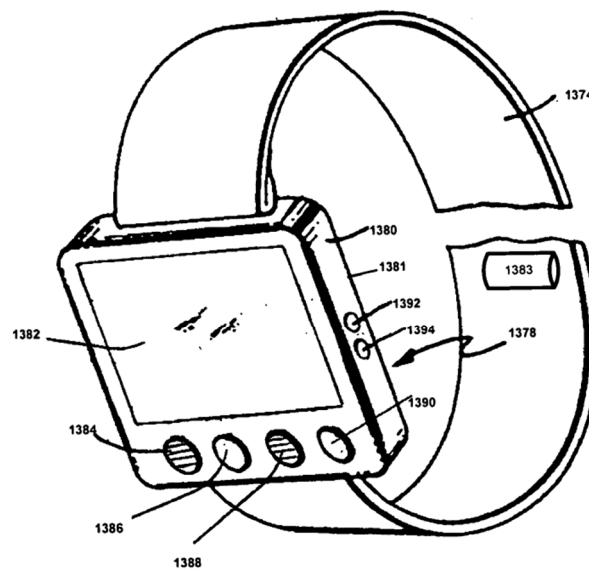


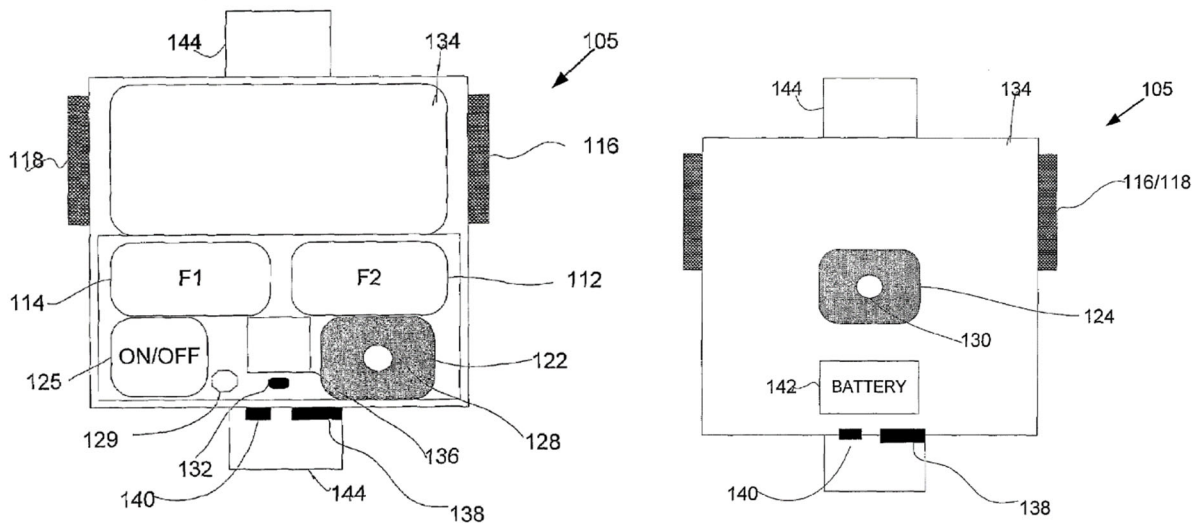
FIG. 6A

Id., Fig. 6A.

85. Tran also teaches that the various sensors do not have to be in the wrist band as “[i]n one embodiment, the sensors for monitoring vital signs are enclosed in a wrist-watch sized case supported on a wrist band. The sensors can be attached to

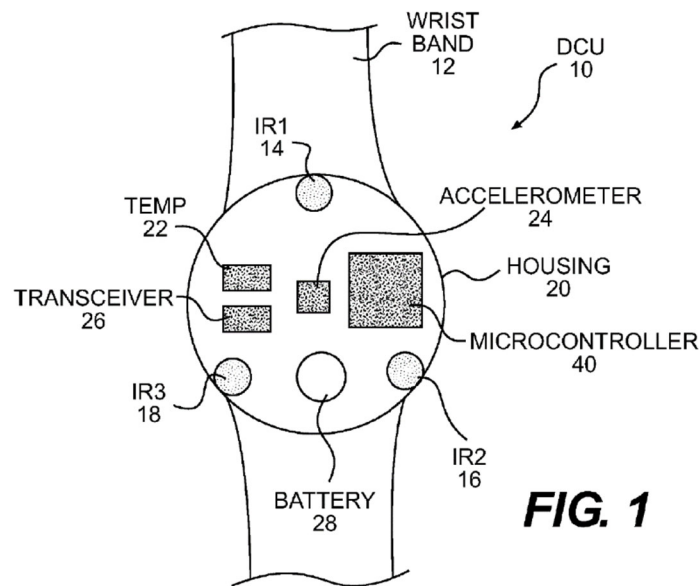
the back of the case.” EX1034 [0336]. Thus, a POSITA would have known from Tran’s disclosure that a watch may have ECG and pulse sensors in the wristband or the watch casing.

86. In the year 2008, US 20080208009 A1 was published by Shklarski (“Shklarski,” EX1035). Shklarski teaches an electronic watch including “one or more electrodes, for example, an ECG RA (Right Arm) finger electrode 122, an ECG LA (Left Arm) wrist electrode 124 (FIG. 2B), and an ECG REF[] (Reference) wrist electrode 126.” EX1035 [0028]. Shklarski additionally teaches that the “wearable device 105 may include at least one blood oxygen level (SpO₂) transceiver 128 to measure the level of the oxygen in the patient’s blood, and at least one pulse transceiver 130 (shown in FIG. 2B) to measure the patient’s pulse.” EX1035 [0029]. The blood oxygen, pulse, and ECG sensors on the front and back of the watch are shown below:



EX1035, Figs. 2A, 2B.

87. In August 2012, US 20120221254 A1 was published by Kateraas (“Kateraas,” EX1014). Kateraas, like many other references before it, teaches a “sensor array” that may be “located at any position along wrist band 12” but that “the sensor array is located in housing 101” in a position “adjacent to the underside of the wrist of a user.” EX1014 [0058]. The sensor array may comprise “accelerometer 24; infrared sensors 14, 16, and 18; and/or temperature sensor 22.” EX1014 [0058]. Kateraas Figure 1 is shown below:



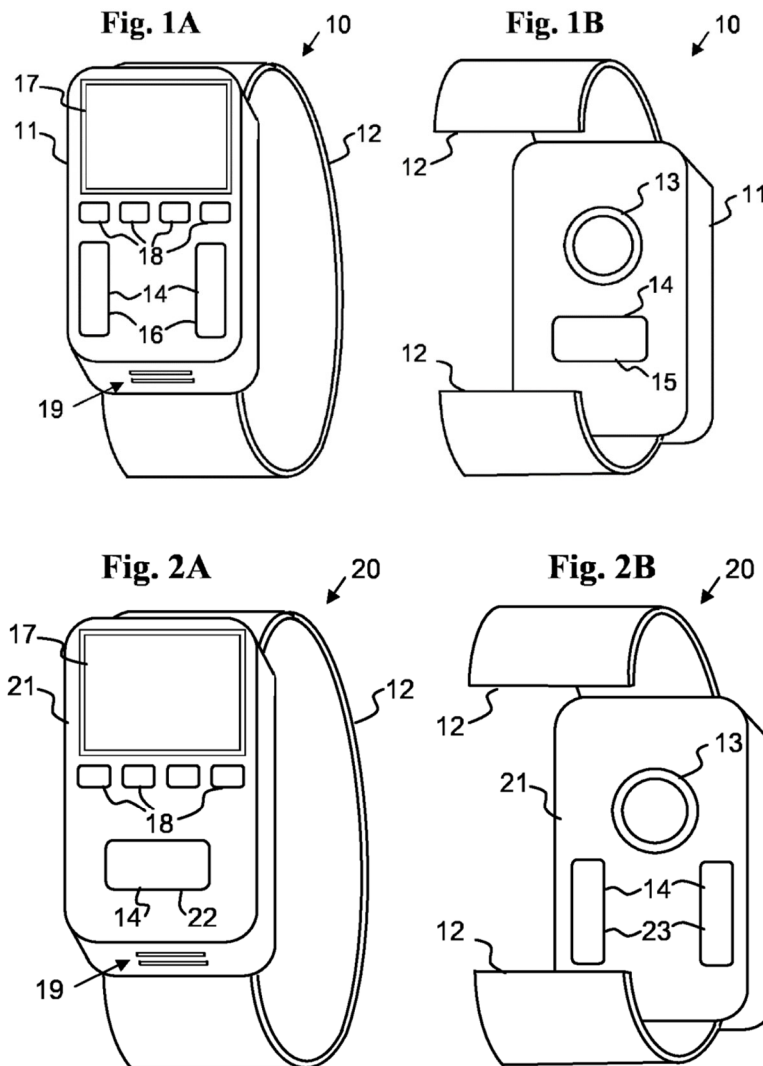
EX1014, Fig. 1.

88. Kateraas teaches that its sensor array may “monitor only a single biological marker. Alternatively, an individual sensor in the array may be configured to monitor multiple biological markers.” EX1014 [0012]. Some of these biological markers are “pulse rate, body temperature, blood oxygen content, or any other suitable marker.” EX1014 [0012].

89. Kateraas specifies that its sensor array may be covered by a transparent “window 103” that may be comprised of “germanium, zinc selenide, sapphire, IR glass, IR polymer, barium fluoride, calcium fluoride, and combinations thereof.” EX1014 [0059].

90. Thus, a POSITA would have known from the disclosure in Kateraas that the underside of a biosensing watch may have an “array” of sensors covered by a transparent, sapphire window.

91. In October 2012, WO 2012140559 A1 was published by Shmueli (“Shmueli,” EX1008) teaching a “heart monitoring device 20” with an oximetry (SpO₂) sensor and “ECG sensing” contacts where “[t]he oximetry sensor 13 (not shown) preferably faces the back side of the hand.” EX1008 at 11. Shmueli teaches that its “ECG measuring unit preferably includes at least three areas 14, each providing electrical contact with the subject.” In one configuration “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.” *Id.* at 10. In another configuration shown in Figures 2A and 2B the ECG sensing unit “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.” *Id.* at 11. These configurations with either two of the three electrodes (14) on the back or two of the three electrodes (14) on the front of the biosensing watch are shown below:

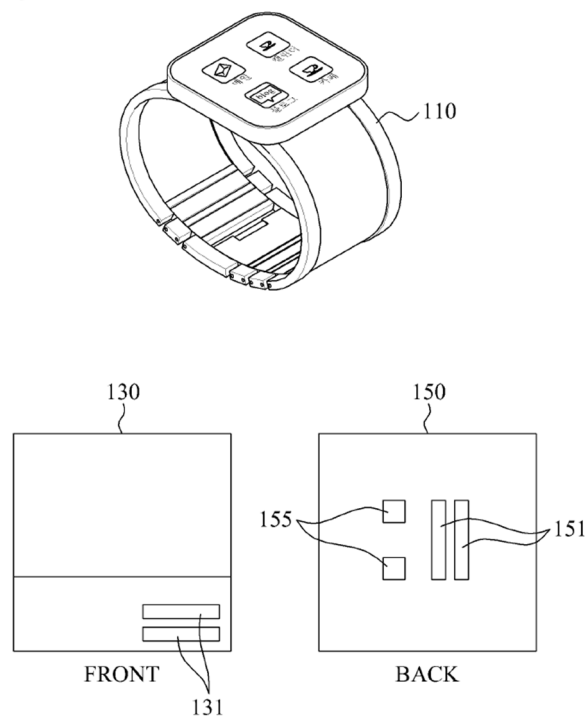


EX1008, Fig. 1A, 1B, 2A, 2B.

92. A POSITA would have known from Shmueli that a biosensing watch could incorporate ECG and optical sensors in the same device. Further, a POSITA would have known that this watch could either have two of the three ECG electrodes on the front of the watch (Fig. 1A and 1B) or two of the three electrodes on the back of the watch (Fig. 2A and 2B).

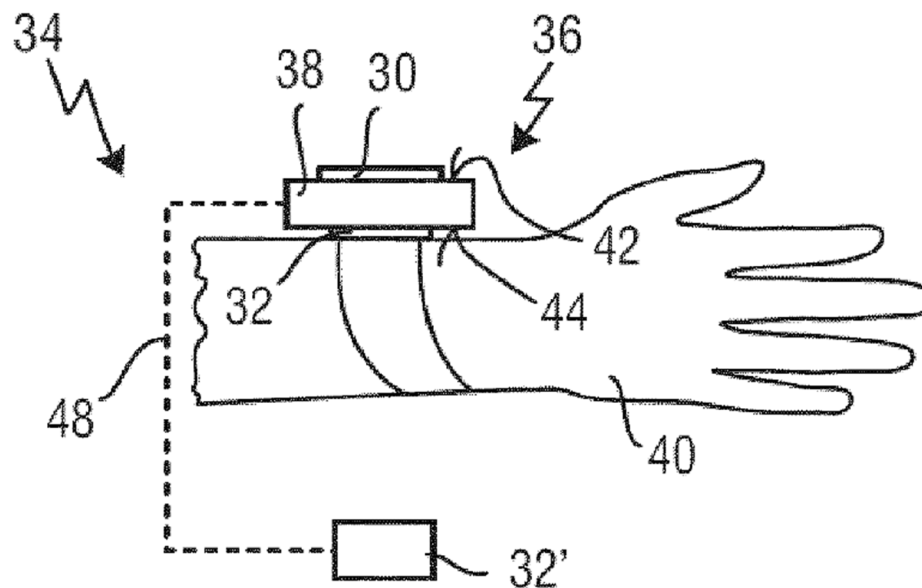
93. In September 9, 2013, Choi was filed as KR10-2013-0107833 (“Choi”, EX1023, see EX1011 for the PCT publication). Choi teaches a watch with six sensors (four on the back, 155 and 151, and two on the front, 131) to detect skin impedance, an ECG, PPG, or electromyogram (EMG). (EX1023 [44]–[45]; EX1011 [51]–[52]).

[Fig. 1]



94. Choi additionally teaches that its watch may incorporate a touch-sensitive display (EX1023 [32]; EX1011 [43]). Thus, a POSITA would have known from Choi that a biosensing watch may have a touchscreen with four sensors on the back of the watch and two additional sensors on the front of the watch.

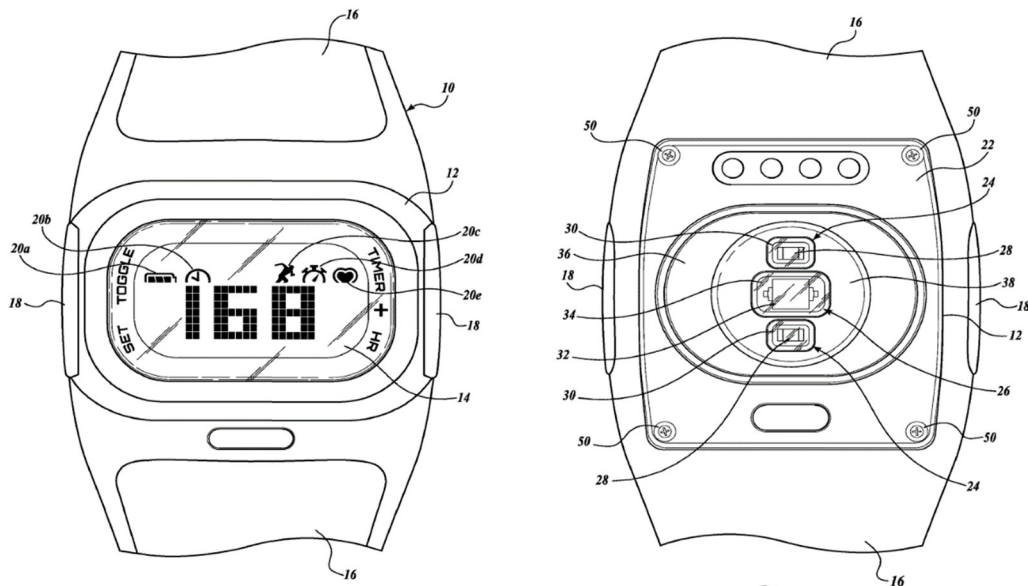
95. In March of 2014 Coppola (EX1020) was filed as EP Application 141631147. Coppola taught the placement of multiple electrodes on the back, front, side, and auxiliary portion of a biosensing watch. EX1020 14:14–16. Coppola also teaches the incorporation of an optical PPG sensing unit. *Id.* at 13:26–29.



EX1020 at 28.

96. Coppola teaches that it is advantageous to place an ECG electrode on the side of a watch because “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.” EX1020 14:14–16. Thus, a POSITA would have understood that a biosensing watch may comprise multiple electrodes on different surfaces of a watch along with an optical PPG sensing unit.

97. In April of 2014 Fei (EX1010) was filed as US provisional application 61/976388 and later published as US 20140371601 A1. Like the other watches that came before it, Fei teaches the incorporation of an optical emitter and optical detectors on the rear surface of a watch, but Fei teaches the additional measuring of “heart rate, glucose level, apnea, respiratory stress, and other physiological conditions.” EX1010 at 4.



EX1010 at 17, 18.

98. In May of 2014 Yuen (EX1016) was published as US Publication 2014/0135594. Yuen teaches the incorporation of an optical sensor on the front side of a watch to measure “heart rate, heart rate variability, heart rate recovery” and other physiological parameters. EX1016 [0098]. Yuen explicitly teaches that the optical sensor may be covered by a “ceramic” material. EX1016 [0070].

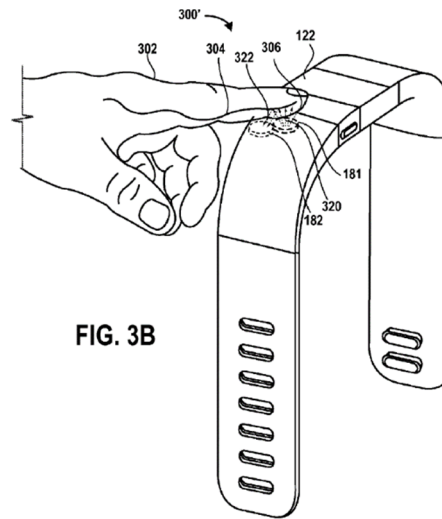
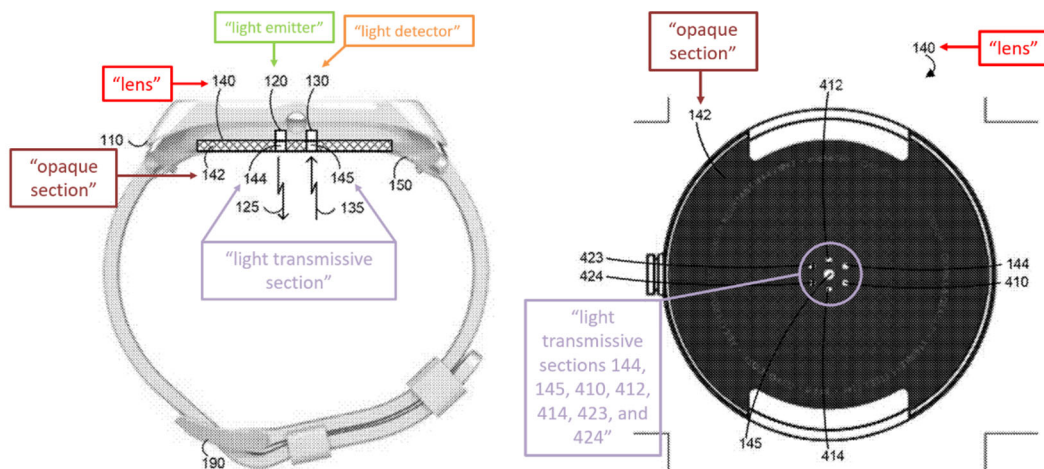


FIG. 3B

EX1016 at 6.

99. In August 2014 Fraser (EX1041) was filed and later published as US 2015/0355604 A1. Fraser teaches multiple optical emitters and a light detector that are aligned with transmissive sections in a lens cover that spans the back side of its biosensing watch. EX1041 [0017]–[0018]. Fraser also teaches the incorporation of a wireless charging coil surrounding the optical emitters and detector. EX1041 [0026].



See EX1041 at 2, 5.

100. Thus, a POSITA would have known from Fraser that a biosensing watch may incorporate an array of emitters and detector, a lens with light transmissive sections aligned with the optical components, and a wireless charging coil.

101. This overview is not meant to be exhaustive, and other advancements were made in the field of biosensing watches. However, an explanation of the decades of technology in the field of biosensing watches prior to September 2014 may be helpful in understanding the general knowledge of a POSITA as it relates to the challenged patent. Further, it is important to note that the '483 prosecution history shows that only one of these references was cited by or substantively considered by the Examiner during the prosecution of the '483 patent. *See* EX1002 generally. Particularly, the '483 prosecution history reveals that the Examiner only relied on the teachings of Lo, EX1031. *Id.* at 707–708.

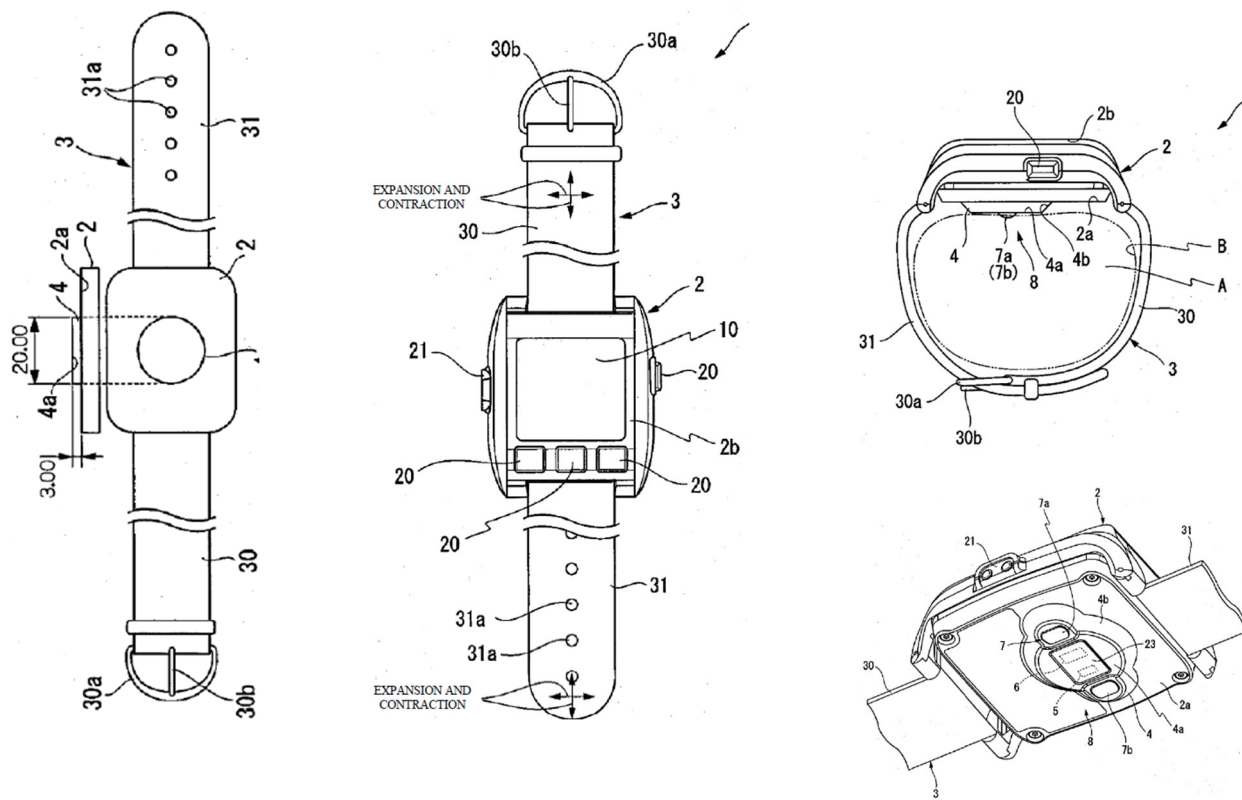
X. Introduction to Selected Prior Art References

A. Kotanagi (EX1005)

102. As noted above, the '483 patent was believed to be distinguishable from the prior art based at least on the placement of electrodes on the housing of a watch. EX1002 at 40 (providing reasons for allowance as “the prior art fails to describe the

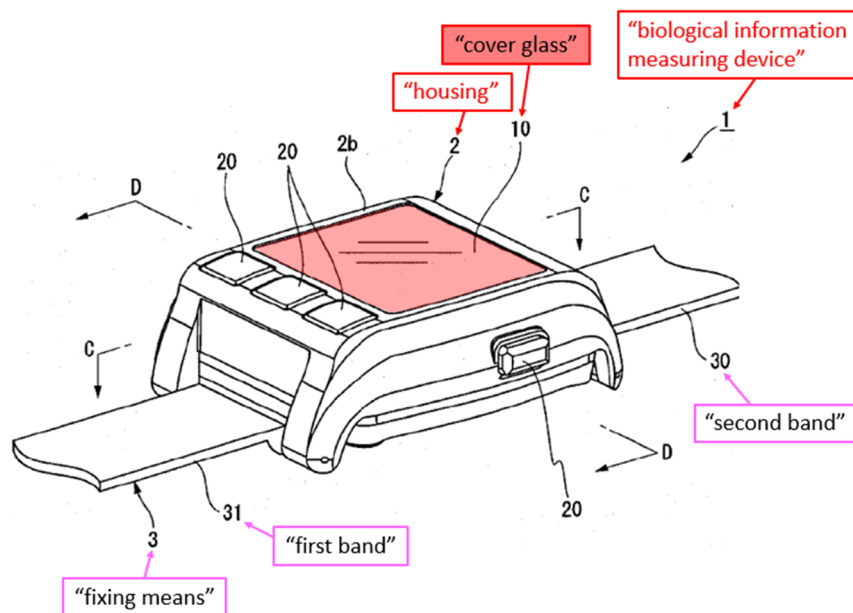
configuration of the electrodes as presently recited with respect to the locations on the housing”). Kotanagi in view of Coppola teaches this and many of the other limitations.

103. PCT Patent Publication WO 2005092182 (“Kotanagi,” EX1005) claims an earliest priority date of March 26, 2004, more than a decade before Apple’s ’483 patent application was filed. EX1005 at 1. Kotanagi was not cited or reviewed in the ’483 patent’s prosecution history and is not listed on the face of the ’483 patent. EX1002 generally; EX1005 at 1. Kotanagi describes and illustrates a “biological information measuring device” in the form of a wristwatch:



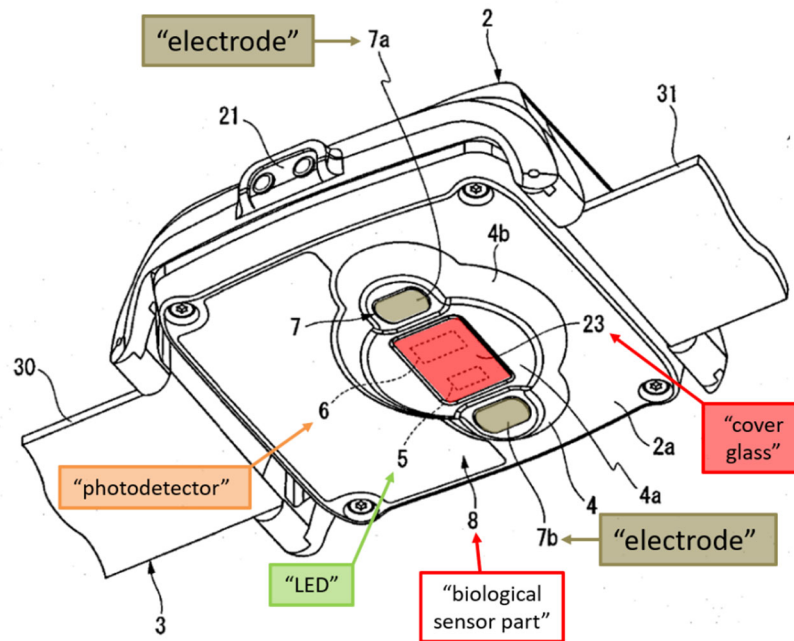
EX1005 at Figs 1, 2, 5, 8.

104. The watch has touch electrodes and sensors (behind a window in a protruding bulge at its base) for directing optical signals to and, receiving optical reflection from, a user's skin. Kotanagi teaches that the device can be charged wirelessly. EX1005 ¶53. The upper surface contains a glass electronic display, and it has a wristband:



Id. at Fig. 4.

105. The lower (skin-facing) surface of Kotanagi's wristwatch contains biological sensors. It has two electrodes on the rear exterior surface of the watch and at least one optical biosensor, shown below:



Id. at Fig. 5.

106. Kotanagi's LED and photodetector measure a user's heart pulse rate via light emitted and reflected from skin back to the optical biosensor. EX1005 ¶46.

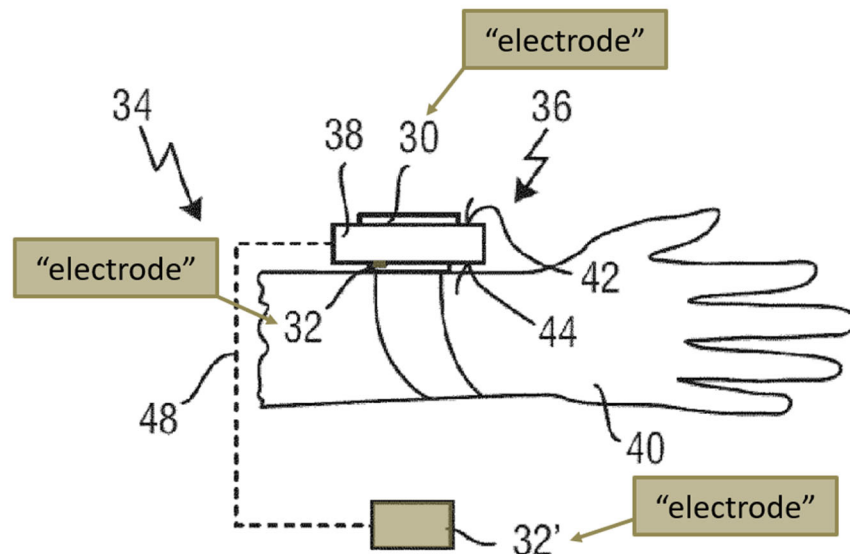
B. Coppola (EX1009; EX1020)

107. Coppola was filed April 2, 2014 as EP Patent Application 14163114.3 (EX1009 "Coppola EP"). Coppola subsequently published as WO 2015/150199 A1 (EX1020 "Coppola").

108. Like Kotanagi, Coppola teaches the measurement of a heart rate through an optical sensor but the watch in Coppola "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.” EX1020 7:8-10; EX1009 9:19-21.

109. Coppola shows that its biosensing watch may have multiple electrodes on differing sides of the watch:



See EX1009 at 27; EX1020 at 25.

110. Finally, Coppola explicitly teaches that it may be advantageous to place an electrode on the side of a biosensing watch to allow for a larger screen: “**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.” EX1009 at 16:21–23; EX1020 at 14:14–16 (emphasis supplied). Thus,

Coppola teaches it may be advantageous to place an ECG electrode on the side of a biosensing watch.

C. Status of References as Prior Art

111. The references are prior art to the '483 patent (earliest alleged priority of September 2, 2014) for the following reasons:

Exhibit No.	Description	Prior Art Basis
1001	'483 patent (background section)	Admitted Prior Art
1005	Kotanagi	Post-AIA 35 U.S.C. §102(a)(1) – published October 6, 2005
1006	Honda	Post-AIA 35 U.S.C. §102(a)(1) – issued July 24, 2001
1014	Kateraas	Post-AIA 35 U.S.C. §102(a)(1) – published August 30, 2012
1020	Coppola	Post-AIA 35 U.S.C. §102(a)(2) – effectively filed April 2, 2014 (see EX1009)
1029	Schmid	Post-AIA 35 U.S.C. §102(a)(1) – published March 1, 1983
1034	Tran	Post-AIA 35 U.S.C. §102(a)(1) – published November 29, 2007
1041	Fraser	Post-AIA 35 U.S.C. §102(a)(2) – effectively filed June 5, 2014
1049	Miller	Post-AIA 35 U.S.C. §102(a)(1) – issued January 7, 2014

112. In my opinion, these references constitute analogous art because they are from the same field of endeavor as the '483 patent, e.g., biosensing watches and personal electronic devices. They are also reasonably pertinent to a particular problem with which the inventor was involved, e.g., arrangement of optical and electrical biosensors on such devices. The volume and character of the overlapping features between the references listed above and the subject patent provides further evidence that these references are analogous art and highly relevant for a POSITA. For example, the side-by-side figures in the section above titled "Overview of the '483 Patent" (*supra* §VIII(A)) show many similarities between the patent and the Kotanagi reference. These figures and similar figures throughout this document support the obviousness combinations generally and also support the conclusion that these references are analogous art. For at least these reasons, I understand that, under U.S. patent law, a POSITA is presumed to have been aware of these references. *In re Nilssen*, 851 F.2d 1401, 1403 (Fed. Cir. 1988). As set forth in detail below in the context of the invalidity analysis, a POSITA would have been motivated to combine these references at the relevant time for many additional reasons.

a. Fraser 35 U.S.C. § 102(a)(2) Analysis

113. I understand that Fraser (EX1041) is a U.S. patent publication that was filed August 19, 2014, and as it predates the earliest priority of the '483 patent it is therefore prior art. 35 U.S.C. § 102(d)(1).

b. Coppola 35 U.S.C. § 102(a)(2) analysis

114. I understand that PCT Pub. No. WO 2015150199 (“Coppola” EX1020) was published on October 8, 2015 and is prior art under post-AIA 35 U.S.C. § 102(a)(2) because it designates⁴ the United States and claims an effective filing date that predates the earliest effective filing date of the ’483 patent. As I understand, WO 2015150199 Claims priority to EP14163114.3, filed April 2, 2014 (“Coppola EP”, EX1009).

115. It is my opinion that Coppola is literally supported by the filing in Europe of Coppola EP. Coppola EP’s Figures 1–8 are identical to the published figures in Coppola. EX1020 at 24–28; EX1009 at 26–30. Coppola EP provides support for every limitation relied upon in this Declaration, as shown by parallel pinpoint citations in this Declaration to both Coppola and the earliest effective filing disclosure, Coppola EP.

⁴ See 35 U.S.C. § 374 stating “The publication under the treaty defined in section 351(a), of an international application designating the United States shall be deemed a publication under section 122(b), except as provided in section 154(d)”

116. It is my opinion that Coppola EP provides support for at least one Claim in the Coppola PCT publication.⁵ To demonstrate this, Claim 1 of the Coppola PCT publication is shown below:

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),

⁵ It has been explained to me that a showing that Coppola EP supports one of Coppola's claims is not necessary under USPTO guidance indicating that *Dynamic Drinkware* does not apply to post-AIA cases. See EX1047 at 3. Nevertheless, I understand that Masimo makes such a showing out of an abundance of caution in view of Board cases applying *Dynamic Drinkware* to certain post-AIA cases.

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.

EX1020 at 21.

117. I believe portions of Claim 1 of Coppola are supported by the following paragraph from Coppola EP:

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.

EX1009 at 5.

118. The remaining portions of Claim 1 of Coppola are supported by the following paragraph:

[T]he 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 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.

EX1009 at 14.

119. A claim chart comparison of the published claim (EX1020) and the provisional support (EX1009) are shown below:

Published Claim 1 (EX1020 at 21)	Provisional Support (EX1009 at 5, 14)
A system (34) for detecting variation of heart rate, HR, of a user (14), comprising:	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 (12) for measuring a heartbeat-related optical signal of said user (14) over time;	an optical sensing unit for measuring a heartbeat related optical signal of said living being over time,
a processing unit (20) for deriving an HR- variation signal	a processing unit for deriving an HR variation signal from said heartbeat-

Published Claim 1 (EX1020 at 21)	Provisional Support (EX1009 at 5, 14)
from said heartbeat-related optical signal;	related optical signal,
an analyzing unit (22) for comparing said derived HR-variation signal to a reference HR range; and	an analyzing unit 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.	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 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 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.

120. Thus, I believe Coppola EP supports at least one Claim in the Coppola PCT publication, and Coppola is entitled to the earliest priority date of April 2, 2014.

XI. ANALYSIS OF SPECIFIC GROUNDS

121. In my opinion, Claims 1–20 of the '483 patent would have been obvious in view of the prior art to a POSITA at the relevant time. The cited references teach every claim limitation, though not always using identical terminology. *See In re*

Bond, 910 F.2d 831, 832 (Fed. Cir. 1990) (disclosure need not be *ipsissimis verbis*).

My reasoning is further set forth below.

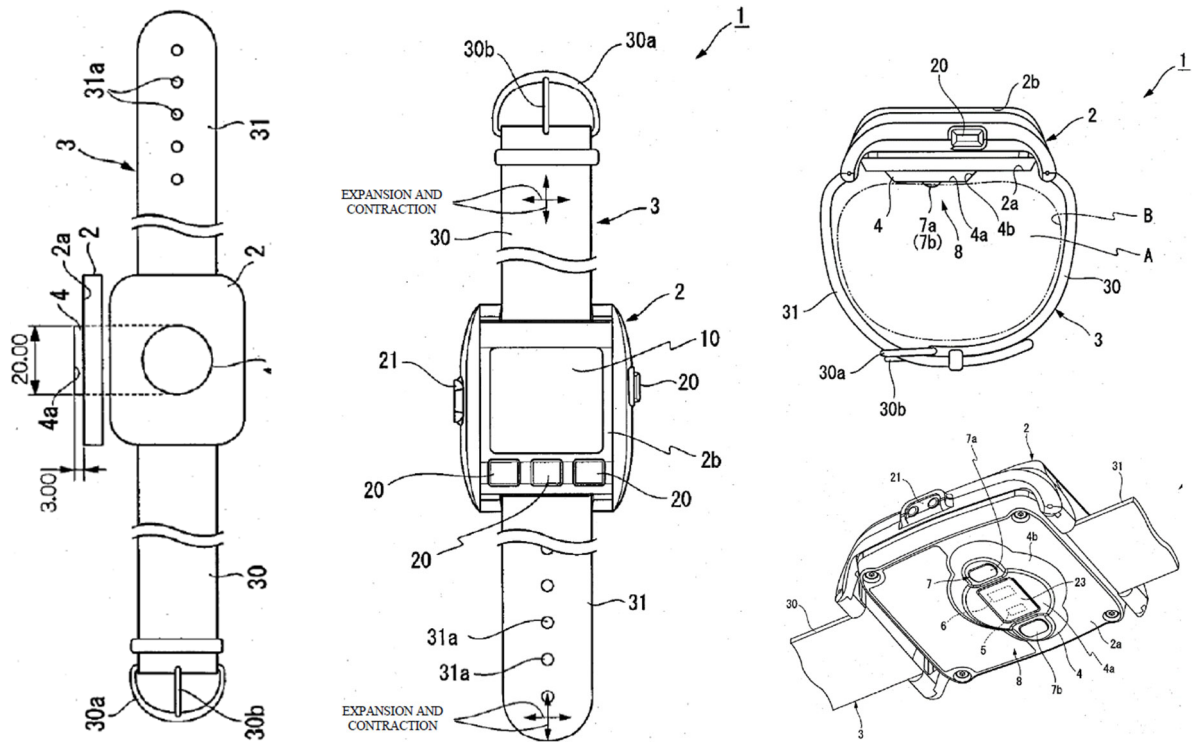
A. Ground 1: Claims 1–3, 5–6, 10–14, and 16–20 are unpatentable because they would have been obvious over Kotanagi in view of Coppola.

1. Independent Claim 1

1. A wearable electronic device comprising:
 - a housing defining a first opening and a second opening;
 - a display positioned at least partially within the first opening;
 - a front cover positioned over the display and defining at least a portion of a front exterior surface of the wearable electronic device;
 - a biosensor module comprising:
 - a rear cover positioned at least partially within the second opening and defining an optically transparent window and a protruding convex surface;
 - an optical sensor aligned with the optically transparent window;
 - a first electrode positioned along a rear surface of the wearable electronic device; and
 - a second electrode positioned along the rear surface of the wearable electronic device; and
 - a third electrode positioned along a side of the wearable electronic device, wherein:
 - the wearable electronic device is configured to measure a first physiological parameter of a wearer using the optical sensor; and
 - the wearable electronic device is configured to measure a second physiological parameter using the first electrode, the second electrode, and the third electrode.

a. [1a] “A wearable electronic device comprising:”

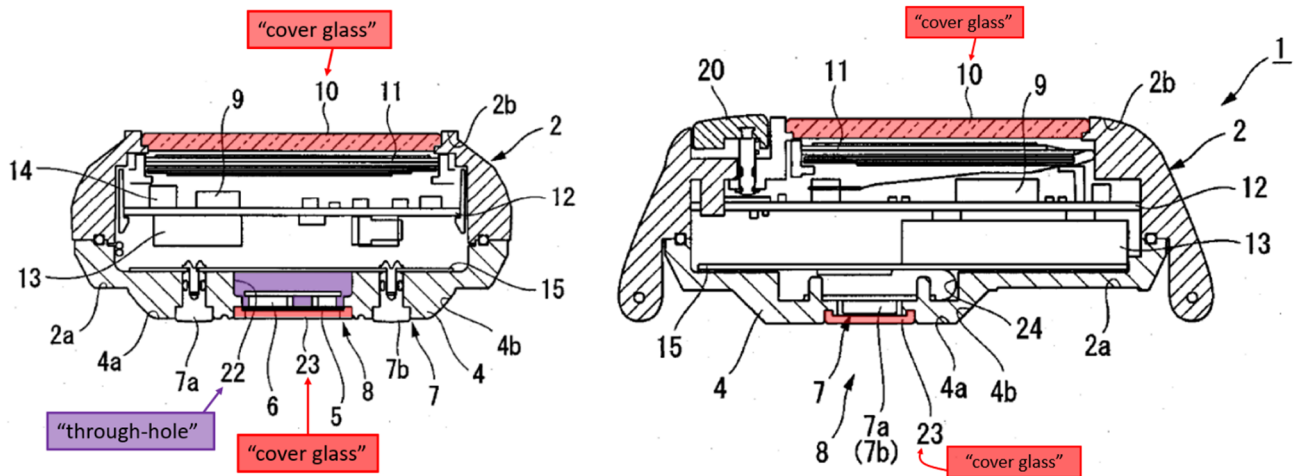
122. Kotanagi describes a “wristwatch-type device which detects pulse rate as a type of biological information while mounted to the wrist.” EX1005 at 10.



Id. at 23, 24, 26, 28 (Figs. 1, 2, 5, 8).

b. [1b] “a housing defining a first opening and a second opening;”

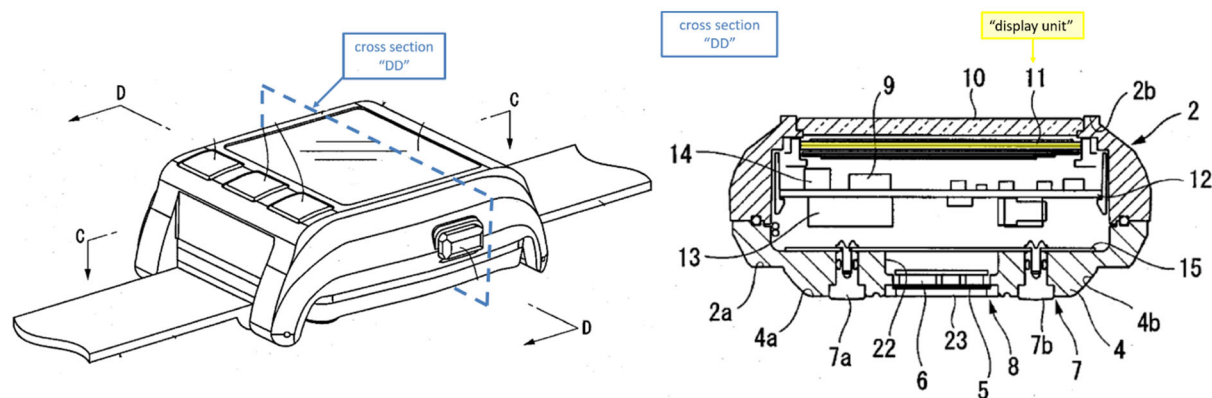
123. Kotanagi teaches a “housing 2 . . . made of plastic or a metal material such as aluminum.” EX1005 ¶48. Kotanagi’s housing has a “first opening” at the top and a “second opening” (“through-hole 22”) at the bottom, both shown in the cross-sections below. The cover glass 10 and the cover glass 23 span these openings:



EX1005 at 27 (Figs. 7, 6).

c. [1c] “a display positioned at least partially within the first opening;”

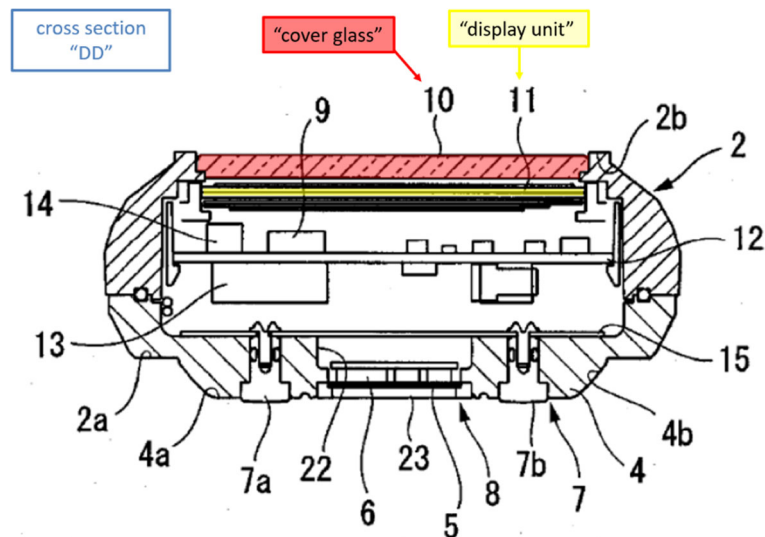
124. In Kotanagi, a “cover glass 10 with a substantially square shape is fitted into the central portion of the upper surface 2b of the housing 2, and a display part 11 for displaying the aforementioned pulse rate that is detected and various other information is disposed inside the cover glass 10.” *Id.* ¶48.



See id at 25, 27 (Figs. 4, 7).

d. [1d] “a front cover positioned over the display and defining at least a portion of a front exterior surface of the wearable electronic device;”

125. In Kotanagi, “a display part 11 for displaying the aforementioned pulse rate that is detected and various other information is disposed inside the cover glass 10.” *Id.* ¶48. This cover glass 10 defines at least a portion of the front exterior surface of the device:



See id at 27 (Fig. 7).

e. [1e] “a biosensor module comprising:”

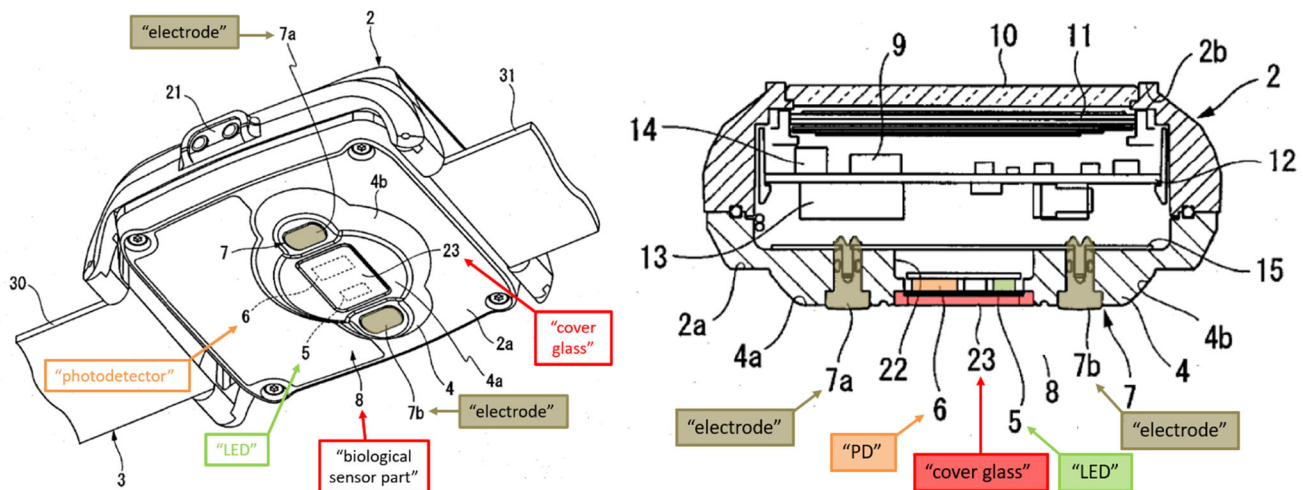
126. Kotanagi teaches

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... 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.

EX1005 ¶46.

127. Kotanagi's teaching of such a module satisfies subsequent limitations: [1f] a rear cover (cover glass 23); [1h] an optical sensor (photodetector 6 and LED 5); and [1i] electrodes (electrodes 7a/7b). This biosensor module is located at the rear of Kotanagi's device, as illustrated below:



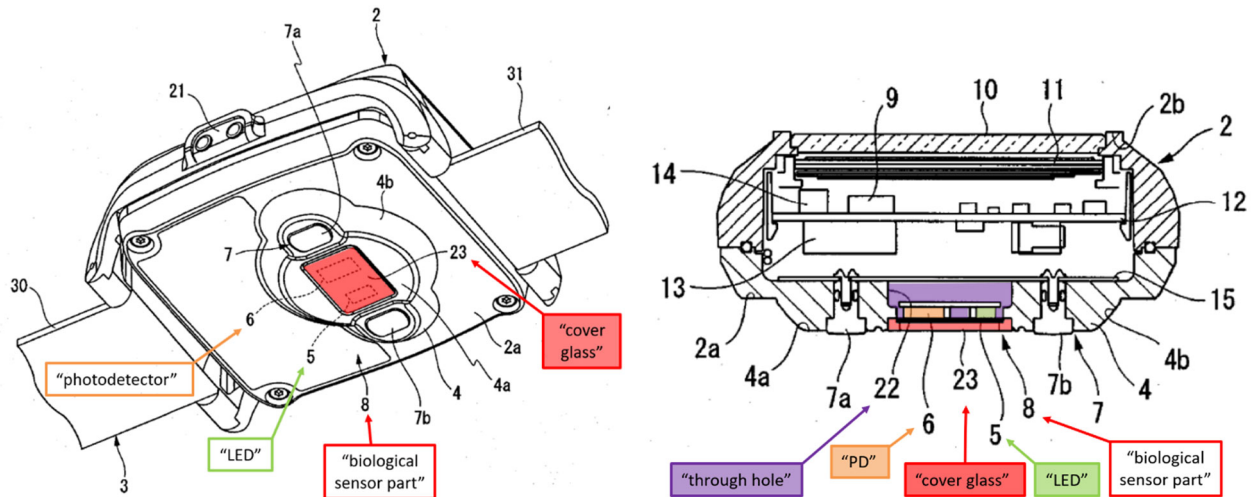
See id. at 26, 27 (Figs. 5, 7).

f. [1f] “a rear cover positioned at least partially within the second opening and defining an optically transparent window”

128. Kotanagi has a cover glass 23 “fixed to the housing 2 so as to block the through-hole 22.” EX1005 ¶55. Consistent with the construction in section VI(1) above, I glass cover comprises an optically transparent window as “data processing

part 9 emits light from the LED 5 toward the living body” through the cover glass and “PD 6 can receive reflected light corresponding to the pulsation of arteries.” *Id.*

¶65. Thus, the cover glass 23 is positioned within the second opening:

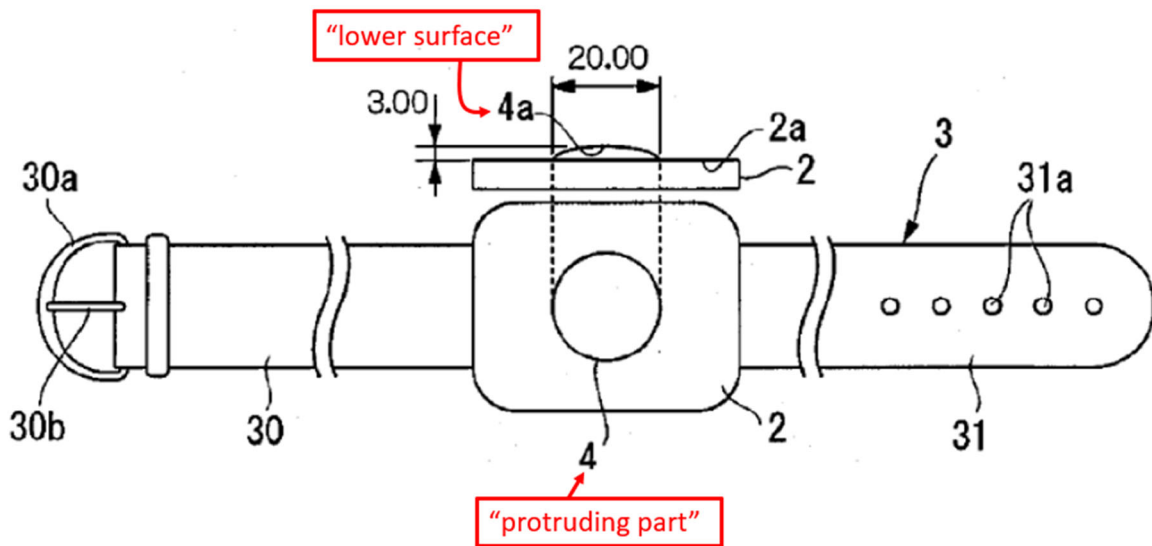


See EX1005 at 26, 27 (Figs. 5, 7).

g. [1g] “and a protruding convex surface;”

129. Kotanagi teaches the cover can form, or comprise part of, a convex protrusion: “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.”

EX1005 ¶(0080).

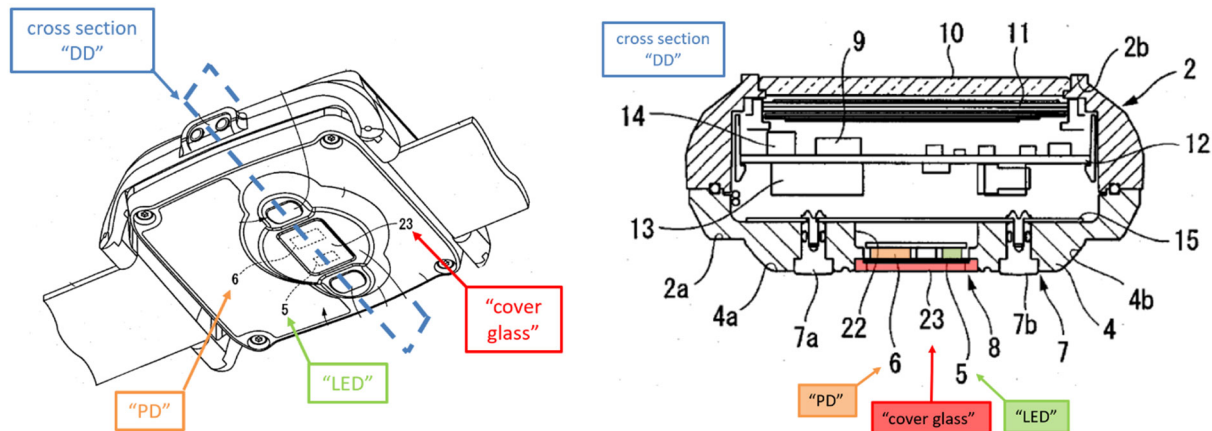


See EX1005 at 28 (Fig. 10).

130. A POSITA would have understood from Kotanagi's Figure 10 that the protruding part can form a convex "cover glass" that spans the "through-hole 22." *Id.* at 28. Kotanagi states that its protruding part causes the body to "deform[] smoothly," which "enhances the adherence." EX1005 ¶¶35,80.

h. [1h] "an optical sensor aligned with the optically transparent window;"

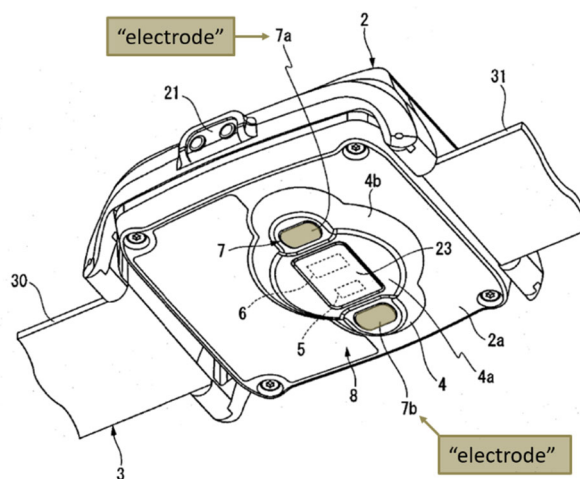
131. Kotanagi's "LED 5 and the PD 6 are disposed adjacent to one another . . . so as to touch the inside of the glass cover 23." *Id.* ¶55. Thus, the LED and PD are positioned such that they are aligned with the optically transparent cover glass.



See EX1005 at 26, 27 (Figs. 5, 7).

- i. [1i] “a first electrode positioned along a rear surface of the wearable electronic device; and a second electrode positioned along the rear surface of the wearable electronic device; and”

132. Kotanagi teaches a “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.” *Id.* ¶59. The pair of electrodes are placed on the rear surface of Kotanagi’s device, as shown:

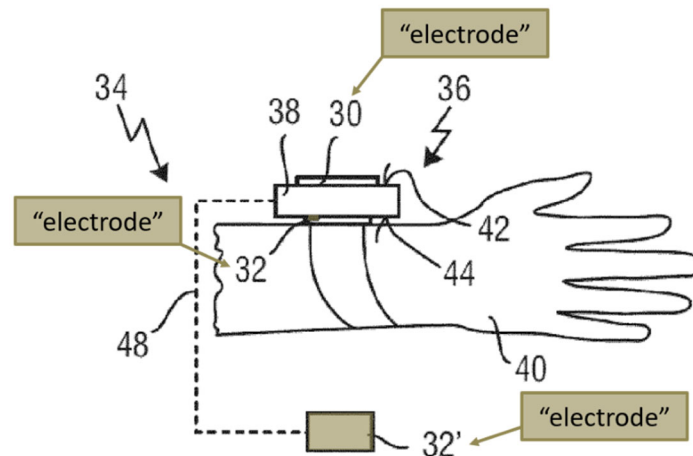


See *id.* at 26 (Fig. 5).

j. [1j] “a third electrode positioned along a side of the wearable electronic device, wherein:”

133. Kotanagi teaches 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.” EX1005 ¶14 (emphasis supplied); *see also id.* ¶86 (teaching a plurality of electrodes). Thus, Kotanagi itself teaches or suggests a third electrode which can also be used to determine contact with skin. Alternatively, a third electrode could be added (e.g., to a different area of Kotanagi’s watch) to provide an ECG measurement as is well known in the art. *See supra* § IX and *infra* note 5. A POSITA would have considered this option based on Kotanagi’s teaching of additional electrodes and the known benefits of electrocardiography.

134. A POSITA would have looked to other similar devices with multiple electrodes in the same field of endeavor, such as Coppola. This reference also teaches a biosensing watch with multiple electrodes:

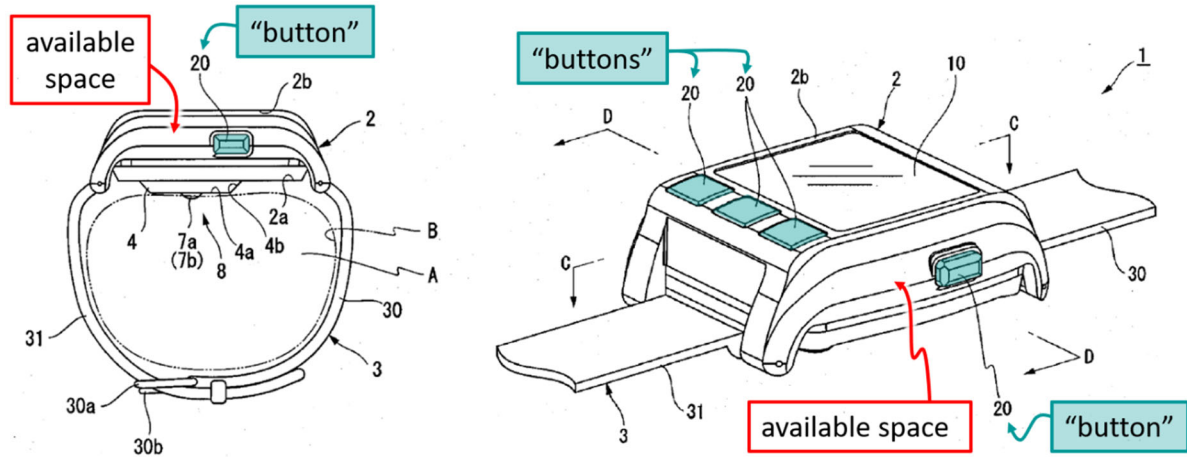


See EX1009 at 27; EX1020 at 25 (Fig. 3).

135. Coppola explains how dangerous conditions such as atrial fibrillation (AF) and their causes are detected by electrocardiography (ECG)—especially when combined with optical sensors, e.g., photoplethysmograph (PPG) sensors. EX1020 2:22–31, 3:10–21; EX1009 4:22–32, 5:10–21. Given these life-saving benefits, a POSITA would have configured Kotanagi’s multiple electrodes for ECG measurements to enhance its optical measurements.

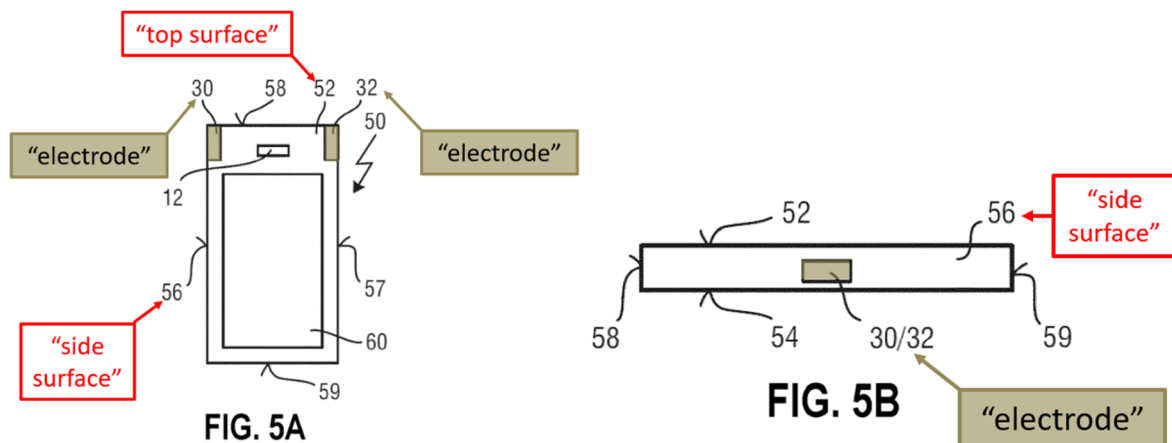
136. Coppola teaches that it may be advantageous to place an electrode on the side of a biosensing watch to allow for a larger screen: “**By placing first electrode 30 not on the front side 42, but on the side of the watch or on the strap instead**, the GUI element 46 can cover the whole front side 42 of the watch.” EX1009 at 16:21–23; EX1020 at 14:14–16 (emphasis supplied). This is consistent with, in Kotanagi’s case, minimizing disruption of Kotanagi’s front buttons. Kotanagi has available

space for a side electrode, so adding Coppola's side electrode would have been feasible:



EX1005 at 24, 25 (Figs. 2 and 4).

137. Coppola teaches that the particular location of the electrodes is not critical, but that two electrodes should be placed on “different surfaces” of the device, and “[i]n particular, at least one electrode 30, 32 may be arranged on a back surface 54 or a side surface.” EX1009 18:5–7; EX1020 15:32–16:1. A configuration with an electrode on the side of a device is annotated below:



See EX1009 at 28; EX1020 at 26.

138. Based on both Kotanagi's and Coppola's teachings of multiple electrodes, a POSITA would have known to add a third electrode⁶ and, by positioning the third electrode on the side (Kotanagi already has two on the rear) of Kotanagi's device, enable ECG measurement while leaving room for a larger screen on the front.

⁶ Through the decades many biosensing watches in the prior art have used three or more electrodes for ECG measurements. EX1008 at Figs. 1A–2B (showing three electrodes 14 on the front and back of the watch); EX1011 at Fig. 1 and EX1023 at Fig. 1 (showing four ECG contacts 131 and 151); EX1027 at Fig. 2 (showing three electrodes placed on the top, bottom, and band of the watch for ECG measurements); EX1029 at Fig. 1, 5–13 (showing configurations of two active (“A”, 21, 33) electrodes and a neutral (“N”, 22, 32) electrode for ECG measurements); EX1031 at Fig. 1 (showing three electrodes 14, 16, and 18 for ECG measurements); EX1033 at Fig. 5 (showing two electrodes, 560 and 561, on the upper sides the watch, and electrode 515 on the lower side of the watch for ECG measurements); EX1035 at Figs. 2a,2b and [0028] (teaching three ECG electrodes: 122 (front), 124 (back), and 126 (reference)).

- k. [1k] “the wearable electronic device is configured to measure a first physiological parameter of a wearer using the optical sensor; and”**

139. Kotanagi explicitly teaches that “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 ... As a result, the PD 6 can generate a pulse signal.” EX1005 ¶65. Thus, Kotanagi teaches measuring a pulse signal as a first physiological parameter.

- l. [1l] “the wearable electronic device is configured to measure a second physiological parameter using the first electrode, the second electrode, and the third electrode.”**

140. Kotanagi’s electrodes 7a and 7b detect a “potential difference between the electrodes.” EX1005 ¶59. A POSITA would have considered this potential difference a separate physiological parameter from the pulse signal because it involves an electrical “discharge” through the skin. *Id.* ¶14 (“the pair of electrodes come into contact with the living body surface so that a discharge occurs through the living body surface”).

141. As discussed above, Kotanagi also provides that the “electrodes need not be a pair” and a “plurality of electrodes” may be provided. *Id.* ¶¶14,86. Coppola teaches a biosensing watch with “electrical sensing unit [that] 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.” EX1009 at 8:23–27; EX1020 at 6:13–17. For such deep insights, a POSITA would have added Coppola’s ECG capability to Kotanagi.

142. Coppola teaches that its “electrical measurement of the HR-variation signal may be performed with two body parts on size [sic] lying opposite one another with respect to the heart of the living being 14” and that “an ECG with even more than two electrodes could be valuable, there is also the possibility to have even more electrodes.” EX1009 at 17:20–23; EX1020 at 15:12–15.

143. Adding ECG capability to Kotanagi would have been highly desirable—e.g., to help address atrial fibrillation problems, etc. as explained by Coppola (EX1020 2:22–31, 3:10–21; EX1009 4:22–32, 5:10–21)—and could be accomplished with relatively minor changes. Since Kotanagi teaches two electrodes on the bottom surface of the watch, a POSITA would have known from Coppola’s teaching that “at least two of all the electrodes” should be “arranged on two different surfaces” (EX1009 18:5–6; EX1020 15:32–33) and would have added a third electrode “on the side” of Kotanagi’s watch so that Kotanagi’s screen “can cover the whole front side 42 of the watch.” EX1020 16:21–23; EX1009 at 14:14–16. This allows the side electrode to be “touched by a finger of the other hand for an actual

ECG measurement” (EX1020 7:8; EX1009 9:18–19) so that the “electrodes are separately contacted or contactable to two body parts on sides lying opposite one another with respect to the heart of the user” (EX1020 6:22–23; EX1009 8:32–33).

144. Thus, in view of the teachings of Kotanagi and Coppola, a POSITA would have configured Kotanagi’s device with a third, side electrode to measure ECG as a second physiological parameter.

m. Motivation to Combine Kotanagi and Coppola

145. Based on the teachings above, A POSITA would have been motivated prior to September 2014 to combine Kotanagi and Coppola. They are analogous art in the same field because they both teach a watch with optical and electrical biosensors. Kotanagi teaches an LED and PD to detect pulse rate and “a plurality of electrodes” to detect electrical potential. EX1005 ¶¶14,46,86. Coppola teaches a device that “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.” EX1020 7:8–10; EX1009 9:19–21. A POSITA would have wanted to include ECG functions in Kotanagi’s watch to better monitor heart health.

146. A POSITA would have used Coppola simply to add a third electrode (e.g., to the side) and configure the electrodes for ECG measurement as Kotanagi already teaches electrodes to measure an electrical potential and that “the electrodes need not be a pair, and a plurality of electrodes, for example, may be provided.”

EX1005 ¶14; *see id.* ¶86 (teaching a plurality of electrodes). Further, Coppola teaches that using electrodes exploits a “well-established ECG technique” and that “an ECG with even more than two electrodes could be valuable.” EX1009 at 8:26, 17:22–23; EX1020 at 6:16, 15:15.

147. As stated above, Coppola does not limit its electrodes to a specific location, but merely states that electrodes should be “arranged on two different surfaces of the mobile communication device.” EX1009 18:5–7; EX1020 15:32–16:1. Coppola motivates a POSITA to provide a third electrode on the side of Kotanagi’s biosensing watch to provide more space for a display on the front of the watch. EX1009 16:21–23; EX1020 at 14:14–16 (“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.”). Thus, a POSITA would have used Coppola to add a third (side) electrode to Kotanagi, would have configured the electrodes for ECG measurement, and made the other modifications shown above to be obvious.

148. In view of Coppola and the many three-electrode biosensor watches (e.g., *supra* note 6), a POSITA would have also found it obvious to provide three electrodes in Kotanagi’s watch at least to: 1) gain insight into the cardiac cycle and address atrial fibrillation (*see* EX1020 2:22–31, 3:10–21, 6:13–17, 17:24–27;

EX1009 4:3–8, 8:23–28, 19:30–33); 2) improve signal to noise⁷ ratio with backup or additional measurements; 3) provide additional sensors as a failsafe if one stops working; 4) provide multiple contact points that are easier to access; 4) allow for different measurements (ECG and skin conductance) to enhance the features and information available to the user; 6) provide additional contact points for continuous skin contact⁸ during measurements as the watch is bumped, shifted, or jostled (such as during exercise); 7) allow a user to take an ECG measurement from multiple areas “lying opposite one another with respect to the heart” (EX1009 at 17:22–23; EX1020

⁷ EX1031 7:33–34 (“[t]he digital watch embodiment uses a three contact approach to help eliminate noise”); *id.* 3:16-18 (“All EKG probes pickup noise some of which is from the environment and some of which is generated by the body itself”).

⁸ EX1031 3:25–26 (“loose contact between the electrodes and the skin . . . changes the impedance of this contact erratically”).

at 15:14–15); and/or 8) provide a reference electrode to measure the voltage between the two other conductive areas.⁹

149. Further, various permutations of ECG biosensing watch electrodes were known¹⁰ prior to the filing of the '483 patent. As discussed above, the Examiner

⁹ EX1027 at 6 (teaching an “ECG signal” may be “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”).

¹⁰ See § IX *supra*, Biosensing Watches Through the Decades. See EX1008 at 20 (Claim 15 teaching ECG measurement with two or three electrodes in three different configurations); EX1027 at Fig. 2 (showing electrodes in the top, bottom, and band of the watch for ECG measurements); EX1029 at Fig. 1, 5–13 (showing various configurations of active (“A”, 21, 33) and neutral (“N”, 22, 32) electrodes for ECG measurements); EX1030 at Figs. 1,2 (showing electrodes 4a and 4b on the front and back of the watch for ECG measurements); EX1031 at Fig. 1 (showing electrodes 14, 16, and 18 for ECG measurements); EX1033 at Fig. 5 (showing “conductive areas 560 and 561” on the upper sides the watch, and “conductive area 515” on the lower side of the watch for ECG measurements); EX1034 [0237] (teaching an electrode on the band and the back of the watch for ECG

concluded in the Non-Final Rejection that the “location of the sensor ... presents little critical structure” for a biosensing watch ECG (EX1002 at 705). The Examiner reasoned that “to include such [electrode] sensors on the housing as opposed to the attachment band is considered to have been obvious to one of ordinary skill in the art.” *Id.* Applicant’s response did not provide any expert testimony or evidence contrary to this conclusion. EX1002 at 144–145. In contradiction to Apple’s assertions, the Examiner’s original line of reasoning is supported by the disclosure of Coppola, which teaches the feasibility of rearranging electrodes where Coppola’s first electrode is placed “not on the front side 42, but on the side of the watch or on the strap *instead*.” EX1020 14:14–16; EX1009 16:21–23 (emphasis added). Thus, the claimed electrode arrangement is obvious, as Coppola teaches that ECG electrodes may be placed in the front (EX1020 13:14–16; EX1009 16:21–23), side (*id.*), strap (*id.*), back (EX1020 13:23–35; EX1009 15:29–31), or an auxiliary “wired” location of a biosensing watch (EX1020 15:7–10; EX1009 17:14–17). Hence, Coppola confirms that the placement of electrodes on various surfaces of a biosensing watch would have involved mere combinations of familiar elements

measurements); EX1035 at Figs. 2a,2b (showing electrodes 122 (front), 124 (back), and 126 for ECG measurements); EX1008 at Figs. 1a,1b (showing two electrodes 16 on the front and one electrode 15 on the back for ECG measurements).

according to known methods to yield predictable results. *See KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. at 416 (2007).

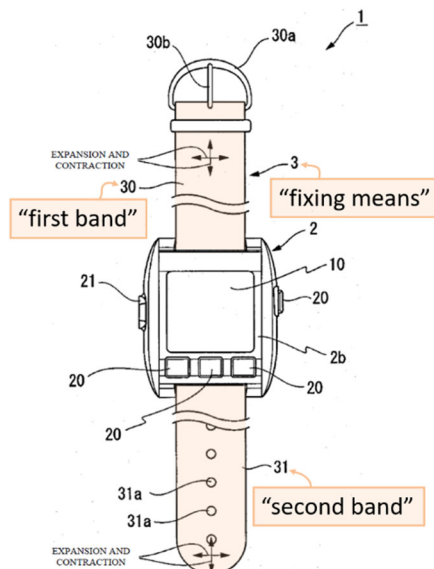
150. This motivation applies equally to the other claims rejected under Ground 1. Further motivations are provided throughout this Declaration.

2. Dependent Claim 2

151. Claim 2 depends from Claim 1 and adds:

- a. [2a] “the wearable electronic device further includes a watch band coupled to the housing and configured to couple the wearable electronic device to a wearer”**

152. Kotanagi has a “means for fixing” the watch to an arm (*id.* Abstract):
“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.” *See id.* at 11.



See EX1005 at 23 (Fig. 1).

b. [2b] “the optical sensor is a heart-rate sensor;”

153. Kotanagi explicitly teaches that “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 ... As a result, the PD 6 can generate a pulse signal.” EX1005 ¶65.

154. As Kotanagi’s watch measures heart rate in the same location as the ’483 patent, in the wrist, a POSITA would have considered a “pulse signal” to teach a “hear-rate” at least because they are directly correlated, the pulse manifests the rate, and has the same cadence as heart contractions.

c. [2c] “the first electrode is an electrode of an electrocardiograph sensing system; and”

155. As discussed in limitation [11], Kotanagi in view of Coppola teaches an ECG measurement with a first, second, and third electrode. Using Kotanagi’s existing electrodes to allow for different measurements (ECG and skin conductance) would have enhanced the features and information available to the user without, removing their existing function as taught by Kotanagi. Thus, the first electrode would be an electrode of an electrocardiograph sensing system, as it participates in the measurement of an ECG.

d. [2d] “the second physiological parameter is an electrocardiogram.”

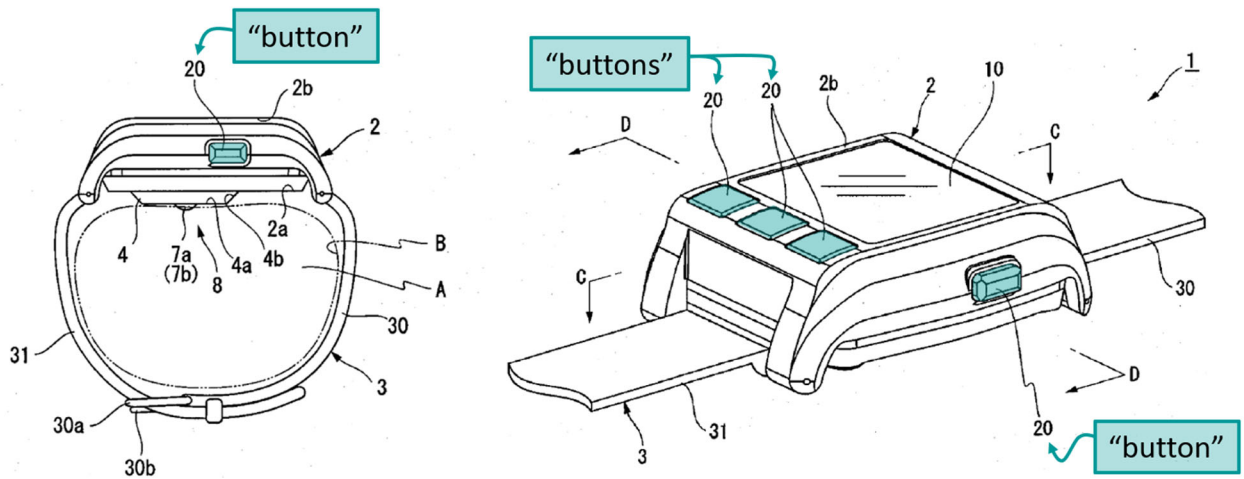
156. As discussed in limitation [11], Kotanagi in view of Coppola teaches an ECG measurement, consistent with this claim limitation.

3. Dependent Claims 3 and 5

157. Claims 3 and 5 have identical scope.¹¹ Both depend from Claim 1 and add **“further comprising an input device positioned along a side of the housing and configured to receive at least one of a rotational input or a translational input.”**

158. Kotanagi teaches buttons (20) on the top of the housing and “one button 2[0] disposed on the side surface of the housing 2” and that “[v]arious operations can be performed by pressing each of these buttons 20.” EX1005 ¶52. Pressing a button is a translational input, as the button is “translated” inward as it is pressed. This is consistent with the use of “translate” in the ‘483 patent. EX1001 at 53:1–2 (the crown (button) “may be configured to translate along an axis when pressed or pulled by the user”).

¹¹ Dependent Claims 3 and 5 are verbatim copies of each other and depend from the same independent claim.

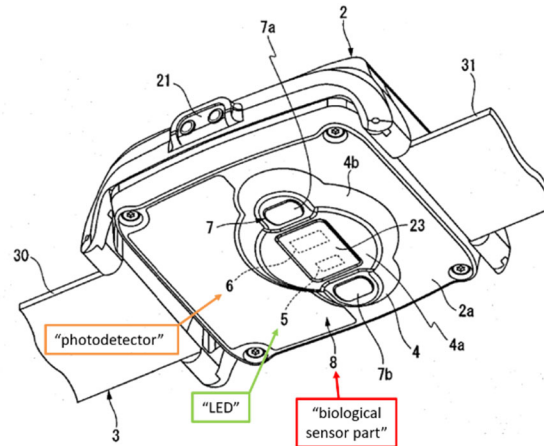


See Fig. 2. EX1005 at 24 (Fig. 3).

4. Dependent Claim 6

159. Claim 6 depends from Claim 1 and further adds **“wherein the optical sensor comprises: an optical emitter configured to emit an optical signal; and an optical receiver configured to receive a reflected portion of the optical signal.”**

160. Kotanagi’s optical sensor described with respect to limitation [1h] includes both the claimed emitter (“LED 5”) and receiver (“a PD (Photodetector) (light-receiving part) 6 for receiving reflected light from the living body out of the light emitted by the LED 5.”). EX1005 ¶46.



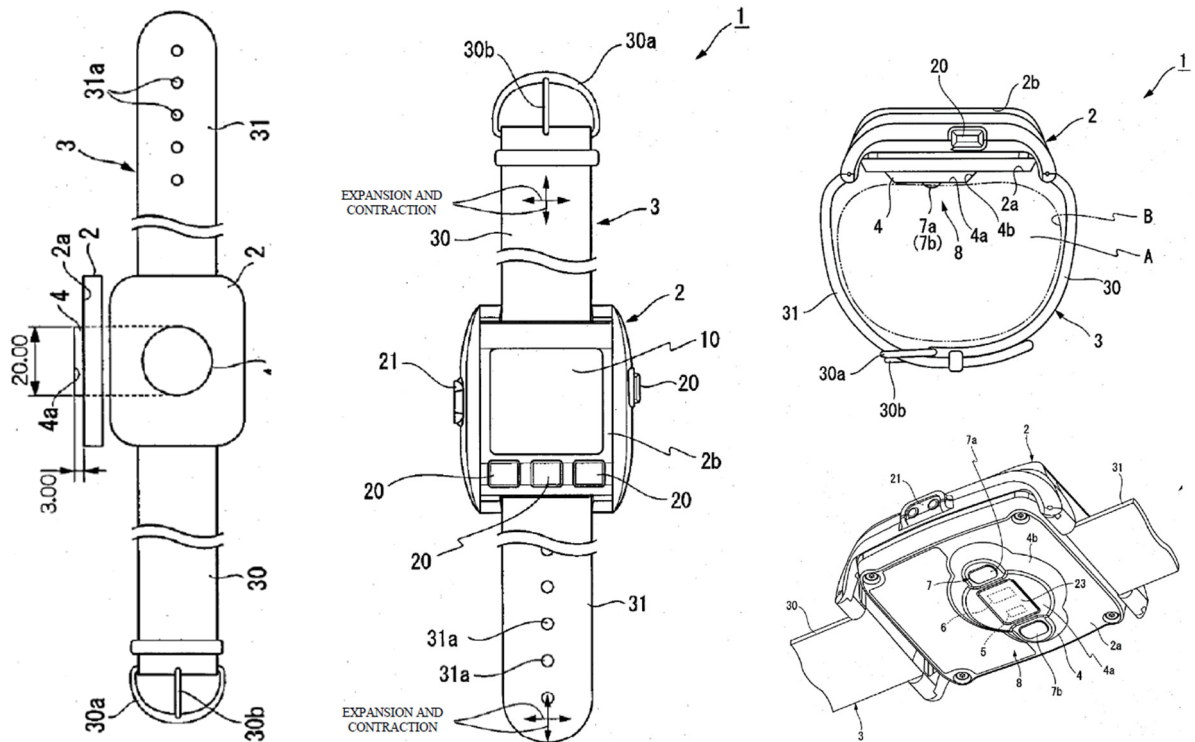
See EX1005 at 26 (Fig. 5).

5. Independent Claim 10

10. An electronic watch comprising:
- a display;
 - a housing at least partially enclosing the display;
 - a front cover positioned over the display and defining at least a portion of a front exterior surface of the electronic watch;
 - a biosensor module defining at least a portion of a rear exterior surface of the electronic watch opposite the front exterior surface, the biosensor module comprising:
 - a rear cover defining an optically transparent window;
 - an optical sensor positioned below the optically transparent window;
 - a first electrode positioned along the rear exterior surface of the electronic watch; and
 - a second electrode positioned along the rear exterior surface of the electronic watch; and
 - a third electrode positioned along a side of the electronic watch, wherein:
 - the electronic watch is configured to measure a first physiological parameter of a wearer using the optical sensor; and
 - the electronic watch is configured to measure a second physiological parameter using the first electrode, the second electrode, and the third electrode.

a. [10a] “An electronic watch comprising:”

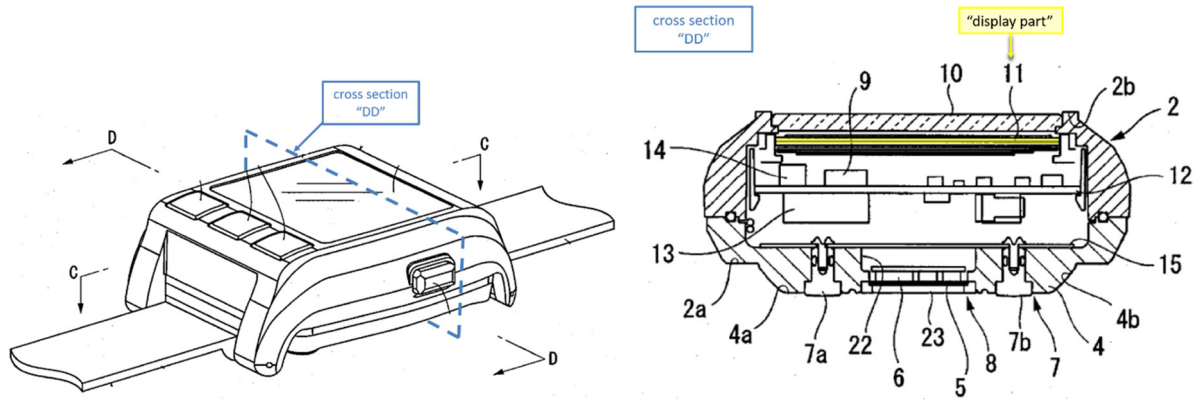
161. Kotanagi describes a “wristwatch-type device which detects pulse rate as a type of biological information while mounted to the wrist.” EX1005 at 10.



Id. at 23, 24, 26, 28 (Figs. 1, 2, 5, 8).

b. [10b] “a display;”

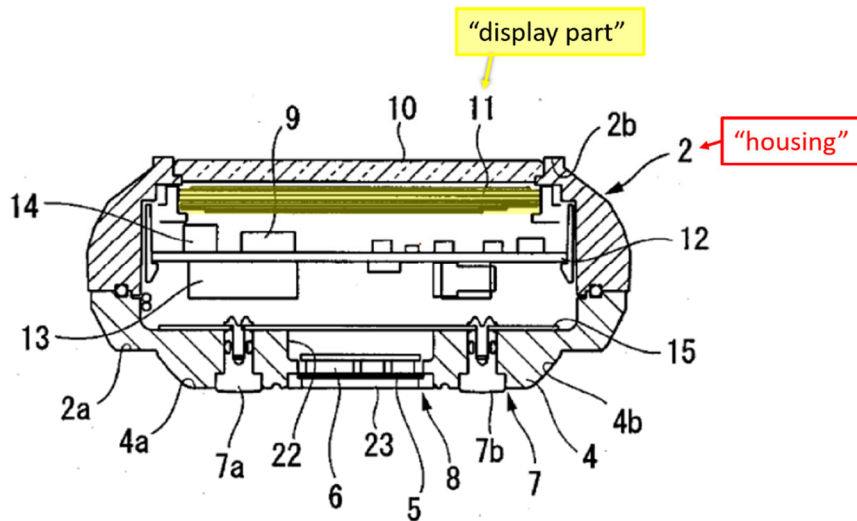
162. Kotanagi teaches that “a display part 11 for displaying . . . pulse rate that is detected and various other information is disposed inside the cover glass 10.” EX1005 ¶48.



See id. at 25, 27 (Figs. 4,7).

c. [10c] “a housing at least partially enclosing the display;”

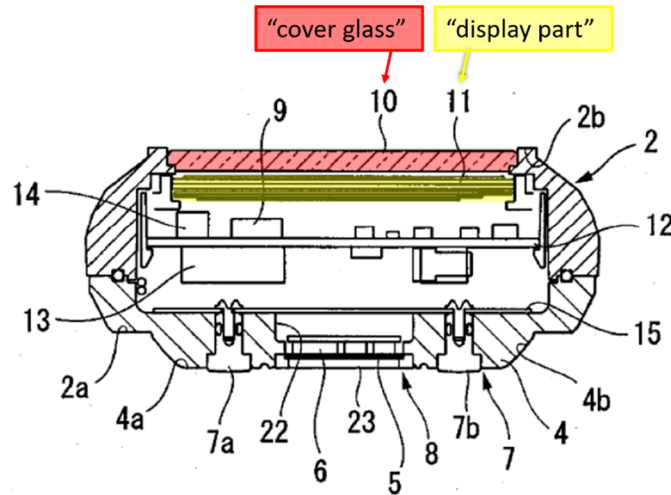
163. Kotanagi teaches “A cover glass 10 with a substantially square shape is fitted into the central portion of the upper surface 2b of the housing 2, and a display part 11 for displaying the aforementioned pulse rate that is detected and various other information is disposed inside the cover glass 10.” EX1005 ¶48. Thus, the housing at least partially encloses the display:



See EX1005 at 27.

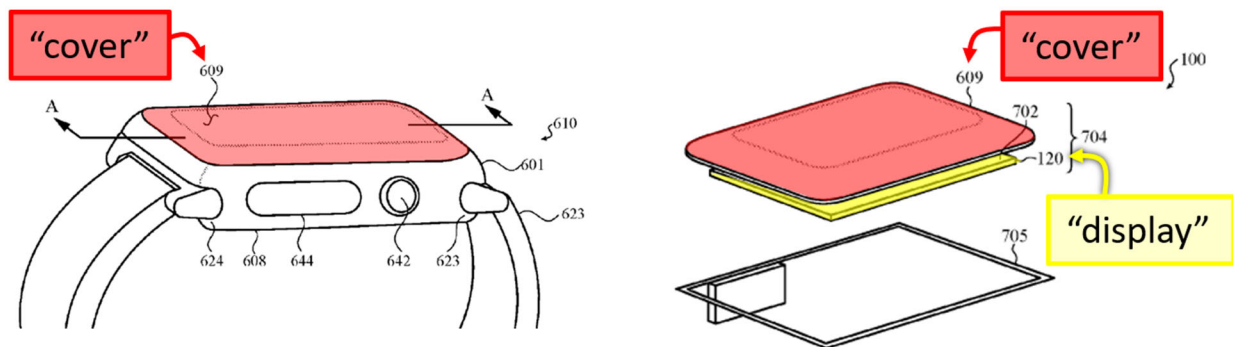
d. [10d] “a front cover positioned over the display and defining at least a portion of a front exterior surface of the electronic watch;”

164. Kotanagi teaches a “cover glass 10” is in the front exterior surface:



See EX1005 at 27 (Fig. 7).

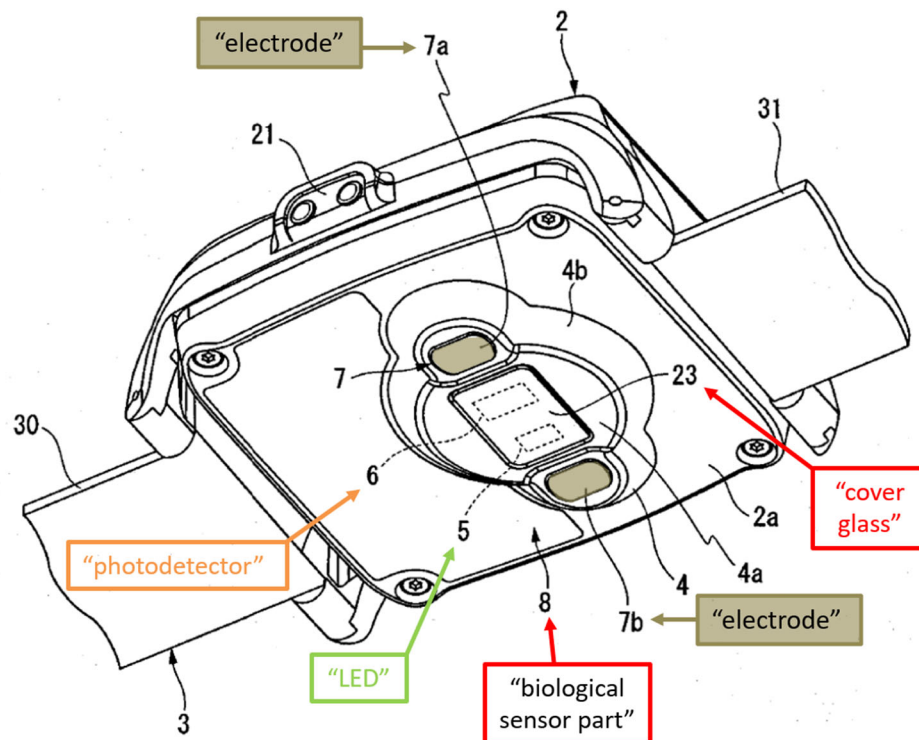
165. The cover glass 10 is positioned “over” the display 11 in the figure above. This is consistent with the ’483 patent’s display, which is also under a cover glass in the opening:



See EX1001 at 12–13 (Figs. 6, 7). Accordingly, Kotanagi teaches this limitation.

- e. [10e] “a biosensor module defining at least a portion of a rear exterior surface of the electronic watch opposite the front exterior surface, the biosensor module comprising:”

166. Claim limitations [10e]–[10i] specify that the ’483 biosensor module comprises a rear cover, an optical sensor, and electrodes. Kotanagi’s biological sensor includes a rear cover glass 23, optical components (photodetector 6 and LED 5), and electrodes 7a and 7b. This biosensor module is located on, and helps define, the rear exterior surface of Kotanagi’s device:

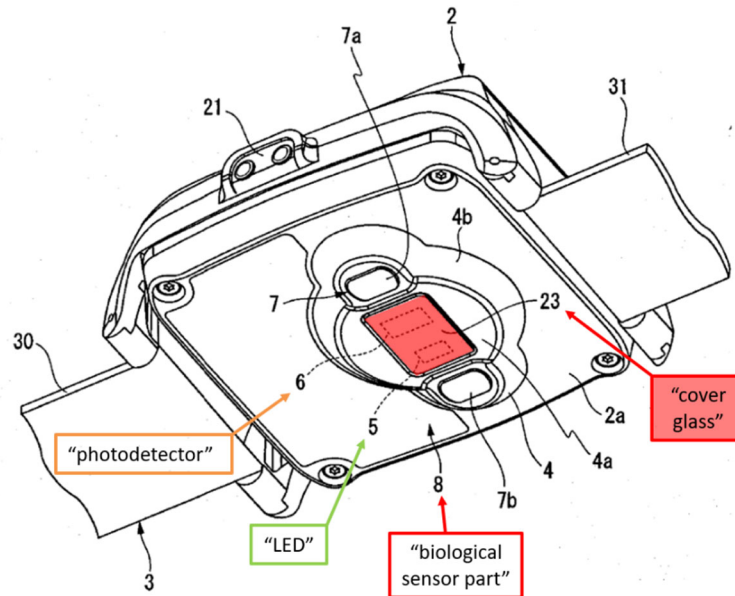


See id. at 26 (Fig. 5).

- f. [10f] “a rear cover defining an optically transparent window;”

167. Consistent with the construction in section VI(1) above, Kotanagi teaches a rear “glass cover 23” that operates as an optically transparent window for

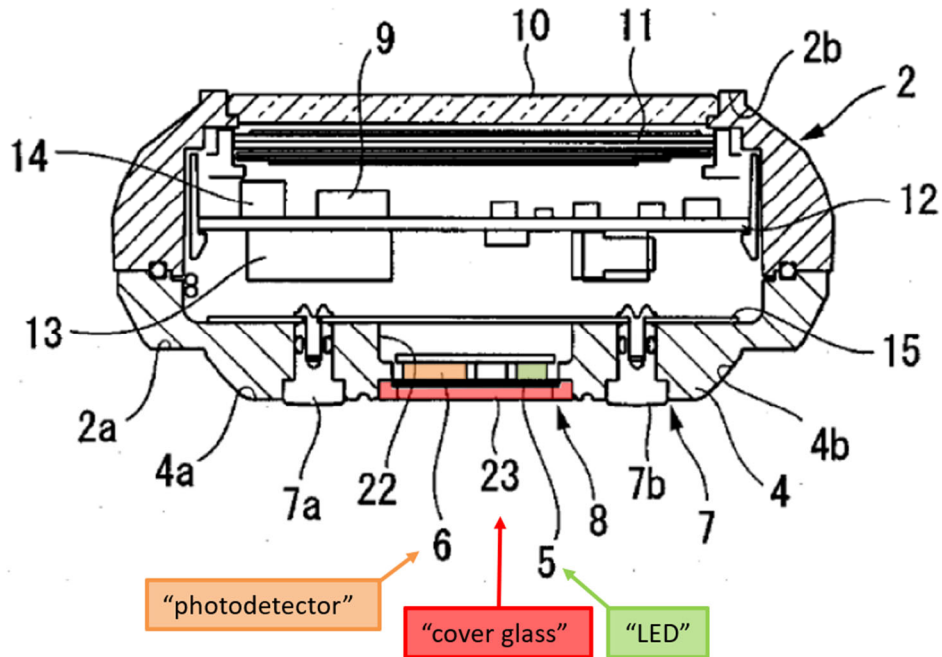
the biological sensor: “LED 5 and the PD 6 are disposed adjacent to one another . . . so as to touch the inside of the glass cover 23.” *Id.* ¶55. The cover is optically transparent because the LED emits light through it and “PD 6 can receive reflected light corresponding to the pulsation of arteries.” *Id.* ¶65.



See id. at 26 (Fig. 5).

g. [10g] “an optical sensor positioned below the optically transparent window;”

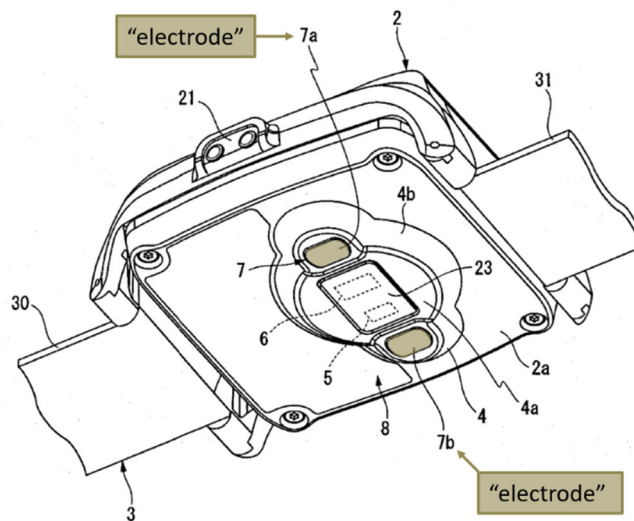
168. As noted for limitation [10f], Kotanagi’s “LED 5 and the PD 6 are disposed adjacent to one another . . . so as to touch the inside of the glass cover 23.” *Id.* ¶55. Thus, the LED and PD are positioned “below” the cover glass 23.



See EX1005 at 27 (Fig. 7).

h. [10h] “a first electrode positioned along the rear exterior surface of the electronic watch; and a second electrode positioned along the rear exterior surface of the electronic watch; and”

169. Kotanagi teaches a pair, or plurality, of rear electrodes, 7a and 7b that are positioned on the rear surface of the device. EX1005 ¶¶59, 86.



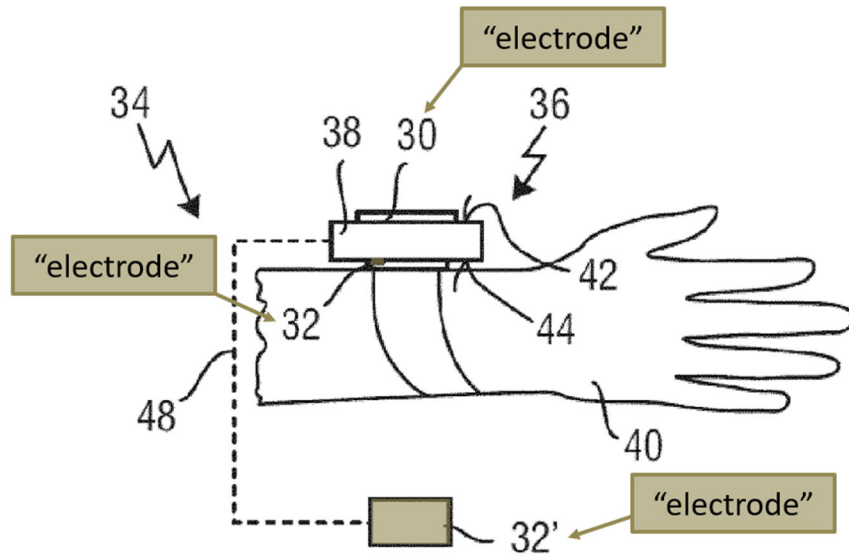
See id. at 26 (Fig. 5).

i. [10i] “a third electrode positioned along a side of the electronic watch, wherein:”

170. As noted for limitation [1j], the combination of Kotanagi and Coppola teaches a third electrode positioned along a side of the biosensing watch.

171. Kotanagi teaches 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.” EX1005 ¶14 (emphasis supplied); *see id.* ¶86 (teaching a plurality of electrodes). Thus, Kotanagi itself teaches or suggests a third electrode. The third electrode can also be used to determine contact with skin. Alternatively, a third electrode could be added to a different surface of Kotanagi’s watch in order to provide an ECG measurement, as is well known in the art. *See supra* § IX and *infra* note 5.

172. For example, Coppola also teaches a biosensing watch with multiple electrodes for measurement of an ECG:

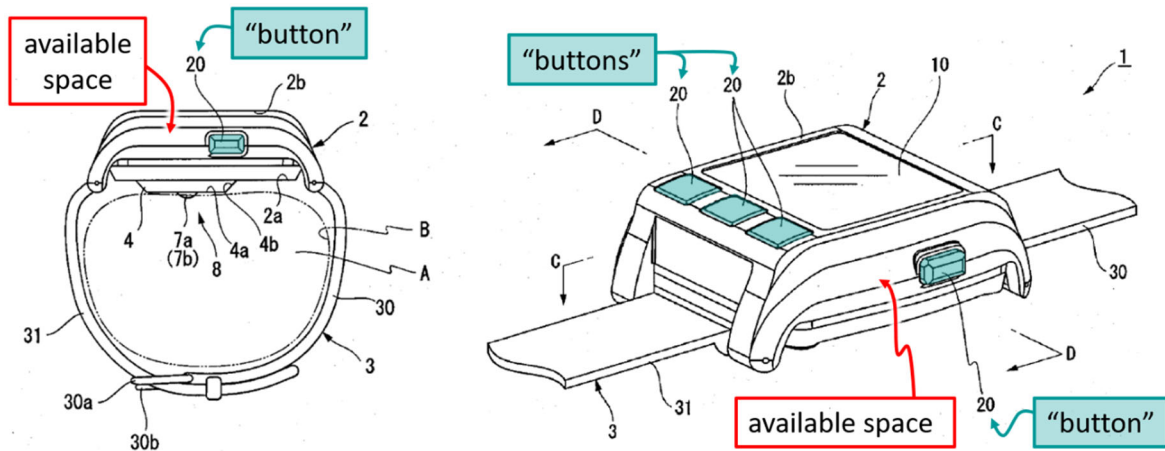


See EX1009 at 27; EX1020 at 25 (Fig. 3).

173. Coppola explains how dangerous conditions such as atrial fibrillation (AF) and their causes are detected by electrocardiography (ECG)—especially when combined with optical sensors, e.g., photoplethysmograph (PPG) sensors. EX1020 2:22–31, 3:10–21; EX1009 4:22–32, 5:10–21. Given these life-saving benefits, a POSITA would have configured Kotanagi’s multiple electrodes for ECG measurements to enhance its optical measurements.

174. A POSITA would have known from Coppola it is advantageous to place an electrode on the side of a biosensing watch to allow for a larger screen: “***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.” EX1009 at 16:21–23; EX1020 at 14:14–16 (emphasis supplied). This is

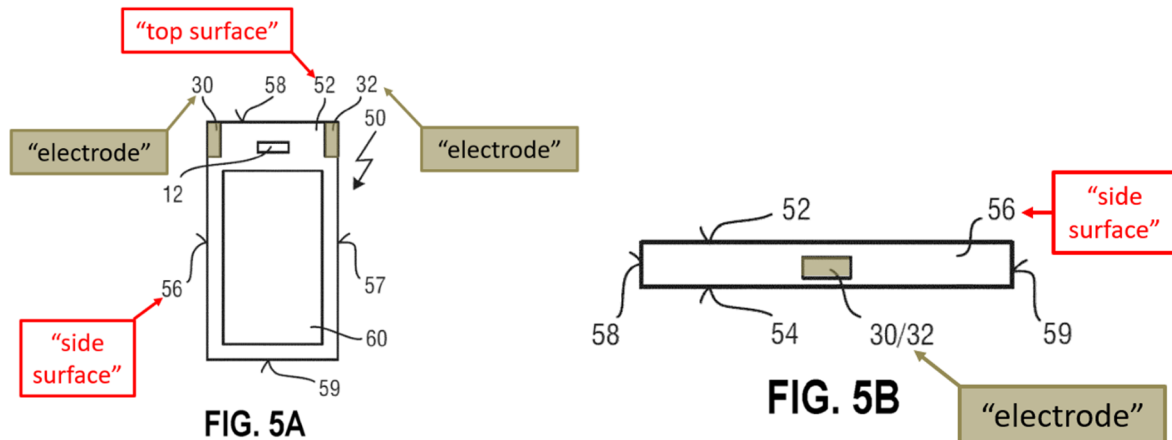
consistent with, in Kotanagi's case, minimizing disruption of Kotanagi's front buttons. Kotanagi has available space for a side electrode, so adding Coppola's side electrode would have been feasible:



EX1005 at 24, 25 (Figs. 2 and 4).

175. Coppola teaches that the particular location of the electrodes is not critical, but that two electrodes should be placed on “different surfaces” of the device, and “[i]n particular, at least one electrode 30, 32 may be arranged on a back surface 54 or a side surface.” EX1009 18:5–7; EX1020 15:32–16:1.

176. A configuration with an electrode on the side of a device is annotated below:



See EX1009 at 28; EX1020 at 26.

177. Based on both Kotanagi's and Coppola's teachings of multiple electrodes, a POSITA would have known to add a third electrode¹² and, by

¹² Many biosensing watches through the decades have used three or more electrodes for ECG measurements. EX1008 at Figs. 1A–2B (showing three electrodes 14 on the front and back of the watch); EX1011 at Fig. 1 and EX1023 at Fig. 1 (showing four ECG contacts 131 and 151); EX1027 at Fig. 2 (showing three electrodes placed on the top, bottom, and band of the watch for ECG measurements); EX1029 at Fig. 1, 5–13 (showing configurations of two active ("A", 21, 33) electrodes and a neutral ("N", 22, 32) electrode for ECG measurements); EX1031 at Fig. 1 (showing three electrodes 14, 16, and 18 for ECG measurements); EX1033 at Fig. 5 (showing two electrodes, 560 and 561, on the upper sides the watch, and electrode 515 on the lower side of the watch for ECG measurements); EX1035 at

positioning it on the side (Kotanagi already has two on the rear) of Kotanagi's device, enable ECG measurement while leaving room for a larger screen on the front.

j. [10j] “the electronic watch is configured to measure a first physiological parameter of a wearer using the optical sensor; and”

178. As noted for limitation [1k], Kotanagi teaches measuring a first physiological parameter (e.g., pulse rate), with its optical sensor.

179. Kotanagi teaches measuring a “pulse signal” from reflected light that is emitted and detected from its optical components: “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 ... As a result, the PD 6 can generate a pulse signal.” EX1005 ¶65. Kotanagi's data processing part 9 converts the pulse signal into a “pulse rate.” EX1005 ¶66.

Figs. 2a,2b and [0028] (teaching three ECG electrodes: 122 (front), 124 (back), and 126 (reference)).

- k. [10k] “the electronic watch is configured to measure a second physiological parameter using the first electrode, the second electrode, and the third electrode.”**

180. As shown for limitations [11], [2c], and [2d] Kotanagi in view of Coppola teaches the measurement of an ECG with a first, second and third electrode. *See supra* note 6 (many watches have used three or more electrodes for ECG measurement).

181. Kotanagi’s electrodes 7a and 7b detect a “potential difference between the electrodes.” EX1005 ¶59. As discussed above, Kotanagi teaches that the “electrodes need not be a pair” and a “plurality of electrodes” may be provided. *Id.* ¶¶14,86.

182. Coppola teaches a biosensing watch with “electrical sensing unit [that] 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.” EX1009 at 8:23–27; EX1020 at 6:13–17.

183. Coppola explains that its “electrical measurement of the HR-variation signal may be performed with two body parts on size [sic] lying opposite one another with respect to the heart of the living being 14” and that “an ECG with even more

than two electrodes could be valuable, there is also the possibility to have even more electrodes.” EX1009 at 17:20–23; EX1020 at 15:12–15.

184. Adding ECG capability to Kotanagi would have been highly desirable—e.g., to help address atrial fibrillation problems, etc. as explained by Coppola (EX1020 2:22–31, 3:10–21; EX1009 4:22–32, 5:10–21)—and could be accomplished with relatively minor changes. Since Kotanagi teaches two electrodes on the bottom surface of the watch, a POSITA would have known from Coppola’s teaching that “at least two of all the electrodes” should be “arranged on two different surface” (EX1009 18:5–6; EX1020 15:32–33) and would have added a third electrode “on the side” of Kotanagi’s watch so that Kotanagi’s screen “can cover the whole front side 42 of the watch.” EX1020 16:21–23; EX1009 at 14:14–16. This would allow the side electrode to be “touched by a finger of the other hand for an actual ECG measurement” (EX1020 7:8; EX1009 9:18–19) so that the “electrodes are separately contacted or contactable to two body parts on sides lying opposite one another with respect to the heart of the user” (EX1020 6:22–23; EX1009 8:32–33).

185. Thus, in view of the teachings of Kotanagi and Coppola, a POSITA would have found it obvious to measure a second physiological parameter (ECG) with a first, second, and third electrode.

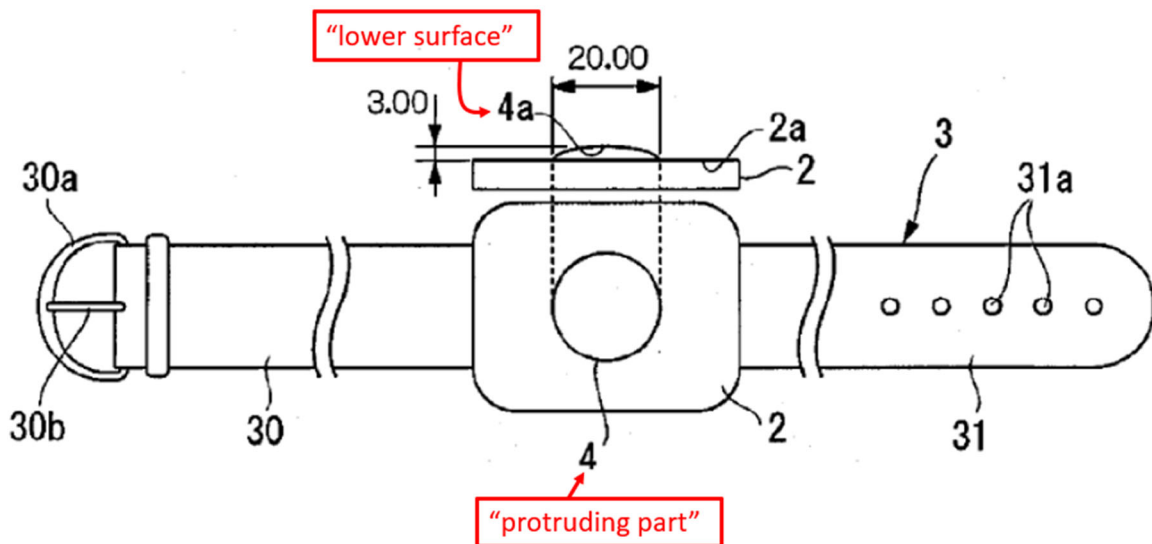
I. Motivation to Combine Kotanagi and Coppola

186. A POSITA would have been motivated to combine the teachings of Kotanagi and Coppola at least for the reasons stated in section XI(A)(1)(m). Further motivations to combine are provided throughout this Declaration.

6. Dependent Claim 11

187. Claim 11 depends from Claim 10 and adds “**wherein the rear cover defines a convex exterior surface.**”

188. As noted for limitation [1g], Kotanagi teaches the cover can form or comprise part of a convex protrusion: “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.” EX1005 ¶80.



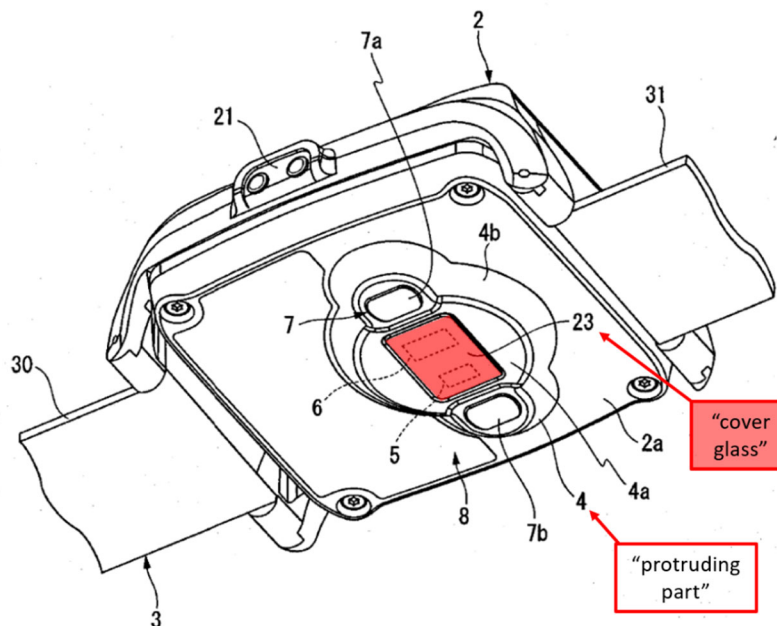
See EX1006 at 28 (Fig. 10).

189. A POSITA would have understood from Kotanagi's Figure 10 that the protruding part can form a convex "cover glass" that spans the through-hole 22. *Id.* at 28. Kotanagi states that its protruding part causes the body to "deform[] smoothly," which "enhances the adherence." EX1005 ¶¶35, 80.

7. Dependent Claim 12

190. Claim 12 depends from Claim 10 and adds **"wherein the optically transparent window is located within a portion of the rear cover that defines the convex exterior surface."**

191. As discussed and illustrated above with regard to Claim 11, Kotanagi teaches a convex exterior surface. A POSITA would have understood from Figure 10 that the "protruding part 4" of Figure 10 is formed from Kotanagi's cover glass 23. In a different embodiment, Kotanagi shows a window in protruding part 4:



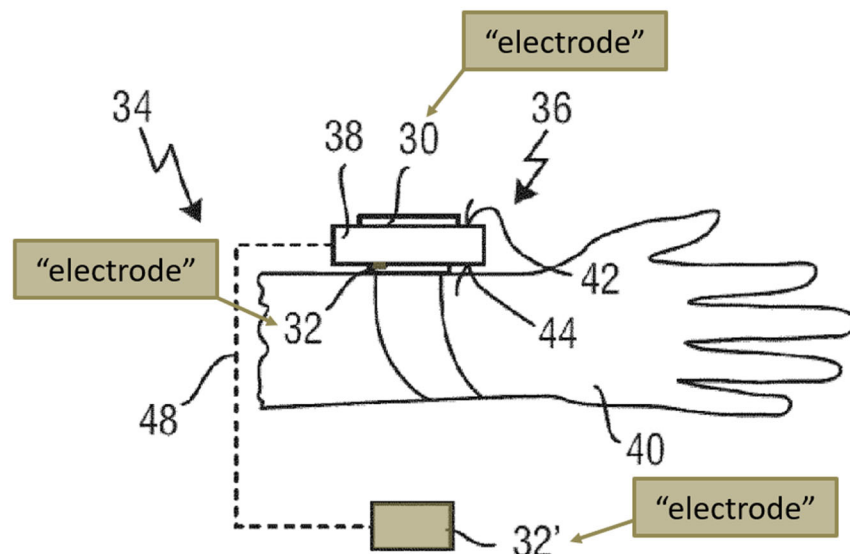
See EX1005 at 26 (Fig. 5).

192. Kotanagi teaches that the “biological sensor part” (which includes cover glass 23) “is disposed on a lower surface of the protruding part.” EX1005 ¶7. As Kotanagi’s Figure 10 illustrates, this “lower surface” can be convex.

8. Dependent Claim 13

193. Claim 13 depends from Claim 10 and adds “**wherein the first electrode, the second electrode, and the third electrode are part of an electrocardiograph sensing system.**”

194. As discussed for limitations [10i]–[10k] (referencing [1j]–[1l], [2c]–[2d]), Kotanagi in view of Coppola teaches an ECG measurement with a first, second, and third electrode.



See EX1009 at 27; EX1020 at 25 (Fig. 3). See EX1009 at 8:23–25; EX1020 at

6:13–15 (“electrocardiography ECG unit comprising at least a first and a second electrode.”) Thus, the electrodes would all be part of the claimed electrocardiograph sensing system.

195. Consistent with discussion of limitations [1j]–[1l], [2c]–[2d], and the motivations provided in § XI(A)(1)(m), a POSITA would have combined Kotanagi and Coppola to use three electrodes for ECG measurement, not only based on the teachings of Kotanagi and Coppola—e.g., to gain “deep insights into the cardiac cycle” EX1009 8:26–27; EX1020 6:16–17—but also to provide multi-functionality, reliability (e.g., through redundancy), improved signal strength, and an ergonomic design (a side electrode is convenient to touch).

9. Dependent Claim 14

196. Claim 14 depends from Claim 10 and adds “**wherein the first physiological parameter is a heart rate.**”

197. As noted for limitations [1k] and [10j] Kotanagi teaches measuring a first physiological parameter with its optical sensor, as light is emitted from the LED 5, partially absorbed by hemoglobin in blood vessels, and partially reflected back to the PD 6, which “generates a pulse signal.” EX1005 ¶65. Data processing part 9 converts the pulse signal into a “pulse rate.” *Id.* ¶66. As Kotanagi’s watch measures heart rate in the same location as the ’483 patent, in the wrist, a POSITA would have considered a “pulse rate” to teach “heart rate” at least because they are directly

correlated, as pulsing fluctuations in blood flow result from and are a manifestation of heart contractions.

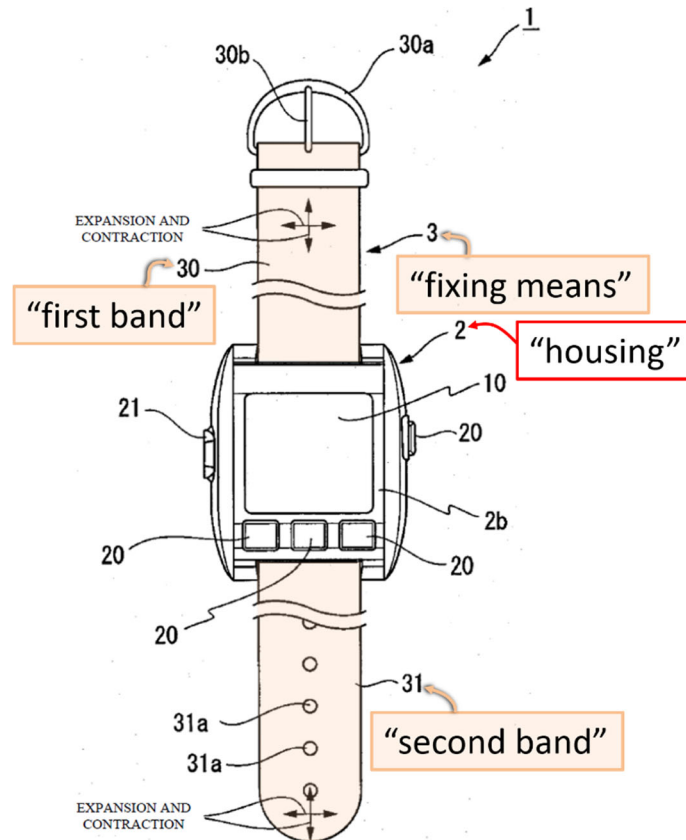
10. Independent Claim 16

16. A wearable electronic device comprising:
- a housing;
 - a band attached to the housing and configured to couple the wearable electronic device to a user;
 - a touch-sensitive display positioned at least partially within the housing;
 - a rear cover positioned at least partially within a rear opening defined along a rear portion of the housing, the rear cover defining at least a portion of a rear exterior surface of the wearable electronic device and having an optically transparent portion;
 - an optical sensor positioned within the housing and configured to emit an optical signal through the optically transparent portion;
 - a first electrode positioned along the rear exterior surface of the wearable electronic device;
 - a second electrode positioned along the rear exterior surface of the wearable electronic device; and
 - a third electrode positioned along a side of the wearable electronic device, wherein:
 - the wearable electronic device is configured to measure a first physiological parameter using the optical sensor; and
 - the wearable electronic device is configured to measure a second physiological parameter using the first electrode, the second electrode, and the third electrode.

- a. [16a] **“A wearable electronic device comprising: a housing; a band attached to the housing and configured to couple the wearable electronic device to a user;”**

198. Kotanagi describes a “biological information measuring device 1 [that] includes a housing (main body) 2 . . . and a fixing means 3 for mounting the housing 2 to the wrist.” EX1005 ¶45. Kotanagi teaches that “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.” (*id.* ¶60).



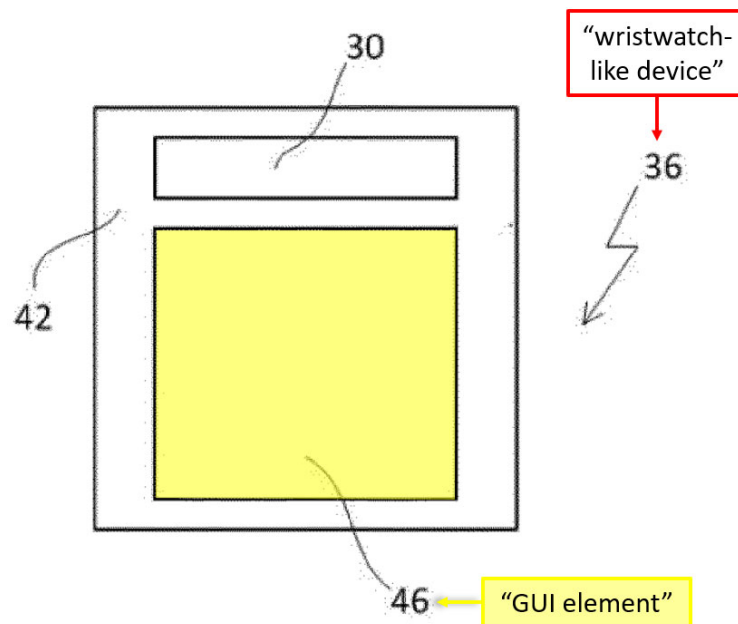
See *id.* at 23 (Fig. 1).

b. [16b] “a touch-sensitive display positioned at least partially within the housing;”

199. Kotanagi teaches a “liquid crystal display device” that may display information based on “input from each button 20.” EX1005 ¶51.

200. In the same field of endeavor, Coppola teaches that its “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.”



See EX1009 at 27; EX1020 at 25 (Fig. 4A).

201. Coppola teaches that 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.” EX1009 8:14–15; EX1020 6:4–5 (emphasis added). Through the GUI element the watch “can be used as a smart watch” and display the “internet, SMS (Short Message Service)” or other services. EX1020 14:7–10; EX1009 16:14–17.

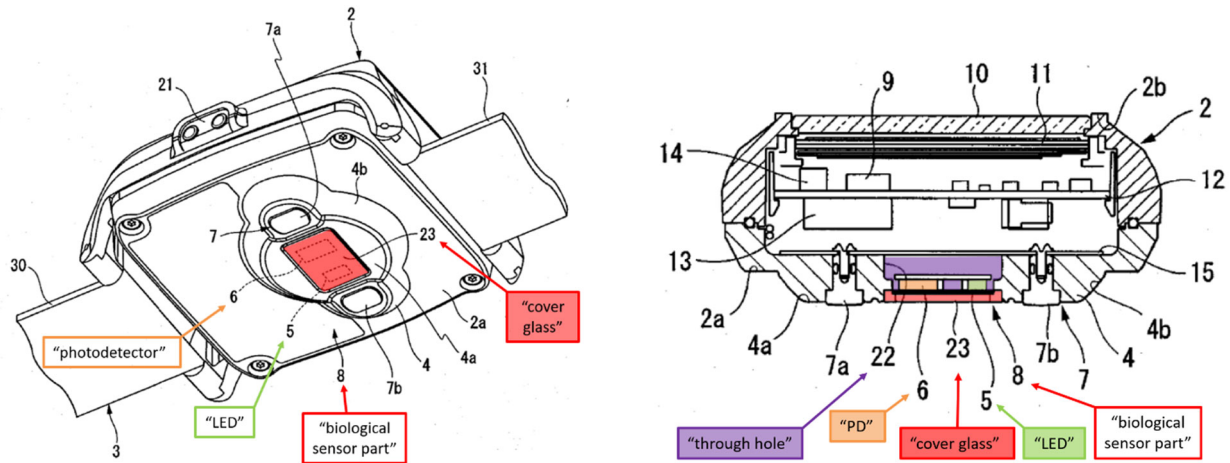
202. A POSITA would have been motivated to incorporate a touchscreen in Kotanagi as it reduces the need to provide buttons on the front side of Kotanagi’s device, increase the size of Kotanagi’s screen (without expanding device size),

reduce the number of separate components and moving parts in Kotanagi's device (reducing mechanical failure risk), and provide additional functionality not enabled by hardware buttons alone (a touchscreen or virtual "buttons" can be programmed for varying situations and functions, while the larger screen can provide additional context for these situations and functions). Further, touchscreens were known in the art,¹³ and this combination provides "familiar elements" that do "nothing more than yield predictable results." *See KSR*, 550 U.S. at 416.

- c. **[16c] "a rear cover positioned at least partially within a rear opening defined along a rear portion of the housing, the rear cover defining at least a portion of a rear exterior surface of the wearable electronic device and having an optically transparent portion;"**

203. Consistent with the discussion of limitation **[1f]**, Kotanagi teaches a rear cover glass 23 within and closing off "through-hole 22" and forms a portion of the rear exterior surface:

¹³ *See* EX1041 [0020] (biosensing watch with a "touch screen display"); EX1016 [0046] (biosensing watch with "touch sensitive screen inputs"); EX1011 [43]–[44] (biosensing watch with a "touch display").

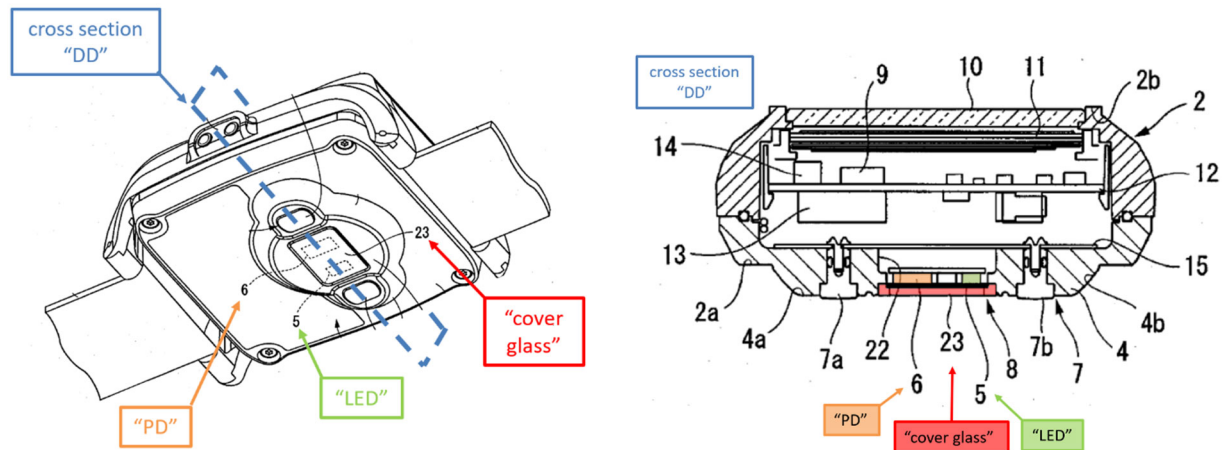


See EX1005 at 26, 27 (Figs. 5 and 7).

204. The “cover glass 23” is optically transparent because it allows the LED 5 to emit light toward the living body, and through it, the photodetector 6 receives “reflected light corresponding to the pulsation of arteries.” *Id.* ¶65.

d. [16d] “an optical sensor positioned within the housing and configured to emit an optical signal through the optically transparent portion;”

205. Kotanagi explains that its “cover glass 23” covers optical components of its biosensor moldule: “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 . . . so as to touch the inside of the glass cover 23.” *Id.* ¶55.

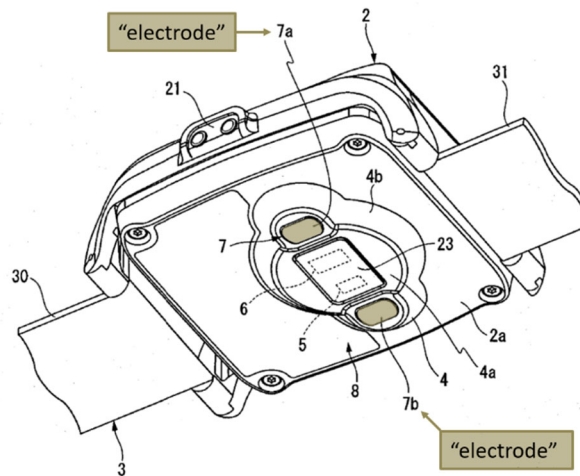


See EX1005 at 26, 27 (Figs. 5 and 7).

206. Consistent with the explanation of limitation [1h] and dependent Claim 6 *supra*, A POSITA would have understood that because Kotanagi’s “cover glass 23 is fixed to the housing 2 so as to block the through-hole 22” (EX1005 ¶55), its LED and photodetector work by emitting and receiving optical signals through the cover glass. Thus, Kotanagi’s optical biosensor satisfies this limitation.

- e. [16e] “a first electrode positioned along the rear exterior surface of the wearable electronic device; a second electrode positioned along the rear exterior surface of the wearable electronic device; and”

207. As noted for limitation [1i], Kotanagi teaches a “pair of electrodes 7a and 7b” on the rear surface of the device that detect skin contact using a “potential difference between the electrodes.” *Id.* ¶59.



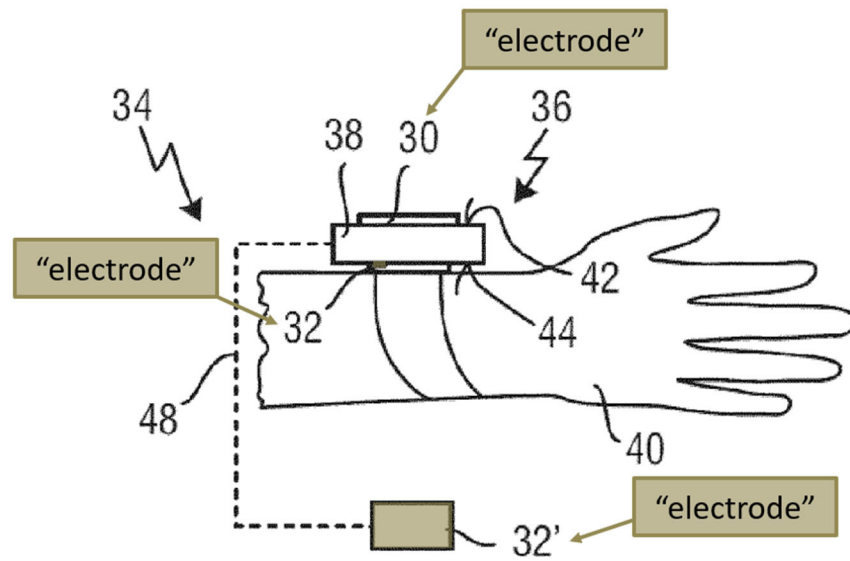
See *id.* at 26 (Fig. 5).

f. [16f] “a third electrode positioned along a side of the wearable electronic device, wherein:”

208. As shown with limitation [1j], Kotanagi in view of Coppola teaches a third electrode on the side of the wearable device.

209. Kotanagi teaches 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.” EX1005 ¶14 (emphasis supplied); see *id.* ¶86 (teaching a plurality of electrodes). Thus, Kotanagi itself teaches or suggests a third electrode, which can also be used to measure skin contact. Alternatively, the third electrode could be added (e.g., to a different area of Kotanagi’s watch) to provide an ECG measurement, as is well known in the art. A POSITA would have considered this option based on Kotanagi’s teaching of additional electrodes and the known benefits of electrocardiography.

210. A POSITA would have looked to other similar devices with multiple electrodes in the same field of endeavor, such as Coppola. This reference also teaches a biosensing watch with multiple electrodes, as shown below:



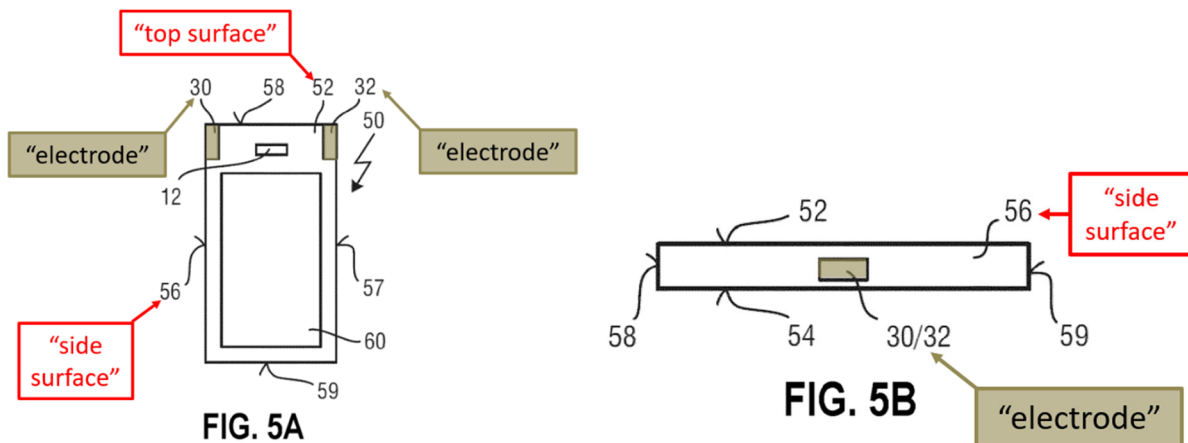
See EX1009 at 27; EX1020 at 25 (Fig. 3).

211. Coppola explains how dangerous conditions such as atrial fibrillation (AF) and their causes are detected by electrocardiography (ECG)—especially when combined with optical sensors, e.g., photoplethysmograph (PPG) sensors. EX1020 2:22–31, 3:10–21; EX1009 4:22–32, 5:10–21. Given these life-saving benefits, a POSITA would have configured Kotanagi’s multiple electrodes for ECG measurements to enhance its optical measurements.

212. A POSITA would have known from Coppola that it is advantageous to place an electrode on the side of a biosensing watch to allow for a larger screen: “***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.” EX1009 at 16:21–23; EX1020 at 14:14–16 (emphasis supplied). Coppola teaches that the particular location of the electrodes is not critical, but that two electrodes should be placed on “different surfaces” of the device, and “[i]n particular, at least one electrode 30, 32 may be arranged on a back surface 54 or a side surface.” EX1009 18:5–7; EX1020 15:32–16:1.

213. This configuration, with an electrode on the side of a device, is annotated below:



See EX1009 at 28; EX1020 at 26.

214. Based on both Kotanagi's and Coppola's teachings of multiple electrodes, a POSITA would have known to add a third electrode¹⁴ and, by positioning it on the side (Kotanagi already has two in the rear), enable ECG measurement while leaving room for a larger screen on the front.

g. [16g] “the wearable electronic device is configured to measure a first physiological parameter using the optical sensor; and”

215. As shown for limitation [1k], Kotanagi teaches a pulse rate measurement with its optical sensor.

h. [16h] “the wearable electronic device is configured to measure a second physiological parameter using the first electrode, the second electrode, and the third electrode.”

216. As shown for limitations [1l], [2c], and [2d] Kotanagi in view of Coppola teaches an ECG measurement with a first, second, and third electrode.

¹⁴ Many prior art watches have used three or more electrodes for ECG measurement. EX1008 Figs. 1A–2B (electrodes 14); EX1011 Fig. 1 and EX1023 Fig. 1 (contacts 131 and 151); EX1027 Fig. 2 (electrodes on top, bottom, and band); EX1029 Fig. 1, 5–13 (“A”, 21, 33 and “N”, 22, 32); EX1031 Fig. 1 (electrodes 14, 16, and 18); EX1033 Fig. 5 (electrodes, 560, 561, 515); EX1035 Figs. 2a,2b and [0028] (122 (front), 124 (back), and 126 (reference)).

Thus, a POSITA would have found it obvious to measure a second physiological parameter, such as an ECG, with a first, second, and third electrode.

i. Motivation to Combine Kotanagi and Coppola

217. A POSITA would have been motivated to combine Kotanagi and Coppola for the reasons stated above with regard to Claim 1 in *supra* § XI(A)(1)(m). Further motivations are provided throughout this Declaration.

11. Dependent Claim 17

218. Claim 17 depends from Claim 16 and adds **“the first electrode, the second electrode, and the third electrode are part of an electrocardiograph sensing system; and the second physiological parameter is an electrocardiogram.”**

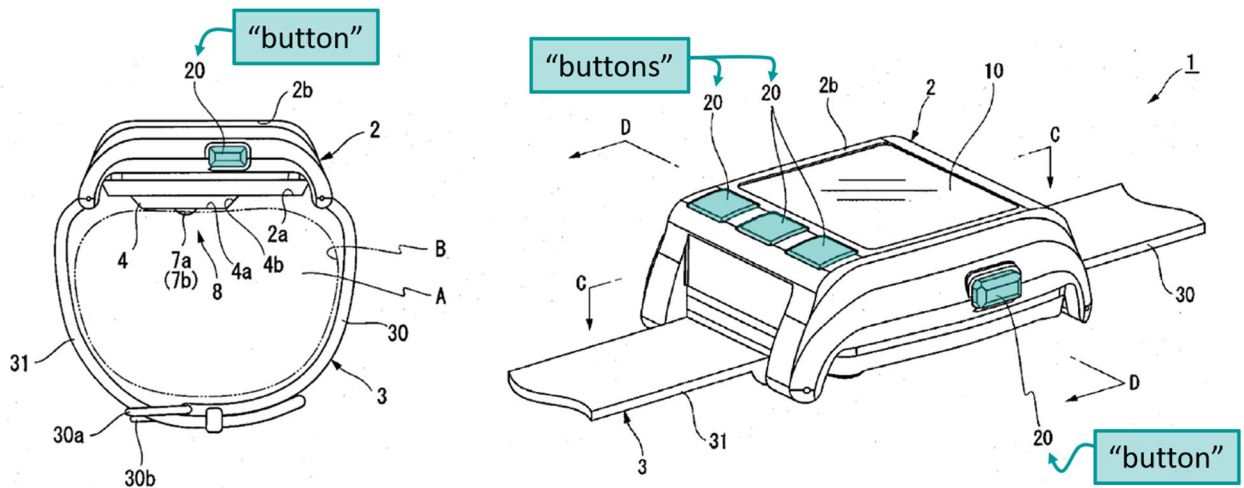
219. These limitations are obvious based on the analysis for limitation [11], [2c], and [2d] *supra* as Kotanagi in view of Coppola teaches the measurement of an electrocardiogram with a first, second, and third electrode. An electrocardiogram is measured with an electrocardiographic sensing system. Thus, a POSITA would have found that Kotanagi in view of Coppola teaches these limitations.

12. Dependent Claim 18

220. Claim 18 depends from Claim 16 and adds **“further comprising an input device positioned along a side of the housing and configured to receive at least one of a rotational input or a translational input.”**

221. As shown for Claims 3 and 5 above, Kotanagi teaches a translational input device (button 20) on the side of the housing. EX1005 ¶52.

222. Kotanagi teaches buttons (20) on the top of the housing and “one button 2[0] disposed on the side surface of the housing 2” and that “[v]arious operations can be performed by pressing each of these buttons 20.” EX1005 ¶52. Pressing a button is a translational input, as the button is “translated” inward as it is pressed.



See EX1005 at 24 (Fig. 3).

223. Thus, a POSITA would have found that Kotanagi meets this limitation.

13. Dependent Claim 19

224. Claim 19 depends from Claim 16 and adds **“wherein the rear cover defines a convex exterior surface.”**

225. As discussed above with regard to Claim 11 *supra*, Kotanagi teaches a rear cover that defines a convex exterior surface.

14. Dependent Claim 20

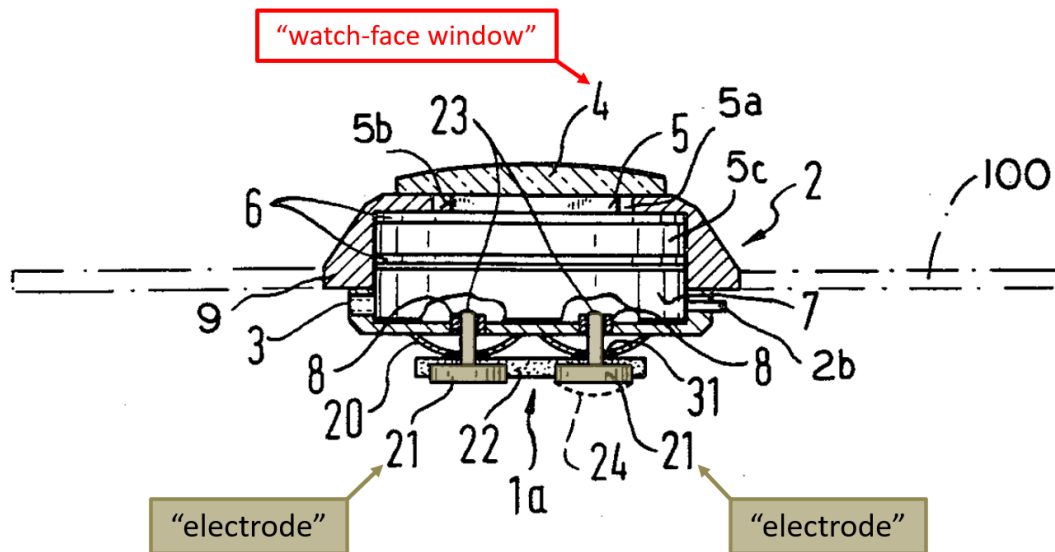
226. Claim 20 depends from Claim 16 and adds **“wherein the optical sensor comprises: an optical emitter configured to emit the optical signal through the optically transparent portion; and an optical receiver configured to receive a reflected portion of the optical signal through the rear cover.”**

227. These limitations are obvious based on the analysis for Claim 6 *supra*, including the figure showing transmission through the cover glass 23.

B. Ground 2: Claims 1–3, 5–6 and 10–14 are unpatentable because they would have been obvious over Kotanagi in view of Schmid.

228. This Ground applies Kotanagi identically to the analysis provided above in Ground 1 for Claims 1–6 and 10–14, except that Schmid is used to teach a third electrode (limitations [1j], [10i]) in order to measure a second physiological parameter (limitations [1l], [10k]), namely an electrocardiogram (e.g., Claims 2, 13).

229. Schmid, which was published in 1983, teaches a “heart-frequency measuring assembly” in a “wristwatch housing or case and which contains the electrodes in an electrode set or a plurality of such electrode sets.” EX1025 5:3–7.



See EX1025 at 2.

230. Schmid teaches significant benefits for EKG measurements using such a device. These include analyzing and diagnosing heart conditions and monitoring cardiac activity. EX1029 1:14–16, 2:5–9. A POSITA would have found it obvious to enhance Kotanagi’s biosensing features with EKG measurements to provide the added benefits explained in Schmid.

231. Schmid teaches that two closely-spaced electrodes and a third, reference electrode can be used for EKG measurement:

According to the invention as described, two electrodes (measurement or input electrodes) and the neutral or reference electrode can be disposed in close proximity with measurement results which nevertheless are at least as precise as the electrodes heretofore used for EKG measurements inspite [sic] of the many times greater spacing employed with the conventional electrodes.

EX1025 4:15–22.

232. Schmid further shows in Figs. 5–13 that an ECG electrode structure is not particularly limited and active electrodes (“A” or “33” and “34”) and a neutral (ground) electrode (“N” or “32”) may be arranged in “various configurations” (EX1029 6:36), some of which are shown below:

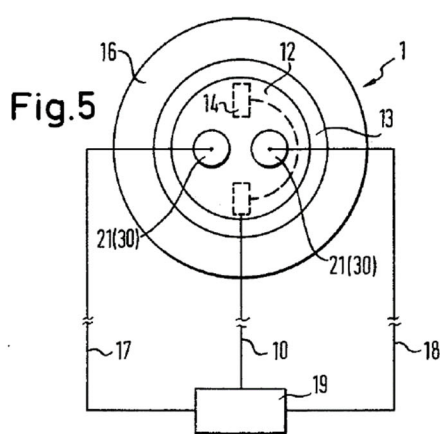


Fig. 5

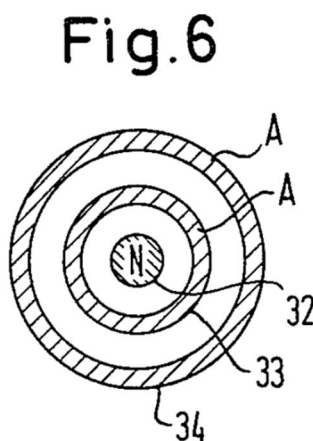


Fig. 6

Fig. 7



Fig. 9

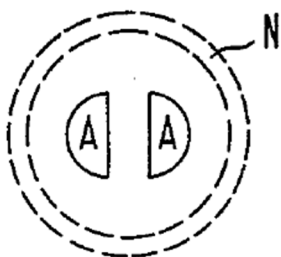


Fig. 11

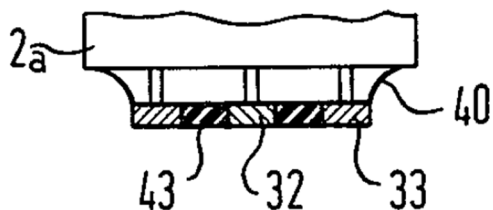
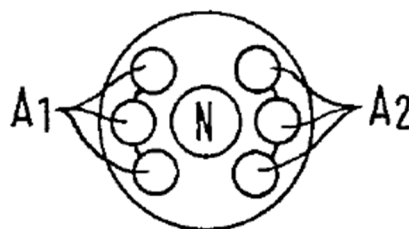


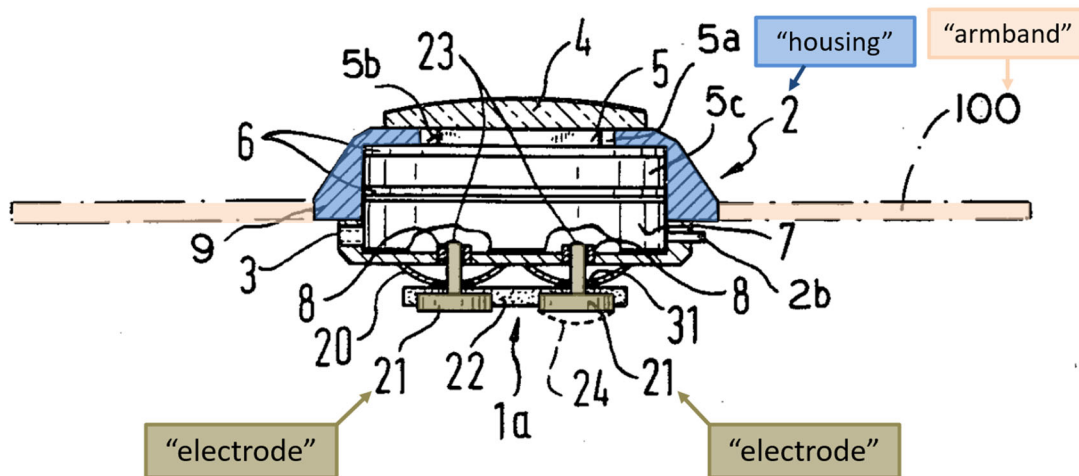
Fig. 13



Id., Figs. 5, 6, 7, 9, 11, 13.

233. The reference electrode can be formed by “[t]he armband 100 and/or the housing 2” (EX1025 5:20–22), in which case “ring 13 can be ... dispensed with entirely.” EX1025 8:25–26. Because the housing forms the side of the watch, which connects to the armband, putting the reference electrode in either place locates a

third electrode at the watch side, as claimed. The figure below shows how the housing 2 and armband 100 are located at the side of the watch.



See EX1025 at 2 (Fig. 1).

234. Thus, a POSITA would have found obvious an EKG measurement with three electrodes, including a third neutral or reference electrode on the side of the watch, in view of Kotanagi and Schmid.

a. Motivation to Combine Kotanagi and Schmid

235. Prior to September 2014, a POSITA would have been motivated to combine Kotanagi and Schmid as they are in the same field of endeavor of biosensing watches. This person would have expected to succeed in adding a third electrode because, for example, Kotanagi already teaches electrodes to measure an electrical potential and 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.” EX1005 ¶14. *See id.* ¶86 (plurality of electrodes).

236. In view of Schmid and the many three-electrode biosensor watches (e.g., *supra* note 6), a POSITA would have expected success and found it obvious to provide three electrodes in Kotanagi’s watch at least to: 1) analyze and diagnose heart conditions and monitor cardiac activity (EX1029 1:14–16, 2:5–9); 2) improve signal to noise¹⁵ ratio with backup or additional measurements; 3) provide additional sensors as a failsafe if one stops working; 4) provide multiple contact points that are easier to access; 5) allow for different measurements (EKG and skin conductance) with differently spaced electrodes to enhance the features and information available to the user; and/or 6) provide additional contact points for continuous skin contact¹⁶ during EKG measurements as the watch is bumped, shifted, or jostled (such as

¹⁵ EX1031 7:33–34 (“[t]he digital watch embodiment uses a three contact approach to help eliminate noise”).

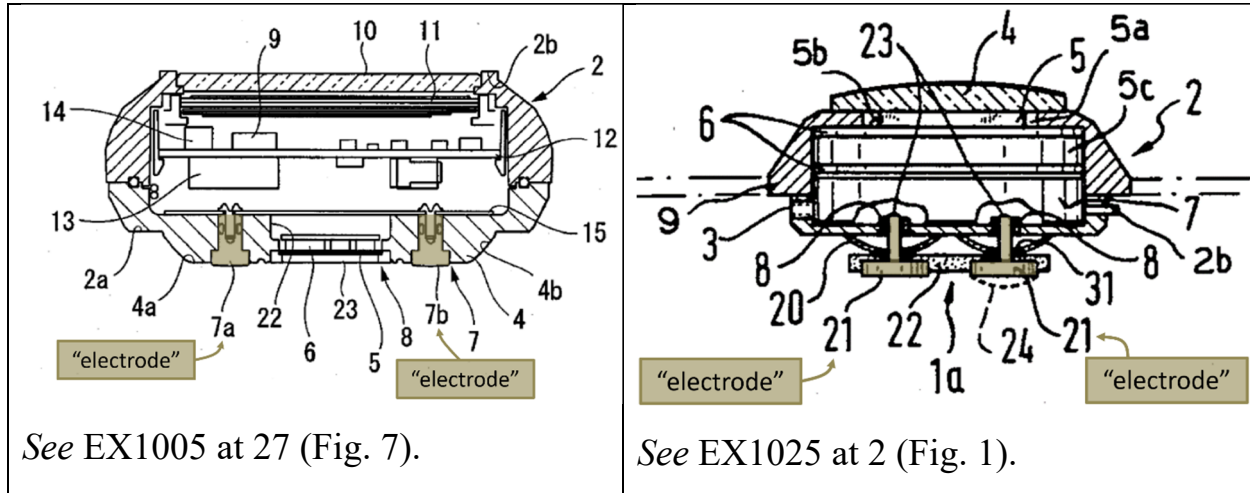
¹⁶ EX1031 3:25–26 (“loose contact between the electrodes and the skin . . . changes the impedance of this contact erratically”).

during exercise). A POSITA would have expected success in adding a third electrode to the side based on many similar, known watch electrode arrangements.¹⁷

237. Schmid teaches that its watch enables the measurement of an EKG via electrodes disposed in “close proximity” and which are “are at least as precise as the electrodes heretofore used for EKG measurements inspite [sic] of the many times greater spacing employed with the conventional electrodes.” EX1025 at 4:17–22. Thus, a POSITA would have been motivated to use Schmid to utilize a compact EKG configuration.

238. A POSITA would have expected success because the configurations of electrodes in Schmid and Kotanagi are very similar.

¹⁷ See EX1008 at 20 (Claim 15, three configurations); EX1027 Fig. 2 (electrodes in top, bottom, band); EX1029 at 5–13, Fig. 1 (active (“A”, 21, 33) and neutral (“N”, 22, 32) electrodes); EX1030 Figs. 1, 2 (electrodes 4a and 4b); EX1031 Fig. 1 (electrodes 14, 16, and 18); EX1033 Fig. 5 (conductive areas 515, 560 and 561); EX1034 [0237] (electrode on band, back); EX1035 Figs. 2a,2b (electrodes 122 (front), 124 (back), and 126); EX1008 Figs. 1a,1b (electrodes 16, 15).



239. Both Kotanagi and Schmid have two skin-contact (measurement) electrodes on the rear surface of their watch. A POSITA would have found it simple and feasible to embed an electrode in the housing or armband of Kotanagi (side of the watch), as Kotanagi already possesses those components.

240. This motivation applies equally to all the claims rejected under Ground 2, as Schmid is applied instead of Coppola to teach a third electrode on the side of the watch for an ECG measurement in Claims 1–3, 5–6, 8, and 10–14. Further motivations are provided throughout this Declaration.

C. Ground 3: Claim 4 is unpatentable because it would have been obvious over Kotanagi in view of Coppola and Tran

1. Dependent Claim 4

241. Claim 4 depends from Claim 1 and further adds “**wherein the second physiological parameter is a galvanic skin response.**”

242. Kotanagi's "pair of electrodes 7a and 7b" use a current to measure whether the watch is in contact with the user's skin based upon a "potential difference" (or voltage, V) between the electrodes. EX1005 ¶59.

243. Tran teaches that a two-electrode skin measurement also provides skin conductance, or galvanic skin response ("GSR"), based on a simple calculation using a known value. EX1034 [0280] ("a small current is passed through one of the electrodes into the user's body"). Tran is highly analogous to Kotanagi, teaching a housing with "bioelectric contacts" that may be in a "patch, a wristwatch, a band, a wristband" etc. EX1034 [0034]. Tran's watch is shown below:

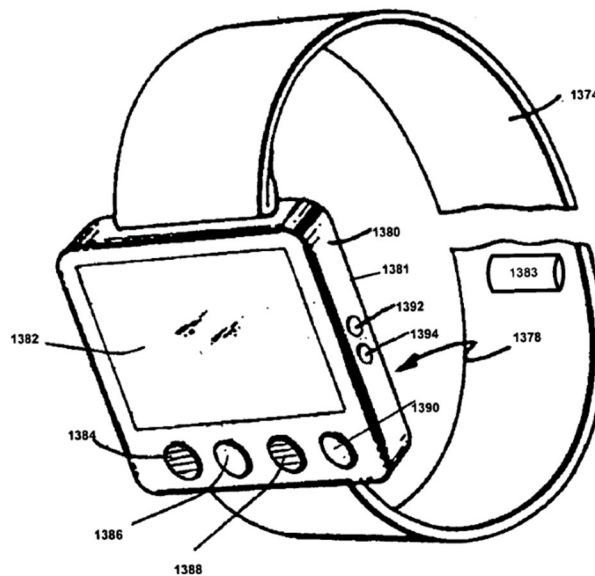


FIG. 6A

EX1034 at 5.

244. Like Kotanagi, Tran teaches "two electrodes on the wrist watch" to measure a "voltage signal from the surface of the body," but it does so "in terms of

impedance.” *Id.* [0260]. Tran teaches that a “Galvanic Skin Response (GSR) sensor” uses electrodes to measure and “calculate the skin resistance” in a “patch, a wristwatch, a band, a wristband” etc. (*Id.* [0034]). Tran states:

In another embodiment, the patch includes a Galvanic Skin Response (GSR) sensor. In this sensor, a small current is passed through one of the electrodes into the user's body such as the fingers and the CPU calculates how long it takes for a capacitor to fill up. The length of time the capacitor takes to fill up allows us to calculate the skin resistance: a short time means low resistance while a long time means high resistance.

EX1034 [0280].

245. A POSITA would have known how impedance (resistance, or R , in a DC circuit) relates to voltage through Ohm's law, $I=V/R$: “Ohm's Law: current in a circuit is directly proportional to voltage and inversely proportional to resistance in a DC circuit. *Id.* [0259] Because Kotanagi's device measures voltage between its electrodes (EX1005 ¶59) a current (I) would have been known or readily discoverable. A POSITA would have understood from Tran that galvanic skin response simply measures skin conductance (measured using resistance), a simple measurement to make using Kotanagi's existing skin-electrode circuit. Thus, based

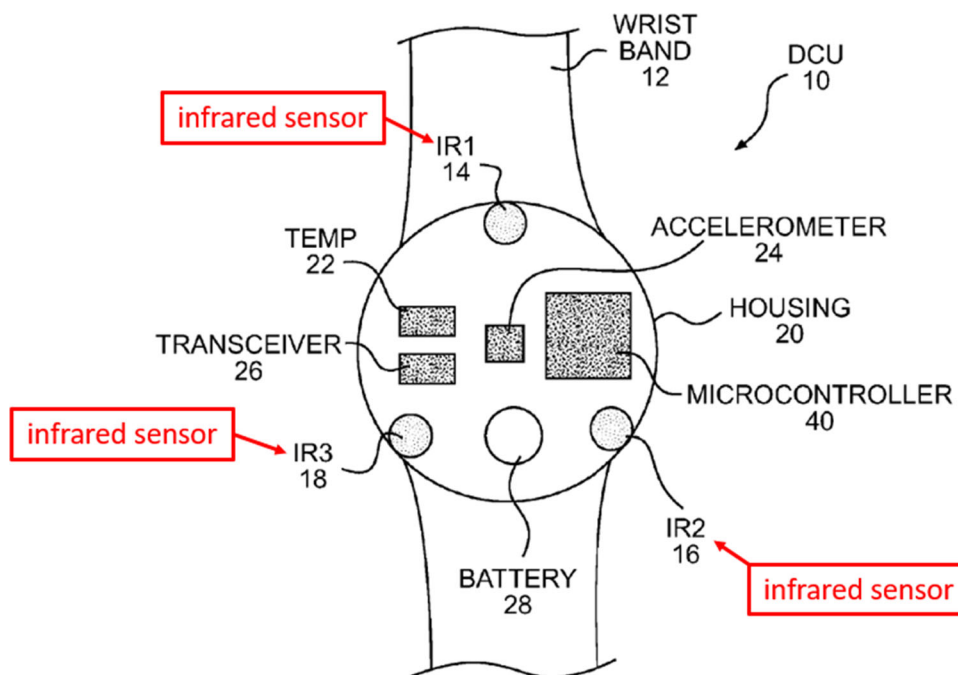
on Tran, a POSITA would have simply divided Kotanagi's existing potential difference measurement (V) by the known current (I) to calculate the skin resistance, or GSR, between its two electrodes, without making any modifications to Kotanagi's existing two-electrode structure.

D. Ground 4: Claim 15 is unpatentable because it would have been obvious over Kotanagi in view of Coppola and further in view of Kateraas.

246. Claim 15 depends from Claim 10 and adds “**wherein the rear cover comprises sapphire.**”

As discussed above, Kotanagi teaches a rear cover composed of glass.

247. Like Kotanagi, **Kateraas** (EX1014), which published in 2012, describes a biosensing wristwatch:



See EX1014 at 2 (Fig. 1).

248. Kateraas teaches that sapphire can form a “window” of “infrared transmissive or transparent material . . . to allow radiation emitted from infrared sensors 14, 16, and 18” to pass out of the device and “impinge upon the underside of the user’s wrist” and allow “infrared radiation reflected or emitted from the user’s skin” to pass into the device via the sapphire window. EX1014 [0059]. “Such infrared transmissive or transparent materials” for the window “may include, e.g., germanium, zinc selenide, **sapphire**, IR glass, IR polymer, barium fluoride, calcium fluoride, and combinations thereof.” *Id.* (emphasis added).

a. Motivation to Combine Kotanagi, Coppola, and Kateraas

249. The ’483 patent explains that “cover glass” is a term of art and is often used generically, “regardless of the material.” EX1001 21:56–59. Accordingly, a POSITA would have considered various materials for the rear cover based on the ’483 patent’s use of this generic phrase. Because Kotanagi’s optical sensor features are intended to emit and receive similar radiation, to the same portion of the human body (wrist), for the same biosensing purposes taught by Kateraas (pulse sensing), a POSITA would have looked to Kateraas for useful window materials and expected success in using sapphire for the cover glass 23.

250. Prior to September 2014, a POSITA would have been motivated to provide a sapphire rear cover, and expected success, as Kotanagi and Kateraas both teach light emission and reflection on the underside of a watch to measure the pulse rate of a user. Kotanagi teaches LED 5 for generating light and PD (Photodetector) 6 for receiving a pulse signal. EX1005 ¶46. Kateraas likewise teaches that “infrared sensors 14, 16, or 18 may provide robust data from which accurate pulse readings may be determined.” EX1014 [0032]. Further, Kateraas teaches that the cover of a biosensing module may include “sapphire, IR glass, IR polymer...” EX1014 [0059]. Since Kotanagi teaches cover glass 23 as a covering for a biosensor module a POSITA would have found glass and sapphire obviously substitutable in view of the list of materials in Kateraas. Such a substitution would have been a mere combination of familiar elements according to known methods that do no more than yield predictable results. *See KSR* at 416.

E. Ground 5: Claim 7 is unpatentable because it would have been obvious over Kotanagi in view of Coppola or Schmid and further in view of Fraser.

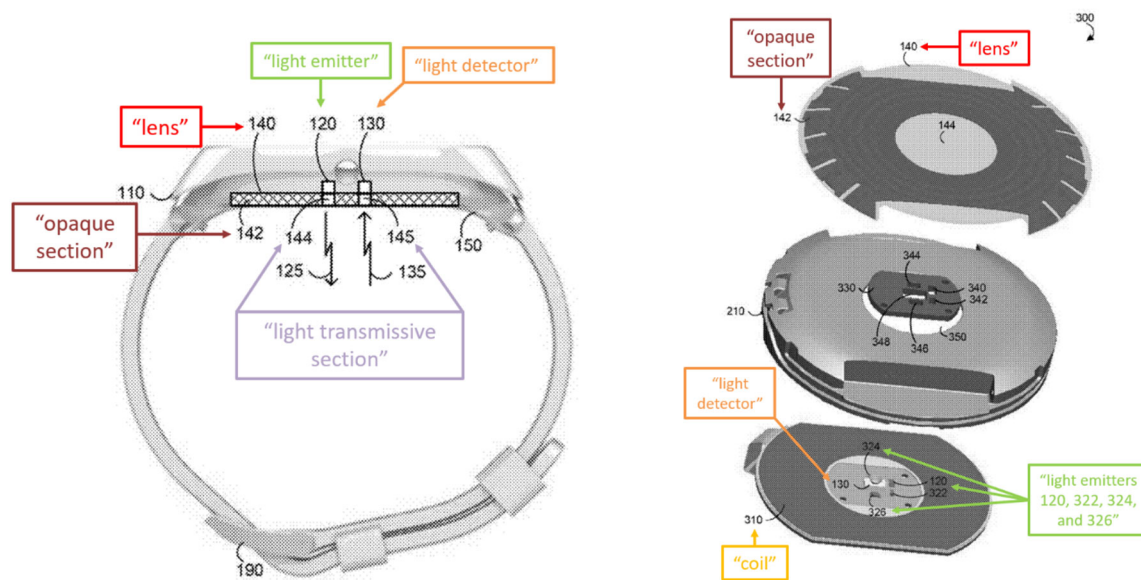
1. Dependent Claim 7

251. Claim 7 depends from Claim 1 and adds “**wherein: the optical emitter is a first optical emitter configured to emit light having a first wavelength; and the optical sensor further comprises a second optical emitter configured to emit light having a second wavelength different from the first wavelength.**”

252. Grounds 1 and 2 both use Kotanagi to demonstrate that Claim 1 is unpatentable, but for the third (ECG) electrode and related teachings, Ground 1 uses Coppola and Ground 2 uses Schmid.

253. This Ground applies Kotanagi, Coppola, and Schmid identically to the analyses provided above for Claim 1 under both Grounds 1 and 2. However, it adds the teachings of Fraser to Kotanagi for the further limitations of dependent Claim 7.

254. Kotanagi teaches an LED optical emitter, and in the same field of endeavor Fraser teaches that the skin-facing side of a biosensing watch may be used for “photoplethysmography, pulse Oximetry, and other biometric sensing” using an array of light emitters (120, 322, 324, 326). EX1041 [0016], [0027].



See EX1041 at 2, 5 (Figs. 1,3).

255. Fraser teaches that its biosensing watch may emit different wavelengths via “a combination of red, infrared, and green light emitters.” EX1041 [0015].

Accordingly, Fraser teaches that its watch includes a red light emitter 120, an infrared light emitter 322, and two green light emitters 324 and 326. *Id.* [0024]. By using different wavelengths, the watch may probe different physiological parameters such that the “red and infrared light emitters can be used to detect blood oxygen saturation and a green light emitter can be used to detect heart rate.” EX1041 [0015]. At least by September 2014, based on Fraser’s disclosure, a POSITA would have been motivated to further modify Kotanagi (even after any modifications taught by Coppola or Schmid), to include a second optical emitter, to improve its optical sensing features (e.g., to determine blood oxygen saturation in addition to pulse rate), as Kotanagi already has a transparent cover facing the skin, with room to place additional small emitters near the existing optical components on the cover glass 23.

a. Motivation to Combine Kotanagi and Fraser

256. A POSITA would have been motivated to combine the multiple wavelengths of Fraser with the LED of Kotanagi for various reasons. Both teach biosensing watches with similar shapes and rear biosensors. For example, the use of multiple wavelengths in a biosensing watch (as taught by Fraser) allows probing of additional physiological parameters. This is consistent with, and a natural extension of, Kotanagi’s biosensing goals. A POSITA would have expected success because, like Kotanagi, Fraser teaches that its “wrist worn device” may be used to measure “heart rate” via a photoplethysmography measurement. EX1005 ¶1;

EX1041 [0015]–[0016]. By September 2014, a POSITA would have known that additional biometric data (e.g., how well the lungs are working to insert blood into the blood stream) is more helpful than simply knowing how quickly the heart is beating—especially if the blood it is circulating does not have enough oxygen. Gaining this significant medical information would have been a strong reason to add one or more new emitters (e.g., red and green, as taught by Fraser.) *Id.* [0015]. Thus, a POSITA would have been motivated in September 2014 to add at least one LED, or use the color emitters of Fraser, to additionally measure blood oxygen saturation. Further, multiple emitters can aim or emit differently, and they can work together to increase signal strength, etc. A POSITA would have found multiple emitters desirable for all these reasons.

257. Fraser also teaches, like Kotanagi, that its biosensing watch may be charged in a “contactless” or wireless manner with a wireless charging coil surrounding its optical emitters. EX1005 ¶53, EX1041 [0026]. This similarity would have added to the expectation of success by a POSITA in combining them. For example, Fraser shows that wireless charging structures can be coiled around optical elements and provide desired functionality despite being closely adjacent to the optical elements.

b. Motivation to Combine Coppola, Kotanagi and Fraser

258. Ground 1 provides reasons for combining Kotanagi and Coppola. Any modifications to Kotanagi in this process (e.g., adding a side ECG electrode), would not have interfered with placing one or more different-wavelength LEDs in the rear as taught by Fraser. Indeed, the same motivation—improving sensing capabilities—would animate both modifications and they are fully compatible.

c. Motivation to Combine Schmid, Kotanagi and Fraser

259. Ground 2 provides reasons for combining Kotanagi and Schmid. Any modifications to Kotanagi in this process (e.g., adding a side ECG electrode), would not have interfered with placing one or more different-wavelength LEDs in the rear as taught by Fraser. Indeed, the same motivation—improving sensing capabilities—would animate both modifications and they are fully compatible.

260. Thus, a POSITA would have found the combination of Kotanagi’s LED and Fraser’s multiple light emitters obvious in view of the teachings above.

F. Ground 6: Claim 9 is unpatentable because it would have been obvious over Kotanagi, Coppola or Schmid, and further in view of Honda.

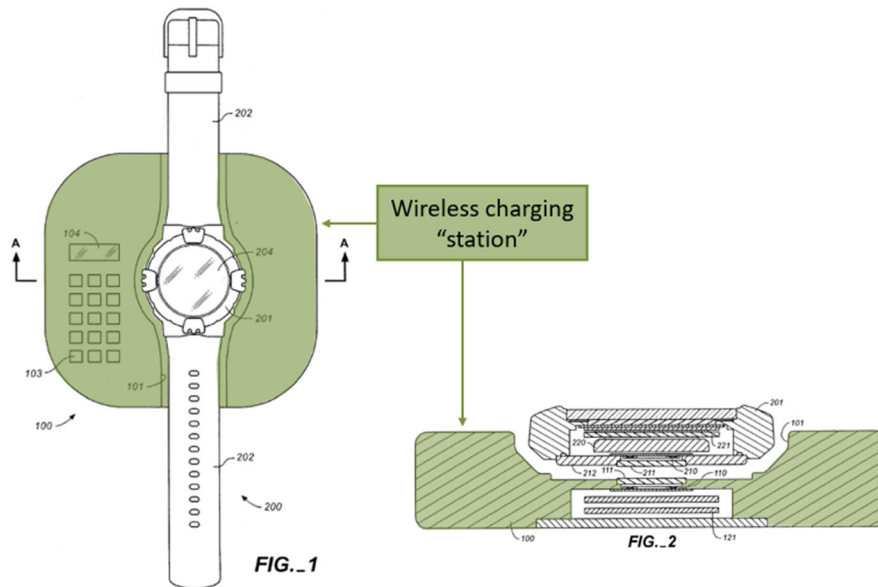
261. Claim 9 depends from Claim 1 and adds “**further comprising a wireless charging system configured to receive power wirelessly, from an external charging dock, through the rear exterior surface of the wearable electronic device.**”

262. Grounds 1 and 2 both use Kotanagi to demonstrate how Claim 1 is unpatentable, but for the third (ECG) electrode and related teachings, Ground 1 uses Coppola and Ground 2 uses Schmid.

263. This Ground applies Kotanagi, Coppola, and Schmid identically to the analyses provided above for Claim 1 under both Grounds 1 and 2. However, it adds the teachings of Honda to Kotanagi for the further limitations of dependent Claim 9.

264. Kotanagi teaches that instead of a wired connection terminal for charging, “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.” EX1005 ¶53 (emphasis supplied). A POSITA would have known prior to the ’483 Patent’s filing that a transformer utilizes coils and that such contactless charging typically involves an external charging dock.

265. **Honda**, which issued in 2001, discloses such a charging dock (or station) for a biosensing wristwatch. Honda’s figures show plan and cross-section views:

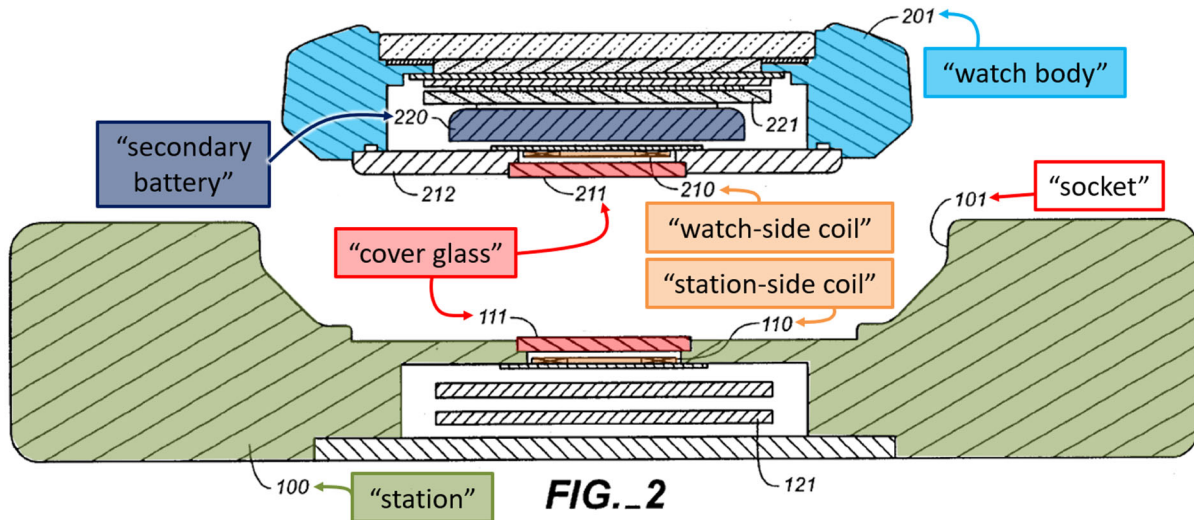


266. See EX1006 at 2–3 (Figs. 1, 2). Like Kotanagi, Honda teaches a biosensor: “the electronic watch 200 detects biological information including the pulse rate or the heart rate of the body.” EX1006 6:17–20. Like Kotanagi, the Honda watch has a “cover glass” over an opening in the bottom face of the watch. *Id.* at 6:24–25. These similarities increase a POSITA’s expectation of a successful combination.

267. Honda teaches inductive coupling of a charging station coil and a watch coil:

When the electronic watch 200 is placed onto the station 100, the station-side coil 110 and the watch-side coil 210 are physically out of contact with each other, but magnetically coupled with each other because the surfaces of coil winding of both coils are generally in parallel to each other.

EX1006 6:36–40.



See id. at 3 (Fig. 2). This creates magnetic flux that induces current in the watch-side coil and charges the watch battery.

268. Given Honda’s teaching of a wireless receive coil near a rear opening similar to that taught in Kotanagi (where both Honda’s and Kotanagi’s openings have a cover glass), a POSITA would have used Honda’s teachings to either: 1) modify Kotanagi to position a wireless charging coil behind Kotanagi’s cover glass, LED, and PD; or 2) enlarge Kotanagi’s opening and cover glass to make room for a coil behind the cover glass, surrounding the LED and PD. In either case, the result would be a wireless charging system configured “to receive power wirelessly, from an external charging dock, through the rear exterior surface of the wearable electronic device,” as claimed.

a. Motivation to Combine Kotanagi and Honda

269. Kotanagi and Honda are both assigned to Seiko companies. *See* EX1005 at 1, EX1006 at 1. Thus, a POSITA having Kotanagi would have readily

identified Honda and considered the two references together. Prior to September 2014, a POSITA would have been motivated to make the modifications explained above based on teachings of both Kotanagi and Honda and would have had a reasonable expectation of success in doing so. Kotanagi teaches a pulse rate biosensor watch that may be charged in a “contactless state” (EX1005 ¶(0053)), motivating a POSITA to look to Honda for “familiar elements” that do “nothing more than yield predictable results.” *See KSR* at 4, EX1005 ¶(0053). Honda teaches wireless watch charging and sensors for measuring pulse/heart rate of the body (EX1006 6:14–20; 8:40–42), motivating a POSITA to look to Kotanagi to “implement a predictable variation.” EX1006 6:14–20; 8:40–42; *see KSR* at 4. Thus, there is an express teaching in both references that the subject matter in each may be combined with the other. *See KSR* at 4.

270. Moreover, existing similarities between the main watch embodiments of Kotanagi and Honda would have caused a POSITA to expect success when combining features or inserting components from one into the other. Both have a watch shape, both have biosensors, and both have a cover glass over an opening in the bottom face of the watch. For these reasons and those explained above, a POSITA would have been motivated to combine Honda and Kotanagi.

b. Motivation to Combine Coppola, Kotanagi and Honda

271. Ground 1 provides reasons for combining Kotanagi and Coppola. Any modifications to Kotanagi in this process (e.g., adding a side ECG electrode), would not have interfered with modifications to enable wireless charging as taught by Honda. Indeed, Honda itself teaches optical biosensors and wireless charging, in a similar-shaped watch device, so these three references are fully compatible.

c. Motivation to Combine Schmid, Kotanagi and Honda

272. Ground 2 provides reasons for combining Kotanagi and Schmid. Any modifications to Kotanagi in this process (e.g., adding a side ECG electrode), would not have interfered with modifications to enable wireless charging as taught by Honda. Indeed, Honda itself teaches optical biosensors and wireless charging, in a similar-shaped watch device, so these three references are fully compatible.

273. Thus, a POSITA would have combined Kotanagi's biometric watch with Honda's wireless charging structures in view of the teachings above.

G. Ground 7: Claim 8 is unpatentable because it would have been obvious over Kotanagi in view of Coppola or Schmid and further in view of Miller.

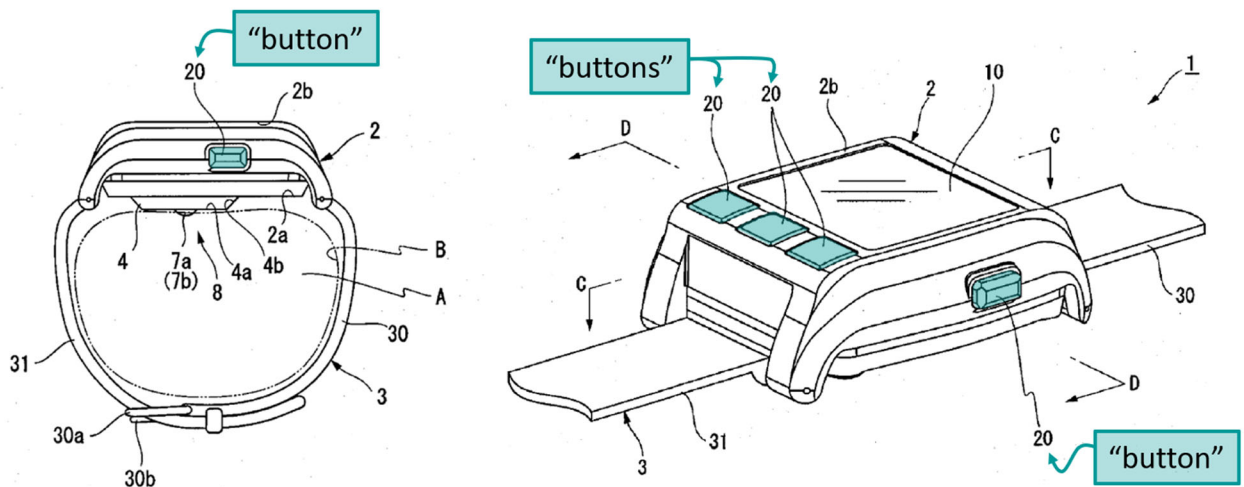
1. Dependent Claim 8

274. Claim 8 depends from Claim 1 and adds **“further comprising an input device positioned along a side of the housing and configured to receive a rotational input and a translational input.”**

275. Grounds 1 and 2 both use Kotanagi to demonstrate how Claim 1 is unpatentable, but for the third (ECG) electrode and related teachings, Ground 1 uses Coppola and Ground 2 uses Schmid.

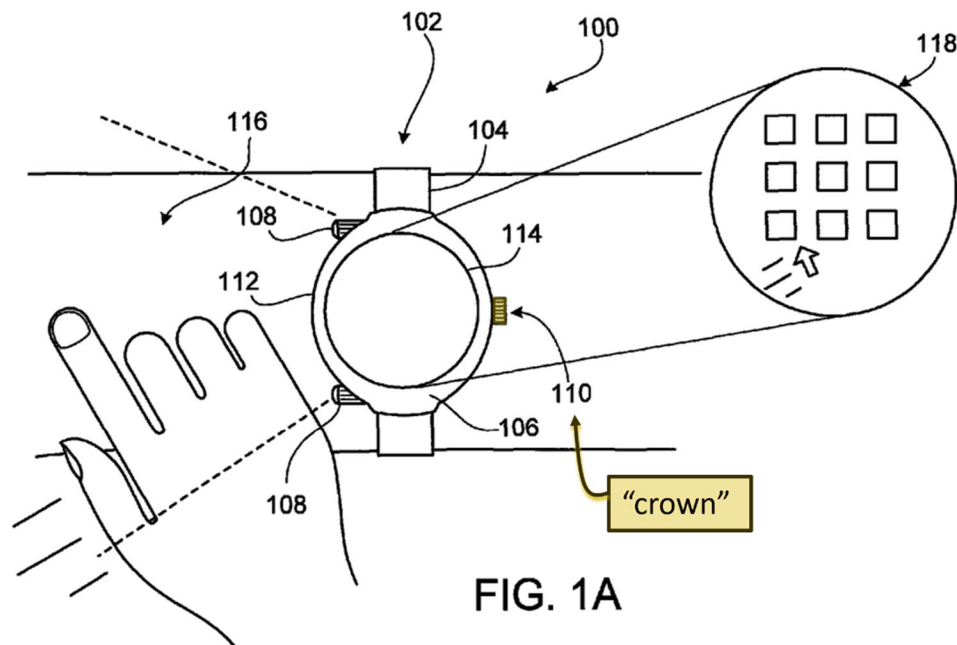
276. This Ground applies Kotanagi, Coppola, and Schmid identically to the analyses provided above for Claim 1 under both Grounds 1 and 2. However, it adds the teachings of Miller to Kotanagi for the further limitations of dependent Claim 8.

277. As discussed with respect to Claims 3 and 5 above, Kotanagi teaches buttons (20) including a button on the side of the watch that is “translated” by pushing on it.



See EX1005 at 24 (Fig. 3).

278. Like Kotanagi, Miller teaches a watch with an input device (“crown 110”) on the side:



EX1049 at 3.

279. Miller teaches that its crown is configured for rotational input (twisting) and translational input (pressing and pulling) for manipulating its touchscreen GUI:

In some implementations, by **pressing** the crown 110, the user may toggle the computing device interface . . . In some implementations, the crown **110** may extend out from the device **102** and **swivel** about its axis . . . Sensors at the base of the crown 110 may be positioned to sense motion of the crown 110 in various directions, much like what occurs with a joystick input mechanism . . . a user may extend the crown **110** and **twist** it to move between GUI applications.

EX1049 4:37–51 (emphasis added).

a. Motivation to Combine Kotanagi and Miller

280. In view of Kotanagi's use of side buttons (but with fewer movement modes) and the benefits described in Miller of both pressing and swiveling, a POSITA would have been motivated to combine Kotanagi and Miller in order to provide additional functionalities to its buttons, such as swiveling, twisting, toggling, or using the button like a joystick.

b. Motivation to Combine Coppola, Kotanagi and Miller

281. Ground 1 provides reasons for combining Kotanagi and Coppola. Any modifications to Kotanagi in this process (e.g., adding a side ECG electrode), would not have interfered with modifications to enable rotating and translating buttons as taught by Miller. Indeed, by adding more movement modes to Kotanagi's side buttons, fewer such buttons are needed, leaving more room for the side electrode taught by Coppola. These three references are fully compatible.

c. Motivation to Combine Schmid, Kotanagi and Miller

282. Ground 2 provides reasons for combining Kotanagi and Schmid. Any modifications to Kotanagi in this process (e.g., adding a side ECG electrode), would not have interfered with modifications to enable rotating and translating buttons as taught by Miller. Indeed, by adding more movement modes to Kotanagi's side buttons, fewer such buttons are needed, leaving more room for the side electrode taught by Schmid. These three references are fully compatible.

283. For the reasons above, a POSITA would have added Miller's translating and rotating crown to Kotanagi's biometric watch, as modified by Coppola or Schmid to include a third ECG electrode on the side.

XII. Condensed Summary of Opinions

284. A summary of my opinions of the grounds of obviousness is provided below:

Ground	Claim(s)	Prior Art Combination
1	1–3, 5–6, 10–14, and 16–20	Kotanagi and Coppola
2	1–3, 5–6, and 10–14	Kotanagi and Schmid
3	4	Kotanagi, Coppola, and Tran
4	15	Kotanagi, Coppola, and Kateraas
5	7	Kotanagi, Coppola or Schmid, and Kateraas
6	9	Kotanagi, Coppola or Schmid, and Honda
7	8	Kotanagi, Coppola or Schmid, and Miller

**XIII. LACK OF OBJECTIVE INDICIA OF NONOBVIOUSNESS
SUPPORTS INVALIDITY OF THE CHALLENGED CLAIMS**

285. I understand that “secondary considerations” should be considered but do not control an obviousness conclusion, particularly where, as here, a strong *prima facie* showing of obviousness exists. I am not aware that the patent owner has provided any evidence of secondary considerations, and any such evidence would likely not outweigh the strong *prima facie* case of obviousness outlined in this declaration. Of course, if any such evidence is brought to my attention, I am able to analyze and weigh it along with the other evidence. I understand that Petitioner is reserving the right to respond to any evidence of secondary considerations.

XIV. CONCLUSION

286. For these reasons, it is my opinion that each of Claims 1–20 of the ’483 Patent would have been obvious to a person of ordinary skill in the art prior to September 2014.