

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent of: Ammar Al-Ali
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Title: PHYSIOLOGICAL MONITORING DEVICES, SYSTEMS,
AND METHODS

SUPPLEMENTAL DECLARATION OF DR. BRIAN W. ANTHONY

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I, Brian W. Anthony, of Cambridge, MA, declare that:

I. INTRODUCTION

1. I have been retained by Fish & Richardson, P.C., on behalf of Apple Inc. (“Petitioner”), as an independent expert consultant in *inter partes* review (“IPR”) proceedings IPR2024-00243 and IPR2024-00244 before the United States Patent and Trademark Office (“PTO”). I understand that this declaration will be submitted in support of Petitioner’s Replies to Patent Owner’s Responses to the Petitions for *inter partes* review of the ’159 Patent (U.S. Patent No. 10,722,159) in each of the proceedings. I will refer to the Patent Owner’s Response in IPR2024-00243 as “243-POR” and the Patent Owner’s Response in IPR2024-00244 as “244-POR.”

2. This declaration supplements, and is intended to be read in conjunction with, my declarations in support of Apple’s Petitions in IPR2024-00243 and IPR2024-00244. I will refer to my first declaration in IPR2024-00243 as “243-Declaration” or “243-APPLE-1003,” and my first declaration in IPR2024-00244 as “244-Declaration” or “244-APPLE-1003.” In my first declarations, I address many topics, including (but not limited to) my background and qualifications, the level of skill in art, an overview of the ’159 Patent, claim construction, certain legal standards explained to me by Apple’s counsel, and a

detailed analysis of the prior art against the '159 Patent's claims. The opinions and explanations expressed in my first declarations apply equally here.

3. In writing this Supplemental Declaration, I have considered the following: my own knowledge and experience, including my teaching and work experience in the above fields; and my experience of working with others involved in those fields. I have also reviewed the following materials, in addition to other materials I cite in this declaration:

- APPLE-1004: U.S. Pat. No. 8,670,819 ("Iwamiya")
- APPLE-1005: U.S. Pat. No. 9,392,946 ("Sarantos")
- APPLE-1006: U.S. Pat. No. 8,446,275 ("Utter")
- APPLE-1007: U.S. Pat. No. 6,483,976 ("Shie")
- APPLE-1008: U.S. Pat. Pub. No. 2016/0058312 ("Han")
- APPLE-1009: Design of Pulse Oximeters, J.G. Webster; Institution of Physics Publishing, 1997 ("Webster")
- APPLE-1014: Pang et al., A Neo-Reflective Wrist Pulse Oximeter, IEEE Access, Volume 2 (January 12, 2015)
- APPLE-1015: Li et al., A Wireless Reflectance Pulse Oximeter With Digital Baseline Control for Unfiltered Photoplethysmograms, IEEE Transactions on Biomedical Circuits and Systems, Vol. 6, No. 3 (June 2012)

- APPLE-1016: Cai et al., Implementation of a Wireless Pulse Oximeter Based on Wrist Band Sensor, 3rd International Conference on Biomedical Engineering and Informatics
- APPLE-1017: International Publication No. WO 2001/17421 to Lindberg et al.
- APPLE-1018: Maattala et al., Optimum Place for Measuring Pulse Oximeter Signal in Wireless Sensor-Belt or Wrist-Band, 2007 International Conference on Convergence Information Technology
- APPLE-1019: Fitbit Surge Fitness Super Watch User Manual, Version 1.3 (2015) available at https://help.fitbit.com/manuals/manual_surge_en_US.pdf
- APPLE-1020: Duffy, Jill, Fitbit Surge Review, pcmag.com (Jan. 29, 2015) available at <https://www.pcmag.com/reviews/fitbit-surge>
- APPLE-1021: U.S. Pat. Pub. No. 2006/0253010 (“Brady”)
- APPLE-1022: U.S. Pat. No. 6,014,576 (“Raley”)
- APPLE-1023: Excerpts from Bronzino, The Biomedical Engineering Handbook, CRC Press, Inc. (1995) (“Bronzino”)
- APPLE-1024: Severinghaus et al., Recent Developments in Pulse Oximetry, Anesthesiology, Vol. 76, No. 6 (June 1992)

- APPLE-1025: Duffy, MIO Alpha BLE Review, PC Magazine (Jan. 28, 2013) available at <https://www.pcmag.com/reviews/mio-alpha-ble>
- APPLE-1033: U.S. Pat. No. 6,801,799 (“Mendelson”)
- APPLE-1034: Mendelson et al., A Wearable Reflectance Pulse Oximeter for Remote Physiological Monitoring, Proceedings of the 28th IEEE EMBS Annual International Conference (Sept. 3, 2006)
- APPLE-1035: U.S. Patent Application Publication No. 2013/0267854 (“Johnson”)
- APPLE-1036: U.S. Patent Application Publication No. 2005/0116820 (“Goldreich”)
- APPLE-1037: U.S. Patent No. 5,164,858 (“Aguilera”)
- APPLE-1038: U.S. Pat. No. 5,830,137 (“Scharf”)
- APPLE-1039: U.S. Patent Application Publication No. 2005/0267346 (“Faber”)
- APPLE-1040: ITC Inv. No. 337-TA-1276 Exhibit RX-0508 (Jianchu Yao and Steve Warren, Stimulating Student Learning with a Novel “In-House” Pulse Oximeter Design (2005))
- APPLE-1041: U.S. Patent Application Publication No. 2014/0323829 (“LeBoeuf”)

- APPLE-1042: Fontaine et al., Reflectance-Based Pulse Oximeter for the Chest and Wrist, Worcester Polytechnic Institute (April 2013)
available at <https://digital.wpi.edu/show/6969z2326>
- APPLE-1043: U.S. Patent No. 7,468,036 (“Rulkov”)
- APPLE-1044: International Publication No. WO 2011/051888 (“Ackermans”)
- APPLE-1045: International Publication No. WO 2012/140559 (“Shmueli”)
- APPLE-1046: U.S. Patent No. 7,650,176 (“Sarussi”)
- APPLE-1047: U.S. Patent Application Publication No. 2002/0095092 (“Kondo”)
- APPLE-1048: U.S. Patent Application Publication No. 2015/0355604 (“Fraser”)
- APPLE-1049: U.S. Patent No. 6,398,727 (“Bui”)
- APPLE-1050: Beam Shaping with Cylindrical Lenses, *available at* <https://www.newport.com/n/beam-shaping-with-cylindrical-lenses>
- APPLE-1051: U.S. Patent No. 9,316,495 to Suzuki et al. (“Suzuki”)
- APPLE-1052: U.S. Patent Application Publication No. 2010/0261986 to Chin et al. (“Chin”)

- APPLE-1053: Dickey, Laser Beam Shaping Theory and Techniques, Second Edition, Taylor & Francis Group, LLC (2014)
- APPLE-1054: U.S. Patent Application Publication No. 2014/0051955 to Tiao et al. (“Tiao”)
- APPLE-1081: U.S. Patent Application Pub. No. 2010/0324387 to Moon et al. (“Moon”)

4. I have no financial interest in either party or in the outcome of this proceeding. I am being compensated for my work as an expert on an hourly basis, for all tasks involved. My compensation is not dependent on the outcome of these proceedings or on the content of my opinions.

II. TECHNICAL DISCUSSION

5. The analysis and opinions expressed in my first declarations fully explain why each and every feature of the ’159 Patent’s Challenged Claims is provided in the prior art. As I previously explained with reference to the applied prior art and corroborating references, the Challenged Claims would have been obvious to a POSITA. I understand that Patent Owner and Dr. Madisetti have considered my opinions and offered their own, some of which are inconsistent with my view. Below, I provide further testimony in response to Patent Owner’s arguments. In responding to Patent Owner’s arguments, I have analyzed various publications and materials including materials cited in my first declarations and

additional materials in this declaration. The fact that I have not addressed all of Patent Owner arguments and Dr. Madiseti's opinions should not be interpreted as agreement with them.

A. Iwamiya-Sarantos renders obvious claims 1-2 and 4-13; Iwamiya-Sarantos-Han renders obvious claim 3; and Iwamiya-Sarantos-Utter renders obvious claims 14-25

1. Iwamiya-Sarantos renders obvious a "surface comprising a dark-colored coating" (elements [1.4] and [19.5])

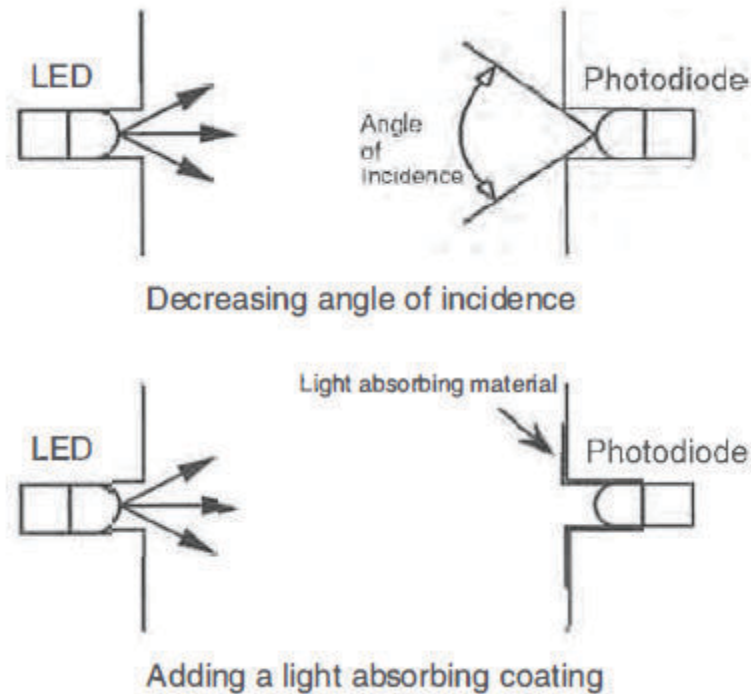
6. Patent Owner contends that the Iwamiya-Sarantos combination "ignored the teachings of Iwamiya" and that a POSITA would be required to use a reflective material to implement Iwamiya's light-shielding frame 18 because "[t]here is nothing in Iwamiya that teaches away from using the disclosed reflective material for the light shielding frame." 243-POR, 12-13. I also fully acknowledge (and agree with) Patent Owner's assertion that "Iwamiya's light shielding frame 18 was already made of light shielding material." *Id.*, 14.

However, as I discussed in my first 243-Declaration, while Iwamiya's original light shielding frame 18 was intended to block unwanted light from reaching the photodiodes, Iwamiya does not disclose a material or implementation for achieving the light blocking functionality of the light shielding frame 18. APPLE-1004, 8:38-42. The reflective material that Patent Owner insists *must* be used to implement the light shielding frame 18 comes from different embodiments of Iwamiya and is employed for different purposes than the light shielding frame 18. 243-APPLE-

1003, ¶¶36-37. Additionally, as I discussed in my first 243-Declaration, a POSITA would have recognized that use of a dark-colored or black coating, as suggested by Sarantos, would have resulted in several predictable benefits over using reflective material. *Id.*, ¶¶33-36, 40-44. Based on my review, a POSITA would have recognized that an opaque, light-absorbing material in the form of a dark-colored coating like that taught in Sarantos to be an obvious and well-known option for implementing the light shielding function of Iwamiya's frame 18. Indeed, the use of such a dark-colored coating was common practice well before the '159 Patent. APPLE-1005, 17:1-25.

7. For example, as corroborated by the Webster reference, a POSITA would have been aware that “[t]o minimize errors, the pulse oximeter designer must attempt to limit the light reaching the photodiode to that which has traveled through tissue containing arterial blood.” APPLE-1009, 96. A POSITA would have recognized that this would include not only preventing light from the light emitters of the device from reaching the photodiode prior to passing through the wearer's tissue (a function largely performed by reflection layers 13 and 15 in Iwamiya's device (APPLE-1004, 6:62-7:3, 7:41-49)), but also blocking of “ambient light” from the surrounding environment. APPLE-1009, 96. Webster further confirms the knowledge of a POSITA by describing “[t]wo additional measures can be taken to ensure this (figure 6.6). One is to decrease the angle of

incidence to the photodiode. The second is to *coat the housing around the photodiode with a material that does not scatter or reflect light.*” *Id.*, 96-97.



APPLE-1009, 97. In another example, Webster again confirms the knowledge of a POSITA to prevent ambient light interference using “the simple solution” of “cover[ing] the sensor site with opaque material.” *Id.*, 111. Therefore, Patent Owner’s assertion that the benefits that I discussed in my first 243-Declaration were based on the teachings of the ’159 patent itself could not be further from the truth. A POSITA would have been well aware of the benefits of using a dark-colored coating to prevent scattering and reflection of light in an optical physiological sensor. APPLE-1009, 96-97.

8. As another corroborating example of the knowledge of a POSITA that it would have been obvious and beneficial to implement Iwamiya's light shielding frame 18 to include a dark-colored coating, as taught by Sarantos, to prevent unwanted light scattering and light paths, the Schulz patent discusses the knowledge of a POSITA that light shields in optical physiological sensors "are advantageously formed from or coated with a light absorbing material which further mitigates the effects of ambient light, as well as stray (i.e., 'secondary') reflected light with the probe generated by the light source 103." APPLE-1032, 9:58-10:23. As Schulz explains (and would have been known to a POSITA), "light generated by the light source 103 can take several paths in reaching the detector" but "only one" of these paths "is the desired path." *Id.* Schulz explains that "these other paths are eliminated or attenuated" through use of "light absorbing material" on the light shield "so as to substantially absorb any secondary reflections prior to being received by the detector 105." *Id.* As such, a POSITA would have understood that allowing light to reflect off the light shield would have increased noise and risked reducing sensor accuracy and that these undesirable outcomes were beneficially reduced through use of a dark-colored coating for the light shield, as taught by Sarantos.

9. I disagree with Patent Owner's suggestion that a POSITA would be led by Iwamiya to select a reflective rather than absorptive material for use on the

light-shielding frame 18. 243-POR, 12-18. Based on my review, a Sarantos-like dark-colored coating would have been more effective than a reflective material at reducing light scatter in the empty space surrounding the frame 18, and this in turn would have been beneficial to reduce the amount of light that could reflect from the surfaces of the space through the optical filter 17 and the photodiodes. A POSITA would have sought to reduce these effects since any light that reflected from the surfaces surrounding the space surrounding frame 18 and through the optical filter 17 to the photodiodes would have different path lengths that could increase optical interference and reduce measurement accuracy. APPLE-1009, 69, 96-97; APPLE-1088, 1:65-2:16, 9:58-10:23.

10. I also disagree with Patent Owner's misinterpretation that Iwamiya specifically instructs a POSITA to use reflective rather than absorptive materials for light shielding. Patent Owner cites portions of Iwamiya that describe the use of reflective materials for components that are different and functionally distinct from the light-shielding frame 18. 243-POR, 14-17 (citing APPLE-1004, 18:61-65, 28:64-29:5, 39:20-24). For example, Patent Owner refers to Iwamiya's description of holder portion 43 being reflective. However, the use of a reflective material for implementing this unrelated structure in a different embodiment in Iwamiya would not have caused a POSITA to ignore the teachings of Sarantos or otherwise dissuaded the POSITA from implementing Sarantos's teachings regarding a dark-

colored coating for blocking light in the device of Iwamiya. For starters, Iwamiya's light shielding frame 18 and the holder portion 43 are not even used in the same embodiments. Iwamiya describes the "holder portion 43" with respect to "second," "third," and "fourth" embodiments. APPLE-1004, 18:61-65, 28:64-29:1, 39:20-24. These embodiments are substantially different from the "first embodiment" that uses light shielding frame 18, as shown below in the FIG. 3 first embodiment and the FIG. 13 second embodiment.

11. For example, the first embodiment with light shielding frame 18 includes a cavity or channel through which light reflected from the tissue may travel around a periphery of the frame 18 if it is not initially directed through optical filter 17. This cavity introduces greater risk of multiple scattering and pathlength variations not present in the embodiments that employ holder portion 43 (where no comparable cavity exists).

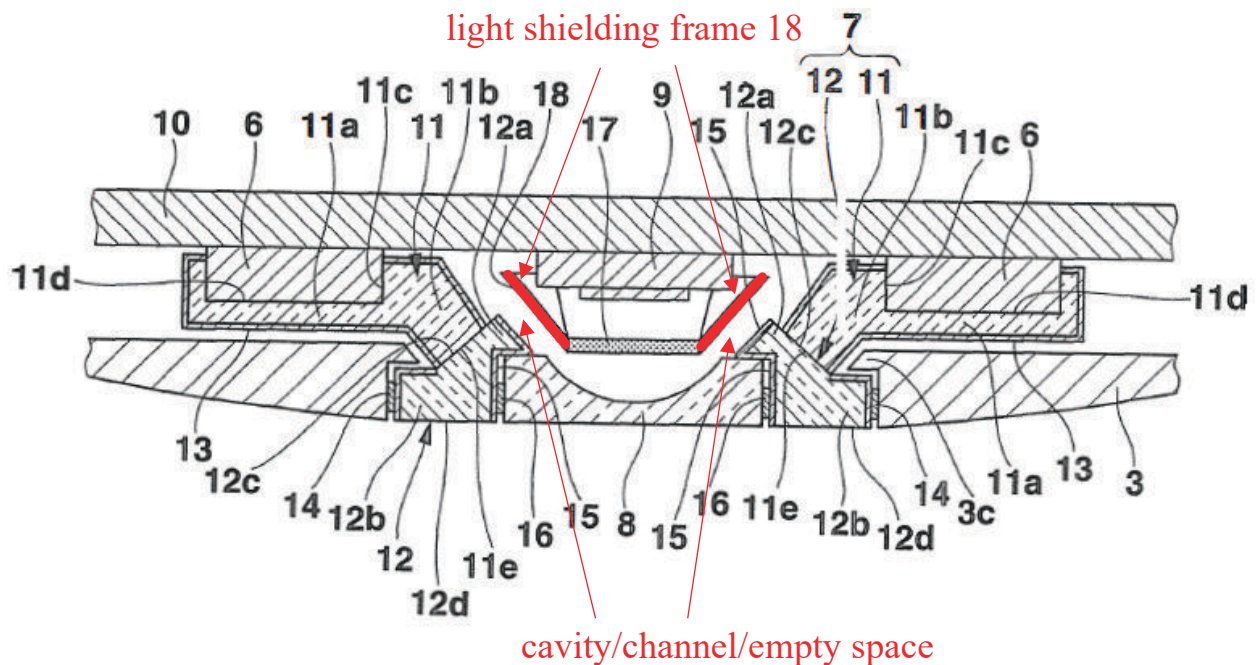


FIG. 3

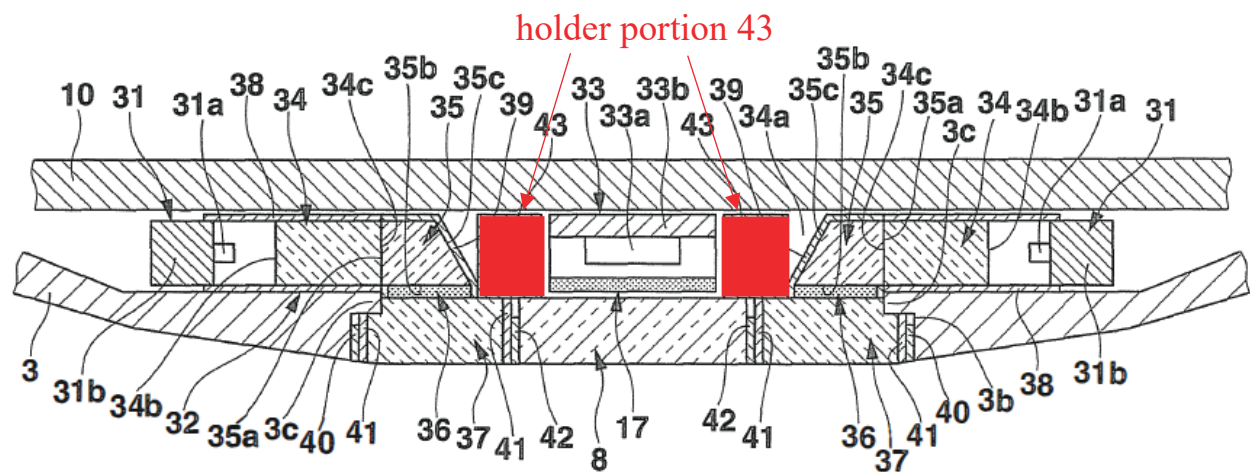


FIG. 13

APPLE-1004, FIGS. 3, 13

12. The geometrical aspects of components across various embodiments and diverse design considerations would have prompted a POSITA to make distinct choices for each component. Consider, for instance, the coatings on

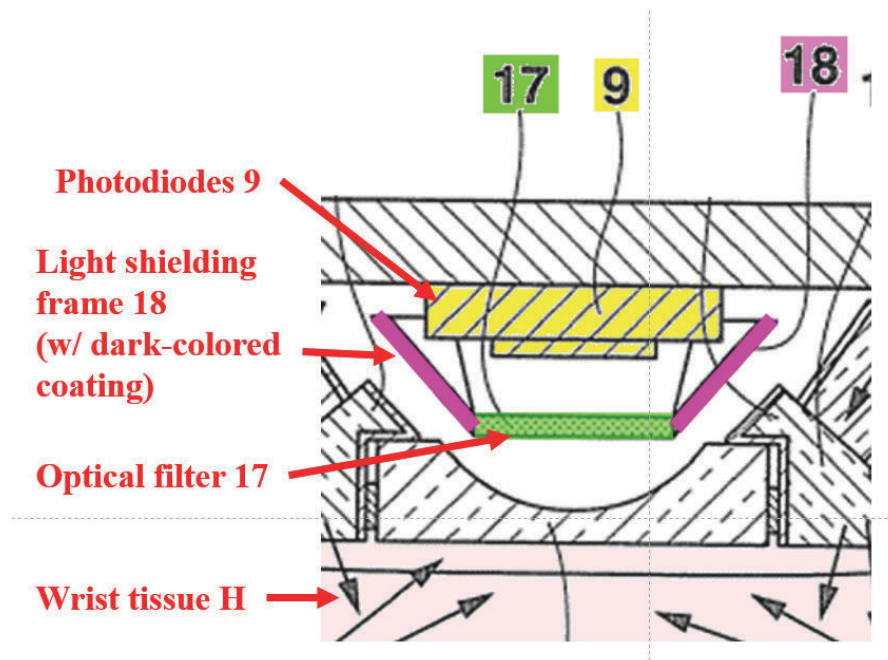
different sides of a structure. On one side, a coating can be light-blocking and reflective, while on the other side, a different coating could be light-blocking and absorptive. These design choices stem from the desired light trajectories and the intricate specifics of the system's overall configuration and geometry. In the case of the large obtuse angle geometry of the light shielding frame 18 of FIG. 3, using a reflective surface could potentially introduce multi-path artifacts more readily, in contrast to the arrangement in FIG. 13. In the embodiment shown in FIG. 13, employing a reflective light-blocking surface on holder portion 43 might enhance the signal as the specific geometry likely has a reduced risk of multi-pass or multi-path artifacts.

13. In contrast to Iwamiya's specific description of reflective materials for layers 13 and 15 and holder portion 43, Iwamiya leaves the choice of a suitable material for light shielding frame 18 to a POSITA. *Compare* APPLE-1004, 6:62-7:3, 7:41-49, 18:61-65, 28:64-29:1, 39:20-24 *with* APPLE-1004, 8:38-42. A POSITA would have found a dark-colored coating as taught in Sarantos to be an obvious and beneficial option for achieving the light-shielding function desired by Iwamiya, for the reasons previously discussed in my first declarations (243-APPLE-1003, ¶¶33-44) and this Supplemental Declaration. Even if some other benefits might flow from use of a reflective material over a dark-colored coating in some cases as alleged by Patent Owner, the mere existence of design tradeoffs

would not have detracted from the obviousness of using a dark-colored coating to shield external light from reaching the photodetectors.

2. Iwamiya-Sarantos (with or without Utter) Renders Obvious “an opening defined in the dark-colored coating is configured to allow at least a portion of light reflected from the tissue to pass through the surface”

14. As I discussed in my first 243-Declaration, Iwamiya describes an optical filter positioned within an opening in the light-shielding frame. As Iwamiya describes, the device includes “an optical filter 17” that “is mounted on the lower side of a light shielding frame 18” between the photodiodes 9 and the tissue H. APPLE-1004, 8:39-42. This configuration is shown in the following detail of FIG. 4 from Iwamiya:

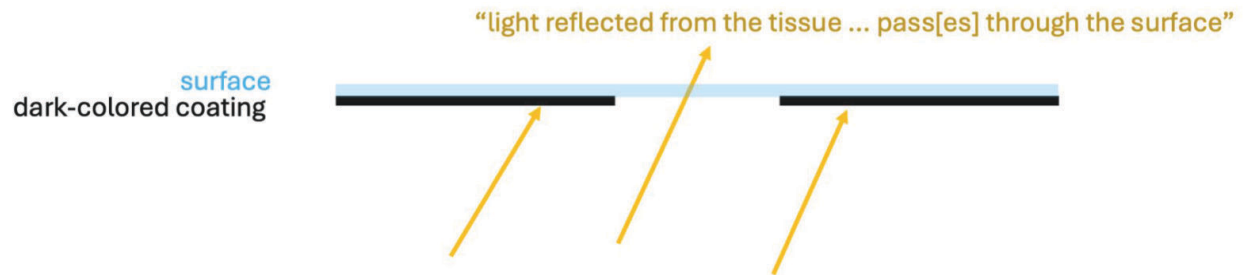


APPLE-1004, Detail of FIG. 4 (annotated)

15. As I discussed in my first 243-Declaration (and in the previous section), a POSITA would have found it obvious and beneficial to apply Satantos's teachings to Iwamiya to coat the light shielding frame 18 with a dark-colored coating. APPLE-1005, 17:1-25. As such, the opening in the center of Iwamiya's light shielding frame 18 is an opening defined in the dark-colored coating in the predictable Iwamiya-Sarantos combination. Iwamiya discloses that light passes through the optical filter 17 that is positioned within this opening in the light shielding frame 18 (which is also an opening in the dark-colored coating). APPLE-1004, 8:42-44.

16. Figure 4 of Iwamiya, reproduced with coloring and annotations above, represents a cross-sectional view of the sensor. APPLE-1004, 4:13-15. Figure 2 shows the sensor looking toward the sensor at the portion that contact's the user's skin.

18. The Patent Owner’s arguments in the 243-POR appear to assert that the claimed “opening” is required to include a transparent or translucent material. 243-POR, 25. Patent Owner includes the following drawing in support of this argument:



Id.

19. However, this drawing does not come from the figures of the ’159 patent and is not based on the actual disclosures of the ’159 patent. Rather, this drawing has been created by Patent Owner with no actual support in the ’159 patent. A POSITA would not have understood elements [1.5] and [19.5] to require that the light pass into and exit from the material that defines the claimed “surface” but rather would have understood that the plain and ordinary meaning of these claim elements can be satisfied by the light passing through an opening in the material that defines the surface. For example, a POSITA would understand that when water passes through the surface of a sieve or a piece of cloth, it flows through the openings rather than through the material itself. Yet, in this example,

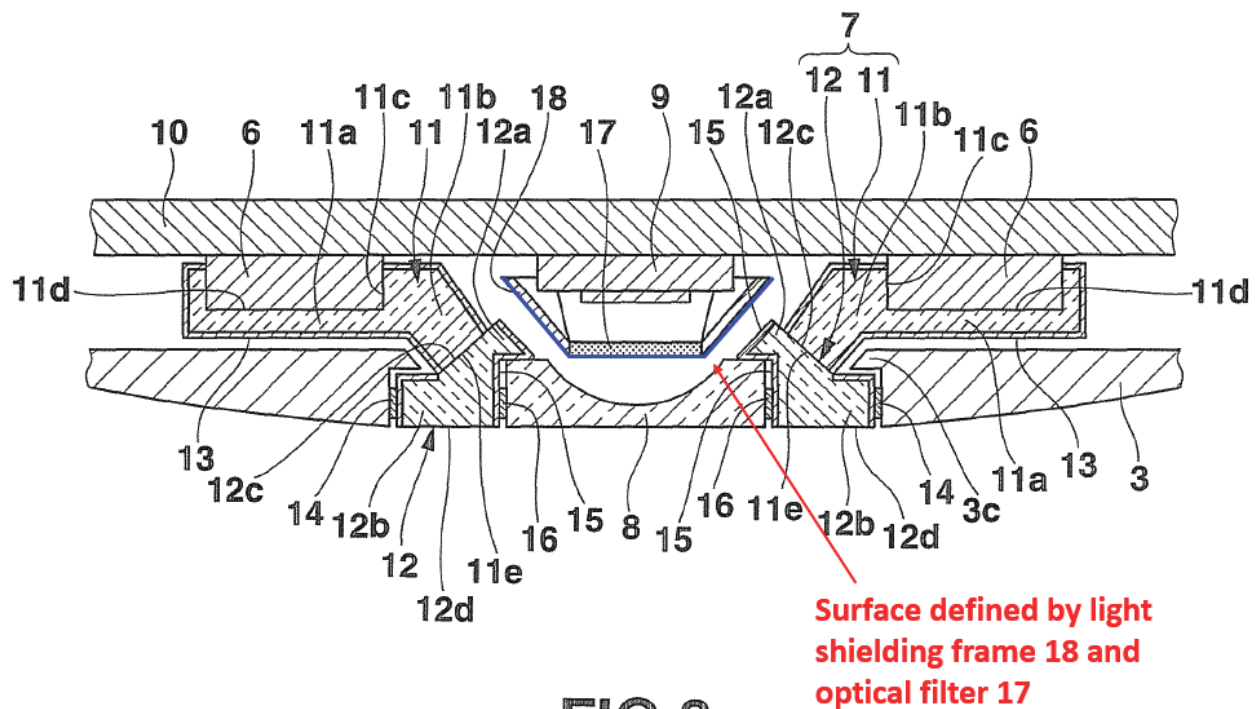
the water would be considered to pass through the surface of the sieve or piece of cloth.

20. This proper assessment of the scope of elements [1.5] and [1.9] becomes even more clear when looking to how the specification of the '159 patent describes the opening in the dark-colored coating that allows light to pass through the surface. That is, all related descriptions in the '159 patent specification describe an opening free of material. There is not a single embodiment within the '159 Patent that describes the opening as including material with the light passing through a surface of that material. For example, one portion of the '159 patent describes a “light-absorbing detector filter” that is rectangular or square and “has an opening through which emitted light may pass.” APPLE-1001, 3:64-4:14, 8:32-53. Notably, not only do these examples in the '159 patent not mention a material positioned within the “opening,” they also do not mention a dark-colored coating. *Id.* In another disclosure in the '159 patent specification, the '159 patent does describe that “[t]he light-absorbing detector filter 306 is illustrated having a top surface coated with a light-absorbing material. The light-absorbing material can be a black opaque material or coating or any other dark color or coating configured to absorb light.” *Id.*, 9:31-36. This example goes on to describe “a rectangular opening 402 is positioned relative to the light concentrator 308 (shown in phantom) and the detector 310 such that light may pass through the rectangular

opening 402, into the light concentrator 308, and to the detector 310.” *Id.*, 9:36-40. In describing this embodiment, the ’159 patent specification goes on to state that “the patient’s finger servicing as the tissue measurement site 102 is positioned over the rectangular opening 402 such that when the front portion of the adhesive substrate is folded over on top of the patient’s finger 102, the emitter 302 and the light diffuser 304 are aligned with the measurement site 102, the filter 306, the light concentrator 308 and the detector 310.” *Id.*, 9:64-10:3. Once again, there is no description of material being positioned within the opening. This is the only example in the ’159 patent that discusses an opening in the dark-colored coating. As such, there is not a single example in the ’159 patent that even mentions including material within the opening, much less that requires that the light pass through a material in the opening. As such, there is simply no support for Patent Owner’s assertion that the opening must include a material nor that the light must enter into the material and exit from the material rather than simply passing through an opening in the material (the configuration actually described in the ’159 patent).

21. To the extent that elements [1.5] and [1.9] are improperly interpreted to require that the light enter and exit a portion of the material that defines the claimed surface, Iwamiya still provides these claim elements. As I discussed in my First 243-Declaration, Iwamiya describes an “an optical filter 17” that “is mounted

on the lower side of a light shielding frame 18” between the photodiodes 9 and the tissue H within the opening of the dark-colored coating in the Iwamiya-Sarantos combination. APPLE-1004, 8:39-42; 243-APPLE-1003, ¶¶64-65. As such, Iwamiya *does* describe a material within the opening in the dark-colored coating configured such that the light enters and exits the material. It is also apparent from Iwamiya’s figures that Iwamiya’s light shielding frame 18 and optical filter 17 together define a surface and therefore Iwamiya provides elements [1.5] and [1.9] even if it is incorrectly interpreted to require that the opening have material positioned therein (an interpretation not supported by the plain language of the claim or the specification, as I discussed above):



APPLE-1004, FIG. 3 (annotated).

3. **Iwamiya-Sarantos (with or without Utter) renders obvious that “the plurality of detectors are arranged in an array having a spatial configuration corresponding to a shape of a portion of the tissue measurement site bounded by the light block” (element [14.4] and claims 5 and 25)**

22. My first declarations demonstrated how claim 5 would have been obvious based on the teachings of Iwamiya-Sarantos and how element [14.4] and claim 25 would have been obvious based on the teachings of Iwamiya-Sarantos, including Iwamiya’s disclosure that its monitoring device includes “**plural** light receiving units 9... two-dimensionally **disposed ... on the same circumference** centered on an optical axis of the scattered light taking unit 8.” APPLE-1004, 14:36-41 (emphasis added); 243-APPLE-1003, ¶¶74-81. Iwamiya’s light block is circular, and the fact that Iwamiya’s plural photodiodes 9 are arranged in “a spatial configuration corresponding to a shape of the portion of the tissue [measurement site encircled/bounded] by the light block” is evident from the fact that the photodiodes 9 are arranged “on the same **circumference** centered on an optical axis” of the circular light taking unit 8. APPLE-1004, 14:36-41. The use of the word “circumference” would have immediately brought to the mind of a POSITA a circular arrangement for the plurality of light receiving units 9, angularly spaced around a circular center at some radial distance. As I previously discussed, based on the express disclosures of Iwamiya, including the description of the photodiodes

9 being arranged in a “circumference,” a POSITA would have understood and it would have been obvious that the photodiodes 9 are thus arranged in an array where each photodiode is angularly spaced around a circular center, at some radial distance from and about the center, and having a spatial configuration corresponding to the circular shape of the tissue measurement site encircled by the circular light block, as illustrated below.

photodiodes 9 arranged “on the same circumference centered on an optical axis” of the circular light taking unit 8

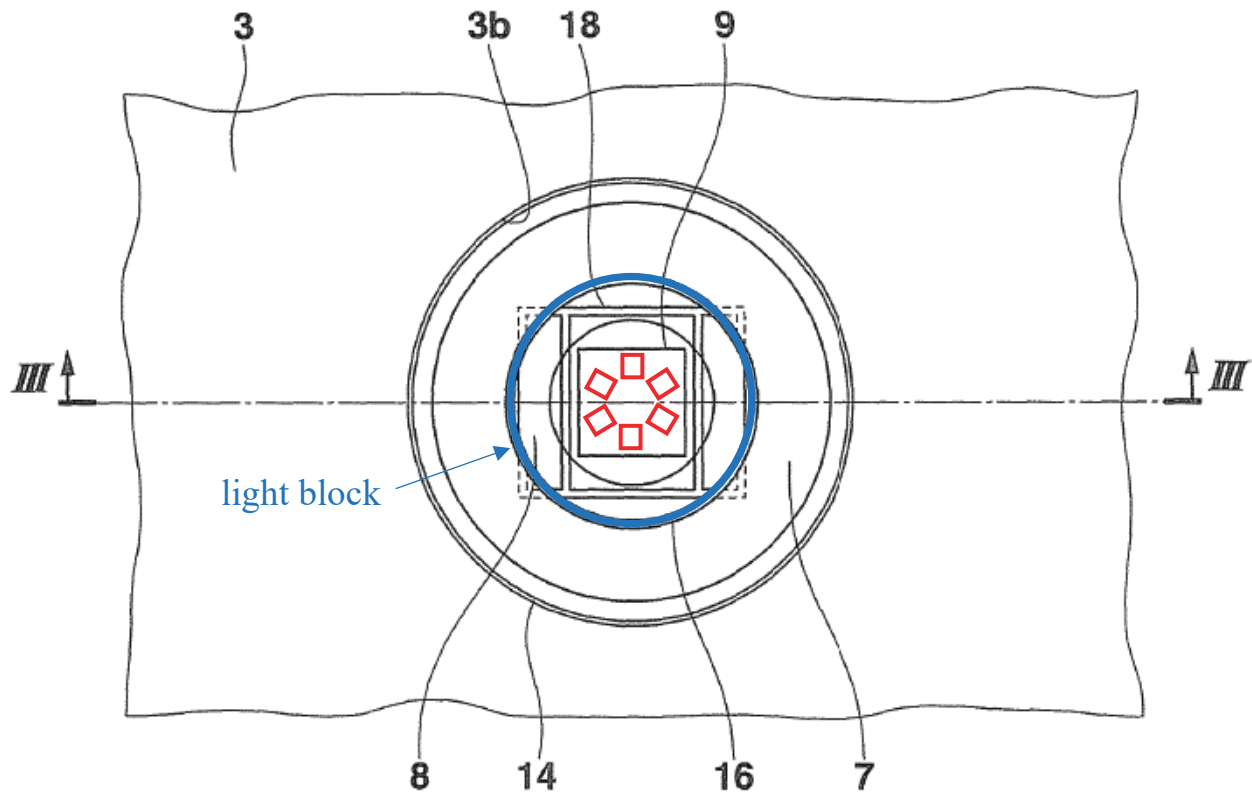


FIG.2

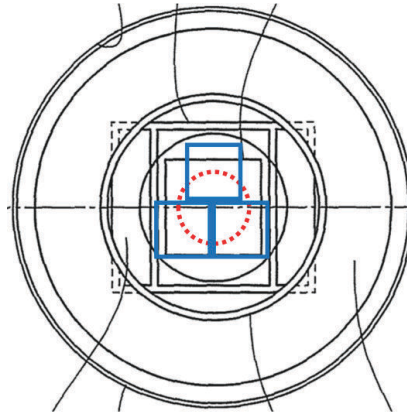
APPLE-1004, FIG. 2 (annotated according to Iwamiya’s teachings)

23. I find Patent Owner’s argument that Iwamiya provides only a “vague description of an alternate embodiment” having a plurality of light receiving units 9 to be problematic insofar as it seeks to hold Iwamiya to a higher standard of disclosure than the specification of the ’159 Patent itself. 243-POR, 62. The ’159 Patent specification merely refers to a “plurality” of photodetectors 310/710, but never expressly discloses that any minimum number of photodetectors is required to form an array. *Cf.* APPLE-1001, 9:25-30, 11:37-43. Iwamiya substantially mirrors the ’159 specification in disclosing “plural photodiodes 9” two-dimensionally arranged around a “circumference” of an optical axis. APPLE-1004, 14:36-41. To the extent a POSITA would have understood the disclosure of the ’159 Patent as teaching more than a small number of photodetectors (e.g., at least six), a POSITA would have understood Iwamiya’s disclosure as encompassing the same. The ’159 Patent describes no critical number or range of numbers of photodiodes required to achieve any particular performance standard or to achieve unexpected results. A POSITA would have found Iwamiya’s disclosure of a plurality of photodiodes sufficient to render obvious more than two or three (e.g., six or more) photodiodes in this context.

24. I also find Patent Owner’s arguments regarding proposed arrangements of three or four photodetectors 9 to be at odds with what a POSITA would have understood from the actual disclosures of Iwamiya. 243-POR, 91-94.

As I mentioned above, the use of the most logical inference that a POSITA would have drawn from the use of the term “circumference” by Iwamiya (rather than describing the photodiodes as being in a square or triangular arrangement) is that the photodiodes were arranged in a circle about the circumference. While the proposed configurations for three or four photodiodes presented in the Patent Owner’s Response may technically fall within the broadest possible interpretation of light receiving units 9 “disposed on the same circumference centered on an optical axis,” they are not indicative of what would have readily come to mind to a POSITA upon reading of this disclosure of Iwamiya in the context of Iwamiya’s broader disclosure as a whole. Rather, a POSITA would have read this disclosure of Iwamiya to represent what it actually says, a plurality of light receiving units 9 arranged in a circle about the same circumference. Additionally, Patent Owner’s assertion that an arrangement of three photodetectors would form “a triangular array” is only true if one were to draw straight lines connecting the center points of the photodetectors. 243-POR, 64-65. However, the actual language in Iwamiya, which describes the light-receiving units as being arranged 'on the same circumference,' implies a circular configuration of some radius. When connecting the center points of the three light-receiving units using arcs of constant curvature, the resulting arrangement clearly forms a circular shape rather than a triangular

one.):



Patent Owner's arguments on this point are also incorrect because they rely on an assumption that the light receiving units 9 must have a square shape. There is no such limitation imparted by Iwamiya and thus a POSITA would have understood that Iwamiya discloses arranging the light receiving units 9 in a circle (thus corresponding to the shape of the portion of the tissue measurement site bounded by the light block) with the specific arrangement and configuration left up to the designer to select based on multiple design and manufacturing considerations for the entire system.

4. Iwamiya-Sarantos (with or without Utter) (IPR2024-00243) and Sarantos (with or without Shie) (IPR2024-00244) provides or at least renders obvious measuring oxygen saturation at the wrist (claims 8 and 17)

(a) Sarantos discloses and renders obvious measuring oxygen saturation at the wrist

25. There is no dispute that Sarantos discloses using photoplethysmographic techniques may also be used to measure other physiological parameters besides heart rate.” EX1005, 13:44-49; 243-EX2100, ¶83; 244-EX2100, ¶107. Sarantos clearly contemplates embodiments where its device would measure blood oxygenation levels using red and infrared light. This is evident from Sarantos’s express description of structural modifications that would be made to accommodate multiple LEDs of different wavelengths, including that “multiple light-emitting devices ... may[] ... be spaced apart from one another, as shown in FIGS. 1 and 2, or may be closely grouped.” APPLE-1005, 13:34-36, 13:44-14:22. And although Sarantos notes that its disclosed “ratios and dimensional values” are “tailored based on the green/yellow light spectrum” rather than the “red or infrared spectra” (*see* APPLE-1005, 18:48-51), Sarantos does not criticize, discredit, or otherwise discourage investigation into the use of red/infrared light for measuring blood oxygen levels. To the contrary, Sarantos expressly discloses such embodiments. APPLE-1005, 13:44-14:22. Based on my review, Sarantos’s description of green/yellow light (APPLE-1005, 18:48-51)

merely indicates that Sarantos chose to illustrate its exemplary embodiments with respect to devices sensitive to green/yellow light rather than other spectra. A POSITA reviewing Sarantos's alternative embodiments for measuring blood oxygen levels (APPLE-1005, 13:36-14:22) would have understood and found obvious that the ratios and dimensions of Sarantos's HAR photodetectors could and would be suitably adjusted to optimize for the detection of red and infrared light as appropriate for measuring blood oxygen saturation levels.

26. Patent Owner now narrowly focuses on the use of the word "or" by Sarantos when describing use of red and infrared wavelengths for measuring blood oxygen saturation. 243-POR, 27-28; 244-POR, 41. First, these arguments by Patent Owner ignore that the term "or" is generally read to be inclusive unless specified otherwise, especially when being read by engineers, such as a POSITA in the relevant technology of the '159 Patent. Second, a POSITA would have understood Sarantos's disclosure to be describing that to measure blood oxygen saturation, each individual LED (or other light emitting device) would have been implemented to "predominantly emit[] light in the red or infrared spectrum" such that in the resulting device the multiple LEDs would collectively emit red and infrared light and thus would have successfully measured blood oxygen saturation. APPLE-1005, 13:44-14:5. Indeed, Sarantos describes that each individual "light source 108 on the right side of FIG. 2 may be a red- or infrared-wavelength LED"

to collectively provide light of both red and infrared wavelengths. *Id.* There is simply not support for the assertion that *all* light sources would be restricted to only red or only infrared wavelength LEDs in Sarantos's blood oxygen saturation measurement implementation. This becomes even more clear when these disclosures of implementing each LED to emit "red or infrared" light are paired with Sarantos's express disclosure of embodiments having "two light-emitting devices that predominantly emit light of different wavelengths." APPLE-1005, 3:60-62. As I have discussed here, Sarantos later makes express what those two "different wavelengths" are in the blood oxygen saturation implementation: red and infrared wavelengths. APPLE-1005, 13:44-14:5.

27. Third, Patent Owner's assertions that Sarantos's blood oxygen saturation implementation utilizes light of *only* red or *only* infrared wavelengths ignores the well-established knowledge of a POSITA regarding which wavelengths of light to use in determining blood oxygen saturation. APPLE-1003, ¶¶87, 94-98. For example, Webster confirms the knowledge of a POSITA that by 2015 it was well-known that "wavelengths of interest in pulse oximetry" are "660 nm and 940 nm." APPLE-1009, 94-96. Brady similarly confirms the knowledge of a POSITA that optical sensors for pulse oximetry have light sources that "typically includes LEDs that generate both red ($\lambda \sim 660$ nm) and infrared ($\lambda \sim 900$ nm)

radiation.” APPLE-1028, [0052]-[0054]¹. Indeed, Brady makes this corroborating disclosure in a wristwatch-based pulse oximeter that is highly similar to that of Sarantos. As such, a POSITA would not have been so confused by Sarantos’s use of the word “or” to forget or ignore the wealth of decades of background knowledge on how to conduct pulse oximetry and which wavelengths of light to use to do so.

(b) A POSITA would have known how to make predictable adaptations to Iwamiya’s device that would allow the device in the Iwamiya-Sarantos combination to measure oxygen saturation

28. I understand that a showing of obviousness does not require a detailed explanation of every predictable structural modification that a POSITA would make to implement a proposed combination. Nonetheless, a POSITA would have known how to adapt Iwamiya’s device to measure oxygen saturation levels using red/infrared light as taught in Sarantos. Iwamiya’s device already includes 940 nm infrared LEDs that would be suitable for measuring blood oxygen levels; it would have been obvious and straightforward to augment the device with one or more

¹ Brady is Exhibit APPLE-1021 in the 244 Proceeding. I am using citation to the exhibit number for Brady in the 243 Proceeding here and throughout this supplemental declaration. It should be understood that any citation to Exhibit APPLE-1028 also refers to Exhibit APPLE-1021 in the 244 Proceeding.

LEDs emitting red light. *See, e.g.,* APPLE-1009, 94 (“The designer should keep in mind the wavelengths of interest in pulse oximetry (660 nm and 940 nm) when deciding on an appropriate photodiode.”). For example, it would have been obvious and straightforward to add one or more red LEDs, as shown below.

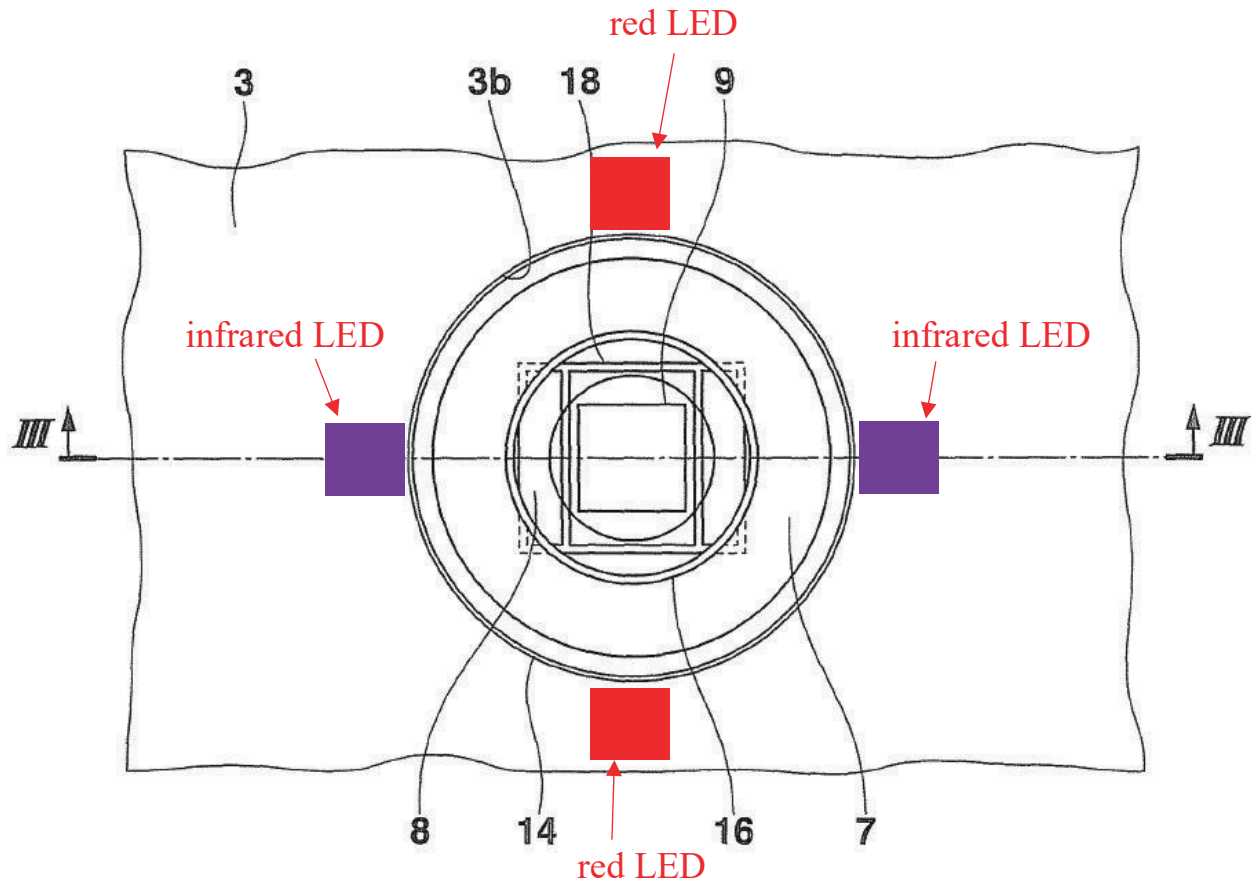


FIG.2

APPLE-1004, FIG. 2 (modified based on Sarantos’s teachings)

As another example, it would have obvious and straightforward to replace one of Iwamiya’s original infrared LEDs with a red LED, as shown below.

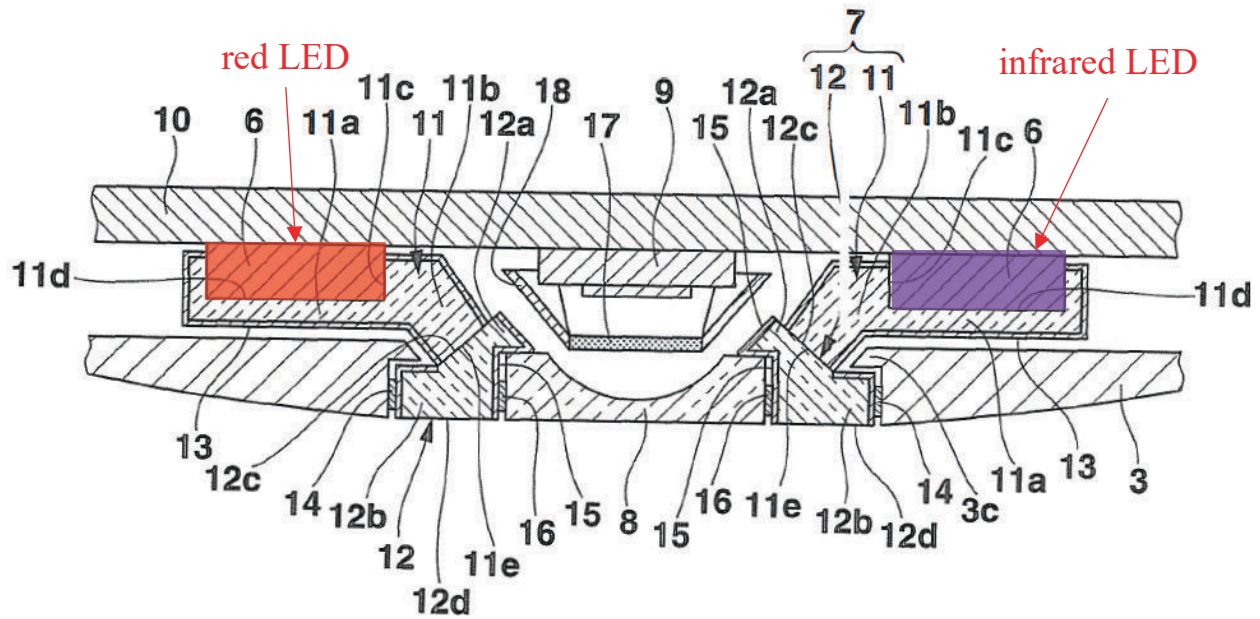


FIG.3

APPLE-1004, FIG. 3 (modified based on Sarantos's teachings)

As yet another example, it would have obvious and straightforward to replace Iwamiya's original infrared LEDs with a red LED and an infrared LED, as shown below.

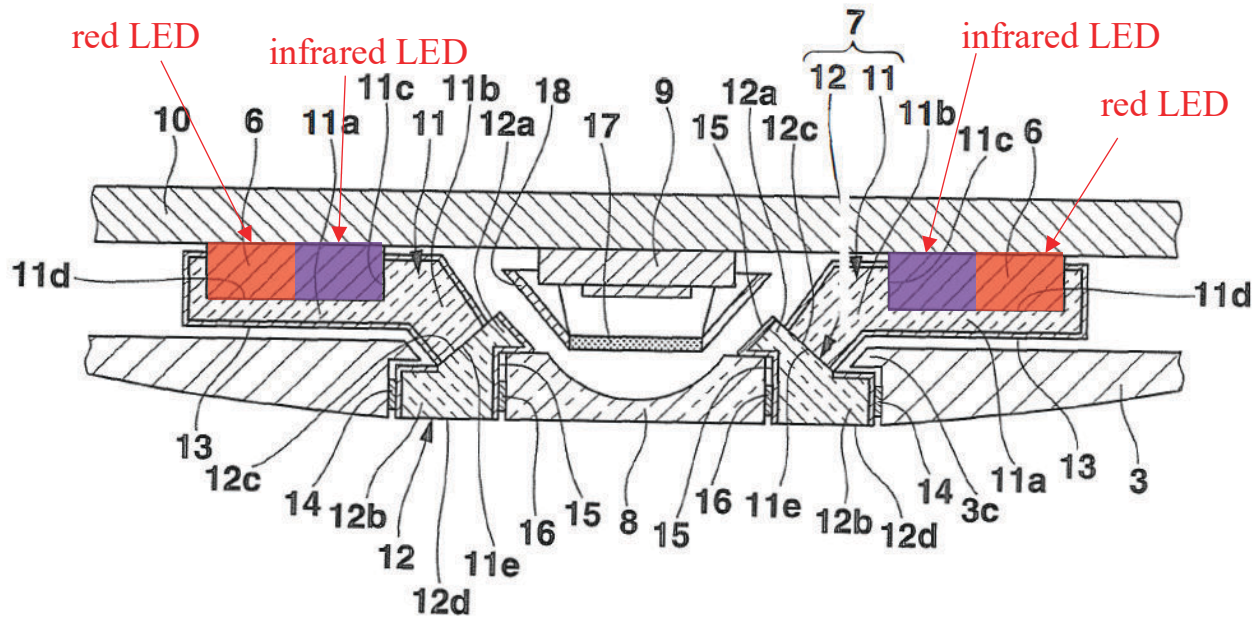


FIG.3

APPLE-1004, FIG. 3 (modified based on Sarantos's teachings)

As I described in greater detail in my First 243-Declaration, a POSITA would have considered the specific placement of the red LED(s) relative to the infrared LED(s) to be a design choice and would have known how to, and would have found it obvious to optimize the sensitivity of the photodiodes, implement an optical filter that would pass both red and infrared light, and implement commonly known signal processing algorithms for calculating oxygen saturation from the detected light signals. 243-APPLE-1003, ¶¶95-99.

(c) Patent Owner mischaracterizes Iwamiya in alleging that it teaches away from measuring blood oxygen saturation using red and infrared light

29. It is true that the main disclosures of Iwamiya focus on accurately detecting a pulse wave for measuring a pulse rate (heart rate), which requires only a single wavelength of light. Iwamiya thus describes using a **single** wavelength of infrared light at 940 nm, instead of a combination of infrared light with red light for measuring a **pulse wave**. APPLE-1004, 1:62-2:6, 6:32-35. But Iwamiya never criticizes, discredits, or otherwise discourages investigation into the use of **two** wavelengths (one in the red wavelength spectrum and one in the infrared light wavelength spectrum) for measuring **oxygen saturation**, and does not criticize, discredit, or otherwise discourage investigation into using an additional wavelength of light as required to make different measurements in different operating modes. A POSITA would have been aware that using two different wavelengths of light provides a second measurement signal, creating redundancy that increases the overall accuracy, improves signal-to-noise ratio, and enhances the performance or functionality of the device when measuring heart rate.

30. A POSITA looking to implement Iwamiya to measure oxygen saturation would not have been led away from modifying Iwamiya's device to include red and infrared LEDs or from implementing any of the other obvious optimizations to Iwamiya's device as described in the preceding section for the

purpose of adding a capability to measure blood oxygen saturation. Indeed, a POSITA would have recognized that Iwamiya's 940 nm wavelength pulse rate measurements would still be retained in the device since 940 nm light is commonly used as one of the wavelengths for measuring oxygen saturation as well. APPLE-1009, 16, 52, 62-63, 73, 79-80; APPLE-1040, 4; APPLE-1056, 16; APPLE-1050, 1; APPLE-1053, 3-4; APPLE-1052, [0007]. Implementing Iwamiya in such a manner (based on the suggestions of Sarantos) would have retained the benefits of Iwamiya's original configuration with respect to measuring pulse rate of users with high melanin in the skin because it would retain the ability to measure pulse using 940 nm wavelength light. EX1004, 1:62-2:6, 21:38-22:12, 10:34-38. By retaining the ability to measure the user's pulse using infrared light at 940 nm wavelength, "even though the epidermis H2 contains the large amount of melanine [sic] pigment, the observation light is light of an infrared band of $\lambda_p=940$ nm" in the resulting Iwamiya-Sarantos combination (or Iwamiya-Sarantos-Utter combination). *Id.*, 10:34-38.

31. Even if the application of Sarantos's suggestions regarding modifications for measuring blood oxygen saturation would cause Iwamiya to somehow perform slightly less efficiently with respect to determining pulse rate in users with high melanin content (it would not, as I discussed above), this would be merely a design consideration and trade-off and, at most, would apply only to users

having “a large amount of melanin[] pigment” and therefore the proposed modifications would be suitable for all other users having less than a “large amount” of melanin in their skin. APPLE-1004, 1:53–2:6, 6:31–34, 10:34–38, 11:43–49, 1:28-52. A POSITA’s desire to expand the capabilities of Iwamiya’s device by adding a red wavelength to measure oxygen saturation in addition to pulse rate would have justified any design tradeoffs necessary to implement oxygen saturation measurements.

(d) A POSITA would have been motivated to modify Iwamiya’s device to measure oxygen saturation at the wrist based on the suggestions of Sarantos

32. In my First 243-Declaration, I articulated numerous reasons that would have motivated a POSITA to apply the teachings of Sarantos to the device of Iwamiya to measure blood oxygen saturation to achieve known benefits that would have been apparent to a POSITA. 243-APPLE-1003, ¶¶88-93. This includes: (1) improving the functionality and utility of the resulting device by expanding the range of physiological parameters measured by the resulting device (*id.*, ¶88); (2) allowing people with cardiac or pulmonary disease to check their blood oxygen levels (including when jogging or exercising) (*id.*, ¶89); (3) allowing pilots to determine if they need supplemental oxygen to thereby prevent dangerous flying situations (*id.*, ¶90); (4) providing alpinists with the ability to avoid injury or death by easily monitoring blood oxygen levels while climbing in high altitudes

(*id.*, ¶91); (5) increased user satisfaction with such a device thereby increasing good will toward such a product and increasing sales and brand recognition (*id.*, ¶92); (6) providing increased flexibility including the ability to monitor symptoms of decreased ability to ventilate such as cyanosis, dyspnea, tachypnea, decreased level of consciousness, increased work of breathing and loss of protective airway reflexes. (*id.*, ¶93); and (7) allowing for monitoring of patients in different kinds of environments including moving of patients. (*id.*, ¶93). Any one of these reasons would have motivated a POSITA to apply Sarantos’s suggestions to Iwamiya’s device and a POSITA would have recognized that the resulting device would have achieved all of these benefits and more.

33. I note that Dr. Madisetti’s assertion that a POSITA would not have been able to implement the resulting device to “measure oxygen saturation at the wrist continuously through motion” is both incorrect and also, even if true, would not have detracted from the benefit of measuring blood oxygen saturation when exercising or jogging. 243-EX2100, ¶86. For example, algorithms for correcting for motion artifacts when measuring blood oxygen saturation were well-known to a POSITA by 2015. For example, U.S. Patent Publication No. 2010/0324387 to Moon et al. (“Moon”) (filed in 2009 and published in 2010) describes techniques for identifying and correcting for such motion artifacts. For example, Moon describes various examples in which the system filters the PPG and PTT

waveforms using detected motion of the patient to more accurately determine SpO₂. APPLE-1081, [0025], [0073]-[0074], [0089]-[0092]. Moon describes that “[t]he filter, for example, can be a matched filter, described in detail below.” *Id.*, [0025]. Moon goes on to describe that if “motion is determined to be present, the algorithm proceeds to analyze both RED/IR(PPG) waveforms to determine if they are distorted in any way.” *Id.*, [0073]. If “a pulse is corrupted by noise” due to movement, the system “deploys a ‘matched filter’ to process both the RED/IR(PPG) waveforms to maximize signal-to-noise ratios of the pulses therein.” APPLE-1081, [0089]. Such noise correction techniques would have been easily implemented, using software and simple motion detection hardware, to allow the resulting device to “determine accurate SpO₂ and cNIBP values even when motion-related noise is present.” *Id.* Moon provides a detailed description of how to correct for such motion induced noise. *Id.*, [0089]-[0092]. Moon’s motion correction techniques allow for “motion [to] be detected and accounted for during pulse oximetry measurements to minimize the occurrence of false alarms and, additionally, make accurate readings in the presence of motion.” *Id.*, [0082], [0089], [0102]-[0103]. However, all of this is really an aside because a POSITA also would have known that a person who is jogging or otherwise engaged in an exercise activity would be able to briefly pause their workout to measure their blood oxygen saturation level using the device of Iwamiya-Sarantos without

having to worry about motion artifacts. Indeed, such a solution would be preferable to that suggested by Masimo because continuous monitoring of blood oxygen saturation would be more likely to drain the battery of the device. Additionally, as I described in my First 243-Declaration, and in the following section, a POSITA would have had a reasonable expectation of success in applying Sarantos's suggestions to Iwamiya's device to determine blood oxygen saturation at the wrist. 243-APPLE-1003, ¶¶94-109.

(e) Sarantos enables measuring oxygen saturation at the wrist and a POSITA would have reasonably expected success in modifying Iwamiya to measure oxygen saturation at the wrist based on Sarantos's suggestions

34. As I stated in my First 243-Declaration, a "POSITA would have reasonably expected success in adapting Iwamiya's sensor" to measure oxygen saturation "because wrist-worn pulse oximetry sensors, such as that described in Sarantos, were well-known in the art." 243-APPLE-1003, ¶87. I understand that Patent Owner attempts to refute my opinion in this regard, but based on my review of the record evidence, I believe Patent Owner's arguments that a POSITA would have lacked a reasonable expectation of success implementing a device that would determine oxygen saturation at the wrist are baseless. As I discussed in my First 243-Declaration and my First 244-Declaration, I reviewed over a dozen references that antedate the '159 Patent and that underscore how determining oxygen

saturation at the wrist was not only well known, but devices had been developed that successfully and repeatedly measured the physiological signals used to determine blood oxygen saturation before the '159 Patent. 243-APPLE-1003, ¶¶100-109; 244-APPLE-1003, ¶¶75-84. These references reinforce and corroborate my original opinion from my First 243-Declaration that a POSITA would have reasonably expected success in adapting Iwamiya's sensor to measure oxygen saturation at the wrist and my First 244-Declaration that Sarantos enables measuring oxygen saturation at the wrist.²

² As I stated in both of my First Declarations, in reviewing these references, a variety of wrist locations were proposed as suitable measurement sites for obtaining PPG signals useful for measuring blood oxygen levels of the user. Some references propose measuring from the outer portion of the wrist while others propose measuring from the inner portion of the wrist. Based on my review, measurements from both the inner and outer portions of the wrist would have been obvious and suitable in the prior art combinations that I proposed in my First Declarations in a manner that would meet the requirements of claims 8 and 17 (which do not limit where the measurements must be taken on the wrist). For example, Iwamiya's emitters/detectors are disposed on the back cover of a wristwatch case 1. APPLE-1004, 5:57-64, 9:61-63, FIG. 1. Sarantos includes a

35. I provided detailed reviews of the Maattala, Cai, Li, Fontaine, and Pang references in each of my first two declarations and therefore will not repeat that analysis here. 243-APPLE-1003, ¶¶100-109; 244-APPLE-1003, ¶¶75-84. Each of these references demonstrates that detection of the physiological signals at the wrist used for determining blood oxygen saturation was successfully conducted prior to the '159 patent. *Id.* The additional references that I cited in my First Declarations similarly demonstrate the feasibility of determining blood oxygen

similar configuration. APPLE-1005, 7:12-23; FIGs. 2, 22. A POSITA would have known that the body of a wristwatch case can be worn to contact either the inner or outer portions of the wrist. Even if a user prefers to wear the wristwatch upwards on the outer portion of the wrist ordinary use in telling time, it would be a simple task to rotate the watch such that the back cover of the case would contact the inner portion of the wrist when the user desires to take an oxygen saturation measurement. Some of the references observed that a stronger signal could be obtained from the inner wrist rather than the outer wrist where Apple sought to measure SpO₂ in the Watch. This further exemplifies how the experience of the Apple engineers in developing the Watch is not probative of reasonable expectation of success with respect to the claims of the '159 Patent, which do not require measuring from the outer wrist.

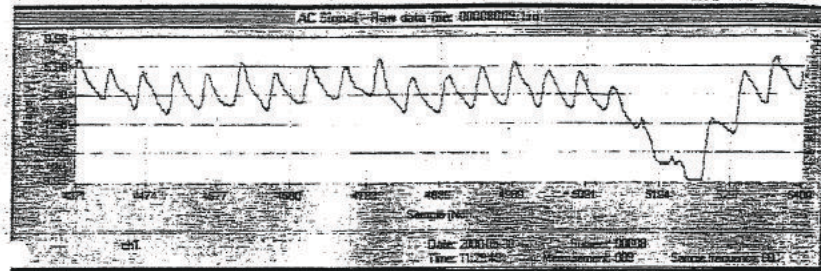
saturation at the wrist prior to the '159 Patent. 243-APPLE-1003, ¶109; 244-APPLE-1003, ¶84.

36. For example, Brady is a patent application filed in 2006 that describes a wrist-worn physiological sensor that can measure and track various physiological parameters and other measurable statistics of the wearer, including “calories burnt during a set time period, [] heart rate, **blood oxygenation levels**, distance traveled, target zones and optionally dynamic blood pressure.” APPLE-1028, [0046]-[0047], [0032]-[0033]. The heart rate and blood oxygenation level parameters are measured using an optical device. *Id.* [0033]. Brady describes various specific configurations for the optical sensor, including different combinations of wavelengths of light emitted by its light emitters, that can be used to measure blood oxygen saturation. *Id.*, [0051]-[0054]. For example, in one configuration:

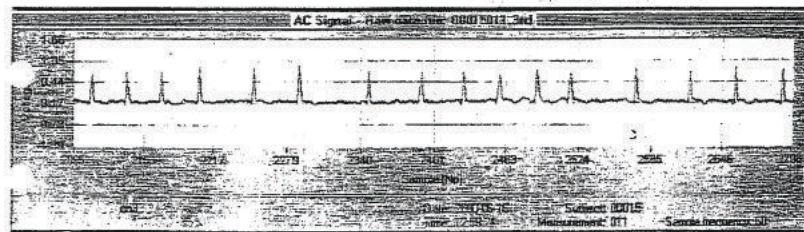
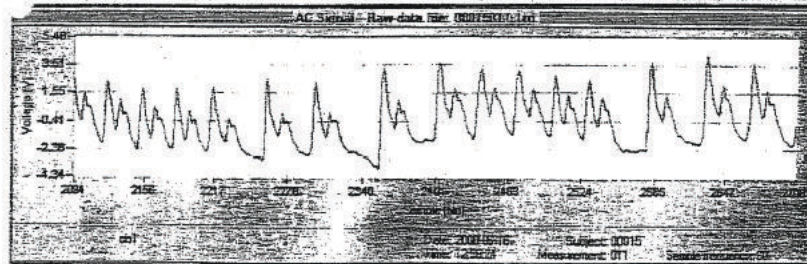
[T]he optical sensor 30 is a **pulse oximetry device with a light source 135 that typically includes LEDs that generate both red ($\lambda \sim 660 \text{ nm}$) and infrared ($\lambda \sim 900 \text{ nm}$) radiation**. As the heart pumps blood through the arteries **in the wrist of the user**, blood cells absorb and transmit varying amounts of the red and infrared radiation depending on how much oxygen binds to the cells' hemoglobin. The photodetector 130, which is typically a photodiode, detects transmission at the red and infrared wavelengths, and in response generates a radiation-induced signal.

APPLE-1028, [0052]. Brady describes another example in which “the first light source 135 emits light in an infrared range ($\lambda \sim 900$ nm) and the second light source 135 a emits light in a red range ($\lambda \sim 630$ nm).” *Id.*, [0053]. In another example, “[t]he light source 135 typically is a light-emitting diode that emits light in a range from 570 nanometers to 1100 nanometers.” *Id.*, [0054]. A “flexible pulse oximetry board” calculates the blood oxygenation level based on the detected reflected light. *Id.*, [0058].

37. In another example, Lindberg describes an apparatus having “a patch which in turn is making part of a handcuff construction suitable for *wrist measurements*...for determining *blood characteristics* including Hb and also *SpO₂*.” APPLE-1017, 18. Lindberg specifically describes embodiments in which “[t]he PPG sensor was especially designed to be used on the wrist.” *Id.*, 49. Lindberg describes various details on how to specifically blood oxygen saturation at the wrist, describing that “[f]or SpO₂ determination, the above handcuff construction may preferably comprise two LEDs with wavelengths within the red and infrared range.” *Id.*, 49-50. This includes specific embodiments in which “only reflected light was detected, fastened on the wrist.” *Id.*, 52, 80-82. Figure 17 shows the successful measurement of PPG signals.



The PPG signal during blood dilution in the radial artery.



The PPG and ECG signals in a patient with arterial fibrillation.

APPLE-1017, 82

38. In yet another example, Goldreich describes “a wrist-mounted device for measuring at least one physiological parameter of the user” such as “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.” APPLE-1036, [0035]-[0036], [0104]. For example, Goldreich describes measuring blood oxygen

saturation using a sensor having “two light sources, optionally by two LEDs (light Emitting Diode) and a photoelectric detector for example. One of the LEDs emits in the infrared band and the other emits in the red band.” *Id.*, [0124].

39. The ’159 Patent specification does not identify any difficulties, differences in configuration, or problems associated with any of the measurement sites on the body, apart from the fact that some measurement sites would such as the finger and ear would ordinarily be measured with a transmittance-type sensor while other sites such as the wrist and forehead would ordinarily be measured with a reflectance-type sensor. The advantages disclosed by the ’159 Patent, such as an enlarged irradiating area, would not address the unique problems that Patent Owner now alleges would be required to overcome for wrist measurements apart from other locations on the body. *See* APPLE-1001, 7:63-8:19, 8:20-9:10, 11:2-10, 11:44-53.

40. The ’159 Patent only mentions the wrist as a possible tissue measurement site in passing, with no acknowledgment of the alleged challenges of measuring at the wrist and no solutions specifically tailored to addressing the alleged challenges. For example, Dr. Duckworth, Patent Owner’s expert in the IPR proceedings involving the related ’745 patent, conceded that the forehead would provide a much stronger signal for measuring oxygen saturation than the wrist (APPLE-1059, 37:6-8), and yet the ’745 Patent/’159 Patent specification

discloses no sensor adaptations that would be employed to successfully measure a weaker signal at the wrist. The '159 Patent instead assumes that a POSITA would have known how to implement such measurements at the wrist despite the weaker signal. Patent Owner's expert in the related '745 patent proceedings agreed.

APPLE-1080, 17:19-22, 29:2-31:17, 48:17-22.

41. Patent Owner's expert in the related '745 patent proceedings, Dr. Duckworth, was likewise unable to identify any specific feature or combination of features recited in the claims that allows for pulse oximetry at the wrist. APPLE-1080, 33:12-19, 37:9-38:7³, 39:9-45:22, 47:10-16, 49:1-15, 58:6-59:2, 83:20-84:4. Indeed, the differences between claims 1/19 and 14 show that a shape-changing material (elements [1.2]/[19.3]), a dark-colored coating (elements [1.4]/[19.5]), or a specific spatial configuration of the photodiodes (element [14.4]) is not required for measuring oxygen saturation at the wrist because none of these features appear in every independent claim. To the extent a POSITA would have understood the disclosure of the '159 Patent as teaching oxygen saturation measurements at the wrist, a POSITA would have also understood that level of skill is sufficient to enable the prior art.

³ Dr. Duckworth identified FIG. 7A's "light concentrator 708," which does not correspond to any claimed feature.

42. Patent Owner relies on testimony from Apple’s engineers in an earlier ITC proceeding involving the related ’745 Patent (and others) for its assertions that “a POSITA would not have had a reasonable expectation of success in modifying Iwamiya to measure oxygen saturation at the wrist” and “POSITA would not have had a reasonable expectation of success in modifying Sarantos to measure oxygen saturation at the wrist.” 243-POR, 37; 1465-POR, 44. However, the Apple’s engineers’ testimony regarding their subjective experiences developing pulse oximetry for the Apple Watch is entirely different from the issues of whether Sarantos enables performing the basic, claimed function of determining an oxygen saturation parameter at the wrist and whether a POSITA would have reasonably expected success in modifying Iwamiya’s device to perform the basic, claimed function of determining an oxygen saturation parameter at the wrist. Significantly, no record evidence indicates that the Apple engineers intended to speak from the perspective of a POSITA.

43. Patent Owner also fail to place the Apple engineers’ testimony in its proper context, instead cherry-picking soundbites in support of a misleading narrative. Considered in its entirety, it is clear that the challenges confronting the engineers in developing the pulse oximetry feature for the Apple Watch was not

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

44. I understand that evaluating the reasonable expectation of success requires consideration of the appropriate scope of the patent's claimed invention. The '159 Patent claims do not specify a required accuracy or quality of its oxygen saturation measurements. Patent Owner's reliance on evidence of Apple's own successes developing pulse oximetry for the Apple Watch is primarily directed to product design challenges that are not relevant to assessing reasonable expectation of success in a manner commensurate with the broad scope of the oxygen saturation feature actually claimed in the '159 Patent. The broad scope of the claims covers a practical use of a rudimentary pulse oximetry function that does not require the same level of functionality provided in the Watch. For example, as I discussed in both of my First Declarations, U.S. Patent No. 6,398,727 to Bui et al. teaches an alarm/alert system for a pulse oximeter where "[t]he resolution of the pulse oximeter 214 is preferably 1% oxygen saturation and the accuracy is

expected to be +/- 3% oxygen saturation” and includes a broad range (e.g., 50-100%) for the Low and High SpO₂ limits that trigger the alarm/alert system.

APPLE-1079, 15:9-11. As another example, the oxygen saturation parameter might not even need to be a measurement. It could simply be a binary indication of whether a signal sufficient for measuring oxygen saturation has been obtained or an indication that oxygen saturation above a defined level of range had been detected.

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

A. Yeah. Industrial design is an important part of the Apple product. It defines, not only the outside shape of the product, but the look and the feel, and the design language, the aesthetics.

So we not only had to make a product that checked all the boxes of low power, fit in this tiny form factor, worked well across all the use cases, but we also had to make sure that it was beautiful and compatible with the look and feel of what the ID studio was going for for the product vision.

EX2076, 958:19-24

Q. What were some of the challenges that you and your team faced in developing the blood oxygen sensor for the Apple Watch?

A. The challenges were -- were many. The first was we had to fit into the small form factor of the watch and we were trying to hit a moving target, because every -- it seemed like as every year went by the watch got a little smaller.

And we also had to work across -- at the wrist, which was unprecedented -- at the time that we kicked off the blood oxygen sensing at the wrist, there were no commercially available products that did blood oxygen sensing at the wrist.

We also had to fit into a product that had very little space for the resources needed were accurate, and, of course, we had to work across all of the human variation that existed in the world. Those were some major challenges.



Can you give Her Honor just a few examples of other features and functions in the Series 6 beyond the features developed by your team?

A. Yes. There's audio, which can be used to listen to music or make a phone call, speaker microphone. There are motion sensors that can be used to track your motion, steps, your calories burnt through the day. There is a near-field communication sensor that you can use for a point-of-sale display.

There's all sorts of wireless connectivity, Bluetooth, Wi-Fi, including cellular networks for network connectivity, and that's one of the particularly challenging module that's in the Apple Watch, because there's a powerful transmitter that needs to talk with cell phone towers that

are perhaps miles away, and that's a potential source of interference for all the sensors.

There's also other health sensors. There's an ECG sensor. There's a touchscreen. There's -- and it's really kind of a miniature computer in addition to all the sensors.

EX2076, 970:12-971:6

A. Yes. The list between Series 6 and Series 7 is quite similar. There's a few I didn't mention, like GPS, to tell you where you are on a map, there's a compass to give you a heading if you're walking through a map, et cetera.

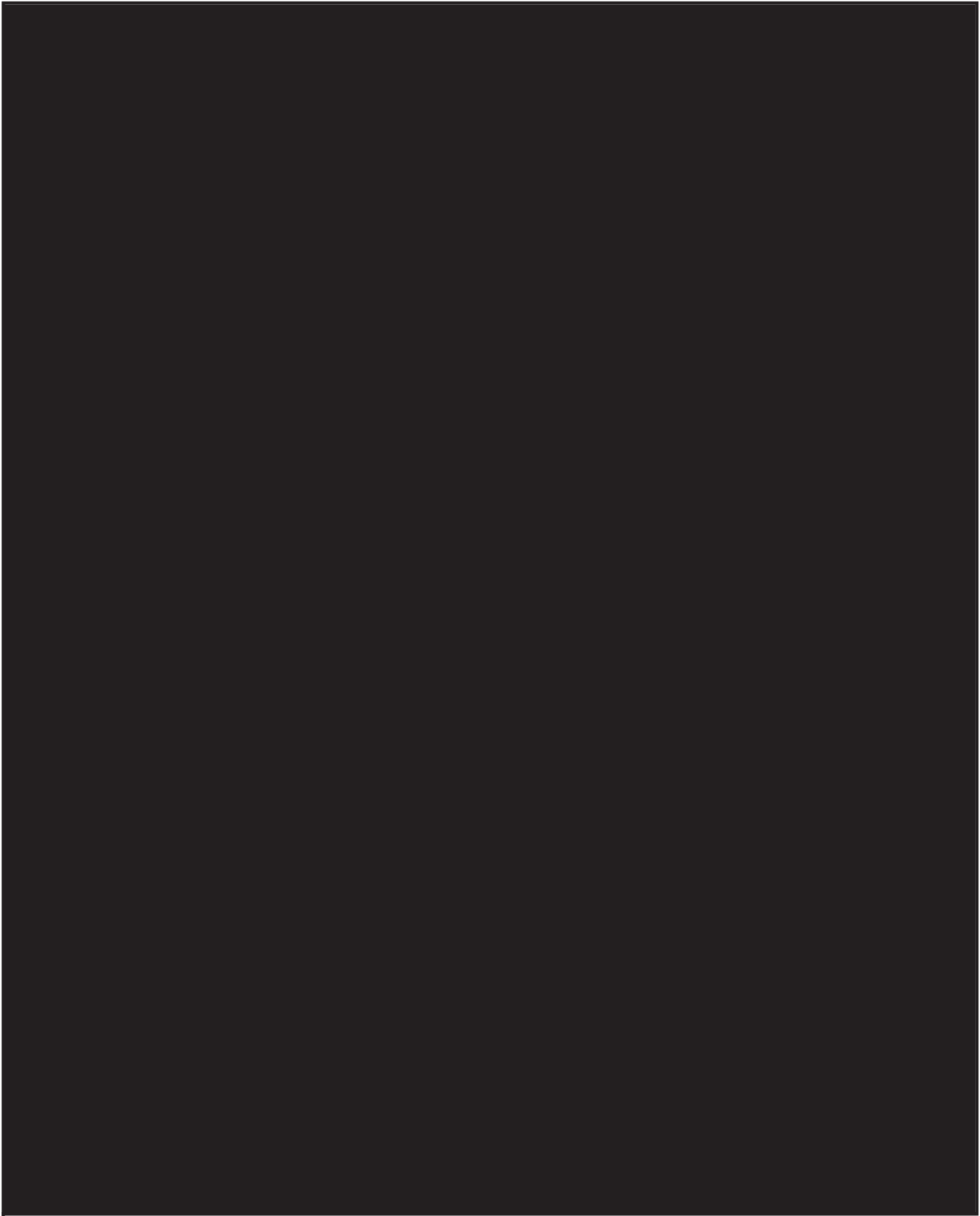
Q. Now I think you touched on some of the challenges posed by all of these different components.

Can you tell us a bit more about the challenges of developing a blood oxygen sensor in light of all of the other components that we see on the specifications that we've gone through?

A. Yes. The Apple Watch is very compact. Everything is co-located in a very tight space. And every single one of these sensors and modules is run by electricity. It can be a source of interference, interference into the blood oxygen sensor.

And we had to, in addition to making an excellent blood oxygen sensor, we also had to consider all of these interference sources and design the integration of the blood oxygen sensor into the watch in a way that avoided these interference sources and worked under the use cases that we care about.

EX2076, 971:10-972:5





47. Block testified that “trying to figure out how to take [the blood oxygen feature] and integrate it into a very complicated, very small consumer electronic device was extremely difficult.”

Q. What are you most proud of with respect to your work on the blood oxygen feature in Apple Watch?

A. It was definitely very hard work to figure out how to make it work on the wrist, but, beyond that, just trying to figure out how to take that and integrate it into a very complicated, very small consumer electronic device was extremely difficult.

EX1084, 902:13-19.

48. Shui explained that the “[REDACTED] challenging part of the work is related to the position of the Apple Watch blood oxygen sensor” within the Apple Watch where [REDACTED]

[REDACTED]

A. [REDACTED] challenging part of the work
is related to the position of the Apple Watch blood
oxygen sensor. The watch is worn on the wrist, and
the wrist is well known for its lack of signal.



EX2082, 108:15-109:20.



[REDACTED]

[REDACTED]

EX2078, 8:6-12; EX2081, 167:18-169:10, 173:13-174:8. Additionally, they were designing a watch with oxygen saturation measurements that were targeted to meet “the same standards that are used to assess clinical grade devices.” EX2078, 949:10-16. Waydo’s testimony is reproduced below:



A. We've tested the watch to the same standards that are used to assess clinical grade devices, and we meet the general accepted standards for accuracy of blood oxygen devices.

EX2078, 949:10-16





“[s]hrinking things down to be much smaller package and use substantially less power and to be used by a consumer in a nonprescription environment” and

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

⁴ The Series 0 Watch was released in Spring 2015. EX2076, 956:9-957:1.



The wrist is just an incredibly different beast. The vascular densities are very small and sparse. It was going to be the first challenge. Shrinking things down to be much smaller package and use substantially less power and to be used by a consumer in a nonprescription environment would ultimately add to additional challenges to think through and work through.

EX2077, 999:5-11

A. So our focus during this period of time was to determine whether or not the signals that we were obtaining for the wrist could be used to reliably calculate an accurate SpO2 reading.

This consisted of room air testing as well as mild levels of hypoxia testing, where we reduced the inspired oxygen to a subject, a volunteer, akin to taking them to higher elevations, eight, ten, up to maybe 14,000 feet in elevation, to see that the signals and the changing of those signals were tracking SpO2 adequately for us to build a device.

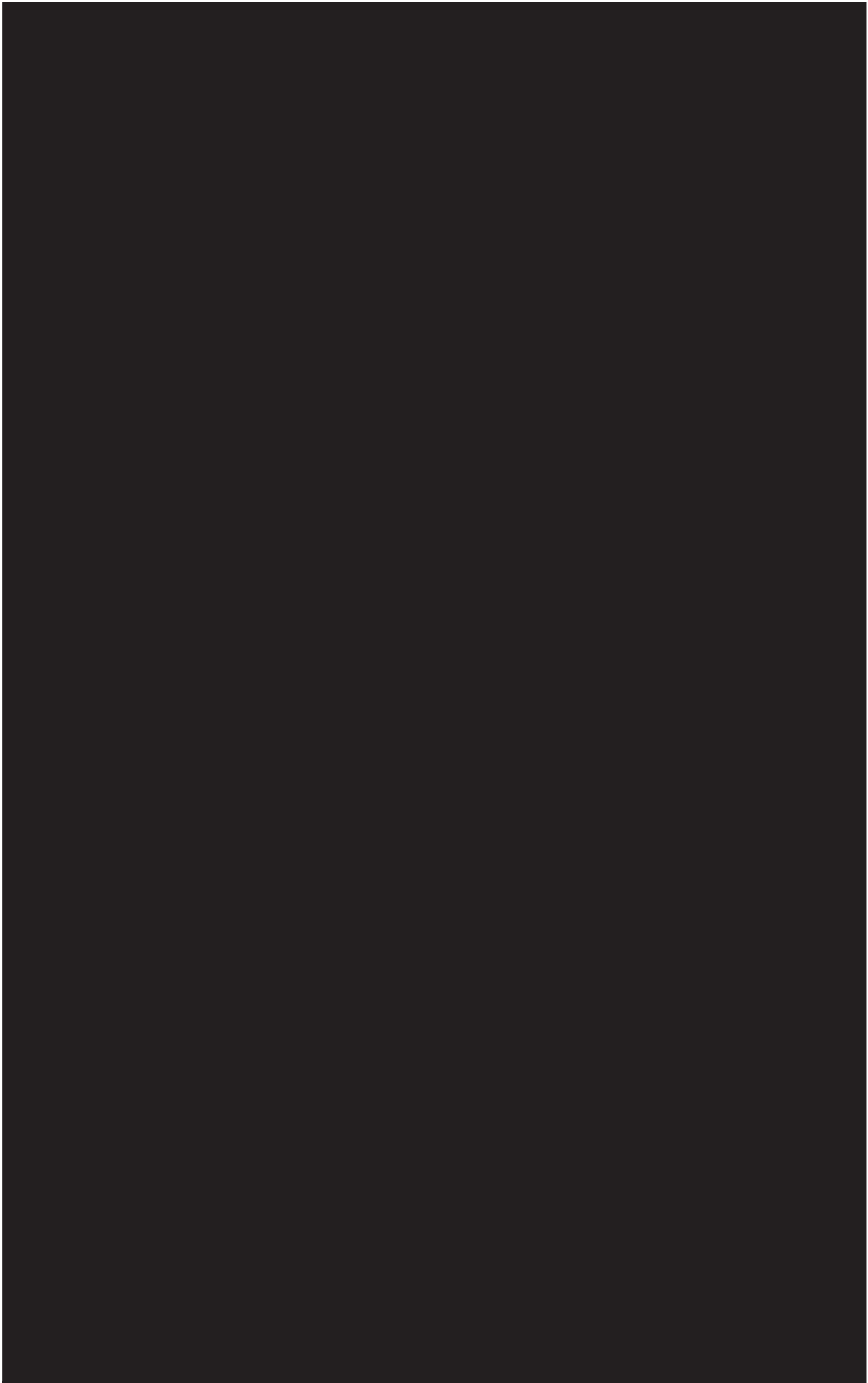
So each of those designs that Mr. Land showed were subjected to combinations of both room air and mild hypoxia testing.

Q. Next, Clinimark testing, what does that refer to?

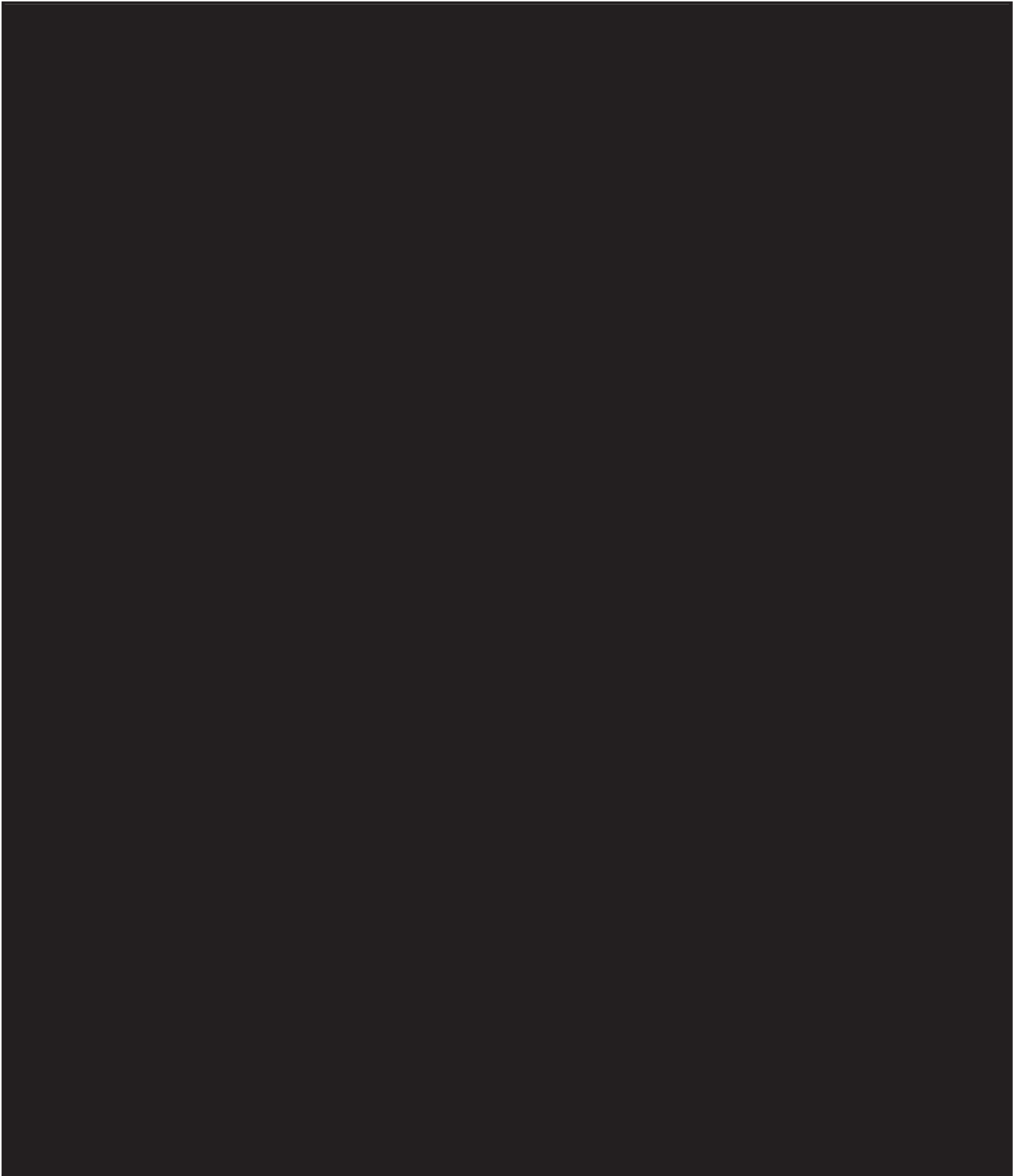
A. We were heading towards our demonstration period, the proof of concept, could we -- could we show that it worked. We had in-house data indicating that at least down to 85 percent SpO2 it was behaving pretty well.

But, ultimately, the product we were targeting would be accurate down to at least 70 percent, and Clinimark

EX2077, 1000:6-1001:1



51. The use case and accuracy goals and requirements were captured in presentation slides dated July 30, 2015, reproduced below.







53. In its response, Patent Owner misrepresents and mischaracterizes the record evidence. [REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED] The evidence also shows that the feasibility of measuring oxygen saturation under room air was established by April 20, 2016, far less than the “six years” that Patent Owner alleged based on a mischaracterization of Mannheimer’s testimony. [REDACTED]

[REDACTED]

██████ Patent Owner’s arguments on no reasonable expectation of success are not supported by the facts.

5. Iwamiya-Sarantos renders obvious “wherein the opening defined in the dark-colored coating comprises a width and a length and wherein the width is larger than the length” (Claim 12)

54. In my First 243-Declaration, I explained that a POSITA would have found it obvious and beneficial to implement the window defined by Iwamiya’s light shielding frame 18 to have a width that is larger than a length of the window, based on the teachings of Sarantos. 243-APPLE-1003, ¶¶118-120. As I discussed in that Declaration, a POSITA would have recognized the benefits from using the improved “high-aspect ratio” (“HAR”) photodiodes disclosed by Sarantos and the corresponding window regions (openings) having the same corresponding shape. APPLE-1005, 9:47-65; 9:48-10:26, 17:42-47 (“the window regions 2226 are mutually coextensive with their respective HAR photodetector elements 2212.”), FIGS. 15-16, 18. As I discussed in my First 243-Declaration (and in Section II.A.1, above), a POSITA would have recognized the benefits of applying Sarantos’s suggestion to use a dark-colored coating on the surface of Iwamiya’s light shielding frame 18 and applying this teaching would include Sarantos’s teachings with respect to the shape of the opening in the dark-colored coating. APPLE-1003, ¶¶31-44, 118-120. For example, a POSITA would have recognized the benefits of using Sarantos’s high-aspect-ratio (HAR) photodiodes because they

are expressly disclosed by Sarantos. As explained in the portions of Sarantos that I previously cited, “a *significant performance increase* may be realized by deviating from the typical square” photodetectors “of conventional PPG sensors.” APPLE-1005, 9:48-67. In another example, Sarantos explains that “[t]he present inventors have determined that the use of non-square photodetector elements in PPG sensors may provide a significant performance increase as compared with traditional PPG designs, which typically utilize square photodetector elements” while “maintaining essentially the same power consumption as a square photodetector element.” *Id.* 7:3-11.

55. As I discussed in my First 243-Declaration, Sarantos describes that “the window regions 2226 through which the light reaches the HAR photodetector elements 2212 each overlap their respective HAR photodetector elements 2212” and “the window regions 2226 are mutually coextensive with their respective HAR photodetector elements 2212.” APPLE1005, 17:42-47; 243-APPLE-1003, ¶120. From this disclosure, a POSITA would have understood that the window regions defined in the dark-colored coating (the optical filter 17 positioned within Iwamiya’s light shielding frame 18 in the predictable combination) includes a width and a length corresponding to the width and length of the respective non-square HAR photodiode, and thus has a width that is larger than the length in at

least some configurations of the predictable combination of Iwamiya with Sarantos.

B. Sarantos renders obvious claims 1-5, 7-9, and 12-13; Sarantos-Brady renders obvious claim 2; Sarantos-Brady-Han renders obvious claim 3; Sarantos-Utter renders obvious claims 14 and 16-25

1. Sarantos renders obvious a “first shape” and a different “second shape” (elements [1.1]-[1.2] and [19.2]-[19.3] and claim 18)

56. As I discussed in my First 244-Declaration, Sarantos discloses that its wearable fitness monitor includes a plurality of light emitting devices and a POSITA would have recognized that the light emitted from this plurality of light emitting devices would have been emitted in a first shape, with the first shape being defined by the specific number and spatial arrangement of the light emitting devices. 244-APPLE-1003, ¶¶31-33. I then discussed how Sarantos’s in-mold label/coating defines the shape of the window portion 226 through which the light emitted by the light source 2208 is guided and that from Sarantos’s disclosures a POSITA would have understood that light shining through a translucent or transparent material as described in the specific arrangement of Sarantos would necessarily change in shape due to the refractive properties of translucent and transparent materials and due to the shape defined by the in-mold label/coating. *Id.*, ¶¶34-35.

57. I provided a few examples of the first light shape in my First 244-Declaration, including examples of a circular arrangement of light-emitting devices 2508 emitting light in a circular first shape. 244-APPLE-1003, ¶33; FIG. 25. However, Sarantos discloses numerous other examples for the arrangement of light emitting devices and a POSITA would have recognized that each different arrangement would have resulted in a different shape for the first shape of the light emitted by the light emitting devices. Sarantos discloses that it's device can be configured to include one or more light sources, each of which may include one or more light-emitting devices" which may emit light at the same or different wavelengths. APPLE-1005, 15:27-31, 13:34-53, 2:18-19, 3:58-62. That is, there can be multiple light sources, and each light source can be made up of multiple light-emitting devices. As such, the shape of each light-emitting device, the spatial arrangement of the light emitting devices within each light source, and the spatial arrangement of the light sources with respect to each other defines the shape of the light emitted by the plurality of light sources (the claimed "first shape"). A POSITA therefore would have understood Sarantos to disclose a wide variety of possible shapes for the light emitted by the plurality of light sources.

58. This is confirmed by Sarantos's descriptions of various different arrangements for the light sources and the light-emitting devices. For example, Sarantos describes that the "multiple light-emitting devices...may, for example, be

spaced apart from one another” for example by being “distributed across the PPG sensor face.” APPLE-1005, 13:34-14:1. Sarantos further describes that the plurality of light sources/light-emitting devices “may be closely grouped.” *Id.* A POSITA would understand that the shape of the light would be different for different spacing between a collection of LEDs/emitters. For example, in some other implementations, light emitting devices may be closely clustered together, e.g., within a millimeter or two or less of each other; in such implementations, the clustered light-emitting devices may be viewed as a single light source with a center point that is, for example, associated with the centroid of the light intensity distribution of the cluster of light-emitting devices when all of the light-emitting devices in the cluster are emitting light simultaneously or that is associated with the averaged location of all of the light-emitting devices in the cluster.” *Id.* Once again, these disclosures reveal that Sarantos contemplated a wide variety of shapes for the shape of the light emitted by the light sources defined by the shape of the light-emitting devices, the spatial arrangement of the light emitting devices within each light source, and the spatial arrangement of the light sources with respect to each other.

59. Sarantos describes that in the implementations in which the light-emitting devices are “closely grouped” or “closely clustered together,” the individual arrangement and gaps between the plurality of emitters would only

become indiscernible at a distance of “approximately two to three feet from the light emitting devices.” *Id.*, 14:5-22. A POSITA would have recognized that the distance between the light source 2276 and window region 2226 in the configuration shown in FIG. 22 would have been on only the order of millimeters and therefore far shorter than the two to three foot distance at which the light-emitting devices could not be distinguished. Therefore, the specific gaps and spacing between the multiple light-emitting devices also would have affected the first shape of the light. For example, four light-emitting devices arranged equidistantly around a center point would produce a clover shape. As another example, if the same four light emitting devices are arranged linearly, this would have produced a linear or oblong shape depending on the specific size of the light-emitting devices and the spacing between the light-emitting devices. Sarantos provides another similar example in FIG. 18 in which it shows a “light source 1808 [that] includes two light-emitting devices 1810” positioned side by side and emitting light at two different wavelengths. APPLE-1005, 15:24-43, 6:39-42.

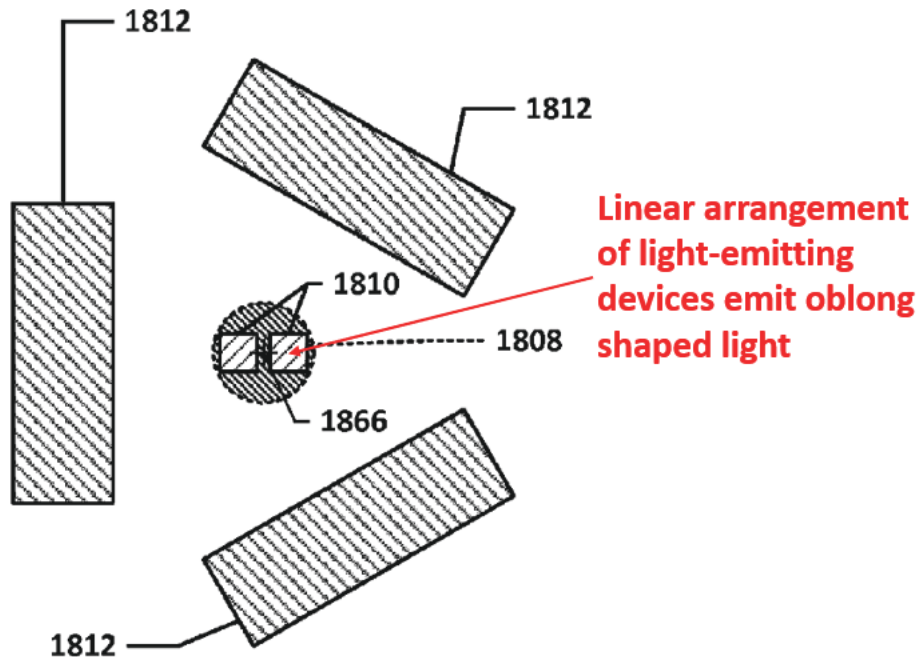


FIG. 18

APPLE-1005, FIG. 18. A POSITA would have recognized that this side-by-side arrangement of the light-emitting devices 1810 would have produced an elongated, oblong, possibly dumbbell first shape for the light, noting again that the design choice variation for the spacing between the LEDs also impacting the first shape. These are only a few examples contemplated by Sarantos. A POSITA reading Sarantos's disclosure as a whole would have instantly recognized various other arrangements of light sources and light-emitting devices based on the disclosures of Sarantos. This is especially true in light of Sarantos's disclosure that all disclosed embodiments may be implemented "in combination with" other disclosed embodiments. APPLE-1005, 21:3-9. As such, a POSITA would have recognized a multitude of arrangements for the of light sources and light-emitting

devices that flow directly from the disclosures of Sarantos.

60. A POSITA also would have recognized that Sarantos discloses, or at least renders obvious, that the light is changed from the above described first shapes into a second shape when passing through the material positioned between the plurality of emitters and the tissue measurement site. Specifically, the light passes through an opening in the window 2278 defined by in-mold label 2276 on the window 2278. APPLE-1005, 17:3-10; 244-APPLE-1003, ¶¶34-35. As explained by Sarantos, the “in-mold label 2276 may be black or otherwise rendered opaque to light to prevent light from entering or exiting the PPG sensor through the window 2278 *except through window regions 2226.*” *Id.* Sarantos also describes that “[i]n other implementations, other masking techniques, such as a painted or silk-screened mask applied to the window 2278, may be used.” APPLE-1005, 17:10-12. The light having the first shape defined by the shape, quantity, and spatial arrangement of the plurality of light sources having multiple light-emitting devices is thus changed to a second shape due to the refractive properties of translucent and transparent materials and due to the shape defined by the in-mold label. That is, the first shape is changed to the second shape based on the specific refractive properties and shape of the window region over the light-emitting devices.

61. For example, Sarantos describes embodiments in which the “optical windows that may slightly *refract light* that passes through the windows.” APPLE-1005, 18:23-31. Sarantos identifies such configurations as being within the scope of its device while distinguishing such refraction from configurations in which the windows “transport or redirect light in a significant manner.” *Id.* These refractive implementations of the optical windows are combined with various different configurations for the shape of the openings in the window regions. For example, Sarantos describes that the window regions may be defined in a variety of manners. APPLE-1005, 17:1-18:16. For example, “windows 2478 may be formed by filling the recesses formed by the walls 2474 and other surrounding structure with a clear, flowable material, such as epoxy, and then allowing the flowable material to cure and harden.” *Id.* Sarantos describes that the window regions can have various shapes, including “square” and “non-square” configurations. *Id.*, 7:3-23; 9:1-28; 17:42-47; 13:34-14:1, 19:33-52 (discussing an annular “first boundary”). Sarantos also makes clear that the various different configurations, shapes of components, and other described aspects of the various embodiments can be employed with and are interchangeable with other arrangements, stating that the present invention is neither limited to any single aspect nor implementation, nor to any combinations and/or permutations of such aspects and/or implementations. Moreover, each of the aspects of the present invention, and/or implementations

thereof, may be employed alone or in combination with one or more of the other aspects and/or implementations thereof.” APPLE-1005, 21:3-9. Thus, the reason I concluded that Sarantos alone renders obvious changing the light from the first shape to a second, different shape (not just a different size of the same shape) is because, as would have been apparent to a POSITA, the *only* scenarios in which Sarantos’s device would not have changed the first shape to a second shape are those configurations in which the arrangement of the plurality of light sources/light-emitting devices and the arrangement of the window region produce the same shape. However, it is clear from Sarantos’s disclosure as a whole (as I reviewed above) that Sarantos contemplates numerous different configurations for the shape of the light emitted by the light sources (based on the shapes, sizes, and spatial configuration of the light-emitters that make up the light sources) and numerous different configurations for the shapes of the windows. As such, it would have been obvious that in most of the combinations contemplated by Sarantos, the shape defined by the arrangement of light-emitting devices (grouped into multiple light sources) would be different than the shape of light defined by the refractive windows having a shape defined by the in-mold label/mask. For example, in the example arrangement shown in FIG. 18, the elongated, oblong, shape created by the two square light-emitting devices positioned side by side

would be changed to a more circular shape by the circular opening in the in-mold label:

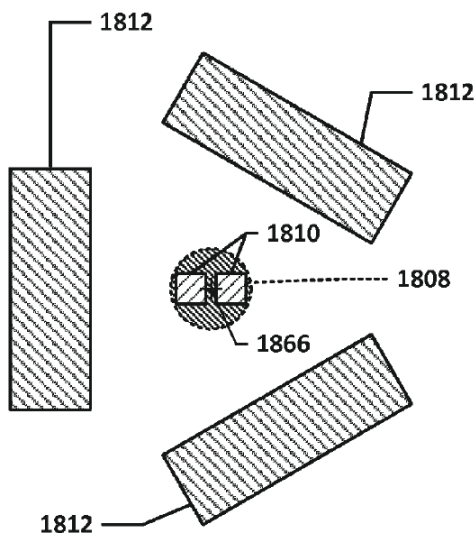


FIG. 18

APPLE-1005, FIG. 18; *see also* FIG. 25 (as another example of a circular opening for the emitted light that would have been combined with the embodiment of FIG. 18, per Sarantos's express contemplation that all embodiments are combinable with all other embodiments). This is merely one example that comes expressly from the embodiments depicted in the Figures. As I discussed above, numerous other arrangements for both the light-emitting devices/light sources and the shape and refractive properties of the window region over the light source(s) would have readily come to the mind of a POSITA based on the disclosures of Sarantos. For example, while Sarantos expressly contemplates embodiments having multiple light sources, the depicted arrangements shown in FIGs 9-19, 21, and 25-26 each

only show one light source. As such, a POSITA would have had the routine and ordinary creativity to develop different arrangements of the light sources/light-emitting devices to achieve the desirable efficiency of the resulting device based on Sarantos's teachings.

2. Sarantos (with or without Shie and/or Utter) renders obvious a plurality of detectors arranged in an array having a spatial configuration corresponding to a shape of a portion of the tissue measurement site bounded by the light block (Claims 5 and 25, element [14.4])

62. Patent Owner argues that FIGS. 22 and 25 represent “different embodiment[s] and that “Figure 25 does not show any light block at all.” 244-POR, 18-19. However, contrary to Patent Owner's assertions, I did not propose combining multiple different embodiments, as Sarantos FIGS. 22 and 25 are cohesive. Sarantos explicit discloses that “FIGS. 22 through 24 depict cross-sections of simplified representations of **various PPG sensors**, in accordance with **various example implementations.**” APPLE-1005, 16:60-62. This is consistent with Sarantos's disclosure that features from the various different configurations described within Sarantos can be combined with features of any other configuration. APPLE-1005, 21:3-9. Thus, Sarantos's FIG. 22 is a representation that is shared with more specific examples regarding the arrangement of the light sources and photodetectors described in Sarantos. Sarantos describes FIG. 25 as “**an example implementation**” of a **PPG sensor**. APPLE-1005, 19:31-35. A

POSITA would have viewed FIG. 25 and its corresponding disclosure as a natural extension of and incorporating the features of FIG. 22, not a distinct disclosure requiring combination to show unpatentability. Indeed, the reason the light block is not shown in FIG. 25 is because FIG. 25 is not intended to be a stand-alone embodiment but rather gives one example configuration for the shape of the light source and the photodetectors that could be employed in any of the embodiments of FIGS. 22 through 24. Specifically, FIG. 25 shows one of the “various example implementations” of corresponding shapes for the light source (having multiple light-emitting devices) and photodetectors in which both have a circular arrangement.

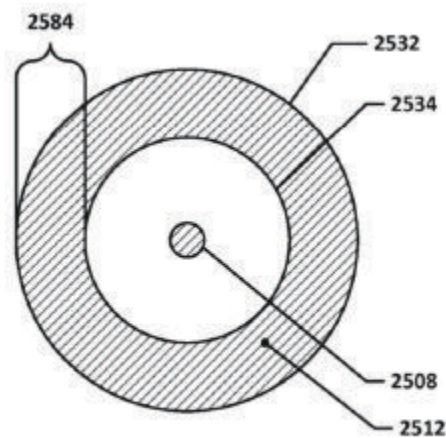


FIG. 25

APPLE-1005, 19:22-35, Fig. 25;

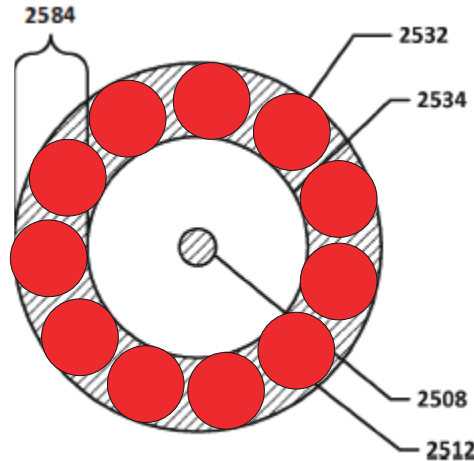
63. Even if FIGS. 22 and 25 depict two different embodiments, a POSITA would have been motivated to include walls in FIG. 25 that separate the light

source 2508 from the photodetector 2512, like walls 2274 depicted in FIG. 22 that perform the same function. APPLE-1005, 17:26-42. As described in Sarantos, FIG. 22 includes photodetector elements 2212 that are positioned on either side of a light source 2208. APPLE-1005, 17:1-3. FIG. 25 similarly includes photodetector element 2512 with a light source 2508 in the middle. APPLE-1005, 19:33-35. Just as FIG. 22 benefits from the walls 2274, which reduces light from the light source 2208 from reaching the photodetectors 2212 without first being diffused through the person's skin, so would FIG. 25 benefit from the same walls. *Id.*

64. Returning to the configuration shown in FIG. 25, the circular spatial arrangement of the light source and photodetectors in this example configuration in combination with the depiction in FIG. 22 of the light block 2274 being positioned equidistantly around the light source would have indicated to a POSITA that a circular arrangement for the light block 2274 would have been the most obvious design choice for the light block due to the annular configuration of detectors around a circular light source, the small form factor of the device overall, and the limited space in Sarantos' PPG sensor. APPLE-1003, ¶62. While it is true that it would have been technically possible to use "a square light block" or a "rectangular" light block with the circular light source and circular photodetector configuration depicted in FIG. 25, as Patent owner asserts (244-POR, 19), a

POSITA would have recognized that the most obvious and logical choice would have been a round light block that patches the circular configuration for both the light source and the array of photodetectors.

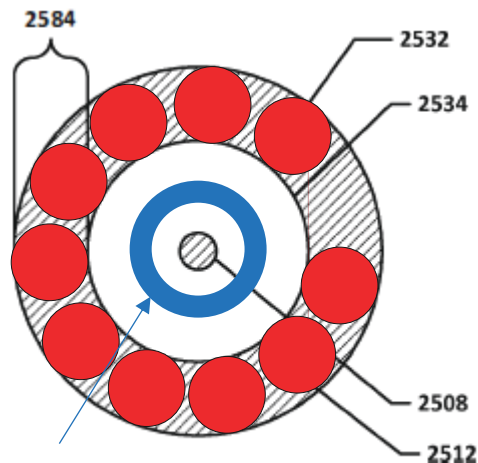
65. Patent Owner argues that FIG. 25 includes only a “single photodetector [which] cannot satisfy the requirement for a “plurality” of detectors.” 244-POR, 20. However, Sarantos explicitly contemplates FIG. 25 having multiple photodetectors: “any of the implementations discussed above with respect to a single photodetector element spaced apart from a light source may also be implemented using a plurality of photodetector elements arranged about the light source.” APPLE-1005, 20:52-57. From Sarantos’s disclosure, a POSITA would have understood that the annular photodetector element 2512 of FIG. 25 can be implemented using a plurality of photodetector elements arranged about the light source in an annular configuration. Below is an example with the plurality of photodetector elements depicted by red circles, although a POSITA would have understood that each photodetector element could also be a different shape, such as arched, square, or rectangular.



APPLE-1005, FIG. 25 (modified). While my illustration above is only an example of what a POSITA would have understood from the disclosures of Sarantos, even if the individual photodetectors had taken on shapes other than circular, a POSITA would have recognized that they still would have been arranged in a circular shape that corresponds to the circular shape of the portion of the tissue measurement site bounded by the light block to correspond to the annular shape expressly depicted for photodetector element 2512 because Sarantos expressly shows a circular configuration for the photodetectors in FIG. 25. This is supported by other disclosures in Sarantos that “each photodetector element in the pattern may be equidistant from the center of the light source and/or evenly spaced within the pattern.” APPLE-1005, 2:26-29, 3:64-4:2. A POSITA would have recognized that a pattern of photo detectors arranged “equidistant from the center of the light source” and “evenly spaced” corresponds to a circular arrangement. Sarantos also

describes that the various different shapes disclosed for its HAR photodetectors are applicable to all embodiments. APPLE-1005, 12:34-37, 21:3-9 (stating that “aspects” and “implementations” of Sarantos’s device “may be employed...in combination with one or more of the other aspects and/or implementations.”). Therefore, the configuration I described in my First 244-Declaration is not a combination of multiple different embodiments but rather is derived directly from Sarantos’s collective disclosures regarding different components that can be employed together within its wearable fitness monitor.

66. Additionally, a POSITA would have recognized that light blocks, as used in Sarantos, come in various shapes and sizes, and would have considered using different shaped light blocks. Given the annular configuration of detectors around a circular LED, the small form factor, and the limited space in Sarantos’s PPG sensor described in FIGS. 22 and 25, a POSITA would have found a circular shape light block to be a reasonable design choice, as shown below. Patent Owner acknowledges that “various shapes of light blocks would have worked” and a POSITA would have recognized that the most logical shape to use with a circular light source and a circular array of photodetectors is a circular light block. 244-POR, 19.



APPLE-1005, FIG. 25 (modified). In this configuration, the plurality of photodetectors would be “arranged in an array having a spatial configuration corresponding to a shape of the portion of the tissue measurement site encircled by the light block” (depicted by the blue ring).

67. Indeed, using a circular light block was common practice well before the Critical Date, and there was nothing new or inventive about changing one light block shape for another. For example, Fontaine shows a circular “optical shield” between “a ring of photodiodes” and “a central light source.” APPLE-1042, 29.

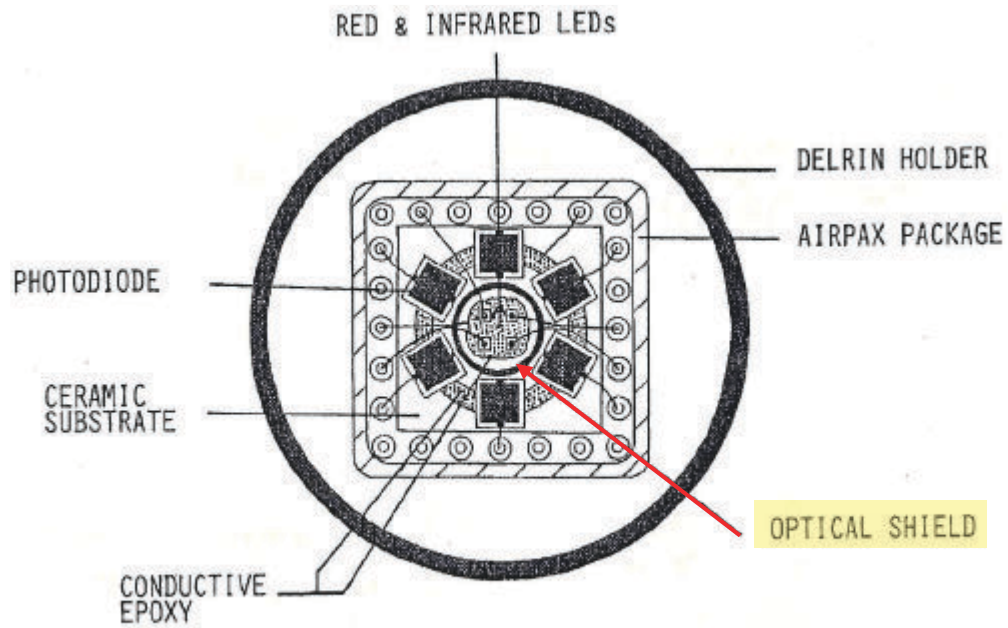
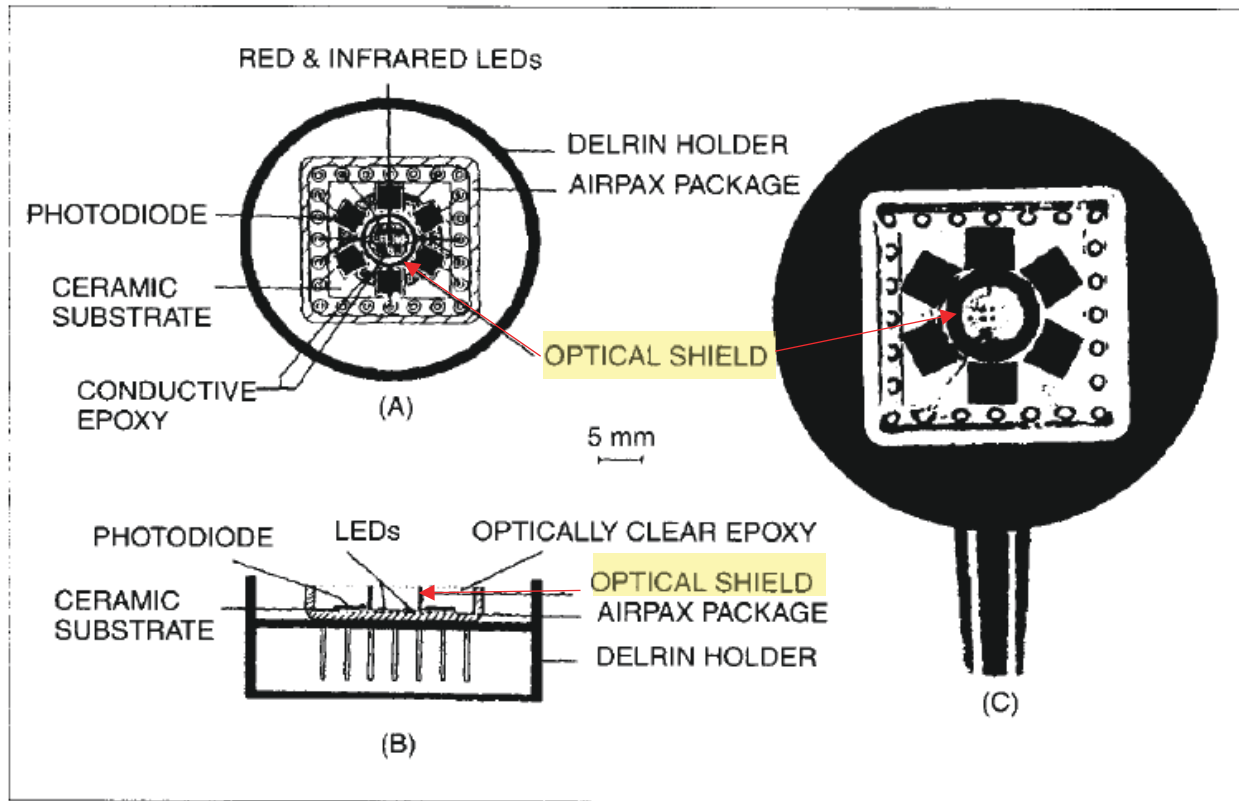


Figure 4.2: Diagram of sensor design 2.^[5]

APPLE-1042, 29

Takatani similarly shows a circular “optical shield” between ring of photodiodes and a central light source. APPLE-1085, 8.



10. Schematic diagram of the reflectance oximeter sensor [68].

APPLE-1085, 8

These references provide evidence of the background knowledge that a POSITA would have brought to bear in an evaluation of the teachings of Sarantos, and confirm the notion that a POSITA would have been aware that a differently shaped light blocks was a known option and would have found it to be simply a matter of design choice to use different shapes.

68. A POSITA would have understood that the Sarantos light block and each of the Fontaine and Takatani light block perform the same function of reducing light from the light source from reaching the detectors without first being diffused through the skin. APPLE-1005, 17:26-42; APPLE-1042, 29; APPLE-

1085, 8. Sarantos does not suggest that the shape of the light block has any functional significance in the operation of the optical sensor, or that any particular known shape was preferred or restricted. Thus, a square shape light block and a circular shape light block were known in the art to be predictable substitutes for one another, and therefore obvious variants.

69. Turning to Patent Owner's assertion that the cross section depicted in FIG. 22 showing walls 2274 positioned on either side of the light source 2226 would have led a POSITA to implement the wearable fitness monitor to "include[e] two separate walls," this assertion is simply not supported by the disclosures of Sarantos at its description of the purpose of the walls 2274. 244-POR, 18-19. Specifically, the function of walls 2274 is to separate the light source 2226 from the photodetectors to "prevent light from the light source 2208 from reaching the HAR photodetector elements" and therefore, gaps between "separate walls" would not have been sufficient for achieving this purpose. APPLE-1005, 17:26-42.

70. Regarding Patent Owner's assertion that "three photodetectors cannot correspond to a circular shape" (POR, 22), the above described examples in Sarantos are unaffected by this assertion as they involve circular arrangements of more than three photodetectors. Additionally, Sarantos includes an express example in which it describes arrangements of "*four* Har photodetector elements

1612...arranged in a *circular array* about a light source.” APPLE-1005, 14:62-64, 2:44-47, 4:19-22; 244-APPLE-1003, ¶65.

71. Further, the ’159 Patent provides no explanation of how the particular light block shape solves some problem or presents some unexpected result. Massimo’s expert in the IPR proceeding involving the related ’745 patent also could not provide an explanation during his deposition. APPLE-1059, 102:19-103:22. Rather, a POSITA would have simply recognized that the light block shape is a non-inventive feature and that it would have been quite routine to use a differently shaped light block.

3. Sarantos (with or without Utter) renders obvious measuring oxygen saturation at the wrist (claims 8 and 17)

72. As explained in Section II.A.4.a, Sarantos discloses measuring oxygen saturation at the wrist. Also as explained in Section II.A.4.e, Patent Owner misrepresents and mischaracterizes much of the record evidence, and Patent Owner’s arguments on no reasonable expectation of success are not supported by the evidence.

C. Sarantos-Shie renders obvious claims 1-5, 7-14, and 16-18; Sarantos-Shie-Brady renders obvious claim 2; Sarantos-Shie-Brady-Han renders obvious claim 3; Sarantos-Shie-Utter renders obvious claims 14 and 16-25

1. Sarantos-Shie renders obvious a “first shape” and a different “second shape” (elements [1.1]-[1.2] and [19.2]-[19.3] and claim 18)

(a) Shie discloses changing a first shape of light into a second shape

73. As I discussed above in Section II.B.1, the first shape of the light emitted by the plurality of light emitters in Sarantos’s wearable fitness monitor is defined by the shape of the light-emitting devices, the spatial arrangement of the light emitting devices within each light source, and the spatial arrangement of the light sources with respect to each other. Additionally, Shie repeatedly describes changing the shape of light. My First 244-Declaration refers to Shie’s broad description of an “optical element” that produces “a predetermined pattern of smoothly varying, non-discontinuous light exiting the optical element” where the light is “altered according to both the macro-optical characteristic of the optical element as well as the homogenizing characteristics of the micro-structures.” 244-APPLE-1003, ¶107 (citing APPLE-1007, Abstract). My First 244-Declaration also cite a specific example of “an optical element in the form of a cylindrical lens” where “the curvature and contour of the cylindrical lens surfaces” “define the macro-optical characteristics of the lens” and “micro-structures” provide “diffusing characteristics” that together yield “light diffusing and **shaping advantages.**” 244-

APPLE-1003, ¶¶107, 109; APPLE-1007, 6:44-7:7. I also analyzed additional disclosures of light shaping features disclosed by Shie, including, “micro-structures” in a substrate “created in such a manner so as to control the direction of light output from a light source so as to **shape the light output** into a desired distribution pattern or envelope” and “applied to objects in order to provide the light homogenizing, **shaping** and directing characteristics.” 244-APPLE-1003, ¶108; APPLE-1007, 5:29-45. Other light shaping lenses disclosed by Shie that I discussed in my First 244-Declaration include “a parabolic convex lens” and various different Fresnel lenses (including circular, square, and rectangular shaped Fresnel lenses). 244-APPLE-1003, ¶¶108, 110-111; APPLE-1007, 7:8-27, 6:3-28. As I discussed in my First 244-Declaration, a POSITA would have recognized that these different lenses would have changed the first shape of the light emitted by Sarantos’s light sources (as defined by the shapes and spatial arrangements of Sarantos’s multiple light-emitting devices clustered into multiple light sources) into a second, different geometric shape in the resulting Sarantos-Shie combination. 244-APPLE-1003, ¶¶107-111.

(b) A POSITA would have been motivated to combine Sarantos and Shie and would have reasonably expected success

74. As I explained in my First 244-Declarations, Sarantos-Shie incorporates Shie’s general teaching of an optical element that shapes the light

output, and a POSITA would have known to try the various different specific lenses described in Shie to determine the best lens for achieving the particular desired outcome. 244-APPLE-1003, ¶¶94-111. A POSITA would have known that various “optical elements” such as lenses “are used routinely to manipulate light in optical instrumentation” and “for directing the light from the light source.” APPLE-1023, 10. And as I explained, there are multiple reasons that would have motivated a POSITA to use a light shape changing material, such as Shie’s, in the sensor of Sarantos: (1) to increase power efficiency by precisely directing the light emitted toward the tissue to shine light closer to the photodiodes, (2) to increase accuracy of measurements and to decrease irregular readings caused by mole or other aberrations on the skin by directing light towards a larger area, and (3) to obscure the LED’s appearance from a user. 244-APPLE-1003, ¶¶96-102.

Regarding the first reason, I also explained several additional benefits that would have resulted from precisely directing the light emitted toward the tissue to shine light closer to the photodiodes, including increasing the signal level of the light detected to the photodiodes that minimizes power consumption while still providing adequate radiated power for pulse oximetry. 244-APPLE-1003, ¶100; APPLE-1009, 76, 105; APPLE-1008, [0050], [0064]. Regarding the first and second reasons, I described that use of the lenses disclosed by Shie in Sarantos’s wearable fitness monitor would have allowed a POSITA to tune the light intensity

to provide the most accurate physiological parameter detection. 244-APPLE-1003, ¶¶100-101.

75. Furthermore, Shie provides direct disclosure that would have allowed a POSITA to select an appropriate lens and lens configuration to achieve these benefits that I described in my First 244-Petition. For example, in my First 244-Declaration I discussed the “parabolic convex lens” having “micro-structures 56 [that] provide the diffusing characteristics” for the lens and can “be designed to shape the light into a narrow distribution.” APPLE-1007, 7:8-27, 5:29-45; 244-APPLE-1003, ¶108. As such, Shie discloses a lens that can be used to achieve the first benefit I described because the microstructures can be used to direct the light narrowly to shine light closer to the photodiodes, which a POSITA would have recognized as achieving the benefit of increasing power efficiency and light intensity in the Sarantos-Shie combination. *Id.* For example, a POSITA would have known that “[b]y narrowing the beam of light emitted, more light can be collected by the lens and/or window resulting in a larger amount of detected light by the light sensor,” thus improving measurement accuracy. APPLE-1008, [0065].

76. Shie also expressly describes that the microstructures 56 for the parabolic convex lens can alternatively be configured to “provide a broader light distribution pattern.” APPLE-1007, 7:8-27. Other lenses described by Shie can also achieve this light spreading functionality, such as the cylindrical lens

described by Shie that spreads light “in a direction perpendicular to its width.”

244-APPLE-1003, ¶109; APPLE-1007, 1:20-24; *see also* APPLE-1050, Figure 1.

A POSTIA would have recognized that implementing these teachings of Shie in the wearable fitness monitor of Sarantos would have facilitated the second benefit of increasing accuracy of measurements and decreasing irregular readings caused by mole, pigment (e.g., tattoos), or other aberrations on the skin by directing light towards a larger area. 244-APPLE-1003, ¶101. Indeed, in my First 244-Declaration I discussed several corroborating references that described the advantages achieved by spreading the light from a light source in a physiological sensor over a wider area to increase accuracy. *Id.*; APPLE-1009, 68-70, 51, 36, 105; APPLE-1023, 60; APPLE-1024, 10. As I previously discussed, the lenses described by Shie can also be employed to “homogenize” the light. 244-APPLE-1003, ¶108; APPLE-1007, 9:36-45. A POSITA would have recognized that such homogenization of the light would further increase the accuracy of the readings of the resulting physiological sensor.

77. Shie includes numerous other disclosures that would have allowed a POSITA to select an appropriate lens “to shape the light output *into a desired distribution pattern*” when applying Shie’s teachings to Sarantos’s wearable fitness monitor to achieve the previously described advantages. APPLE-1007, 5:29-45, 9:36-45; APPLE-1003, ¶¶100, 108. A POSITA would have been able to

perform the routine experimentation required to accurately direct the light “to result in transmitted signals that have sufficient amplitude to provide accurate readings.” APPLE-1022, 3:40-48; APPLE-1009, 105. For example, a POSITA would have recognized that lenses, such as the Fresnel lenses disclosed by Shie, would have been beneficially employed in the Sarantos-Shie device to improve optical signal efficiency to avoid light being “directed at an angle away from the light sensor” and thus “lost.” APPLE-1008, [0064]. As such a POSITA would have known how to implement a Fresnel lens in Sarantos’s wearable fitness monitor to “redirect light to directions that otherwise may be lost or enter into the tissue at shallow angles” and therefore the “redirected light can be collected instead of being lost and/or can mitigate against parasitic non-signal light, resulting in improved optical signal efficiency.” *Id.* As would have been known to a POSITA, such tuning of the light intensity using the lenses described in Shie would have “overcome the issues with lower signal intensity and higher power consumption.” *Id.*, [0050]; *see also* APPLE-1016, 1-4 (describing the known benefit of tuning light to increase light intensity in a wrist-worn pulse oximeter).

78. Finally, regarding the third motivation to combine, a POSITA would have recognized that each of these lenses described by Shie would have achieved the known benefit of obscuring the appearance of the light source from a user. APPLE-1003, ¶¶100-101; APPLE-1008, [0061]-[0063].

2. Sarantos-Shie (with or without Utter) renders obvious measuring oxygen saturation at the wrist (claims 8 and 17)

79. As explained in Section II.A.4.a, Sarantos discloses measuring oxygen saturation at the wrist. Also as explained in Section II.A.4.e, Patent Owner misrepresents and mischaracterizes much of the record evidence, and Patent Owner's arguments on no reasonable expectation of success are not supported by the evidence.

III. CONCLUSION

I currently hold the opinions set expressed in this declaration. But my analysis may continue, and I may acquire additional information and/or attain supplemental insights that may result in added observations.

I hereby declare that all statements made of my own knowledge are true and that all statements made on information and belief are believed to be true. I further declare 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 the Title 18 of the United States Code.

Dated: 2/13/25

By: 

Dr. Brian W. Anthony