Apple Inc. (Petitioner)
v.
Masimo Corporation (Patent Owner)

Petitioner Demonstratives

Case Nos. IPR2020-01713, -01716, -01733, -01737
U.S. Patent Nos. 10,624,564; 10,702,194; 10,702,195; 10,709,366
Before Hon. Josiah C. Cocks, Robert L. Kinder, Amanda F. Wieker
Administrative Patent Judges

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Issue 1

Implementing a Cover with a Protruding Convex Surface

Case Nos. IPR2020-01713, -01716, -01733, -01737
U.S. Patent Nos. 10,624,564; 10,702,194; 10,702,195; 10,709,366

Multiple Benefits of Combining the References

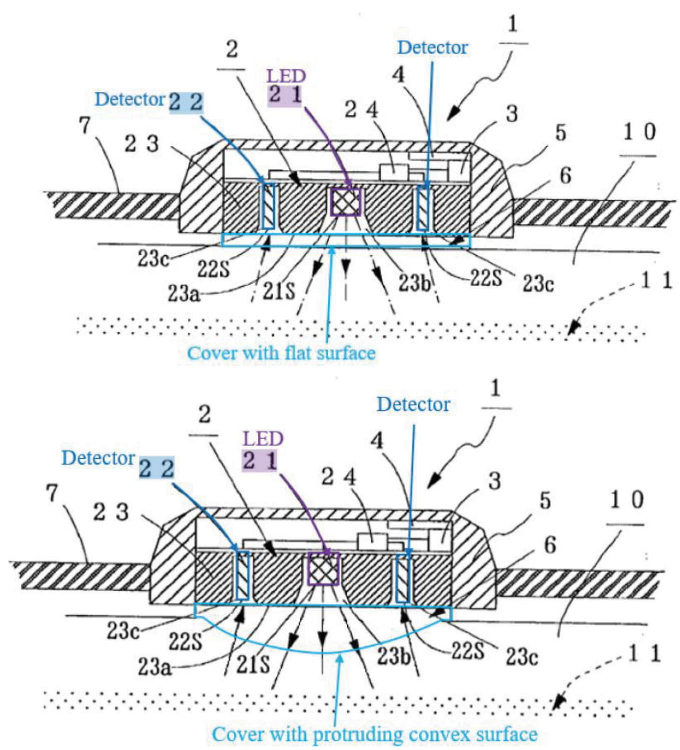
Dr. Kenny's Second Declaration

7. As I explained at length in my first declaration, a POSITA "would have found it obvious to modify the [Aizawa] sensor's flat cover…to include a lens/protrusion…similar to Ohsaki's translucent board 8, so as to [1] improve adhesion between the user's wrist and the sensor's surface, [2] improve detection efficiency, [3] and protect the elements within the sensor housing." APPLE-1003,

IPR2020-01713 APPLE-1050, ¶ 7;
see also APPLE-1003, ¶¶ 66-73.

Aizawa

FIG. 1 (b)



APPLE-1006, FIG. 1(b) (top-before modification; bottom-after modification).

IPR2020-01713 APPLE-1006, FIG. 1(b); APPLE-1003, ¶ 70.

Issue 1A

The Cover's Protruding Convex Surface would Improve Adhesion and Signal Strength

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A POSITA would have Modified Aizawa's Flat Cover

Dr. Kenny's Second Declaration

7. As I explained at length in my first declaration, a POSITA "would have found it obvious to modify the [Aizawa] sensor's flat cover…to include a lens/protrusion…similar to Ohsaki's translucent board 8, so as to [1] improve adhesion between the user's wrist and the sensor's surface, [2] improve detection efficiency, [3] and protect the elements within the sensor housing." APPLE-1003,

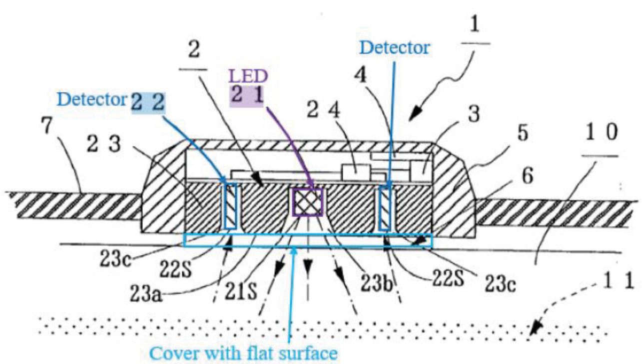
IPR2020-01713 APPLE-1050, ¶ 7;
see also APPLE-1003, ¶¶ 66-73.

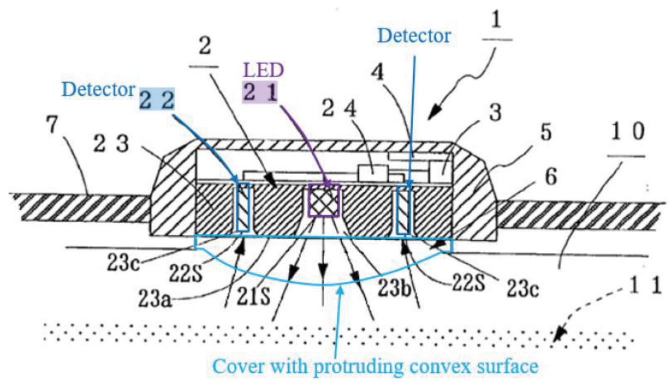
12. Notably absent from Ohsaki's discussion of these benefits is any mention or suggestion that they relate to the shape of the perimeter of translucent board 8 (whether circular, rectangular, ovoid, or other). Rather, when describing the advantages associated with translucent board 8, Ohsaki contrasts a "convex detecting surface" from a "flat detecting surface," and explains that "if the translucent board 8 has a flat surface, the detected pulse wave is adversely affected by the movement of the user's wrist," but that ***if the board "has a convex surface…variation of the amount of the reflected light…that reaches the light receiving element 7 is suppressed.***" APPLE-1003, ¶69; APPLE-1009, [0015], [0025].

IPR2020-01713 APPLE-1050, ¶ 12;
see also APPLE-1003, ¶ 69.

Aizawa

FIG. 1 (b)





IPR2020-01713 APPLE-1006, FIG. 1(b); APPLE-1003, ¶ 70.

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Ohsaki Teaches that a Protruding Convex Surface Prevents Slippage and Improves Signal Strength

Dr. Kenny's First Declaration

67. A POSITA would have recognized that with a flat plate 6, Aizawa's wrist-worn PMD would have slipped along the user's wrist, resulting in variations in the amount of reflected light that reaches the photodetectors, as explained by Ohsaki. APPLE-1009, ¶[0025]. Accordingly, it would have been obvious to a POSITA to modify Aizawa's sensor to include a cover having a protruding convex surface, improving adhesion between a surface of the sensor and the user's wrist. APPLE-1009, ¶[0025]. Doing so would have amounted to nothing more than the use of a known technique to improve similar devices in the same way and combining prior art elements according to known methods to yield predictable results.

68. In particular, as shown in Ohsaki's FIG. 2 (reproduced below), Ohsaki's PMD includes "a package 5, a light emitting element 6 (e.g., LED), a light receiving element 7 (e.g., PD), and a translucent board 8." APPLE-1009, ¶[0017]. The translucent board 8 is arranged such that, when the PMD is worn "on the user's wrist…the convex surface of the translucent board…is in intimate contact with the surface of the user's skin"; this contact between the convex surface and the user's skin prevents slippage, which increases the strength of the signals obtainable by Ohsaki's PMD. APPLE-1009, ¶¶[0015], [0017], [0025], FIGS. 1, 2, 4A, 4B.

IPR2020-01713 APPLE-1003, ¶¶ 67-68.

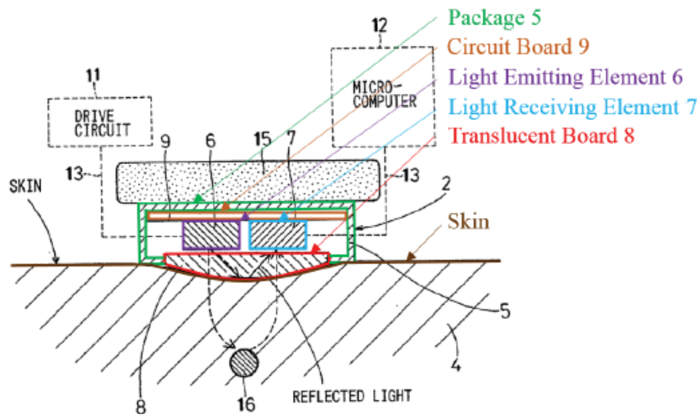
FISH.

Ohsaki Teaches that a Protruding Convex Surface Prevents Slippage

Ohsaki

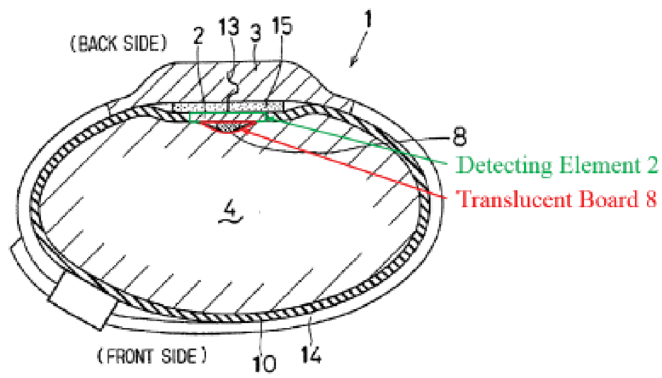
[0025] The detecting element **2** is arranged on the user's wrist **4** so that the convex surface of the translucent board **8** is in intimate contact with the surface of the user's skin. Thereby it is prevented that the detecting element **2** slips off the detecting position of the user's wrist **4**. If the translucent board **8** has a flat surface, the detected pulse wave is adversely affected by the movement of the user's wrist **4** as shown in **FIG. 4B**. However, in the case that the translucent board **8** has a convex surface like the present embodiment, the variation of the amount of the reflected light which is emitted from the light emitting element **6** and reaches the light receiving element **7** by being reflected by the surface of the user's skin is suppressed. It is also prevented that noise such as disturbance light from the outside penetrates the translucent board **8**. Therefore the pulse wave can be detected without being affected by the movement of the user's wrist **4** as shown in **FIG. 4A**.

IPR2020-01713 APPLE-1009, ¶ [0025] (cited at APPLE-1003, ¶¶ 54, 67).



IPR2020-01713 APPLE-1009, FIG. 2; APPLE-1003, ¶ 53.

FIG. 1



IPR2020-01713 APPLE-1009, FIG. 1; APPLE-1003, ¶ 52.

Ohsaki Teaches that a Protruding Convex Surface Improves Signal Strength

Ohsaki

[0025] The detecting element **2** is arranged on the user's wrist **4** so that the convex surface of the translucent board **8** is in intimate contact with the surface of the user's skin. Thereby it is prevented that the detecting element **2** slips off the detecting position of the user's wrist **4**. If the translucent board **8** has a flat surface, the detected pulse wave is adversely affected by the movement of the user's wrist **4** as shown in **FIG. 4B**. However, in the case that the translucent board **8** has a convex surface like the present embodiment, the variation of the amount of the reflected light which is emitted from the light emitting element **6** and reaches the light receiving element **7** by being reflected by the surface of the user's skin is suppressed. It is also prevented that noise such as disturbance light from the outside penetrates the translucent board **8**. Therefore the pulse wave can be detected without being affected by the movement of the user's wrist **4** as shown in **FIG. 4A**.

IPR2020-01713 APPLE-1009, ¶ [0025]
(cited at APPLE-1003, ¶¶ 68-70).

FIG. 4A

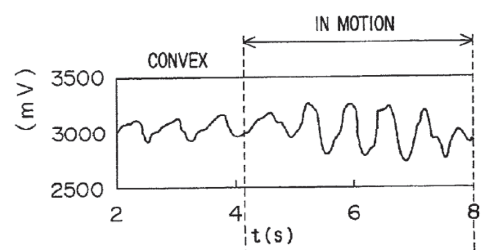
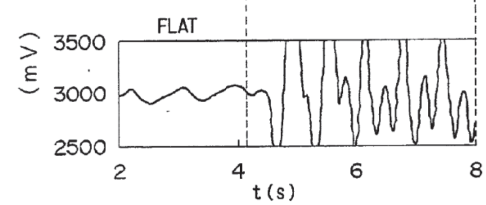
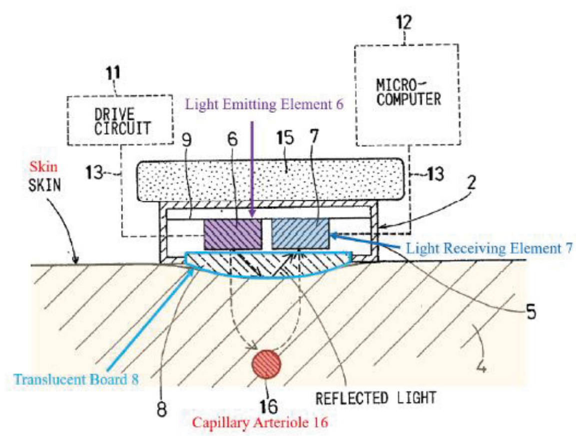


FIG. 4B





IPR2020-01713 APPLE-1009, FIGS. 2, 4A, 4B.

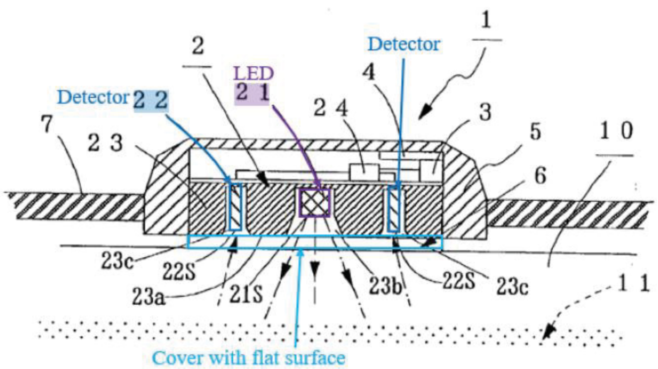
Aizawa's Modified Cover would have Improved Adhesion and Signal Strength

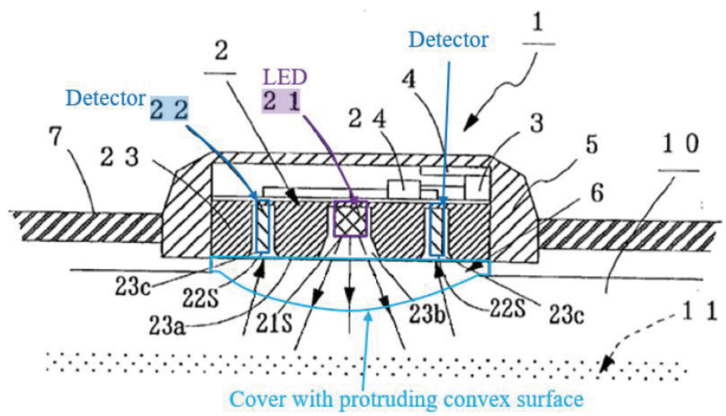
Dr. Kenny's First Declaration

70. As shown below, the POSITA would have found it obvious to modify the sensor's flat cover to include a lens/protrusion, similar to Ohsaki's translucent board 8, so as to improve adhesion between the user's wrist and the sensor's surface, improve detection efficiency, and protect the elements within the PMD housing. APPLE-1009, ¶[0025]; APPLE-1015, ¶¶[0012], [0024], [0033], [0035], FIG. 6 (depicting an LED featuring a convex lens).

IPR2020-01713 APPLE-1003, ¶ 70.

FIG. 1 (b)





IPR2020-01713 APPLE-1006, FIG. 1(b); APPLE-1003, ¶ 70.

Masimo Fails to Rebut Dr. Kenny's Testimony

Dr. Kenny's Second Declaration

¶¶66-73. Rather than attempting to rebut my testimony on these points, Masimo and its witness, Dr. Madisetti, responded with arguments that are technically and factually flawed.

8. Specifically, Masimo contends that "Ohsaki and Aizawa employ different sensor structures (rectangular versus circular) for different measurement locations (back side versus palm side of the wrist), using different sensor surface shapes (convex versus flat) that are tailored to those specific measurement locations" and from this concludes that "[a] POSITA would [not] have been motivated to combine the references and reasonably expected such a combination to be successful." IPR2020-01713, Pap. 14 ("**POR**"), 1-3.

IPR2020-01713 APPLE-1050, ¶¶ 7-8.

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Sensor Structures and Shapes

Dr. Kenny's Second Declaration

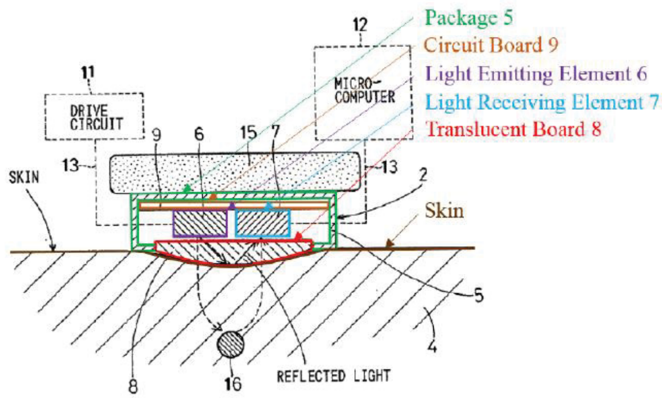
10. Contrary to Masimo's contentions, Ohsaki does not limit its benefits to a rectangular sensor applied to a particular body location, and a POSITA would not have understood those benefits as being so limited. For example, Ohsaki teaches that "the detecting element and the sensor body 3 may be worn on the back side of the user's forearm" or wrist. Nowhere does Ohsaki teach that its sensor can only be worn on a particular body location. APPLE-1009, [0030], [0008]-[0010], Abstract.

IPR2020-01713 APPLE-1050, ¶ 10.

11. In addition to the above, as shown in Ohsaki's FIG. 2 (reproduced below), Ohsaki attributes the reduction of slippage afforded by use of translucent board 8 (and additional related improvements in signal quality) to the fact that "***the convex surface of the translucent board…is in intimate contact with the surface of the user's skin***"[1] when the sensor is worn. APPLE-1003, ¶¶54, 68; APPLE-1009, [0015], [0017], [0025], FIGS. 1, 2, 4A, 4B.

IPR2020-01713 APPLE-1050, ¶ 11.

Ohsaki



IPR2020-01713 APPLE-1009, FIG. 2 (as annotated at APPLE-1050, ¶ 11).

FISH.

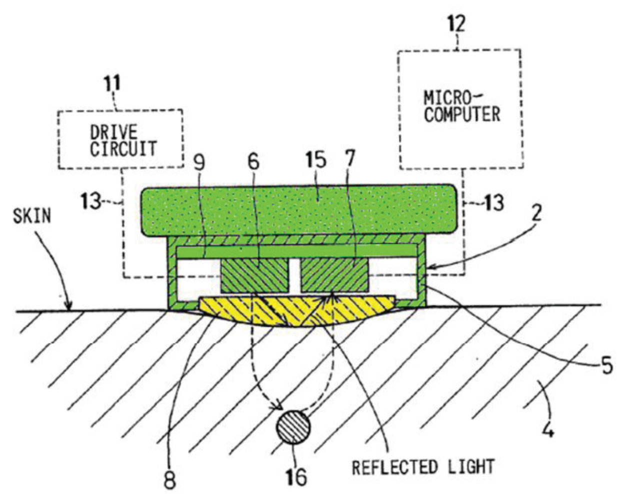
Sensor Structures and Shapes

Dr. Kenny's Second Declaration

18. In my first declaration, I explained that a POSITA would have modified Aizawa in view of Ohsaki such that Aizawa's cover "would include a convex surface, improving adhesion between a subject's wrist and a surface of the sensor." APPLE-1003, ¶67 (citing APPLE 1009, [0025] Ohsaki explains that the "convex surface of the translucent board 8" is responsible for this improved adhesion). Masimo argues that it is not the "convex surface" that improves adhesion in Ohsaki, but instead the "longitudinal shape" of "Ohsaki's translucent board [8]." *See* POR, 10, 17-25 (citing APPLE-1009, [0019]). However, the portion of Ohsaki cited does not include any reference to board 8. *See* APPLE-1009, [0019]. Ohsaki does ascribe a "longitudinal" shape to a different component: "detecting element 2." *See id*. Ohsaki never describes the "translucent board 8" as "longitudinal," and nowhere describes "translucent board 8" and "detecting element 2" as having the same shape. *See generally* APPLE-1009. In fact, as illustrated in Ohsaki's FIG. 2 (reproduced below), translucent board 8 (annotated yellow) is not coextensive with the entire tissue-facing side of detecting element 2 (annotated green).

IPR2020-01713 APPLE-1050, ¶ 18.

Ohsaki



IPR2020-01713 APPLE-1009, FIG. 2 (as annotated at APPLE-1050, ¶ 18).

FISH.

Sensor Structures and Shapes

Dr. Kenny's Second Declaration

12. Notably absent from Ohsaki's discussion of these benefits is any mention or suggestion that they relate to the shape of the perimeter of translucent board 8 (whether circular, rectangular, ovoid, or other). Rather, when describing the advantages associated with translucent board 8, Ohsaki contrasts a "convex detecting surface" from a "flat detecting surface," and explains that "if the translucent board 8 has a flat surface, the detected pulse wave is adversely affected by the movement of the user's wrist," but that ***if the board "has a convex surface…variation of the amount of the reflected light…that reaches the light receiving element 7 is suppressed***." APPLE-1003, ¶69; APPLE-1009, [0015], [0025].

13. From this and related description, a POSITA would have understood that a protruding convex cover would reduce the adverse effects of user movement on signals obtainable by photodetectors which are positioned to detect light reflected from user tissue. APPLE-1003, ¶¶107, 131, 48; APPLE-1009, [0015], [0017], [0025], FIGS. 1, 2, 4A, 4B; *see also* APPLE-1006, [0012], [0013], [0023], [0024], [0026], [0030], [0034], FIGS. 1(a), 1(b). A POSITA would expect that these benefits would apply to the pulse wave sensor of Aizawa, as well as to other wearable physiological monitors.

IPR2020-01713 APPLE-1050, ¶¶ 12-13.

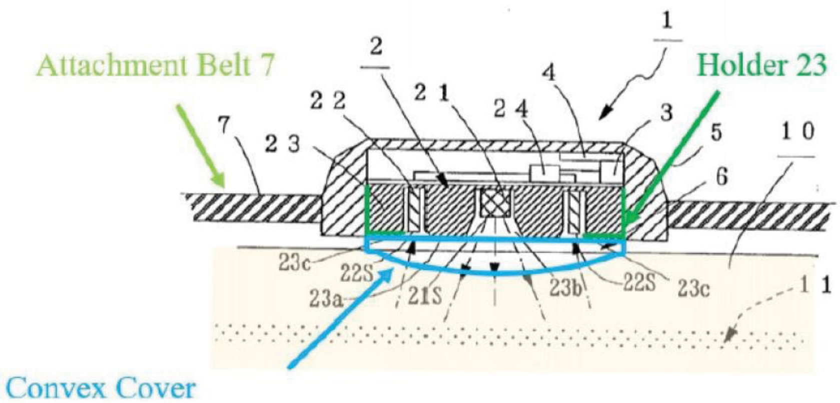
FISH.

Sensor Structures and Shapes

Dr. Kenny's Second Declaration

14. In addition, as I explain with respect to the prior art figures reproduced below, the POSITA would have found it obvious to improve Aizawa's sensor based on Ohsaki's teachings, and would have been fully capable of making any inferences and creative steps necessary to achieve the benefits obtainable by modifying Aizawa's cover to feature a convex detecting surface.[2] *See also* APPLE-1008, ¶¶14-15, FIG. 1; APPLE-1015, [0012], [0024], [0033], [0035], FIG. 6. The following annotated FIG. 1(b) from Aizawa shows the results of the proposed combination:

IPR2020-01713 APPLE-1050, ¶ 14.



IPR2020-01713 APPLE-1006, FIG. 1(b) (annotated).

FISH.

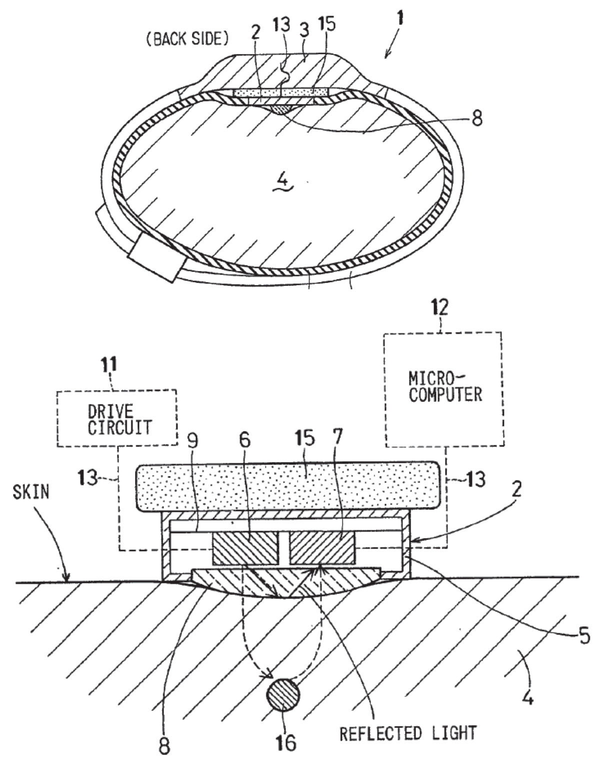
Sensor Structures and Shapes

Dr. Kenny's Second Declaration

21. Attempting to confirm its false conclusion, Masimo asserts that "***Ohsaki illustrates two cross-sectional views*** of its board that confirm it is rectangular." POR, 14 (citing Ex. 2004, [39]-[42]). Masimo identifies these "two cross-sectional views" as FIGS. 1 and 2, and infers the supposed "rectangular shape" of the translucent board 8 based on FIG. 1 showing the "short" side of the device, and FIG. 2 showing the "long" side of the same device. *See* POR, 14-16. But, according to Ohsaki, FIG. 2 is "a schematic diagram," not a cross-sectional view, and Ohsaki never specifies that FIGS. 1 and 2 are different views of the same device. APPLE-1009, [0013]. Accordingly, nothing in Ohsaki supports Masimo's inference that the "translucent board 8" ***must be*** "rectangular" in shape. *See, e.g.,* APPLE-1009, [0013], [0019], [0025], FIG. 2; *Hockerson-Halberstadt, Inc. v. Avia Group Int'l*, 222 F.3d 951, 956 (Fed. Cir. 2000). Further, even if it is possible for the translucent board 8 to be "rectangular," Ohsaki certainly does not teach nor include any disclosure "***requiring***" this particular shape. *Id.*

IPR2020-01713 APPLE-1050, ¶ 21.

Ohsaki



IPR2020-01713 APPLE-1009, FIGS. 1, 2.

Masimo Improperly Relies on Bodily Incorporation

Petitioner's Reply

19. Based on the unsupported contention that translucent board 8 has a "very pronounced longitudinal directionality," Masimo concludes that the translucent board 8 has a "rectangular" shape that is allegedly incompatible with Aizawa. *See* POR, 16-17. But Ohsaki never describes translucent board 8, or any other component, as "rectangular"; in fact, the words "rectangular" and "rectangle" do not appear in Ohsaki's disclosure. *See generally* APPLE-1009.

IPR2020-01713 Pap. 18 (Petitioner's Reply), ¶19.

23. In addition, as discussed above, even if Ohsaki's translucent board 8 were somehow understood to be rectangular, a POSITA would have been fully capable of modifying Aizawa to feature a light permeable protruding convex cover to obtain the benefits attributed to such a cover by Ohsaki. For example, a POSITA would have found it obvious to include a circular light-permeable convex cover based on the teachings of Ohsaki, and take reasonable steps to make sure that the combination of a circular protruding convex cover would function with the other features present in Aizawa so as to provide the benefits discussed above.

IPR2020-01713 Pap. 18 (Petitioner's Reply), ¶23.

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Measurement Locations

Patent Owner's Response

to Ohsaki's." Pet. 22-23. As discussed below, however, Ohsaki indicates that its sensor's convex board ***only*** improves adhesion when used on the ***back*** (i.e., watch) side of the wrist. In contrast, Aizawa ***requires*** its sensor be positioned on the palm side of the wrist, where it measures light reflected from an artery not accessible on the wrist's back side. Ex. 1006 ¶¶[0002], [0007], [0009], [0026], [0027], [0036], Fig. 2. A POSITA seeking to improve adhesion of Aizawa's sensor would not incorporate a feature that only improves adhesion at a different and unsuitable measurement location. Ex. 2004 ¶60.

IPR2020-01713 Pap. 14 (POR), 26.

Dr. Kenny's Second Declaration

10. Contrary to Masimo's contentions, Ohsaki does not limit its benefits to a rectangular sensor applied to a particular body location, and a POSITA would not have understood those benefits as being so limited. For example, Ohsaki teaches that "the detecting element and the sensor body 3 may be worn on the back side of the user's forearm" or wrist. Nowhere does Ohsaki teach that its sensor can only be worn on a particular body location. APPLE-1009, [0030], [0008]-[0010], Abstract. In its summary of invention and claim preambles, Ohsaki explains that the object of its invention is "to provide a human pulse wave sensor which is capable of detecting the pulse wave ***of a human body*** stably and has high detection probability." APPLE-1009, [0007], claims 1-8. Thus, Ohsaki's disclosure should not be narrowly understood as applying to a single location or a single embodiment. Aizawa similarly reveals an embodiment in which its sensor is located on the palm side of the wrist (*see* APPLE-1006, FIG. 2, 0002, 0009), but does not limit its sensor to being applied to just the palm side of the wrist. A POSITA, based on Aizawa and Ohsaki's disclosure, would have understood that the sensors in Aizawa and Ohsaki, when combined in the manner explained in my earlier declaration, would have been applicable to various locations on a human body and would have improved the performance of the sensor by providing the benefits described in these disclosures.

IPR2020-01713 APPLE-1050, ¶ 10.

Measurement Locations

Dr. Kenny's Second Declaration

25. Indeed, Ohsaki's specification and claim language reinforce that Ohsaki's description would not have been understood as limited to one side of the wrist. For example, Ohsaki explains that "the detecting element 2…may be worn on the back side of the user's forearm" as one form of modification. *See* APPLE-1009, [0030], [0028] (providing a section titled "[m]odifications"). The gap between the ulna and radius bones at the forearm is even greater than the gap between bones at the wrist, which is already wide enough to easily accommodate a range of sensor sizes and shapes, including circular shapes. In addition, Ohsaki's claim 1 states that "the detecting element is constructed to be worn on a back side of a user's wrist ***or a user's forearm***." *See also* APPLE-1009, claims 1-2. As another example, Ohsaki's independent claim 5 and dependent claim 6 state that "the detecting element is constructed to be worn on a user's wrist or a user's forearm," ***without even mentioning a backside*** of the wrist or forearm. *See also* APPLE-1009, Claims 6-8. A POSITA would have understood this language to directly contradict Masimo's assertion that "[t]o obtain any benefit from Ohsaki's board, the sensor must be positioned on the backhand side of the wrist." POR, 16. A POSITA would have understood that Ohsaki's benefits provide improvements when the sensor is placed on either side of the user's wrist or forearm. APPLE-1009, [0025], FIGS. 4A, 4B.

IPR2020-01713 APPLE-1050, ¶ 25.

Ohsaki

5. A pulse wave sensor for detecting a pulse wave of a human body comprising:

a detecting element including a light emitting element and a light receiving element; and

a sensor body including a circuit connected to the detecting element via a signal line,

wherein the detecting element is constructed to be worn on a user's wrist or a user's forearm,

wherein the light emitting element and the light receiving element are arranged side by side in a longitudinal direction of the user's arm.

6. A pulse wave sensor as set forth in claim 5, wherein:

the detecting element includes a translucent member which is transparent to light and arranged on the light emitting element and the light receiving element;

the translucent member has a convex surface; and

the translucent member is arranged on the user's wrist or the user's forearm so that the convex surface of the translucent member is in intimate contact with a surface of the user's skin.

IPR2020-01713 APPLE-1009, claims 5, 6.

FISH.

Ohsaki Does Not Limit its Sensor to the Backside of the Wrist

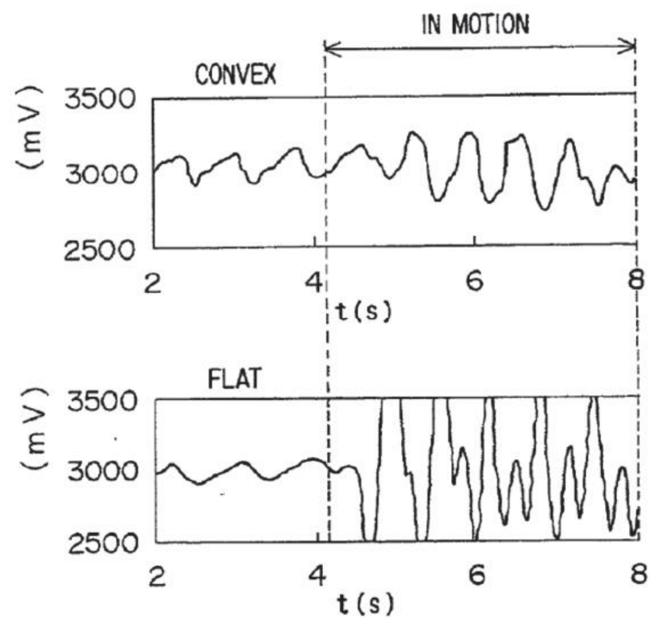
Dr. Kenny's Second Declaration

27. Moreover, even assuming, for the sake of argument, that a POSITA would have understood Aizawa's sensor as being limited to placement on the backside of the wrist, and would have understood Ohsaki's sensor's "tendency to slip" when arranged on the front side as informing consideration of Ohsaki's teachings with respect to Aizawa, that ***would have further motivated*** the POSITA to implement a light permeable convex cover in Aizawa's sensor, to improve detection efficiency of that sensor when placed on the palm side. APPLE-1009, [0015], [0017], [0023], [0025], FIGS. 1, 2, 3A, 3B, 4A, 4B.

28. When describing advantages associated with its translucent board, Ohsaki explains with reference to FIGS. 4A and 4B (reproduced below) that "if the translucent board 8 has a flat surface, the detected pulse wave is adversely affected by the movement of the user's wrist," but that if the board "has a convex surface…variation of the amount of the reflected light…that reaches the light receiving element 7 is suppressed." APPLE-1003, ¶¶69-70; APPLE-1009, [0015], [0017], [0025].

IPR2020-01713 APPLE-1047, ¶¶ 27-28.

Ohsaki



IPR2020-01715 APPLE-1009, FIGS. 4A, 4B.

[0015] **FIGS. 4A and 4B** are graphs of the pulse wave detected by a pulse wave sensor including a convex detecting surface and the pulse wave detected by a pulse wave sensor including a flat detecting surface, respectively.

IPR2020-01713 APPLE-1009, ¶ [0015].

FISH.

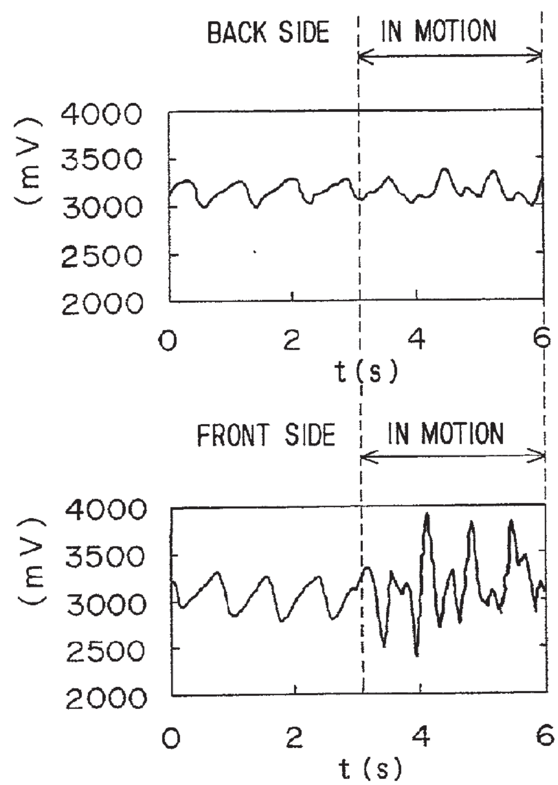
Ohsaki Does Not Limit its Sensor to the Backside of the Wrist

Dr. Kenny's Second Declaration

29. Contrary to Masimo's contentions, a POSITA would not have understood these benefits of a convex surface over a flat surface to be limited to one side or the other of the user's wrist, or to any particular location. APPLE-1009, [0023]-[0025]. Rather, a POSITA would have understood that, by promoting "intimate contact with the surface of the user's skin," a light permeable convex cover would have increased adhesion and reduced slippage of Aizawa's sensor when placed on either side of a user's wrist or forearm, and additionally would have provided associated improvements in signal quality. APPLE-1009, [0015], [0017], [0025]; FIGS. 1, 2, 4A, 4B, claims 3-8; *see also* APPLE-1021, 87, 91. Indeed, a POSITA would have

IPR2020-01713 APPLE-1050, ¶ 29.

Ohsaki



IPR2020-01713 APPLE-1009, FIGS. 3A, 3B.

Reasonable Expectation of Success

Patent Owner's Sur-Reply

Lacking any credible basis to change the shape of Ohsaki's board, Petitioner asserts that Ohsaki's board has ***no*** particular shape. Reply 12-15. Petitioner thus embraces the vague testimony of its declarant, Dr. Kenny, who testified he did not ***know*** the shape of Ohsaki's board and that the board could be "circular or square or rectangular." Ex. 2008 68:21-70:1, 71:7-72:10; Ex. 2027 162:15-20. But Petitioner cannot allege that Ohsaki's board has ***no*** geometry while also arguing Aizawa's cover would be modified "to include a protruding convex surface similar to Ohsaki's" translucent board. Pet. 22-23.

IPR2020-01713 Pap. 21 (Sur-Reply), 4 (citing Ex. 2027, 162:15-20).

Dr. Kenny 2021-09-18 Depo. Transcript

Q. Okay. So Ohsaki doesn't tell you anything about the shape of the board, correct?

A. That's correct. It merely says that if the board has a convex surface, it provides these benefits of, of improved adhesion and, and prevention of light from scattering inside.

Ex. 2027, 162:15-20.

And that in view of the references that are part of this combination, that one of ordinary skill in the art would consider combining the sensor of Aizawa with a convex protrusion, such as in Ohsaki, and could carry out that combination in a way that would be able to deliver the benefits being sought.

Ex. 2027, 158:4-10.

FISH.

Issue 1B

The Cover's Protruding Convex Surface would Enhance Light-Gathering Ability

FISH.

A POSITA would have Modified Aizawa's Flat Cover

Dr. Kenny's Second Declaration

7. As I explained at length in my first declaration, a POSITA "would have found it obvious to modify the [Aizawa] sensor's flat cover…to include a lens/protrusion…similar to Ohsaki's translucent board 8, so as to [1] improve adhesion between the user's wrist and the sensor's surface, [2] improve detection efficiency, [3] and protect the elements within the sensor housing." APPLE-1003, ¶¶66-73. Rather than attempting to rebut my testimony on these points, Masimo and its witness, Dr. Madisetti, responded with arguments that are technically and factually flawed.

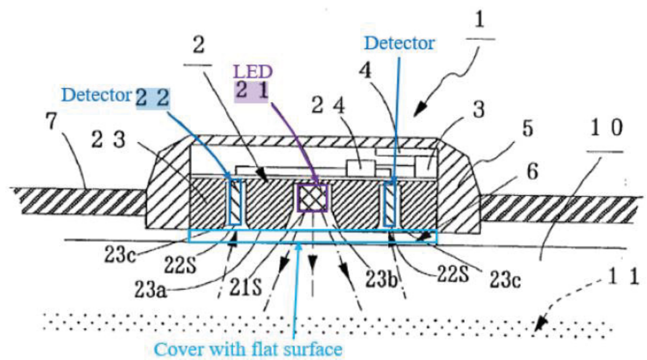
IPR2020-01713 APPLE-1050, ¶ 7.

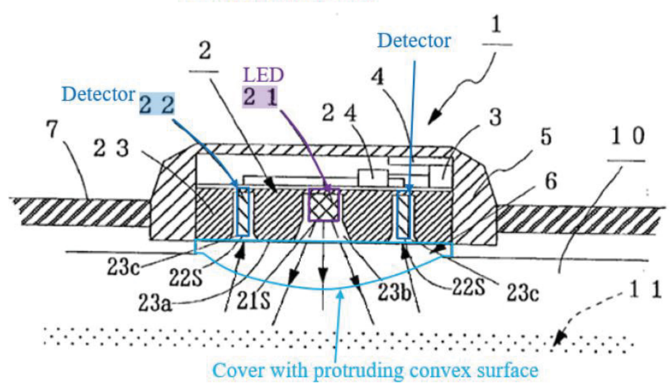
31. Masimo argues that the combined sensor "would direct light away from the detectors and thus decrease light collection and optical signal strength." *See, e.g.*, POR, 38-39. As explained below, a POSITA would have understood the opposite to be true—that a cover featuring a convex protrusion would improve Aizawa's signal-to-noise ratio by causing more light backscattered from tissue to strike Aizawa's photodetectors than would have with a flat cover. APPLE- 1021, 52, 86, 90; APPLE-1051, 84, 87-92, 135-141; APPLE-1059, 803-805; APPLE-1006, FIGS. 1(a)-1(b). The convex cover enhances the light-gathering ability of Aizawa's sensor.

IPR2020-01713 APPLE-1050, ¶ 31.

Aizawa

F I G. 1 (b)





APPLE-1006, FIG. 1(b); APPLE-1003, ¶ 70.

FISH.

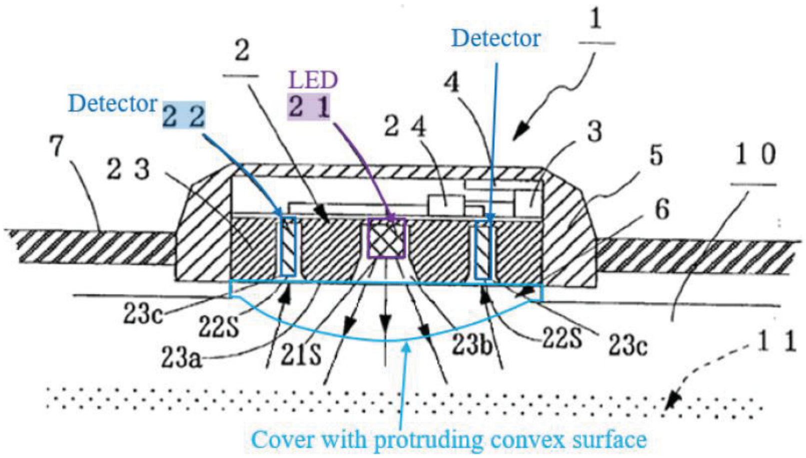
A POSITA Would Have Modified Aizawa's Flat Cover

Dr. Kenny's Second Declaration

34. In contrast, and as explained in more detail below, I have consistently testified that a POSITA would have understood that a convex cover improves "light concentration at pretty much ***all of the locations under the curvature of the lens***," and for at least that reason would have been motivated to modify Aizawa's sensor to include a convex cover as taught by Ohsaki. POR, 39-43; Ex. 2006, 164:8-16.

IPR2020-01737 APPLE-1050, ¶ 34.

Aizawa (modified in view of Ohsaki)



APPLE-1006, FIG. 1(b); APPLE-1003, ¶ 70.

Dr. Kenny's Deposition Transcript

Q. How about the, the, the lens in your combination, the figure at the bottom right below Paragraph 97?

A. Yeah, I would say there's some, given the arrangement of the corpuscles as the reflecting objects in the space all around underneath that lens, that there would be some improvement in the light concentration at pretty much all of the locations under the curvature of the lens.

IPR2020-01737 Ex. 2006, 164:8-16.

FISH.

A POSITA Would Have Modified Aizawa's Flat Cover

Dr. Kenny's First Declaration

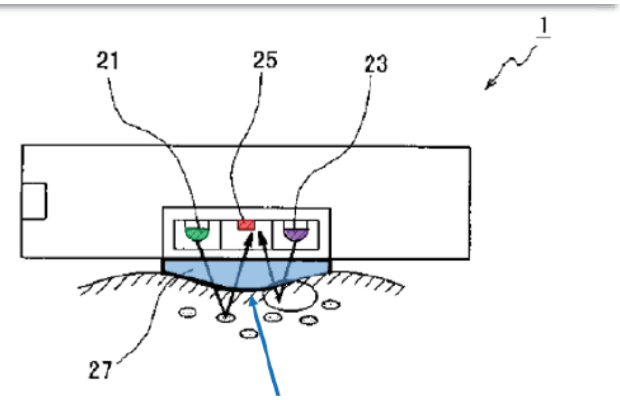
82. Inokawa further teaches that the "lens makes it possible to increase the light-gathering ability of the LED." APPLE-1008, [0015]. Thus, a POSITA would have understood that adding a protruded convex surface to Aizawa would have the additional benefit of increasing light collection efficiency, which would in turn lead to an improved signal-to-noise ratio and more reliable pulse detection. The lens of Inokawa provides precisely such an additional benefit to Aizawa's device by refracting/concentrating incoming light signals reflected by the blood. *Id.*

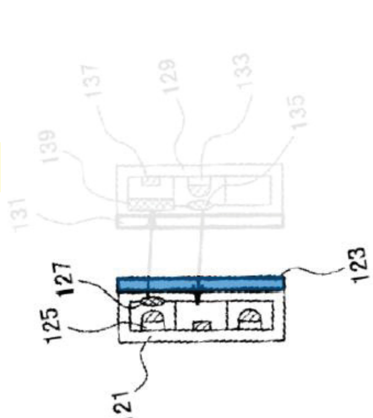
IPR2020-01737 APPLE-1003, ¶¶ 82.

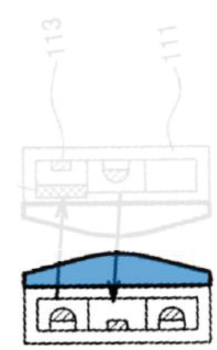
83. A POSITA would have further understood, in view of Inokawa, *how* to implement the convex surface of Ohsaki into Aizawa. For example, as shown below, Inokawa teaches that its cover may be either flat (left) such that "the surface is less prone to scratches," Inokawa at [0106], or in the form of a lens (right) to "increase the light-gathering ability of the LED." APPLE-1008, [0015].

Inokawa

(8) In the invention in Claim 8, a lens is placed on the surface of the sensor-side light-emitting means. This lens makes it possible to increase the light-gathering ability of the LED as well as to protect the LED or PD.







IPR2020-01737 APPLE-1008, FIGS. 2, 17, 16.

A Convex Lens/Protrusion Improves Light-Gathering Ability at All Locations

Dr. Kenny's Second Declaration

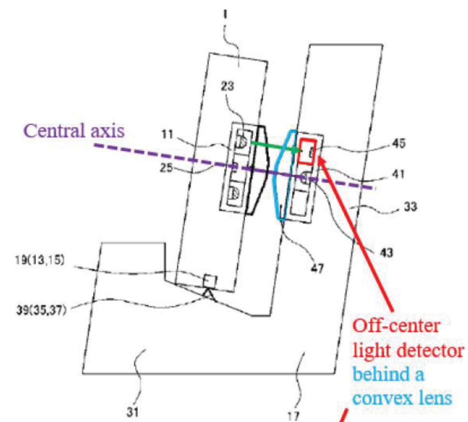
56. Masimo's technically and factually flawed argument is exposed by multiple prior art references, including the Ohsaki and Inokawa references which are the key elements of our combinations. As shown in the figures below, Ohsaki and Inokawa both show embodiments which use a convex lens to direct light to detectors that are not located at the center of a sensor. APPLE-1009, FIG. 2; APPLE-1008, FIG. 3. In Inokawa's Figure 2, an off-center emitter and sensor are configured to send and receive text messages, and are capable of success, even though the detector is not positioned at the center.

IPR2020-01713 APPLE-1050, ¶ 56.

57. If, as asserted by the Patent Owner, a convex lens is required to condense, direct, or focus the light to the center, the embodiments disclosed by Ohsaki and Inokawa would all fail because there is no detector at the center to detect all of the light that would be directed towards the center by the convex board. The Ohsaki and Inokawa embodiments (reproduced above) do not show or otherwise teach that its convex board directs all light towards the center.

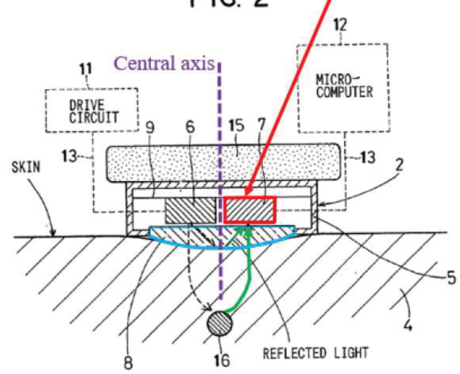
IPR2020-01713 APPLE-1050, ¶ 57.

Inokawa (top) and Aizawa (bottom)



APPLE-1008, FIG. 3

FIG. 2



IPR2020-01713 APPLE-1008 (top); APPLE-1006, FIG. 2 (bottom).

FISH.

A Convex Lens/Protrusion Improves Light-Gathering Ability at All Locations

Dr. Kenny's Second Declaration

49. Indeed, far from focusing light to the center as Masimo contends, Ohsaki's convex cover provides a slight refracting effect, such that light rays that may have otherwise missed the detection area are instead directed toward that area as they pass through the interface provided by the cover. This is particularly true in configurations like Aizawa's in which light detectors are arranged symmetrically about a central light source, so as to enable backscattered light to be detected within a circular active detection area surrounding that source. APPLE-1021, 86, 90. The slight refracting effect is a consequence of the similar indices of refraction between human tissue and a typical cover material (e.g., acrylic). APPLE-1057, 1486; APPLE-1058, 1484).

IPR2020-01713 APPLE-1050, ¶ 49.

APPLE-1021 (Webster)

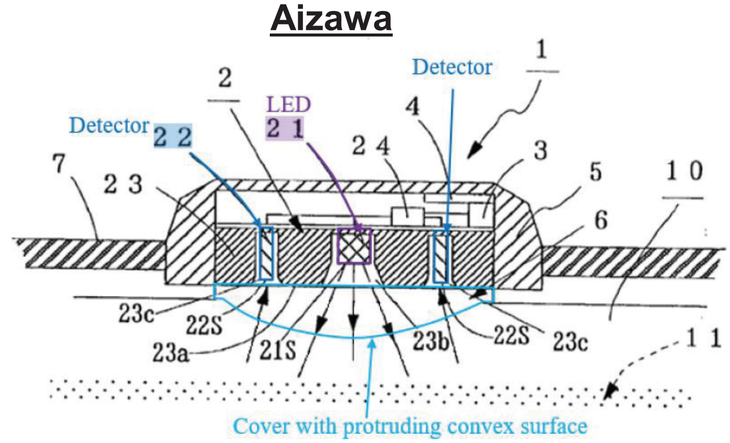
7.2.3 Effect of multiple photodiode arrangement

In a reflectance oximeter, the incident light emitted from the LEDs diffuses through the skin and the back scattered light forms a circular pattern around the LEDs. Thus if we use multiple photodiodes placed symmetrically with respect to the emitter instead of a single photodiode, a large fraction of back scattered light can be detected and therefore larger plethysmograms can be obtained.

To demonstrate this, Mendelson and Ochs (1988) used three photodiodes mounted symmetrically with respect to the red and infrared LEDs; this enabled them to triple the total active area of the photodiode and thus collect a greater fraction of the back scattered light from the skin. The same result can be obtained using a photodiode with three times the area.

IPR2020-01713 APPLE-1021, 90.

Aizawa



IPR2020-01713 APPLE-1006, FIG. 1(b) (annotated with protruding cover)(APPLE-1003, ¶ 70).

FISH.

Masimo Ignores the Behavior of Scattered Light

Patent Owner's Sur-Reply

Even if the theory had merit, however, it would be unavailing because it fails to consider the greater ***decrease*** in light at the detectors due to light redirection to a ***more*** central location. *See* Ex. 2027 19:16-21:8. As Dr. Kenny confirmed, the circle of backscattered light's intensity "***decreases*** with the ***square of the distance***" between the central emitter and peripheral detectors. Ex. 2027 49:17-50:13, 57:10-22; *see also* Ex. 1014 at 2 ("The intensity of the backscattered light decreases in direct proportion to the square of the distance between the photodetector and the LEDs".). Thus, any purported signal obtained from light redirected from the sensor's ***edge*** would be relatively weak and fail to make up for the much greater loss of signal strength when light is redirected away from the detectors and towards a more central position. *See id.*

IPR2020-01713 Pap. 21 (Sur-Reply), 21.

Dr. Kenny's Deposition Transcript

Q. So there, there is some light that would have been captured by the detectors that is redirected and no longer hits the detectors; is that correct?

MR. SMITH: Objection; form.

A. So of all of the photons scattered backwards from all of these sites --

Q. Correct.

A. -- and interacting with this curved optical surface that we're calling the lens, some of those rays are diff- -- sorry -- refracted in a way that directs them toward the detectors which otherwise might have missed, and there would be some other rays that would have hit the detectors that are refracted away from the detectors; that's correct.

Ex. 2027, 19:16-20:8.

FISH.

Masimo Ignores the Behavior of Scattered Light

Patent Owner's Sur-Reply

Even if the theory had merit, however, it would be unavailing because it fails to consider the greater ***decrease*** in light at the detectors due to light redirection to a ***more*** central location. *See* Ex. 2027 19:16-21:8. As Dr. Kenny confirmed, the circle of backscattered light's intensity "***decreases*** with the ***square of the distance***" between the central emitter and peripheral detectors. Ex. 2027 49:17-50:13, 57:10-22; *see also* Ex. 1014 at 2 ("The intensity of the backscattered light decreases in direct proportion to the square of the distance between the photodetector and the LEDs".). Thus, any purported signal obtained from light redirected from the sensor's ***edge*** would be relatively weak and fail to make up for the much greater loss of signal strength when light is redirected away from the detectors and towards a more central position. *See id.*

IPR2020-01713 Pap. 21 (Sur-Reply), 21.

Dr. Kenny's Deposition Transcript

Q. The indication in this figure, "Toward the center," does that indicate the redirection that leads to the detector capturing light that otherwise would have been missed --

MR. SMITH: Objection; form.

Q. -- for a particular ray?

MR. SMITH: Same objection.

A. So just again, reading from Paragraph 42, the "lens' ability to direct light 'toward the center' would allow the detector to capture light that would otherwise have been missed by the detectors, regardless of their location within the sensor device."

Ex. 2027, 19:3-15.

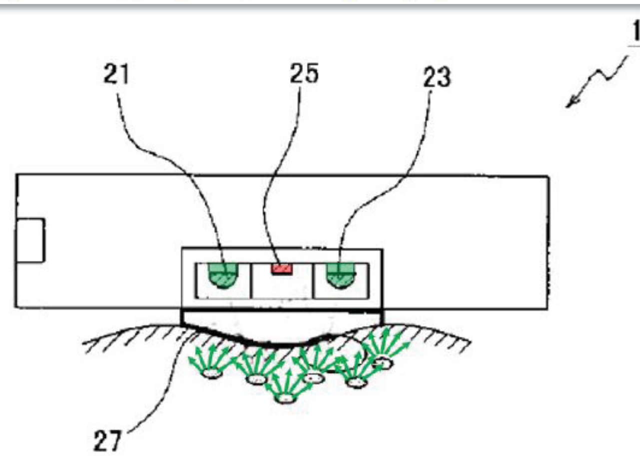
FISH.

Masimo Ignores the Behavior of Scattered Light

Dr. Kenny's Second Declaration

54. The light rays from a diffuse light source, such as the LED-illuminated tissue near a pulse wave sensor or a pulse oximeter, include a very wide range of angles and directions, and cannot be focused to a single point/area with optical elements such as lenses and more general convex surfaces. The example figure below illustrates light rays backscattered by tissue toward a convex lens; as consequence of this backscattering, a POSITA would have understood that the backscattered light will encounter the interface provided by the convex board/lens at all locations from a wide range of angles. This pattern of incoming light cannot be focused by a convex lens towards any single location.

55. To the extent Masimo contends that only *some* light is directed "towards the center" and away from Aizawa's detectors in a way that discourages combination, such arguments also fail. Indeed, far from *focusing* light to a single central point, a POSITA would have understood that Ohsaki's cover provides a slight refracting effect, such that light rays that may have missed the active detection area are instead directed toward that area as they pass through the interface provided by the lens. APPLE-1021, 52; APPLE-1007, [0015]; APPLE-1051, 87-92, 135-141; APPLE-1054, 60:7-61:6, 70:8-18.



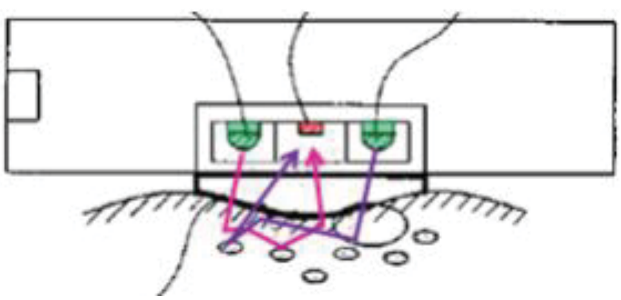
FISH.

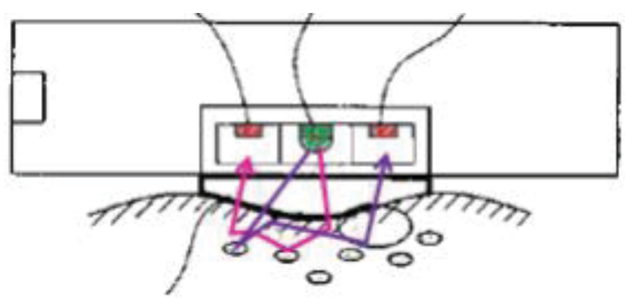
IPR2020-01713 APPLE-1050, ¶¶ 54-55.

The Principle of Reversibility Confirms the Cover's Optical Benefits

Dr. Kenny's Second Declaration

40. In more detail, and as shown with respect to the example paths illustrated below (which include scattering within tissue), each of the countless photons travelling through the system must abide by Fermat's principle. APPLE-1052, 106-111. Consequently, even when accounting for various random redirections and partial absorptions, each photon traveling between a detector and an LED would take the quickest (and identical) path along the segments between each scattering event, even if the positions of the detector and LED were swapped.





FISH.

IPR2020-01713 APPLE-1050, ¶ 40.

The Principle of Reversibility Confirms the Cover's Optical Benefits

Dr. Kenny's Second Declaration

44. When confronted with this basic principle of reversibility during deposition, Dr. Madisetti refused to acknowledge it, even going so far as to express ignorance of "Fermat's principle, ***whatever that is***." APPLE-1054, 89:12-19. Yet Fermat's principle, which states that a path taken by a light ray between two points is one that can be traveled in the least time, regardless of the direction of travel, is one of the most fundamental concepts in optics/physics and plainly requires the basic principle of reversibility. APPLE-1051, 87-92; APPLE-1052, 106-111. Dr. Madisetti further tried to brush away the applicability of this principle as being a "new theory." Id., 84:2- 85:7. But far from being a new theory, this core concept dates back many years, and is offered in Aizawa itself. Indeed, ***Aizawa recognizes this reversibility***, stating that while the configurations depicted include a central emitter surrounded by detectors, the "same effect can be obtained when…a plurality of light emitting diodes 21 are disposed around the photodetector 22." APPLE-1006, [0033]; APPLE-1055, 209:19-21.

IPR2020-01713 APPLE-1050, ¶ 44.

45. In short, based at least on the principle of reversibility, a POSITA would have understood that both configurations of LEDs and detectors—*i.e.*, with the LED at the center as in Aizawa or with the detector at the center as in Inokawa—would identically benefit from the enhanced light-gathering ability of a convex lens/protrusion.

IPR2020-01713 APPLE-1050, ¶ 45.

Aizawa

[0033] In the above embodiment, a plurality of photodetectors **22** are provided for one light emitting diode **21**. The same effect can be obtained when the number of photodetectors **22** is **1** and a plurality of light emitting diodes **21** are disposed around the photodetector **22**. In this case, the size and power consumption of the pulse wave sensor **2** become larger than this embodiment.

APPLE-1006, ¶ [0033].

The Principle of Reversibility Confirms the Cover's Optical Benefits

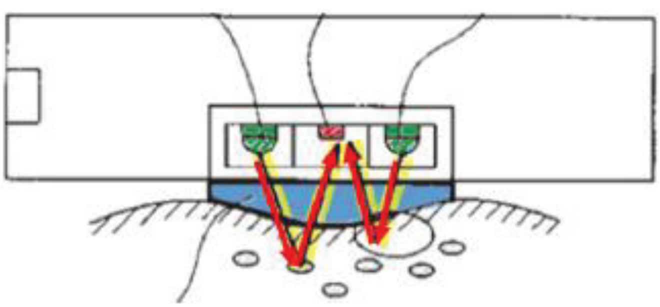
Dr. Kenny's Second Declaration

To help explain, I have annotated Inokawa's FIG. 2 (presented below) to illustrate the principle of reversibility applied in the context of a reflective optical physiological monitor. As shown, Inokawa's FIG. 2, illustrates two example ray paths from surrounding LEDs (green) to a central detector (red):

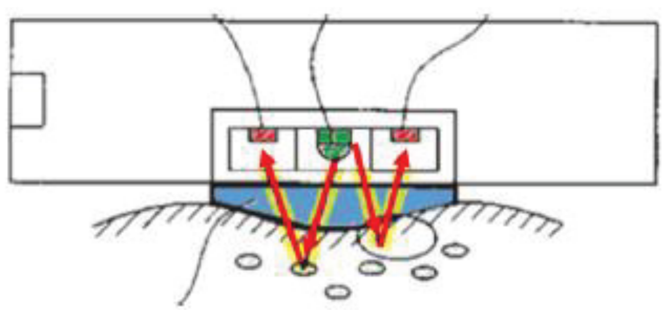
IPR2020-01713 APPLE-1050, ¶ 35.

36. As a consequence of the principle of reversibility, a POSITA would have understood that if the LED/detector configuration were swapped, as in Aizawa, the two example rays would travel identical paths in reverse, from a central LED (red) to surrounding detectors (green). A POSITA would have understood that, for these rays, any condensing/directing/focusing benefit achieved by Inokawa's cover (blue) under the original configuration would be identically achieved under the reversed configuration:

IPR2020-01713 APPLE-1050, ¶ 36.



IPR2020-01713 APPLE-1008, FIG. 2 (as annotated at APPLE-1050, ¶ 35).



IPR2020-01713 APPLE-1008, FIG. 2 (as annotated at APPLE-1050, ¶ 36).

FISH.

Masimo Ignores the Principle of Reversibility

Patent Owner's Sur-Reply

"random" light that was "reflected, transmitted, absorbed, and scattered by the skin and other tissues and the blood before it reaches the detector"); Ex. 2027 188:6-17, 29:11-30:7, 31:8-32:3, 38:17-42:6. Petitioner never explains how the principle of reversibility could apply to such "random" scattered and absorbed light.

Indeed, Dr. Kenny testified that "light backscattered from the tissue can go in a large number of possible directions, not any single precise direction." Ex. 2027 17:12-18; *see also id.* 17:19-19:2 (reiterating random path and absorbance), 38:17-40:13, 40:14-42:6 ("Every photon tracing that particular path…would have a potentially different interaction with the tissue and it would be scattered, potentially, in a different direction than the photon arriving before and after it."). In contrast, the principle of reversibility provides that "a ray going from P to S [in one direction] will trace the ***same route*** as one going from S to P [the opposite direction]" assuming there is ***no*** absorption or scattering. Ex. 1051 at 51 (illustrating diffuse reflection), 53 (defining principle of reversibility), 207 (principle of reversibility requires no absorption). Dr. Kenny also testified that the principle of reversibly applies to a light ray between two points and admitted it does ***not*** apply to randomly scattered light in bulk. Ex. 2027 207:9-208:22. In that circumstance, Dr. Kenny merely testified that light "can go" or "could go" along the same path. *Id.* 207:17-209:21, 210:8-211:6. That hardly supports Petitioner's argument that light will necessarily travel the same paths regardless of whether the LEDs and detectors are reversed.

IPR2020-01713 Pap. 21 (Sur-Reply), 17-18
(citing Ex. 2027, 207:9-208:22).

Dr. Kenny's Deposition Transcript

9/18/2021 Apple, Inc. v. Masimo Corp. Thomas Kenny Jr., Ph.D.

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with the random scattering, even two different photons entering along the same axis are likely to be scattered in, in different exact ways.

But the point of the principle is that any particular pathway of any particular photon is -- can be traversed in the opposite direction and that overall, there's no reason that one would expect that swapping the locations of the emitters and the detectors in a system like this would lead to all the light suddenly being directed in the wrong place for success.

The light paths are capable of being reversed exactly and that in general, one would expect that light that is likely to go in one direction could go in the exact opposite direction.

Q. Fermat's principle, as you stated it, applies to a light ray between two points, correct?

A. Yes.

Q. It doesn't apply to randomly scattered light in bulk, correct?

MR. SMITH: Objection.

A. In its simplest form, no --

Ex. 2027, 208:1-22.

FISH.

Masimo Ignores the Principle of Reversibility

Dr. Kenny's Deposition Transcript

9/18/2021 Apple, Inc. v. Masimo Corp. Thomas Kenny Jr., Ph.D.

Page 208

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Ex. 2027, 208:1-22 (cited at Pap. 21, 18).

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MR. SMITH: Objection; form.

A. -- but one could look at any particular randomly scattered path which would be little pieces of light paths separated by changes in direction with scattering events and the reversibility principle applies to all of the pieces and, therefore, it applies to the aggregate. Light that can go in one direction through this system could go in the exact opposite direction along the exact same path.

And I think maybe the more important point here is that when we're considering what happens to this light as it encounters this convex surface and is refracted by that surface, it is absolutely the case that the light encountering that, that refractive experience is absolutely able to go in either direction along that path. That's fundamental to the principles that underlie the concepts of refraction. So if we're concerned with the impact of the lens on the system, it's absolutely reversible.

Q. Looking at the incoming light, does

Ex. 2027, 209:1-21.

FISH.

Masimo Ignores the Principle of Reversibility

Patent Owner's Sur-Reply

does ***not*** apply to randomly scattered light in bulk. Ex. 2027 207:9-208:22. In that circumstance, Dr. Kenny merely testified that light "can go" or "could go" along the same path. *Id.* 207:17-209:21, 210:8-211:6. That hardly supports Petitioner's argument that light will necessarily travel the same paths regardless of whether the LEDs and detectors are reversed.

IPR2020-01713 Pap. 21 (Sur-Reply), 18 (citing Ex. 2027 207:17-209:21).

Dr. Kenny's Deposition Transcript

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Ex. 2027, 209:11-21.

FISH.

Masimo Ignores the Principle of Reversibility

Patent Owner's Sur-Reply

The principle of reversibility does not indicate that one could reverse ***sensor components*** and still obtain the same ***benefit*** from a convex—as opposed to a flat—surface. As Dr. Kenny testified, the benefit of a convex surface would ***not*** be "obvious" if one moves the "LEDs and detectors around…." Ex. 2006 86:19-87:6.[6]

IPR2020-01713 Pap. 21 (Sur-Reply), 19 (citing Ex. 2006, 86:19-87:6).

Dr. Kenny's Deposition Transcript

I think one of ordinary skill in the art would understand that in Inokawa the objective is to concentrate light at the detector, which is in the center axis of the drawing and that the lens is capable of providing that benefit.

If we're going to move the lenses and the LEDs and detectors around and ask different questions, it's -- it isn't so obvious that Inokawa is specifically considering those scenarios. It's a little more hypothetical.

Ex. 2006, 86:19-87:6.

Masimo's Position is Incoherent

Dr. Kenny's Second Declaration

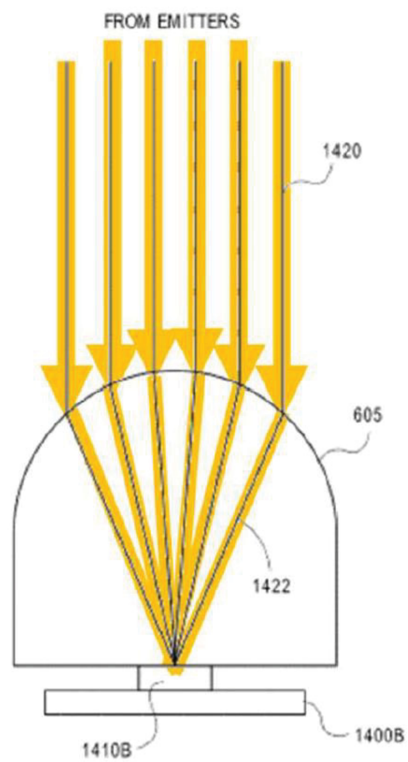
50. To support the misguided notion that a convex cover focuses all incoming light at the center, Masimo relies heavily on the '553 patent's FIG. 14B (reproduced below):

IPR2020-01713 APPLE-1050, ¶ 50.

51. Masimo and Dr. Madisetti treat this figure as an illustration of the behavior of all convex surfaces with respect to all types of light, and conclude that "a convex surface condenses light away from the periphery and towards the sensor's center." POR, 40; APPLE-1052, 56:9-60:2; APPLE-1054 ("…a POSA viewing [FIG. 14B]…would understand that light, ***all light***, light from the measurement site is being focused towards the center").

52. But the incoming collimated light shown in FIG. 14B is not an accurate representation of light that has been reflected from a tissue measurement site. The light rays (1420) shown in FIG. 14B are collimated (i.e., travelling paths parallel to one another), and each light ray's path is perpendicular to the detecting surface.

IPR2020-01713 APPLE-1050, ¶¶ 51-52.



IPR2020-01713 APPLE-1001, FIG. 14B (as annotated at Pap. 14, 40).

FISH.

Masimo's Position is Incoherent

Dr. Kenny's Second Declaration

32. Masimo and its witness, Dr. Madisetti, assert that "a POSITA would have believed that a convex surface would…direct[] light away from the periphery and towards the center of the sensor." In so doing, POR and Dr. Madisetti fail to articulate a coherent position—e.g., whether Masimo's position is that "all" light or only "some" light is directed "to" or "towards the center." POR, 38-44, Ex. 2004, ¶¶79-88.

33. For example, Dr. Madisetti testified during deposition that "as I describe in my Declaration…if you have a convex surface…*all light* reflected or otherwise would be condensed or directed towards the center." APPLE-1054, 40:4-11; *see also id.*, 127:22-128:18; Ex. 2004, 52 ("A POSITA Would Have Understood That a Convex Cover Directs Light ***To The Center*** Of The Sensor"), ¶¶80-83. However, during the same deposition, Dr. Madisetti further stated that that a convex cover would redirect light "towards the center," which could be "a general area at which the convex surface would be redirecting…light" or "a point," while contrasting the phrase "to the center" from "towards the center." APPLE-1054, 105:12-107:1, 133:19-135:11.

IPR2020-01737 APPLE-1050, ¶ 32.

Dr. Madisetti's Deposition Transcript

A. A POSA would understand the center in Figure 14B to be the general area at which the convex surface of the figure would be redirecting, condensing, or focusing light from the measurement site in the view of a POSA.

Q. So you said "general area." How large is that general area?

A. As I said, all I can say is that that's the POSA would understand it, understand this figure to say that the lens, the convex surface, is providing a focusing or condensing or redirecting of the light towards the center. That's all I said.

Q. So if it's a general area, then it's not focusing it to a point?

A. It is as I said. It's redirecting towards the center, and I have -- I do not have a specific opinion, an example. A nonlimiting example of a center could be a point. A nonlimiting example of a center could be a small area. Again, this is dependent on the context, dependent on the type of

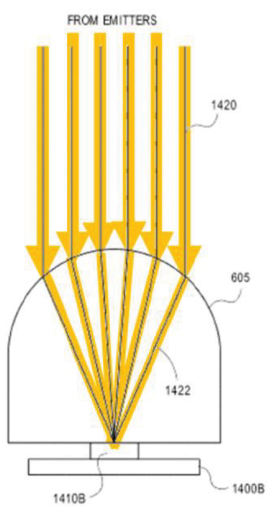
IPR2020-01737 APPLE-1054,133:21-134:18.

Masimo's Position is Incoherent

Dr. Madisetti's Declaration

82. The '564 Patent also confirms these admissions that a convex surface condenses light away from the periphery and towards the sensor's center. Figure 14B (below) "illustrates how light from emitters (not shown) can be focused by the protrusion 605 onto detectors." Ex. 1001 36:12-15. "When the light rays 1420 enter the protrusion 605, the protrusion 605 acts as a lens to refract the rays into rays 1422." Ex. 1001 36:23-25. As shown by Figure 14B of the '564 Patent,

IPR2020-01737 Ex. 2004, ¶ 82.



IPR2020-01737 Ex. 1001, FIG. 14B.

Dr. Madisetti's Deposition Transcript

A. A POSA would understand the center in Figure 14B to be the general area at which the convex surface of the figure would be redirecting, condensing, or focusing light from the measurement site in the view of a POSA.

Q. So you said "general area." How large is that general area?

A. As I said, all I can say is that that's the POSA would understand it, understand this figure to say that the lens, the convex surface, is providing a focusing or condensing or redirecting of the light towards the center. That's all I said.

Q. So if it's a general area, then it's not focusing it to a point?

A. It is as I said. It's redirecting towards the center, and I have -- I do not have a specific opinion, an example. A nonlimiting example of a center could be a point. A nonlimiting example of a center could be a small area. Again, this is dependent on the context, dependent on the type of

IPR2020-01737 APPLE-1054,133:21-134:18.

Masimo's Position is Incoherent

Dr. Kenny's Second Declaration

53. By contrast, the detector(s) of reflectance type pulse detectors detect light that has been "partially reflected, transmitted, absorbed, and scattered by the skin and other tissues and the blood before it reaches the detector." APPLE-1021, 86. For example, a POSITA would have understood from Aizawa's FIG. 1(a) that light that backscatters from the measurement site after diffusing through tissue reaches the circular active detection area provided by Aizawa's detectors from various random directions and angles, as opposed to all light entering from the same direction and at the same angle as shown above in FIG. 14B. APPLE-1021, 52, 86, 90; APPLE-1059, 803-805; *see also* APPLE-1012, FIG. 7. Even for the collimated light shown in FIG. 14B, the focusing of light at the center only occurs if the light beam also happens to be perfectly aligned with the axis of symmetry of the lens. *See* Ex. 2007, 298:11-299:1. If for example, collimated light were to enter the FIG. 14B lens at any other angle, the light would focus at a different location in the focal plane. Further, if the light were not collimated, so that rays enter the lens with a very wide range of incident angles, there would be no focus at all, and many rays will be deflected away from the center. Moreover, since "the center" takes up a very small portion of the total area under the lens, the majority of rays associated with diffuse light entering the lens would arrive at locations away from the center.

IPR2020-01713 APPLE-1050, ¶ 53.

Aizawa

FIG. 1 (a)

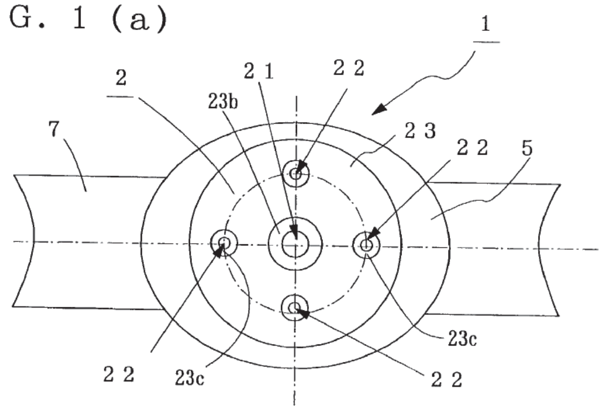
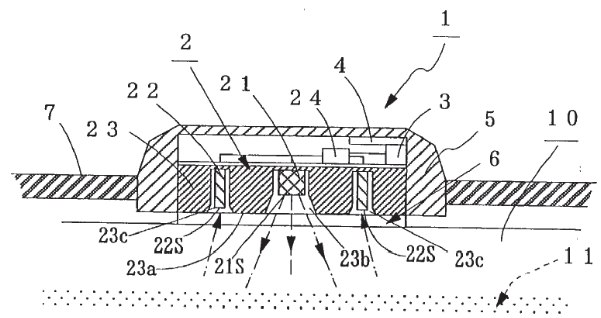


FIG. 1 (b)



APPLE-1006, FIGS. 1(a), 1(b).

Issue 1C

The Cover's Protruding Convex Surface would Protect Sensor Elements

FISH.

A POSITA would have Recognized that a Convex Cover would Protect Sensor Elements

Dr. Kenny's Second Declaration

7. As I explained at length in my first declaration, a POSITA "would have found it obvious to modify the [Aizawa] sensor's flat cover…to include a lens/protrusion…similar to Ohsaki's translucent board 8, so as to [1] improve adhesion between the user's wrist and the sensor's surface, [2] improve detection efficiency, [3] and protect the elements within the sensor housing." APPLE-1003,

IPR2020-01713 APPLE-1050, ¶ 7.

60. Masimo contends that "a POSITA would have understood that Aizawa's flat plate would provide better protection than a convex surface" and be "less prone to scratches." POR, 45-46. Even assuming this to be true, one possible disadvantage that competes with the known advantages of applying Ohsaki's teachings to Aizawa's sensor would not have negated a POSITA's motivation to combine. Moreover, a POSITA would have understood the ***multiple*** advantages of a convex cover described in my earlier declaration outweigh any alleged possibility of scratching (which, at any rate, has nothing whatsoever to do with the protection of optical elements within Aizawa's sensor). Moreover, by choosing a suitable material of the protrusion to be scratch-resistant, such as glass, it would have been obvious for a POSITA to achieve both benefits (light gathering and scratch-resistance) at once.

IPR2020-01713 APPLE-1050, ¶ 60.

FISH.

A Convex Cover would Protect Sensor Elements

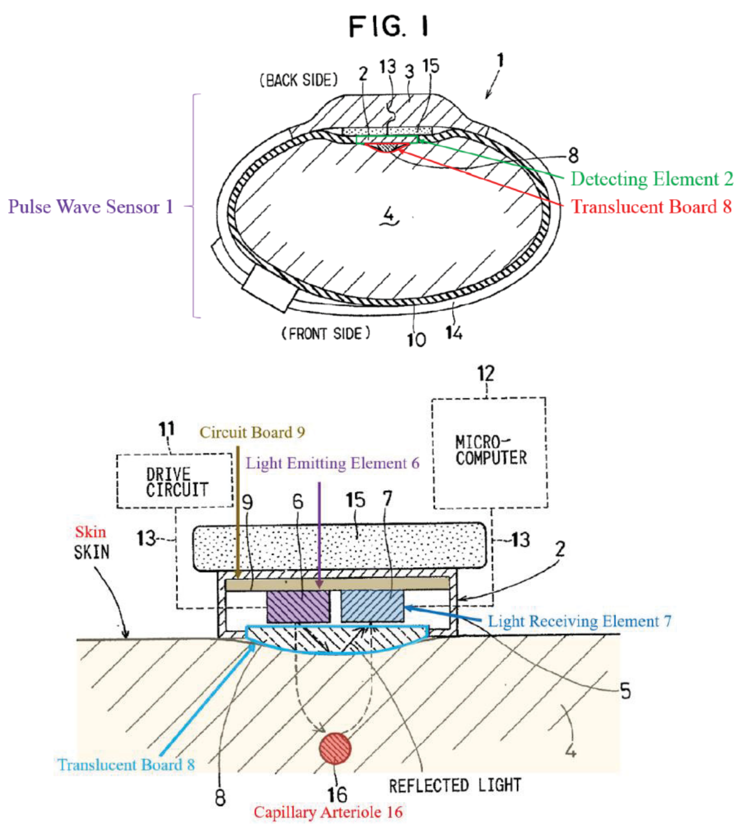
Dr. Kenny's First Declaration

103. As explained in Section VII.A.i, AOG's PMD would have included a cover having a protruding convex surface. The protruding convex surface, as shown in Aizawa's modified FIG. 1(b), would have been used to realize improved adhesion between the user's wrist and the sensor's surface, improve detection efficiency, and protect the elements within the sensor housing. APPLE-1009, ¶¶[0015], [0017], [0025], FIGS. 1, 2, 4A, 4B; *see also* APPLE-1006, ¶¶[0012], [0013], [0023], [0024], [0030], FIGS. 1(a), 1(b); APPLE-1015, ¶¶[0033], [0035], FIG. 6; *see supra* Section VII.A.i.

104. Ohsaki explains that its convex surface would have been "in intimate contact with the surface of the user's skin" to prevent slippage. APPLE-1009, ¶¶[0009]-[0010]. For example, Ohsaki's FIG. 2 shows a cover in the form of a translucent board 8 with a convex surface that has intimate contact with the user's skin and causes the user's skin to deform. *Id.* A POSITA would have understood that the skin deformation was due to the rigidity of the convex surface.

IPR2020-01713 APPLE-1003, ¶¶ 103-104.

Ohsaki



IPR2020-01713 APPLE-1009, FIGS. 1, 2.

FISH.

A Convex Cover would Protect Sensor Elements

Dr. Kenny's First Declaration

70. As shown below, the POSITA would have found it obvious to modify the sensor's flat cover to include a lens/protrusion, similar to Ohsaki's translucent board 8, so as to improve adhesion between the user's wrist and the sensor's surface, improve detection efficiency, and protect the elements within the PMD housing. APPLE-1009, ¶[0025]; APPLE-1015, ¶¶[0012], [0024], [0033], [0035], FIG. 6 (depicting an LED featuring a convex lens).

IPR2020-01713 APPLE-1003, ¶ 70.

Inokawa

(0015)
(8) In the invention in Claim 8, a lens is placed on the surface of the sensor-side light-emitting means. This lens makes it possible to increase the light-gathering ability of the LED as well as to protect the LED or PD.

IPR2020-01713 APPLE-1008, [0015].

FISH.

Masimo Fails to Rebut that a Convex Cover would Protect Sensor Elements

Patent Owner's Sur-Reply

motivation to combine." Reply 33. But, as discussed, Petitioner identifies ***no*** plausible advantages for its asserted combination. Moreover, as Dr. Kenny acknowledged, a convex cover would have been one of ***many*** different alternatives to protect the components of a sensor. Ex. 2009 394:18-396:17. Petitioner never

IPR2020-01713 Pap. 21, 24-25.

Ex. 2009

Q. Are there other ways a person of ordinary skill in the art could design a sensor to protect the components within?

A. I think by selection of other elements of the package, the housing.

Q. Do you mean that the other elements of the package of the housing could be designed to protect the components on the inside?

A. Yes. For example, you know, if we look at my illustration on below Paragraph 88, I think the combination of the cover and other elements of the housing would be -- could be selected so as to provide that protection.

Q. And what other, what elements of the housing other than the cover are providing protection?

A. Well, in this illustration we have the wall, and the planar substrate together providing protection.

IPR2020-01713 Ex. 2009, 395:3-21.

FISH.

A POSITA would have Understood the Multiple Advantages of a Convex Cover to Outweigh Possible Scratching

Patent Owner's Response

Indeed, a POSITA would have understood that Aizawa's ***flat*** plate would provide ***better protection*** than a convex surface. For example, as taught by Inokawa, a flat surface would be less prone to scratches. Ex. 1008 ¶[0106]; Ex. 2004 ¶90. Moreover, Aizawa teaches that its ***flat*** surface actually improves adhesion and detection efficiency for measurements at the palm side of the wrist, next to the artery. *See* Ex. 1006 ¶[0013] ("[A] transparent plate-like member…makes it possible to improve adhesion between the sensor and the wrist and thereby further improve the detection efficiency of pulse waves."); *compare* Ex. 1009 ¶[0023] (Ohsaki's convex board tends to slip on palm side of wrist). There would have been no reason for a POSITA to modify Aizawa's flat adhesive acrylic plate, which already protects the elements within the sensor housing without introducing the complications and concerns arising from a convex shape. Ex. 2004 ¶90.

IPR2020-01713 Pap. 14 (POR), 44-45

Dr. Kenny's Second Declaration

60. Masimo contends that "a POSITA would have understood that Aizawa's flat plate would provide better protection than a convex surface" and be "less prone to scratches." POR, 45-46. Even assuming this to be true, one possible disadvantage that competes with the known advantages of applying Ohsaki's teachings to Aizawa's sensor would not have negated a POSITA's motivation to combine. Moreover, a POSITA would have understood the ***multiple*** advantages of a convex cover described in my earlier declaration outweigh any alleged possibility of scratching (which, at any rate, has nothing whatsoever to do with the protection of optical elements within Aizawa's sensor). Moreover, by choosing a suitable material of the protrusion to be scratch-resistant, such as glass, it would have been obvious for a POSITA to achieve both benefits (light gathering and scratch-resistance) at once.

IPR2020-01713 APPLE-1050, ¶ 60.

Relevant Case Law

"The fact that the motivating benefit comes at the expense of another benefit, however, should not nullify its use as a basis to modify the disclosure of one reference with the teachings of another."

Winner Int'l Royalty Corp. v. Wang, 202 F.3d 1340, 1349, n. 8 (Fed. Cir. 2000).

"[M]ere disclosure of alternative designs does not teach away."

In re Fulton, 391 F.3d 1195, 1201 (Fed. Cir. 2004).

FISH.

Issue 2

Adding a Second Ring of Sensors to Aizawa

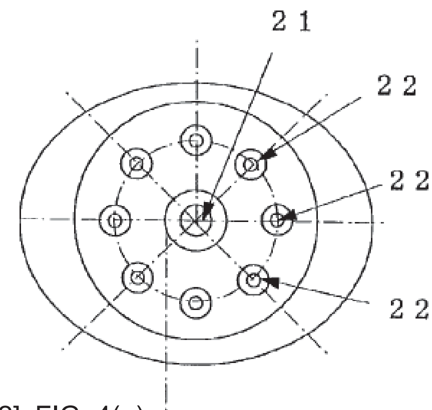
Case Nos. IPR2020-01716, -01733, -01737
U.S. Patent Nos. 10,702,194; 10,702,195; 10,709,366

FISH.

A POSITA Would Have Modified Aizawa to Add a Second Ring of Detectors

Aizawa

[0032] In the above embodiment, four photodetectors which are disposed symmetrically are used to detect the pulse wave of the wrist **10**. The arrangement of the light emitting diode **21** and the photodetectors **22** is not limited to this. For example, to further improve detection efficiency, as shown in **FIG. 4**(*a*), the number of the photodetectors **22** may be increased. Alternatively, to reduce the size of the

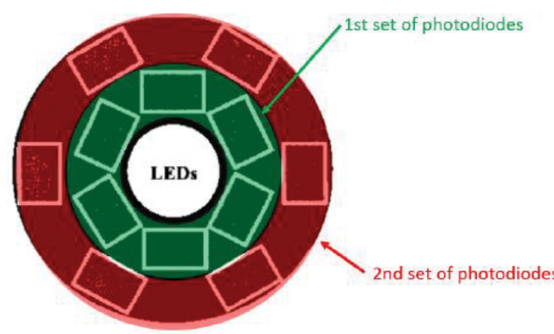


IPR2020-01737 APPLE-1006, [0032], FIG. 4(a).

Mendelson-2003

of R and IR LEDs. As shown schematically in Fig. 1, six PDs were positioned in a close inner-ring configuration at a radial distance of 6.0mm from the LEDs. The second set of six PDs spaced equally along an outer-ring, separated from the LEDs by a radius of 10.0mm. Each cluster of six PDs were wired in parallel and connected through a central hub to the common summing input of a current-to-voltage converter.

IPR2020-01737 APPLE-1024, 3017.



IPR2020-01737 APPLE-1024, FIG. 1 (as annotated at APPLE-1003 ¶¶ 55, 70).

FISH.

A POSITA Would Have Modified Aizawa to Add a Second Ring of Detectors

Dr. Kenny's First Declaration

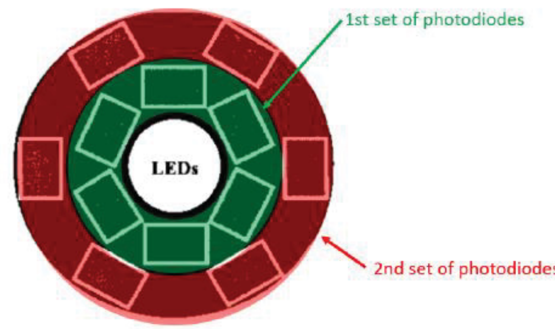
Mendelson-2003 further teaches that this configuration "widen[s] the active area of the PD which helps to collect a bigger portion of backscattered light intensity," thereby improving the light collection efficiency *Id.*, 3019. This configuration thus allows additional light to be captured, which in turn allows a lower brightness of LEDs to be used, which in turn would consume less power.

IPR2020-01737 APPLE-1003, ¶ 70.

A POSITA would have been motivated to provide the well-known feature of providing multiple rings of detectors to a pulse sensor to achieve the predictable benefits offered by Mendelson-2003's description of the same. In fact, Aizawa itself contemplates, and is thus capable of supporting, the addition of extra detectors to improve light collection efficiency, although it does not disclose whether they may be arranged as two concentric rings. APPLE-1006, [0032]. Moreover, as noted above, Mendelson-2003 expressly contemplates adding an additional ring of detectors to a conventional 1-ring PD arrangement precisely as found in Aizawa. APPLE-1024, 3016.

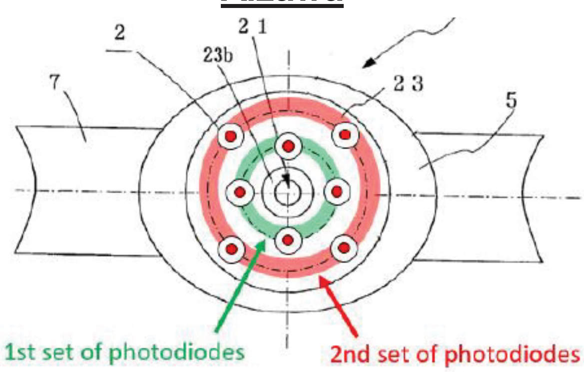
IPR2020-01737 APPLE-1003, ¶ 75.

Mendelson-2003



IPR2020-01737 APPLE-1024, FIG. 1
(as annotated at APPLE-1003 ¶¶ 55, 70).

Aizawa



IPR2020-01737 APPLE-1006, FIG. 1(a)
(as annotated at APPLE-1003 ¶¶ 97, 107).

FISH.

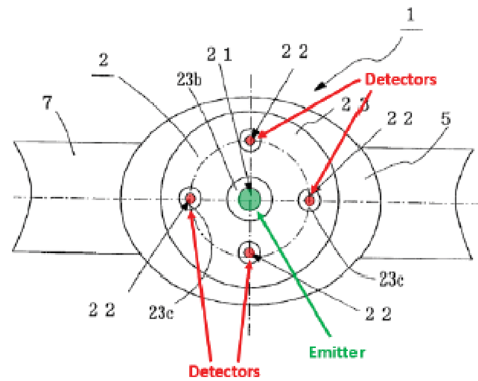
A POSITA Would Have Modified Aizawa to Add a Second Ring of Detectors

Dr. Kenny's Second Declaration

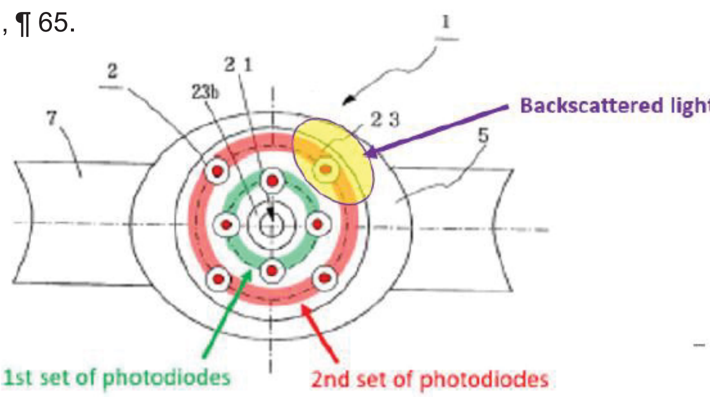
65. But as I previously explained, adding a second ring of sensors to Aizawa allows the modified Aizawa system to "widen[] the active area of the PD" and consequently "collect a bigger portion of backscattered light intensity." APPLE-1003, ¶¶56-70; APPLE-1024, 3019. To illustrate, as shown below, a measurement scenario where the backscattered light only reaches the area highlighted in yellow would not result in light detection without the presence of additional sensors provided by the second ring:

IPR2020-01737 APPLE-1060, ¶ 65.

Aizawa



IPR2020-01737 APPLE-1006, FIG. 1(1a) (as annotated at APPLE-1003 ¶ 49).



IPR2020-01737 APPLE-1006, FIG. 1(a) (as annotated at APPLE-1060 ¶ 65).

A POSITA Would Have Modified Aizawa to Add a Second Ring of Detectors

Dr. Kenny 2021-07-16 Depo. Transcript

A. You know, I think Mendelson -- all of the Mendelson references, or many of them anyway, make prettily clear having a larger detector area is beneficial.

If you have the option, you know, given the configuration of the rest of the system to have larger area detectors and fill up more of the space, that would give you the opportunity to capture more light reflected back from the tissue. I think that's obvious to one of ordinary skill.

IPR2020-01737 APPLE-2026, 102:8-17.

A. I think we've been over this. The second ring gives you the opportunity to capture more signal. Wiring them each ring in parallel an then processing them as described in the declaration gives you the opportunity to apply different amounts of gain to the processing of the inner and the outer ring so that the sum of those signals captures as much information as possible. A person of ordinary skill would consider combining these things in many ways including what is shown here.

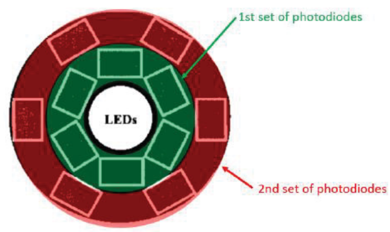
IPR2020-01737 APPLE-2026, 103:3-12.

A POSITA Would Have Found It Obvious to Connect the Photodiodes in Parallel

Mendelson-2003

of R and IR LEDs. As shown schematically in Fig. 1, six PDs were positioned in a close inner-ring configuration at a radial distance of 6.0mm from the LEDs. The second set of six PDs spaced equally along an outer-ring, separated from the LEDs by a radius of 10.0mm. Each cluster of six PDs were wired in parallel and connected through a central hub to the common summing input of a current-to-voltage converter.

IPR2020-01737 APPLE-1024, 3017 and FIG. 1



Dr. Kenny's First Declaration

of photodiodes in the modified Aizawa device should be wired. Thus, a POSITA would have found, in view of Mendelson-2003's express teachings, wiring two rings of photodiodes such that each ring/set of detectors "were wired in parallel" to be a routine and conventional design choice. Indeed, connecting photodiodes in a first set of photodiodes to one another in parallel to provide a first signal stream, as evidenced by Mendelson-2003, was common practice well before the Critical Date, and there was nothing new or inventive about changing the way such photodiodes are connected. *See* APPLE-1025, 4:23-30.

IPR2020-01737 APPLE-1003, ¶ 103.

Dr. Kenny's Second Declaration

62. As I mentioned during my deposition, a POSITA would have recognized and/or found it obvious that the photodetectors of Aizawa are connected in parallel. Ex. 2026, 72:3-9. This is because a POSITA would have known that connecting multiple photodetectors together in parallel allows the current generated by the multiple photodetectors to be added to one another, which would subsequently ensure that even if one of multiple sensors connected in parallel were to be displaced so as to receive no signal, the fact that all the sensors are connected in parallel such that their signals are summed means that a signal will still be detected, in accordance with Aizawa's objective. As explained by Aizawa, the pulse rate is determined by computing the number of outputs above the threshold value per unit time (Aizawa paragraph 28), which is consistent with how a POSITA would consider analyzing the output based on summing of the sensor currents. I explained this previously in my first declaration. APPLE-1003, ¶¶102-103. Thus, to the extent Aizawa itself doesn't expressly teach connecting its photodetectors in parallel, this is merely an implementation detail that a POSITA would have been well aware of (and in fact performed very commonly).

IPR2020-01737 APPLE-1060, ¶ 62.

FISH.

54

A POSITA Would Have Found It Obvious to Connect the Photodiodes in Parallel

Dr. Kenny 2021-07-16 Depo. Transcript

A. Aizawa doesn't say anything about how the detectors are connected. I think one of ordinary skill in the art attempting to follow Aizawa would probably connect those photodiodes in parallel.

IPR2020-01737 APPLE-2026, 72:6-9.

A. I did not find a specific sentence that states that. I think it's obvious to one of ordinary skill in the art that there are benefits to wiring the photodetectors in parallel if you are going to process their signals together and, and obtain information from that processing.

IPR2020-01737 APPLE-2026, 86:18-87:1.

FISH.

Having Separate First/Second Signal Streams Provides Additional Benefits

Dr. Kenny's First Declaration

104. Moreover, a POSITA would have recognized that there can be multiple benefits to separately transmitting signals streams from the near and far detectors—as opposed to combining all the signals from the detectors into a single stream. For example, Mendelson '799 teaches that the detected values from each of its near and far detector arrays can be monitored such that "if both of them are not in the mentioned range, a corresponding alarm is generated indicative of that the sensor position should be adjusted." APPLE-1025, 13:19-30, FIG. 10A. In other words, monitoring each signal stream (from each ring of detectors) separately allows the system to determine when the sensor device is so severely located that its position should be adjusted. Mendelson '799 also teaches that its detector configuration can help detect "movement/breathing artifacts" and subsequently generate "a corresponding alarm signal." APPLE-1025, 13:31-42. Mendelson '799 is able to achieve this (along with other benefits) by maintaining separate streams coming from each of its inner and outer rings of photodetectors. *Id.*

IPR2020-01737 APPLE-1003, ¶ 104.

Dr. Kenny's Second Declaration

71. Lastly, as I previously described in my first declaration, keeping the two signal streams separate provides multiple other benefits, such as detecting sensor displacement as well as being able to more reliably detect weak signals that are only picked up by the outer ring, for example, by utilizing different gain in the amplification of signals captured by the outer ring. *See* APPLE-1003, ¶¶104-106. Masimo's arguments that the benefits of maintaining separate streams as per Mendelson '799 in order to detect dislocation is inapplicable to the modified Aizawa system is misplaced because a POSITA would have recognized that Mendelson '799's general teachings regarding the comparison of "near" and "far" detectors in order to sense dislocation is more broadly applicable to the "near" and "far" rings in Aizawa-Mendelson-2003. APPLE-1025, 12:62-13:5, 13:19-30; APPLE-1003, ¶104. Moreover, Masimo's arguments that "the weaker signals at

IPR2020-01737 APPLE-1060, ¶ 71.

Having Separate First/Second Signal Streams Provides Additional Benefits

Dr. Kenny 2021-07-16 Depo. Transcript

A. I think Mendelson is just one of -- Mendelson '799 is just one of many examples that a person of ordinary skill in the art would be aware of. And in this case, there is a benefit associated with the processing of the signals from the different regions of the photodetectors in a way that helps detect and avoid a problem with the position of the sensor. It's -- I think a person of ordinary skill would have had this and many other things in mind as they were considering the wiring up of the, of the photosensors.

IPR2020-01737 APPLE-2026, 95:1-11.

FISH.

Having Separate First/Second Signal Streams Provides Additional Benefits

Dr. Kenny's First Declaration

from the LED. APPLE-1017, 801. To ensure that the pulse rate data provided by the outer ring is preserved when combined with the pulse rate data provided by the inner ring, a POSITA would have found it obvious, in some implementations, to keep each ring separately wired and connected to its own amplifier (*i.e.*, drive detection circuit 24) to thereby keep the magnitude of the current signals provided by each ring approximately the same before being combined and transmitted to the arithmetic circuit 3. Otherwise, if all the photodiodes in both the first and second rings in the modified Aizawa's sensor device are connected together in parallel such that a single stream is output (from both rings) to a single amplifier, signals detected by the near/first sets of detectors may drown out the weaker signals coming from the far/second sets of detectors, thereby diminishing the enhanced sensitivity and collection efficiency achieved through the widened detection area.

IPR2020-01737 APPLE-1003, ¶ 106.

Mendelson-IEEE-1998

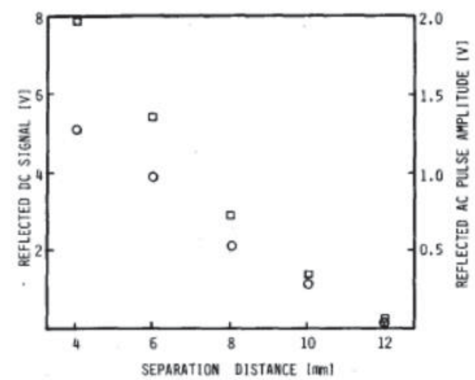


Fig. 4. The effect of LED/photodiode separation on the dc (□) and ac (○) components of the reflected infrared photoplethysmograms. Measurements were performed at a skin temperature of 43°C.

IPR2020-01737 APPLE-1017, FIG. 4.

FISH.

Having Separate First/Second Signal Streams Provides Additional Benefits

Dr. Kenny's Second Declaration

67. Additionally, contrary to Masimo's arguments, adding a second ring of detectors would not have led to an undesirable increase in power consumption. POR, 58-61. Among other things, the LEDs, not the photodetectors, are responsible for consuming the dominant power in the system. Ex. 2026, 104:5-105:14. Thus, widening the detection area to collect a bigger portion of backscattered light, as would be the case with the modified Aizawa system with two rings of detectors, would result in improved light collection efficiency by allowing additional light to be captured and thereby allowing a lower brightness of LEDs to be used, which would result in reduced power consumption. APPLE-1003, ¶¶69-71.

IPR2020-01737 APPLE-1060, ¶ 67.

Relevant Case Law

"The fact that the motivating benefit comes at the expense of another benefit, however, should not nullify its use as a basis to modify the disclosure of one reference with the teachings of another."

Winner Int'l Royalty Corp. v. Wang, 202 F.3d 1340, 1349, n. 8 (Fed. Cir. 2000).

"[M]ere disclosure of alternative designs does not teach away."

In re Fulton, 391 F.3d 1195, 1201 (Fed. Cir. 2004).

FISH.

Having Separate First/Second Signal Streams Provides Additional Benefits

Dr. Kenny's Second Declaration

70. But Mendelson-2003 does not say that using a single, large detector is somehow superior to using multiple, smaller detectors. Instead, the main premise behind Mendelson-2003 is that the two situations are equivalent; that is why they are able to use one configuration (*e.g.,* two rings of detectors) in place of the other (*e.g.,* single large detector). Thus, a POSITA, looking to implement the teachings of Mendelson-2003 regarding the benefits of expanding the detection area, would have recognized that one way to achieve the same would be through the precise configuration as taught by Mendelson-2003, namely using two rings of discrete photodetectors that are each connected in parallel and that each provide a separate stream. Indeed, it is well known that a single larger photodetector can be replaced with multiple smaller ones. *See, e.g.,* APPLE-1016, 915 ("[W]e showed that a concentric array of ***either discrete PDs, or an annularly-shaped PD ring***, could be used to increase the amount of backscattered light detected..."). Thus, a POSITA trying to maximize the detection area to increase sensitivity and lower power consumption, as in Mendelson-2003, would have recognized that one way to implement this configuration is to, like Mendelson-2003, use two rings of parallel detectors.

IPR2020-01737 APPLE-1060, ¶ 70.

Mendelson-2003

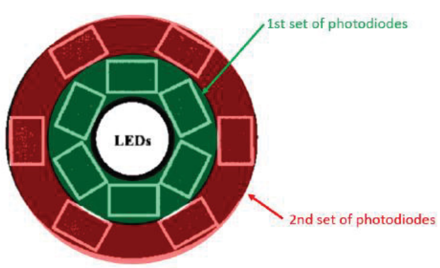


Table 1. Comparison of estimated battery life for different PD configurations. Values based on forehead measurements for a typical 220mAhr coin size battery.

PD CONFIGURATION	BATTERY LIFE [Days]
Near	45.8
Far	20.3
Near+Far	52.5

IPR2020-01737 APPLE-1024, 3017, 3019.

Issue 3

The Dependent Claims are Obvious

Case Nos. IPR2020-01713, -01716, -01733
U.S. Patent Nos. 10,624,564; 10,702,194; 10,702,195

FISH.

’564 Claims 16 and 17 are Obvious

Dr. Kenny’s First Declaration

146. As noted above in Sections VI.B and VII.A, AOG’s PMD includes a protruding convex surface similar to the protruding surface of Ohsaki’s cover, which is designed to be “in intimate contact with the surface of the user’s skin,” to prevent slippage of the detecting element on the user’s wrist. APPLE-1009, ¶¶[0009]-[0010], FIG. 2.

147. In incorporating Ohsaki’s teachings, a POSITA would have found it obvious that a device designed to fit on a user’s wrist would be on the order of millimeters. *See also* APPLE-1010, 2 (describing its “optical reflectance transducer” as “small (⌀ = 22mm)”); APPLE-1014, 2 (describing a “standard 24-pin (dimensions: 19 x 19 mm) microelectronic package” for its sensor); APPLE-1023, 9:40-65 (describing a protrusion on a biological measurement device that causes a subject’s tissue to deform by a depth of about 2 to 20 mm). Additionally, the POSITA would have taken the user’s comfort into consideration—Ohsaki’s convex cover, for example, is said to solve the problem of “the user feel[ing] uncomfortable” due to pressure from the device and belt on the user’s limbs. APPLE-1009, ¶[0006].

IPR2020-01713 APPLE-1003, ¶¶ 146-147.

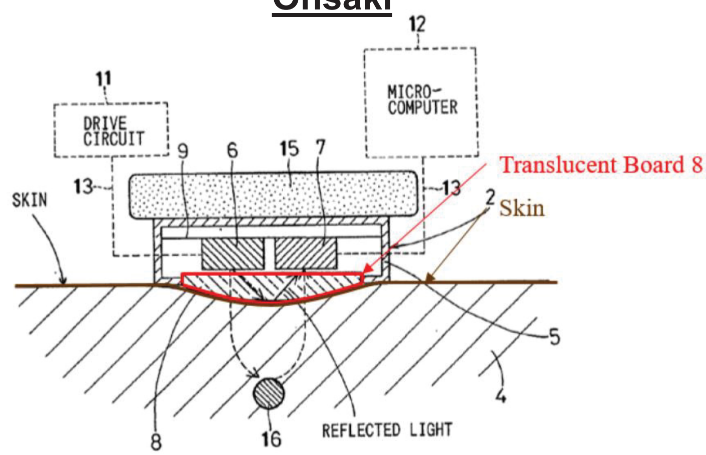
’564 Patent

16. The user-worn physiological measurement device of claim **10**, wherein the protruding convex surface protrudes a height between 1 millimeter and 3 millimeters.

17. The user-worn physiological measurement device of claim **16**, wherein the protruding convex surface protrudes a height greater than 2 millimeters and less than 3 millimeters.

IPR2020-01713 APPLE-1001 (’564 Patent), Claims 16, 17.

Ohsaki



IPR2020-01713 APPLE-1009, FIG. 2 (annotated).

’564 Claims 16 and 17 are Obvious

Kondoh

Also, a protrusion part is preferably provided on the face of the forming part contacting the surface of the organism.

Here, the protrusion part may be provided between the light source part and the light receiving part. In this case, the protrusion part is preferably located at a distance of about 3 to 30 mm from the light source part.

Also, the light source part or/and light receiving part may be provided in the protrusion part.

Here, the protrusion part has preferably a shape such that the organism is deformed so that an area of the surface of the organism having a longitudinal dimension of about 3 to 10 mm and a lateral dimension of 3 to 50 mm is concaved to the depth of about 2 to 20 mm.

Also, there may be a plurality of light source parts or/and light receiving parts.

Also, the apparatus of measuring biological information using light of the present invention preferably has the light source part comprising a first light source part provided at a first predetermined location of the forming part and a second light source part provided at a second predetermined location of the protrusion part, and the light receiving part comprising a first light receiving part provided at a third predetermined location of the forming part opposite to the first predetermined location with the protrusion part therebetween and a second light receiving part provided at a fourth predetermined location of the protrusion.

IPR2020-01713 APPLE-1023, 9:40-65; APPLE-1003, ¶ 147.

Mendelson-2006

The prototype system, depicted in Fig. 1, consists of a body-worn pulse oximeter that receives and processes the PPG signals measured by a small (ϕ = 22mm) and lightweight (4.5g) optical reflectance transducer. The system consists of three units: A Sensor Module, consisting of the optical transducer, a stack of round PCBs, and a coin-cell battery. The information acquired by the Sensor Module is transmitted wirelessly via an RF link over a short range to a body-worn Receiver Module. The data processed by the Receiver Module can be transmitted wirelessly to a PDA.

IPR2020-01713 APPLE-1010, 2; APPLE-1003, ¶ 147.

Mendelson-1988

The optical reflectance sensor used in this study consists of two red (peak emission wavelength: 660 nm) and two infrared (peak emission wavelength: 930 nm) LED chips (dimensions: 0.3 × 0.3 mm), and six silicon photodiodes (active area: 2.74 × 2.74 mm) arranged symmetrically in a hexagonal configuration as shown in Figure 2. To maximize the fraction of backscattered light collected by the sensor, the currents from all six photodiodes were summed. The LEDs and photodiode chips were mounted with conductive epoxy (Epo-tek H31, Epoxy Technology, Inc. Billerica, Massachusetts) on a ceramic substrate (dimensions: 13.2 × 13.2 × 0.25 mm) that was housed in a standard 24-pin (dimensions: 19 × 19 mm) microelectronic package (AIRPAX, Cambridge, Maryland), which is commonly used for packaging electronic circuits. The optical components were intercon-

IPR2020-01713 APPLE-1014, 2; APPLE-1003, ¶ 147.

FISH.

’564 Claims 16 and 17 are Obvious

Petitioner Reply

62. The POR argues that nothing in the references teaches or suggests that a protrusion with the claimed height in claims 16 and 17 would have been obvious, and dismisses the prior art mapping for claims 16 and 17 as hindsight based. POR, 47-48. As explained below, the POR ignores evidence establishing the obviousness of the claimed dimensions, and further mischaracterizes arguments in my earlier declaration and the disclosure of the references.

63. For example, Mendelson 2006 and Mendelson 1988 indicate the relative sizes (e.g., ~13 x 13 mm) of sensors as of the Critical Date (these references are not relied upon for any alleged disclosure of a cover). APPLE-1003, ¶147; Petition, 78. Even Patent owner acknowledges that Mendelson 2006 and Mendelson 1988's sensors are "*similarly sized sensors*." POR, 48. Moreover, the POR mischaracterizes the Mendelson sensors as being limited to forehead sensors. POR, 48. In fact, Mendelson 2006 expressly teaches that "in reflection pulse oximetry, the LEDs and PD are both mounted side-by-side on the same planar substrate to enable readings *from multiple body locations*" and repeatedly describes its sensor as "a *body-worn* pulse oximeter," which would suggest to a POSITA that Mendelson 2006's sensor is not limited to a forehead sensor, as asserted by the POR. APPLE-1010, 912, 913; *see also* APPLE-1014, 167 ("skin reflectance oximetry could enable SpO2 measurement from more centrally located parts of the body such as the forearms, chest, and forehead").

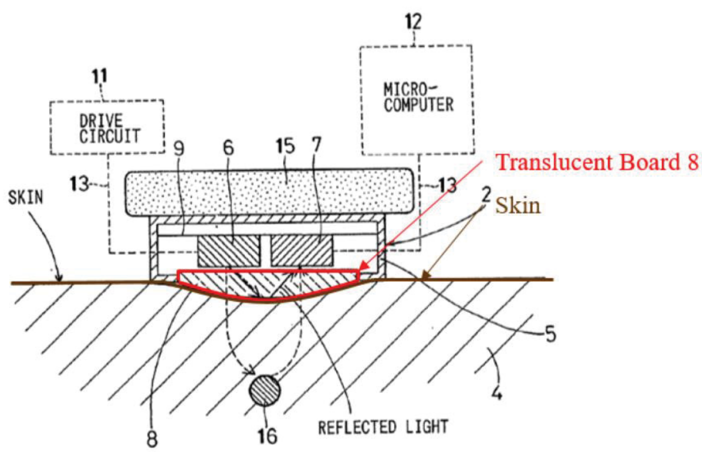
IPR2020-01713 Pap. 18, ¶¶ 62-63.

Dr. Kenny's First Declaration

148. A POSITA would have found it obvious that in order to provide a comfortable cover that prevents slippage, the convex surface should protrude a height between 1 millimeter and 3 millimeters. Indeed, there would have been a finite range of possible protruding heights, and it would have been obvious to select a protruding height that would have been comfortable to the user. Accordingly, AOG renders obvious [16].

IPR2020-01713 APPLE-1003, ¶ 148.

Ohsaki



IPR2020-01715 APPLE-1009, FIG. 2 (annotated).

’564 Claims 16 and 17 are Obvious

Patent Owner’s Sur-Reply

B. Claims 16 and 17

As Masimo explained, the ’564 Patent’s inventors discovered a convex protrusion between about 1 mm to about 3 mm in height improves “signal strength by about an order of magnitude versus other shapes.” Ex. 1001 20:29-33; *see also id.* 20:25-34; Ex. 2004 ¶93; POR 47. Claim 16 requires the convex surface protrude “a height between 1 millimeter and 3 millimeters,” and claim 17 requires “a height greater than 2 millimeters and less than 3 millimeters.” Ex. 1001 Claims 16-17. Nothing in Ohsaki, Aizawa, or Goldsmith suggests a protrusion with any claimed height would have been beneficial, as the inventors discovered. POR 47-49; Ex. 2004 ¶¶94-96.

IPR2020-01713 Pap. 21, 25.

’564 Patent

In an embodiment, the photodetectors can be positioned within or directly beneath the protrusion **305** (see FIG. **3**E). In such cases, the mean optical path length from the emitters to the detectors can be reduced and the accuracy of blood analyte measurement can increase. For example, in one embodiment, a convex bump of about 1 mm to about 3 mm in height and about 10 mm^2 to about 60 mm^2 was found to help signal strength by about an order of magnitude versus other shapes. Of course other dimensions and sizes can be employed in other embodiments. Depending on the properties desired, the length, width, and height of the protrusion **305** can be selected. In making such determinations, consideration can be made of protrusion’s **305** effect on blood flow at the measurement site and mean path length for optical radiation passing through openings **320**, **321**, **322**, and **323**. Patient comfort can also be considered in determining the size and shape of the protrusion.

IPR2020-01713 APPLE-1001 (’564 Patent), 20:25-42.

FISH.

’564 Claim 11 is Obvious

Dr. Kenny’s First Declaration

61. Sherman discloses a magnetic fastening mechanism for “wrist instruments,” such as wristwatches. APPLE-1013, 1:4-10. As shown in Sherman’s FIGS. 2 and 5, the mechanism includes a pair of flexible strap ends having “permanently magnetizable material” of opposite polarities.” *Id.*, 2:43-62; FIGS. 2 and 5.

IPR2020-01713 APPLE-1003, ¶ 61.

172. Sherman explains that wristwatches that are fastened, e.g., by a buckle or clasp, can be difficult to fasten and can be “unsightly or ha[ve] corners which catch upon sleeves or clothing” resulting in broken connectors or accidental snagging. APPLE-1013, 1:11-24. Sherman explains that this problem could be solved with a magnetic connector providing an “improved flexible strap” that “eliminates buckles or other types of protruding members thereby permitting a thinner, more comfortable flexible strap attachment.” APPLE-1013, 1:11-25, 2:1-62, FIGS. 1-11. Sherman’s strap ends “curve around the wrist of a wearer and [] overlap one another” such that the “magnetized particles provide a holding force resisting separation of the strap ends.” APPLE-1013, 2:43-62.

173. A POSITA would have looked to Sherman because it provided details of a wrist-worn device fastening mechanism that addresses the above-noted problems, is easy to engage, and improves user comfort. APPLE-1013, 1:11-25, 2:9-11.

IPR2020-01713 APPLE-1003, ¶¶ 172-173.

Sherman

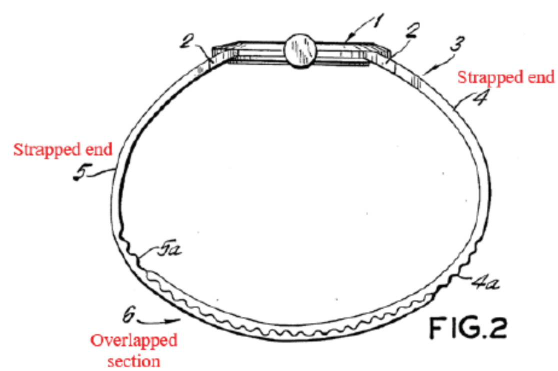


FIG.2

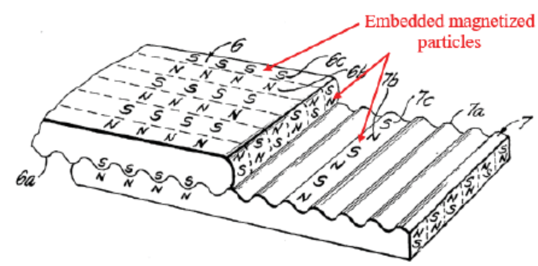


FIG.5

IPR2020-01713 APPLE-1013, FIGS. 2, 5.

’564 Claim 11 is Obvious

Dr. Kenny’s Second Declaration

67. The POR presents a number of irrelevant arguments to attack the combination of Sherman with Aizawa, Ohsaki, and Goldsmith. POR, 51-52. The POR’s arguments focus on Ohsaki’s disclosure of ***an example (not required)*** pressure of 5-15 mmHg and the use of a “cushion 15 such as a sponge or a gel…inserted between the detecting element 2 and the sensor body 3.” *Id.*; APPLE-1009, ¶¶21, 26, 18, FIG. 1 (reproduced below).

68. However, the use of a cushion on the backside of Ohsaki’s device or a purported desired pressure in Ohsaki are not relevant to the obviousness of using Sherman’s magnetic fastener in the Aizawa, Ohsaki, and Goldsmith physiological monitoring device (“AOG PMD”). For instance, as shown in Ohsaki’s figure above and Sherman’s FIGS. 2 and 5 below, the modification of the connecting mechanism or fastening means in the AOG PMD would be on the front side where the connecting mechanism would previously include fasteners (shown in green in Ohsaki’s FIG. 1 above) that can “catch upon sleeves or clothing.” APPLE-1013, 1:11-24; APPLE-1003, ¶172. In fact, the fastening means in Ohsaki’s device is an example of the type of fastening Sherman’s design is meant to improve upon for the reasons I explained previously by in my earlier declaration. APPLE-1003, ¶¶171-174.

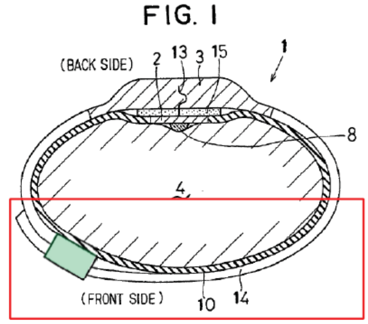
IPR2020-01713 APPLE-1050, ¶¶ 67-68.

69. Moreover, disclosure of an example pressure (not a required pressure) in Ohsaki’s device would not have dissuaded a POSITA from modifying the AOG PMD (which is not limited to Ohsaki’s desired pressure) in view of Sherman’s teachings to improve the fastening means and obtain other benefits (e.g., by eliminating issues such as snagging, broken connections that a user would otherwise have experienced without the improved magnetic connecting mechanism). APPLE-1003, ¶¶171-174; Petition, 93-94.

IPR2020-01713 APPLE-1050, ¶ 69.

Ohsaki

FIG. 1



IPR2020-01713 APPLE-1009, FIG. 1.

FISH.

Overview of the Challenged Patents

FISH.

’564 Patent Overview

US010624564B1

(12) **United States Patent**
Poeze et al.

(10) **Patent No.: US 10,624,564 B1**
(45) **Date of Patent: *Apr. 21, 2020**

(54) **MULTI-STREAM DATA COLLECTION SYSTEM FOR NONINVASIVE MEASUREMENT OF BLOOD CONSTITUENTS**

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(72) Inventors: **Jeroen Poeze**, Rancho Santa Margarita, CA (US); **Marcelo Lamego**, Cupertino, CA (US); **Sean Merritt**, Lake Forest, CA (US); **Cristiano Dalvi**, Lake Forest, CA (US); **Hung Vo**, Fountain Valley, CA (US); **Johannes Bruinsma**, Opeinde (NL); **Ferdyan Lesmana**, Irvine, CA (US); **Massi Joe E. Kiani**, Laguna Niguel, CA (US); **Greg Olsen**, Lake Forest, CA (US)

(73) Assignee: **Masimo Corporation**, Irvine, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **16/725,292**

(22) Filed: **Dec. 23, 2019**

Related U.S. Application Data

(63) Continuation of application No. 16/534,949, filed on Aug. 7, 2019, which is a continuation of application (Continued)

(51) **Int. Cl.**
A61B 5/1455 (2006.01)
A61B 5/00 (2006.01)
A61B 5/145 (2006.01)

(52) **U.S. Cl.**
CPC .... *A61B 5/1455* (2013.01); *A61B 5/14532* (2013.01); *A61B 5/14546* (2013.01); (Continued)

(58) **Field of Classification Search**
CPC .... A61B 5/1455; A61B 5/14551; A61B 5/14552; A61B 5/14532; A61B 5/14546; (Continued)

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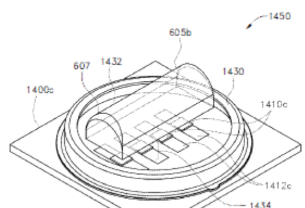
Primary Examiner — Eric F Winakur
Assistant Examiner — Chu Chuan Liu
(74) *Attorney, Agent, or Firm* — Knobbe Martens Olson & Bear LLP

(57) **ABSTRACT**

The present disclosure relates to noninvasive methods, devices, and systems for measuring various blood constituents or analytes, such as glucose. In an embodiment, a light source comprises LEDs and super-luminescent LEDs. The light source emits light at at least wavelengths of about 1610 nm, about 1640 nm, and about 1665 nm. In an embodiment, the detector comprises a plurality of photodetectors arranged in a special geometry comprising one of a substantially linear substantially equal spaced geometry, a substantially linear substantially non-equal spaced geometry, and a substantially grid geometry.

30 Claims, 65 Drawing Sheets



- The ’564 Patent’s earliest effective filing date is July 3, 2008.
- The ’564 Patent includes 30 claims, of which claim 1 is independent.
- Independent claim 1, recites, among other features:
  “A user-worn physiological measurement system comprising: one or more emitters configured to emit light into tissue of a user; at least four detectors arranged on a substrate; a cover comprising a protruding convex surface ….”

IPR2020-01713, APPLE-1001
(U.S. Patent No. 10,624,564)(“’564 Patent”).

FISH.

’564 Patent: Background

Dr. Thomas Kenny’s First Declaration

40. In its background section, the ‘564 Patent explains that “[t]he standard of care in caregiver environments includes patient monitoring through spectroscopic analysis using, for example, a pulse oximeter,” and that “[d]evices capable of spectroscopic analysis generally include a light source(s) transmitting optical radiation into or reflecting off a measurement site, such as, body tissue carrying pulsing blood.” *Id.*, 2:16-25. “After attenuation by tissue and fluids of the measurement site, a photo-detection device(s) detects the attenuated light and outputs a detector signal(s) responsive to the detected attenuated light.” *Id.*, 2:21-30. “A signal processing device(s)” then “process[es] the detector(s) signal(s) and outputs a measurement indicative of a blood constituent of interest, … other physiological parameters, or other data or combinations of data useful in determining a state or trend of wellness of a patient.” *Id.*, 2:25-30.

IPR2020-01713, APPLE-1003 ¶ 40.

41. In this way, the ‘564 Patent confirms that prior art “devices capable of spectroscopic analysis” (“for example, a pulse oximeter”), generally included one or more light sources configured to emit light into user tissue, one or more detectors configured to detect light after attenuation by the user’s tissue and to output responsive signal(s), and one or more signal processors configured to process signals and to output measurements of physiological parameters. *Id.*, 2:16-30.

IPR2020-01713, APPLE-1003 ¶ 41.

’564 Patent

BACKGROUND

The standard of care in caregiver environments includes patient monitoring through spectroscopic analysis using, for example, a pulse oximeter. Devices capable of spectroscopic analysis generally include a light source(s) transmitting optical radiation into or reflecting off a measurement site, such as, body tissue carrying pulsing blood. After attenuation by tissue and fluids of the measurement site, a photo-detection device(s) detects the attenuated light and outputs a detector signal(s) responsive to the detected attenuated light. A signal processing device(s) process the detector(s) signal(s) and outputs a measurement indicative of a blood constituent of interest, such as glucose, oxygen, met hemoglobin, total hemoglobin, other physiological parameters, or other data or combinations of data useful in determining a state or trend of wellness of a patient.

In noninvasive devices and methods, a sensor is often adapted to position a finger proximate the light source and light detector. For example, noninvasive sensors often include a clothespin-shaped housing that includes a contoured bed conforming generally to the shape of a finger.

IPR2020-01713, APPLE-1001, 2:16-35.

’564 Patent: Brief Description

Dr. Kenny’s Declaration

43. The exemplary physiological measurement system 100 shown in the ’564 patent’s FIG. 1 (reproduced below) includes “a sensor 101 … that is coupled to a processing device or physiological monitor 109.” APPLE-1001, 11:56-67, 5:44-48. “In an embodiment, the sensor 101 and the monitor 109 are integrated together into a single unit.” APPLE-1001, 11:56-67.

IPR2020-01713, APPLE-1003 ¶ 43; Pet. 5.

44. The ’564 patent’s FIGS. 2A-2D (reproduced below) illustrate “example monitoring devices 200 in which the data collection system 100 can be housed.” APPLE-1001, 16:31-42, 5:48-51. Each of the “monitoring devices 200” include a sensor 201 and a monitor 209. *Id.*, FIGS. 2A-2D, 16:31-18:38.

45. The ’564 patent describes several potential architectures with respect to the detector submount and sensor as shown in FIGS. 14A-14I. APPLE-1001, 6:48-59, 35:45-38:32. For example, in FIG. 14D, a housing 1430 including “a transparent cover 1432, upon which the protrusion 605b is disposed” surrounds each of the detectors 1410c. APPLE-1001, 36:40-51.

IPR2020-01713, APPLE-1003 ¶¶ 44-45; Pet. 6-7

’564 Patent

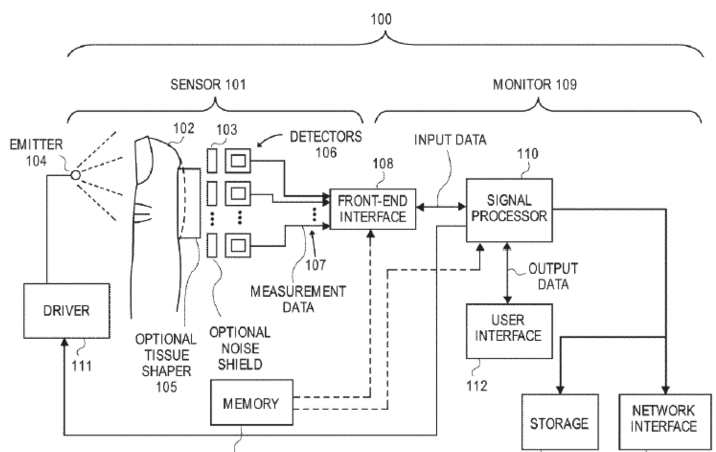


FIG. 1

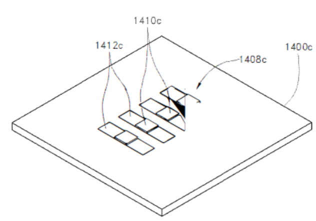


FIG. 14C

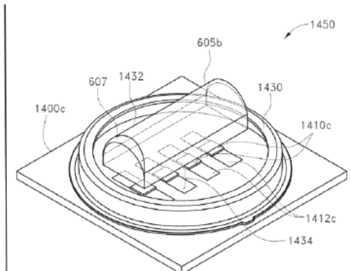


FIG. 14D

IPR2020-01713, APPLE-1001 FIGS. 1, 14C, 14D; Pet. 6-8.

FISH.

’564 Patent: Brief Description

Dr. Kenny’s Declaration

38. Prior to the Critical Date of the ‘564 Patent, numerous products, publications, and patents existed that implemented or described the functionality claimed in the ‘564 Patent. The methodology of the ‘564 Patent was therefore well known in the prior art as of the Critical Date. Further, to the extent there was any problem to be solved in the ‘564 Patent, it had already been solved in the prior art systems before the Critical Date of the ‘564 Patent as I discuss below.

IPR2020-01713, APPLE-1003 ¶ 38; Pet. 5.

41. In this way, the ‘564 Patent confirms that prior art “devices capable of spectroscopic analysis” (“for example, a pulse oximeter”), generally included one or more light sources configured to emit light into user tissue, one or more detectors configured to detect light after attenuation by the user’s tissue and to output responsive signal(s), and one or more signal processors configured to process signals and to output measurements of physiological parameters. *Id.*, 2:16-30.

IPR2020-01713, APPLE-1003 ¶ 41, Pet. 5.

FISH.

’564 Patent: Exemplary Claim

’564 Patent

1. A user-worn physiological measurement device comprising:
  - one or more emitters configured to emit light into tissue of a user;
  - at least four detectors arranged on a substrate;
  - a cover comprising a protruding convex surface, wherein the protruding convex surface extends over all of the at least four detectors arranged on the substrate, wherein at least a portion of the protruding convex surface is rigid;
  - one or more processors configured to:
    - receive one or more signals from at least one of the at least four detectors, the one or more signals responsive to at least a physiological parameter of the user; and
    - process the one or more signals to determine measurements of the physiological parameter;
  - a network interface configured to communicate with a mobile phone;
  - a touch-screen display configured to provide a user interface, wherein:
    - the user interface is configured to display indicia responsive to the measurements of the physiological parameter, and
    - an orientation of the user interface is configurable responsive to a user input;
  - a wall that surrounds at least the at least four detectors, wherein the wall operably connects to the substrate and the cover;
  - a storage device configured to at least temporarily store at least the measurements of the physiological parameter; and
  - a strap configured to position the physiological measurement device on the user.

IPR2020-01713, APPLE-1001 (’564 Patent), 44:62-45:29 (Independent Claim 1).

FISH.

’194 Patent: Exemplary Claim

’194 Patent

1. A physiological measurement system comprising:
a physiological sensor device comprising:
one or more emitters configured to emit light into tissue of a user;
a first set of photodiodes, wherein:
the first set of photodiodes comprises at least four photodiodes,
the photodiodes of the first set of photodiodes are connected to one another in parallel to provide a first signal stream, and
each of the photodiodes of the first set of photodiodes has a corresponding window that allows light to pass through to the photodiode;
a second set of photodiodes, wherein:
the second set of photodiodes comprises at least four photodiodes,
the photodiodes of the second set of photodiodes are connected to one another in parallel to provide a second signal stream, and
each of the photodiodes of the second set of photodiodes has a corresponding window that allows light to pass through to the photodiode;
a wall that surrounds at least the first and second sets of photodiodes; and
a cover comprising a protruding convex surface, wherein the protruding convex surface is above all of the photodiodes of the first and second sets of photodiodes, wherein at least a portion of the protruding convex surface is rigid, and wherein the cover is above the wall; and
a handheld computing device in wireless communication with the physiological sensor device, wherein the handheld computing device comprises:
one or more processors configured to wirelessly receive one or more signals from the physiological sensor device, the one or more signals responsive to at least a physiological parameter of the user;
a touch-screen display configured to provide a user interface, wherein:
the user interface is configured to display indicia responsive to measurements of the physiological parameter, and
an orientation of the user interface is configurable responsive to a user input; and
a storage device configured to at least temporarily store at least the measurements of the physiological parameter.

IPR2020-01716, APPLE-1001 (’194 Patent), 45:2-40 (Independent Claim 1)

FISH.

’195 Patent: Exemplary Claim

’195 Patent

1. A user-worn physiological measurement device that defines a plurality of optical paths, the physiological measurement device comprising:
   - one or more emitters configured to emit light into tissue of a user;
   - a first set of photodiodes positioned on a first surface and surrounded by a wall that is operably connected to the first surface, wherein:
     - the first set of photodiodes comprises at least four photodiodes, and
     - the photodiodes of the first set of photodiodes are connected to one another in parallel to provide a first signal stream;
   - a second set of photodiodes positioned on the first surface and surrounded by the wall, wherein:
     - the second set of photodiodes comprises at least four photodiodes, and
     - the photodiodes of the second set of photodiodes are connected to one another in parallel to provide a second signal stream; and
   - a cover located above the wall and comprising a single protruding convex surface configured to be located between tissue of the user and the first and second sets of photodiodes when the physiological measurement device is worn by the user,
   - wherein the physiological measurement device provides a plurality of optical paths, wherein each of the optical paths:
     - exits an emitter of the one or more emitters,
     - passes through tissue of the user,
     - passes through the single protruding convex surface, and
     - arrives at a corresponding photodiode of the at least one of the first or second sets of photodiodes, the corresponding photodiode configured to receive light emitted by the emitter after traversal by the light of a corresponding optical path of the plurality of optical paths and after attenuation of the light by tissue of the user.

IPR2020-01733, APPLE-1001 (’195 Patent), 44:63-45:34 (Independent Claim 1)

FISH.

’366 Patent: Exemplary Claim

’366 Patent

1. A noninvasive physiological parameter measurement device adapted to be worn by a wearer, the noninvasive physiological parameter measurement device comprising:
   - one or more light emitters;
   - a substrate having a surface;
   - a first set of photodiodes arranged on the surface and spaced apart from each other, wherein:
     - the first set of photodiodes comprises at least four photodiodes, and
     - the photodiodes of the first set of photodiodes are connected to one another in parallel to provide a first signal stream responsive to light from at least one of the one or more light emitters attenuated by body tissue;
   - a second set of photodiodes arranged on the surface and spaced apart from each other, wherein:
     - the second set of photodiodes comprises at least four photodiodes,
     - the photodiodes of the second set of photodiodes are connected to one another in parallel to provide a second signal stream responsive to light from at least one of the one or more light emitters attenuated by body tissue, and
     - at least one of the first signal stream or the second signal stream includes information usable to determine a physiological parameter of a wearer of the noninvasive physiological parameter measurement device;
   - a wall extending from the surface and configured to surround at least the first and second sets of photodiodes; and
   - a cover arranged to cover at least a portion of the surface of the substrate, wherein the cover comprises a protrusion that extends over all of the photodiodes of the first and second sets of photodiodes arranged on the surface, and wherein the cover is further configured to cover the wall.

IPR2020-01737, APPLE-1001 (’366 Patent), 44:57-45:27 (Independent Claim 1)

FISH.

Overview of the Instituted Grounds

FISH.

Instituted IPR2020-01713 Grounds

Ground	Challenged IPR2020-01713 Claim(s)
Obvious (§ 103) over Aizawa, Ohsaki, and Goldsmith	1-10, 13-30
Obvious (§ 103) over Aizawa, Ohsaki, Goldsmith, and Sherman	11
Obvious (§ 103) over Aizawa, Ohsaki, Goldsmith, and Rantala	12
Obvious (§ 103) over Aizawa, Ohsaki, Goldsmith, and Ali	1-10, 13-30
Obvious (§ 103) over Aizawa, Ohsaki, Goldsmith, Ali, and Sherman	11
Obvious (§ 103) over Aizawa, Ohsaki, Goldsmith, Ali, and Rantala	12

IPR2020-01713 Paper 2, 9; Paper 7, 1, 10, 11.

The Aizawa-Ohsaki-Goldsmith Combination

Dr. Thomas Kenny's First Declaration

47. Aizawa discloses a "pulse wave sensor…detecting light output from a light emitting diode and reflected from the artery of a wrist of a subject." APPLE-1006, Abstract, ¶[0002]. In some embodiments, Aizawa's sensor includes "four photodetectors disposed around the light emitting diode" and a "holder" that secures the light emitting diode (LED) and photodetectors. *Id.*, Abstract, ¶[0023]; FIGS. 1(a), 1(b).

48. The sensor can be worn by a user with the LED facing the user's wrist, and fastened using a belt. *Id.*, ¶[0026]. The LED irradiates an artery of the wrist "with light having a wavelength of an infrared range," and the optical sensor non-invasively detects "the pulse wave…from light reflected from a red corpuscle in the artery." APPLE-1006, ¶¶[0002], [0008]-[0018].

IPR2020-01713, APPLE-1003 ¶¶ 47-58; Pet. 10-12.

Aizawa

FIG. 1 (a)

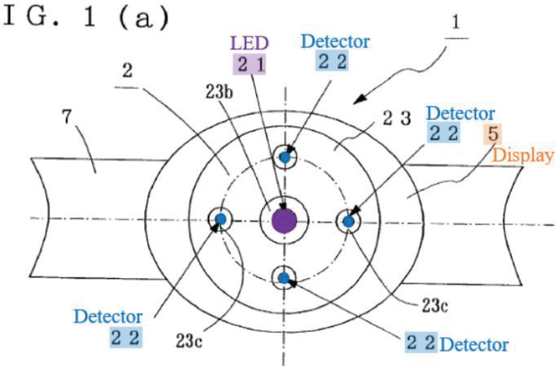
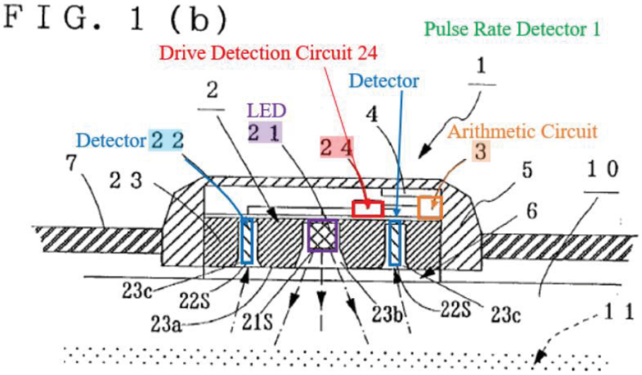


FIG. 1 (b)



IPR2020-01713, APPLE-1006 FIGS. 1(a), 1(b).

FISH.

The Aizawa-Ohsaki-Goldsmith Combination

Dr. Thomas Kenny's First Declaration

54. Translucent board 8 is "attached to the opening of the package 5" and when the sensor is worn "on the user's wrist…the convex surface of the translucent board…is in intimate contact with the surface of the user's skin." APPLE-1009, ¶¶[0009], [0010], [0015], [0017], [0023]-[0025], FIGS. 1, 2, 4A, 4B. This contact prevents slippage, which results in an increase in the signal strength detected by Ohsaki's sensor. *Id*.

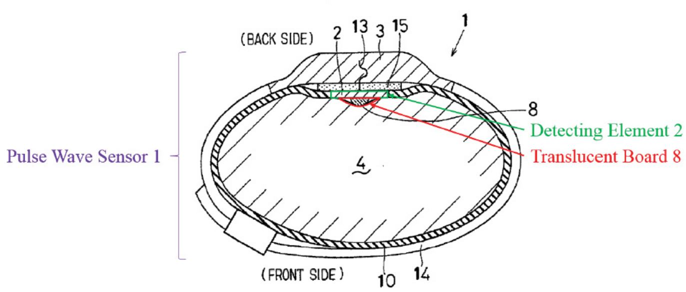
IPR2020-01713, APPLE-1003 ¶ 54; Pet. 15.

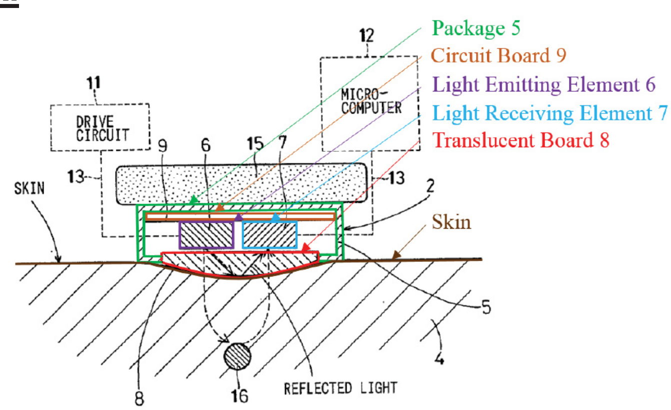
72. To the extent that Aizawa does not explicitly disclose a substrate, a POSITA would have been motivated to modify Aizawa to incorporate a substrate, such as Ohsaki's circuit board 9 to secure photodetectors 22 and enable photodetectors 22 to send signals to other portions of the PMD. Doing so would have amounted to nothing more than the use of a known technique to improve similar devices in the same way and combining prior art elements according to known methods to yield predictable results.

IPR2020-01713, APPLE-1003 ¶ 72; Pet. 23-24.

Ohsaki

FIG. I





IPR2020-01713, APPLE-1009 FIGS. 1, 2.

The Aizawa-Ohsaki-Goldsmith Combination

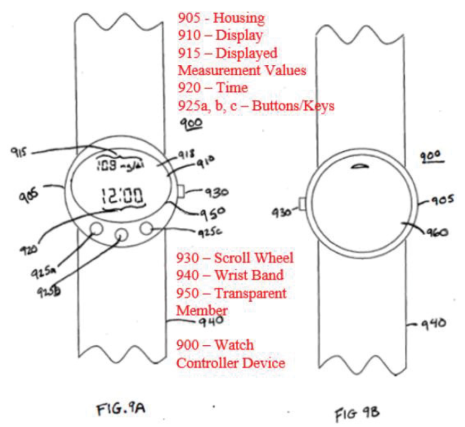
Dr. Thomas Kenny's First Declaration

56. Goldsmith's WCD 900 can "be used with any number of...diagnostic devices" including "cardiac and other sensors" to obtain physiological measurements such as user temperature, blood glucose level, oxygen level, and heart rate. APPLE-1011, ¶¶[0082]-[0084], [0095], [0037], [0038], claims 25, 26.

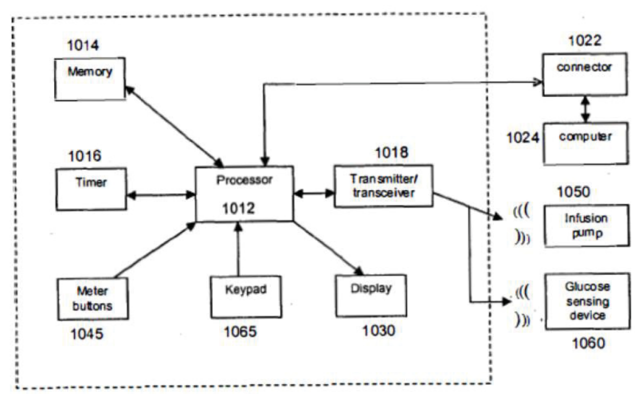
59. Among other components, the WCD includes a memory, processor, transceiver, and display (e.g., a touch screen). APPLE-1011, FIG. 10, ¶¶[0088], [0091], [0093], [0095], [0085]-[0087], [0090], [0093], [0102], [0104], claims 9, 10, 12, 13, 26, 43-45. A "processor 1012 contained in the [WCD's] housing 1015 is adapted to process data and commands inputted by the user, and a transmitter/transceiver 1018 contained in the housing 1015 and coupled to the processor 1012 transmits such communications, including data indicative of" a user's physiological parameters, to other devices (e.g., a computer, cellular phone, and/or PDA). APPLE-1011, ¶¶[0007], [0016]-[0018], [0035], [0052], [0087]-[0089], [0097], [0101]. The transceiver may, e.g., receive diagnostic information from sensors and transmit that information to other devices. *Id.*, ¶¶[0052], [0088], [0094], [0087], [0034], [0036]. The memory can store data such as heart rate data. *Id.*, ¶¶[0037], [0044], [0091], [0095], [0097].

IPR2020-01713, APPLE-1003 ¶¶ 56, 59; Pet. 16-18.

Goldsmith



IPR2020-01713, APPLE-1006 FIG. 9a, 9b.



IPR2020-01713, APPLE-1006 FIGS. 9a, 9b, 10.

FISH.

The Aizawa-Ohsaki-Goldsmith Combination

Dr. Thomas Kenny's First Declaration

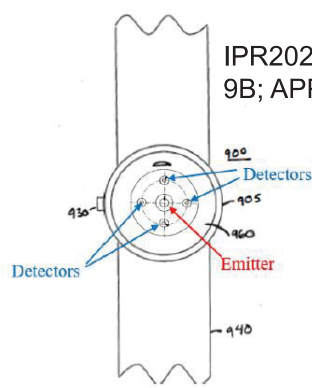
77. As explained in more detail below, a POSITA would have been motivated and found it obvious to incorporate Aizawa's wrist-worn pulse wave sensor with a protruding convex surface (as taught by Ohsaki) into Goldsmith's integrated wrist-worn WCD that includes, among other features, a touch screen, network interface, storage device, and temperature sensor. APPLE-1011, FIG. 10, ¶¶[0085]-[0088], [0090]-[0093], [0095], [0102], [0104], [0011], [0013], [0014], [0018], [0022]-[0024], [0035], [0043], [0046], [0050], [0052], FIGS. 8, 10, claims 5, 9, 10, 12, 13, 26, 43-45 53.

78. Indeed, a POSITA would have understood that incorporating the sensor resulting from Aizawa and Ohsaki's combined teachings ("Aizawa-Ohsaki sensor") into Goldsmith's WCD would have enhanced the sensor's utility and improved the user's experience in many ways. For example, and as explained in more detail below, a POSITA would been motivated to incorporate the Aizawa-Ohsaki sensor into Goldsmith's WCD to enable a user to view and interact with heart rate data during exercise via the WCD's touch-screen display, and to enable heart rate data to be monitored by the user and/or others through any of the devices with which the WCD can communicate. APPLE-1006, ¶¶[0004], [0035]; APPLE-1011, ¶¶[0017], [0034], [0036], [0082]-[0085], [0087]-[0089], [0095], [0097], FIGS. 9A, 9B, 10.

IPR2020-01713, APPLE-1003 ¶¶ 77-78; Pet. 27-29.

81. Consistent with Aizawa, Ohsaki, and Goldsmith's disclosures, a POSITA would have found it obvious to incorporate the Aizawa-Ohsaki sensor into the rear side of Goldsmith's WCD, such that the emitter and detectors included in the sensor face the user's skin. APPLE-1006, ¶¶[0023]-[0027], FIGS. 1(a), 1(b), 2; APPLE-1009, FIGS. 1, 2; APPLE-1011, ¶[0087]. The resulting physiological monitoring device ("AOG PMD") is illustrated in the figure below, which combines Goldsmith's FIG. 9B and Aizawa's FIG. 1(a). Other components disclosed by Goldsmith such as the network interface, transceiver, and storage device, would have been located within the AOG PMD's housing, e.g., between the touch-screen display and the substrate supporting the detectors. APPLE-1011, FIGS. 8, 10.

IPR2020-01713, APPLE-1003 ¶ 81; Pet. 31.



IPR2020-01713, APPLE-1011 FIG. 9B; APPLE-1003 51; Pet. 31-41.

FISH.

The AOG-Sherman Combination

Dr. Thomas Kenny's First Declaration

61. Sherman discloses a magnetic fastening mechanism for "wrist instruments," such as wristwatches. APPLE-1013, 1:4-10. As shown in Sherman's FIGS. 2 and 5, the mechanism includes a pair of flexible strap ends having "permanently magnetizable material" of opposite polarities." *Id.*, 2:43-62; FIGS. 2 and 5.

IPR2020-01713, APPLE-1003 ¶ 61; Pet. 91-92.

Sherman

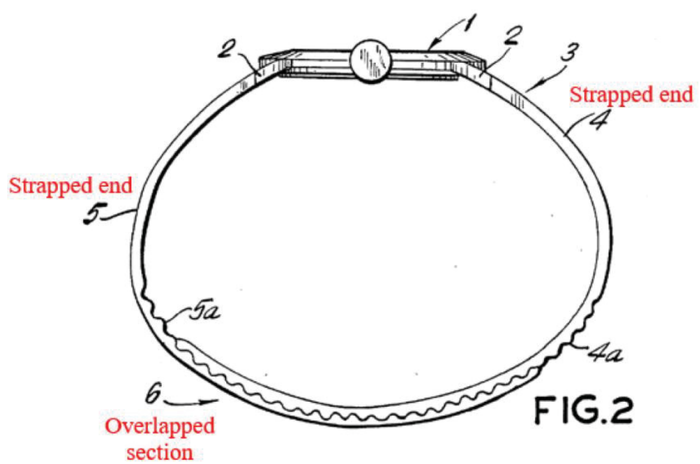


FIG.2

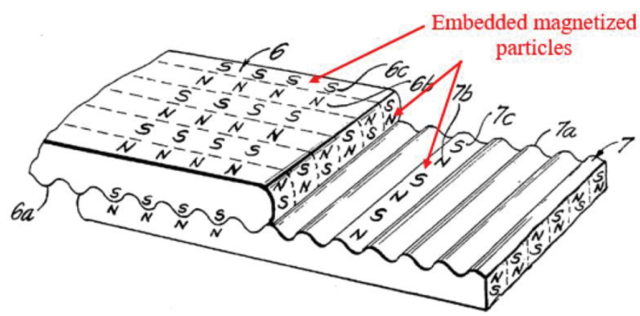


FIG.5

IPR2020-01713, APPLE-1013 FIGS. 2, 5.

FISH.

The AOG-Sherman Combination

Dr. Thomas Kenny's First Declaration

172. Sherman explains that wristwatches that are fastened, e.g., by a buckle or clasp, can be difficult to fasten and can be "unsightly or ha[ve] corners which catch upon sleeves or clothing" resulting in broken connectors or accidental snagging. APPLE-1013, 1:11-24. Sherman explains that this problem could be solved with a magnetic connector providing an "improved flexible strap" that "eliminates buckles or other types of protruding members thereby permitting a thinner, more comfortable flexible strap attachment." APPLE-1013, 1:11-25, 2:1-62, FIGS. 1-11. Sherman's strap ends "curve around the wrist of a wearer and [] overlap one another" such that the "magnetized particles provide a holding force resisting separation of the strap ends." APPLE-1013, 2:43-62.

173. A POSITA would have looked to Sherman because it provided details of a wrist-worn device fastening mechanism that addresses the above-noted problems, is easy to engage, and improves user comfort. APPLE-1013, 1:11-25, 2:9-11.

174. Combining the teachings of AOG and Sherman would have amounted to nothing more than the use of a known technique to improve similar devices in the same way and combining prior art elements according to known methods to yield predictable results. The combination involves nothing more than applying a known technique to fasten two ends of a strap for attaching a wrist worn device to a user's arm. Furthermore, the elements of the combined system would each perform similar functions they had been known to perform prior to the combination. *Id.* Indeed, a POSITA would have readily understood how to implement magnetic strap ends for a "wrist instrument" having an attachment strap. APPLE-1013, 1:5-11.

IPR2020-01713, APPLE-1003 ¶¶ 172-174; Pet. 93-94.

The AOG-Rantala Combination

Dr. Thomas Kenny's First Declaration

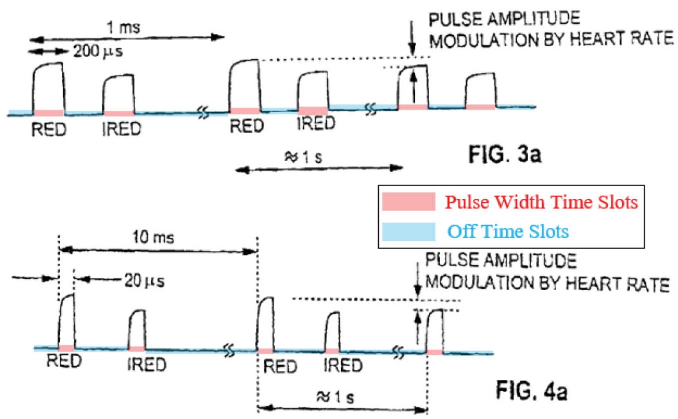
63. To optimize and minimize power consumption in the pulse oximeter, Rantala teaches that the control unit 18 changes at least one parameter, such as the pulse width, pulse repetition rate, and pulse amplitude, of the duty cycle of the pulse train driving the LEDs. APPLE-1022, 5:13-36. In more detail, Rantala

IPR2020-01713, APPLE-1003 ¶ 63; Pet. 96-97.

64. The control unit can define a signal-to-noise ratio (SNR) and change the duty cycle of a pulse train of a signal to achieve the desired SNR for a pulse train signal. APPLE-1022, 5:37-6:19, FIG. 2. Examples of a pulse train generated by the control unit are shown in Rantala's FIGS. 3a and 4a below, with the pulse width of the pulse train in FIG. 4a being narrower than the pulse width shown in the pulse train of FIG. 3a to save power in the oximeter. APPLE-1022, 6:20-56. As can be seen, the pulse trains includes pulse width time slots and off time slots.

IPR2020-01713, APPLE-1003 ¶ 64; Pet. 96-97.

Rantala



IPR2020-01713, APPLE-1022 FIG. 3a, 4a.

FISH.

The AOG-Rantala Combination

Dr. Thomas Kenny's First Declaration

176. Rantala explains that because oximeters are battery-operated mobile devices that are used in various environmental conditions and on users with varying characteristics, power consumption must be minimized/optimized without compromising the performance of the pulse oximeter. APPLE-1022, 2:25-35, Abstract. Rantala discloses the above-noted solution (i.e., controlling the duty cycle of the emitters) to address the issue of power optimization in pulse oximeters. APPLE-1022, 2:54-3:48.

177. A POSITA would have recognized that AOG's PMD, which is a wrist-worn mobile device that uses emitters to obtain user physiological measurement data, would have similar issues of power consumption as a pulse oximeter with emitters. Like Rantala's pulse oximeter, the AOG PMD is also a battery-operated mobile device that is used in various environmental conditions and on users with varying characteristics. APPLE-1011, FIG. 8, ¶¶[0053], [0100], [0041].

178. To optimize power consumption in AOG's PMD, a POSITA would have applied the power optimization method disclosed by Rantala in AOG's PMD so that power consumption in the PMD could similarly be optimized. In particular, a POSITA would have found it obvious to that one or more processors in AOG's PMD would implement Rantala's control unit functionality to optimized power by changing at least one parameter, such as the pulse width, pulse repetition rate, and pulse amplitude, of the duty cycle of the pulse train driving the AOG's LED. APPLE-1022, 5:13-6:19. Indeed, doing so would have amounted to nothing more than the use of a known technique to improve similar devices (e.g., monitoring devices with optical emitters to sense pulse) in the same way and combining prior art elements according to known methods to yield predictable results.

IPR2020-01713, APPLE-1003 ¶¶ 176-178; Pet. 97-98.

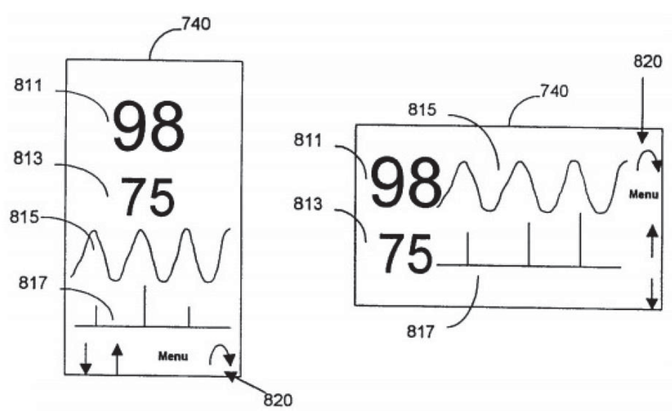
AOG (with or without Sherman/Rantala) and Ali

Dr. Thomas Kenny's First Declaration

65. Ali is directed to determining and displaying a user's pulse rate using a pulse oximeter. APPLE-1019, 4:17-26, 10:41-11:2. Ali's pulse oximeter can display information in a portrait or landscape mode in response to the selection of a key by a user. APPLE-1019, 5:23-25, 12:7-16, 12:47-67, 11:59-67. For example, pulse rate is shown in the portrait orientation in FIG. 8B and in the landscape orientation in FIG. 8C. The scales for the graphs in the two orientations are different such that the x-axis is spread across the display screen over a larger area in FIG. 8C and consequently can be viewed more clearly.

IPR2020-01713, APPLE-1003 ¶ 65; Pet. 100.

Ali



IPR2020-01713, APPLE-1019 FIGS. 8B, 8C.

FISH.

AOG (with or without Sherman/Rantala) and Ali

Dr. Thomas Kenny's First Declaration

181. Ali's pulse oximeter, like AOG's PMD, "may be incorporated as a module or built-in portion of a multiparameter patient monitoring system." APPLE-1019, 1:23-33. Recall from Sections VI.C and VII.A that AOG's PMD incorporates Goldsmith's touch screen display and user interface and also displays a user's pulse rate. APPLE-1011, ¶¶[0002], [0013], [0014], [0035]-[0038], [0082]-[0088], [0095], [0102], claims 25, 26.

182. Goldsmith acknowledges that the rendering of content on its user interface display can be incorrect due to screen formatting, scaling, and resolution issues. APPLE-1011, ¶[0049]. Goldsmith then teaches that its display is configurable in various ways based on user input to facilitate user viewing, e.g., to be able to view the contents of a graph more clearly or improve the font size of text. APPLE-1011, ¶¶[0049], [0102], [0104].

183. To the extent that Patent Owner argues that AOG does not render [1h] obvious for the reason noted above in Section VII.B.i.[1h], it would have been obvious for a POSITA to incorporate the teachings of Ali into AOG's PMD. In particular, to address problems in displaying graphs and text as described in Goldsmith, a POSITA would have included Ali's capability to select user interface orientation through a user input such that the user may have more control over the display and enjoy an improved viewing experience customized for the user's preferences. APPLE-1011, ¶¶[0102], [0104], [0049], [0055], claim 30.

IPR2020-01713, APPLE-1003 ¶¶ 181-183; Pet. 101-103.

Instituted IPR2020-01716/-01733/-01737 Grounds

Ground	Challenged Claim(s)		
	IPR2020-01716	IPR2020-01733	IPR2020-01737
Obvious (§ 103) over Aizawa, Mendelson-2003, Ohsaki, Mendelson-2006	1-18, 20, 22-30		
Obvious (§ 103) over Aizawa, Mendelson-2003, Ohsaki, Mendelson-2006, Beyer	19-21		
Obvious (§ 103) over Aizawa, Mendelson-2003, Ohsaki, Goldsmith		1-17	1-12, 14-27
Obvious (§ 103) over Aizawa, Mendelson-2003, Ohsaki, Goldsmith, Ali		1-17	
Obvious (§ 103) over Aizawa, Mendelson-2003, Ohsaki, Goldsmith, Sherman			13

FISH.

Aizawa-Mendelson-2003-Ohsaki Combination

Dr. Kenny's First Declaration

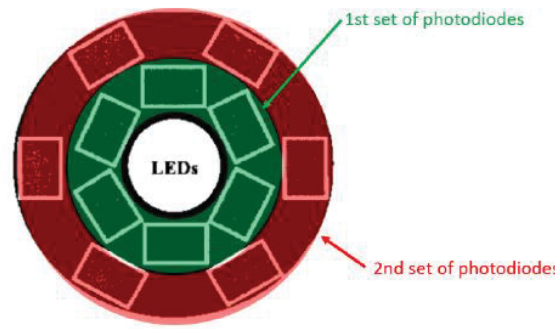
Mendelson-2003 further teaches that this configuration "widen[s] the active area of the PD which helps to collect a bigger portion of backscattered light intensity," thereby improving the light collection efficiency *Id.*, 3019. This configuration thus allows additional light to be captured, which in turn allows a lower brightness of LEDs to be used, which in turn would consume less power.

IPR2020-01737 APPLE-1003, ¶ 70.

A POSITA would have been motivated to provide the well-known feature of providing multiple rings of detectors to a pulse sensor to achieve the predictable benefits offered by Mendelson-2003's description of the same. In fact, Aizawa itself contemplates, and is thus capable of supporting, the addition of extra detectors to improve light collection efficiency, although it does not disclose whether they may be arranged as two concentric rings. APPLE-1006, [0032]. Moreover, as noted above, Mendelson-2003 expressly contemplates adding an additional ring of detectors to a conventional 1-ring PD arrangement precisely as found in Aizawa. APPLE-1024, 3016.

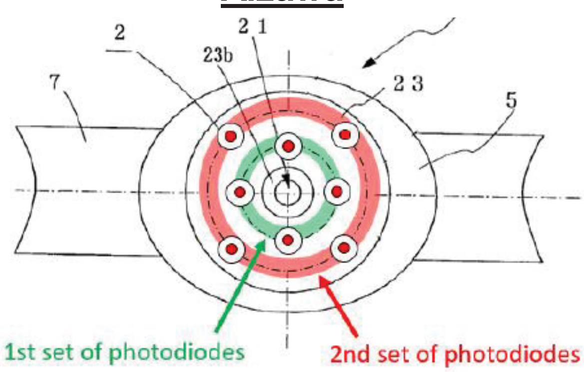
IPR2020-01737 APPLE-1003, ¶ 75.

Mendelson-2003



IPR2020-01737 APPLE-1024, FIG. 1
(as annotated at APPLE-1003 ¶¶ 55, 70).

Aizawa



IPR2020-01737 APPLE-1006, FIG. 1(a)
(as annotated at APPLE-1003 ¶¶ 97, 107).

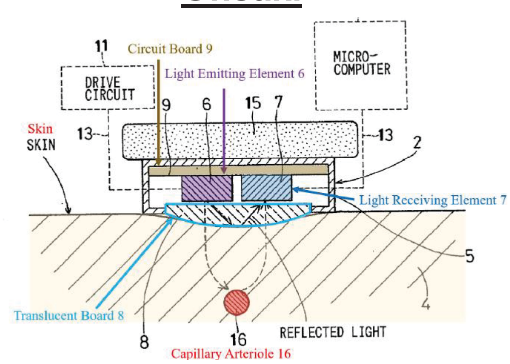
Aizawa-Mendelson-2003-Ohsaki Combination

Dr. Kenny's First Declaration

76. A POSITA would have been able and motivated to *further* combine the teachings of Aizawa-Mendelson-2003 with the teachings of Ohsaki such that the cover of Aizawa-Mendelson-2003's wrist-worn sensor would include a convex surface, improving adhesion between a subject's wrist and a surface of the sensor. APPLE-1014, [0025] (the convex surface prevents slippage of the detecting element from its position on the subject's wrist, and the convex nature of the surface suppresses the "variation of the amount of the reflected light" that reaches the detecting element).

IPR2020-01737 APPLE-1003, ¶ 76.

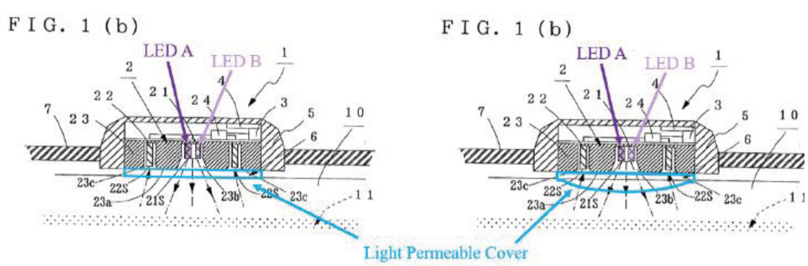
Ohsaki



IPR2020-01737 APPLE-1014, FIG. 2 (as annotated at APPLE-1003 ¶ 77).

79. Thus, as I show below, a POSITA would have found it obvious to modify the sensor's flat cover (left) to include a lens/protrusion (right), similar to Ohsaki's translucent board 8, so as to improve adhesion between the user's wrist and the sensor's surface, improve detection efficiency, and protect the elements within the sensor housing. APPLE-1014, [0025] (explaining that the convex surface of translucent board 8 prevents slippage of a detecting element from its position on the wrist, and suppresses the "variation of the amount of the reflected light" that reaches the detecting element).

IPR2020-01737 APPLE-1003, ¶ 79.



IPR2020-01737 APPLE-1006, FIG. 1(b) (as annotated at APPLE-1003 ¶ 79).

FISH.

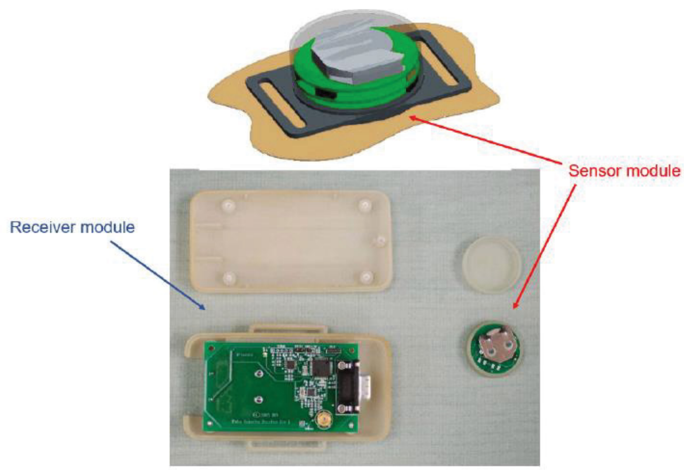
Aizawa-Mendelson-2003-Ohsaki-Mendelson-2006 Combination

Dr. Kenny's First Declaration

86. A POSITA would have been motivated to combine Mendelson-2006's receiver module and PDA with Aizawa's detector to enable a convenient and user-friendly interface with Aizawa's detector (which does not include a separate display/interface) and the ability to remotely monitor the user's physiological parameters. APPLE-1016, 914. A POSITA would have recognized that applying Mendelson-2006's receiver module and PDA to Aizawa's sensor would have led to predictable results without significantly altering or hindering the functions performed by Aizawa's sensor. Here, a POSITA would have had a reasonable expectation of success in making this modification, and would have reasonably expected to reap benefits of convenient interface with and monitoring of Aizawa's sensor.

IPR2020-01716 APPLE-1003, ¶ 86.

Mendelson-2006



IPR2020-01716 APPLE-1015, FIGS. 1, 3

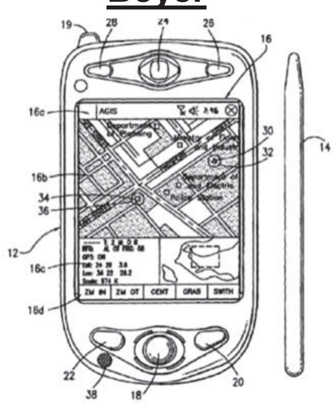
Aizawa-Mendelson-2003-Ohsaki-Mendelson-2006-Beyer Combination

Dr. Kenny's First Declaration

211. A POSITA would have considered using a different PDA than the one mentioned in Mendelson-2006 to be obvious and a routine and conventional design choice. Indeed, using a PDA that is also a mobile phone, as evidenced by Beyer, was common practice well before the Critical Date, and there was nothing new or inventive about changing one type of PDA for another.

IPR2020-01716 APPLE-1003, ¶ 211.

Beyer



IPR2020-01716 APPLE-1019, FIG. 1.

Mendelson-2006

IPR2020-01716 APPLE-1015, FIG. 3.

FISH.

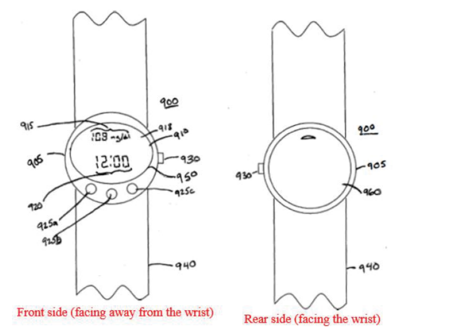
Aizawa-Mendelson-2003-Ohsaki-Goldsmith Combination

Dr. Kenny's First Declaration

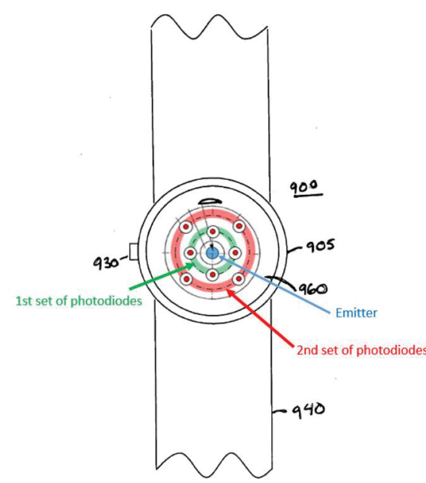
89. Goldsmith states that its watch device may receive data "directly from a sensor transmitter on the patient's skin," adding that "the controller device may monitor heart rate," and a POSITA would have understood that Goldsmith's heart rate sensor could be implemented by integrating the Aizawa-Mendelson-2003-Ohsaki sensor into Goldsmith's watch controller device, which would have enhanced the sensor's utility and improved the user's experience in many ways. APPLE-1027, [0087], [0095]. For example, a POSITA would have incorporated the Aizawa-Mendelson-2003-Ohsaki sensor into Goldsmith's watch device to enable a user to view and interact with heart rate data during exercise via the Goldsmith's touch-screen display, and to enable heart rate data to be monitored by the user and/or others through any of the devices with which Goldsmith's device can communicate. APPLE-1006, [0004], [0035]; APPLE-1027, [0017], [0034], [0036], [0082]-[0085], [0087]-[0089], [0095], [0097], FIGS. 9A, 9B, 10.

IPR2020-01737 APPLE-1003, ¶ 89.

Goldsmith



IPR2020-01737 APPLE-1027, FIGS. 9A, 9B.



IPR2020-01737 APPLE-1003, ¶ 93.

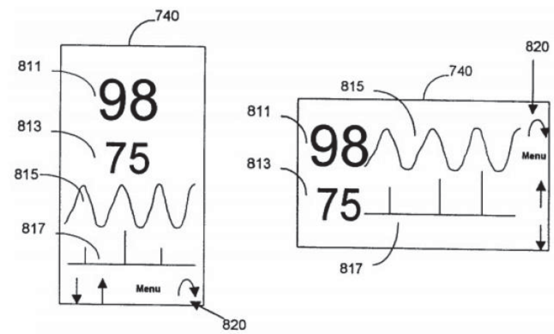
Aizawa-Mendelson-2003-Ohsaki-Goldsmith-Ali Combination

Dr. Kenny's First Declaration

190. Accordingly, it would have been obvious for a POSITA to incorporate the teachings of Ali into Aizawa-Mendelson-2003-Ohsaki-Goldsmith. In particular, to address problems in displaying graphs and text as described in Goldsmith, a POSITA would have included Ali's capability to select user interface orientation through a user input such that the user may have more control over the display and enjoy an improved viewing experience customized for the user's preferences. APPLE-1027, [0102], [0104], [0049], [0055], claim 30.

IPR2020-01733 APPLE-1003, ¶ 190.

Ali



IPR2020-01733 APPLE-1046, FIGS. 8B, 8C.

FISH.

Aizawa-Mendelson-2003-Ohsaki-Goldsmith-Sherman Combination

Dr. Kenny's First Declaration

211. Goldsmith generally discloses the use of a fastener for carrying a measurement device on a user's body (e.g., wrist) but provides no details describing the fastener. APPLE-1027, [0039]. Accordingly, to secure the Aizawa-Mendelson-2003-Ohsaki-Goldsmith device onto a user's wrist using Goldsmith's fastening mechanism, a POSITA would have been motivated to look to other wearable, wrist worn devices such as Sherman's, for details regarding a mechanism for fastening a monitoring device.

213. A POSITA would have looked to Sherman because it provided details of a wrist-worn device fastening mechanism that addresses the above-noted problems, is easy to engage, and improves user comfort. APPLE-1047, 1:11-25, 2:9-11

IPR2020-01737 APPLE-1003, ¶¶ 211-213.

Sherman

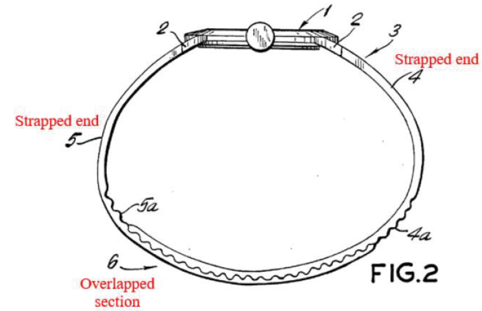


FIG.2

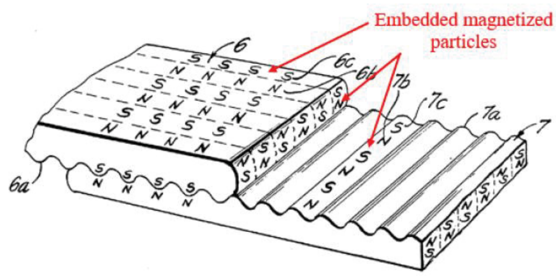


FIG.5

IPR2020-01737 APPLE-1047, FIGS. 2, 5.