

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

MASIMO CORPORATION,

Petitioner,

v.

APPLE INC.,

Patent Owner.

Case No. IPR2023-00734

U.S. Patent No. 10,942,491

SUPPLEMENTAL DECLARATION OF R. JAMES DUCKWORTH, PH.D

I declare that all statements made herein on my own knowledge are true and that all statements made on information and belief are believed to be true, and further, that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

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

Dated: 4/19/2024



R. James Duckworth, Ph.D

TABLE OF CONTENTS

	Page No.
I. INTRODUCTION	1
II. INFORMATION AND MATERIALS CONSIDERED.....	1
III. EXPERIENCE AND QUALIFICATIONS	5
IV. APPLICABLE LEGAL STANDARDS	5
V. SUMMARY OF OPINIONS	6
A. Apple’s Arguments Do Not Have Merit With Respect to the Obviousness of Claim 7 over Kotanagi and Honda	9
1. Apple does not dispute the Petition’s affirmative motivations to combine Kotanagi and Honda.	9
2. Kotanagi’s listing of a particular dimension would not have prevented a POSITA from combining with Honda.	11
3. Honda’s generalized goals of “quick and efficient” charging would not have deterred a Kotanagi / Honda combination.	16
4. Apple’s arguments appear to depend on a false legal standard.	23
5. Apple’s arguments fail to account for the “available space” and the potential for enlargement.....	24
6. The Fraser reference Apple cites actually undermines Apple’s argument and shows expectation of success.....	30
7. Apple’s arguments are not consistent with the physics of wireless charging.	34

TABLE OF CONTENTS
(cont'd)

	Page No.
8. Apple’s modeling is fundamentally flawed in several ways.	43
B. Claim 14	48
C. Claim 1	49
1. Kotanagi’s existing electrodes would obtain an ECG.....	51
2. Kotanagi’s existing electrodes plus additional electrodes would obtain an ECG.....	58
D. Claims 13 and 17	60
E. Claims 2–6, 8–12, 15–16, and 18–19.....	60
VI. CONCLUSION.....	60

I. INTRODUCTION

327. I previously submitted an initial declaration on March 20, 2023, in connection with this IPR, IPR2023-00734. I incorporate by reference the entire contents of my earlier declaration, which has been submitted as EX1003. Also for convenience, I continue paragraph numbering in this declaration at paragraph 327 because my previous declaration contained 326 numbered paragraphs.

328. I have been asked by counsel to review additional materials and render my expert opinion in connection with additional technical matters related to the Inter Partes Review of U.S. Patent 10,942,491.

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

II. INFORMATION AND MATERIALS CONSIDERED

330. In order to render opinions on this matter, in addition to the materials I listed in my previous declaration, I have reviewed the following materials:

Masimo's Exhibit No.	Description
1052	Deposition Transcript of Brian Anthony, Ph.D.
1053	U.S. Publication No. 20120078116 ("Yamashita")
1054	<i>Apple Inc. v. Masimo Corporation, et al.</i> , Aug. 31, 2023, Joint Claim

	Construction, Case No. 1:22-cv-01378-MN (D. Del.)
1055	U.S. Patent No. 9,583,256 B2 (“Lapetina”)
1056	U.S. Provisional Application No. 61/886,930 (“Lee Provisional”)
1057	U.S. Publication No. 20150135310 (“Lee Nonprovisional”)
1058	<i>Apple Inc. v. Masimo Corporation, et al.</i> , Jul. 13, 2023, Joint Claim Construction Chart, Case No. 1:22-cv-01378-MN (D. Del.)
1059	<i>Apple Inc. v. Masimo Corporation, et al.</i> , Aug. 31, 2023, Joint Claim Construction Brief, Case No. 1:22-cv-01378-MN (D. Del.)
1061	E. Ertin et al., <i>AutoSense: Unobtrusively Wearable Sensor Suite for Inferring the Onset, Causality, and Consequences of Stress in the Field</i> (2011)
1062	Final Rejection in U.S. Application No. 18/075,253

Apple’s Exhibit No.	Description
2001	U.S. Patent Pub. No. 2014/0107493 to Yuen et al. (“Yuen”)
2003	U.S. Patent Pub. No. 2017/0011210 to Cheong et al. (“Cheong”)
2004	U.S. Patent No. 7,946,758 to Mooring (“Mooring”)
2005	U.S. Patent Pub. No. 2014/0139486 to Mistry et al. (“Mistry”)
2006	U.S. Patent No. 8,229,535 to Mensinger et al. (“Mensingher”)
2007	U.S. Patent No. 7,682,070 to Burton (“Burton”)

Apple's Exhibit No.	Description
2010	U.S. Prov. App. No. 61/943,004 ("Cheong Provisional")
2011	File History of U.S. Patent App. No. 17/188,995
2012	File History of U.S. Patent App. No. 17/951,973
2013	File History of U.S. Patent App. No. 18/075,253
2014	File History of U.S. Patent App. No. 18/119,175
2019	Prosecution History of US Patent No. 10,627,783
2020	U.S. Patent Pub. No. 2014/0275852 to Hong et al. ("Hong")
2021	U.S. Patent No. 4,448,199 to Schmid ("Schmid")
2023	S. Annam, "Scholar Works at UT Tyler Four-Coil Wireless Power Transfer Using Resonant Inductive Coupling," Electric Engineering Theses, Paper 19 (2012).
2024	Z. Atrachchi et al., "Efficiency Examination of The Circular Coils with Two Types of Cross-Sections for WPT System," UMDC-SDSP (2020).
2025	Y. Li et al., "Maximizing Transfer Distance for WPT via Coupled Magnetic Resonances by Coupling Coils Design and Optimization," IEEE Access, vol. 8, pp. 74157–74166 (2020).
2026	Y. Li et al., "Influences of Coil Radius on Effective Transfer Distance in WPT System," IEEE Access, vol. 7, pp. 125960–125968 (2019).
2027	Y. Li et al., "Directional characteristics of wireless power transfer via coupled

Apple's Exhibit No.	Description
	magnetic resonance,” Electron., Vol. 9, No. 11, pp. 1–14 (2020).
2028	K. A. Mohamad et al., “Effect of Circular Coil Dimension on Resonant Coupling Wireless Power Transfer System,” J. Telecommun. Electron. Comput. Eng., Vol. 10, No. 2–6, pp. 19–23 (2018).
2029	A. P. Sample et al. “Analysis, experimental results, and range adaptation of magnetically coupled resonators for wireless power transfer,” IEEE Trans. Ind. Electron., Vol. 58, No. 2, pp. 544–554 (2011).
2030	G. Vigneau et al., “Design and modeling of PCB coils for inductive power charging,” Wirel. Power Transf., Vol. 2, No. 2, pp. 143–152 (2015).
2031	R. Vinge, “Wireless Energy Transfer by Resonant Inductive Coupling,” p. 83 (2015).
2032	F. Wen et al., “Research on optimal receiver radius of wireless power transfer system based on BP neural
2033	U.S. Patent Pub. No. 2007/0228404 to Tran et al. (“Tran”)
2034	U.S. Patent Pub. No. 2005/0274971 to Wang et al. (“Wang”)
2035	U.S. Patent Pub. No. 2010/0193804 to Brown et al. (“Brown”)
2036	U.S. Patent Pub. No. 2005/0030518 to Nishi et al. (“Nishi”)
2037	U.S. Patent No. 7,455,423 to Takenaka (“Takenaka”)
2038	Declaration of Dr. Brian Anthony, Ph.D.
2039	Deposition Transcript of R. James Duckworth, Ph. D.

Apple's Exhibit No.	Description
2040	G. Patancheru, "Wearable Hear Rate Monitoring Unit"
2041	Pulse Sensor Easy to Use Heart Rate Sensor and Kit (World Famous Electronics)
2042	"Bringing Vital Signs Monitoring into the Wearable Domain" (April 2023)

331. Any other materials referenced directly or indirectly in this declaration.

III. EXPERIENCE AND QUALIFICATIONS

332. In my earlier declaration, I outlined my qualifications. A true and correct copy of my curriculum vitae (CV) has been submitted as EX1004.

333. I make this declaration based on personal knowledge, and I am competent to testify about the matters set forth herein.

IV. APPLICABLE LEGAL STANDARDS

334. I am an electrical and computer engineer by training and profession. The opinions I express in this Declaration involve the application of my knowledge and experience to the evaluation of the '491 Patent and certain prior art to the '491 Patent.

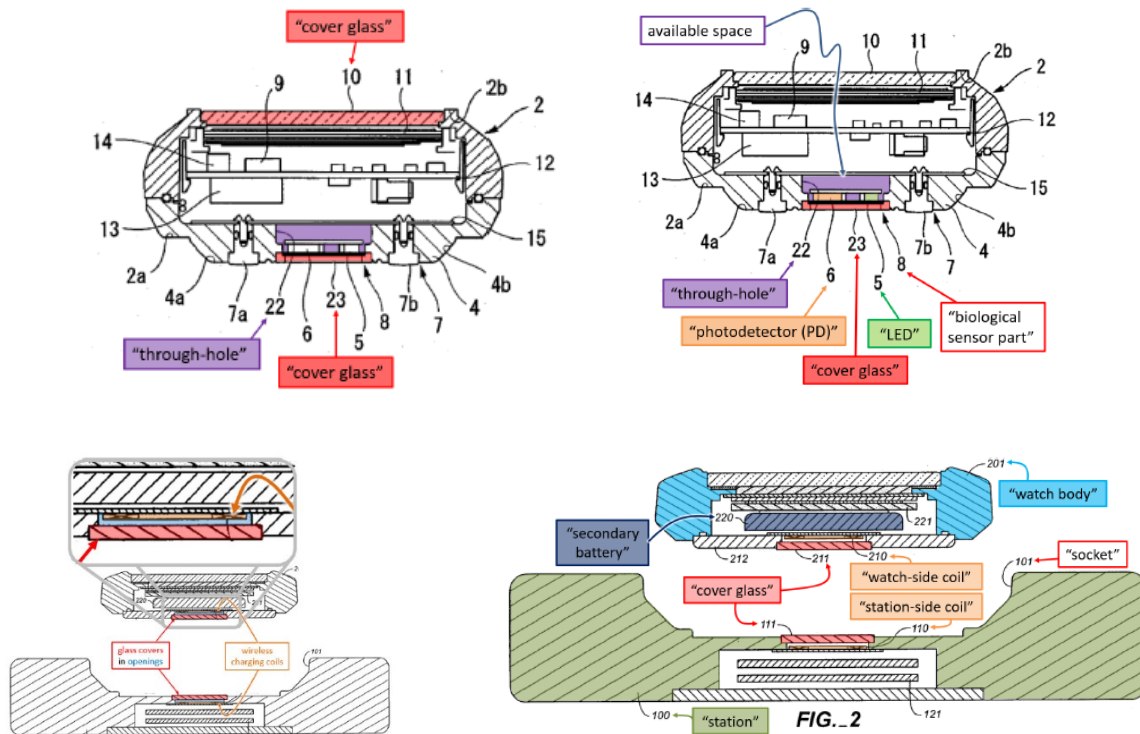
335. Although I have been involved as a technical expert in patent matters before, I am not an expert in patent law. Therefore, I have been advised of certain principles of patent law applicable in this matter, which I have used in arriving at my determinations and opinions.

V. SUMMARY OF OPINIONS

336. My earlier declaration, which has been submitted as EX1003, describes my opinions regarding the grounds of unpatentability of Claims 1–19 of the ’491 patent. In this declaration I address Apple’s response to those grounds of unpatentability provided in the Patent Owner’s Response (“POR”).

337. To summarize my opinions, I continue to hold to my conclusion that Claims 1-19 of the ’491 patent would have been obvious to a POSITA based on the teachings of the prior art at the time of invention. My opinions are expressed in the paragraphs below:

338. It is my opinion that Apple’s POR does not identify missing elements in the references cited in the Petition. Instead, Apple argues that the petition does not demonstrate “how or why” a POSITA would have made the proposed obviousness combinations. POR at 1. To the contrary, the petition explains in detail how and why a POSITA would have been motivated to combine the references in the grounds and how and why such a combination would have been obvious. For example, each ground provides descriptions showing what a POSITA would do, and how (*e.g.*, Pet. at 17, 21, 23–25), and these descriptions include detailed color figures such as those shown below:



Id.

339. In my previous declaration and the accompanying petition each Ground also devotes a section to motivations—why a POSITA would have combined the references. *See, e.g.*, Pet. at 27–30, 53–54, 66–66, etc. For Claim 7, the Petition and my previous declaration cited motivating passages in both Kotanagi and Honda, illustrated structural similarities, and explained technical compatibilities suggesting a combination would succeed. Pet. at 27–28. The Petition provided additional motivations even outside these specifically labeled sections.

340. Apple next alleges that language in the Petition’s cited obviousness references (such as Kotanagi and Honda) somehow refutes the way these references

are characterized in the Petition. POR at 1, 3–5. But Apple’s arguments fail to credit what a POSITA would have learned from the full teachings of these combined references. Such a person would not have been constrained by sub-part dimensions listed for a Kotanagi embodiment and would have at least known the basics (like wireless charging coils) from Honda. Apple’s arguments miss that a POSITA would have been motivated to enlarge Kotanagi’s cover glass and consider various tradeoffs to position and configure the charging coil. Indeed, Apple’s expert, Dr. Anthony, stated that a POSITA could have used these references to align the coils as claimed. EX1052 at 210:6–11. I agree. Further, even under Apple’s improper (10 mm) dimensional constraints, Apple’s own evidence (EX2028) shows that coils having a 10 mm diameter are “suitable to charge wearable and medical devices.” EX2028 at 1–2, 5.

341. Apple states that a wireless charging coil “could” be provided in Kotanagi’s through hole 22. POR at 4. Apple then points to an allegedly “better alternative” based on Fraser (*id.* at 5) and ignores the motivations and benefits described in the Petition and my accompanying declaration. I understand that the law does not require Petitions to rely on the most desirable combination. Moreover, Apple’s arguments misrepresent the physics of flux distribution around coils. Correctly understood, Fraser’s teachings bolster the invalidity of the ’491 patent.

342. Finally, Apple argues that because Kotanagi describes skin contact detection as an intended use for its rear-facing electrodes, a POSITA would not have applied Choi’s teachings to use Kotanagi’s electrodes for ECG measurement. But skin contact is fully consistent with ECG measurement. Accordingly, as explained in the Petition and my accompanying declaration, a POSITA would have considered these teachings complimentary of each other and combined them with an expectation of success.

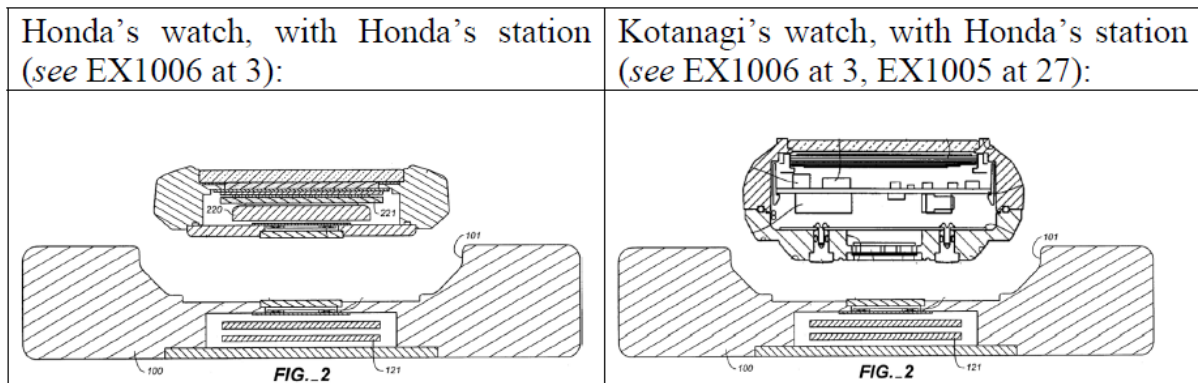
A. Apple’s Arguments Do Not Have Merit With Respect to the Obviousness of Claim 7 over Kotanagi and Honda

343. Apple’s POR uses pages 31–61 to argue for the validity of Claim 7, but fails to sufficiently rebut the Petition or the supporting evidence found in my previous declaration.

1. Apple does not dispute the Petition’s affirmative motivations to combine Kotanagi and Honda.

344. From my review it does not appear that Apple’s POR ever directly contradicts or disputes any of the affirmative motivations to combine Kotanagi and Honda provided in the Petition. *E.g.*, Pet. at 27–30, 53–54, 65–66, etc. For instance, Apple does not deny that both references teach biosensing watches with heart rate detection or that Kotanagi refers to charging in a “contactless state.” EX1005 ¶(0053). Apple does not deny that Honda teaches wireless charging details that are directly applicable to biosensing watches. EX1006 6:14–20; 8:40–42. EX1003 ¶130.

Apple does not deny that both Kotanagi and Honda have glass-covered rear openings, or that Honda positions a wireless receive coil behind its glass. Nor does Apple deny that the figures appear to show Kotanagi's watch profile fits well into Honda's charging station (aligning Kotanagi's rear glass cover with Honda's charging coil), even without modifying that station:



Pet. at 86. Because all the motivations described in the Petition stand unrebutted, Apple's POR would need to show significant countervailing evidence. It is my opinion that the POR failed to show any such countervailing evidence. Indeed, Apple's expert stated that wireless charging can be an improvement over wired charging as taught by Kotanagi (EX1052 at 45:13–46:2), including being preferable for “waterproofness” (*id.* at 169:16–171:7). I agree that wireless charging can be an improvement over wired charging, including for “waterproofness.”

2. Kotanagi’s listing of a particular dimension would not have prevented a POSITA from combining with Honda.

345. Apple argues that an alleged 20 mm “size restriction” on Kotanagi’s protruding part 4 limits the coil size to 10 mm, and thus limits charging speed. POR at 3, 34–35. I do not agree with Apple’s premise or conclusion with regard to the 20 mm protrusion. However, even these sizes would not have discouraged a POSITA from making the Kotanagi / Honda combination provided in the grounds of the Petition. Particularly, a paper cited by Apple (for other purposes, e.g., used by Dr. Anthony to explain his modeling methodology and approach) validates the use of coils that are approximately 10 mm or smaller, showing that 6.5 mm and 9.5 mm coils are “suitable to charge wearable and medical devices.” EX2028 at 2, 5. I note that EX2028 discusses “resonant inductive coupling,” a subclass of inductive coupling wherein “both [transmitting and receiving] coils are operating at the same resonant frequency.” *Id.* at 2. It is my opinion that a POSITA would have understood how to apply the principles of resonance coils and induction coils. *See, e.g.,* EX1015 (“Park”) at 22 (“the transmitting coil (14) may be the transmitting induction coil and/or the transmitting resonance coil illustrated in FIG. 1”); *id.* at 24 (“[t]he receiving coil (32) may be the receiving resonance coil and/or the receiving induction coil illustrated in FIG. 1”); EX1001 (’783 patent) at 44:55–57 (“The transmit coil 1832 may transmit power to the device 100 via electromagnetic

induction or magnetic resonance.”). The paper’s (EX2028’s) Figure 13 shows that with a 9-turn receiver coil of 9.5 mm diameter (RX7) and separation distance of 1 cm, a matching diameter transmitter coil (9-turn, 9.5 mm diameter) can output power of 8 Watts. And Apple’s expert stated that the wattages in Figure 13 “are a good power level” for a small wearable device. EX1052 at 112:8–113:4. I agree.

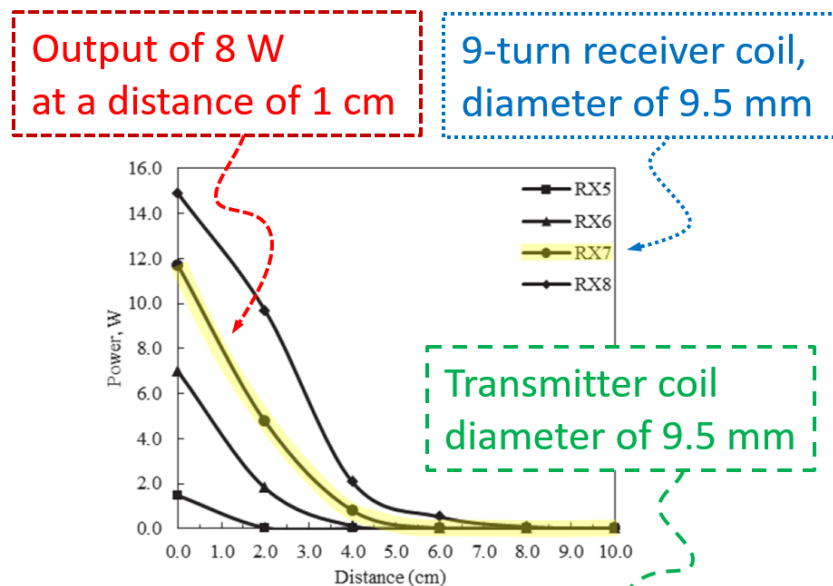


Figure 13: Output power over distance using TX3 ($D_{T2} = D_{R2} = 9.5 \text{ mm}$).

EX2028 Fig. 13. This power transmission of 8 Watts is sufficient to charge a wearable medical device. For example, this exhibit states that power transmission examples it provides are “suitable to charge wearable and medical devices.” *Id.* at 5. Accordingly, Apple’s own evidence shows a likelihood of success in combining Kotanagi and Honda, even if this were to require coils with a diameter of 10 mm or less. Such an arrangement would be sufficient for obviousness because I understand

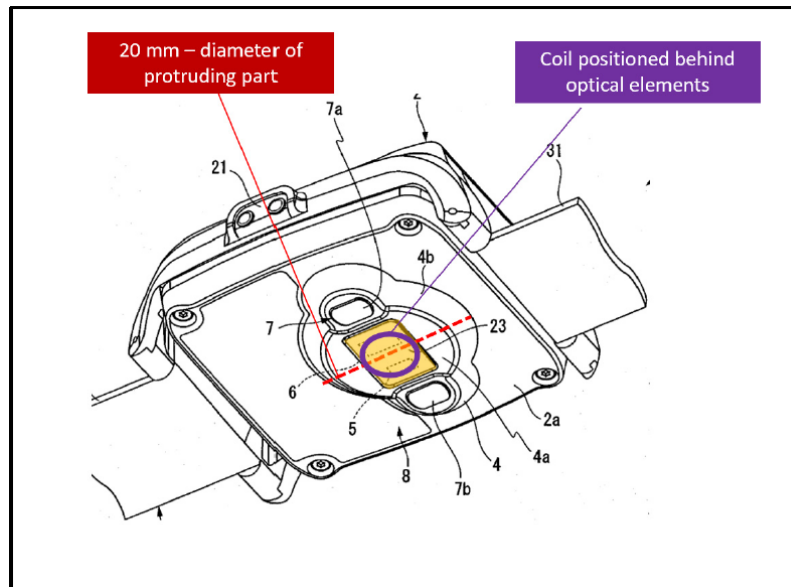
that courts have concluded that a combination may be any “suitable option.” *Intel Corp. v. Qualcomm Inc.*, 21 F.4th 784, 800 (Fed. Cir. 2021) (showing a combination was sufficient because it was a “suitable option.” (quoting *PAR Pharm., Inc. v. TWI Pharms., Inc.*, 773 F.3d 1186, 1197–98 (Fed. Cir. 2014))).

346. Moreover, if, under the relevant engineering trade-offs, a POSITA wanted to increase charging speed, consistent with Honda’s teachings, Honda would have provided the motivation and information to either re-size or reshape Kotanagi’s protrusion and/or cover glass to provide for a larger coil. Such modifications are consistent with Kotanagi’s teachings because, for example, Kotanagi explains its protrusion “may have any shape,” and its embodiments are non-limiting. EX1005 ¶¶ 74, 75.

347. Further, Apple bases its arguments entirely on Kotanagi’s description of the protruding part diameter in Figure 8 as “not greater than 20 mm.” *Id.* at 20. This portion of Kotanagi exclusively relates to Figure 8 (EX1005, ¶¶76–77), but Apple improperly applies it to Figure 5. Indeed, Apple’s expert stated that Figure 5 is scaled differently from figures 8–10. EX1052 at 80:11–22. I agree. Thus, it is my opinion that Apple’s wireless charging analysis is incorrect.

348. In the POR, Apple labels Figure 5 (not Figure 8) with this alleged constrained, measuring the 20 mm for the **widest** diameter at the base of the protruding part 4, even though it is the **narrowest** portion that contacts living body

with a “light force.” Moreover, Apple simply superimposes its assumed dimensions and estimates that the cover glass is “roughly half or less than half (~10 mm or less)” the diameter of the protrusion.



POR at 38.

349. However, even if Apple had annotated the correct figure in an accurate manner, Kotanagi touts the 20 mm size allows for easily pressing it against the living body surface “with a light force.” EX1005 ¶¶ 37, 77. A POSITA would not have taken such a specific size as a requirement, given that many other sizes can also be pressed “with a light force” (and larger surfaces tend to spread force more effectively for a “light force”). Furthermore, Kotanagi later explains its protruding part “may have any shape” that protrudes, and its technical scope is “not limited to the embodiment described above.” EX1005 ¶¶ 74, 75. Therefore, by its own disclosure

and as understood by a POSITA, Kotanagi's teachings are not limited to the particular dimensional constraint urged by Apple.

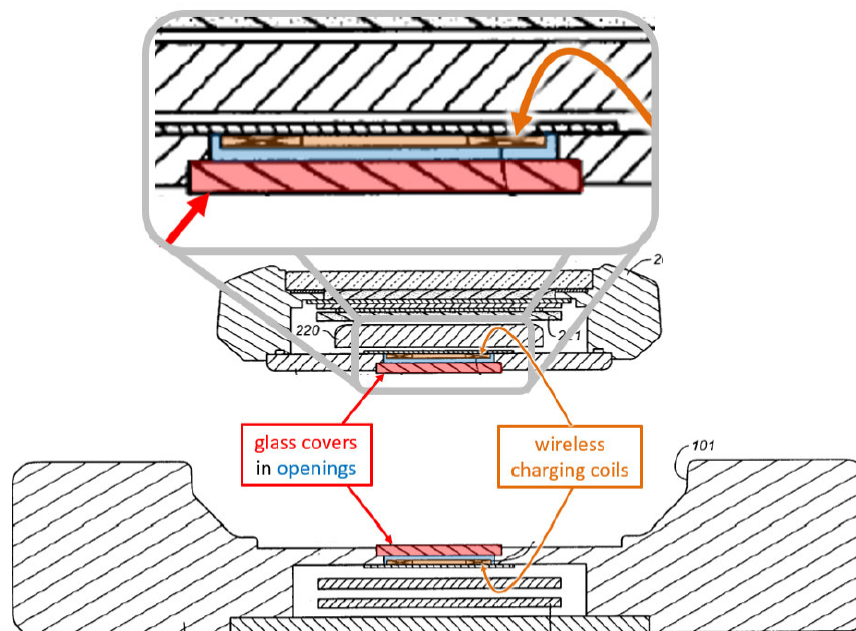
350. Even disregarding Kotanagi's teachings that it is not limited to particular dimensions, the grounds of invalidity are based upon the **combination** of Kotanagi's and Honda's teachings to demonstrate obviousness of the '491 patent's claims. An alleged "upper bound" diameter "according to [Kotanagi's] invention" (POR at 32) would not apply to such a combination—a combination that by definition lies outside of "Kotanagi's invention." Indeed, Apple's expert stated that Honda includes no such size constraints for its coil. EX1052 at 177:2–178:15. I agree. Honda does not include such size restraints for its coil.

351. Moreover, it is my opinion that Apple's POR fails to account for the abilities of a POSITA, as I understand that "A person of ordinary skill in the art is also a person of ordinary creativity, not an automaton." *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 421 (2007). In adding Honda's coil to Kotanagi's device, a POSITA would have weighed the benefits and drawbacks of coil sizes and shapes, as well as potential adjustments to accommodate a wider coil or more coil turns. I understand that courts have previously stated that "a given course of action often has simultaneous advantages and disadvantages, and this does not necessarily obviate motivation to combine," and a POSITA would have considered such advantages and disadvantages. *Medichem, S.A. v. Rolabo, S.L.*, 437 F.3d 1157, 1165 (Fed. Cir.

2006); *see* Paper 14 (Institution Decision) at 36–37. Apple’s expert stated that engineers typically perform optimization that involves trade-offs to address constraints. EX1052 at 19:17–20:20. I agree. It is my opinion and experience that engineers typically perform trade-offs to address constraints.

3. Honda’s generalized goals of “quick and efficient” charging would not have deterred a Kotanagi / Honda combination.

352. Apple argues that Kotanagi’s alleged “size restrictions” are “contrary to” and “frustrate” Honda’s goal of “quick and efficient” wireless charging. POR at 3, 34, 42–44, 53, 57. Honda is cited for the underlying wireless charging features, as illustrated in the Petition:



See EX1006 at 3 (Fig. 2).

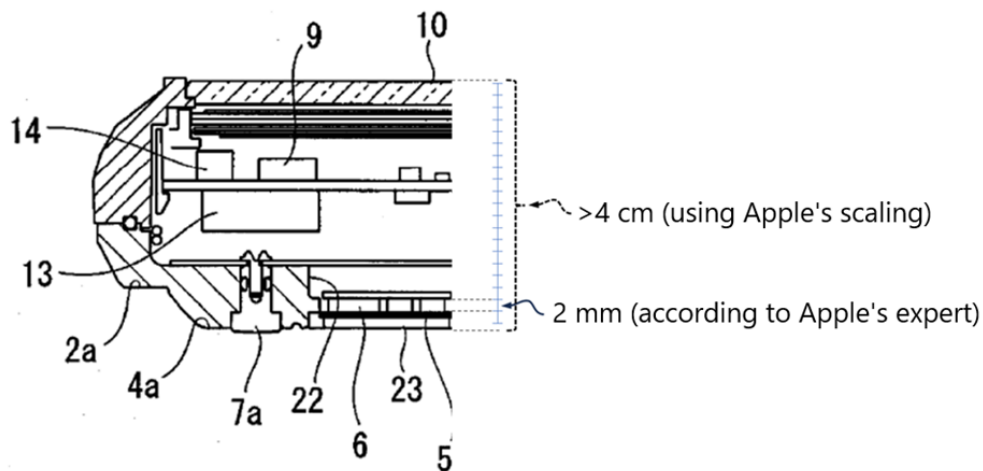
E.g., Pet. at 23. Such coil placement is consistent with both: **Kotanagi**'s teaching to charge in a "contactless state" (EX1005 ¶(0053)); and the purpose expressed in the very first sentence of **Honda**: device charging "in a non-contact fashion." EX1006 col. 1:4–6. Moreover, Apple's expert stated that, depending on the intended use, devices "can benefit from either fast charge or trickle charge or a little bit of charge." EX1052 at 18:22–19:6. I agree. Devices can benefit from various charging speeds based on intended use.

353. Thus, although the claims do not require any particular charging speed, Honda's teachings about fast and efficient charging would have helped motivate the combination, including to suggest potential modifications to a POSITA.

354. Moreover, Apple mischaracterizes Honda as only teaching optimum charging speeds (e.g., POR at 41–45), but Honda teaches more than this. *See generally* EX1006. I understand that courts have reasoned that references may be relied upon for all that they would have reasonably suggested to a POSITA. *Merck & Co. v. Biocraft Laboratories*, 874 F.2d 804, 807 (Fed. Cir., 1989). Honda teaches the basic fundamentals of wireless charging (such as inclusion of wireless charging coils) in addition to its aspirational goal of fast and efficient charging.

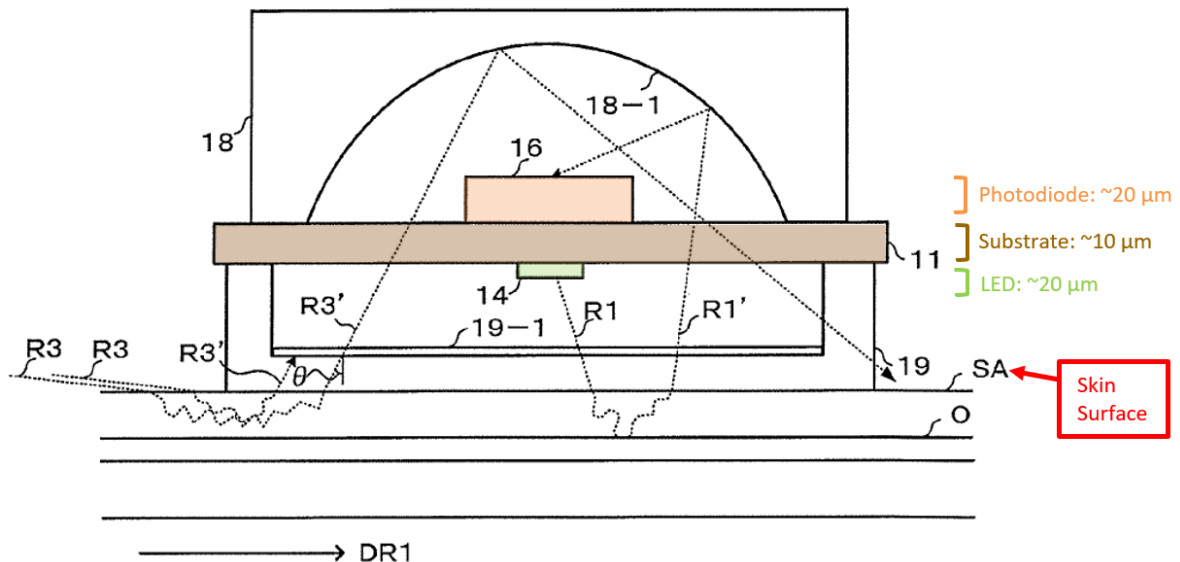
355. With regard to charging distance, Apple argues that the combination of Kotanagi and Honda would require "precisely the increased spacing" Honda seeks to avoid (POR at 43) and that "the optical elements would span ~2-4 mm (or more)

in depth/vertical dimension.” EX2038 ¶150. Apple does not support this last assertion or explain any underlying assumptions. Apple’s argument depends on the improper assumption that Figure 5 is drawn to exact relative dimensions. However, by implication, such an assumption would result in a watch greater than 4 centimeters tall:



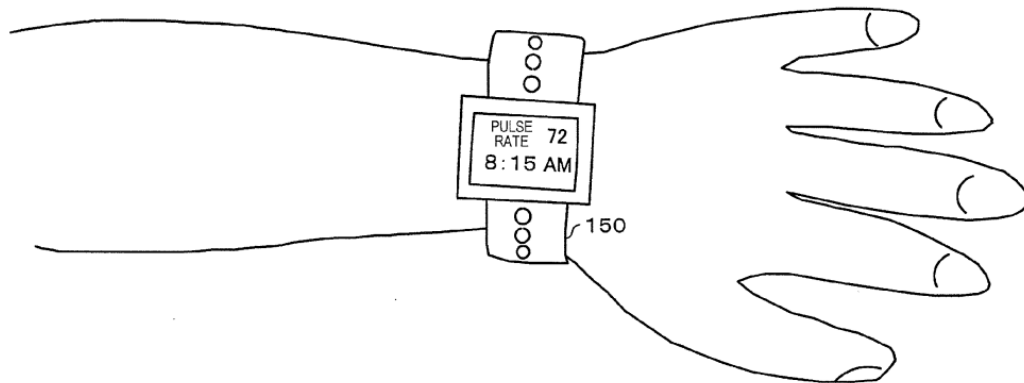
356. Accordingly, Apple’s assertion of 2 mm for the height of these components overestimates the thickness of LEDs and PDs illustrated. It also is inaccurate compared to the size of LEDs and PDs that would have been used by a POSITA in 2014. A POSITA would have known that biosensing components incorporated on the back of a biosensing watch would have been configured as thin as $<50\text{ }\mu\text{m}$. For example, EX1053 teaches that biosensing watch may have an LED as thin as $20\text{ }\mu\text{m}$, a photodiode as thin as $20\text{ }\mu\text{m}$, and a substrate holding the photodiode and LED that is as thin as $10\text{ }\mu\text{m}$. EX1053, [0092] (“The thickness of

the light-emitting part 14 is, e.g., 20 μm to 1000 μm .”); [0093] (“The thickness of the light-receiving part 16 is, e.g., 20 μm to 1000 μm .”); [0069] (“thickness of the substrate 11 is e.g., 10 μm to 1000 μm ”). Although EX1053 contemplates a thickness of 1,000 μm for PD/LED, a POSITA would have understood that this is a maximum thickness of a PD or LED and would have considered something much thinner, such as 20 μm , in order to reduce the thickness of the optical biosensing components. An illustration of the thickness of the components is shown below:



EX1053 at 2. The photodiode (16) and LED (14) shown above are configured on opposite sides of the substrate, but a POSITA would have been capable of arranging them on the same side of the substrate (consistent with Kotanagi’s teachings), thus reducing the overall thickness of the PD, LED, and substrate assembly to 30 μm . Because Kotanagi teaches that its LED and PD “touch the inside of the glass cover

23” (EX1005, ¶55) a POSITA would have known that an LED/PD would have only needed to add ~30 microns between the coil and Kotanagi’s cover glass 23 in the mapping where the coil is provided in the available space behind Kotanagi’s PD and LED. A biosensing unit assembly with these thicknesses would have been readily incorporated into a device like Kotanagi’s for many reasons. First, Yamashito, Kotanagi, and Honda were all filed by Seiko. EX1053 at 1; EX1005 at 1; EX1006 at 1. Thus, a POSITA such as a Seiko engineer would have been aware of their teachings prior to 2014. Second, Yamashito, Kotanagi, and Honda are all in the same field of wearable electronic devices with biosensors. Yamashito teaches that its biological information detector is “provided to a back cover of the wristwatch.” EX1053, [0126].



EX1053 at 16. Furthermore, Apple’s exhibits also contradict the POR’s estimated thicknesses. One of Apple’s exhibits (EX2008), published in 2007, teaches LEDs with luminescent material structure “between about 15 and about 100 microns

[0.015–0.1 mm] thick.” EX2008 ¶ [0008]. In view of these very thin LED structures that would have been used in 2014, the combination of Kotanagi and Honda would have achieved suitably effective wireless charging. Apple’s other exhibits that are cited to allege that LEDs and photodetectors must have a thickness of 1mm+ are entirely inapplicable to biomedical measurements with light signals. For example, EX2008, EX2015, and EX2016 teach photodetector integration with a display screen, etc.

357. Apple states that “positioning Honda’s wireless charging receive coil behind Kotanagi’s optical elements” would cause undesirable “noise and interference.” POR at 39–40. However, it is my opinion that any effects from structures near a receive coil (whether positive or negative) would have been evaluated as engineering trade-offs. Apple argues that Honda requires optimized speed, but a POSITA would have balanced speed and coil size. This is consistent with my understanding that courts ruled that “simultaneous advantages and disadvantages . . . [do] not necessarily obviate motivation to combine.” *Medichem, S.A.*, 437 F.3d at 1165. Evaluating such engineering trade-offs typically involves considerations that are not binary, but rather a matter of degree. In fact, Honda itself refers to a continuum of outcomes. EX1006, 2:38–43, 2:55–60 (as gap between coils increases, “the degree of magnetic coupling weakens”); *id.*, 13:14–16 (as the distance between the coils decreases, the “transmission efficiency increases in

accordance with a quadratic curve.”); *see* POR at 42. Additionally, Honda recognizes these tradeoffs when showing the estimated charging efficiencies with metal materials in the path of wireless charging. EX1006 at 14 (stainless steel of 1 mm; “Glass + Foil 10 μ m”); *see also Id.*, 13:49–51 (“even if one side of an insulating material is coated with a one- μ m thick deposit of metal, such as of aluminum, any degradation attributed to eddy currents does not take place”); *Id.*, 16:16–19 (“With a metal used, the efficiency in the magnetic coupling drops, but *when the magnetic coupling efficiency is not a concern, the use of a metal is possible.*”) (emphasis added). These continuum considerations are standard in technical development processes and would not have discouraged a POSITA from combining Kotanagi and Honda. Indeed, Apple’s expert stated that the engineering process involves trade-offs like this. EX1052 at 19:17–20:20. I agree. In my opinion and experience, the engineering process involves these types of trade-offs.

358. Apple’s modeling discussion (*infra* § V(A)(8); *see* EX2038, ¶¶165–169; POR at 49–50) also points to a continuum of outcomes. As an initial matter, the model’s description is flawed. However, its general conclusions are unsurprising: larger or more numerous coils can provide faster charging. Thus, a POSITA at the relevant time would have considered charging efficiency, coil size, coil position, number of coil windings, available space, and many other factors when using Honda to modify Kotanagi. These considerations do not negate that incorporating Honda’s

coil teachings into Kotanagi is desirable, and a POSITA would have expected success in achieving wireless charging in a modified Kotanagi device.

4. Apple’s arguments appear to depend on a false legal standard.

359. Apple’s POR repeatedly argues the Petition’s proposed combinations are inferior to other allegedly faster-charging alternatives. POR at 4, 35, 46, 54, 60, 62, 64. Each time, Apple admits that the Petition’s proposed combination of Kotanagi and Honda “could” be made. *Id.* at 4, 54, 61, 63, 65 (e.g., “Petitioner has presented a device configuration in which a wireless charging coil *could* be provided in Kotanagi’s through hole 22”) (emphasis in original). But Apple then argues that the presence of the allegedly “better” alternatives would have dissuaded a POSITA from even attempting the proposed combination.

360. All these arguments by Apple inject a standard of desirability that I understand is irrelevant to the obviousness analysis. I understand that a claim is invalid for obviousness if a POSITA would have been motivated to make the combination, regardless of whether the combination would have been the best possible alternative. Adding a wireless charging coil improves and is consistent with Kotanagi, and allows Kotanagi’s device to achieve suitable wireless charging speed and efficiency. Further, neither Honda nor the claims require a particular charging speed or efficiency. *See* EX1001, 58:1–60:35; EX1006, 16:16–19 (“With a metal used, the efficiency in the magnetic coupling drops, but *when the magnetic coupling*

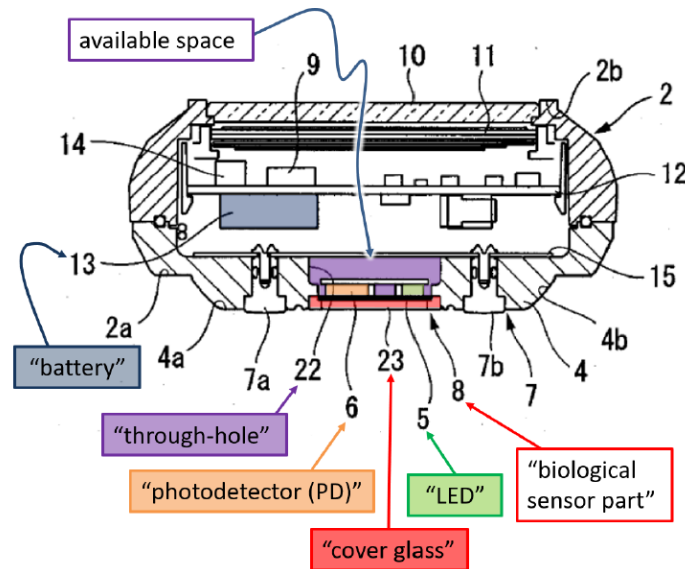
efficiency is not a concern, the use of a metal is possible.”) (emphasis added).

Accordingly, a POSITA would have been motivated to add wireless charging to Kotanagi. Apple’s arguments regarding alternative, unclaimed locations for the coil and alleged undesirable outcomes (e.g., reduced efficiency) do not undermine Masimo’s contentions of unpatentability.

361. Accordingly, even if Apple’s proposed alternatives were better for certain purposes such as charging speed—which, to be clear, Apple has not shown—Apple’s alternatives do not rebut the motivations-to-combine described in the grounds of invalidity.

5. Apple’s arguments fail to account for the “available space” and the potential for enlargement.

362. The grounds of invalidity in the Petition annotates Kotanagi’s Figure 7 to indicate “available space near Kotanagi’s opening” where a POSITA would have positioned a wireless receive coil (Pet. at 25, 37, 79):



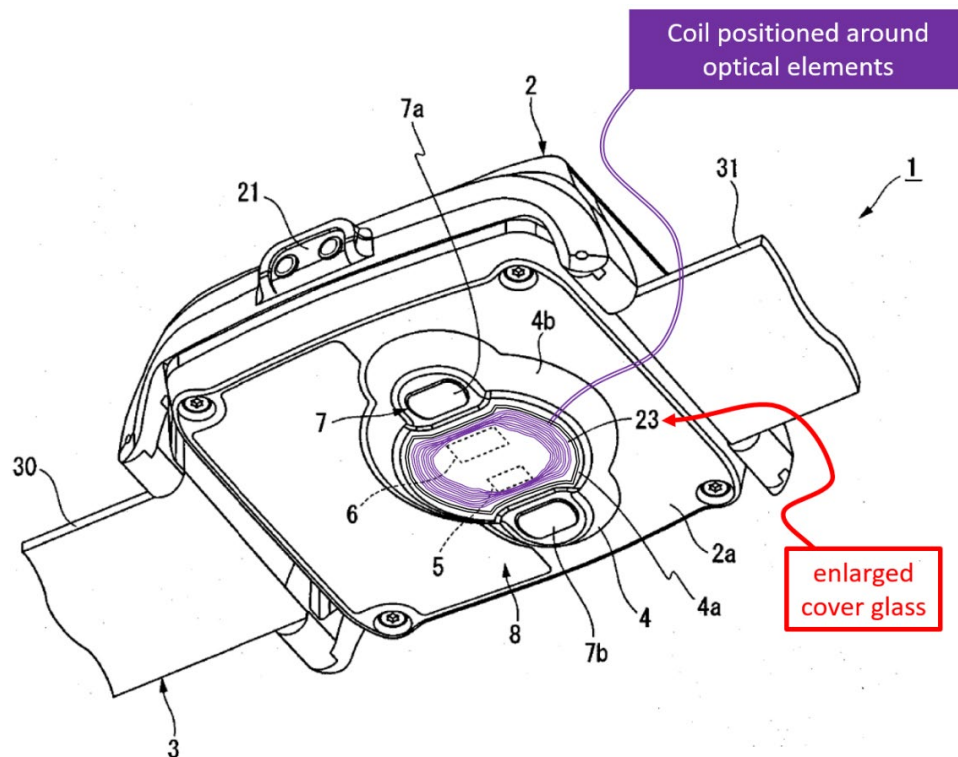
See Pet. at 25, 37, 79; EX1005 at 27. The available space, corresponding to the “through-hole 22” and shaded in purple above, includes space behind and to the sides of the PD 6 and the LED 5. Masimo’s petition explains at pages 24–25 that:

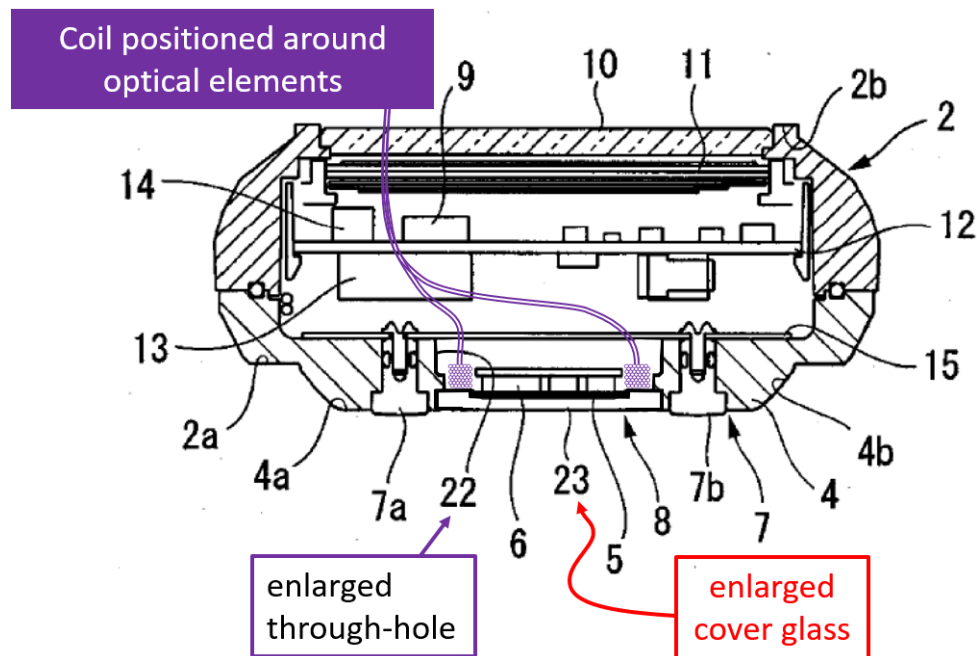
[A] POSITA would have used Honda’s teachings to either: 1) modify Kotanagi to position a wireless charging coil behind Kotanagi’s cover glass, LED, and PD; or 2) enlarge Kotanagi’s opening and cover glass to make room for a coil behind the cover glass, surrounding the LED and PD. In either case, the resulting magnetic flux would pass through the biosensor module, including the cover glass, as taught by Honda.

Pet. at 24–25.

363. Apple argues that Kotanagi restricts the size of a wireless charging coil and bases its calculations on this alleged restriction. POR at 36–37, 58–59. As demonstrated above (*see supra* § V(A)(2)), this argument contradicts several non-restrictive passages in Kotanagi and ignores how a POSITA would have used this

reference (combined with Honda). Apple's arguments also presume that coils could only have been circular, that Kotanagi's cover glass could not have been enlarged, and that the coil could therefore only have been located behind the PD and LED or extend beyond the lateral edges of the cover glass. POR at 36–37, 58–59. To the contrary, as illustrated in the example design option below, even under Apple's unreasonable constraint that the protruding part 4 could not be enlarged, the cover glass can be enlarged and a coil can be inserted behind it:





See EX1005 at 26, 27 (Figs. 5, 7); compare POR at 40, 59. In the figures above, the coil is shown schematically with closely stacked windings in the narrower side spaces adjacent the optical elements, and in a more nested, spread-out configuration that is consistent with the Petition’s teaching that a POSITA would “enlarge Kotanagi’s opening and cover glass.” Other coil configurations are also possible (e.g., stacking more coil windings on or around those depicted in the figures above).

364. The Petition and my previous declaration expressly stated that in view of Honda, a POSITA would optionally have “enlarge[d] Kotanagi’s opening and cover glass to make room for a coil behind the cover glass.” Pet. at 24. This modification renders moot Apple’s arguments (POR at 51–52) that the coil “would not fit” behind the cover glass. Nothing in Apple’s POR demonstrates that a person

having a bachelor's degree and three or more years of experience developing devices would not have been fully capable of and motivated to make these modifications. It is my opinion that a POSITA would have been capable and motivated to make these straightforward modifications.

365. Apple also argues that the electrodes 7a and 7b limit any expansion (POR at 56), so a coil “would not fit” (*id.* at 57). But in the above example modification, the electrodes have not been moved.

366. Despite Apple's disparagement of two Kotanagi modifications (POR at 38, 40), Apple does not show that these hypothetical versions fail to satisfy the claim limitations. The claims do not require any particular charging speed or coil size, and, as mentioned previously, Apple's own exhibit confirms that a 10 mm coil would have been “suitable.” EX2028 at 5.

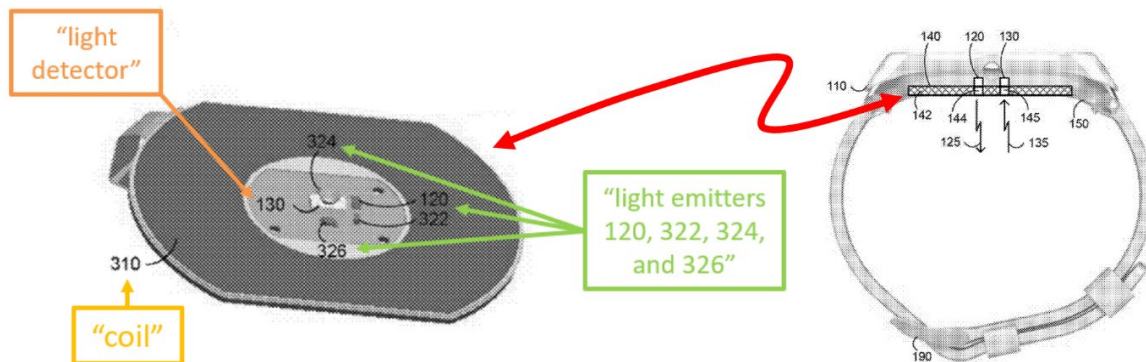
367. Instead of pointing to claim requirements, Apple inaccurately points to alleged *Kotanagi* size restrictions to argue that the proposed modification would “frustrate *Honda's* goals and intended purpose.” POR at 40–42 (emphasis added); *id.* at 57–58. As noted above (*see supra* § V(A)(3)), Apple has not shown any specific goal of Honda would actually be frustrated, and in fact Honda's goal of efficient charging is consistent with the teachings of both Kotanagi and Honda and would have motivated a POSITA to make the combination.

368. Apple cites Honda for the concept that charging weakens with greater distance between coils and strengthens with closer distance. POR at 42–43. Rather than discouraging a Kotanagi-Honda combination, this would have been considered in the engineering trade-offs facing a POSITA.

369. Apple cites Honda to argue that air-core coils are superior (POR at 44–45, 57–58), but fails to note that this statement in Honda is specific to nonelectronic watches (where a suddenly magnetized metal gear, for example, would cause problems as I mentioned in my deposition [see EX2020 at 85:1–86:20]). However, Apple’s reliance on this teaching regarding “air-coils” is misleading. Particularly, Honda’s very next passage states “[w]hen the present invention is applied to an *electronic* apparatus in which these concerns are not important, *a coil having a core can be used.*” EX1006 col. 6:45–47 (emphasis added). Thus, Honda teaches that a core material is one of the engineering trade-offs a POSITA would have considered if the watch is a *not* an electronic apparatus. In Kotanagi’s electronic apparatus, incorporating a wireless charging receive coil (like those taught in Honda) into Kotanagi’s available space—either extant or enlarged—would have been desirable, and a POSITA would have expected success in achieving wireless charging.

6. The Fraser reference Apple cites actually undermines Apple’s argument and shows expectation of success.

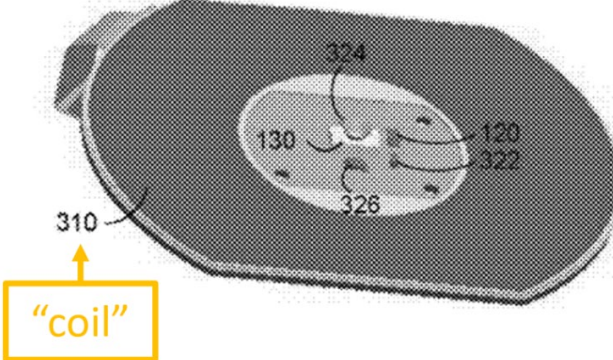
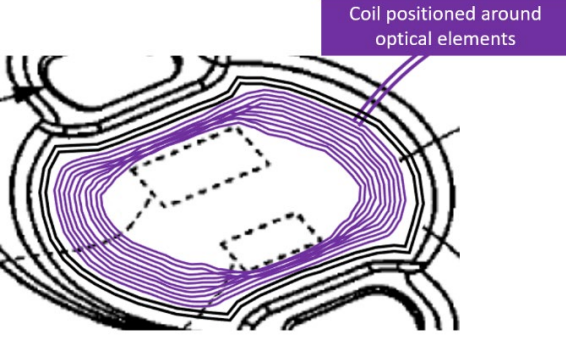
370. Apple next points to another prior art reference, Fraser, that teaches a wide perimeter coil 310 surrounding central optical elements. POR at 46–56.



See EX1041 at 4, 2 (Figs 3, 1). The Petition and my prior declaration included Fraser as evidence for feasibility and expectation of success (Pet. at 29) and for Ground 3 (dependent claims 8 and 15). Pet. at 61–70. As mentioned above, Apple’s version of the Kotanagi-Honda combination is improperly constrained (*see* POR at 46), and Apple continues to use this improperly constrained version for comparison to Fraser. Apple argues that a larger, Fraser-type coil is better than the improperly constrained combination because the Fraser-type version would counteract alleged “signal degradations.” *Id.* But this attempt to use a “better” combination is fundamentally flawed. Additionally, Apple could not point to any part of Fraser that formed their parameters for a “Fraser like” coil. EX1052 at 146:17–147:16; 148:12–149:2. Apple argues Fraser is superior because (1) it allegedly is larger than the coil in the

Petition's combination and (2) it surrounds the optical elements so that they are not in the transmission path. POR 48. But as shown above, even 6.5–9.5-mm-diameter coils provide sufficient current. Further, one of the Petition's proposed alternatives is a larger coil, surrounding the optical elements, consistent with Fraser's teachings. And a POSITA would have known to enlarge the cover if necessary.

371. Further, Apple's underlying substantive argument regarding Fraser-type coils is false for two reasons. First, Apple fails to recognize that because Fraser is also analogous prior art, it provides evidence **supporting** the ability of a POSITA to "enlarge Kotanagi's opening and cover glass to make room for a coil behind the cover glass, surrounding the LED and PD." Pet. at 24. Fraser shows a substantially enlarged cover glass that covers almost the entire lower surface of its biosensing watch. EX1041 at 2. Additionally, Fraser's teachings (of which Apple admits "a POSITA would have been aware," POR at 46) undermine several of Apple's arguments in the POR. Indeed, Fraser illustrates that a POSITA would have known at the relevant time that coils: (1) need not be circular (*see* EX1041, Fig. 3); (2) can effectively surround optical elements so that an "air core" is not required (consistent with EX1006 col. 6:47; *see* EX1041 ¶ [0026]); and (3) can be positioned behind non-metallic surfaces (similar to an enlarged cover glass):

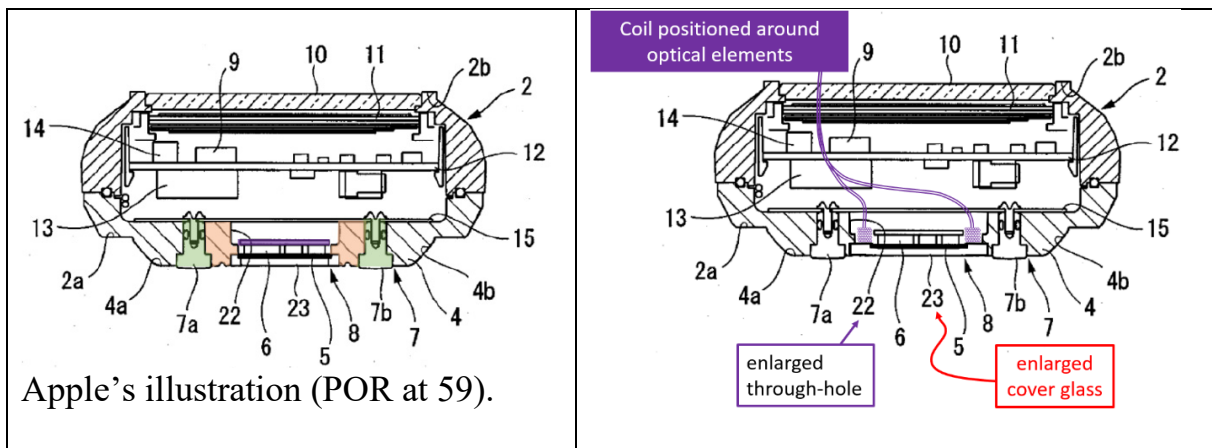
Non-circular coil in Fraser, surrounding optical elements.	Potential modification of Kotanagi.
 See Pet. at 29, 66; EX1041, Figure 3.	 Detail of figure.

For example, by stating that Fraser shows an “actually functioning” configuration (POR at 4, 35, 46, 54, 60, 62, 64) Apple has admitted that an “air core” is not necessary. Thus, to the extent Fraser provides a prior art alternative that would also have been available to a POSITA, this fails to undermine the Petition’s proposed combination of Kotanagi-Honda. Rather, this demonstrates how a POSITA would have reasonably expected success in making the Petition’s proposed modifications.

372. Second, Apple’s argument depends on its assertion that the Fraser-style coil would cause power transmission to pass through the rear housing surface of Kotanagi “and not the cover.” POR at 46, 61. This ignores that a POSITA would have enlarged the cover glass (Pet. At 24), consistent with Honda’s teaching that wireless power transfer through glass is highly desirable. EX1006, Fig. 15. Apple’s expert stated that power would “traverse” Fraser’s housing, which is thicker than Fraser’s cover/lens 140. EX1052 at 215:14–17. It is my opinion that power would

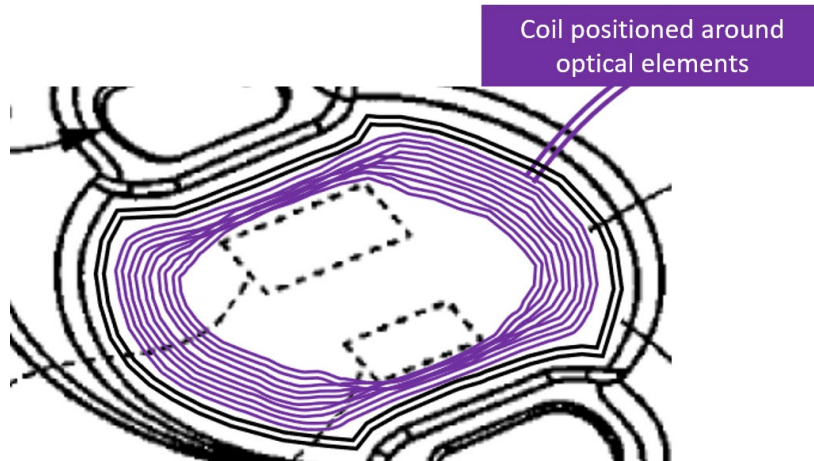
thus “traverse” Fraser’s cover. Therefore, Fraser provides an available prior art alternative, bolstering a POSITA’s expectation of success.

373. The POR makes several references to alleged “space limitations,” including the illustration at the left below, to show limited space for coils. POR at 58–61. Contrary to these assertions, the illustration at the right below shows how enlarging the through-hole and cover glass would provide more space for coils, even in this cross-section. (Cross sections taken along different axes of this same structure would show even more lateral space for coils).



Indeed, Apple’s expert stated that the “orange-ish pink-ish area” is “the size of coil that could fit.” EX1052 at 191:21–192:17. I agree that the specified area is a size of coil that would fit under Apple’s unsupported assertion that Kotanagi’s protruding part cannot be enlarged. Additionally, the cross-section view does not show the much wider area available for most of the wireless charging coil on either side of these narrow lateral passages. The wider area provides room for more coil loops to

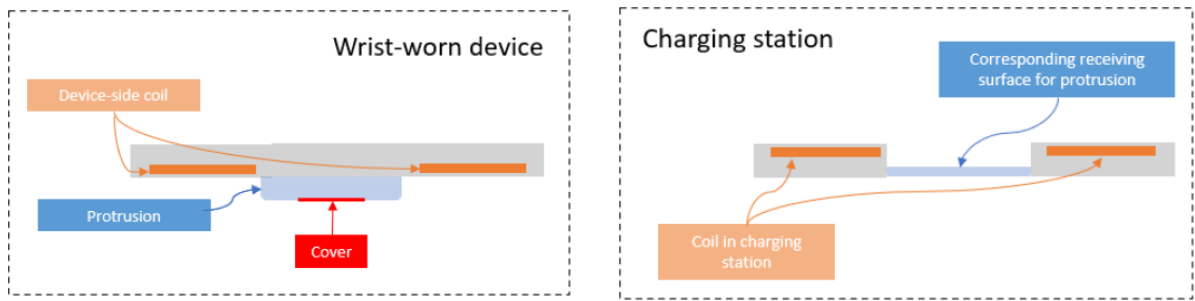
press up against the enlarged glass, reducing their separation distance from the charging coil:



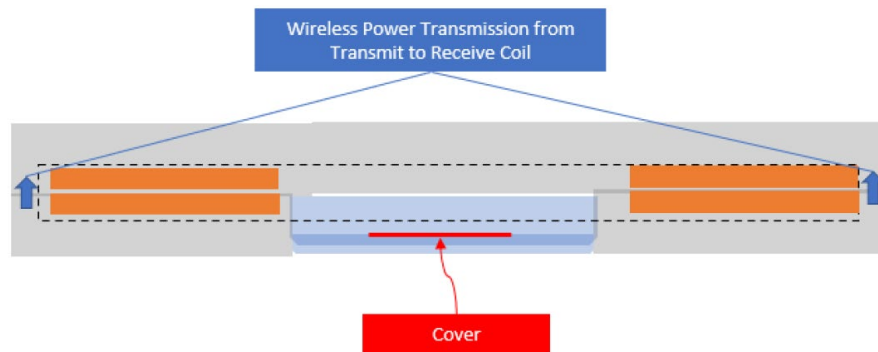
Moreover, even without the enlargement noted above, Apple is wrong about the physics, as explained below.

7. Apple's arguments are not consistent with the physics of wireless charging.

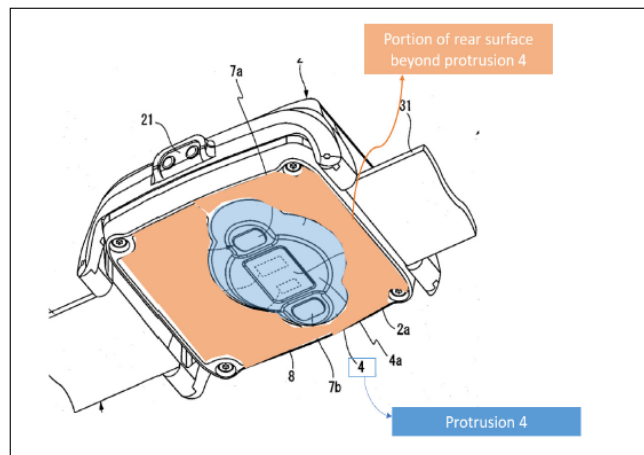
374. Apple tries to draw a contrast by arguing that Kotanagi with a Fraser-like coil would provide efficient charging—but would do so by somehow passing wireless power to the receive coil around, but not through, the cover. POR, 46. This gets the physics wrong. The centrally-positioned cover would pass wireless power to the receive coil. Apple illustrates its notion of power transmission geometry with the Fraser-style example in the figures below.



POR at 52. In the charging configuration, Apple places blue arrows outside the coils, purporting to show where wireless power is transmitted:



Id. Apple argues that because the cover glass 23 in the center of the figure above is “spaced away” from the coils, it “would not be the conduit for the wireless power transmission.” *Id.* Apple also provides the following:

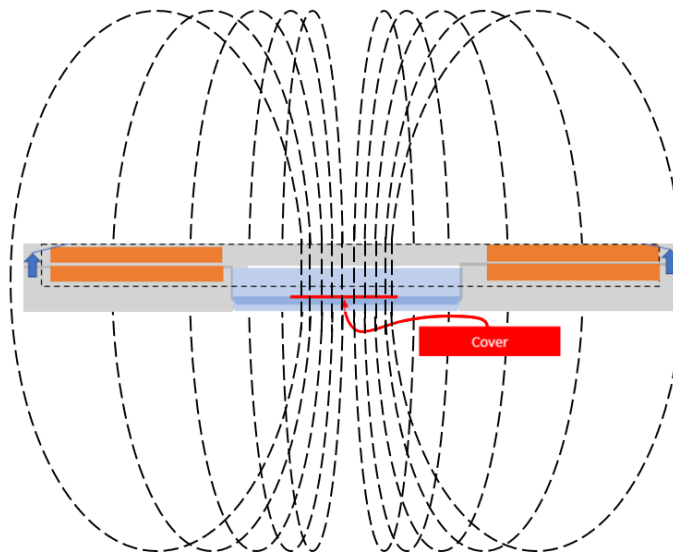


In such a configuration ... ***inductive coupling of the wireless charging receive coil and an external wireless charging device would not be “through the non-conductive material of the cover”*** (i.e., the alleged cover glass 23 in Kotanagi) ***and instead, would be through the rear housing surface*** beyond the protruding part 4 (and the cover glass 23 affixed thereto).

POR at 51–52. (emphasis added).

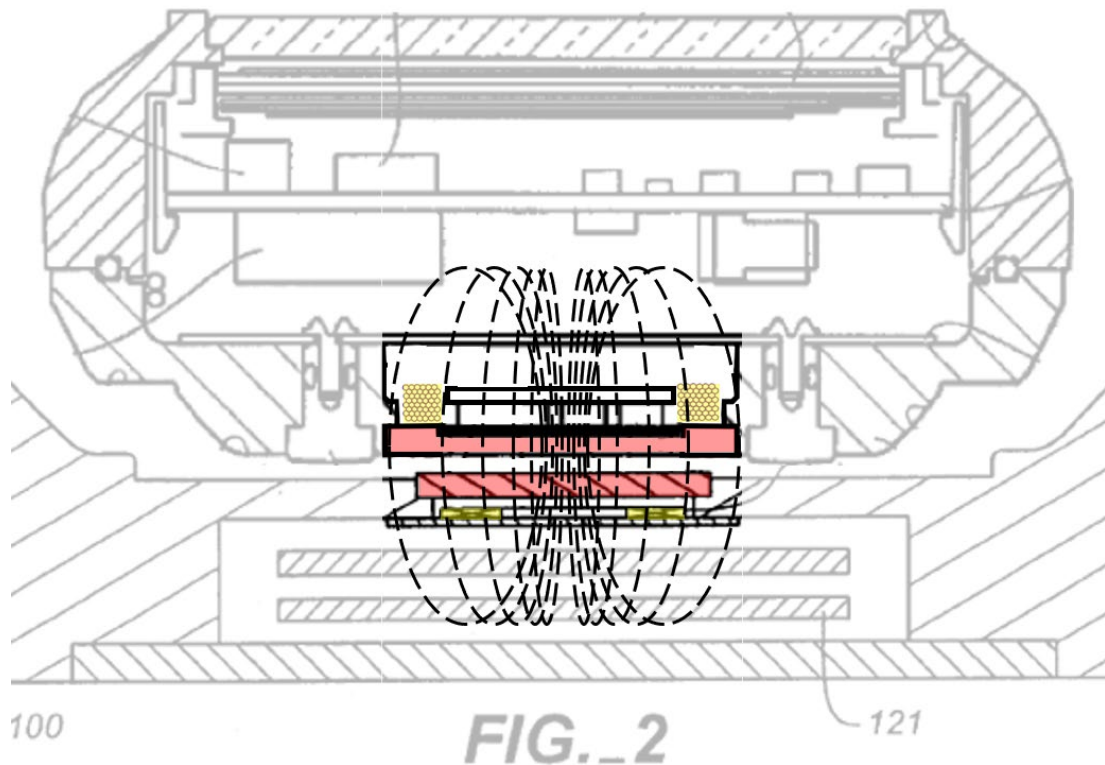
375. These statements by Apple exhibit a fundamental misunderstanding of how wireless charging works. In fact, an alternating drive current in the lower charging coil produces a changing magnetic field. Apple’s expert stated that the magnetic field causes inductive power transfer. EX1052 at 180: 5–10. I agree. Below, dashed lines have been added to Apple’s figure to show the field lines (for convenience, only a partial set of rearwardly-extending field lines is shown here, consistent with the section view of the coils). The changing magnetic field causes, by electromagnetic induction, an electric current to flow in the upper receive coil. In

the illustrated configuration, power is therefore transmitted through the space around the coils—including directly through the center of the paired coils at the position of the strongest magnetic field (illustrated below with the highest density of field lines). The diagram below shows how even in Apple’s Fraser-style example, wireless power would pass through what Apple labels as a “cover” where the magnetic field lines are concentrated.



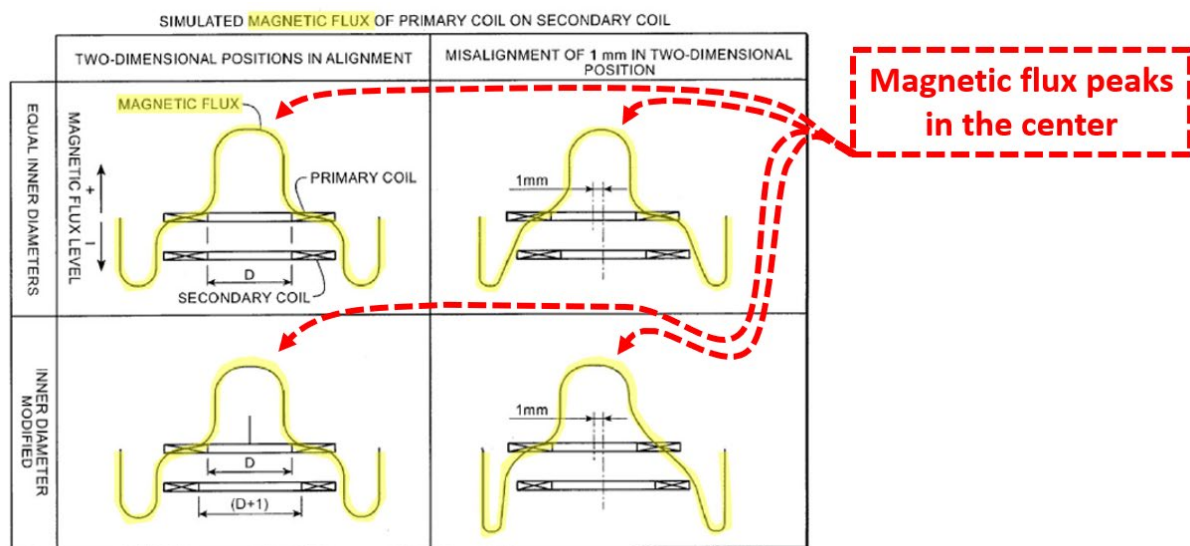
Magnetic field lines are particularly dense in the center of such an arrangement, due to the geometry and orientation of the two charging coils. Accordingly, in the hypothetical situation illustrated by Apple, assuming the glass cover is centered with respect to the two coils, power transfer is in fact more highly concentrated through the central glass cover than through any other region in or around the device. This is true *whether the cover has been enlarged or not*. A similar magnetic field (shown

with the lines below) would transfer power in the Petition’s combination of Kotanagi and Honda (enlarged cover glass approach):



376. Indeed, Apple’s expert stated that the evidence demonstrates a two-coil arrangement concentrates flux density in the center of the coils. EX1052 at 115:20–117:4; 117:21–118:8; 204:20–207:2. I agree. A two-coil arrangement concentrates flux density in the center of the coils, as the evidence shows.

377. Honda’s Figure 10 superimposes plots of “magnetic flux level” onto cross-section views of paired coils, confirming that flux density is highest in the central region. In each of the four situations shown, positive magnetic flux is greatest in the center of the paired coils:



See EX1006 at 9 (Fig. 10); Pet. at 38.

378. Apple’s cited Mohamad paper (EX2028) further confirms the above understanding of wireless charging physics. Its Figure 3 illustrates magnetic flux flowing through the center of two aligned coils during “wireless power transfer”:

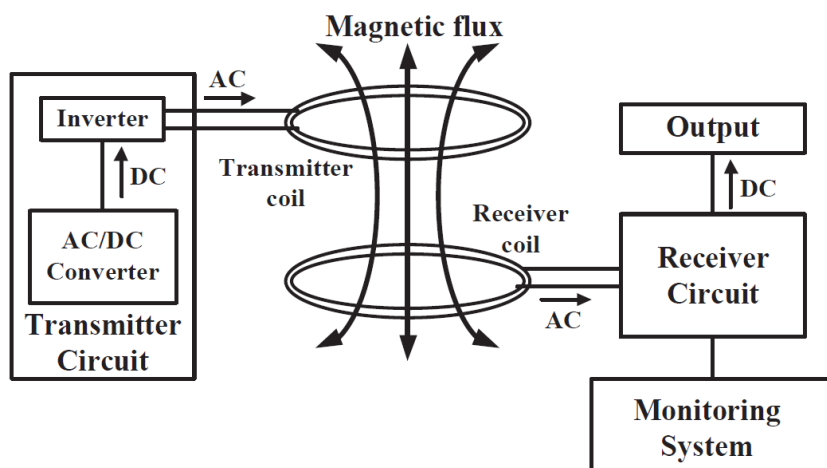
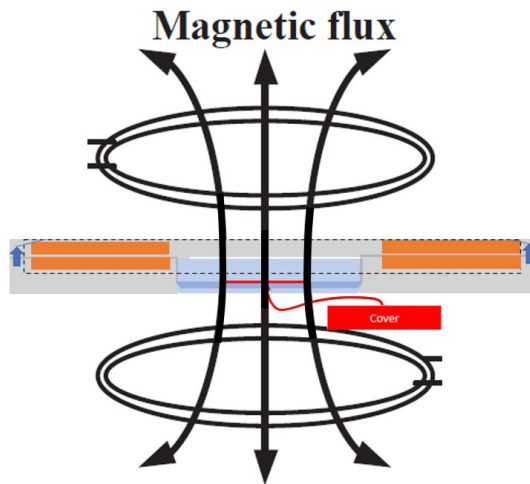


Figure 3: Block diagram of a wireless power transfer

EX2028 at 2; *see also* EX2024 Fig. 5 (illustrating high magnetic flux density (red) in the center, for configurations a and b); EX2023 at 40 (showing central magnetic

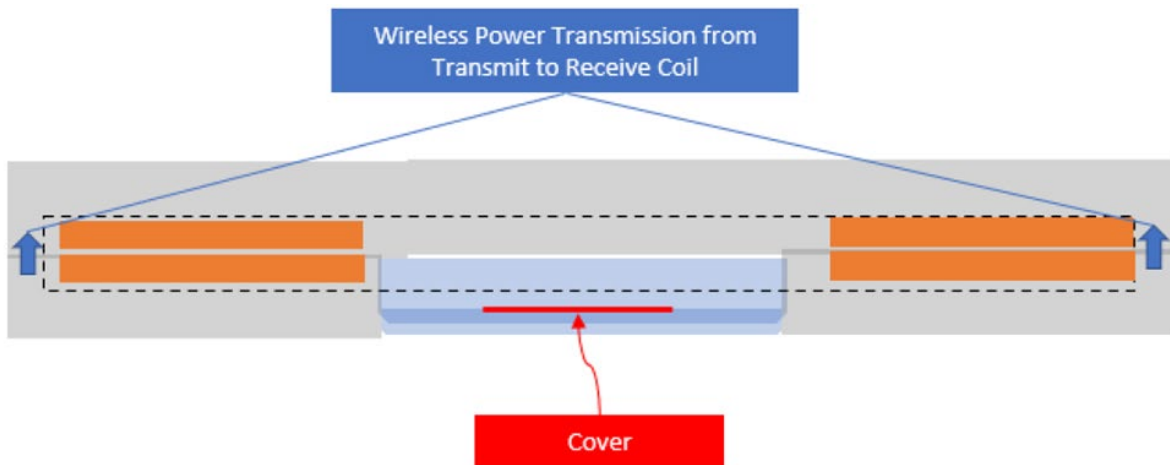
flux ***B***). The following annotated version of Apple’s figure shows how the magnetic flux flows through the location where the cover would be:



See EX2028 at 2; POR at 52. Thus, when wireless charging coils are aligned as shown in Apple’s own figure (POR at 52), wireless power transmission occurs through the center (including through any glass cover that may be present there).

379. Anthony argued that even though ***magnetic flux*** passes through the cover, ***power*** does ***not*** transfer through the cover. EX1052, 154:22–155:12. This ignores that wireless power transfer means using a current in a driving coil to create a magnetic field, which induces a current in a nearby receive coil. A POSITA would have understood that the magnetic field is the only physical thing passing between devices for wireless charging. Accordingly, a POSITA would also have understood that a cover configured to “pass wireless power” is one that passes the magnetic field. As shown above, the magnetic field passes through the center of the coils,

where the cover is located. When confronted with the discrepancy between the above evidence and the blue arrows on Apple's figure (POR at 52), Apple's expert admitted that the blue arrows are "not showing the exact location of where the power is all transferred." EX1052 at 157:11–21.



POR, 52. Anthony was then invited to explain:

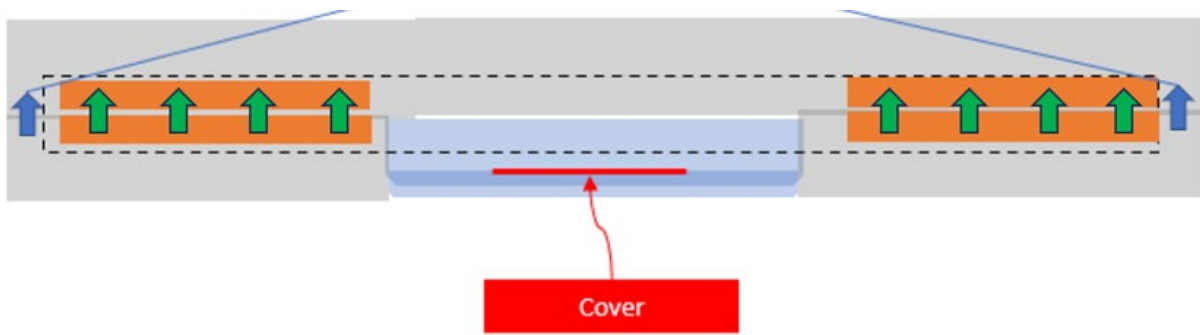
Q: And if you were to draw arrows that did show the exact location of power transfer, where would you put those arrows?

A: Within the dashed box. Power is not through the cover.

Q: Throughout the dashed box, but only where the orange coils are shown. Is that right?

A: Correct.

EX1052, 157:22–158:8.

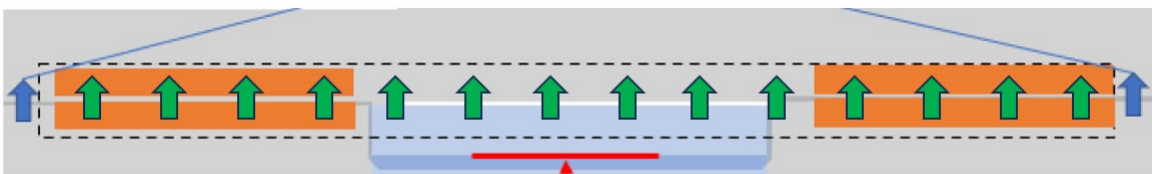


See POR, 52 (green arrows added to illustrate testimony). Anthony then changed his response:

Q: So there would be a series of arrows connecting the two orange coil cross-sections - -

A: Within the dashed box. So, I misspoke there. Not with within where the coils are. But in the space that encompasses the dashed box which includes the coils, the space between the coils. That is where the field is that is transferring from coil one to coil two. So, power is transferring in that region from coil one to [coil] two in the dashed box. Power is not transferring through the cover.

EX1052, 158:9–21.



See POR, 52 (green arrows added to illustrate testimony). But all of Apple's and its expert's charging theories are wrong because they ignore that (1) power transfer

occurs only as a result of the magnetic field and (2) magnetic field lines are continuous, thereby passing through the centrally located glass cover. Accordingly, as shown above, the wireless power in the Petition's proposed combination—as well as in Apple's Fraser-like alternative—does indeed pass through the cover as claimed.

8. Apple's modeling is fundamentally flawed in several ways.

380. Apple alleges it has modeled and simulated a Fraser-like device and compared it to a modeled simulation of Masimo's proposed combination. POR at 49–50, 59–60; EX2038 ¶¶165–170.

381. Each of Apple's simulations requires numerous flawed assumptions, so its detailed results are inherently unreliable. Indeed, all the errors discussed above poison Apple's use and interpretation of the model's results. First, Apple assumes the cover glass and coil would *not* be enlarged (contrary to Pet. at 24) when combining Kotanagi and Honda. Second, Apple again improperly alleges a 20 mm size restriction in Kotanagi (*see* § V(A)(2), (5)), (which it argues results in a coil of only 10 mm diameter). Third, Apple improperly assumes a POSITA would have only used coils with a round shape when other shapes are possible (round, oval, rectangular, etc.). *See* § V(A)(6). With no accurate assumptions underlying the modeling, its detailed conclusions are useless.

382. The broad conclusion from this modeling—that increasing coil width and providing more coil turns can result in faster charging—is unsurprising and

would not have discouraged a POSITA from combining Kotanagi and Honda. Apple's expert stated that the modeling's broad conclusions are unsurprising in view of basic principles of physics. EX1052 at 138:15–139:10. I agree, a POSITA would have understood this and would have readily performed trade-offs as part of the engineering process. Nonetheless, Apple's modeling suffers from additional significant flaws.

383. No Absolute Numbers. The modeling results are expressed in comparative ranges (e.g., 1 versus 100 hours) (POR at 49) providing no real-world reference for comparison. Nowhere does the alleged modeling result provide the specific charging speeds or amounts needed for a small electronic watch. Yet this information would have been critical to a POSITA choosing between design options and considering the relevant trade-offs. If Kotanagi's battery 13 can last through the day, a comparatively smaller coil or slower charging apparatus could accomplish the relevant charging task overnight. A trickle charge may be sufficient—and even preferred over fast charging, when considering battery life and battery degradation. *See* EX1052 at 18:22–19:6. Indeed, Apple's EX2028 concludes that wireless charging that provides currents below sixteen watts is nevertheless “suitable to charge wearable and medical devices.” EX2028 at 5. Thus, even if Apple had accurately constructed its model (which Masimo does not concede), the model omits

the information most critical to a POSITA: the minimum coil configuration (size, spacing, etc.) that would meet the relevant charging need.

384. No Inputs or Equations. Apple fails to provide the actual inputs and underlying equations for its “method of moments” computation technique. EX2038 ¶ 167. Apple just describes the stages generally (*id.*) and produces a graphical output of several groups of curves on a plot (*id.* ¶ 169). For example, Apple’s expert acknowledged withholding the Z, V, I and R matrices (EX1052 at 118:13–119:17), the discretization output (*id.* at 123:10–13), the basis functions (*id.* at 124:6–11), and the interaction matrix (*id.* at 125:10–16). Because neither Apple nor its expert has shown its work in detail, the results are not reproducible, or even testable, based on the cursory information they provide. For example, although Apple cites EX2023, it does not seem to have followed that exhibit’s procedure in its section 4.1 for calculating mutual inductance, which would have shown flux through the center of the coils (and therefore through the cover).

385. Improper Coil Assumptions. Apple assumes that the coil in Kotanagi would have 10 to 20 loops, and that space limitations would “reduce” the number of possible coil turns. POR at 58. But Apple fails to explain *from* what, and *to* what, this reduction would occur. Moreover, Apple ignores the Petition’s explanation that a POSITA would have enlarged the cover glass (Pet. at 24) and fails to address the relevant wire diameters. Honda itself teaches a watch-sized device with a coil

wound from a wire three meters long. EX1006, col. 6:58–59. Such a wire wound in a 10 mm diameter coil would have approximately 95 loops, much more than the 10–20 loops assumed by Apple. To arrive at 95 loops, I calculate the circumference of a circle as 2π times its radius, or $2\pi \cdot r$ (or π times its diameter, or $\pi \cdot d$). Thus, a diameter of 10 mm would correspond to a single loop of $3.14 \cdot 10$, or 31.4 mm, or 3.14 cm. A wire with a total length of 300 cm would have room for $300/3.14$, or > 95 loops. See EX1052 at 189:16–191:7.

386. Irrelevant References. Apple supports its modeling conclusions with a citation to its expert report (EX2038, ¶¶165–170), which in turn cites EX2023–EX2032. POR at 45. However, that includes several references that are not relevant. For example, one describes wireless power transfer for cars, vehicles and large-scale charging (EX2031, *passim*), another exhibit teaches coils with 28cm+ diameters having distances of 0.7 meters (EX2029 at 10), another exhibit relates to coils integrally attached to printed circuit boards (EX2030 at 2), and a further exhibit relates to “high-power long-distance wireless charging” (EX2032 at 1). Apple’s expert never explains in his report (EX2038) how he used these references or how they support his modeling.

387. Mohamad Paper (EX2028). Apple’s cited Mohamad paper demonstrates that increasing the number of coil turns improves power transmission. *Id.* Figs. 7, 8. Thus Honda’s coil with 20+ turns would have power transmission

exceeding the amounts shown in EX2028. This paper also shows that 6.5 mm and 9.5 mm receiver coils having 3–15 turns are useful for “wireless power transfer” and are “suitable to charge wearable and medical devices.” EX2028 at 2, 5. For example, the paper’s Figure 13 shows that with a 9-turn receiver coil of 9.5 mm diameter (RX7) and separation distance of 1 cm, a matching diameter transmitter coil can achieve output power of 8 Watts.

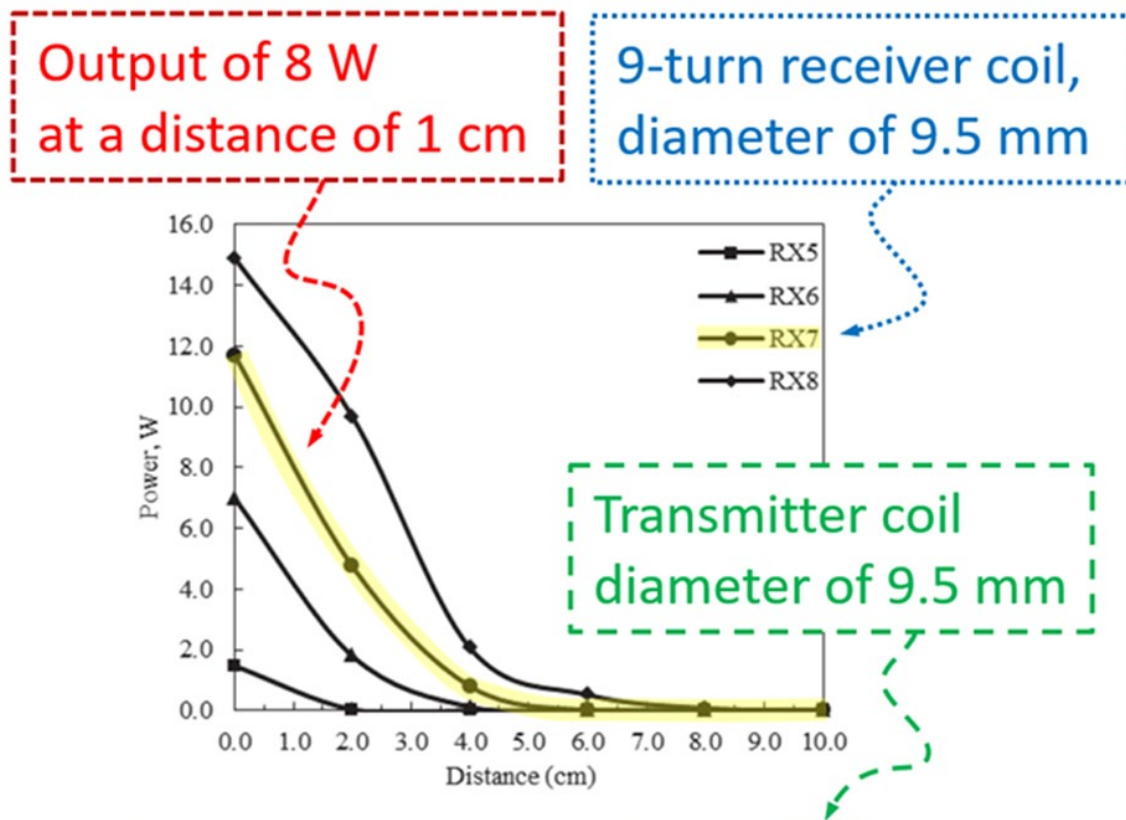


Figure 13: Output power over distance using TX3 ($D_{T2} = D_{R2} = 9.5$ mm).

Id., Fig. 13. This is sufficient to charge a wearable medical device. *Id.* at 5. Thus, Mohamad contradicts Apple’s position that similar coil sizes and distances would have discouraged a Kotanagi-Honda combination.

388. For the reasons above, Apple’s arguments fail to demonstrate the validity of the pending claims, including Claim 7.

B. Claim 14

389. Apple’s repeats its Claim 7 arguments for Claim 14. For Claim 14, Apple again concedes that Kotanagi and Honda together provide all the claimed elements and that “a wireless charging coil *could* be provided in Kotanagi’s through hole 22.” POR at 63. Thus, a POSITA would have found the combination at least “suitable,” which I understand is legally sufficient. *Intel Corp.*, 21 F.4th at 800.

390. Moreover, Apple’s repeated arguments (POR at 61–63) are incorrect for the reasons explained above in § V(A). For example, Kotanagi does not limit itself to particular dimensions, so a POSITA with ordinary creativity would not be constrained when combining it with Honda. A POSITA would have considered enlarging the cover glass to make room for an even larger coil. The trade-offs involved in combining Kotanagi and Honda are well within the skill of a POSITA to create a suitable option. *See* EX1052 at 19:17–20:20 (explaining the standard engineering trade-off process). Regardless, as explained above, Apple’s own evidence shows that 10 mm coils, and coils surrounding optical components, can work for charging wearable and medical devices. EX2028 at 2, 4–5.

391. In any case, the aligned coils would establish magnetic flux right through the center of the glass cover, as shown by Apple’s own exhibits.

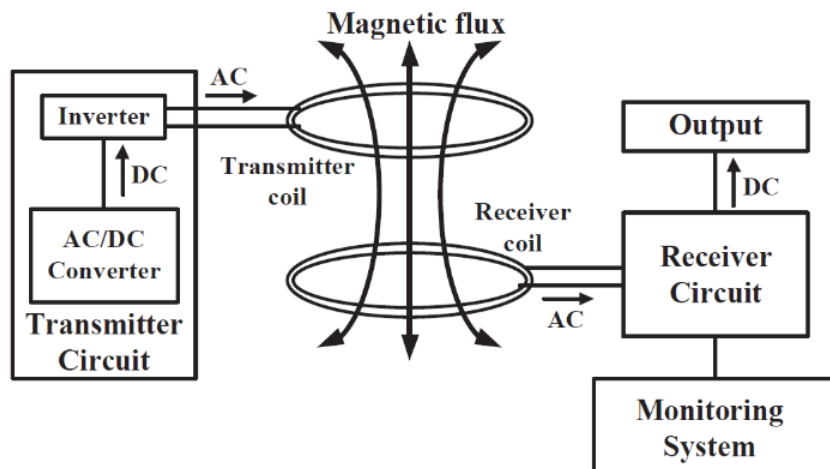


Figure 3: Block diagram of a wireless power transfer

EX2028 at 2.

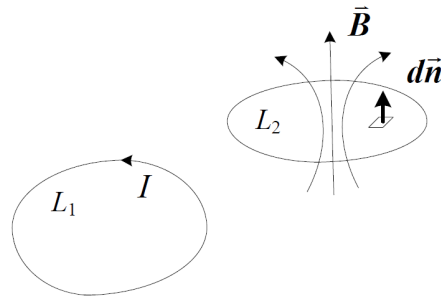


Figure 4.2: Geometry for computation of flux linkages and mutual inductance between closed paths L_1 and L_2

EX2023 at 40. Accordingly, Apple’s arguments for Claim 14 are wrong for the same reasons explained above for Claim 7.

C. Claim 1

392. Apple repeats its arguments again for limitation [1g] of Claim 1 (POR at 63–65). These are wrong for the same reasons explained above for Claims 7 and 14.

393. Apple then argues that the combination does not render obvious the following limitations: “a first electrode positioned along a rear surface of the electronic watch; and a second electrode positioned along the rear surface of the electronic watch,” wherein “*the electronic watch is configured to measure an electrocardiogram using the first and the second electrode.*” POR at 65–66 (emphasis added). Apple does not dispute that Kotanagi includes two electrodes on the rear surface. Instead, Apple argues that “Kotanagi does not disclose or contemplate any ECG capability” and that Kotanagi’s electrodes “only have a skin contact detection function.” POR at 69–70. Masimo never contended that Kotanagi’s electrodes make a pulse measurement. *Id.* at 66–67. Instead, the Petition and my declaration explained that Kotanagi’s rear electrodes work in conjunction with the optical sensor to achieve pulse measurement because the electrodes determine whether the watch is on properly and in contact with the skin. *See* Pet. at 50, 70. However, the Petition and my supporting declaration demonstrated that it would have been obvious to add ECG capability to Kotanagi:

[A] POSITA would have used Kotanagi’s existing electrodes and Choi’s teachings to either: **(1)** use signals from Kotanagi’s existing electrodes to obtain an ECG; or **(2)** add one or more additional electrodes to Kotanagi (as taught by Choi) and use both it and the existing electrodes to obtain an ECG.

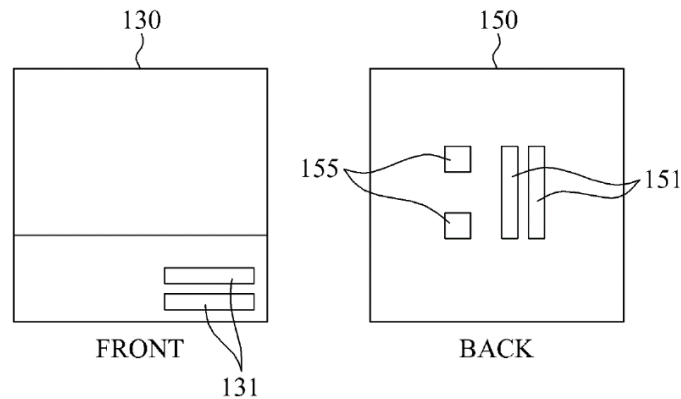
Pet. at 52.

394. A POSITA would have known how to apply, and expected success in applying, well-known technology to obtain an ECG using those electrodes. Pet. at 51–54. My analysis is supported by the PTO where, in a related application, it expressly found that “*ECG collection may be implemented via electrodes 7a and 7B of Kotanagi.*” EX1062 at 10 (April 25, 2023 Final Rejection in U.S. Patent Appl. No. 18/075,253) (claiming priority to the ’491 patent) (emphasis added). I agree.

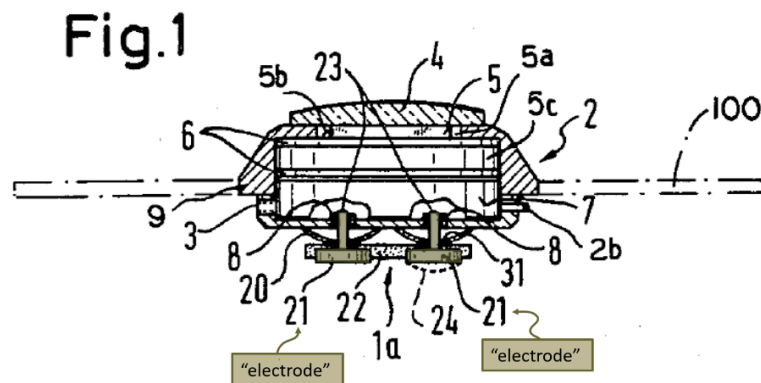
1. Kotanagi’s existing electrodes would obtain an ECG

395. Apple argues that Choi “contemplates” detecting ECG signals “in at least two different portions of the body” using sensors positioned on two different surfaces. POR at 67–68 (citing EX1011 at ¶52). But that portion of Choi, cited by Apply, does not teach that measuring from two different surfaces for ECG is mandatory, just that two surfaces “*may*” be needed. EX1011 at ¶52.

396. Further, in another part of Choi, Choi explains that watch back sensors alone can measure ECG. Specifically, Choi discloses that a second biosignal is detected “by the sensor 131 provided on the front 130 *and/or* the sensor 151 provided on the back 150.” *Id.* at ¶47. Choi discloses that the second biosignal may include ECG. *Id.*



397. As far back as 1980, Schmid disclosed using two closely-spaced, rear electrodes to measure ECG:



E.g., EX1029 at 2 (Fig. 1); EX1003 at ¶233; Pet. at 52. Indeed, Apple admits that “Schmid’s electrodes are used to measure ECG.” POR at 73. *See also* EX1055 (Lapetina) at 5:52–62 (disclosing that two “electrical contacts 160, 170 protruding from the [rear surface of the] housing 130 could additionally be used ... to sense an electrocardiogram (ECG) signal”). These references establish that ECG measurement from two electrodes spaced apart on a single surface was well-known in the art.

398. In view of Choi, and the state of the art, a POSITA would have expected success in using Kotanagi's two electrodes spaced apart on a single surface to measure ECG.

399. Apple argues that because Schmid suggests offloading signal processing to “the electronics of a conventional EKG machine” Schmid's wrist-worn device is not *alone* configured to measure ECG. *Id.* at 73–74. But Schmid merely states that its signals can be sent to an “apparatus for evaluating and/or plotting such signals as, for example, in EKG.” Ex. 1029 at 1:1-10. By 2014, any processing necessary for ECG could fit in a watch. Indeed, Choi teaches ECG processing on a watch. Choi refers to the “growing computing power of the mobile device” allowing users to handle tasks “previously performed using a personal computer.” EX1011 at ¶ [2]. The '491 patent provides no details on how to process ECG signals, relying instead on generic processors. EX1001 at 11:19–29.

400. Apple argues that Masimo has not shown Kotanagi's electrodes are “biosensors.” POR at 68. Kotanagi repeatedly describes the contact detection electrodes as part of the “biological sensor.” EX1005 at ¶¶ 7–8, 13, 46, 58, 86. Regardless, Kotanagi's electrodes detect a discharge through the living body surface. *Id.* at ¶64; *see also* EX1011 at ¶18 (Choi's second biosensor measures ECG and/or an impedance signal). Therefore, Kotanagi's electrodes measure a biological

parameter. A POSITA would have understood that Kotanagi's electrodes are "biosensors."

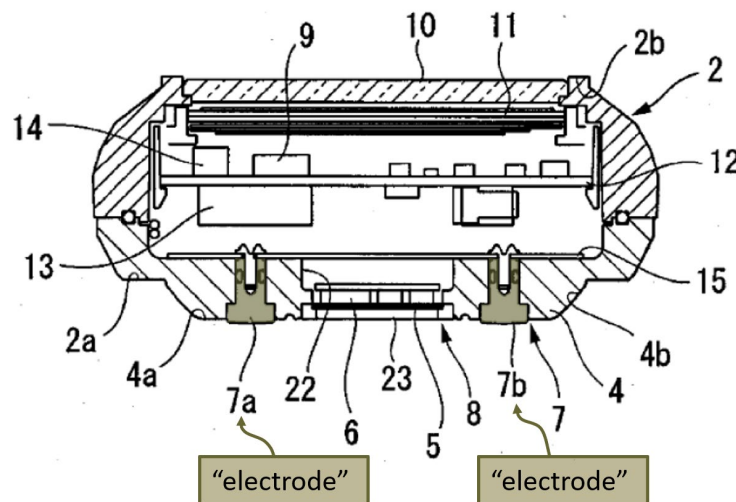
401. Apple also argues that structural similarities between Kotanagi and Choi are insufficient to provide a motivation to combine. POR at 68. However, Masimo's motivation-to-combine arguments do not rely on mere structural similarities. Among other reasons, a POSITA would have been motivated to add ECG to Kotanagi to improve biosensing (e.g., by expanding its capability to measure heart function beyond pulse rate). Pet. at 53–54. *See also* EX1055 (Lapetina) (disclosing a smartwatch that measures pulse rate, GSR, and ECG, among other physiological measurements); EX1056 (Lee Provisional) ¶2 (disclosing a smartwatch with a "PPG sensor ... in the center" and "two metal electrodes [that] can be used as ECG and/or GSR electrodes"); EX1057 (Lee Nonprovisional), Fig. 1C. Indeed, Choi discloses this very combination of PPG, skin contact via impedance, and ECG functionality in a single device. EX1011 at ¶7 (disclosing a smartwatch that may sense "***an electrocardiogram (ECG) signal, a photoplethysmogram (PPG) signal, a voice of the user, and an impedance signal*** generated by a body of the user") (emphasis added).

402. Apple further argues ECG and Kotanagi's potential difference measurements are not analogous. POR at 70. But the Petition did not assert that potential difference is analogous to ECG. Rather, the Petition explained that Choi's

“impedance signal ... is analogous to the electrical potential taught in Kotanagi.”

Further, impedance, electrical potential, and ECG each require the use of metal electrodes to observe electrical activity on the skin surface.

403. Apple argues that Masimo failed to show implementation details, such as how Kotanagi’s electrodes can be configured to both detect skin contact and measure ECG. POR at 70. This argument fails for two reasons. First, a POSITA would have known that no structural changes are needed to use Kotanagi’s electrodes to measure ECG. Rather, Kotanagi discloses conventional electrodes—*i.e.*, solid metal leads that protrude for body contact—useable for standard electrode functions:



EX1005 at 27 (Fig. 7). Moreover, a POSITA would have known that the same electrical contacts (*i.e.*, electrodes) can be used to detect various physiological signals, such as GSR, ECG, GSP, EMG, etc. EX1055 at 5:52-62. Any further

configuration would have been known to a POSITA, including how to use standard ECG processing circuits or algorithms to measure ECG using Kotanagi's electrodes alone or with one or more additional, structurally similar electrodes. For example, at least as of 2011, it was known to use the same electrodes to obtain both GSR and ECG measurements. EX1061, §1¶4 ("the ECG and GSR share a common electrode"). This was done using a "baseline correction circuit." *Id.* §3.2¶3 (circuit allows integration of GSR sensing "into the same electrode through applying a fixed, known differential between the electrodes"). GSR and skin contact sensing are both "potential difference" measurements. *Id.* §3.2¶3 (GSR measurements apply known "potential" across two electrodes and measure resistance; EX1005, ¶59 (body surface contact sensing "based on the potential difference between" electrodes 7a and 7b). Thus, EX1061 shows a POSITA would have expected success in using Kotanagi's electrodes for the dual purposes of ECG and skin contact sensing. *See also* EX1056, ¶19 (ECG and GSR sensors having common electrodes can be used to "detect removal of the device from the wrist"); EX1057, ¶21, 39–41.

404. Further, a POSITA would have known to use the electrodes to detect skin contact and, then, once confirmed, to measure ECG. This process is consistent with Kotanagi's teaching of first detecting skin contact and then measuring pulse rate with its optical sensor. EX1005, ¶59.

405. Further, a POSITA would have known that an initial contact detection followed by a continuous signal (optical or ECG) would indicate that skin contact is being maintained.

406. Apple’s argument that Choi does not teach dual-purpose electrodes (“using the same electrodes for both skin contact detection and ECG measurements”) (POR at 71) is irrelevant. As discussed above, the same electrodes can be used for various purposes, including ECG and skin contact detection. Apple further argues that Choi’s disclosure in Figure 3 of a separate “second sensor” to detect ECG and a “wearing detection sensor” using impedance shows that the same electrodes cannot both measure ECG and detect skin contact using impedance. POR at 70. This argument ignores another embodiment in which the biosignal measured by Choi’s second sensor can be an ECG and/or an impedance signal generated by a body of the user. EX1011 ¶47, 56.

407. Apple argues that Choi does not disclose or suggest using **both** ECG and impedance for Choi’s user-authentication function. POR at 72. This argument is irrelevant because the claims do not require authentication. Therefore, I understand that the obviousness combination need not implement Choi’s user-authentication function to render the claims obvious. *Intel Corp. v. Qualcomm Inc.*, 21 F.4th 784, 800 (Fed. Cir. 2021) (reference’s intended purpose does not control the obviousness inquiry); *In re Heck*, 699 F.2d 1331, 1333 (Fed. Cir. 1983) (prior-

art patents are “relevant for all they contain”). My previous declaration showed it would have been obvious to add ECG to Kotanagi to improve biosensing regardless of whether ECG authenticates a user. In any event, Apple’s argument that Choi does not disclose using both ECG and impedance for Choi’s user-authentication is incorrect. Choi teaches that its second sensor detects a “second signal,” which may include an ECG signal and/or an impedance signal. EX1011 ¶56. Choi also teaches using the second signal for user authentication. EX1011, Abstract, ¶27

408. Apple argues that reconfiguring Kotanagi’s electrodes to measure ECG rather than detect skin contact would frustrate Kotanagi’s purpose. POR at 72. But the Petition does not propose to measure ECG *rather than* detect skin contact. The Petition’s proposal to use Kotanagi’s electrodes to measure ECG does not prevent using the electrodes to detect skin contact. *See* Pet. at 52.

2. Kotanagi’s existing electrodes plus additional electrodes would obtain an ECG

409. Alternatively, if a POSITA wanted to configure a watch measure ECG on two surfaces, a POSITA would have found it obvious to add one or more additional electrodes (as taught by Choi) to Kotanagi to obtain an ECG. Pet. at 52. Apple argues that any new electrodes would need to be on the rear surface to detect skin contact. POR at 69. This argument incorrectly assumes that the proposed

combination uses the additional electrodes *to detect skin contact*. The Petition proposes adding one or more electrodes *to detect ECG*. Pet. at 52.

410. Apple argues that moving Kotanagi's rear electrodes to a different surface would frustrate Kotanagi's purpose of detecting skin contact. POR at 69–70. But Masimo does not propose moving the rear electrodes. Rather, Masimo proposes to keep Kotanagi's rear electrodes but add additional electrodes as taught by Choi. Pet. at 52. As discussed above, a POSITA would have known how to use Kotanagi's pre-existing rear electrodes to both detect skin contact and measure ECG. A POSITA would also have known how to use one or more additional electrodes on a different surface to measure ECG. Indeed, Choi's device uses electrodes to both detect skin contact (through impedance) and measure ECG. EX1011 at ¶47

411. In addition, Apple's allegation that Kotanagi's electrodes would be used solely to detect skin contact ignores that Masimo proposed combining Kotanagi and Choi to obtain an ECG. Pet. at 52. As discussed above, Masimo explained that a POSITA would have been motivated to add ECG functionality to Kotanagi for improved biosensing. Choi discloses electrodes 131 and 151 on two surfaces to detect ECG. Choi also discloses a wearing detection sensor to verify the device is on the wrist before detecting ECG. Similarly, Kotanagi discloses using its electrodes to detect skin contact as a threshold before detecting pulse rate. A POSITA would have known how to use both Kotanagi's existing electrodes and added electrodes as

taught by Choi to obtain an ECG. Specifically, the existing electrodes would detect skin contact to trigger the ECG measurement and the added electrodes would perform the ECG measurement. Thus, combining Kotanagi's existing electrodes with additional electrodes to obtain an ECG would have merely combined familiar elements according to known methods to yield predictable results. *See KSR*, 550 U.S. at 416; *Pet.* at 53–54.

D. Claims 13 and 17

412. Apple's arguments for Claims 13 and 17 rely entirely on its arguments for Claim 1. *POR* at 75. These are wrong for the same reasons explained above for that claim. *Supra* § V(C).

E. Claims 2–6, 8–12, 15–16, and 18–19

413. Apple's arguments for Claims 2–6, 8–12, 15–16, and 18–19 rely entirely on its arguments for the independent claims. *POR* at 76. These arguments are wrong for the same reasons explained above. *Supra* § V(A)–(C).

VI. CONCLUSION

414. For these reasons, it is my opinion that each of Claims 1–19 of the '491 Patent would have been obvious to a POSITA at the relevant time in September 2014. It is further my opinion that Apple has not provided any evidence that these claims would have been non-obvious or that a POSITA would have been dissuaded or discouraged from combining the references provided in the Petition.