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UNITED STATES DISTRICT COURT
CENTRAL DISTRICT OF CALIFORNIA
SOUTHERN DIVISION

MASIMO CORPORATION,
a Delaware corporation; and
CERCACOR LABORATORIES, INC.,
a Delaware corporation,

Plaintiffs,

v.

APPLE INC., a California corporation,
Defendant.

CASE NO. 8:20-cv-00048-JVS (JDEx)

EXPERT REPORT OF STEVE WARREN, Ph.D. REGARDING CERTAIN OF PLAINTIFFS' ALLEGED TECHNICAL TRADE SECRETS

[redacted]

I. INTRODUCTION

1. I understand that Plaintiffs Masimo Corporation ("Masimo") and Cercacor Laboratories ("Cercacor") (together, "Plaintiffs") have sued Apple in Case No. 8:20-cv-00048 filed in the U.S. District Court for the Central District of California. I understand the case involves Plaintiffs' assertion of certain alleged trade secrets.

2. I have been retained by defendant Apple as an expert in this litigation. If called, I expect to testify regarding the subject matter set forth in this report.

3. I am being compensated for my time spent working on this case. This compensation is at my normal consulting rate of $375 per hour. My compensation does not depend upon the outcome of this case or any opinion that I offer.

II. QUALIFICATIONS

4. My educational background, career history, publications, and other relevant experience and qualifications provided herein are only a summary. My complete CV, which sets forth my education, professional appointments, publications authored in the previous 10 years, presentations, grant activity, courses I have taught, service activities, and cases in which I have testified during the previous 4 years, is attached as Appendix A.

A. Education/Preparation

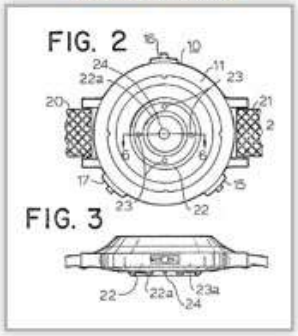
5. I received a B.S. in Electrical Engineering (Summa Cum Laude) from Kansas State University ("KSU") in 1989, an M.S. in Electrical Engineering from KSU in 1991 (Master's Thesis: "An Empirical Study of the Dynamic Hysteresis Characteristics of Ferromagnets"), and a Ph.D. in Electrical Engineering from The University of Texas at Austin in 1994 (graduate fellowship; laser-induced fluorescence of coronary artery and aorta; Monte Carlo simulation of light/tissue interaction; intravascular ultrasound; Dissertation: "Combined Intravascular Ultrasound and Fluorescence Spectroscopy for the Diagnosis of Atherosclerosis"). During the

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Transparent Coverings for Photodiodes

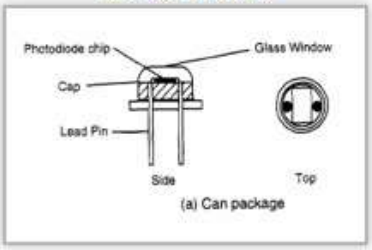
Cramer (1978)



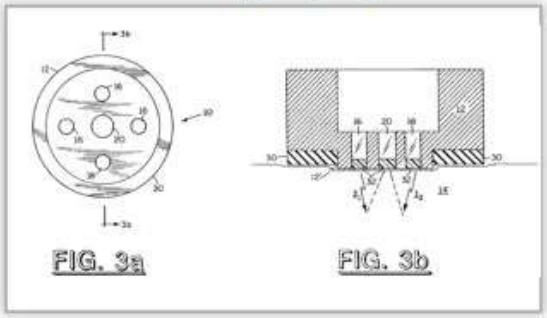
Kansas State



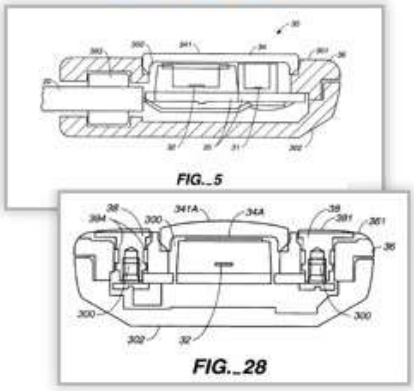
Webster (1997)



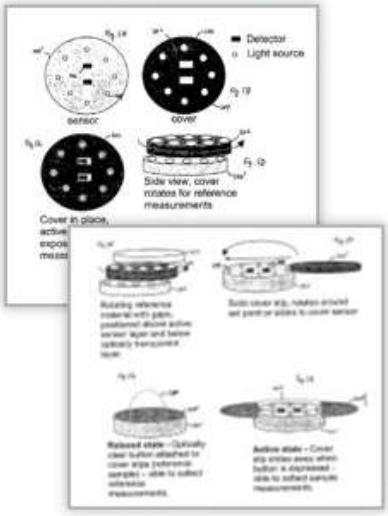
Nippon (1987)



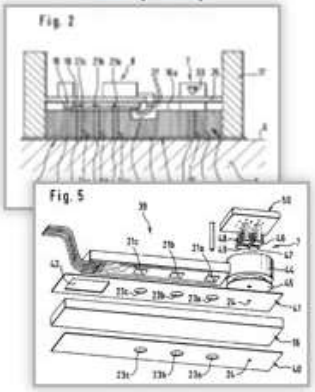
Seiko 131 (1996)



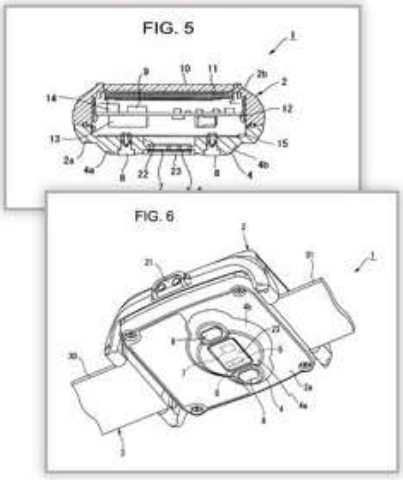
Lumidigm 582 (2005)



Haar (1996)



Seiko (2006)



109. For the reasons set forth above, by 2014 it was well-known that light-based physiological sensors, including pulse rate and blood oxygen sensors, could use transparent coverings for photodiodes, and that there were benefits to such designs.

5. Protrusions That Press Into Tissue

[redacted]

110. Before 2014, it was widely known that light-based physiological detection devices, including pulse oximeters, could use protrusions of various shapes, including protrusions intended to conform to human tissue.

111. The use of a protrusion is a common design choice for light-based physiological measurement devices, including pulse oximeters. A protrusion can be used to improve the contact between the sensor head and the skin and reduce errors caused by ambient light entering into the sensor head without first propagating through tissue. ITPs would also understand that a protrusion could make the device more comfortable to wear over extended periods of time, improve measurement quality, and reduce device slippage due to better contact with tissue. Protrusions can help to improve the quality of light-based signals received by optical biosensing devices.

112. Below, I have listed some disclosures, by 2014, of protrusions of various shapes, including protrusions intended to conform to human tissue:

- Nippon at 2:53-62 ("In one embodiment of the invention, the sensor housing has a flat lower face with a central protrusion in which a plurality of light emitting diodes and an optical sensor are mounted in a vertical configuration. When the sensor is placed on the patient's tissue, the portion of the sensor face containing the LEDs and detector protrudes slightly into the tissue. This feature provides a more repeatable coupling effect between the face of the sensor and the tissue and increases the sensitivity of the sensor.");

- Denso at [0233] ("[0233] Further, convex members 2033 are arranged on the light shielding plate 2031 so as to surround the light transmitting plate 2029 thrice. The triple surrounding of the convex members 2033 may be changed to single, double or quadruple surrounding. Further, the height of the convex member 2033 is designed to be sufficient for causing appropriate depressed portions in the skin when the pulse wave sensor 2003 is fixed to the human body's arm or the like. For example, the height of the convex member 2033 is about 0.3 mm. As described later, the convex members 2033 are provided to prevent reception of external light in the PD 2025. Further, the convex members 2033 are multiple projection lines each having head and tail ends. A gap 2035 is formed between the both ends of each projection line for prevention of steaming. Further, the intervals among the triple layers of the convex members 2033 (e.g., see intervals SI and S2 in FIG. 32B) are not equal but random intervals. Note that as the convex members 2033, a material having a flexible characteristic is used such that when the pulse wave sensor 2003 is fixed to the human body's arm or the like, the convex members 2033 comes to make a contact with the human body's skin

without gap. For example, silicon material is preferable. In the figure, the convex members 2033, the light shielding plate 2031 and the casing 2020 are separate members, but the casing 2020 may be processed to have the same functions as those of the convex member 2033 and the light shielding plate 2031.");

- Cramer at 5:12-25 ("Now referring to FIGS. 2-5, which are side and under side views of the invention of FIG. 1, the typical relationship of the straps 20 and 21 to the case 11 are more clearly apparent, and in these views the transducer portion on the underside of the case 11 may be seen. This transducer structure is contained within a boss region 22 of substantial diameter in order to provide a relatively large area of intimate contact with the user's wrist. This will insure both comfortable wearing and sufficient contact for obtaining an accurate pulse indication by either a pulse transducer of the pressure type contained therein shown in FIGS. 4 and 5, or by the preferred embodiment employing an infra-red source-detector combination as best shown in FIG. 2."); *see id.* at Figs. 1-6, 9, shown below;

- Hon at 5:20-48 ("With reference now to FIGS. 3 and 4, a sensor 14 representative of each of sensors 14a–f is illustrated. The sensor 14 includes six infrared transmitters 24 arranged about and spaced from a photoresponsive element 26. Each of the infrared transmitters 24 and the photoresponsive element 26 are embedded in a plastic base 28 and protrude through a surface 30 of the base 28. Consequently, when base 28 is positioned to face either the cervical or vaginal wall and as the vaginal fluids are absorbed by cushion 20 in device 10 or 10' each of the associated infrared transmitters and the photoresponsive element are pressed against that cervical or vaginal wall which faces base 28. The protrusion of transmitters 24 and element 26 through the surface 30 aids in minimizing the effects of forces tending to separate each of the sensors from the tissues since both the transmitters and photoresponsive element are pressed into the tissues. Transmitters 24 are angled inwardly of the sensor 14 to transmit infrared radiation to a point in the tissues beneath the element 26. The sensor 14 also includes an annular guard ring 32 defining the lateral border of the base 28. The guard ring 32 is adapted to press against the tissue and block the transmission of any surface waves in the tissue from the surface thereof adjacent the transmitters 24 and the element 26, since such waves may tend to temporarily separate the transmitters 24 and the element 26 from the tissue, introducing artifacts into the signal produced by the sensor 14."); *id*. at 6:65-69 ("The capillary blood flow in the woman's forehead may be obtained by pressing a sensor of the type shown in FIGS. 3 and 4 against the forehead and maintaining the sensor so positioned with the use of a head strap.");

- Lumidigm at 7:57-63 ("The sensor head 32 may have other shapes, including oval, square and rectangular shapes. The sensor head 32 may also have a compound curvature on the optical surface to match the profile of a device in which it is mounted, to incorporate ergonomic features that allow for good optical and mechanical coupling with the tissue being measured, or for other technical or stylistic reasons.");

- Seiko at 7:52-55 ("When the housing 2 is mounted to the wrist A, since the protrusion part 4 protrudes than the lower face 2a of the housing 2, the organism surface B and the lower face 4a of the protrusion part 4 become a closely contacted state.")

[redacted]

- Seiko 131 at 3:22-28 ("When the outside surface of the light transmittance plate is a convex surface, pressure is applied to the light transmittance plate by simply holding the outside surface of the light transmittance plate lightly against the body surface, and positive contact between the body surface and outside surface of the light transmittance plate can therefore be improved.")

- Seiko 182 at [0077] ("By forming the protruding part 4 into a circle, when the housing 2 is mounted to the wrist A, the protruding part 4 is pressed against the living body surface B with equal force, so there adherence is good. At this time, since the diameter of the protruding part 4 is not greater than 20 mm, the protruding part 4 can be pressed with a light force, which makes it possible to further eliminate any oppressive feeling. Here, the difference between the maximum diameter and the minimum diameter of the wrist is typically 3 mm. Therefore, as illustrated in FIG. 8, by setting the distance between the lower surface 4a of the protruding part 4 and the lower surface 2a of the housing 2 to 3 mm, it is possible to accommodate changes in the thickness of the wrist, which makes it possible to enhance adherence without creating a gap between the lower surface 4a of the protruding part 4 and the living body surface B. Accordingly, the adherence of the biological sensor part 8 can be improved.")

- Rafert at 4:7-5:40 ("The cover portions 58, 60 are preferably rounded so as to minimize any shearing effects when applied to a patients skin. This shape also provides a smooth boundary transition from the blood-depleted tissue portions to the surrounding blood-perfused tissue portions, which enhances the mobility of the boundary region in response to the heartbeat cycle."); *id*. at 6:4-24 ("The photodetector 38 is enclosed by a rounded protective cover, such as a silicone cap 76, which exerts localized pressure on the patient's body portion when the sensor 10 is placed in physical conformance therewith.");

113. Relevant diagrams from these and other disclosures are reproduced below—demonstrating that, by 2014, there were numerous designs of protrusions of various shapes, including protrusions intended to conform to human tissue.

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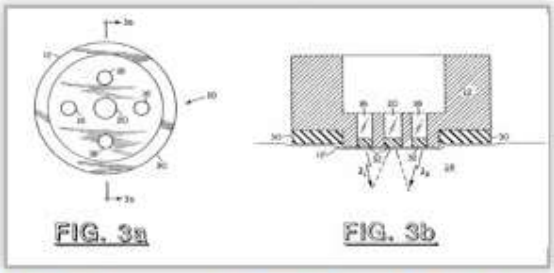
Kansas State 6D



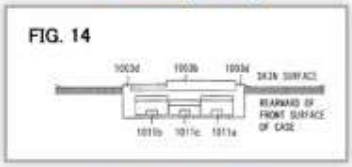
Kansas State 4D



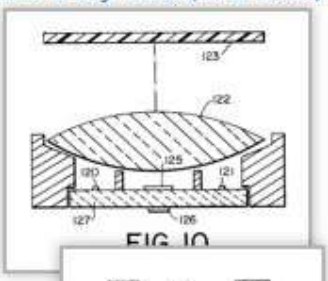
Nippon (1987)



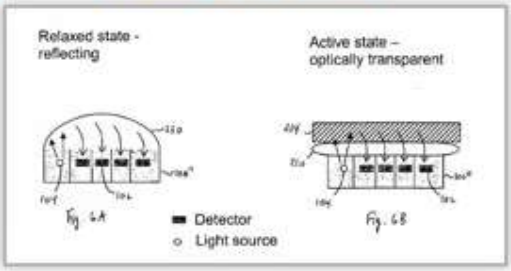
Denso (2005)



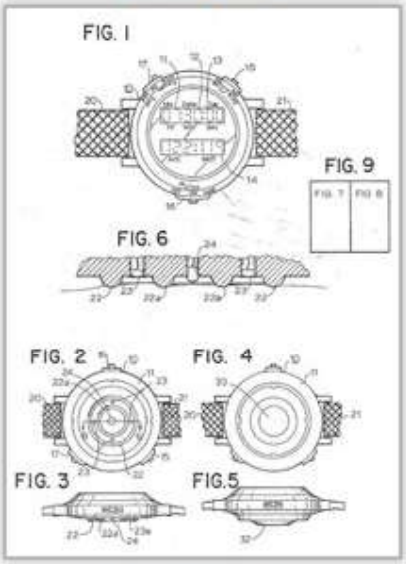
McCarthy 1998 (filed 1996)

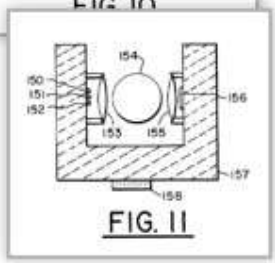


Lumidigm 582 (2005)

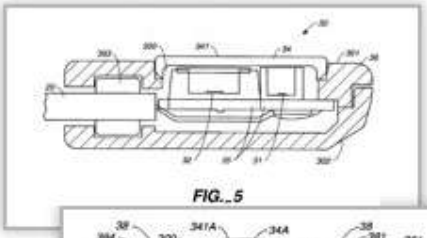


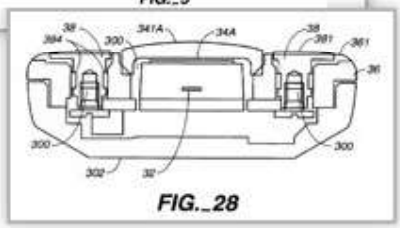
Cramer (1978)



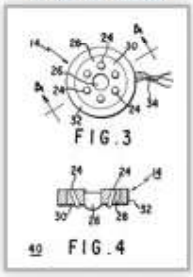


Seiko 131 (1996)

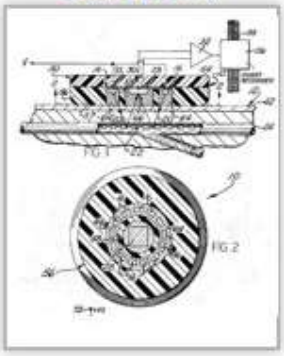




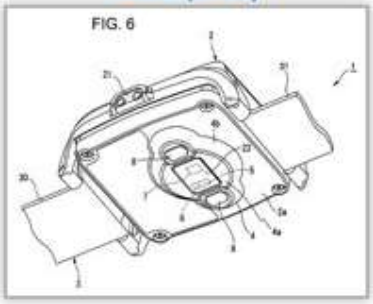
Hon (1982)



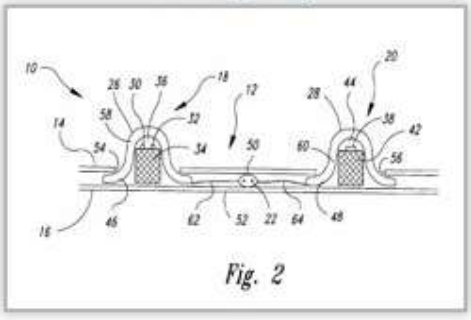
Smart (1971)



Seiko 182 (2005), Seiko (2006)



Rafert (1996)



[redacted]

114. For the reasons set forth above, by 2014 it was well-known that light-based physiological sensors, including pulse rate and blood oxygen sensors, could use protrusions of various shapes, including protrusions intended to conform to human tissue, and that there were benefits to such designs.

C. Background on Light Shunting or "Light Piping"

115. Plaintiffs were not the first to discover the phenomenon of light traveling from sensor emitter(s) (such as LEDs) to sensor detector(s) (such as photodiodes) without passing through patient tissue, nor were Plaintiffs even the first to coin the term "light piping." For example, a textbook titled "Design of Pulse Oximeters" was edited by J.G. Webster and was published in 1997 ("Webster 1997"). Webster taught that "***Optical shunting occurs when light from the sensor's LEDs reaches the photodiode without passing through the tissue. Optical shunting leads to erroneous readings in the value of SaO2 as the amount of light detected by the photodiode is greatly increased by optical shunting.***" Webster 1997 at 95;[12] *see also, e.g.*, *id.* at 79, 185. In other words, what Plaintiffs term "light piping" was already described by Webster 1997 as "optical shunting." Webster 1997 also taught ITPs the importance and value of "limit[ing]" optical shunting, such as through the use of "***light impervious barriers*** … placed between LEDs and the photodiode" and "***coat[ing]*** the housing around the photodiode with a material that does not scatter or reflect light." *Id.* at 79.

116. Almost a decade prior to the publication of Webster's seminal textbook on pulse oximetry, a well-known article called "Pulse Oximetry Uses and Abuses" by Schnapp and Cohen (Schnapp 1990), published in *Chest*, clearly stated the negative effect of light shunts on pulse oximeter accuracy: "Excessive light from a number of sources, including surgical lamps, infrared

[12] All emphasis is added unless otherwise noted.

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Dated: September 23, 2022

Steve Warren, Ph.D.

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