IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re *Inter Partes* Review of:)
U.S. Patent No. 6,926,670)
Issued: August 09, 2005)
Application No.: 10/054,330)
Filing Date: January 22, 2002)

For: Wireless MEMS Capacitive Sensor for Physiologic Parameter Measurement

FILED VIA E2E

PETITION FOR *INTER PARTES* REVIEW OF U.S. PATENT NO. 6,926,670

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1001	U.S. Patent No. 6,926,670 ("'670 Patent")
1002	Prosecution history for U.S. Patent Application No. 10/054,330 ("'670 FH")
1003	U.S. Provisional Patent Application No. 60/263,327 ("'327 provisional")
1004	U.S. Provisional Patent Application No. 60/278,634 ("'634 provisional")
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1006	U.S. Patent No. 6,939,299 ("Petersen")
1007	U.S. Provisional Patent Application No. 60/170,450 ("Petersen provisional")
1008	Eun-Chul Park et al., *Hermetically Sealed Inductor-Capacitor (LC) Resonator For Remote Pressure Monitoring*, 37 Jpn. J. Appl. Phys. 7124 (1998) ("Park")
1009	U.S. Patent No. 6,278,379 ("Allen-379")
1010	Orhan Şevket Akar, *Silicon Micromachined Capacitive Pressure Sensors for Industrial and Biomedical Applications* (Sept. 1998) (Master's thesis, Graduate School of Natural and Applied Sciences of the Middle East Technical University) ("Akar")
1011	U.S. Patent No. 5,488,869 ("Renaud")
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1016	U.S. Patent No. 4,026,276 ("Chubbuck")
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1018	U.S. Patent No. 6,201,980 ("Darrow")
1019	R. Puers et al., *Electrodeposited Copper Inductors for Intraocular Pressure Telemetry,* 10 J. Micromech. Microeng. 124 (2000) ("Puers")
1020	Timothy J. Harpster et al., *A Passive Wireless Integrated Humidity Sensor,* 14th IEEE International Conference on Micro Electromechanical Systems 553 (2001) ("Harpster")
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1026	Orhan Akar et al., *A Wireless Batch Sealed Absolute Capacitive Pressure Sensor,* Eurosensors XIV, The 14th European Conference on Solid-State Transducers 585 (Aug. 2000) ("Akar-2000")
1027	Orhan Akar & Tayfun Akin, *Micromachined Capacitive Silicon Pressure Sensor for Industrial and Biomedical Applications,* Electrical and Electronics, Computer Engineering 7th National Congress (1997) (including certified English translation and original Turkish version of article)

I. INTRODUCTION

Abbott Laboratories, Abbott Laboratories, Inc., St. Jude Medical, Inc., and CardioMEMS LLC request *inter partes* review of claims 1-5, 21, 26-27, and 31 of U.S. Patent No. 6,926,670, titled "Wireless MEMS Capacitive Sensor for Physiologic Parameter Measurement" ("'670 patent") (Ex. 1001). According to USPTO records, the '670 patent is assigned to Integrated Sensing Systems, Inc.

The '670 patent relates to an implantable inductor-capacitor (LC) resonant sensor device for continuous remote monitoring of physiologic parameters in a patient. As the '670 patent acknowledges, the use of LC resonant circuits for use as wireless implantable sensors was "well-known to those knowledgeable in the art." '670 patent, 1:32-37. While the challenged claims recite a sensing device being a "micro electromechanical system (MEMS)" with an "integrated inductor," those common features were taught by multiple prior art references not before the examiner and by the admitted prior art.

Accordingly, Petitioner asks the Board to institute review of the '670 patent and find all challenged claims unpatentable.

II. MANDATORY NOTICES UNDER 37 C.F.R. § 42.8

A. Real Parties in Interest (37 C.F.R. § 42.8(b)(1))

The real-parties-in-interest are Abbott Laboratories, Abbott Laboratories, Inc., St. Jude Medical, LLC, and CardioMEMS LLC (collectively, "Petitioner").

B. Related Matters (37 C.F.R. § 42.8(b)(2))

The ’670 patent has been asserted in the following district court case pending in the Eastern District of Michigan: *Integrated Sensing Systems, Inc. v. Abbott Laboratories, et al.*, Case No. 2:19-cv-10041-DPH-EAS.

C. Lead and Backup Counsel and Service Information

Under 37 C.F.R. §§ 42.8(b)(3), 42.8(b)(4), and 42.10(a), Petitioner designates the following lead counsel:

- Michael A. Morin (Reg. No. 40,734), michael.morin@lw.com, Latham & Watkins LLP; 555 Eleventh Street, NW, Ste. 1000; Washington, D.C. 20004-1304; 202.637.2298 (Tel.); 202.637.2201 (Fax).

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Under 37 C.F.R. § 42.10(b), a Power of Attorney from Petitioner is attached. Petitioner consents to electronic service.

D. Fee for *Inter Partes* Review

The Director may charge the fee specified by 37 C.F.R. § 42.15(a) to Deposit Account No. 506269.

III. GROUNDS FOR STANDING (37 C.F.R. § 42.104(A))

Petitioner certifies that the ’670 patent is available for *inter partes* review and that the Petitioner is not barred or estopped from requesting *inter partes* review of the challenged claims of the ’670 patent on the grounds identified herein.

IV. IDENTIFICATION OF CLAIMS BEING CHALLENGED (37 C.F.R. § 42.104(B))

A. Statutory Ground for the Challenge

Petitioner requests *inter partes* review of claims 1-4, 21, 26-27, and 31 of the ’670 patent on these grounds:

Ground	**Claims**	**Basis**
1	1-4, 21, 26, 31	§ 102: Petersen
2	26-27	§ 103: Petersen in view of Renaud
3	1-4, 21, 31	§ 102: Park
4	26-27	§ 103: Park in view of Renaud

V. OVERVIEW OF THE ’670 PATENT

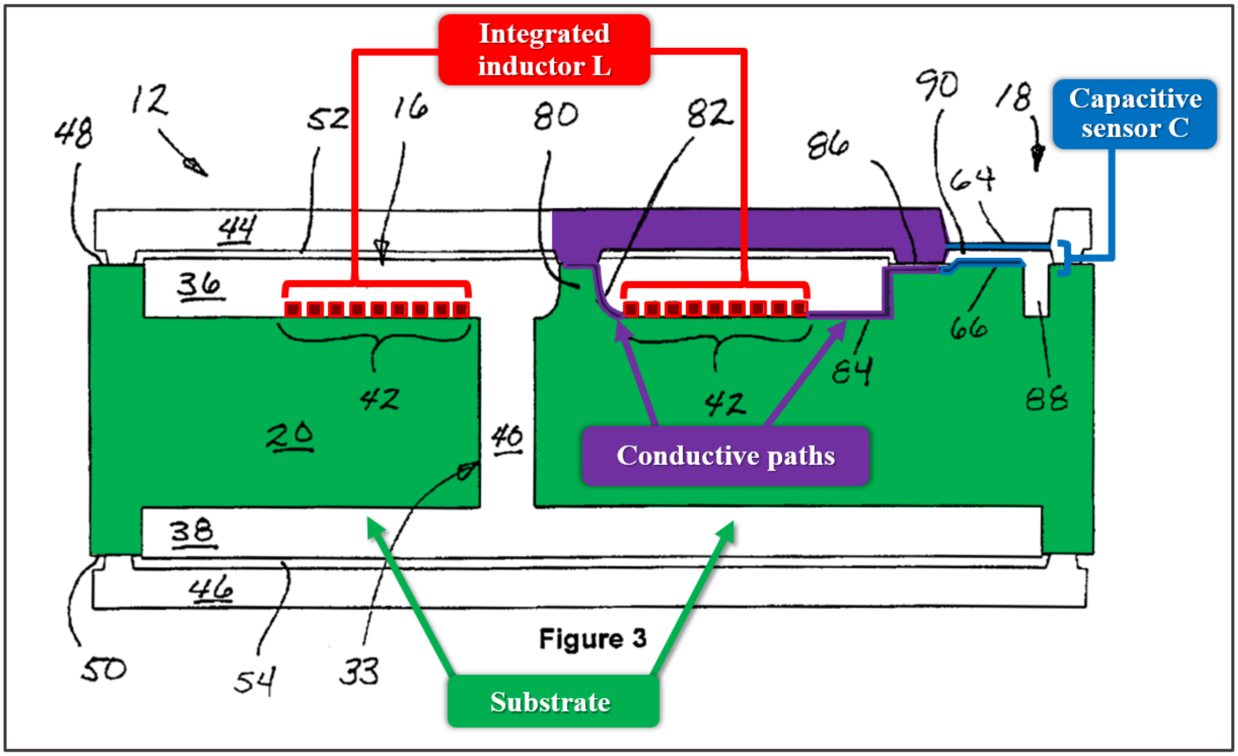
A. The ’670 Patent

The ’670 patent claims priority to provisional application nos. 60/263,327 (“’327 provisional,” Ex. 1003), filed January 22, 2001, and 60/278,634 (“’634 provisional," Ex. 1004), filed March 26, 2001, and relates to "an implantable microfabricated sensor device and system for measuring a physiologic parameter of interest within a patient." '670 patent, Abstract.

The '670 patent explains that LC resonant circuits, also referred to as "LC tank resonators," were "well-known to those knowledgeable in the art" for use as wireless implantable sensors. '670 patent, 1:32-37; Allen Decl. ¶ 38 (Ex. 1024) (explaining that the term "tank" is used because the oscillation of energy between the inductor and capacitor connected in parallel is analogous to water sloshing back and forth in a tank). The LC resonant circuit of the implantable sensing device includes a (1) parallel plate capacitor (represented by the letter C), which varies with some physical parameter (e.g., pressure), thus acting as a "capacitive sensor," and (2) an inductor (represented by the letter L) that operates as an antenna for wireless communication with an external readout device, and (3) a series-parallel connection between the capacitor and inductor. '670 patent, 1:32-50, 10:30-35; Allen Decl. ¶¶ 38-40.

The '670 patent states that the LC resonator devices of the prior art fabricated the capacitive sensor and the inductor separately. '670 patent, 2:51-59. This allegedly resulted in assemblies that may be (1) "too large for many desirable applications, including intraocular pressure monitoring and/or pediatric applications" and (2) "prohibitively expensive to manufacture." *Id*. Accordingly, the ’670 patent teaches and claims an “invention” in which the inductor is “microfabricated with the sensor itself” using common MEMS fabrication techniques. *Id.*, 3:28-31, 3:46-60 (“[T]he present invention provides a MEMS sensor … microfabricated utilizing common microfabricating techniques.…”); Allen Decl. ¶¶ 45-51 (also discussing admitted prior art LC resonant sensors).

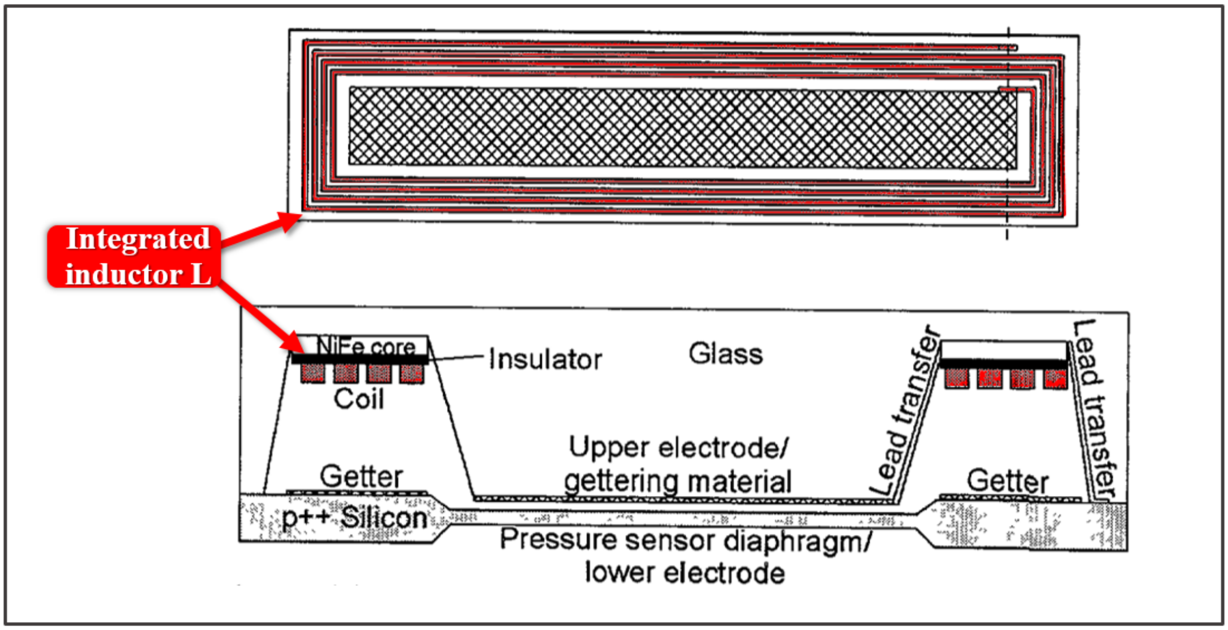
Annotated Figure 3 below is a cross section of the ’670 patent’s pressure sensing device, showing the “integrated inductor” coil (red) and the capacitive “sensor” (blue), including its movable electrode 64 and fixed electrode 66. ’670 patent, 6:30-32, 7:25-36. The integrated inductor coil and fixed electrode 66 are formed on the surface of a common “substrate 20” (green). *Id.*, 7:30-35. Although Figure 3 depicts the capacitive sensor to the side of the integrated inductor, the ’670 patent also explains that the sensor “may be located within, above, or below the turns of the coil 42.” *Id.*, 9:45-50. Also shown in annotated Figure 3 are the “traces 82, 84” that create a plurality of “electrical path[s]” (purple) that connect the two plates of the capacitor to the inner and outer most turns of the integrated inductor, forming a LC resonant circuit. *Id.*, 8:66-9:7.



’670 patent, Fig. 3 (annotated); Allen Decl. ¶¶ 52-53.

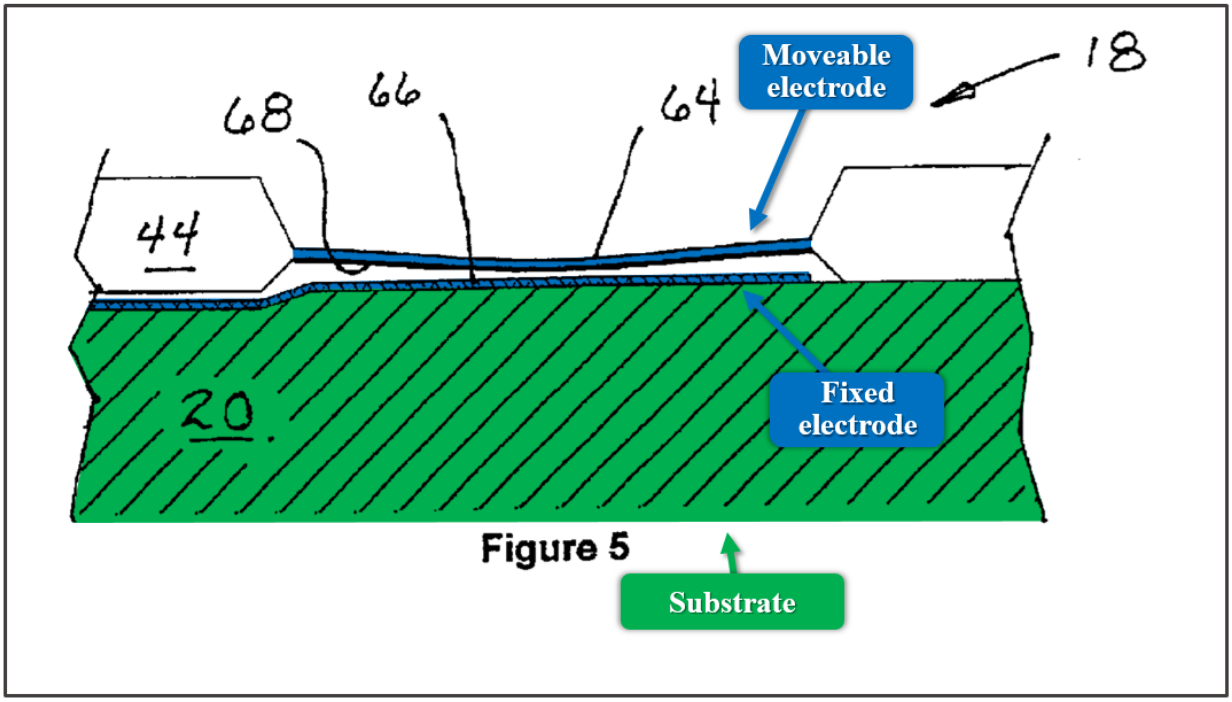
Figure 3 is a cross section and so the integrated inductor coil 42 is depicted as a discontinuous series of black squares. Those black squares represent a continuous planar coil of conductive material forming the integrated inductor. Allen Decl. ¶ 54; ’670 patent, 6:30-41.

A top down depiction of an integrated inductor is shown in annotated Figure 12(b) from the ’634 provisional, which shows how the coils look from above:



’634 provisional, Fig. 12(b) (annotated), Ex. 1004, 3, 9 (Figure 12 depicts “[i]ntegration of an inductor or coil into a capacitive sensor structure.”); Allen Decl. ¶ 54.

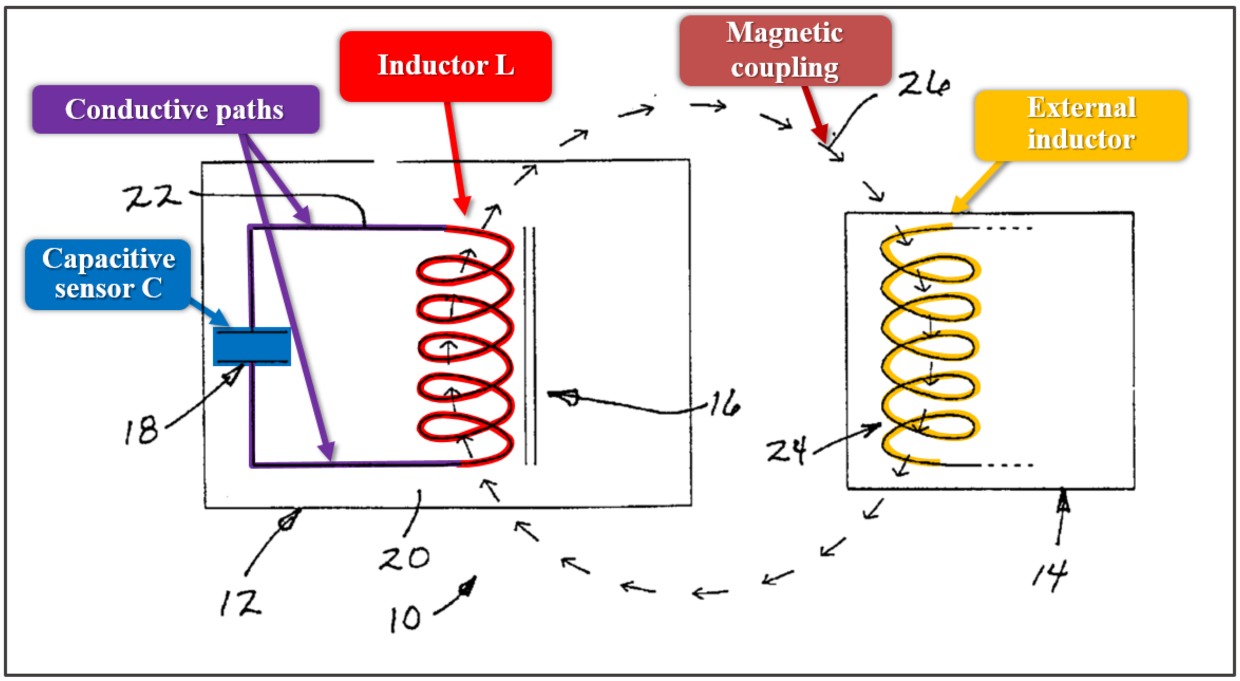
Annotated Figure 5 from the ’670 patent below is an enlarged cross-sectional view of Figure 3’s capacitive sensor 18. ’670 patent, 4:46-48. Capacitive sensor 18 can be “constructed in many forms commonly know[n] to those familiar with the art.” *Id.*, 7:27-29. The bottom plate of capacitive sensor 18 (called “conductive layer” or “fixed electrode 66”) is formed on the surface (“upper face 48”) of substrate 20. *Id.*, 7:33-36. Upper cap layer 44 is formed to define a thin and flexible diaphragm 64 (also called “moveable electrode 64”). *Id.*, 7:28-38. The diaphragm 64 can be conductive and/or plated with a conductive layer 68.



’670 patent, Fig. 5 (annotated), 7:26-38; Allen Decl. ¶ 55.

The diaphragm (with or without the conductive layer) is referred to as the “moveable electrode” of the capacitor because applied pressure to the top surface of the capacitive pressure sensor deflects (moves) it towards fixed electrode 66. ’670 patent, 7:66-8:2; Allen Decl. ¶ 56. That movement changes the capacitance between the two plates. ’670 patent, 8:15-18 (the “standard equation of parallel plate capacitance, C= ϵA/d” where “plate separation d will vary with the applied pressure”). Thus, by implanting the sensor so that the moveable electrode is arranged in the path of the physical property being measured (e.g., pressure of a fluid), the property can be deduced by a change in capacitance. *Id.*, 8:2-6; Allen Decl. ¶ 56.

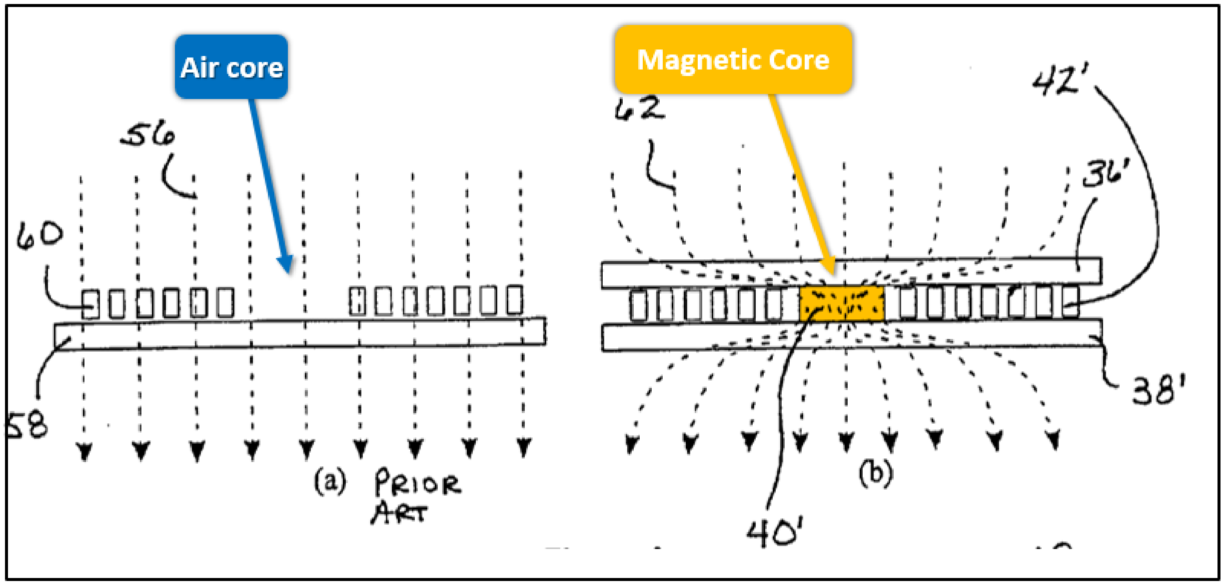
The ’670 patent includes a “schematic illustration of a wireless MEMS sensor system according to the principles of the present invention” as shown in annotated Figure 1 below. ’670 patent, Fig. 1, 4:32-34. On the left is the “pressure sensing device,” 12, which includes the “integrated inductor 16” (red) and “capacitive pressure sensor 18” (blue) connected in parallel (purple), and on the right is a non-implantable “readout device 14” that includes a “second inductor 24” (yellow).



’670 patent, Fig. 1 (annotated), 5:60-64; Allen Decl. ¶ 57.

The arrows arranged in a circle between the integrated inductor and non-implantable inductor show that the inductors are “couple[d] magnetically.” ’670 patent, 5:62-64. Before 2001, magnetic coupling was (and still is) a basic principle of wireless communication between two inductors placed in close proximity. Allen Decl. ¶¶ 41-44; ’670 patent, 1:33-36 (providing as background that “[a] number of proposed schemes for wireless communication rely on magnetic coupling between an inductor coil associated with the implanted device and a separate, external 'readout' coil"); 5:65-67 (stating that "readout device[s]" used to measure impedance of an external coil are "well known in the industry and in the sensing field in general"). This magnetic, or inductive, coupling allows detecting the physical parameter measured by the capacitive sensor. '670 patent, 1:35-49.

Thus, the integrated inductor allows reading the sensor wirelessly: any change in capacitance is measured indirectly by measuring the impedance of an external readout coil magnetically coupled to the integrated inductor. *Id.*, 1:50-54 (explaining this technique was known in the prior art), 5:62-64; Allen Decl. ¶¶ 39-44, 57. According to the '670 patent's alleged invention, the improvement is increasing the coupling effectiveness (and thus the distance at which the sensor may be read) by having an integrated inductor that comprises a "magnetic core" to concentrate the magnetic field, as shown above in Figure 3 and below in Figure 4B:



’670 patent, Fig. 4, 4:40-46, 6:63-7:16; Allen Decl. ¶ 58. Only claims 7-18 arguably recite the alleged improvement of including a “magnetic core” within the integrated inductor, and none of those claims are challenged here. *Id.* ¶ 59.

B. The Challenged Claims

Claim 1 is the only independent claim and recites an “implantable microfabricated sensor device for measuring a physiologic parameter of interest within a patient,” wherein the sensor device essentially comprises three elements:

1. an “integrated inductor” formed on a substrate;
2. a “sensor” that is formed at least in part on the substrate;
3. wherein the integrated inductor and sensor are electrically connected by a “plurality of conductive paths” to define an “LC tank resonator.”

As shown in the grounds below, sensor devices having these properties were disclosed in numerous prior art references. And, as discussed below, the remaining challenged claims depend from claim 1 and are also invalid in view of the prior art discussed herein.

C. Prosecution History

During prosecution, the examiner rejected all claims as obvious over U.S. Patent No. 6,567,703 to Thompson, et al., in view of U.S. Patent No. 6,101,371 to Barber, et al. '670 FH (Ex. 1002), 306. Specifically, the examiner found that the combination taught all of the limitations of claim 1, and that "the specific limitations of the dependent claims are either inherently or obviously met by either one of the cited references." *Id.*, 307.

In response, the patentee argued that the "claims of the present application specifically recite that the claimed MEMS device includes a sensor responsive to physiologic parameters that is formed at least in part on the surface of the substrate." *Id.*, 317. The applicant then argued that the art does not expressly state that "a portion of a sensor is formed on the surface of the substrate" and therefore fails to disclose the claimed feature. *Id*. The examiner issued a notice of allowance without any remarks.

VI. CLAIM CONSTRUCTION

The Board construes the claims "using the same claim construction standard that would be used" in District Court. 37 C.F.R. § 42.100.

A. "integrated inductor"

The term "integrated inductor" in claim 1 means "an inductor microfabricated with the sensor itself." This construction is correct because the patent expressly gives it that definition, it is the plain meaning in the art, it is supported by the surrounding claim language, and it is supported by the specification.

First and foremost, the '670 patent defines integrated inductor:

> Still another object of the present invention is to provide a wireless MEMS sensor system in which the sensing device utilizes ***an integrated inductor, an inductor microfabricated with the sensor itself***.

'670 patent, 3:28-31.[1] This is an explicit definition of what an "integrated inductor" is. *See Trading Techs. Int'l., Inc. v. eSpeed, Inc.*, 595 F.3d 1340, 1353 (Fed. Cir. 2010) (finding inventors defined the term "static" where the specification stated "The values in the price column are static; that is, they do not normally change positions unless a re-centering command is received (discussed in detail later).").

The '670 patent's definition of "integrated inductor" is also supported by the rest of the claim language. *Phillips v. AWH Corp.*, 415 F.3d 1303, 1314 (Fed. Cir. 2005) (en banc) ("[T]he claims themselves provide substantial guidance as to the meaning of particular claim terms."). The "integrated inductor" of claim 1 is

[1] All emphasis added unless otherwise noted.

"formed on a substrate," just like the components of an integrated circuit are formed with each other on a substrate using microfabrication techniques most often already known in the art. Allen Decl. ¶¶ 66-68. The preamble of claim 1 further reinforces this conclusion, reciting that the implantable pressure sensing device is "microfabricated" and that it comprises both the "integrated inductor" and a "sensor." '670 patent, claim 1. The subsequent claim limitations require that the "integrated inductor" and "at least one sensor" are "formed on" the same substrate. *Id.* Because the integrated inductor and sensor are microfabricated on the same substrate, a POSITA would have understood that the inductor and capacitor are microfabricated *together*. Allen Decl. ¶ 66-68.

Moreover, the '670 patent distinguishes an "integrated inductor" from hand or machine wound inductors formed as discrete components. Allen Decl. ¶ 70. The '670 patent identifies other prior art references using LC resonant circuits that did "not take advantage of recent advances in silicon (or similar) microfabrication technologies" like the claimed invention. '670 patent, 1:67-2:7. Those references each describe an inductor formed as a discrete component by wrapping a wire around a mandrel, then assembling them into a sensor device with a capacitive sensor. Allen Decl. ¶¶ 71-72 (comparing the inductors disclosed in the conventionally fabricated LC resonators with the inductors disclosed in the microfabricated LC resonators).

Following this background discussion, the ’670 patent exclusively discloses planar or layered inductors formed on the surface of the substrate using known microfabrication techniques. ’670 patent, 3:47-50 (“The implantable unit is microfabricated utilizing common microfabricating techniques….”); 5:60-64 (“As an example, the preferred embodiment integrates a capacitive pressure sensor 18 into a common substrate 20 with the integrated inductor 16.”), Figs. 3, 4, 11; Allen Decl. ¶ 69; *Boss Control, Inc. v. Bombardier Inc.*, 410 F.3d 1372, 1377 (Fed. Cir. 2005) (“[T]he patentee’s choice of preferred embodiments can shed light on the intended scope of the claims.”).

The explicit definition in the ’670 patent of “integrated inductor” is consistent with how the term was used in the art at the time. *Arthur A. Collins, Inc. v. N. Telecom Ltd.*, 216 F.3d 1042, 1044-45 (Fed. Cir. 2000). The term “integrated inductor” is akin to an “integrated circuit,” and refers to forming an inductor on a substrate such that it can be batch microfabricated with other components (such as a capacitive sensor) rather than individually constructed of discrete electronic components. Allen Decl. ¶¶ 73-74 (discussing examples below).

For example, the ’670 patent cites to Darrow as disclosing a “microfabricated sensors” that are an “alternative to conventionally fabricated devices” that require “complex assembly processes [that make] such devices prohibitively expensive to manufacture for widespread use.” ’670 patent, 2:57-67. As prior art of record, Darrow has "particular value as a guide to the proper construction of [integrated inductor], because it may indicate not only the meaning of the term to persons skilled in the art, but also that the patentee intended to adopt that meaning." *Kumar v. Ovonic Battery Co.*, 351 F.3d 1364, 1368 (Fed. Cir. 2003) (citation omitted). Darrow describes an "integrated inductor" that is "directly fabricated on a wafer (or wafers) ***with other required circuit components, to form an integrated, MEMS-based implantable transducer circuit***." Darrow (Ex. 1018), 7:1-7, claim 22.

Other prior art references also show that a POSITA would have understood "integrated inductor" to be consistent with the express definition in the '670 patent. *Collins*, 216 F.3d at 1044-45 ("Even when prior art is not cited in the written description or the prosecution history, it may assist in ascertaining the meaning of a term to a person skilled in the art."). For example, Petersen describes an "integrated micromachined inductor coil" that is a "flat coil that is coplanar and coaxial with the first capacitor plate" and "made by removing selected portions of material from a conductive sheet." Petersen (Ex. 1006), 3:67-4:11; 7:32-37. Petersen distinguishes its inductor from non-integrated inductors in the prior art that are "produced by hand winding and hand assembly, which is both costly and inefficient." Petersen, 2:41-43; *see also, generally, id.*, 2:35-3:19 (discussing five prior art references disclosing LC resonant sensors using non-integrated inductors); Allen Decl. ¶ 74.

For these reasons, the term "integrated inductor" should be construed as an "inductor microfabricated with the sensor itself."

Regardless, this petition does not turn on this definition; even if the Board adopts a broader definition, *e.g.*, merely requiring the "inductor" to be physically and/or electrically "integrated" with the rest of the device, the claims are unpatentable for the same reasons presented herein. Allen Decl. ¶ 76.

B. "[said sensing device] being a micro electromechanical system (MEMS)"

The Board should construe "[said sensing device] being a micro electromechanical system (MEMS)" in claim 1 to mean that "[said sensing device] is made using microfabrication processes such as micromachining," but the claims are unpatentable under any reasonable construction of this term for the reasons explained herein.

The specification shows that an electromechanical sensor device is a MEMS device when it is made using microfabrication processes. Indeed, the '670 patent admits that small electromechanical sensor devices were known in the prior art, but stated that they do not "take advantage of recent advances in silicon (or similar) microfabrication technologies." '670 patent, 2:4-7; *see also, id.*, 1:20-2:50 (describing known prior art devices). Rather, those "devices require a complex electromechanical assembly with many dissimilar materials," resulting in "complex assembly processes" that "make such devices prohibitively expensive to manufacture for widespread use." *Id.*, 2:50-59. In contrast with these prior art devices, the '670 patent's "MEMS sensor system" is manufactured using "common microfabricating techniques," providing a "device where all components are located on the same chip." *See id.*, 3:47-52; Allen Decl. ¶¶ 77-79 .

The '670 patent also claims priority to two provisional applications that expressly define "micromachined" as "using batch-microfabrication techniques understood by those familiar with the art that are typically common to integrated-circuit and/or MicroElectroMechanical Systems (MEMS) fabrication processes." '327 provisional (Ex. 1003), 1; '634 provisional (Ex. 1004), 2. In other words, micromachining is a type of microfabrication, and both micromachining and microfabrication of the electromechanical components comprising the claimed sensor device (e.g. an "integrated inductor" and "sensor responsive to physiologic parameters"), will result in the sensing device being a MEMS, as reflected in Petitioner's construction. Allen Decl. ¶¶ 80.

Petitioner's construction also reflects how the term "MEMS" was used in the art at the time. Allen Decl. ¶ 81; *Collins*, 216 F.3d at 1044-45. For example, Roy teaches that MEMS "refers to a class of miniature electromechanical components and systems that are fabricated using techniques originally used in the fabrication of microelectronics," e.g., MEMS "pressure sensors" are "manufactured using microfabrication and micromachining techniques." Roy (Ex. 1012), 2:17-25. As another example, Christenson explains that "MEMS devices are created by microfabrication processes and techniques sometimes referred to as micromachining." Christenson (Ex. 1014), 1:30-32; *see also, e.g.,* Discenzo (Ex. 1013), 2:15-19 (describing a "viscosity sensor of a MEMS (micro-electro mechanical systems) type" that is "made using integrated circuit-like microfabrication techniques").

VII. PERSON HAVING ORDINARY SKILL IN THE ART

A person of ordinary skill in the art at the relevant time (around 2001) would have had at least a bachelor's degree in electrical or mechanical engineering (or equivalent) and at least two years' industry experience, or equivalent research. Alternatively, a POSITA could substitute directly relevant additional education for experience, e.g., an advanced degree relating to the design of implantable medical devices, or an advance degree in electrical or mechanical engineering (or equivalent), with at least one year of industry experience. Allen Decl. ¶ 34.

This Petition does not turn on this precise definition, and the claims would be unpatentable from the perspective of any reasonable POSITA. *Id.* ¶ 36.

VIII. GROUND 1: CLAIMS 1-4, 21, 26, AND 31 ARE ANTICIPATED BY PETERSEN

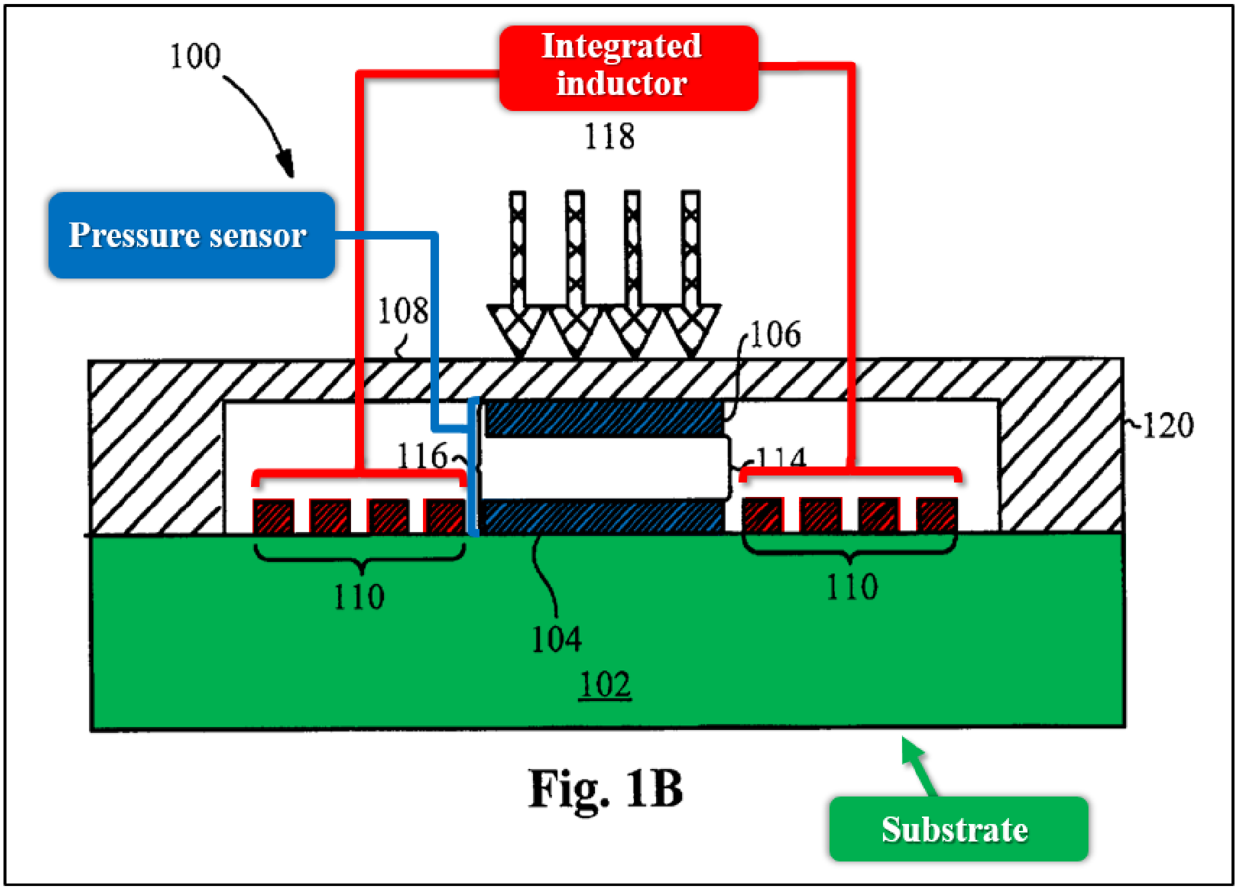
Petersen anticipates each one of these claims because it discloses each and every element arranged as in the claim.

A. Overview—Petersen (Ex. 1006)

Petersen is § 102(e) prior art as of its U.S. filing date, December 8, 2000. Petersen is also prior art as of the filing of its provisional application ("Petersen provisional," Ex. 1007), December 13, 1999, as will be discussed later.

Like the '670 patent, Petersen explains that implantable LC resonant circuits were well-known in the art, but they typically used non-integrated inductors "produced by hand winding and hand assembly, which is both costly and inefficient." Petersen, 2:41-43; *see also, generally, id.*, 2:35-3:19 (discussing LC resonant sensors using non-integrated inductors). Solving the same alleged problem identified in the '670 patent in the same way, Petersen discloses an "implantable miniaturized pressure sensor [that] ***integrates a capacitor and an inductor in one small chip,*** forming a resonant LC circuit." Petersen, Abstract; Petersen provisional, 33-34, 37-39; Allen Decl. ¶¶ 90-91. Petersen explains that by using an integrated inductor, its sensing devices are cheaper and more efficient and can measure "intraocular pressure, intravascular pressure, intracranial pressure, pulmonary pressure, [etc.]," among other applications. Petersen, 9:50-65; *see also* Petersen provisional, 33-34, 37-39, 62-63.

As shown in annotated Figures 1B and 1A of Petersen below, Petersen's pressure sensor device is fabricated using a "silicon Micro Electro Mechanical (MEMS) approach" (Petersen, 7:30-32; Petersen provisional, 37-39), and includes an "integrated micromachined inductor coil 110," which is formed on a "glass substrate 102," and a capacitive pressure sensor, which has a "lower capacitor plate" formed on the same substrate.



Petersen, Fig. 1B (annotated), 7:32-36 ("underlying glass substrate 102 containing the lower capacitor plate 104 and the integrated micromachined inductor coil 110."); Petersen provisional, 14, 37-39; Allen Decl. ¶ 92.

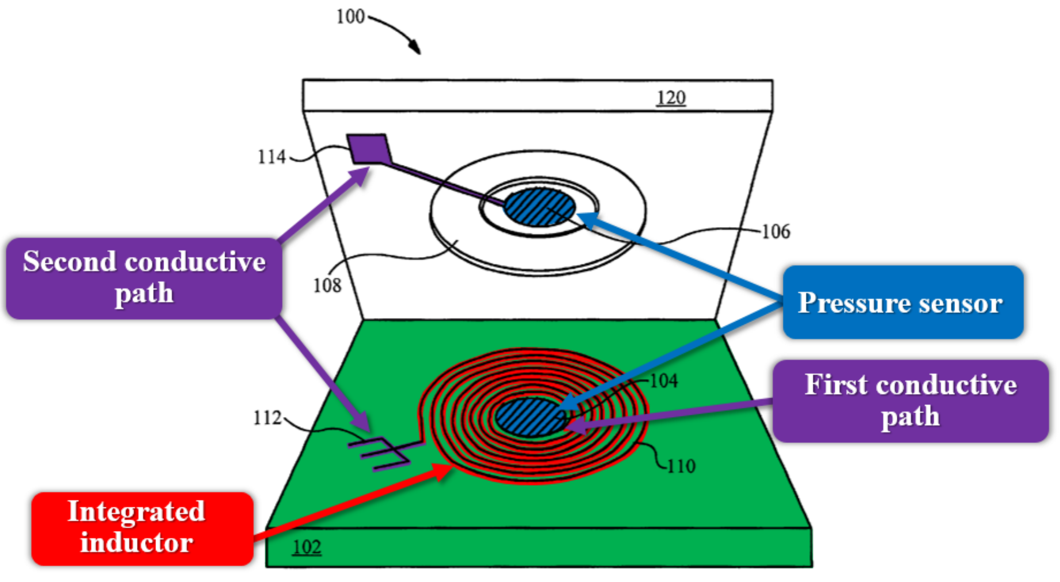
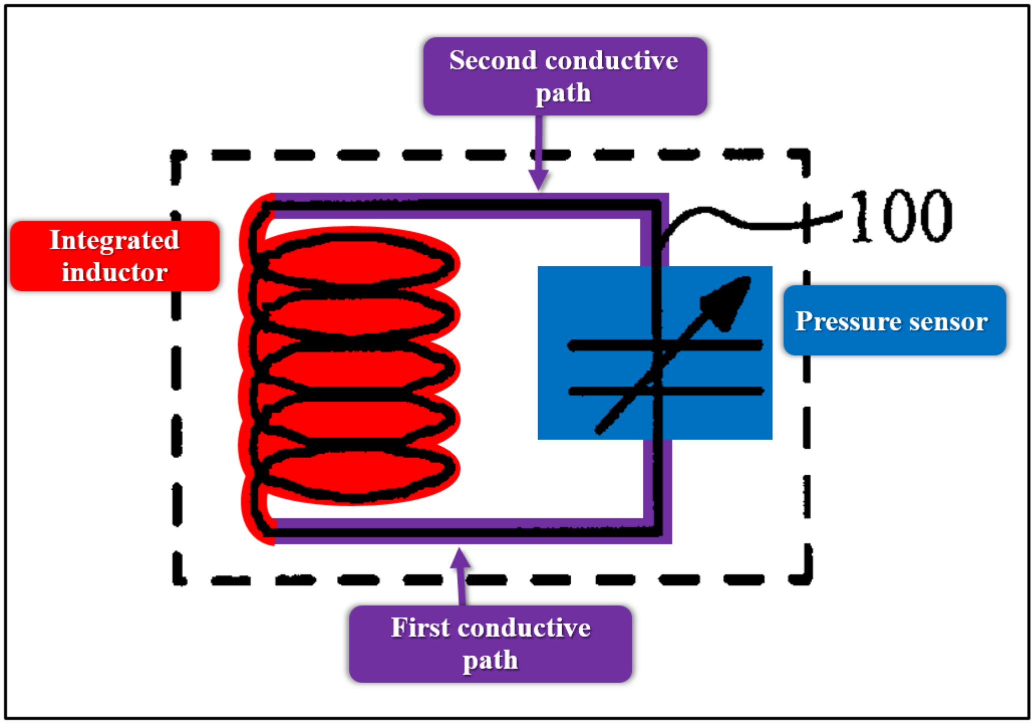


Fig. 1A

Petersen, Fig. 1A (annotated); Allen Decl. ¶¶ 93-94.

Petersen discloses that "[t]he capacitor 116 and the inductor 110 are electrically coupled to each other" in parallel by two conductive paths, "thereby forming a resonant LC circuit characterized by a resonant frequency." Petersen, Fig. 1A (annotated above), 7:40-42; Petersen provisional, 33-34, 37-38, 62-63; Allen Decl. ¶ 95. This is shown schematically in Petersen's circuit diagram of Figure 5, annotated below.



Petersen, Fig. 5 (cropped, annotated), 8:25-31, 8:45-56; Petersen provisional, 39, 78; Allen Decl. ¶ 95.

Petersen also discloses that its LC resonant pressure sensor device can be incorporated into a "pressure measurement system," shown in annotated Figure 5 below, that uses an "external detector pick-up coil 502" to wirelessly detect changes in pressure detected by the implantable sensor.

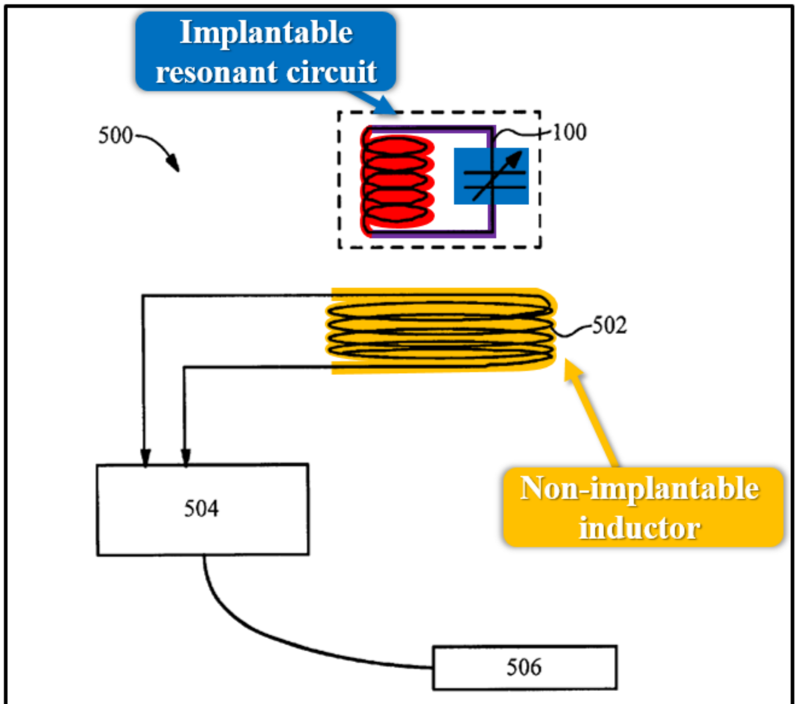


Fig. 5

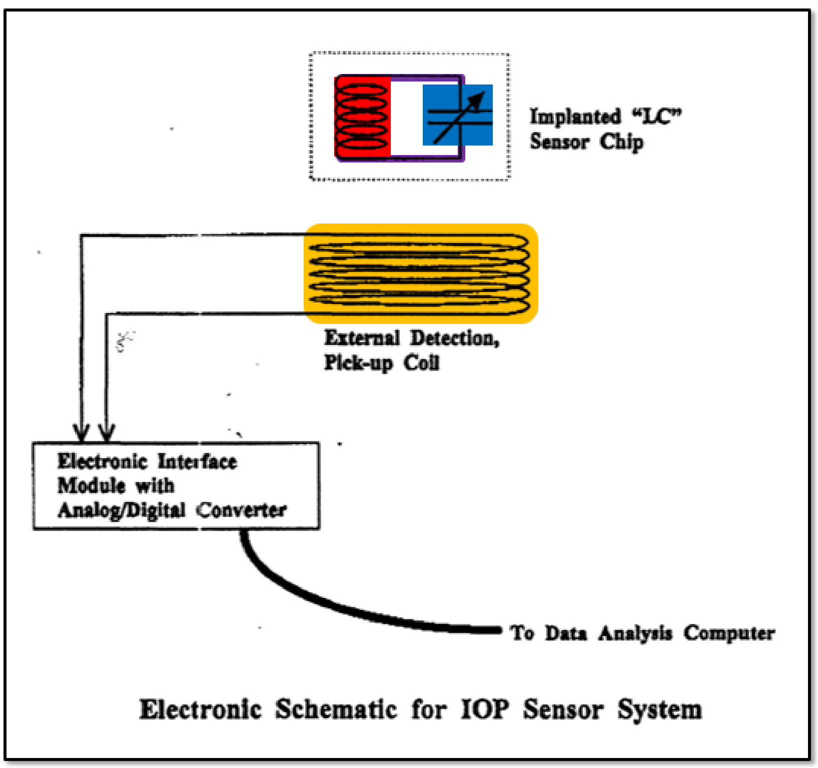
Petersen, Fig. 5 (annotated), 8:25-30, 8:39-44; Petersen provisional, 39, 78; Allen Decl. ¶ 96.

1. Petersen is Entitled to its Provisional Application's Filing Date

Should Patent Owner attempt to antedate Petersen's U.S. filing date, Petersen is also entitled to the filing date of the Petersen provisional: Petersen was filed within one year of the Petersen provisional's filing, names at least one inventor in common, and includes a specific reference to the Petersen provisional. Petersen, Cover; 35 U.S.C. § 119. Further, the provisional provides adequate support for at least claim 21 in the Petersen patent. *Medtronic, Inc. v. Niazi Licensing Corp.*, IPR2018-00609, Paper 8 at 11 (P.T.A.B. Aug. 20, 2018) (holding that, under *Dynamic Drinkware*, a non-provisional application is entitled to the benefit of the provisional application's filing date if the provisional application "support[s] just one claim" in the non-provisional); *Dynamic Drinkware, LLC v. Nat'l Graphics, Inc.*, 800 F.3d 1375, 1381-82 (Fed. Cir. 2015).

a. "21. A pressure measurement system comprising"

The Petersen provisional discloses an "IOP [intraocular pressure] sensor system" including an "implanted 'LC' Sensor Chip" and an "External Detection Pick-Up Coil."



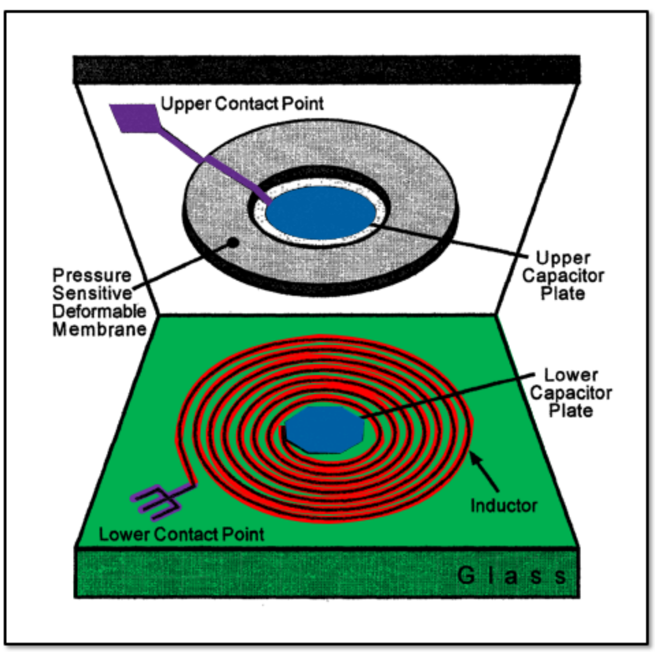
See, e.g., Petersen provisional (Ex. 1007), 78 (annotated); *see also id.*, 34, 36-38; Allen Decl. ¶ 98.

b. "a) a pressure sensor having an inductor/capacitor resonant circuit, the inductor/capacitor resonant circuit including:"

The Petersen provisional discloses that "the proposed IOP sensor is based on the use of a passive capacitive pressure sensor in an inductor-capacitor resonant circuit." Petersen provisional, 33; *see also id.*, 34, 36-38, 78; Allen Decl. ¶ 99.

c. "i) at least one first spiral inductor coil having a first end and a second end; and"

The Petersen provisional discloses that the IOP sensor includes "an integrated micromachined inductor coil." Petersen provisional, 37-38. As shown in annotated Figure 4 below, the micromachined inductor coil is a spiral inductor having a first end connected to the "Lower Capacitor Plate" and a second end connected to the "Lower Contact Point."



Petersen provisional, Figure 4 (annotated), 38; Allen Decl. ¶ 100.

d. "ii) at least one first capacitor plate connected to the first end of the first spiral inductor coil"

As discussed and shown in annotated Figure 4 above, the Petersen provisional discloses the first end of the spiral inductor coil is connected to the "Lower Capacitor Plate." *See, e.g.,* Petersen provisional, 37, 38; Allen Decl. ¶ 101.

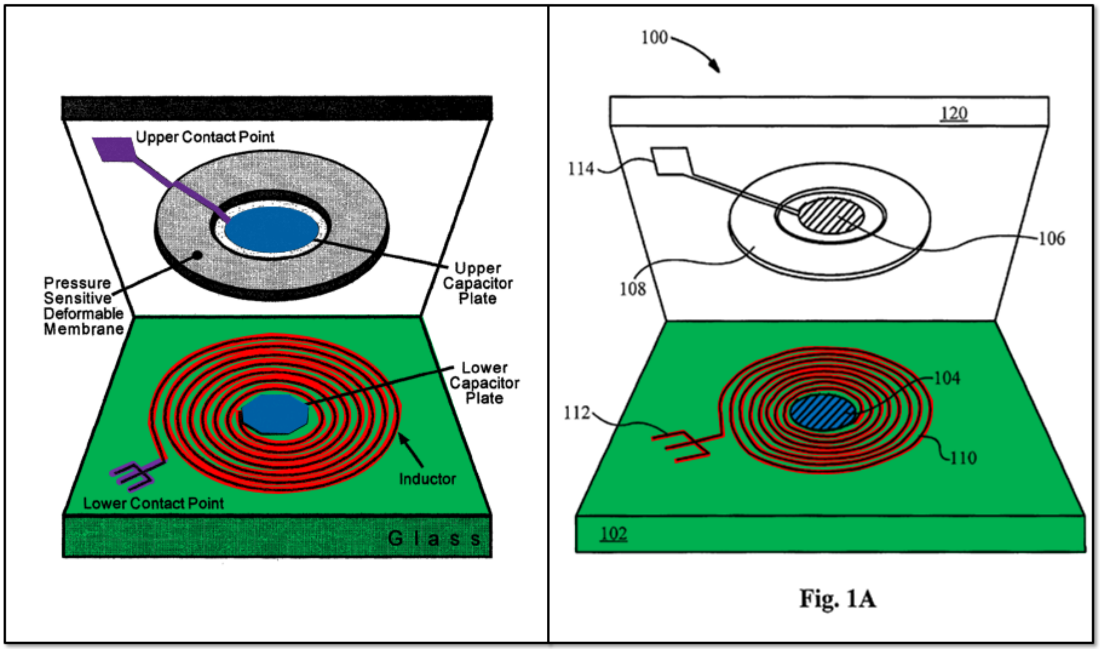
e. "wherein the first spiral inductor coil and the first capacitor plate are made by removing selected portions of material from a flat conductive sheet; and"

The Petersen provisional discloses that the "spiral inductor and capacitor" are fabricated by depositing a "thin metal seed layer" onto the substrate, which is then "etched away from the areas between the plated metal coils and capacitor plates." Petersen provisional, 37-38; *see also, e.g., id.*, 38, 69; Allen Decl. ¶ 102.

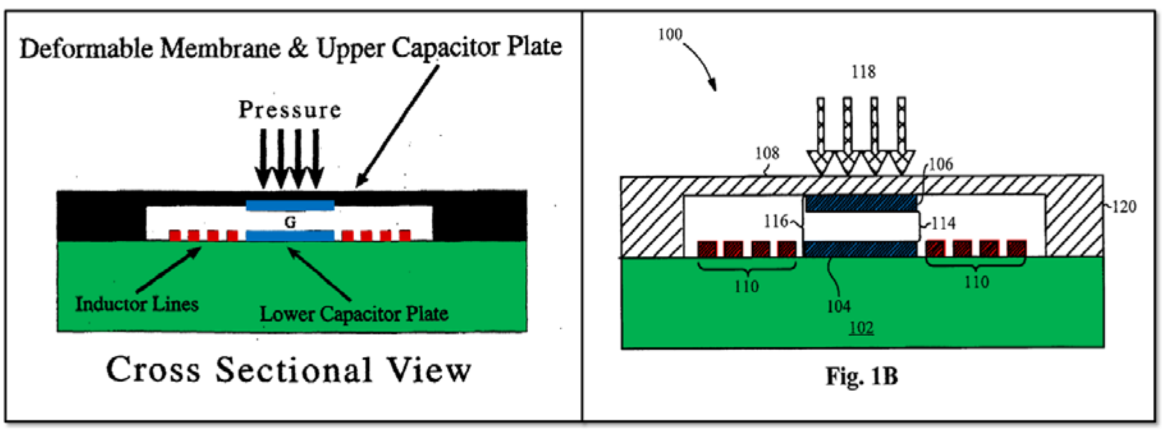
f. "b) a remote external detector pick-up coil disposed proximate the pressure sensor."

The Petersen provisional discloses an "External Detector Pick-up Coil, which will consist of a flat, wound coil about the size of a quarter." It also teaches that the external coil must be disposed proximate to the pressure sensor, i.e., the external coil "must be placed within about an inch of the Sensor Chip." Petersen provisional, 39; *see also, e.g., id.*, 78; Allen Decl. ¶¶ 103-104.

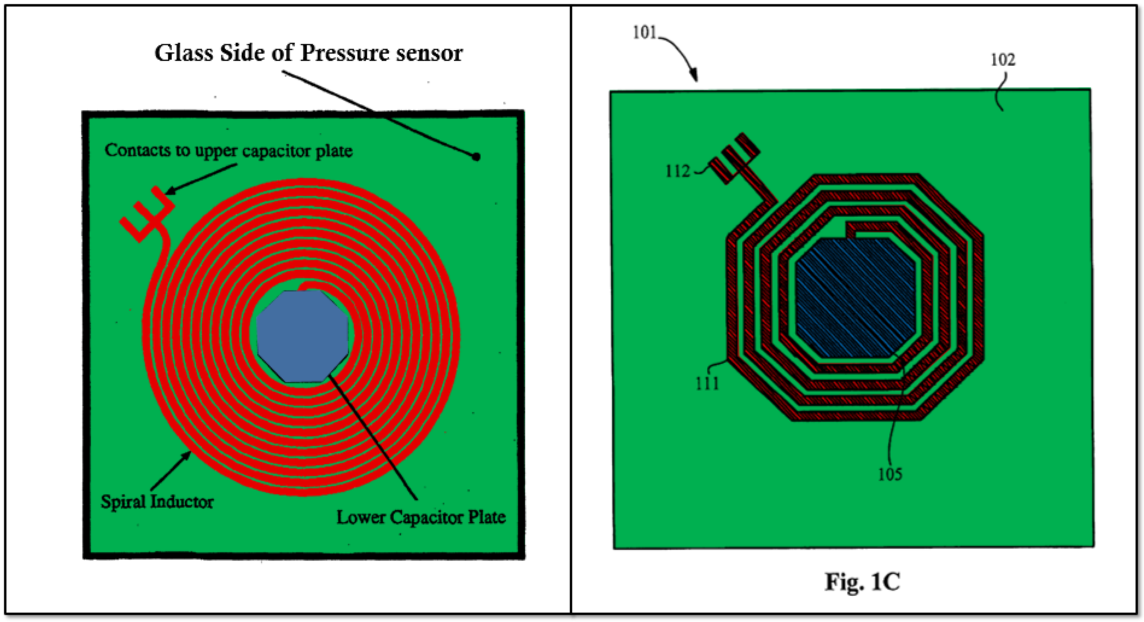
In addition to fully supporting and enabling claim 21 of Petersen, the teachings in Petersen that Petitioner relies upon were carried forward from the Petersen provisional, as demonstrated by way of citations to both Petersen and the Petersen provisional throughout this ground. In fact, as shown below, the Petersen provisional includes virtually identical figures carried through to Petersen that Petitioner relies on as shown below.



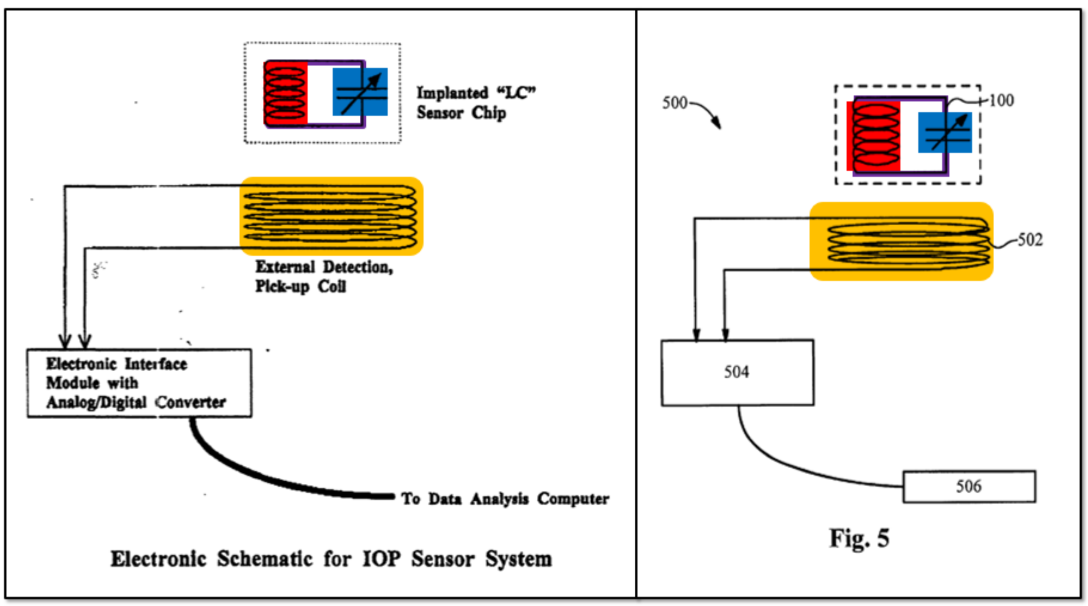
Petersen provisional, 38 (annotated); Petersen, Fig. 1A (annotated).



Petersen provisional, 14 (annotated); Petersen, Fig 1B (annotated).



Petersen provisional, 15 (annotated); Petersen, Fig. 1C (annotated).



Petersen provisional, 78 (annotated); Petersen, Fig. 5 (annotated); Allen Decl. ¶¶ 105-106 (annotating figures above).

Thus, Petersen is § 102(e) prior art as of December 13, 1999, the date its provisional was filed.

B. Claim 1

1. [1pre]—"An implantable microfabricated sensor device for measuring a physiologic parameter of interest within a patient, said sensor comprising:"

Petersen discloses this feature, describing an "***implantable*** miniaturized ***pressure sensor***" that is "***micromachined***[2] from silicon" and "may be used to ***measure*** intraocular pressure, intravascular pressure, intracranial pressure, pulmonary pressure, biliary-duct pressure, blood pressure, pressure in joints, and pressure in any body tissue of [sic] fluid." Petersen, Abstract, 9:50-54; *see also id.*, 3:37-41, 3:65-4:3, 5:5-13; Petersen provisional, 37-39, 62-63; Allen Decl. ¶¶ 173-174. In particular, Petersen discloses a "method of fabrication of the pressure sensor 100 us[ing] a silicon Micro Electro Mechanical System (MEMS) approach" including a "deformable membrane 108 of the sensor 100 … made of silicon" and a "glass substrate 102 containing the lower capacitor plate 104 and the integrated micromachined inductor coil 110." Petersen, 7:29-37; Petersen provisional, 37-39.

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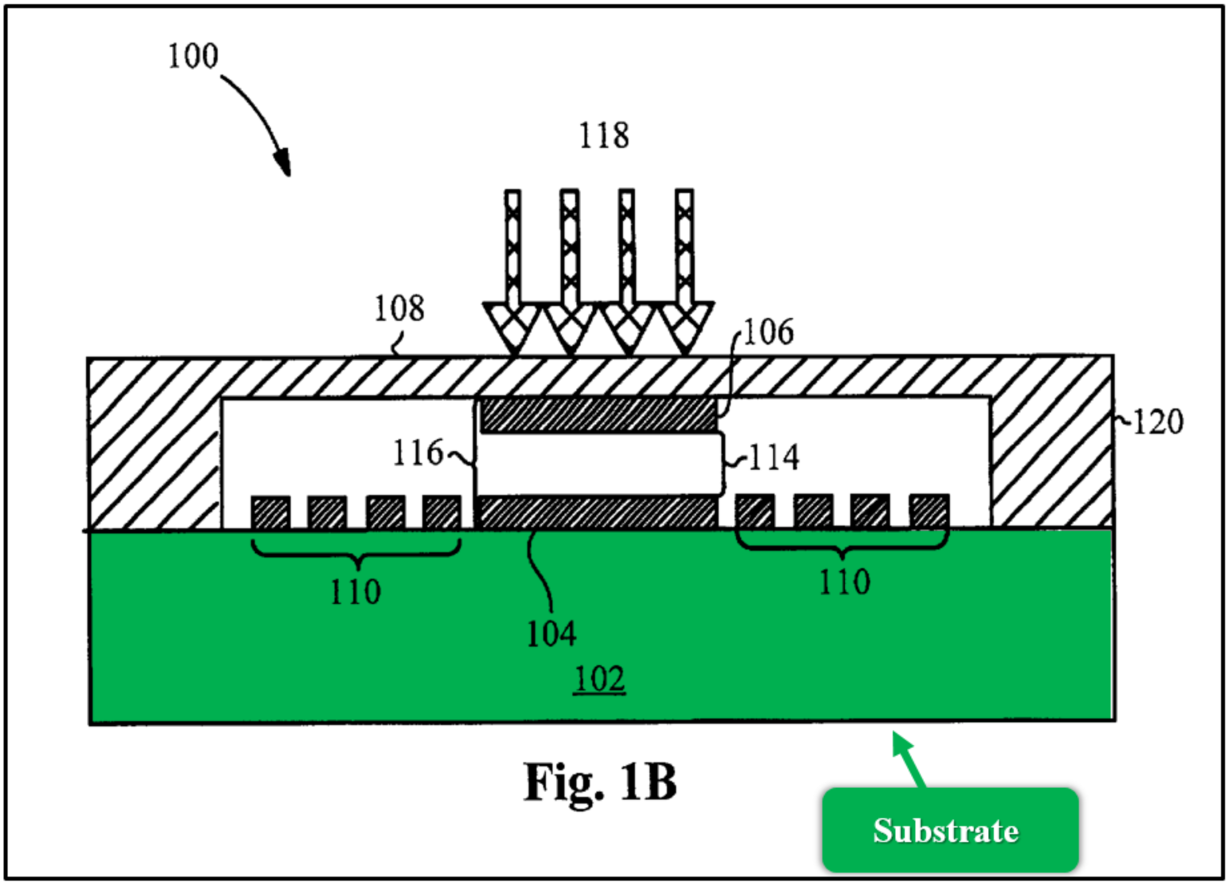
[2] "Micromachined" is and was a common microfabrication technique for making ICs and MEMS. Allen Decl. ¶¶ 173, 78-81; '634 provisional, 2; '327 provisional, 1; *see* Section VI.B above.

2. [1a]—"an implantable sensing device, said sensing device being a micro electromechanical system (MEMS) comprising"

Petersen discloses an "implantable sensing device" for measuring pressure within a patient. *See* limitation [1pre] above. Petersen further discloses that the "method of fabrication of the pressure sensor 100 uses a silicon ***Micro Electro Mechanical System (MEMS) approach***, which is well known in the art." Petersen, 7:30-32; Petersen provisional, 37-38 (describing "Silicon MEMS Approach"). Using this MEMS approach, Petersen discloses that the "deformable membrane 108 of the sensor 100 is made of silicon, and the silicon bearing the membrane is bonded to the underlying glass substrate 102 containing the lower capacitor plate 104 and the integrated micromachined inductor coil 110." Petersen, 7:32-36. Petersen also discloses that the "pressure sensor 100 with the fully integrated capacitor 116 and inductor 110 may be miniaturized to a size less than 2x2x0.5 mm." *Id.*, 7:38-40. Accordingly, Petersen's sensing device fabricated using a MEMS approach ***is*** a "micro electromechanical system (MEMS)" as claimed, including electrical components (an integrated inductor and capacitor) and mechanical movement (a deformable membrane). Allen Decl. ¶¶ 175-177.

3. [1b]—"a substrate,"

Petersen discloses a pressure sensor 100 that comprises a "***substrate*** 102" (Petersen, 6:39-40, 7:34), annotated in Figure 1B below.



Petersen, Fig. 1B (annotated), 4:16-22, 6:37-40; *see also id.*, Fig. 1A (also showing substrate 102); Petersen provisional, 14, 37-38, 66; Allen Decl. ¶ 178.

4. [1c]—"an integrated inductor formed on the substrate,"

Petersen discloses an "***integrated*** ***micromachined*** ***inductor*** coil 110" is formed on top of the substrate 102. Petersen, 7:32-36, 6:30-40; Petersen provisional, 33 ("[O]ur sensors consist of a fully integrated single coil."), 37-38; *see also* Petersen, Abstract ("integrates a capacitor and an inductor in one small chip…"). A cross section of the integrated inductor coil is shown in annotated Figure 1B below, which, like the cross section disclosed in the ’670 patent, is shown as a series of black squares.

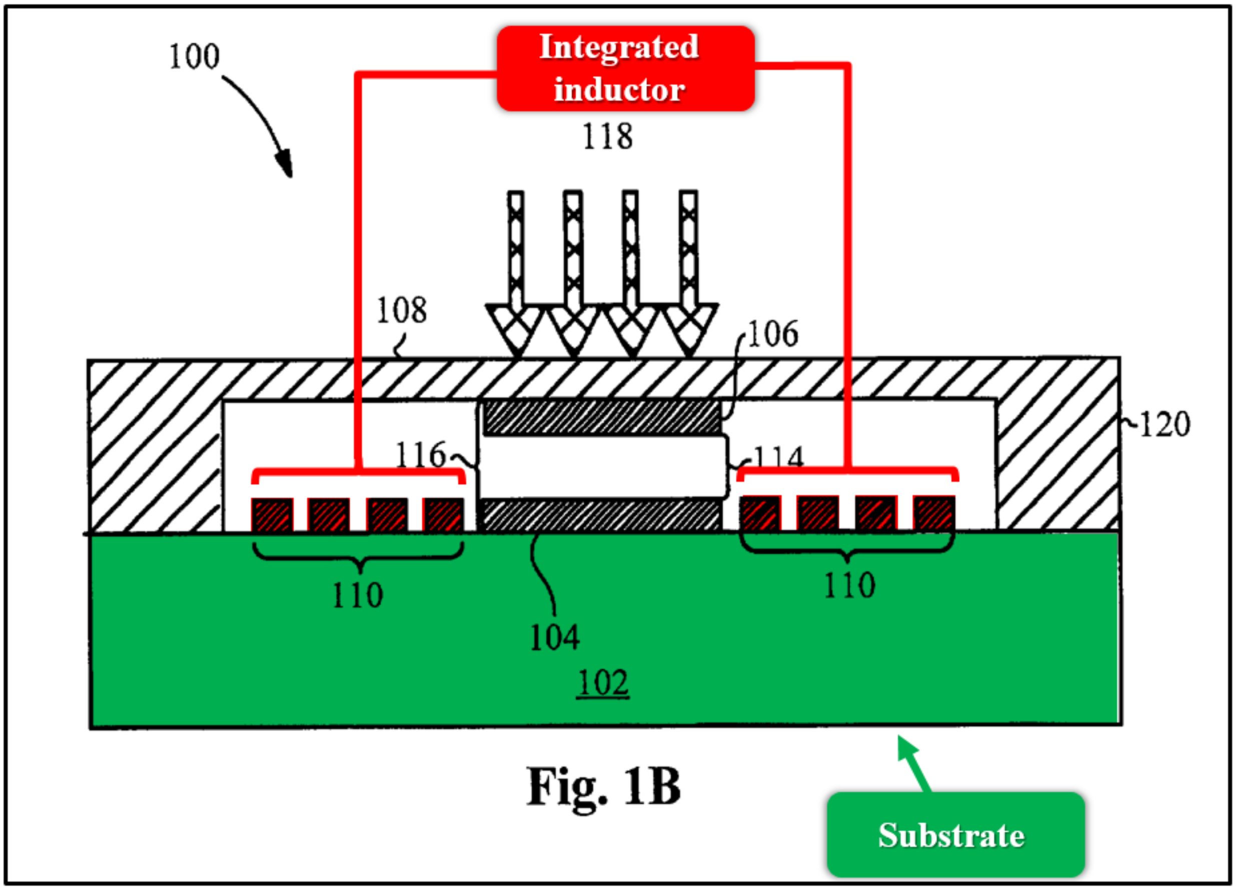


Fig. 1B

Petersen, Fig. 1B (annotated); Petersen provisional, 37-38, 14; Allen Decl. ¶ 179.

Petersen discloses that the integrated inductor is a continuous spiral around the lower capacitor plate that can have a variety of shapes. For example, annotated Figure 1A below shows a top down view of the integrated inductor coil that “spirals around the lower capacitor plate 104” and discloses this limitation.

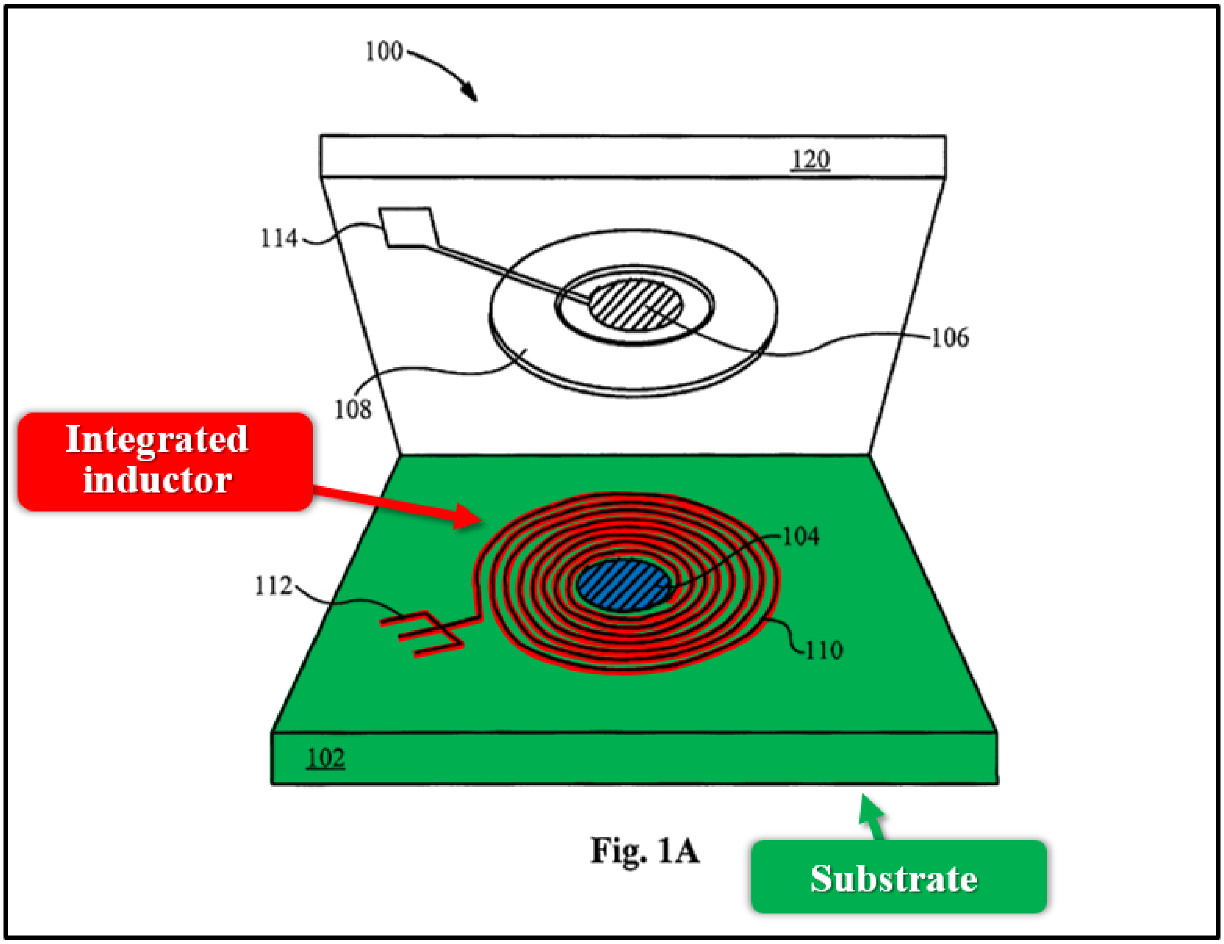


Fig. 1A

Petersen, Fig. 1A (annotated), 6:32-34; Petersen provisional, 37-38, 15; Allen Decl. ¶ 180.

Figure 1C shows an "alternative layout" that also discloses this limitation, including an "octagonal spiral inductor 111 coiled in a coplanar fashion around the octagonal capacitor plate 105." Petersen, 6:52-56. Petersen also discloses that the "spiral inductor 111 may have other shapes such as circular, square, and others." *Id.*, 6:56-57.

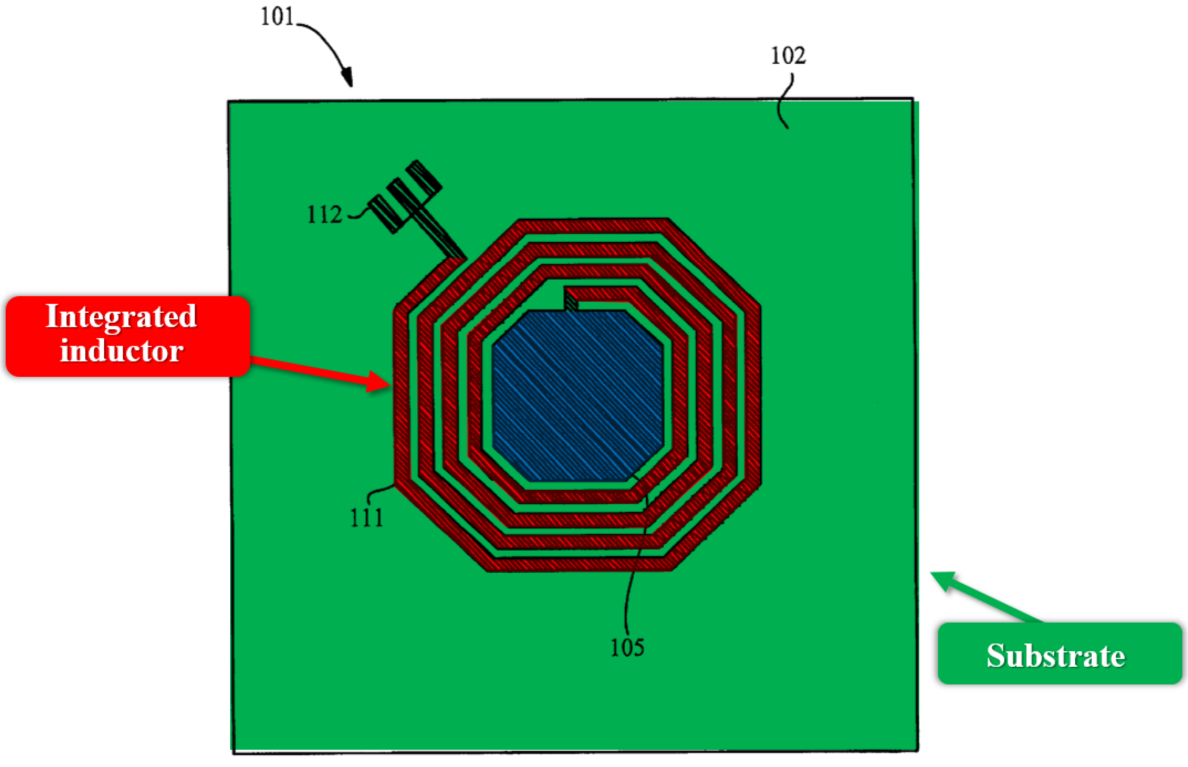


Fig. 1C

Petersen, Fig. 1C (annotated); Petersen provisional, 81; Allen Decl. ¶ 181.

Furthermore, Petersen's integrated inductor is microfabricated with the sensor itself. Petersen explains that in each layout the integrated inductor is a "spiral ***micromachined*** coil" and that it is fabricated with the first plate of the capacitive sensor. Petersen, 4:4-11, 7:38-40 ("[T]he fully integrated capacitor 116 and inductor 110 may be miniaturized to a size less than 2x2x0.5 mm."); Petersen provisional, 38-39; Allen Decl. ¶ 182.

5. [1d]—"at least one sensor responsive to the physiologic parameters and being formed at least in part on the substrate,"

Petersen discloses that its intraocular pressure sensor 100 comprises a "lower capacitor plate 104" and an "upper capacitor plate 106," together forming a capacitive sensor that is responsive to pressure (e.g., intraocular or cardiovascular pressure) applied to the external surface of the sensor device when implanted in the body. Petersen, Abstract, 6:30-32, 7:43-47. The "lower capacitor plate 104" is deposited on "top of a substrate 102" as shown in annotated Figure 1B below.

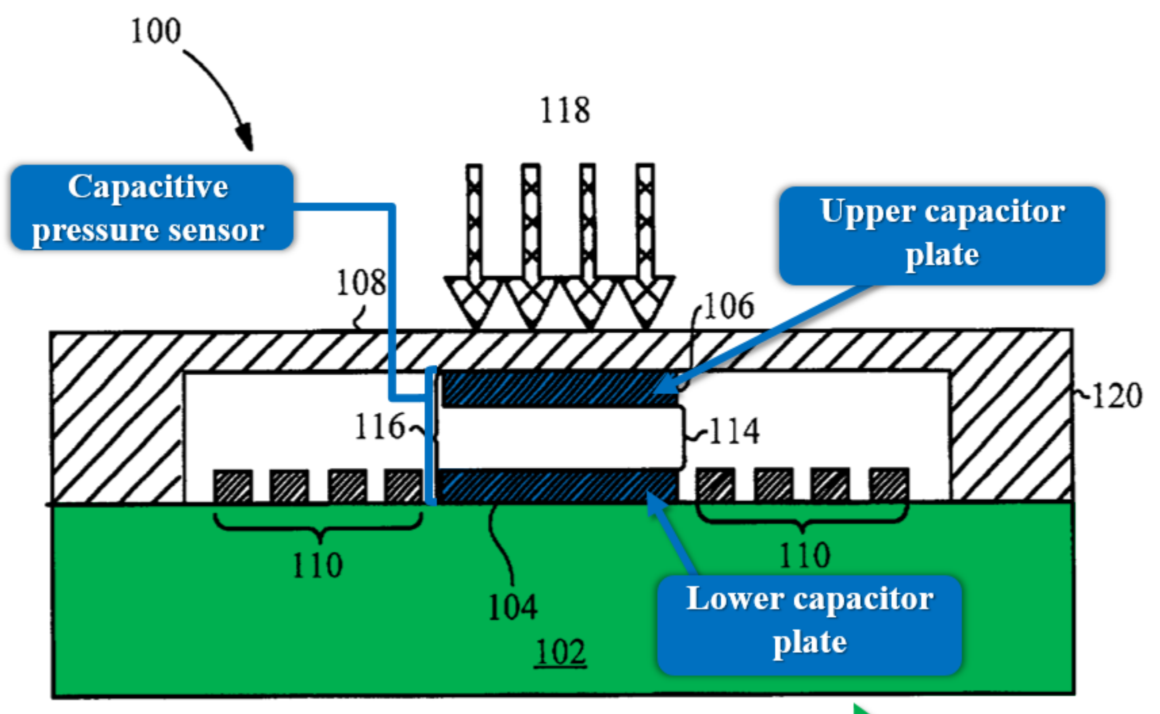


Fig. 1B

Petersen, Fig. 1B (annotated), 6:37-40, 7:32-36 ("glass substrate 102 containing the lower capacitor plate 104"); Petersen provisional, 37-39, 14-15; Allen Decl. ¶ 183.

The lower capacitor plate 104 and upper capacitor plate 106 are also shown in annotated Figure 1A below.

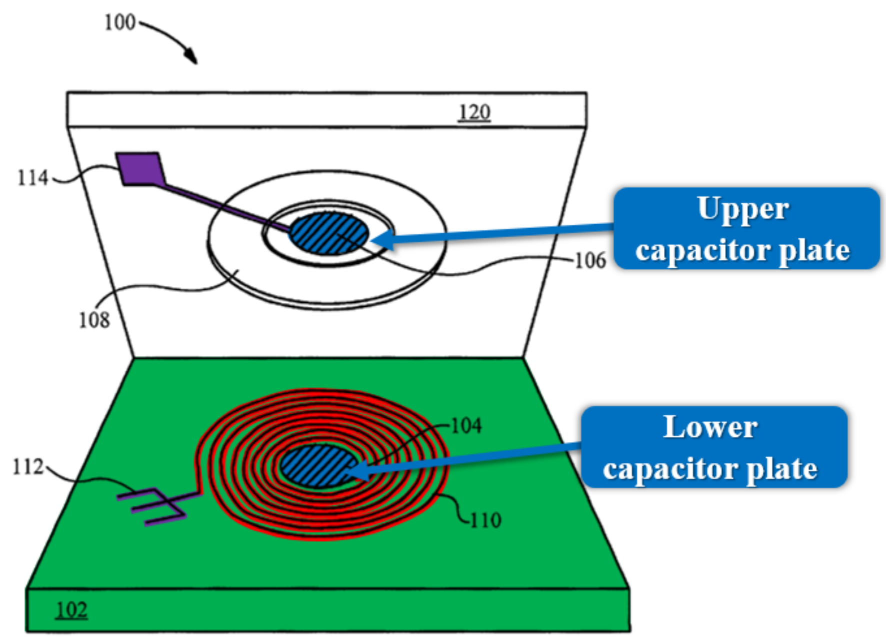


Fig. 1A

Petersen, Fig. 1A (annotated), 6:30-39 ("The lower capacitor plate 104 and the flat inductor coil 110 are placed on top of a substrate 102."); Petersen provisional, 37-39, 14-15; Allen Decl. ¶ 184.

Petersen also discloses an "alternative layout of the lower side of a pressure sensor 101," having an "octagonal" shaped lower capacitor plate 105 and integrated inductor coil 111 formed on a common substrate 102, as shown in annotated Figure 1C below.

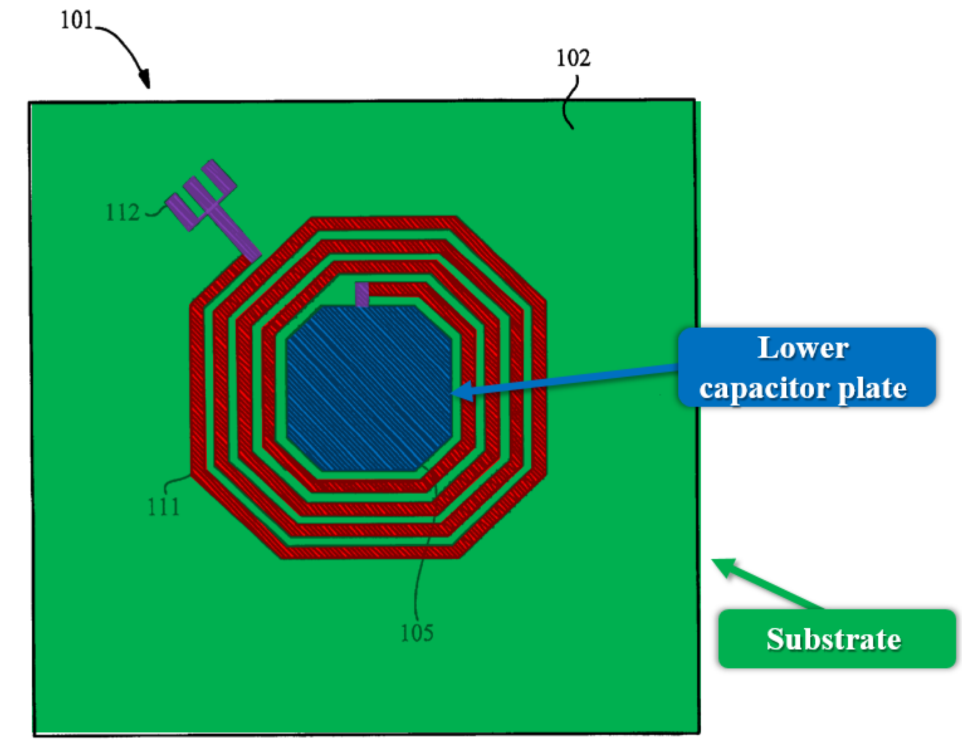
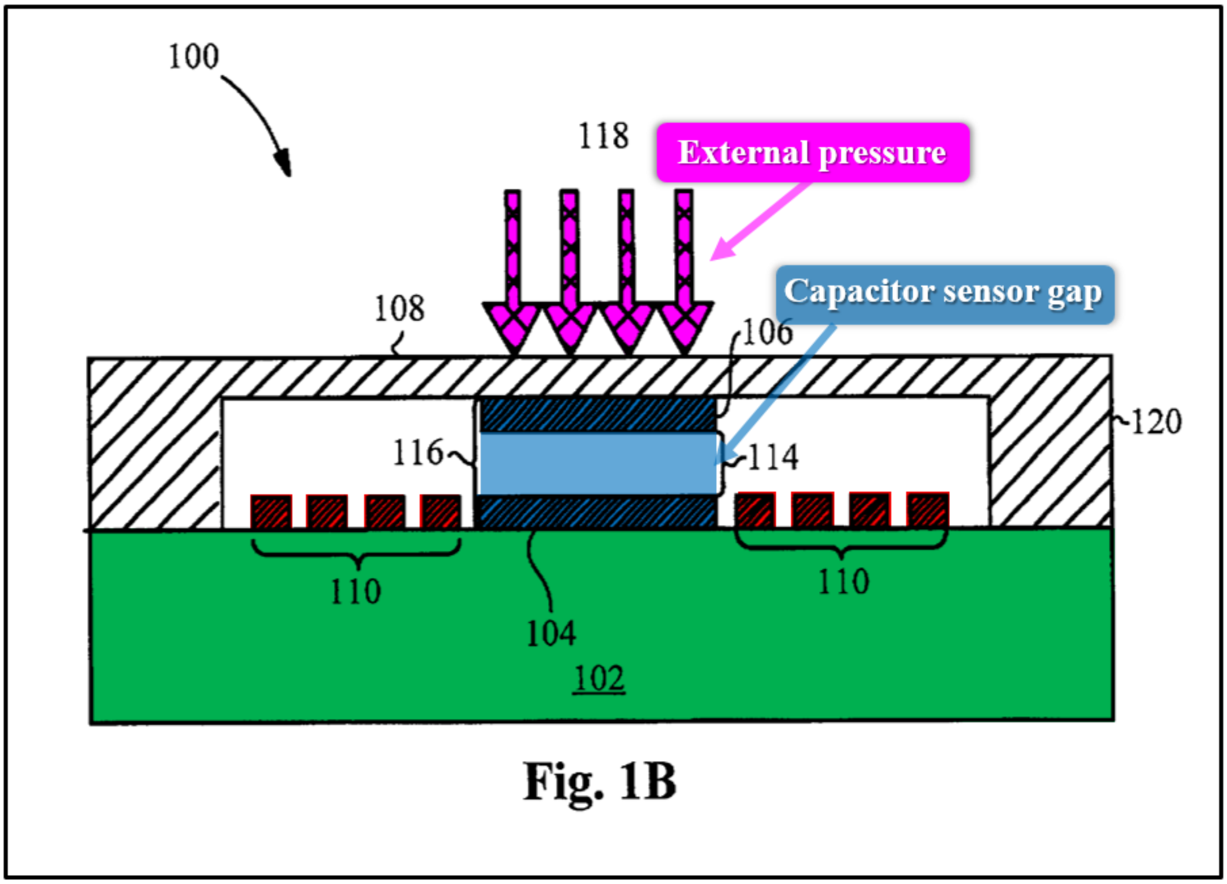


Fig. 1C

Petersen, Fig. 1C (annotated), 6:52-56; Petersen provisional, 37-39, 14-15; Allen Decl. ¶ 185.

The capacitor plates form a capacitive "sensor," in the same way that the '670 patent's "capacitive sensor" is a sensor. '670 patent, 7:26-41; Allen Decl. ¶ 186. When an "external fluid, gas, or mechanical pressure" is applied to the outer surface of the deformable membrane 108, illustrated by the four arrows 118 in Figure 1B below, it "deflects the membrane 108 along with the upper capacitor plate 106, which varies the gap 124 of the capacitor 116." Petersen, 7:43-45; Petersen provisional, 32-33 ("When the IOP level [i.e., physiological parameter] is altered, the pressure-induced displacement of the diaphragm changes the value of the circuit capacitance."); *see also id.*, 37-38. The capacitance of the capacitive sensor 100 is a function of the distance between the first and second capacitor plates, "[t]hus, the capacitance value and the resonant frequency" of the capacitive sensor 100 "vary as functions of fluid pressure 118." Petersen, 7:45-48; Petersen provisional, 33-34, 37-38, 62-63; Allen Decl. ¶¶ 186-187.



Petersen, Fig. 1B (annotated), 7:43-47; Petersen provisional, 14; Allen Decl. ¶ 186.

Petersen also discloses that its capacitive pressure sensor is "responsive to the physiologic parameters" as claimed. Allen Decl. ¶¶ 188-189; Petersen, 3:36-60 (measure "pressure of tissue, fluid, or gas in a body chamber" and "intraocular pressure"); 5:5-23; 8:46-47 ("measure intraocular or intra-tissue pressures"), 9:50-59 (other physiologic parameters that can be measured using the disclosed pressure sensor); Petersen provisional, 14-15, 33-34, 37-38, 62-63.

6. [1e]—"a plurality of conductive paths electrically connecting said integrated inductor with said sensor,"

Petersen discloses that its LC resonant circuit has a plurality of conductive paths electrically connecting the integrated inductor and capacitor ("said sensor"). Petersen, Abstract ("The upper and lower capacitor plates are connected to one or more spiral inductor coils."), 7:40-42 ("The capacitor 116 and the inductor 110 are electrically coupled to each other, thereby forming a resonant LC circuit characterized by a resonant frequency."); Petersen provisional, 15, 37-38. There are a plurality of conductive paths because one end of the inductor is connected to the capacitor's upper plate, and the other end is connected to the lower plate, as was typical in LC resonant circuits prior to 2001. Allen Decl. ¶ 190.

The first conductive path, connecting the inner coil of the integrated inductor to the capacitor's lower plate, is easiest to see in Figure 1C of Petersen, annotated below, which shows an "octagonal" shaped lower capacitor plate 105 (blue) that is electrically coupled (purple) to the integrated inductor coil 111 (red).

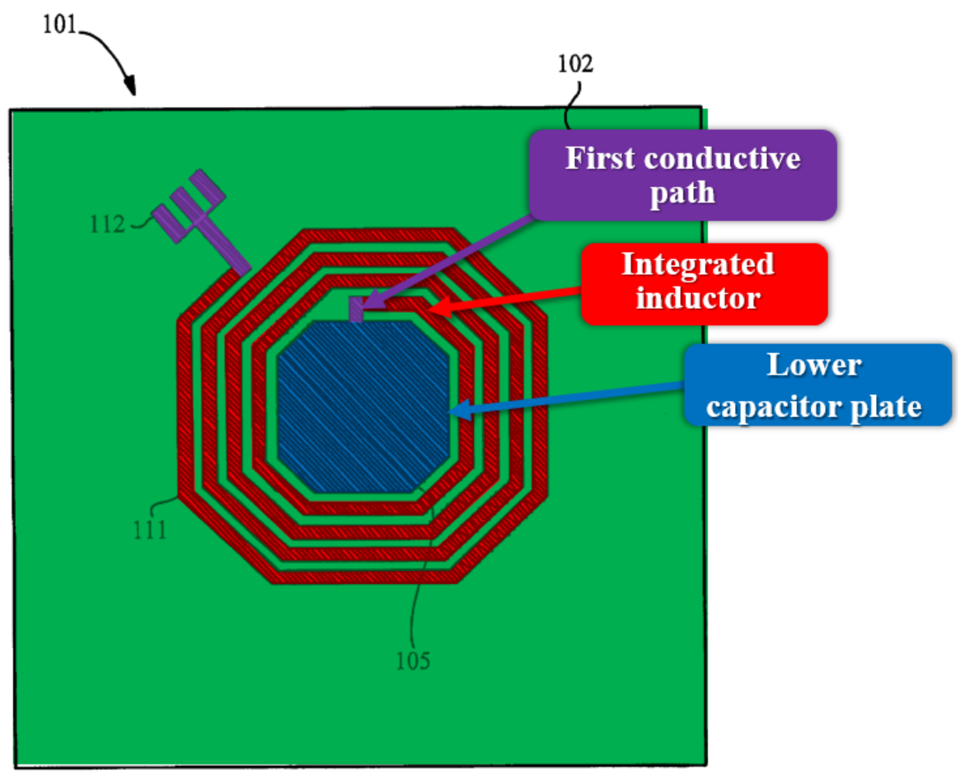


Fig. 1C

Petersen, Fig. 1C (annotated); Petersen provisional, 15, 37-38; Allen Decl. ¶ 191.

This first conductive path is the same with respect to Petersen's Figure 1A but is harder to see because the components are very close to each other. Specifically, the lower capacitor plate 104 (blue) is connected to the inner ring of the integrated inductor coil 110 as illustrated in annotated Figure 1A below.

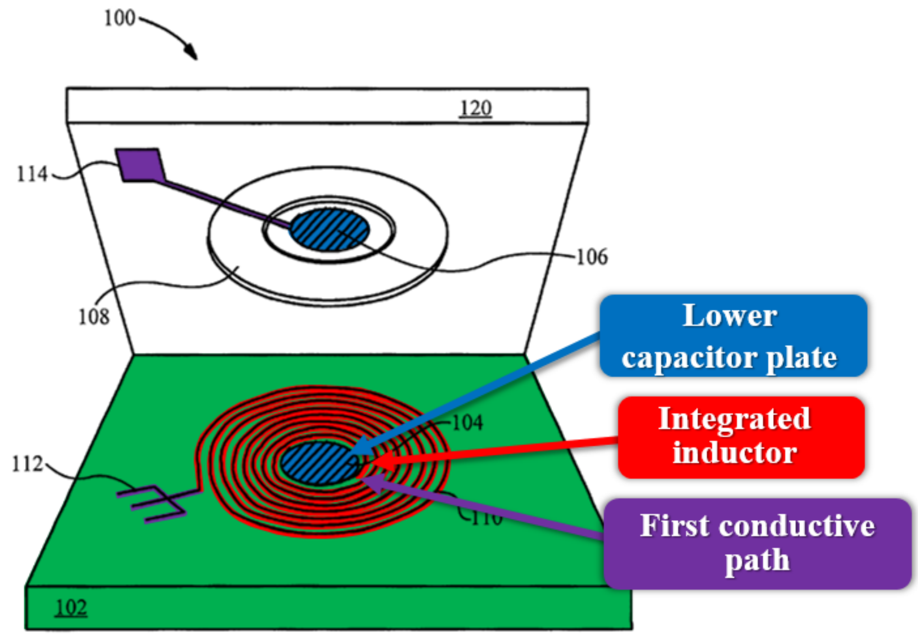


Fig. 1A

Petersen, Fig. 1A (annotated); Petersen provisional, 37-38; Allen Decl. ¶ 192.

The second conductive path electrically connects the upper capacitor plate 106 to the integrated inductor (111 if octagonal or 110 if circular) via "a lower contact point 112 and an upper contact point 114." Petersen, 6:49-52; Petersen provisional, 37-38. This first part of this second conductive path is shown in annotated Figure 1C below (from the inductor coil to the lower contact point) and the entire path is shown in annotated Figure 1A below.

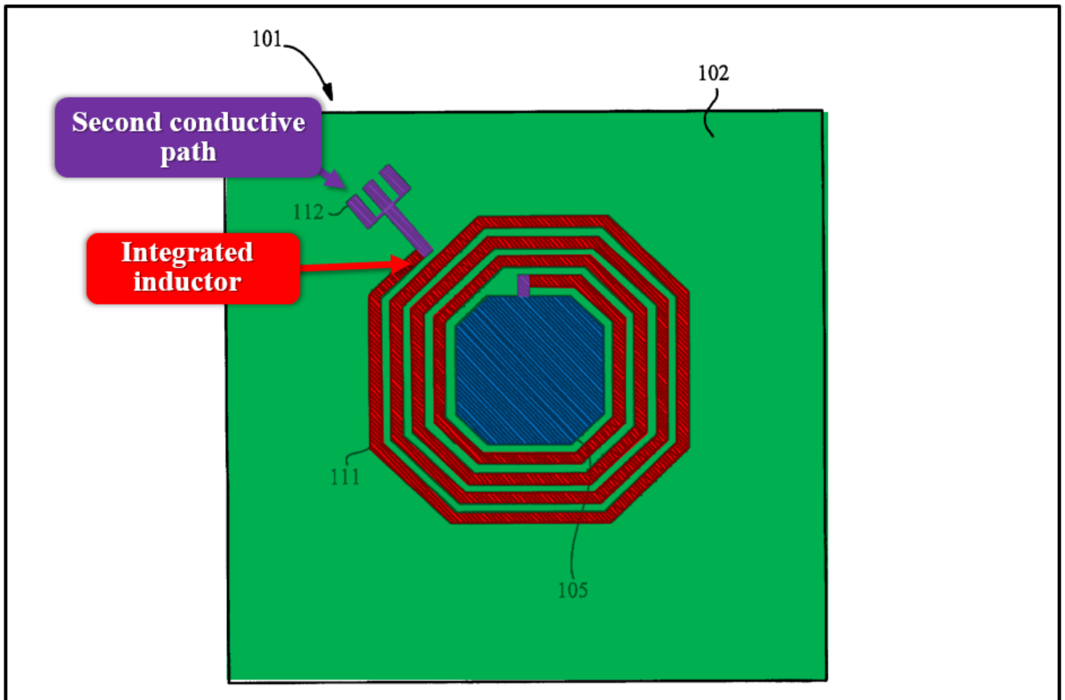


Fig. 1C

Petersen, Fig. 1C (annotated); Petersen provisional, 81; Allen Decl. ¶ 193.

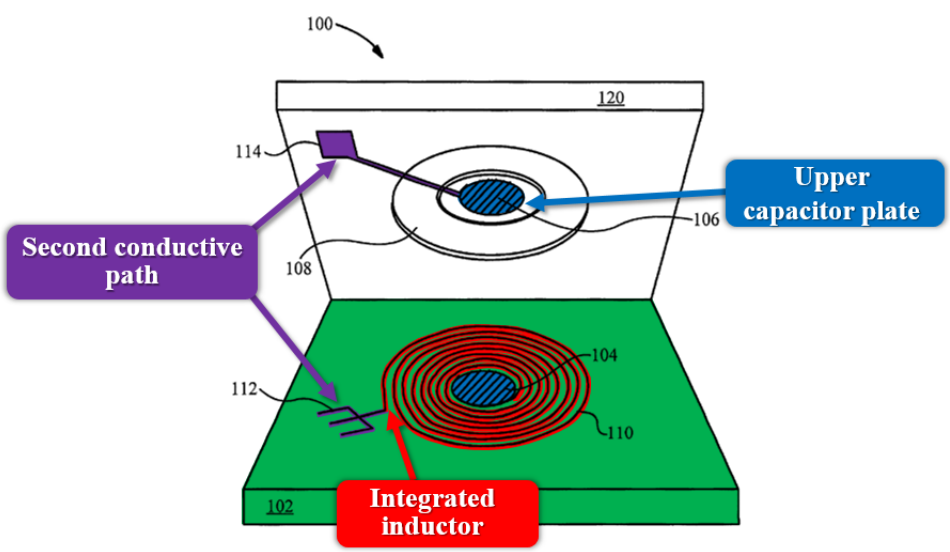
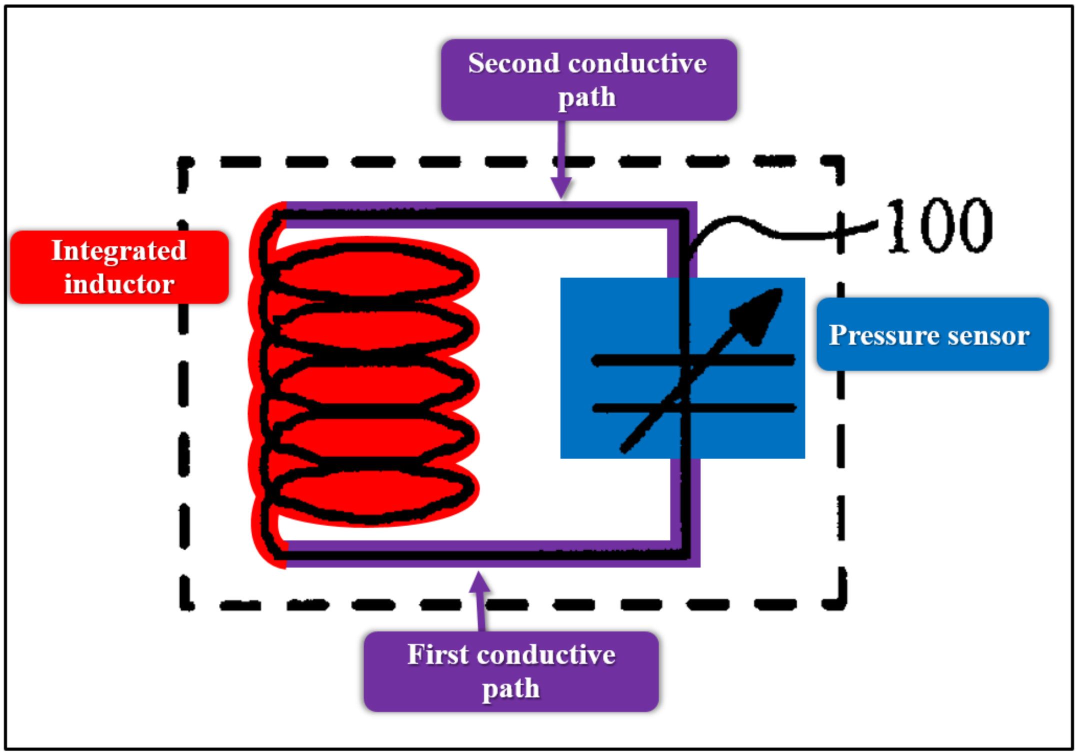


Fig. 1A

Petersen, Fig. 1A (annotated), 6:49-52; Petersen provisional, 15, 37-38; Allen Decl. ¶ 193.

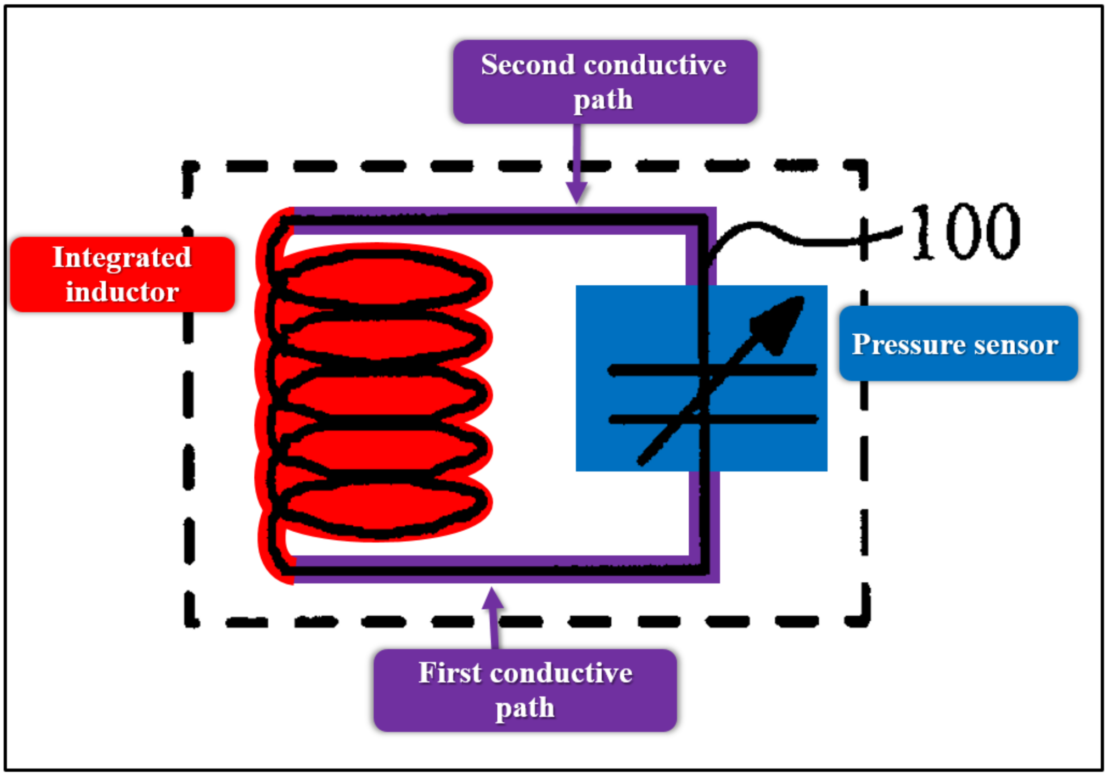
These two conductive paths connecting the integrated inductor with the capacitive sensor are also shown schematically in Petersen's circuit diagram of the implantable pressure sensor 100, annotated below.



Petersen, Fig. 5 (cropped, annotated), 8:25-31, 8:45-56; Petersen provisional, 39, 78; Allen Decl. ¶ 194.

7. [1f]—"said integrated inductor, said sensor and said conductive paths cooperatively defining an LC tank resonator."

Petersen teaches that the integrated inductor (limitation [1c] above), capacitor pressure sensor 116 (limitation [1d] above) and conductive paths (limitation [1e] above) together define an LC tank resonator. This is shown schematically in annotated Figure 5 below.



Petersen, Fig. 5 (cropped, annotated); *see also id.*, Abstract ("forming a resonant LC circuit"); 3:65-4:3 ("an inductor/capacitor resonant circuit (or resonant LC circuit)"); 5:40-43 ("The resonant frequency of the LC circuit is detected…."), 7:40-42 ("The capacitor 116 and the inductor 110 are electrically coupled to each other, thereby forming a resonant LC circuit characterized by a resonant frequency."), 4:34-36, 8:65-9:5; Petersen provisional, 33-34, 37-39; Allen Decl. ¶¶ 194-195, 38 (also explaining that an "LC tank resonator" is the name for a resonant LC circuit with the capacitor and inductor in parallel); *c.f.* '670 patent, Figure 1 (showing the same circuit diagram in the context of the alleged invention of the '670 patent).

C. Claims 2 and 3

Claim 2 depends from claim 1, further reciting "wherein said sensor is a capacitive sensor having a fixed electrode and a moveable electrode." Claim 3 depends from claim 2, and further recites "wherein said fixed electrode is formed on said substrate." These claims are anticipated for the same reasons as claim 1 and as further explained in the following paragraphs.

Petersen's lower capacitor plate, discussed at length above, corresponds to the claimed "fixed electrode." It is fixed because it is formed on the surface of the glass substrate. Petersen, 6:30-35, 7:32-36 ("glass substrate 102 containing the lower capacitor plate 104"), Figs. 1A-1C; Petersen provisional, 14-15, 37-39; Allen Decl. ¶ 198.

Petersen's upper capacitor plate, also discussed above, corresponds to the claimed "moveable electrode." *See also* Petersen, 7:32-34, 7:43-45; Petersen provisional, 38. Petersen explains that an "external fluid, gas, or mechanical pressure 118 ***deflects*** the membrane 108 ***along with the upper capacitor plate 106***." Petersen, 7:43-45, 6:30-31, 6:42-49; *see also id.*, 8:45-56 (describing deflection of the upper capacitor plate in response to changes in pressure); Petersen provisional, 37-39. Thus, Petersen's upper plate is "moveable" when pressure is applied. Allen Decl. ¶¶ 199-200; *cf.* '670 patent, 7:66-8:2 ("[P]ressure applied to the exterior or top surface of the capacitive pressure sensor 18 causes the diaphragm 64 (or at least the center portions thereof) to ***deflect*** downward toward the fixed electrode 66.").

The fixed and moveable electrodes of Petersen are shown below in annotated Figures 1A and 1B.

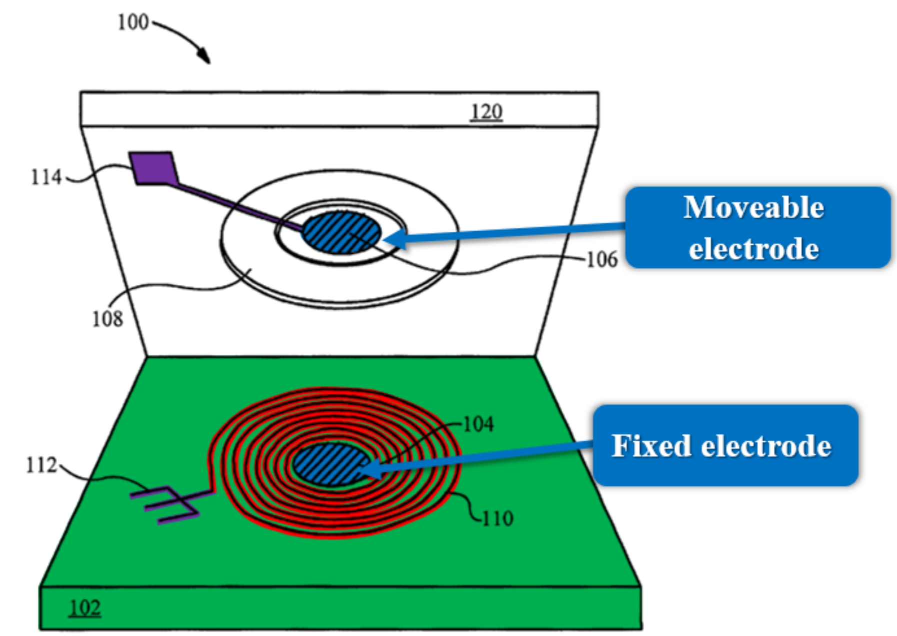


Fig. 1A

Petersen, Fig. 1A (annotated); Petersen provisional, 14, 37-39; Allen Decl. ¶ 201.

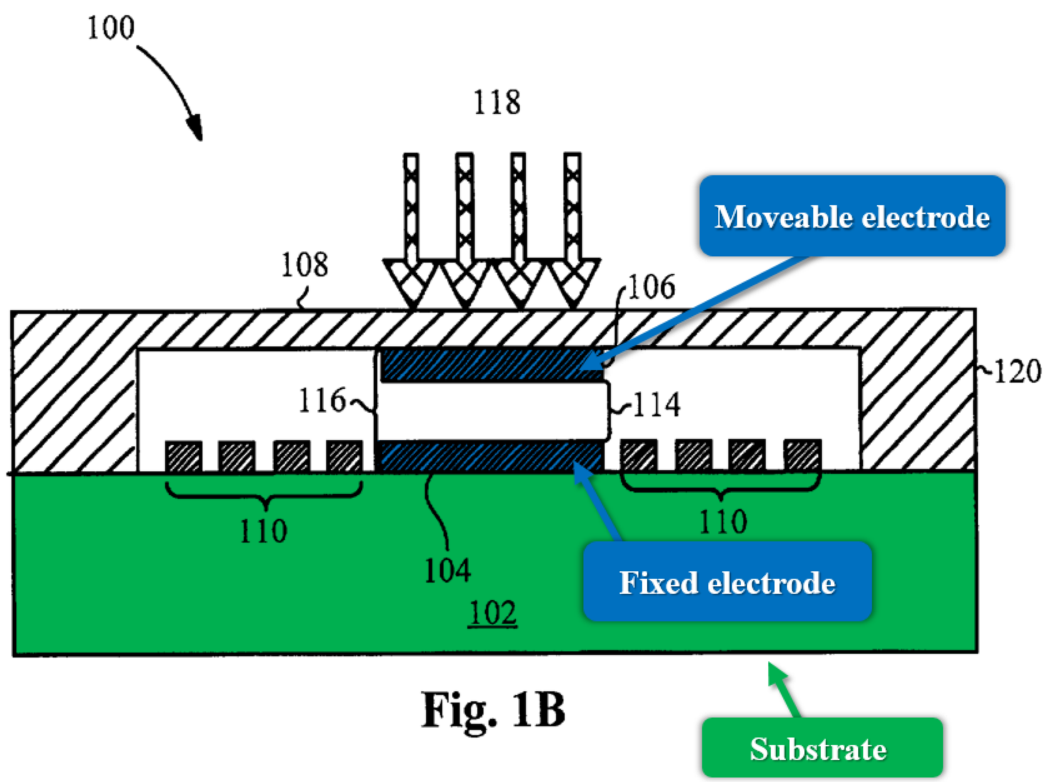


Fig. 1B

Petersen, Fig. 1B (annotated); Petersen provisional, 14, 15, 37-39; Allen Decl. ¶¶ 201-202 (also showing that Petersen, Fig. 1C discloses the claimed "fixed electrode" on the substrate).

D. Claim 4

Claim 4 depends from claim 2, further reciting "wherein said sensor is a pressure sensor." It is anticipated for the same reasons as claim 2 and as further explained here.

Petersen is entitled "implantable continuous intraocular pressure sensor," and discloses that the capacitor 116 of "pressure sensor 100" varies as a function of pressure. Petersen, Cover, Abstract, 3:37-41, 7:30-47 (describing fabrication of pressure sensor 100 using MEMS approach), 8:45-56 (detailing how Petersen's pressure sensor device can "measure intraocular or intra-tissue pressures"); Petersen provisional, 14-15, 33-34, 37-39, 78; Allen Decl. ¶¶ 204-205.

E. Claim 21

Claim 21 depends from claim 1, further reciting "wherein said sensor device is wireless." Claim 21 is anticipated for the same reasons as claim 1 and as further explained below.

Petersen teaches that the sensor device described above is a "***remote*** and miniaturized continuous pressure measuring sensor." Petersen, 3:62-64; Petersen provisional, 19 ("The external energy source is used to excite the LC circuit and the resulting signal … is received remotely via the external detector pickup coil.").

A POSITA would have understood "remote" in this context to mean "wireless" as discussed below. Allen Decl. ¶¶ 207-211. Petersen teaches that the sensor device described above with respect to claim 1 "may be incorporated into a pressure measurement system." Petersen, 8:25-27; Petersen provisional, 39, 78. In this pressure measurement system, shown in annotated Figure 5 below, "[t]he resonant frequency of the sensor 501 is detected by applying a signal to the external detector pick-up coil 502."

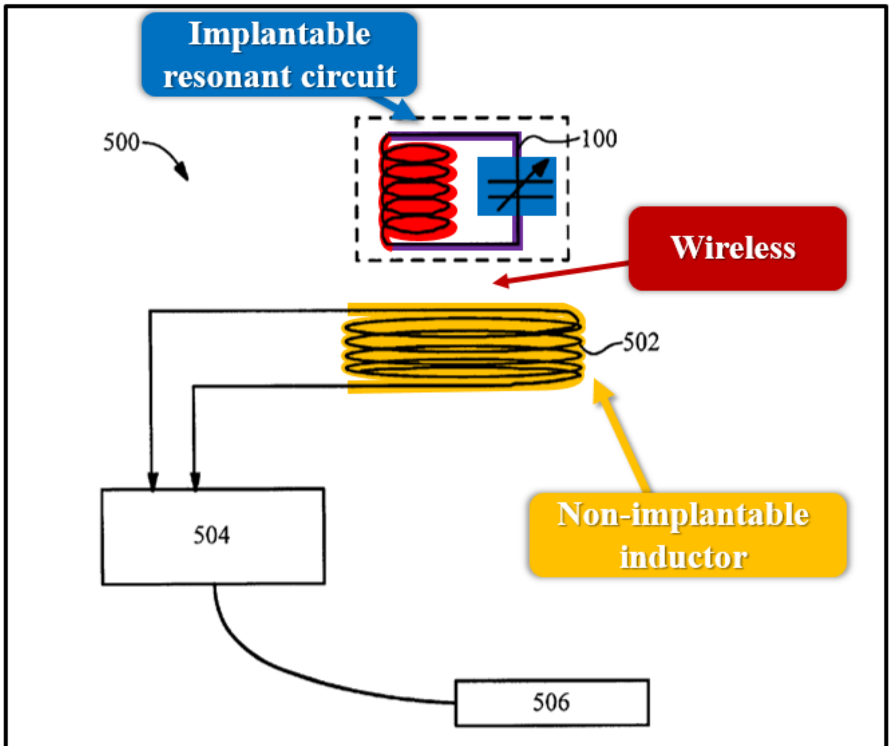


Fig. 5

Petersen, Fig. 5 (annotated), 8:57-58; Petersen provisional, 34, 39, 78; Allen Decl. ¶ 208.

Further, as annotated above, the "external detector pick-up coil 502" is "disposed proximate" to, but remote from, the implantable sensor device 501, and includes no wires connecting the sensor device to the external pick-up coil. Petersen, 8:27-30; Petersen provisional, 34, 39, 78; *c.f.* '670 patent, Fig. 1. Thus, it is "wireless," which is the reason for using a resonant LC circuit, even in the prior art recognized by Petersen and the '670 patent. Petersen, 2:44-3:30; '670 patent, 1:33-2:22; Allen Decl. ¶¶ 207-210. As Petersen's Provisional explains, the "resonant frequency of the resonant circuit and hence the correlated intraocular pressure will be measured continuously, using an external electromagnetic excitation and pickup coil." Petersen provisional, 60. This electromagnetic coupling-based wireless detection is the same way that the '670 patent detects pressure changes wirelessly. Allen Decl. ¶¶ 210-211; *cf.* '670 patent, Fig. 1; *see also*, *e.g.*, Akar-2000 (Ex. 1026), 585-88 (describing a "***wireless*** capacitive sensor" in the context of implantable LC circuits, wherein "[t]he change in the resonant frequency is ***sensed remotely*** with inductive coupling, ***eliminating the need for wire connection*** to monitor the applied pressure"); Akar (Ex. 1010), 8 (similar).

F. Claim 26

Claim 26 depends from claim 1, further reciting "wherein said sensor is a capacitive sensor including a fixed electrode and a moveable electrode, said fixed and moveable electrodes defining a chamber therebetween, said chamber being in fluid communication with a displacement cavity." This claim is anticipated for the same reasons as claims 1 and 2 (which also recites the fixed and moveable electrodes), and as further described below.

As established with respect to claim 2 above, Petersen discloses a capacitive sensor having a fixed electrode formed on the surface of the glass substrate and a moveable electrode formed on a deformable membrane 108.

Furthermore, Petersen discloses a gap (the claimed "chamber") is the volume between the fixed and moveable electrodes ("defining a chamber therebetween") as shown in Figure 1B below:

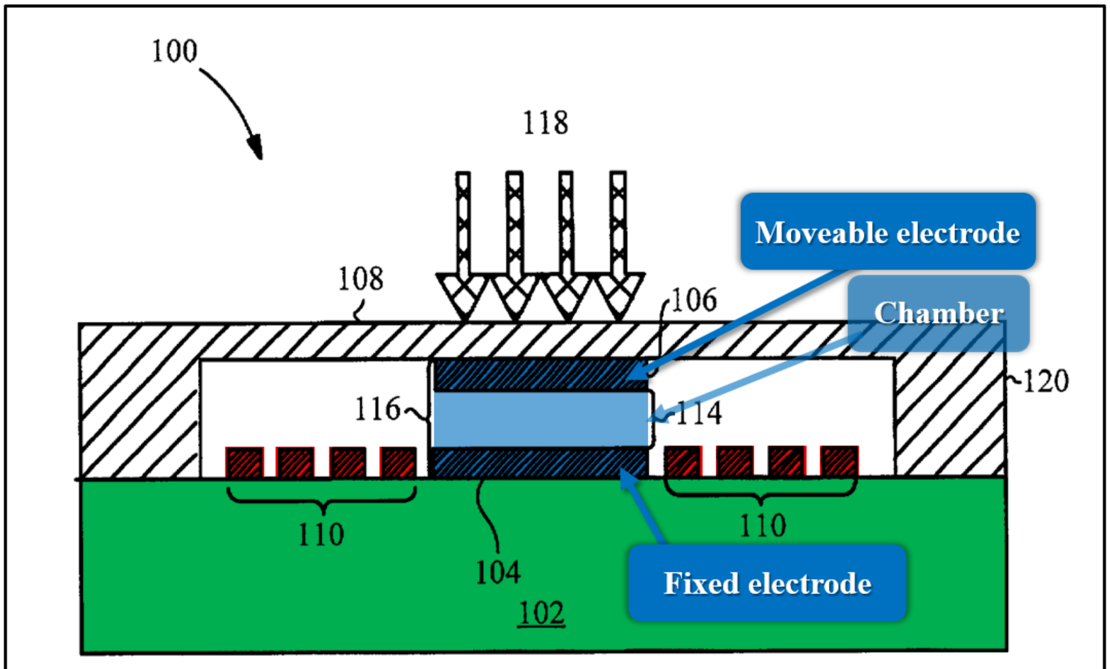
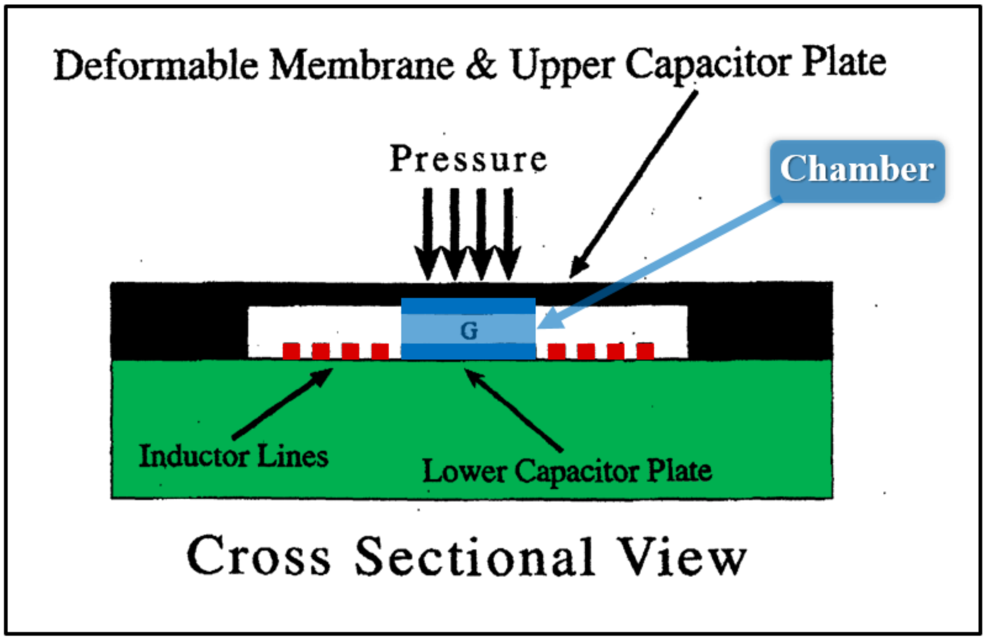


Fig. 1B

Petersen, Fig. 1B (annotated), 7:43-45 ("An external fluid, gas or mechanical pressure 118 deflects the membrane 108 along with the upper capacitor plate 106, which varies the gap 124 of the capacitor 116."); Petersen provisional, 14; Allen Decl. ¶¶ 213-214.

This is also shown in the Petersen provisional, with the gap (chamber), labeled as G in the annotated figure below, between and defined by the lower and upper plates (fixed and moveable electrodes):



Petersen provisional, 14 (annotated); Allen Decl. ¶ 215.

Petersen's chamber is also in "fluid communication with a displacement cavity" as shown in annotated Figure 1B below:

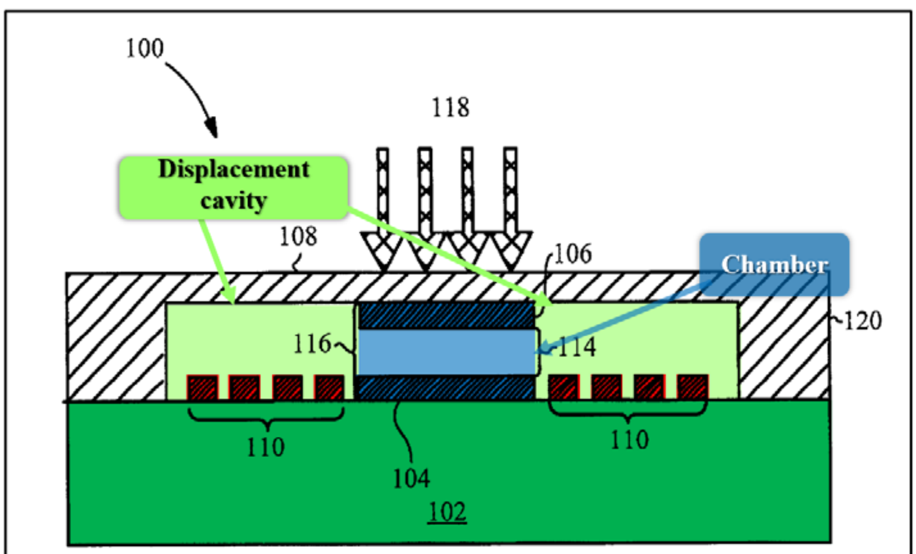
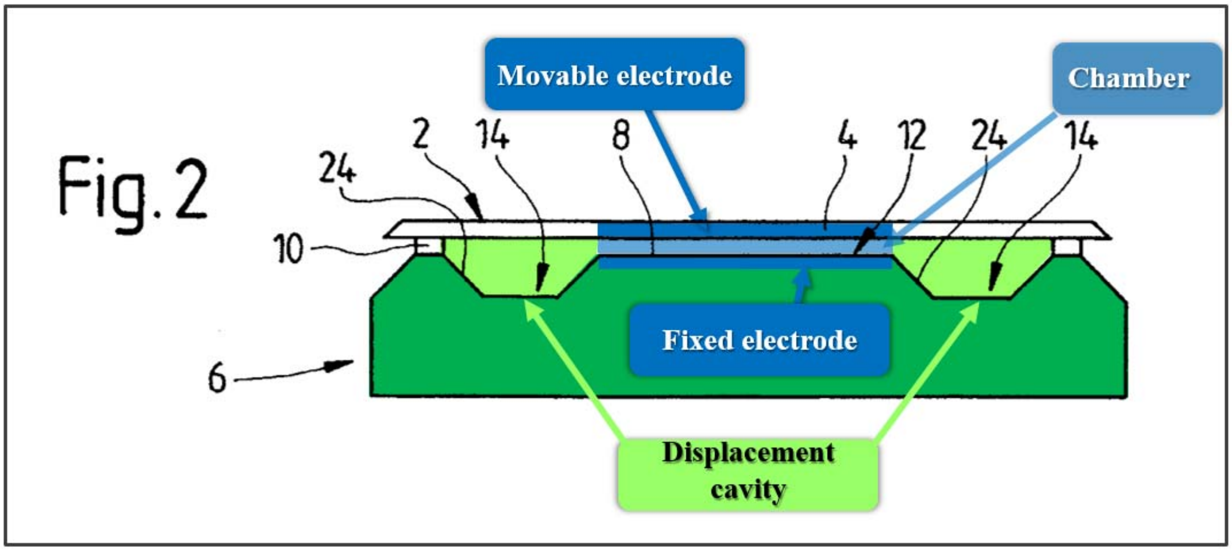


Fig. 1B

Petersen, Fig. 1B (annotated); Allen Decl. ¶ 216 (explaining that the chamber is in fluid communication with the cavity, allowing displacement of residual gasses from the chamber with movement of the upper plate).

The ’670 patent explains that a displacement cavity “is sized such that the total internal sensor volume, the combined volume of the displacement cavity 88 and the interior chamber 90, varies minimally with deflection of the diaphragm 64 over its operational range of displacement” to “compensate for the various negative effects of any residual gas” inside the detector. ’670 patent, 9:25-37; Allen Decl. ¶¶ 217-218. That is true here, too, as the combined volume of Petersen’s displacement cavity and gap (chamber) are large compared to the change in volume that occurs when the upper moveable plate deflects due to changes in sensed pressure. Allen Decl. ¶ 217 (also explaining that a displacement cavity ensures that the upper plate’s deflection will have a smaller effect on the internal pressure of the sensor due to any internal gas).

It is no surprise that Petersen did not expressly label its displacement cavity. Allen Decl. ¶ 218. To be clear, this had long been a common technique, and was described as a “known solution” by Renaud in 1994 to the problems associated with residual gasses in micromachined pressure sensors:



Renaud (Ex. 1011), Fig. 2 (annotated), 1:40-66, 2:25-56, 4:13-16, 4:54-59 (filed in 1994, noting that a "known solution" to mitigate problems caused by residual gas was to create a larger "reference volume" (i.e., displacement cavity), and further describing having the volume completely surround the chamber); Allen Decl. ¶ 218.

G. Claim 31

Claim 31 recites: "The sensor device of claim 1 as part of a sensing system further comprising a non-implantable readout device, said readout device including a second inductor adapted to magnetically couple with said integrated inductor to read changes in said LC tank resonator as a result of said sensor sensing the physiologic parameter of interest." Petersen anticipates claim 31 for the same reasons as claim 1, and further because Petersen describes its sensor is "incorporated into a pressure measurement system" that functions as claimed here. Petersen, 8:25-27.

Specifically, Petersen explains that the sensor is inserted into a patient's tissue or organ (Petersen, 8:45-48), and that the top plate of the capacitive sensor deflects towards the bottom plate depending on the pressure applied to the diaphragm. *Id.*, 7:43-47, 8:45-51. Thus, "pressure-induced motions of the diaphragm change the value of the capacitor element, which, in turn, change the resonant frequency of the LC circuit." *Id.*, 8:52-56 (also stating that an increase in pressure causes a decrease in resonant frequency); Petersen provisional, 39, 60, 78; Allen Decl. ¶¶ 222-223

Petersen discloses that these changes in resonant frequency of the sensor, which are "a result of said sensor sensing the physiologic parameter of interest," are read wirelessly by an "external detector pick-up coil 502 disposed proximate the sensor 501." Petersen, 8:27-30; Petersen provisional, 19, 34, 39, 62-64, 78; *see also* discussion of claim 21, *supra*. This external detector pick-up coil is the claimed "second inductor adapted to magnetically couple with said integrated inductor," as indicated in annotated Figure 5 below.

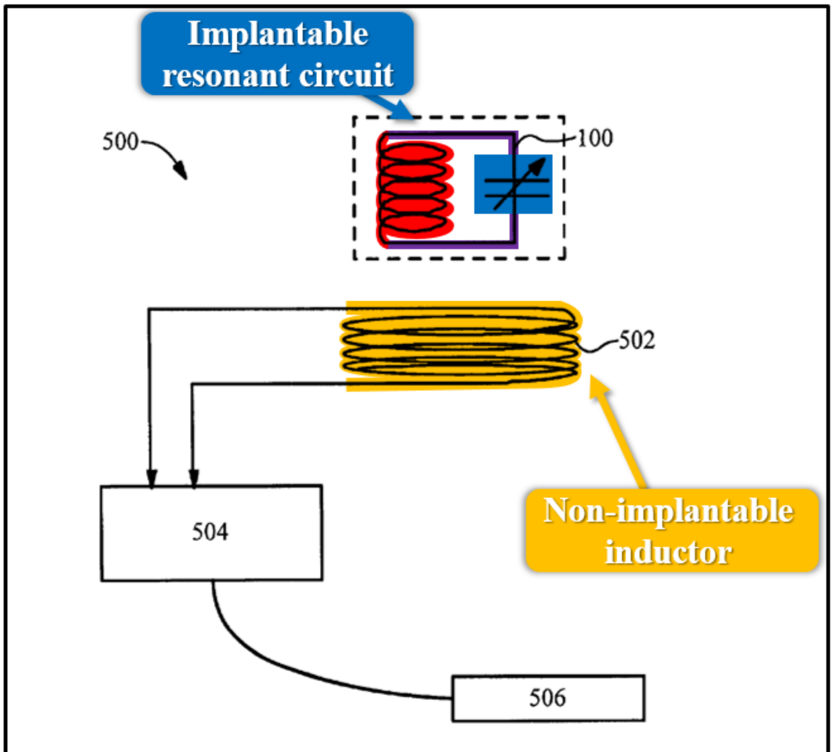


Fig. 5

Petersen, Fig. 5 (annotated); Petersen provisional, 60 ("The resonant frequency of the resonant circuit and hence the correlated intraocular pressure will be measured continuously, using an external electromagnetic excitation and pickup coil."), 19, 34, 39, 62-64, 78; Allen Decl. ¶¶ 220-221.

Petersen also discloses that the external detector pick-up inductor coil can be "placed in a device that can be worn" by the patient, and is therefore not "implantable" as claimed. Petersen, 5:32-36, 8:39-44; Petersen provisional, 19, 34, 78; Allen Decl. ¶ 221.

Petersen teaches that the external detector pick-up coil detects changes from the implanted LC tank resonator as follows:

> The resonant frequency of the sensor 501 is detected by applying a signal to the external detector pick-up coil 502. The signal applied to the external detector pick-up coil 502 is varied in frequency until the resonant frequency of the sensor 501 is located.

Petersen, 8:57-61; Petersen provisional, 19, 34, 78; Allen Decl. ¶ 224; *see also* '670 patent, 1:33-65 (explaining that wireless communication relying on magnetic coupling between an implanted inductor in a LC tank resonator and an external "readout" coil is "well-known to those knowledgeable in the art"). In this way, the pressure detected by the implanted sensor can be "measured on a continuous basis." Petersen, 8:65-9:5; Petersen provisional, 34, 63-64; Allen Decl. ¶ 225.

IX. GROUND 2: CLAIMS 26-27 ARE UNPATENTABLE OVER PETERSEN IN VIEW OF RENAUD

A. Overview—Renaud (Ex. 1011)

U.S. Patent No. 5,488,869 ("Renaud") is entitled "Capacitive Absolute Pressure Measurement Sensor and Method of Manufacturing a Plurality of Such Sensors." Renaud is § 102(b) prior art because it issued more than one year before the '670 patent's actual and earliest-claimed filing dates.

Renaud discloses an improved capacitive pressure sensor having a "fixed electrode" and "mobile electrode" arranged to "define a chamber" between them, and a "reference volume connected to said chamber," i.e., the claimed displacement cavity. Renaud, Abstract, 2:36-48. Renaud recognizes that such reference volumes were already known (when filed in 1994), and proposed an improved volume formed as a "groove running around the fixed electrode" in the substrate. Renaud, 2:53-55; Allen Decl. ¶¶ 127-129.

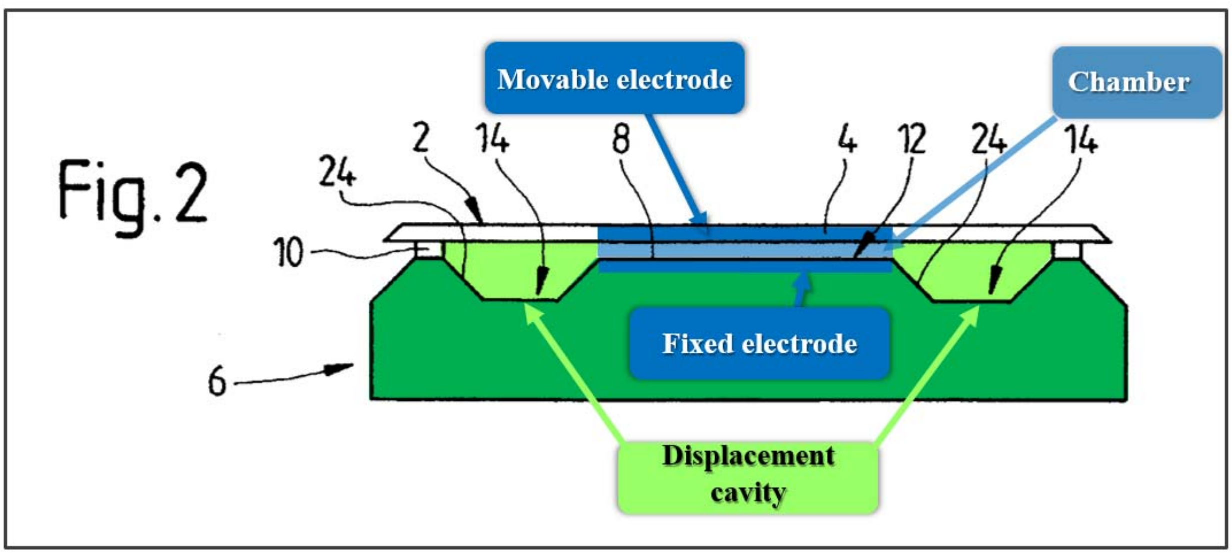
B. Claims 26 and 27

Claim 26 depends from claim 1, further reciting "wherein said sensor is a capacitive sensor including a fixed electrode and a moveable electrode, said fixed and moveable electrodes defining a chamber therebetween, said chamber being in fluid communication with a displacement cavity." Claim 27 depends from claim 26, and further recites "wherein said displacement cavity is defined within said substrate."

Claims 26 and 27 would have been obvious for the same reasons already discussed for claim 26 over Petersen alone and as further explained in the following paragraphs. As already established, Petersen anticipates claim 26, teaching each and every element arranged as in the claim. It would have also been obvious to modify Petersen in view of Renaud, and the resulting combination renders claim 27 obvious.

The combination also renders claim 26 obvious if the Board concludes that Petersen alone does not disclose a displacement cavity.

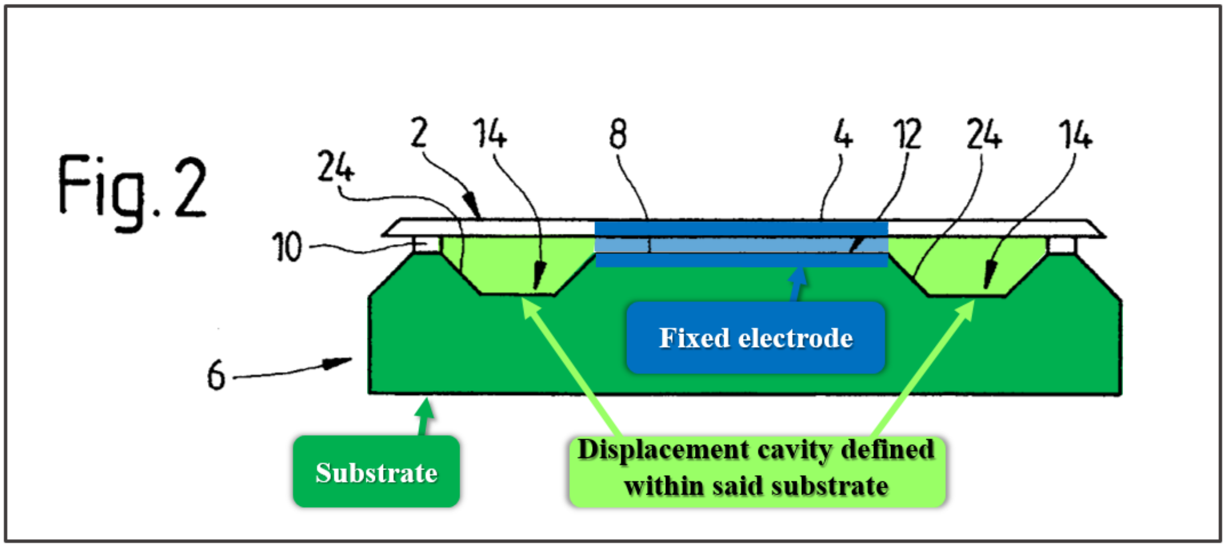
Like Petersen, Renaud discloses a capacitive pressure sensor includes "a ***mobile electrode 4***" formed on a semiconductor "membrane 2" and a "***fixed electrode 8***" formed on a "substrate 6." Renaud, 3:56-61, 4:5-6. As shown in annotated Figure 2 below, the fixed and mobile (i.e., "moveable") electrodes define a "***chamber 12***" between them, and both show a volume ("cavity") outside of and surrounding the chamber. Furthermore, Renaud discloses the claimed displacement cavity, stating that its chamber is connected to a "***cavity forming the reference volume 14*** which is placed in the second element 6." *Id.*, 4:1-12, 4:55-59.



Renaud, Fig. 2 (annotated), 4:12-16 ("The sensor also comprises a reference volume 14 in contact with the chamber 12 to reduce the pressure of the gas contained in the chamber 12 which result from the degassing which occurs during the manufacturing of the sensor 1."), 4:56-58 ("[V]olume 14 is composed of a groove which extends around the fixed electrode 8."), Abstract, 5:51-56, 8:12-17; Allen Decl. ¶¶ 228-229.

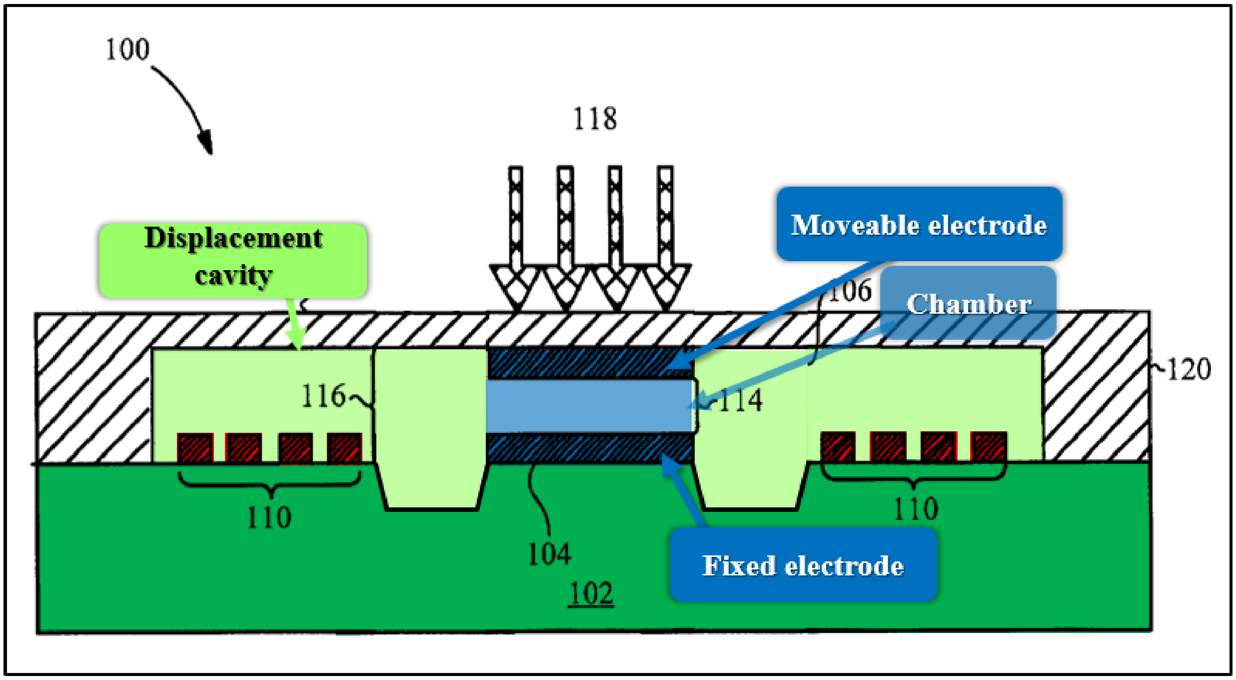
Indeed, Renaud explains that displacement cavities were already known at the time of its filing in 1994, and the above cavity is an improved version. Renaud, 1:40-66, 2:25-56, 4:13-16, 4:54-59 (filed in 1994, noting that a "known solution" to mitigate problems caused by residual gas was to create a larger "reference volume" (i.e., displacement cavity), and further describing having the volume completely surround the chamber); Allen Decl. ¶¶ 230, 127-130.

Notably, Renaud's displacement cavity is defined within the substrate, as required by claim 27. Specifically, Renaud's fixed electrode is formed on a semiconductor substrate 6 (a sensor formed "at least in part on the substrate" in claim 1) and the displacement cavity (Renaud's "reference volume 14") discussed above with respect to claim 26 is formed "by a groove running around the fixed electrode" within that substrate. Renaud, 2:53-55, 4:55-59, 5:51-56, 6:23-30 (groove 14 is etched in the substrate). Accordingly, Renaud discloses a "displacement cavity is defined within said substrate" as annotated in Figure 2 below.



Renaud, Fig. 2 (annotated); Allen Decl. ¶¶ 230-231.

The resulting modified device of Petersen would be of the form below:



Allen Decl. ¶ 232 (modifying Petersen, Fig. 1B in view of Renaud).

C. Motivations to Combine Petersen with Renaud

A POSITA would have been motivated to combine Petersen and Renaud. Renaud teaches a method for improving micromachined capacitive pressure sensors having a fixed and moveable electrode, and Petersen discloses an analogous sensor that is "micromachined from silicon" and includes a first and second plate corresponding to a fixed and movable electrode, as discussed previously. Petersen, Abstract, 7:30-36. Thus, a POSITA would have understood that Renaud and Petersen are analogous art. Allen Decl. ¶ 234.

Renaud teaches that in the course of manufacturing micromachined capacitive pressure sensors, such as in Petersen, "degassing can occur within the structure of the sensor leading to the creation of residual pressure inside the chamber." Renaud, 1:54-56. The residual gas in the chamber causes the sensor not to provide an "exact reading of the absolute pressure" and affects the "stability and/or the reproductibility [sic] of the readings" of the sensor. *Id.*, 1:55-60. One solution, known even at the time Renaud was filed in 1994, was to use a displacement cavity or, as Renaud calls it, a "reference volume" that decreases the pressure of the residual gas by increasing the total volume. *Id.*, 1:53-65; Allen Decl. ¶ 237. This has the additional beneficial effects of increasing temperature stability (*i.e.*, a given change in temperature will have a smaller effect on internal pressure), and it will also reduce the percentage change in volume for a given diaphragm (moveable electrode) deflection, further mitigating the undesirable effects caused by gas inside the device. Allen Decl. ¶¶ 235-236. Renaud offers an improved displacement cavity—it is made larger without increasing the size of the device as a whole by etching it into the substrate "by a groove running around the fixed electrode." Renaud, 2:53-55.

Notably, a displacement cavity was a well-known solution for a common problem. As already mentioned, Renaud discussed it in his prior art section in 1994. In addition, the Petersen provisional noted that there could be "potential problems with long-term sensor drift due to moisture or gas absorption" within the sealed cavity, which it addressed in part by hermetically sealing the capacitive sensor and integrated coil together. Petersen provisional, 33-34. Likewise, the '670 patent addressed the same problem with the same solution years later, calling it a "displacement cavity" and did not tout it as an innovation of any kind. '670 patent, 9:2-40 (explaining that its displacement cavity eliminates the "negative effects of any residual gas"). Thus, a POSITA implementing Petersen's device would have used the displacement cavity taught in Renaud to improve sensitivity to pressure changes in the micromachined pressure sensor disclosed in Petersen. Allen Decl. ¶ 238.

A POSITA also would have been motivated to look to Renaud to improve the accuracy of Petersen's capacitive sensor because Petersen specifically identifies inaccurate pressure readings as a problem it was trying to solve. Allen Decl. ¶ 238.

For example, Petersen teaches hermetically sealing its capacitive sensor to avoid fluid contacting the plates of the capacitive sensor, which could cause an "inaccurate pressure signal." Petersen, 7:43-56. Renaud also teaches a sealed capacitive sensor, but explains that residual gasses caused by that sealing process can still cause inaccuracies that Petersen was trying to avoid. Renaud, 1:55-60. And while Petersen already discloses a displacement cavity above and between the coils of the integrated inductor, *see* Section VIII.F above (claim 26), a POSITA would have been motivated to further mitigate any residual gas effects by increasing the size of that cavity by etching it within the substrate as disclosed in Renaud. Allen Decl. ¶ 238; Renaud, 1:62-66. Indeed, Renaud explains that by forming the reference volume within the substrate provides an "enlarged reference volume in its active zone and which provides great sensitivity at the same time creating a sensor with a very simple structure" but still allows "a simplified and economical method of manufacturing." *Id.*, 2:25-35.

Moreover, Renaud provides that etching the cavity as a groove within the substrate provides a further benefit of "reducing the size of the active part of the measuring capacitator without reducing the sensitivity of the sensor so that the relative sensitivity of the sensor according to the invention is increased." *Id.*, 2:56-60. Thus, a POSITA would have been motivated to etch a displacement cavity within the substrate in Petersen in order to economically (1) provide further compensation for residual gasses trapped within the sealed capacitive sensor, and (2) delimit the outline of the bottom plate of the capacitor. Allen Decl. ¶ 235, 238.

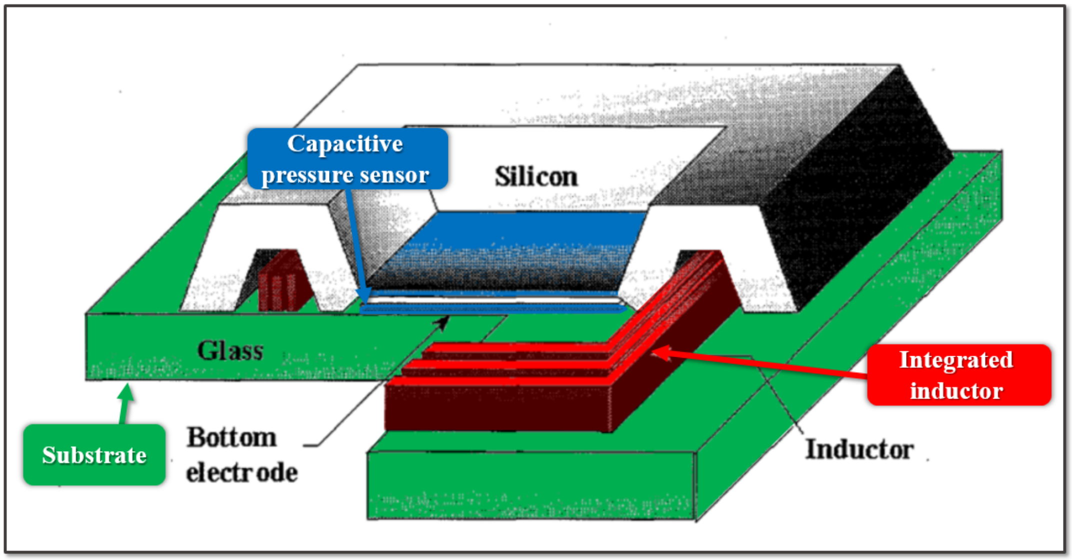
Furthermore, Renaud explains that "minimisation of the internal stresses and the drift in temperature" of capacitive pressure sensors by inserting a displacement cavity can be done with "[t]he use of conventional semiconductor material micromachining technique" by the "implementation of a series of very simple steps." Renaud, 3:24-29. Specifically, Renaud teaches forming the reference volume using "conventional" elimination techniques such as etching the substrate. *Id.*, 5:51-6:48. A POSITA would have used these conventional techniques to implement in Petersen, which discloses similar etching techniques in different embodiments of its sensor. Petersen, 7:7-10, 8:10-11 ("Material may be removed by any suitable technique, *e.g.*, wet etch, plasma etch, laser milling, ion milling and the like."). As a result, a POSITA would have been motivated to combine Petersen and Renaud because the resulting combination would have involved only the use of a known technique to improve a similar method and would have reasonably been expected to succeed. Allen Decl. ¶ 239. Moreover, Renaud teaches that its improved capacitive pressure sensors comprising a displacement cavity can have general dimensions of "1.9x2.2x0.5 mm," which a POSITA would have understood to be compatible with the devices designed by Petersen having dimensions of approximately "2x2x0.5 mm." Renaud, 8:21-27; Petersen, 7:38-40; Allen Decl. ¶ 240.

X. GROUND 3: CLAIMS 1-4, 21, 31 ARE UNPATENTABLE OVER PARK

A. Overview—Park (Ex. 1008)

Eun-Chul Park et al., "Hermetically Sealed Inductor-Capacitor (LC) Resonator For Remote Pressure Monitoring," 37 Japanese Journal of Applied Physics 7124 ("Park") was published and publicly available in a reputable journal in December of 1998 and is therefore § 102(b) prior art. Hsieh-Yee Decl. (Ex. 1022) ¶¶ 35-44 (expert librarian declaration describing public availability). Park is identified on the cover of the '670 patent and in the specification (further evidencing its public availability *and* establishing it as admitted prior art), but it was not discussed by the examiner.

Park teaches an "integrated inductor-capacitor (LC) resonator structure fabricated using bulk micromachining and anodic bonding technologies." Park, 7124. The remote pressure-monitoring device is used in "biomedical applications" to wirelessly measure "intraocular, cardiovascular and brain pressures." *Id.*, 7124. The structure of the disclosed "LC resonant pressure sensor" is shown in annotated Figure 1 below, where the capacitive pressure sensor is "composed of a p^+ silicon membrane and a metal electrode on the glass substrate" and the inductor is also "fabricated on the glass" substrate. *Id.*. The pressure sensor device is a "fully integrated LC resonant structure without any hybrid components."



Park, Fig. 1 (annotated[3]); Allen Decl. ¶¶ 108-109.

Park teaches that the LC resonant pressure sensor can be monitored remotely using a non-implantable transmission coil inductor as shown in annotated Figure 10 below.

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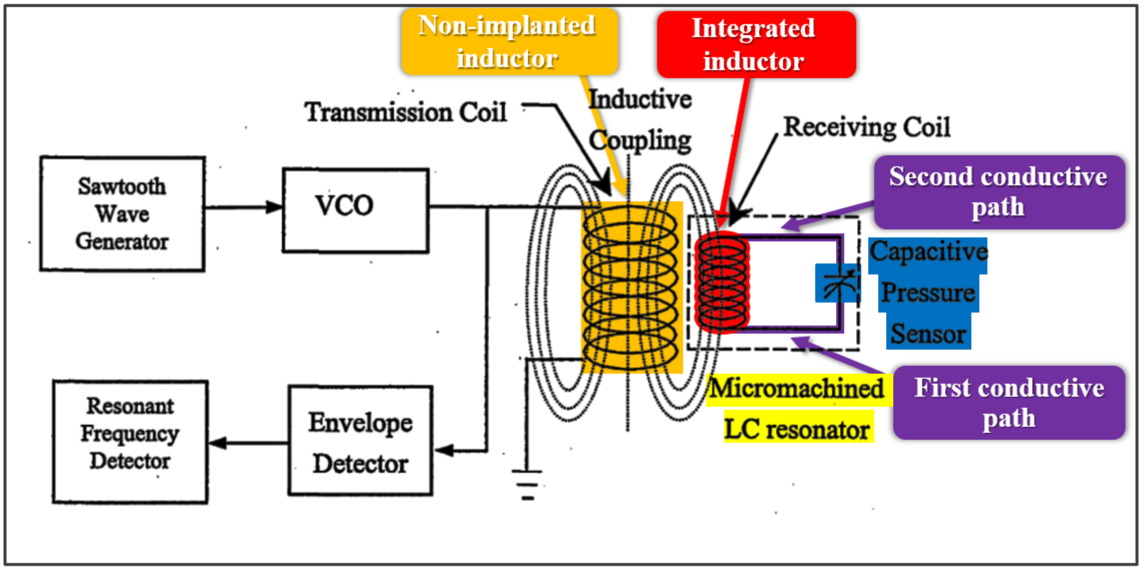
[3] All black text and arrows in Park's figures are original, e.g., "Silicon" and "Bottom Electrode." Only the colored annotations have been added throughout.



Park, Fig. 10 (annotated), 7127; Allen Decl. ¶ 111.

As noted above, the ’670 patent lists Park as one of several “microfabricated sensors” that had been “reported in the literature” in the background section of the specification. ’670 patent, 2:60-64.

The ’670 patent does not distinguish its alleged invention from Park in particular. Rather, it glosses over Park and other admitted prior art references, contending they were all limited to separation distances between the implantable sensor and the external readout inductor of “1-2 cm at most.” *Id.*, 3:1-5. The ’670 patent purports to increase this distance to “greater than 2 cm” by using a “novel construction” including a “magnetic core” consisting of a post with plates on each side. *Id.*, 3:40-45, 4:2-10. Even generously assuming that using a magnetic core in an inductor coil was “novel,” ***a magnetic core is not recited in the challenged***

claims. Rather, that feature appears only in claims 7-18, which are not challenged here. Allen Decl. ¶ 114.

The ’670 patent also attempts to generally distinguish over Park and other admitted prior art by contending they located the sensor and inductor “separately”—as opposed to using an integrated inductor. ’670 patent, 3:1-5. For at least Park, that is simply false. As already demonstrated, Park expressly discloses a “fully integrated LC resonant structure without any hybrid components.” Park, 7124; Allen Decl. ¶¶ 112-113.

In view of the foregoing and as discussed below, Park anticipates claims 1-4, 21 and 31 of the ’670 patent.

B. Claim 1

a. [1pre]—“An implantable microfabricated sensor device for measuring a physiologic parameter of interest within a patient, said sensor comprising:”

Park discloses an “integrated inductor-capacitor (LC) resonator structure fabricated using bulk ***micromachining***[4] and anodic bonding technologies,” where “pressure change is monitored by a capacitive ***pressure sensor***.” Park, 7124, 7128;

[4] “Micromachined” is and was a common microfabrication technique for making ICs and MEMS. Allen Decl. ¶¶ 242, 78-81; ’634 provisional, 2; ’327 provisional, 1; *see* Section VI.B above.

see also id., Figs. 1 ("Structure of micromachined LC resonant pressure sensor"), 4 ("Schematic diagram of fabrication process flow"), 10 ("Schematic diagram of measurement system"); Allen Decl. ¶¶ 241-242. Park teaches that this "***micromachined***, hermetically sealed structure is suitable for biomedical applications such as ***intraocular, cardiovascular and brain pressure monitoring***," each of which are "physiologic parameter[s] of interest within a patient" as claimed. *Id.*, 7124. Park states that its "inductor-capacitor (LC) resonator which is composed of a capacitive ***pressure sensor*** and inductor can be ***implanted*** in the patient's eye and transmit pressure information to an external detector." *Id.*

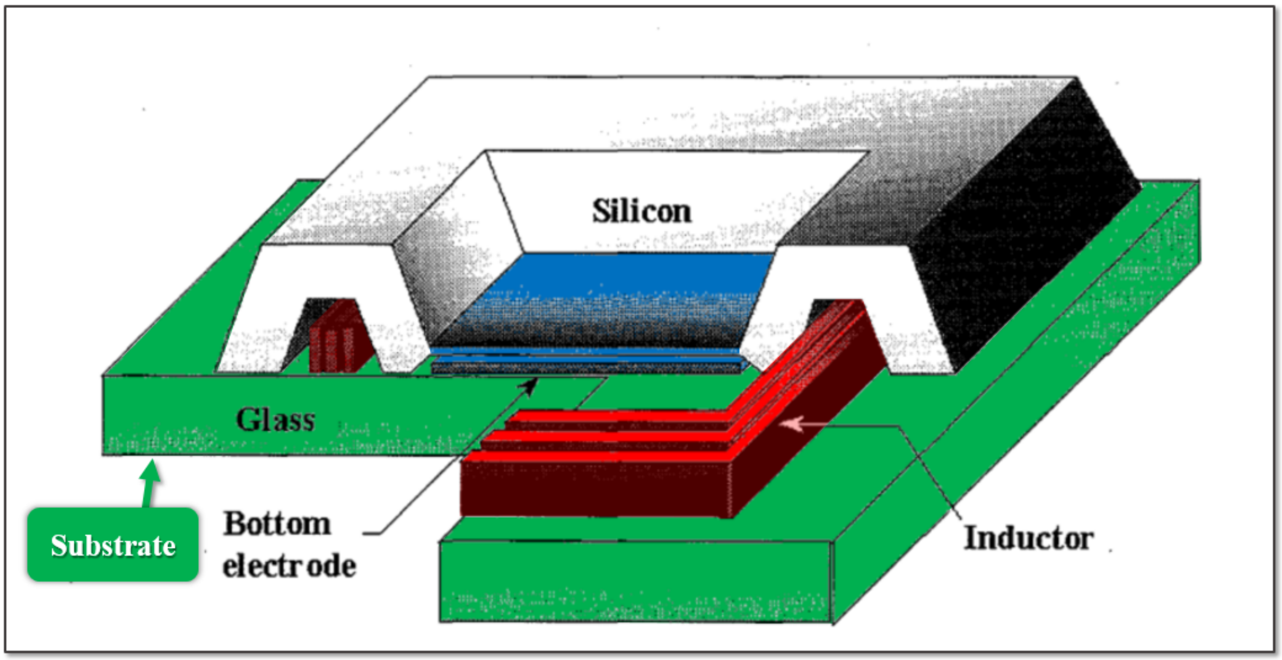
b. [1a]—"an implantable sensing device, said sensing device being a micro electromechanical system (MEMS) comprising"

As discussed with reference to limitation [1pre], Park discloses an implantable pressure sensing device. *See* limitation [1pre] above. Park teaches that the pressure sensing device is fabricated using "***micromachining*** and anodic bonding technologies," and is a "fully integrated LC resonant structure without any hybrid components and does not require any special packaging process." Park, 7124, 7128.

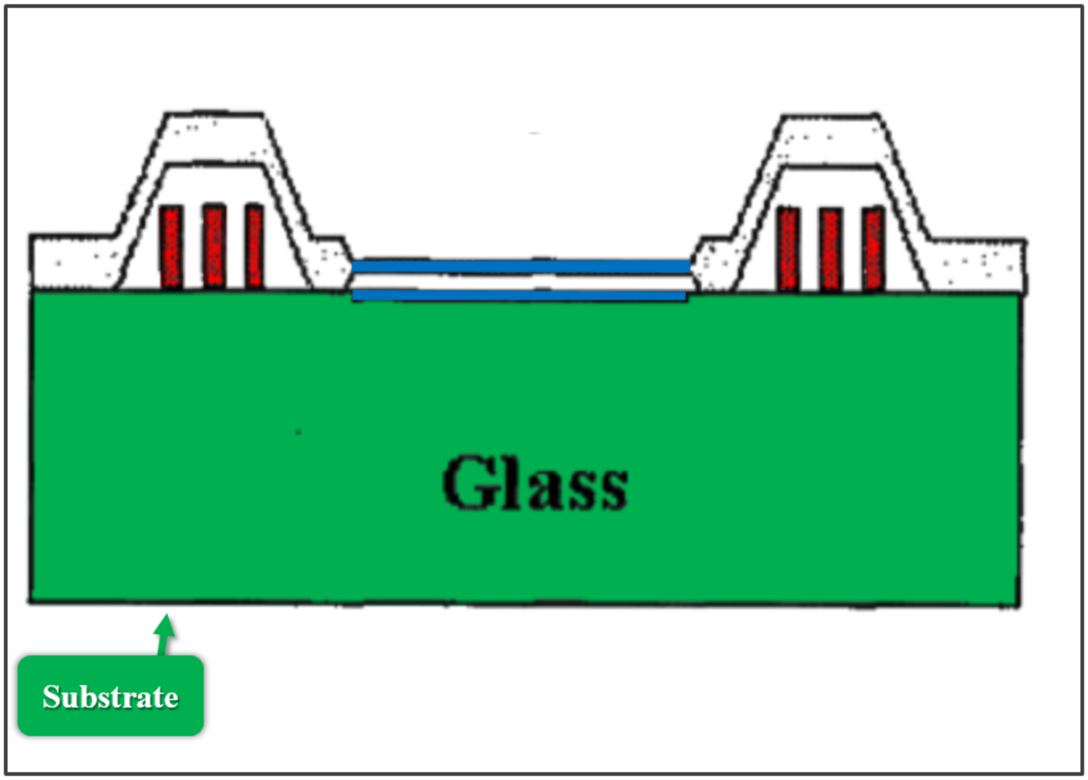
Because all of the components of the LC resonant circuit are fabricated using micromachining techniques, and the fabricated device includes electrical components (an integrated inductor and capacitive sensor) and mechanical movement (a deformable silicon diaphragm), Park's sensing device is a "micro electromechanical system (MEMS)." Allen Decl. ¶¶ 244-245; Park, 7125-26; Section VI.B above; *cf.* '327 provisional (Ex. 1003), 1; '634 provisional (Ex. 1004), 2.

c. [1b]—"a substrate,"

Park discloses that the "proposed LC resonant pressure sensor" includes a "glass substrate" as annotated in Figures 1 and 4(f) below.



Park, Fig. 1 (annotated), 7124; Allen Decl. ¶ 246.

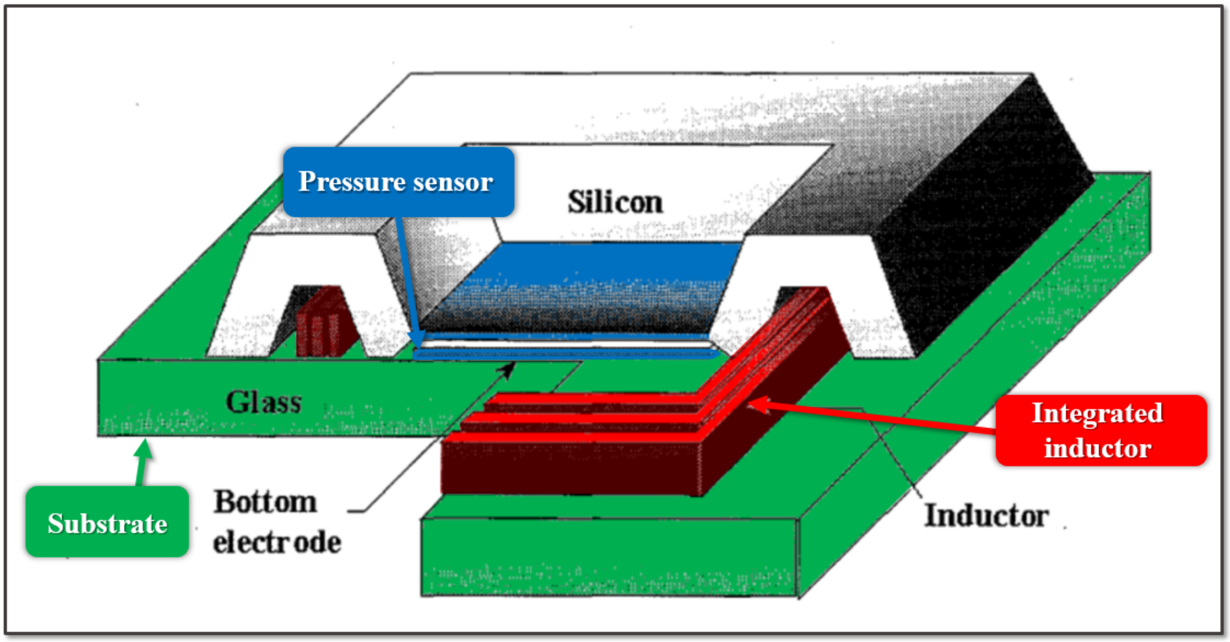


Park, Fig. 4(f) (annotated); Allen Decl. ¶ 246.

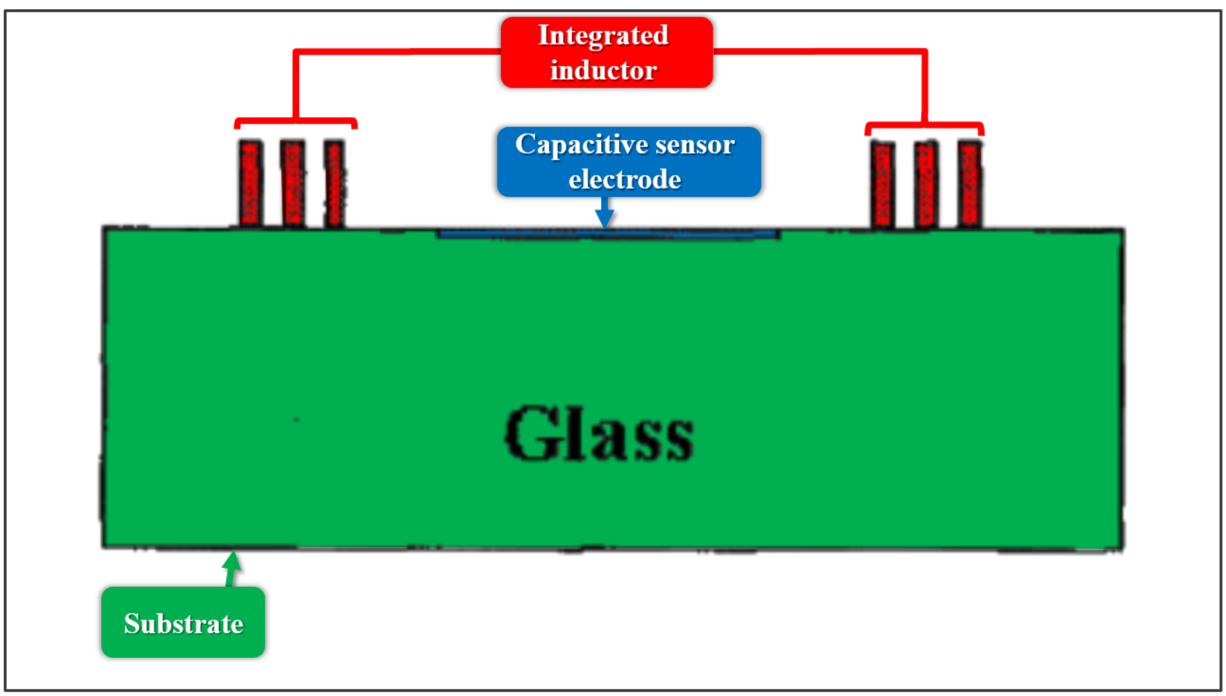
d. [1c]—"an integrated inductor formed on the substrate,"

Park discloses an "inductor is fabricated on the glass [substrate] by CU-electroplating." Park, 7124, 7125 ("the inductor is fabricated on glass"); Allen Decl. ¶ 247.

This inductor is an integrated inductor: it is the "L" in Park's "fully integrated LC resonant structure without any hybrid components." *Id.*, 7124, 7128.

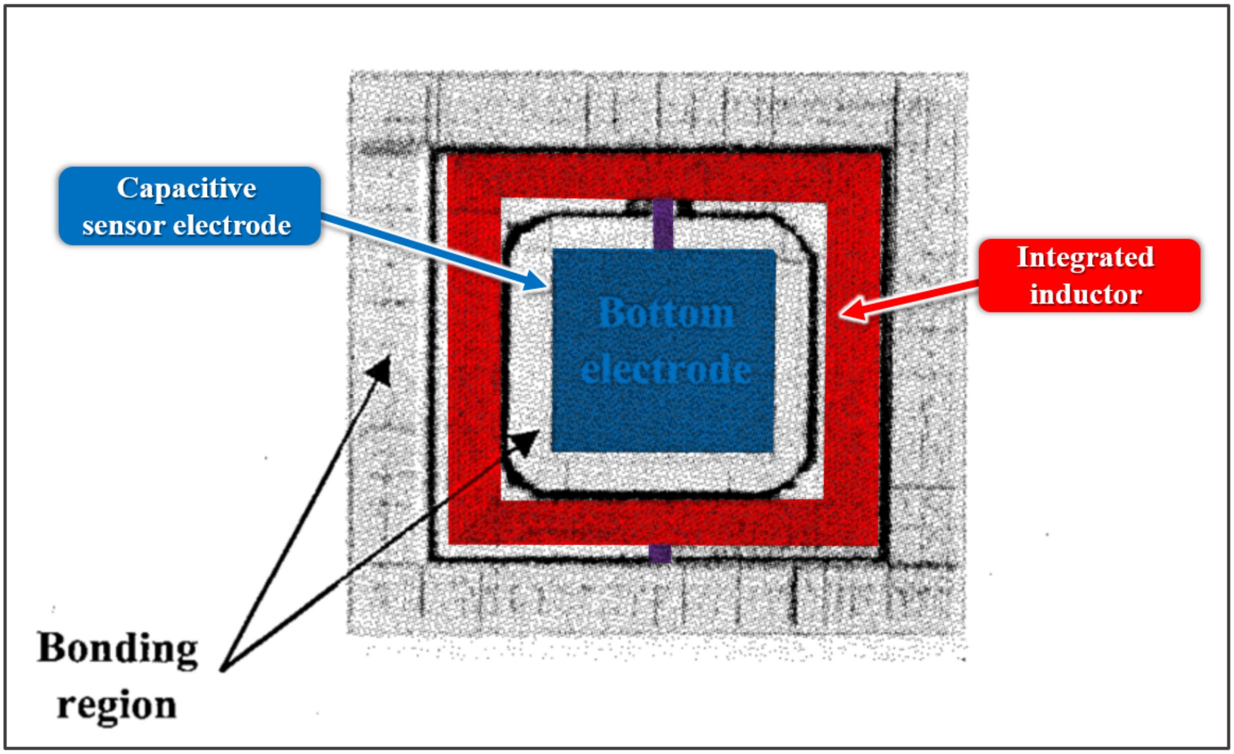


Park, Fig. 1 (annotated); Allen Decl. ¶ 248.



Park, Fig. 4(d) (annotated); Allen Decl. ¶ 248.

In addition, the inductor is an "integrated inductor" because it is fabricated using "micromachining" technology and it is formed on the surface of the glass substrate with a "metal electrode" of the capacitive pressure sensor, as shown in annotated Figures 1 and 4(d) above, and in annotated Figure 8(b) below.

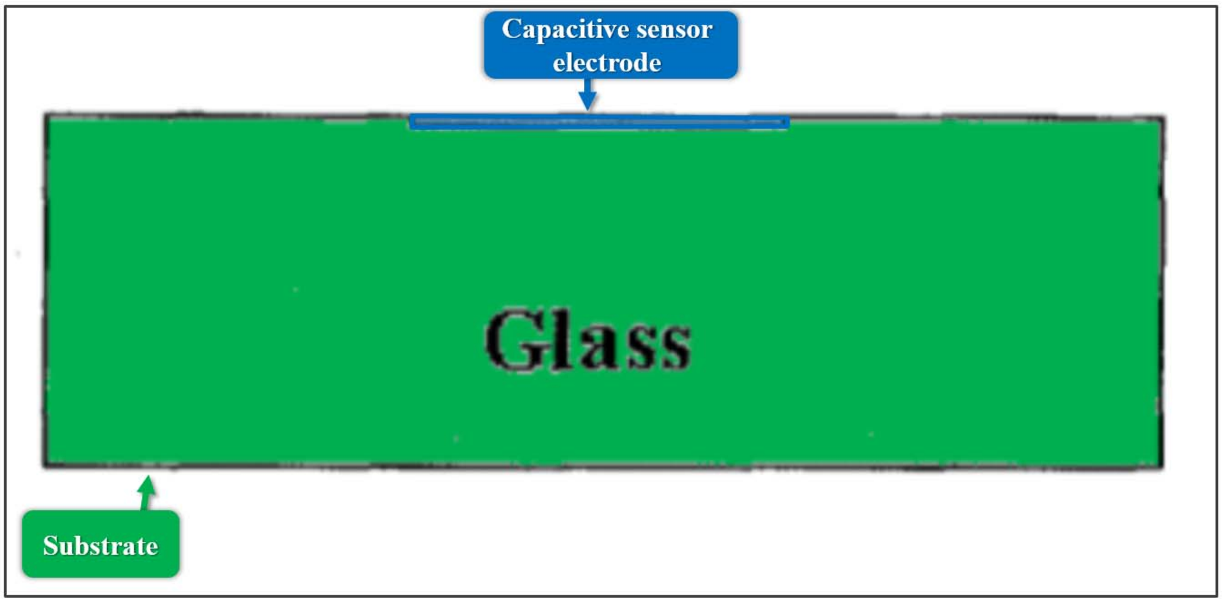


Park, Fig. 8(b) (annotated), 7126-27 ("summary of the fabrication process flow of the LC resonator structure"); Allen Decl. ¶¶ 249-250.

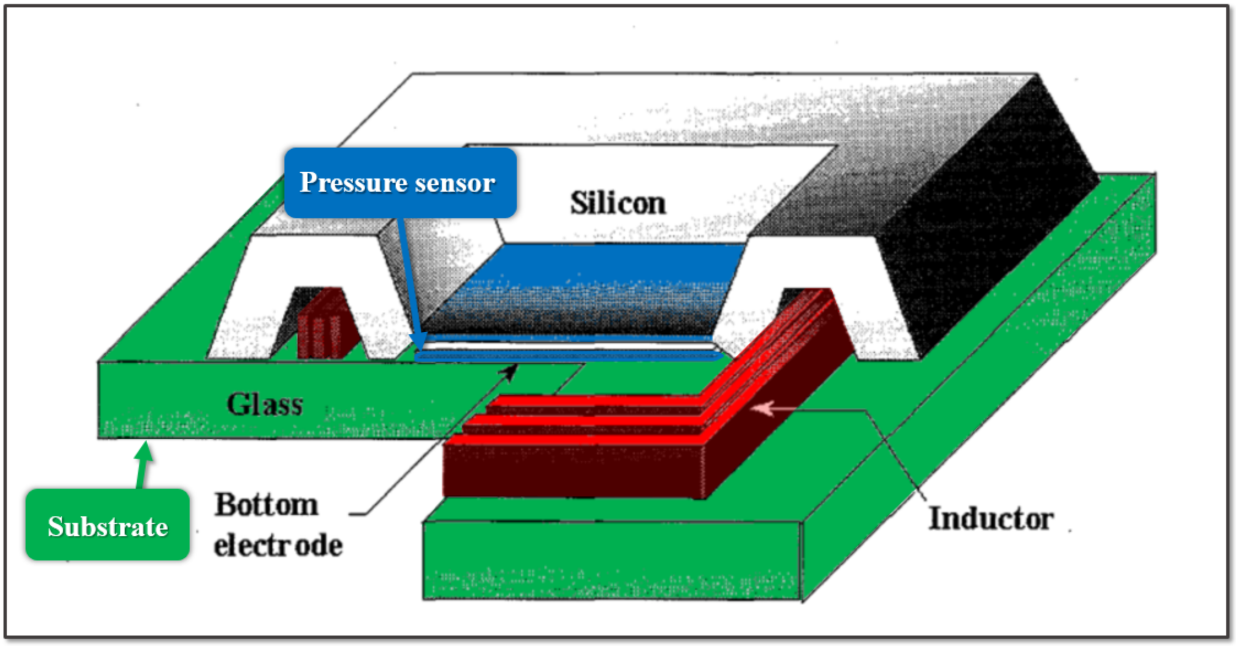
e. [1d]—"at least one sensor responsive to the physiologic parameters and being formed at least in part on the substrate,"

Park monitors "pressure change [using] a ***capacitive pressure sensor***," and recites that the entire "structure is suitable for biomedical applications such as intraocular, cardiovascular and brain pressure monitoring" (physiologic parameters).

Park, 7124. This capacitive pressure sensor is formed at least in part on a substrate: it is "composed of a p^+ silicon membrane and ***a metal electrode on the glass substrate***." *Id.*, 7124. Park's capacitive sensor thus includes two electrodes or plates that form a "sensor" for the same reasons that the '670 patent's capacitive sensor is a sensor. Allen Decl. ¶¶ 251-252; '670 patent, 7:26-41, Fig. 5. This is further illustrated in Park's Figures 4(c) and 1 below.



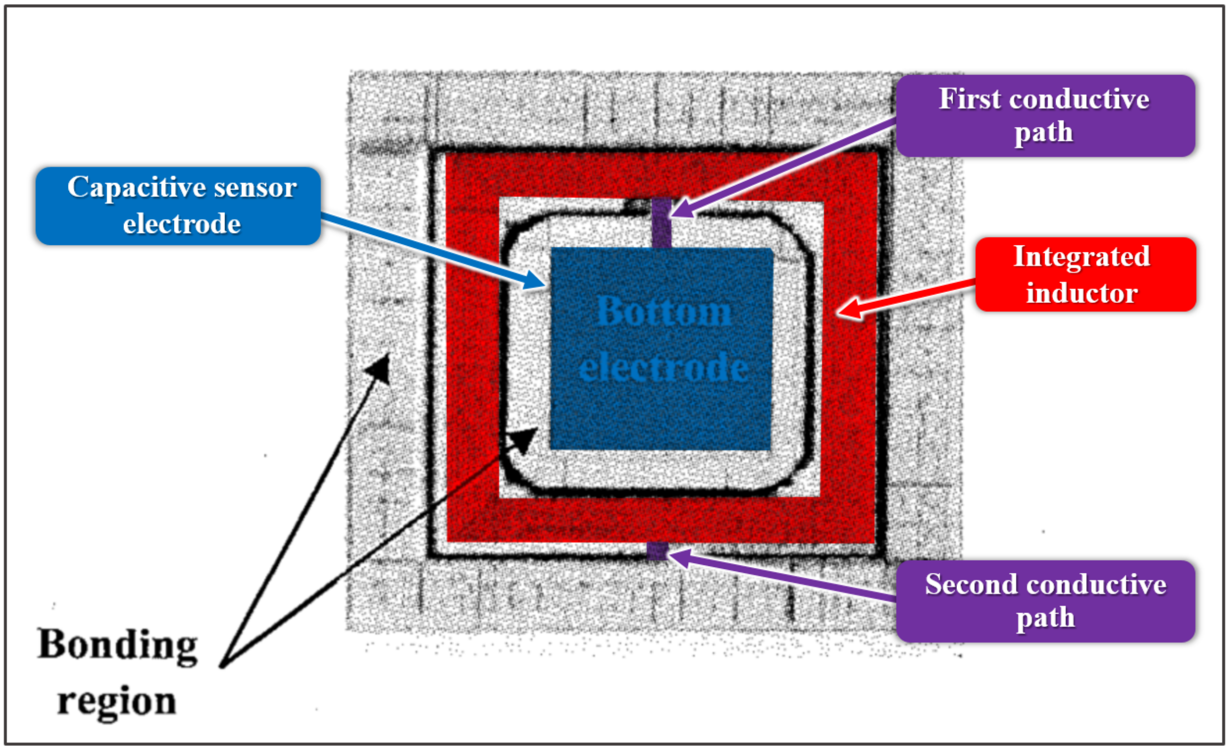
Park, Fig. 4(c) (annotated, depicting bottom electrode fabrication step); *see also id.*, Figs. 4(d), (e) and (f) (subsequent fabrication steps); Allen Decl. ¶ 252.



Park, Fig. 1 (annotated); Allen Decl. ¶ 253.

f. [1e]—"a plurality of conductive paths electrically connecting said integrated inductor with said sensor,"

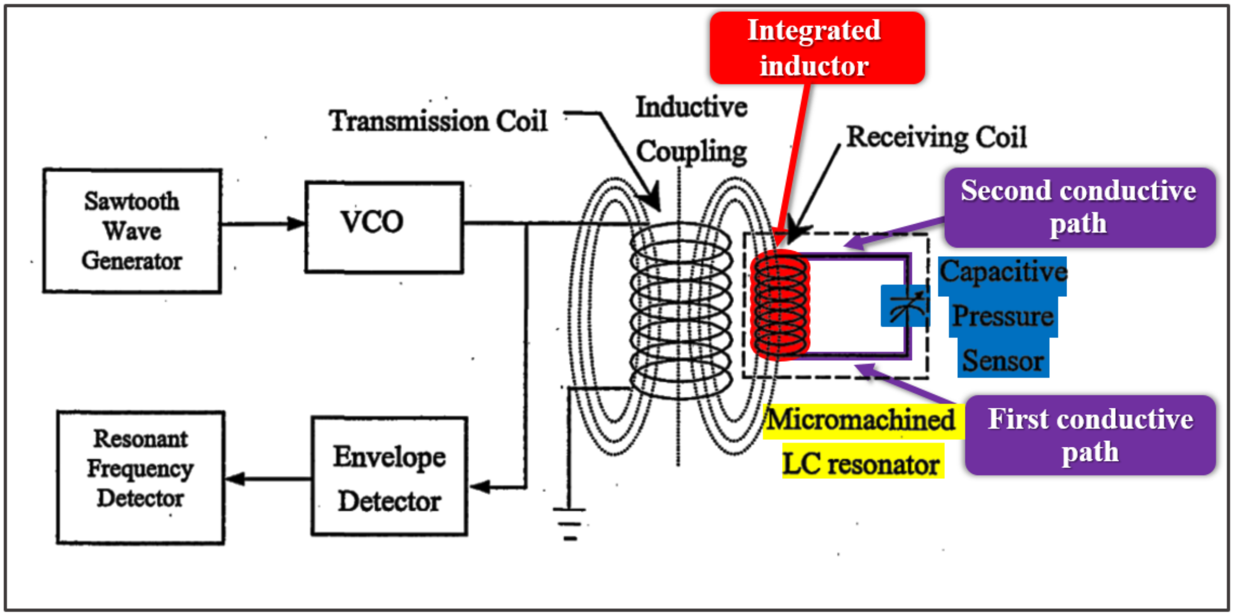
Park discloses this limitation, describing an integrated inductor and capacitive sensor that are electrically connected in parallel (thus using a plurality of conductive paths) to form an LC resonant circuit. Allen Decl. ¶ 254. As illustrated in Figure 8(b) below, which shows the LC resonator structure from the glass substrate side, a first conductive path electrically connects the bottom electrode of the sensor with the inner turn of the integrated inductor.



Park, Fig. 8(b) (annotated); Allen Decl. ¶ 255.

Park also discloses a second conductive path (partially shown in annotated Figure 8(b) above) that electrically connects the outer turn of the integrated inductor with the silicon diaphragm of the capacitive pressure sensor. Allen Decl. ¶ 256. The remainder of the conductive path is formed when the doped silicon layer comprising the diaphragm electrode of the capacitive sensor is bonded to the glass at the "bonding regions" annotated by Park. *Id.* Because doped silicon is a conductive material, the bonding process causes the integrated inductor to be "connected to the capacitor electrode" through the silicon layer. Park, 7124; Allen Decl. ¶ 256.

Park's two conductive paths connecting the inductor in parallel with the sensor are also shown in Park's schematic below:



Park, Fig. 10 (annotated); Allen Decl. ¶ 254.

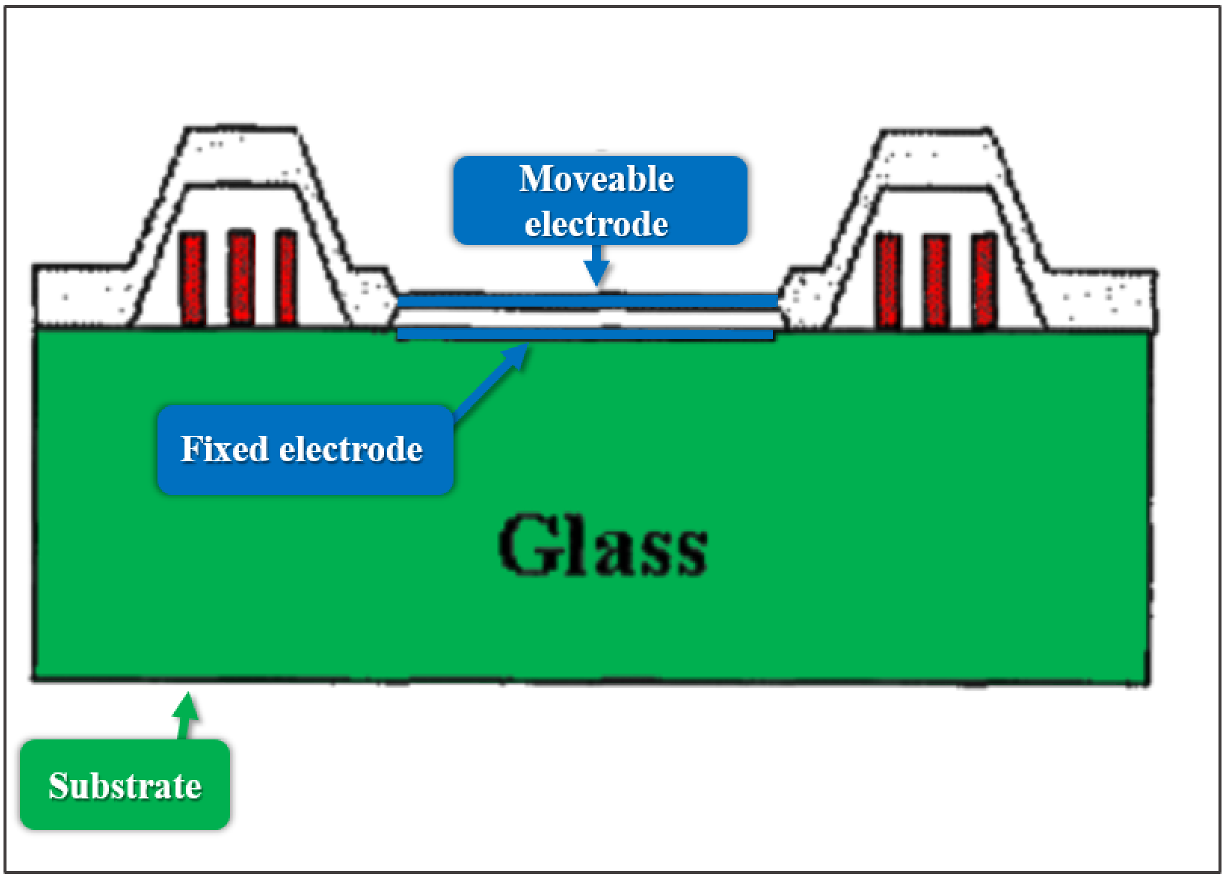
g. [1f]—"said integrated inductor, said sensor and said conductive paths cooperatively defining an LC tank resonator."

Park discloses this limitation, describing its integrated inductor (limitation [1c] above), capacitive sensor (limitation [1d] above), and plurality of conductive paths (limitation [1e] above) together define an "integrated inductor-capacitor (LC) resonator structure." Park, 7124, 7128, Figs. 1, 4, 8, 10; *see* limitations [1c], [1d], [1e] above; Allen Decl. ¶ 257.

C. Claims 2 and 3

Claim 2 depends from claim 1, further reciting "wherein said sensor is a capacitive sensor having a fixed electrode and a moveable electrode." Claim 3 depends from claim 2, and further recites "wherein said fixed electrode is formed on said substrate." These claims are anticipated for the same reasons as claim 1 and as further explained below.

As shown in Figure 4(f) below, Park discloses that its "capacitive pressure sensor is composed of" a "metal electrode on the glass substrate" (*i.e.*, the claimed "fixed electrode" that is "formed on said substrate") and "a p^+ silicon membrane" (i.e., the claimed "moveable electrode"). Park, 7124.



Park, Fig. 4(f) (annotated); Allen Decl. ¶ 259.

The silicon membrane (also referred to by Park as a silicon diaphragm) is a "moveable electrode" because it moves closer to (or further from) the fixed electrode in response to external pressure increasing (or decreasing), corresponding to higher (or lower) capacitance. Park, 7124-25, Fig. 2 (graphical depiction of "simulated capacitance vs pressure response of capacitive pressure sensor"); Allen Decl. ¶ 260.

D. Claim 4

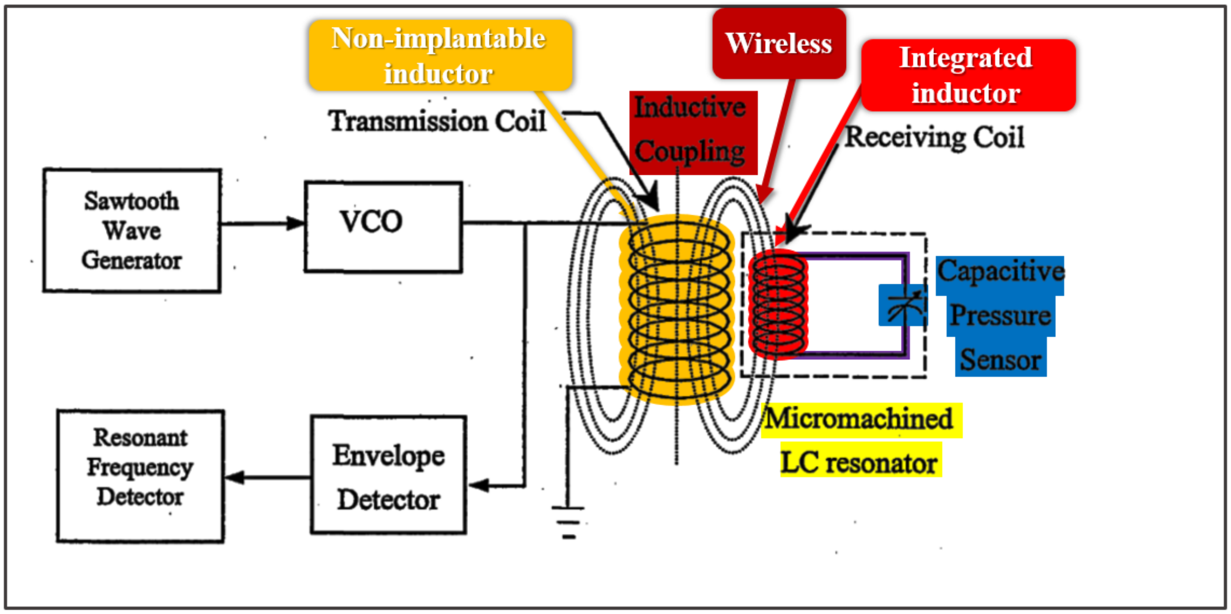
Claim 4 depends from claim 2, and further recites "wherein said sensor is a pressure sensor." This claim is anticipated for the same reasons as claim 2. As already discussed at length, Park's sensor device includes a "capacitive pressure sensor." Park, 7124-25; limitation [1d] above; Allen Decl. ¶¶ 261.

E. Claim 21

Claim 21 depends from claim 1, and further recites "wherein said sensor device is wireless." This claim is anticipated for the same reasons as claim 1 and as further explained below.

Park's pressure sensor device is wireless. Park, 7124 (discussing measuring pressure "wirelessly," and that keywords for searching for the article include "wireless pressure sensor"); Allen Decl. ¶ 264. For example, Park explains that, in biomedical applications, "intraocular, cardiovascular and brain pressures are required to be measured wirelessly." Park, 7124. It explains that since the 1960s, "there have been a few attempts to detect pressure wirelessly," but that those prior approaches led to device sizes that were "relatively large." *Id*. Accordingly, Park set out to fabricate "a micromachined LC resonator used to monitor IOPs remotely," that achieves "the integration of a capacitive pressure sensor and an inductor on the same chip." *Id.*

That is, Park's readout device reads the pressure sensed by the implanted micromachined LC resonator by detecting (wirelessly) the impedance change of the transmission coil through inductive coupling as annotated in Figure 10 below:

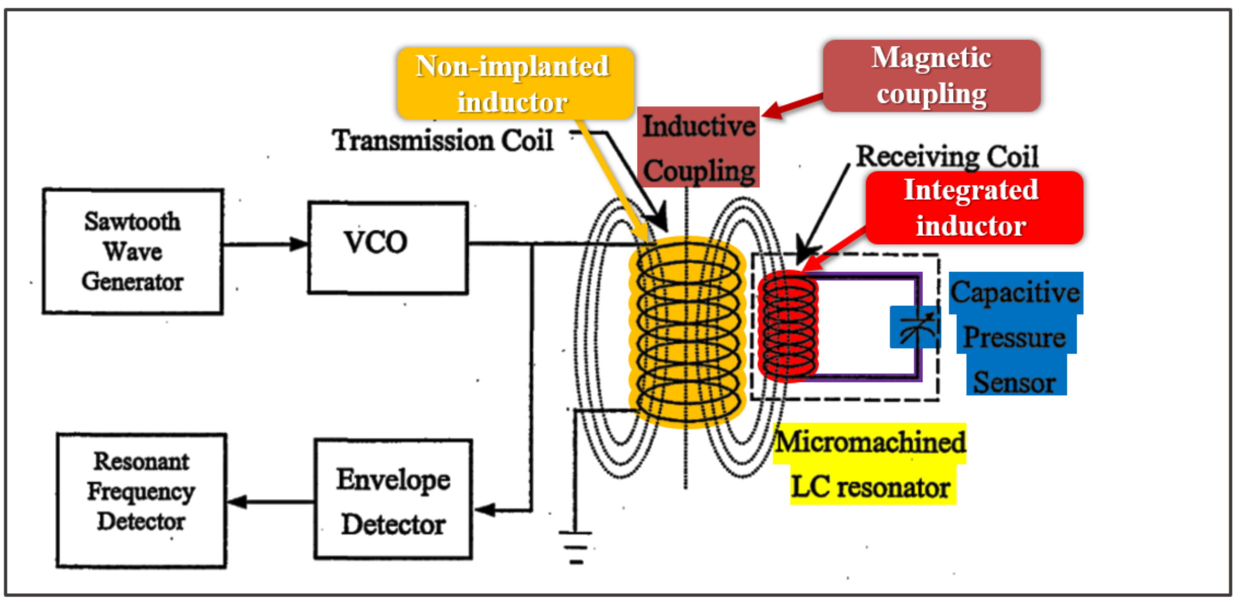


Park, Fig. 10 (annotated), 7127-28; Allen Decl. ¶ 263.

F. Claim 31

Claim 31 recites: "The sensor device of claim 1 as part of a sensing system further comprising a non-implantable readout device, said readout device including a second inductor adapted to magnetically couple with said integrated inductor to read changes in said LC tank resonator as a result of said sensor sensing the physiologic parameter of interest." Park anticipates this claim for the same reasons as claim 1 and as further explained below.

Park discloses its sensor as part of a "measurement system used to remotely monitor pressure changes." Park, 7127. As shown in annotated Figure 10 below, this measurement system comprises the sensor (i.e., Park's implanted micromachined LC resonator) and a non-implantable readout device that includes a voltage controlled oscillator (VCO) and a "transmission coil." *Id.* The transmission coil is a "second inductor" that provides "inductive" (magnetic) coupling with the integrated inductor. *Id.*



Park, Fig. 10 (annotated); *c.f.* '670 patent, Fig. 1; Allen Decl. ¶ 266.

Park teaches that because the transmission coil is "inductively coupled" with the integrated inductor, "pressure changes" detected by the capacitive sensor of the implanted LC resonant device can be "measured remotely" as an "abrupt impedance change of the transmission coil." Park, 7127, Fig. 11 (graphical representation of a "[t]ypical response of monitoring system"); Allen Decl. ¶¶ 267-270. Thus, Park states that the micromachined LC resonator can be "used to monitor IOPs [intraocular pressures] remotely," *i.e.*, a physiological parameter of interest. Park, 7124.

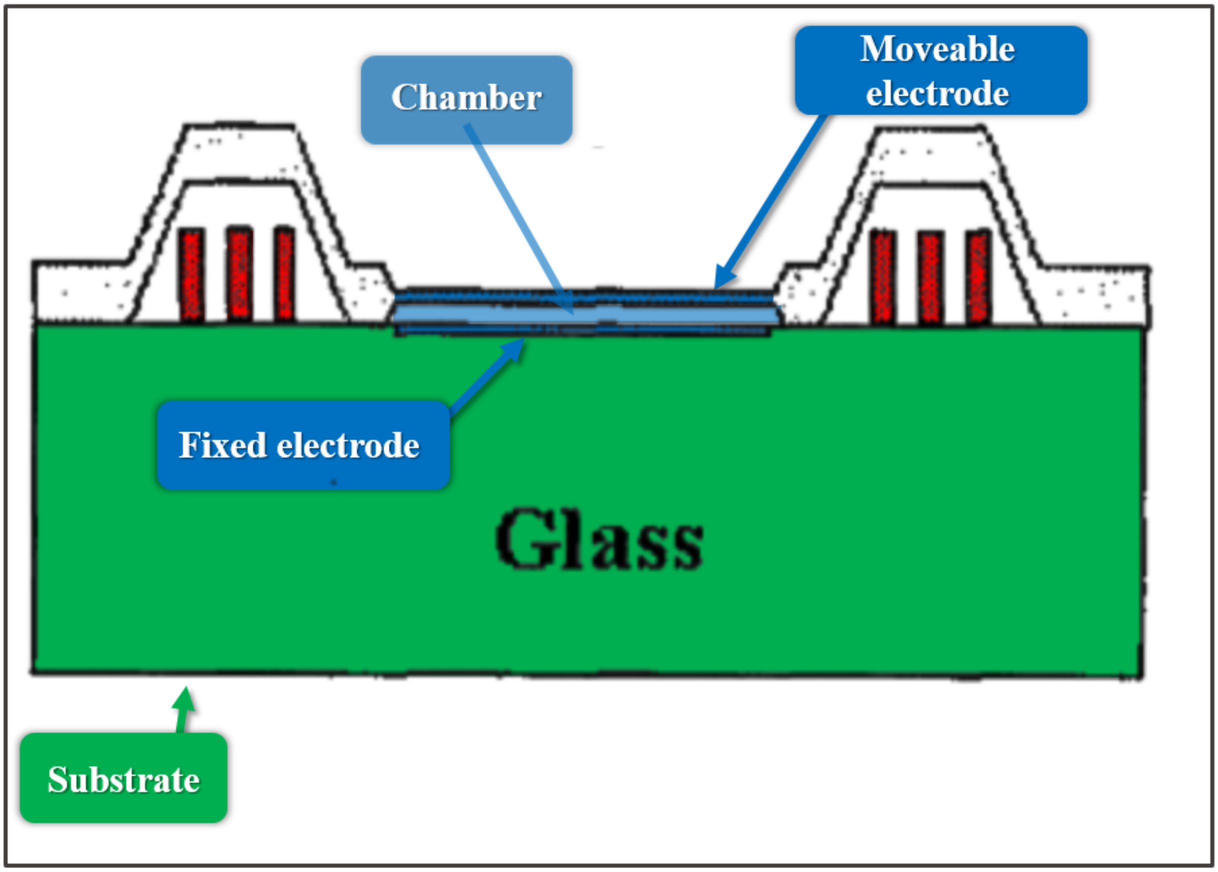
XI. GROUND 4: CLAIMS 26-27 ARE UNPATENTABLE OVER PARK IN VIEW OF RENAUD

A. Claims 26 and 27

Claim 26 depends from claim 1, further reciting "wherein said sensor is a capacitive sensor including a fixed electrode and a moveable electrode, said fixed and moveable electrodes defining a chamber therebetween, said chamber being in fluid communication with a displacement cavity." Claim 27 depends from claim 26, and further recites "wherein said displacement cavity is defined within said substrate."

Claims 26 and 27 would have been obvious for the same reasons already discussed for claim 1 over Park alone and as further explained in the following paragraphs. As already established, Park teaches each of the limitations of claim 1 arranged as in the claim.

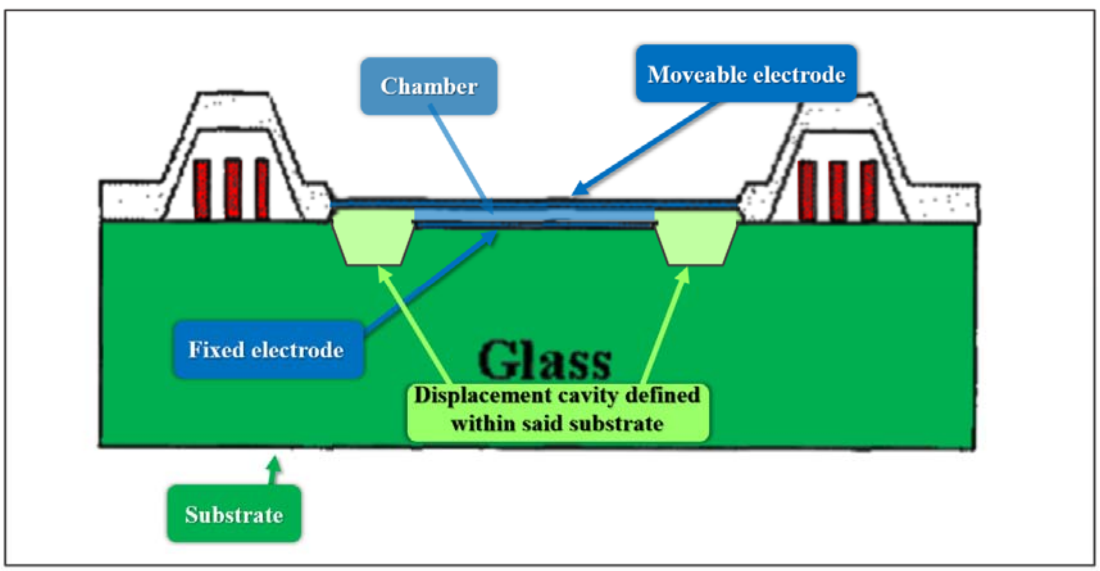
Moreover, as discussed with respect to claim 2 above, Park discloses that its "capacitive pressure sensor is composed of" a "metal electrode on the glass substrate" (i.e., the claimed "fixed electrode" that is "formed on said substrate") and "a p^+ silicon membrane" (i.e., the claimed "moveable electrode"). Park, 7124. The space between these electrodes defines a chamber. Allen Decl. ¶ 273. This is shown below:



Park, Fig. 4(f) (annotated); Allen Decl. ¶ 273.

Park does not, however, expressly disclose a "displacement cavity" in the substrate as required by claims 26 and 27.

Modifying Park to include a displacement cavity would have been obvious in view of Renaud.[5] Like Park, Renaud discloses a capacitive pressure sensor includes "a ***mobile electrode 4***" formed on a semiconductor "membrane 2" and a "***fixed electrode 8***" formed on a semiconductor "substrate 6." Renaud, 3:56-61, 4:5-6. The details of Renaud's capacitive pressure sensor, including a "chamber" defined between the fixed and moveable electrodes, and a reference volume or displacement cavity in fluid communication therewith, are discussed above in the Petersen-Renaud ground above. That discussion is incorporated herein by reference. *See* Section IX.A, IX.B above; Allen Decl. ¶ 275-278. The resulting modified device of Park would be of the form below:



Allen Decl. ¶ 279 (modifying Park, Fig. 4(f), in view of Renaud).

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[5] Renaud is introduced in the Petersen-Renaud ground above.

B. Motivations to Combine Park with Renaud

A POSITA would have been motivated to combine Park and Renaud. Park discloses using "bulk micromachining and anodic bonding technologies" to form a "capacitive pressure sensor" comprising a metal electrode on a glass substrate (a "fixed electrode") and a "p^+ silicon membrane" (a "moveable electrode") separated by an "air gap of the pressure sensor." Park, 7124, 7126; Allen Decl. ¶ 281.

As explained in section IX.C and incorporated by reference here, the use of a "displacement cavity" to prevent the well-known problem of residual gas within the air gap of a capacitive pressure sensor (the gap between the two electrodes) was well known, and Renaud teaches a displacement cavity for such use. Thus, it would have been obvious to use the displacement cavity taught in Renaud (or any similar teaching or common knowledge in the art, for that matter) to improve pressure sensitivity of the micromachined pressure sensor disclosed in Park. Allen Decl. ¶¶ 281-283, 285.

Park discloses, for example, that its sensor devices can be implanted and used for "intraocular, cardiovascular, and brain pressure monitoring," which require detection of small changes in pressure, motivating a POSITA to design a capacitive sensor for those applications to be more pressure sensitive. Park, 7124; Allen Decl. ¶ 284. Indeed, the purpose of implanting a sensor for monitoring cardiovascular pressure (as compared to known non-invasive cardiovascular sensors) is to get as accurate a reading as possible. *Id.*

In addition, Park teaches a "hermetically sealed" capacitive sensor (Park, 7128), and Renaud also teaches a sealed capacitive sensor, but explains that residual gasses caused by that sealing process can still cause inaccuracies that a POSITA would have wanted to avoid. Renaud, 1:55-60. A POSITA would have been motivated to reduce those inaccuracies by etching a cavity within the substrate as taught by Renaud. Allen Decl. ¶ 286; Renaud, 1:62-66. Moreover, Renaud provides that etching the cavity as a groove within the substrate provides a further benefit of "reducing the size of the active part of the measuring capacitator without reducing the sensitivity of the sensor so that the relative sensitivity of the sensor according to the invention is increased." Renaud, 2:56-60. Renaud further explains that it seeks to provide an "enlarged reference volume in its active zone and which provides great sensitivity at the same time creating a sensor with a very simple structure" but still allows "a simplified and economical method of manufacturing." *Id.*, 2:25-35. A POSITA would have been motivated to include all of these benefits in Park. Allen Decl. ¶ 286.

Furthermore, Renaud explains that "minimisation of the internal stresses and the drift in temperature" of capacitive pressure sensors by inserting a displacement cavity can be done with "[t]he use of conventional semiconductor material micromachining technique" by the "implementation of a series of very simple steps." Renaud, 3:24-29. Specifically, Renaud teaches forming the reference volume using "conventional" elimination techniques such as etching the substrate. *Id.,* 5:51-6:48. A POSITA would have used these conventional techniques to implement in Park, which already discloses the use of etching to form the "air gap of the pressure sensor" and for "inductor sealing" of its sensor device. Park, 7126. As a result, a POSITA would have been motivated to combine Park and Renaud because the resulting combination would have involved only the use of a known technique to improve a similar method and would have reasonably expected to succeed. Allen Decl. ¶ 287. Moreover, Renaud teaches that its improved capacitive pressure sensors comprising a displacement cavity can have general dimensions of "1.9x2.2x0.5 mm," which a POSITA would have understood to be compatible with the devices designed by Park having dimensions of approximately "3 mm x 3 mm x 0.6 mm." Renaud, 8:21-27; Park, 7128; Allen Decl. ¶ 288.

XII. NO SECONDARY CONSIDERATIONS OF NONOBVIOUSNESS EXIST

There are no secondary considerations known to Petitioner or alleged by Patent Owner. Should Patent Owner proffer any evidence of secondary considerations in its Preliminary Response, that evidence should not be considered for institution purposes, or Petitioner should be given leave to file a reply with rebuttal evidence. *See Garmin Int'l, Inc. v. Wis. Archery Prods., LLC*, IPR2018-

01137, Paper 11 at 29 (P.T.A.B. Dec. 11, 2018). If Patent Owner cites the commercial success of Petitioner's products accused of infringement, Petitioner disputes that (1) its products practice the claims of the '670 patent and (2) any nexus exists between the commercial success of Petitioner's products and the claimed inventions of the '670 patent, and should be permitted a reply to rebut such allegations.

XIII. THE BOARD SHOULD REACH THE MERITS OF THIS PETITION

As mentioned in the Related Proceedings section above, this petition is being filed concurrently with another. Together, the two petitions present grounds over four unique and different primary references. The Board should therefore institute each petition on the merits rather than exercise its discretion under § 314(a) to deny either one.

As an initial matter, the art presented concurrently in each petition was not "previously" presented in IPRs. *Intel Corp. v. Hera Wireless S.A.*, IPR2018-01700, Paper 9 at 25 (P.T.A.B. Apr. 19, 2019) ("The petitions were filed on the same day, eliminating any concern that either petition relies on 'the same or substantially the same prior art or arguments previously … presented to the Office.'" (citing 35 U.S.C. § 325(d)) ("*Intel*"). The only art presented across both petitions that was even before the Office was Park. But Park was not discussed by the examiner at all and was not the basis of any rejection during prosecution. *Apple Inc. v. Qualcomm Inc.*, IPR2018-01316, Paper 7 at 25 (P.T.A.B. Jan. 18, 2019) ("The fact that neither [Applicant Admitted Prior Art] nor Majcherczak was the basis of rejection weighs strongly against exercising our discretion to deny under 35 U.S.C. § 325(d).").

The Board has discretion to deny institution under § 314(a), but the follow-on petition situation of *General Plastics* does not apply here. *See General Plastic Industrial Co., Ltd. v. Canon Kabushiki Kaisha*, IPR2016-01357, Paper 19 (P.T.A.B. Sept. 6, 2017). Nonetheless, Petitioner recognizes that "multiple, concurrent proceedings per patent presents a significant burden for the Board," especially when there are "other related patents also each challenged by multiple petitions at the same time." *E.g.*, *Comcast Cable Commc'ns LLC v. Rovi Guides, Inc.*, IPR2019-00224, Paper 10 at 3 (P.T.A.B. Apr. 3, 2019).

For example, in *Comcast*, the Petitioner filed *six IPR petitions challenging the same patent claims*, as well as *nearly two dozen other petitions* challenging five other asserted patents. *Id.*, 3.[6] The Board refused to deny the petitions outright, but ordered the petitioner to rank its "six Petitions in the order in which it wishes the panel to consider the merits." *Id.*, 4.

In contrast, Petitioner is filing just two petitions here against the one asserted patent. This case is more akin to *Intel*, where the Board was faced with just two

[6] Comcast filed 28 separate IPRs against six asserted patents.

petitions. The Board did "not regard the two proceedings as 'vexatious multiplication of proceedings,'" and instituted on the merits. *Intel* at 25-26.

Here too, there is no vexatious multiplication of proceedings. Rather, Petitioner is filing IPRs shortly after being accused of infringement, before the patent owner's infringement positions have solidified. IPRs are meant to be an alternative to district-court litigation, but to be an alternative (*i.e.*, to obtain a stay), the IPR needs to be filed as soon as practicable. Here, the Complaint was served in February of this year, and other than a venue dispute, the parties have done nothing in the litigation. Given the early stage of the district court litigation, and the fact that there are only two petitions here, it would not be wasteful of the Board's or the parties' resources to institute both IPRs—especially since any denied ground will not be subject to the IPR estoppel. *See Shaw Indus. Grp. v. Automated Creel Sys., Inc.*, 817 F.3d 1293, 1300 (Fed. Cir. 2016).

The grounds presented in the two petitions are very different, even more so than in *Intel*. The Park grounds (in this petition) are unique because Park is prior art under 35 U.S.C. § 102(b) and cannot be antedated by Patent Owner. In contrast, Petersen (also in this petition) is § 102(e) art that Patent Owner may attempt to antedate, and Petersen includes a displacement cavity (but not one that is within its substrate like Renaud's) that is not disclosed in Park.

Likewise, one of the primary references in the other petition (Allen-379, Ex. 1009) is not a § 102(b) reference, and Patent Owner may attempt to antedate it.

In another example, Akar (Ex. 1010) (in the other petition) is the only primary reference to expressly disclose a displacement cavity defined within its substrate. All the other grounds rely on a secondary reference for that disclosure. And in another example, the Allen-379 grounds challenge claims 5, 22-25, and 28-29, which are not challenged in any other ground, because Allen-379 expressly discloses the relevant features (*e.g.*, monolithic structure, surface machined temperature sensor, etc.).

For the above reasons, and respecting the finite resources of the Board, Petitioner respectfully asks the Board to reach the merits and institute both of its petitions.

XIV. CONCLUSION

For the above reasons, the Board should institute *inter partes* review of all challenged claims of the ’670 patent on the grounds presented in this petition.

Respectfully submitted,

Dated: July 15, 2019

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CERTIFICATE OF COMPLIANCE WITH 37 C.F.R. § 42.24

I hereby certify that this petition complies with the word count limitation of 37 C.F.R. § 42.24(a)(1)(i) because the petition contains a total of 13,713 words, which is the sum of 13,382 words calculated by Microsoft Word's word-count feature and 331 words hand-counted in the figures. This total excludes the cover page, signature block, and the parts of the petition exempted by 37 C.F.R. § 42.24(a)(1).

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CERTIFICATE OF SERVICE

The undersigned certifies that a complete copy of this petition for *Inter Partes* Review of U.S. Patent No. 6,926,670 and all Exhibits and other documents filed together with this petition were served on the official correspondence address for the patent shown in PAIR and a courtesy copy to Integrated Sensing Systems, Inc.'s current litigation counsel:

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