

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

LIMITLESS SPACE INSTITUTE, INC.

IPR2026-00469

U.S. Patent No. 12,302,769

DECLARATION OF DR. ALEJANDRO W. RODRIGUEZ

**UNDER 37 C.F.R. § 1.68 IN SUPPORT OF
PETITION FOR *INTER PARTES* REVIEW**

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EXHIBIT LIST

No.	Exhibit Description
1001	U.S. Patent No. 12,302,769 (“the 769 Patent”)
1002	File History of U.S. Patent No. 12,302,769
1003	Declaration of Dr. Alejandro W. Rodriguez
1004	C.V. of Dr. Alejandro W. Rodriguez
1005	Harold White, et. al, “ <i>Worldline numerics applied to custom Casimir geometry generates unanticipated intersection with Alcubierre warp metric</i> ,” Eur. Phys. J. C (2021) 81:677, (“ <u>White</u> ”)
1006	U.S. Pub. No. 2022/0216812, titled “Enhanced quantum vacuum energy devices” (“ <u>Model-812</u> ”)
1007	Viktor Dodonov. “Fifty years of the dynamical Casimir effect.” <i>Physics</i> 2.1 (2020): 67-104, (“ <u>Dodonov</u> ”)
1008	Harold White, et. al., “Dynamic vacuum model and Casimir cavity experiments.” <i>Journal of the British Interplanetary Society, General Interstellar Issue</i> 73.7 (2020): 268-272, (“ <u>White-BIS</u> ”)
1009	H. B. G. Casimir, <i>Proc. K. Ned. Akad. Wet.</i> 51, 793 (1948), p. 795 (“ <u>Casimir-1948-paper</u> ”).
1010	U.S. Pub. No. 20170372917, titled “Pattern transfer technique and method of manufacturing the same” (“ <u>Yoo</u> ”)
1011	U.S. Pat. No. 9,076,736, titled “Patterning method for semiconductor device fabrication” (“ <u>Huang</u> ”)
1012	T. Islam, “ <i>Advanced interfacing techniques for the capacitive sensors</i> ,” <i>Advanced Interfacing Techniques for Sensors: Measurement Circuits and Systems for Intelligent Sensors</i> . Cham: Springer International Publishing, 2017. 73-109 (“ <u>Islam</u> ”)
1013	Sheikh S. Mahtab, et al. “ <i>Etching Technologies in Semiconductor Manufacturing: A Short Review</i> .” International Conference on

	Emerging Applications of Material Science and Technology. Cham: Springer Nature Switzerland, 2024 (“ <u>Mahtab</u> ”).
1014	U.S. Pub. No. 2020/0358375, titled “Quantum noise power devices” (<u>Model-375</u>)
1015	U.S. Pat. No. 7,379,286, titled “Quantum vacuum energy extraction” (“ <u>Haisch</u> ”)
1016	Microsoft Computer Dictionary, 5 th ed.
1017	S. Wu, et al. “ <i>Three-dimensional printed, dual-band, dual-circularly polarized antenna array using gap waveguide technology.</i> ” Applied Sciences 12.21 (2022): 10704 (“ <u>Wu</u> ”)
1018	S. Zhang, et al., “ <i>Solvent-induced changes in PEDOT: PSS films for organic electrochemical transistors.</i> ” APL materials 3.1 (2015) (Zhang).
1019	H. Jouhara, et al. “ <i>Thermoelectric generator (TEG) technologies and applications.</i> ” International Journal of Thermofluids 9 (2021): 100063 (“ <u>Jouhara</u> ”)
1020	“Tony R. Kuphaldt Lessons In Electric Circuits, Volume V – Reference,” Fourth Edition, last update April 19, 2007

TABLE OF ABBREVIATIONS AND CONVENTIONS

Abbreviation	Meaning
769 Patent	Ex.1001: U.S. Patent No. 12,302,769 ("the 769 Patent")
IPR	<i>inter partes</i> review
Petitioner	EverWave, Inc. ("EverWave")
Patent Owner or PO	Limitless Space Institute, Inc.
<i>xx:yy-zz</i>	column <i>xx</i> , lines <i>yy</i> to <i>zz</i>

1. I, Alejandro W. Rodriguez, declare as follows:

. **INTRODUCTION**

2. I am making this declaration in support of Petitioner's request for an *Inter Partes* Review of U.S. Patent No. 12,302,769 ("the 769 Patent") to White.

3. I am being compensated for my work in this matter at my standard hourly rate. I am also being reimbursed for reasonable and customary expenses associated with my work and testimony in this proceeding. My compensation is not contingent on the outcome of this matter or the specifics of my testimony.

4. I have been asked to provide my opinions regarding whether the subject matter of claims 1-20 ("the Challenged Claims") of the 769 Patent would have been obvious to a person having ordinary skill in the art ("POSITA") at the time of the alleged invention, in light of the prior art. It is my opinion that the Challenged Claims would have been obvious to a POSITA.

5. In the preparation of this declaration, I have studied:

- The 769 Patent (Ex.1001);
- The prosecution history of the 769 Patent (Ex.1002); and
- The additional references and publications I refer to below and/or identified in the exhibit list.

6. In forming the opinions expressed below, I have considered: the documents listed above; the relevant legal standards, including the standard for obviousness; and my own knowledge and experience based upon my work in the

field of quantum physics, electromagnetics, and nanoscale device engineering, including systems involving vacuum fluctuations, Casimir phenomena, and micro- and nano-fabricated structures as described below.

7. My opinions in this Declaration address whether the prior art discloses or renders obvious the claimed structures and measurable electrical potentials recited in the Challenged Claims.

8. Unless otherwise noted, all emphasis in any quoted material has been added.

9. Since I was retained, I have been in frequent contact with counsel while working on this matter to communicate my opinions. My opinions are presented both in this Declaration and in the Petition for Inter Partes Review, which it supports. In many, if not most, cases the language used to express my opinions in both documents is substantially the same. This is because I worked with counsel to capture my opinions, and generally speaking we captured them in the Petition itself as opposed to developing both the Petition and Declaration in tandem. My opinions, as reflected in the Petition we prepared, were then incorporated into my Declaration. I make this statement to explain the work process and underscore that the opinions in this Declaration are my own, were formed by me, and were documented with the assistance of counsel in the manner described. As detailed herein, it is my opinion that each of the challenged claims is rendered obvious by prior art references that

predate the earliest priority date of the 769 Patent. If requested, I am prepared to testify about my opinions expressed herein.

I. QUALIFICATIONS AND PROFESSIONAL EXPERIENCE

10. I am over the age of 18 and am competent to write this declaration. I have personal knowledge, or have developed knowledge, of these technologies based upon education, training, or experience, of the matters set forth herein.

11. My complete qualifications and professional experience are described in my Curriculum Vitae, a copy of which can be found in Ex.1004. The following is a brief summary of my relevant qualifications and professional experience.

12. I received a Bachelor of Science in Physics from the Massachusetts Institute of Technology in 2006 and a Ph.D. in Physics from the Massachusetts Institute of Technology in 2010. My doctoral work focused on computational electromagnetics, nanophotonics, and optical physics. Following completion of my Ph.D, I held postdoctoral research positions at Harvard University and the Massachusetts Institute of Technology.

13. My research focuses on electromagnetic theory, nanophotonics, photonic structures, optical materials, and thermal and quantum electromagnetic phenomena. His work spans computational electromagnetics, photonic devices, metasurfaces, near-field radiative heat transfer, and optical cavity systems.

14. I have authored or co-authored over one hundred peer-reviewed journal publications in leading scientific journals, including *Nature Photonics*, *Physical Review Letters*, *Optica*, *Nature Reviews Physics*, and *Science Advances*.

15. I am also an inventor on multiple U.S. patents relating to photonic metasurfaces, nonlinear optical devices, and electromagnetic structure design.

16. I have received numerous honors and awards, including the Presidential Early Career Award for Scientists and Engineers (PECASE), the National Science Foundation CAREER Award, and recognition as a Kavli Fellow of the National Academy of Sciences.

17. In addition to my academic work, I have served as Co-Founder and Chief Technology Officer of Maxwell Labs Inc. and have participated in scientific advisory panels, conference organization, and editorial service within the photonics and electromagnetics research communities.

II. LEVEL OF ORDINARY SKILL IN THE ART

18. My opinions are provided based on what a person of ordinary skill in the art (“POSITA”) in the technical field of the invention would have understood at the time of the purported invention of the 769 patent. I have been asked to assume the date of the purported invention for the 769 patent is June 8, 2023.

19. I understand there are multiple factors relevant to determining the level of ordinary skill in the pertinent art, including (1) the levels of education and

experience of persons working in the field at the time of the invention; (2) the sophistication of the technology; (3) the types of problems encountered in the field; and (4) the prior art solutions to those problems.

20. Based on the materials and information I have reviewed, and on my experience in the technical areas relevant to the Asserted Patents, a POSITA with respect to the Asserted Patents as of the time of the invention, i.e., the earliest possible priority date of the 769 Patent, June 8, 2023, would have had a graduate degree in Physics, Electrical Engineering, or related areas and two years of relevant experience involving the theory, computational techniques, and applications of advanced electromagnetism, quantum physics, condensed matter physics, nano-fabrication technology, and the physics and use of the Casimir effect in devices, pertinent to the 769 Patent's asserted technology. Such a person would have been familiar with Casimir-related phenomena, electrostatic measurement techniques, and standard semiconductor fabrication processes. Lack of professional experience can be remedied by additional education, and vice versa.

21. For purposes of this Declaration, in general, and unless otherwise noted, my statements and opinions, such as those regarding my own experience and what a POSITA would have understood or known generally (and specifically related to the references I consulted herein), reflect the knowledge that existed in the relevant field as of the priority date of the 769 Patent.

III. RELEVANT LEGAL STANDARDS

22. I am not an attorney. In preparing and expressing my opinions and considering the subject matter of the 769 Patent, I am relying on certain basic legal principles that counsel has explained to me.

23. I understand that prior art to the 769 Patent includes patents and printed publications in the relevant art that predate the priority date of the 769 Patent. For purposes of this Declaration, I am applying June 8, 2023, as the priority date of the 769 Patent, but I take no position on that issue.

24. I understand and have been informed that in order for an inventor to be entitled to a patent, the invention must be “new.” There are a number of ways that an invention can be “anticipated,” that is, not new.

25. A patent claim is anticipated if each limitation of the patent claim is found either expressly or inherently in a single item of prior art. While a prior art reference need not use the same words as a patent claim to anticipate the claim, the prior art reference must describe the requirements of the claim with sufficient clarity such that POSITA would have been able to make and use the claimed invention based on the reference and his or her knowledge in the applicable technical field.

26. The disclosure of a feature of a claimed invention can be either “express,” meaning that the text, figures, or other content of a reference actually teaches the aspects of the patent claim, or the disclosure can be “inherent.” An

express disclosure does not need to use the same words as the patent claim being considered, and does not need to be depicted in exactly the same way, but the disclosure must actually convey the claimed invention to POSITA using some combination of words, figures, data, or other portions of the patent. I have been informed and understand that in order to establish that an element of a claim is “inherent” in the disclosure in a prior art reference, it must be clear to a person skilled in the art that the missing element is an inevitable part of what is explicitly described in the reference, and that it would have been recognized as necessarily present by a person skilled in the art. I understand that inherency cannot be established by probabilities or possibilities, and the mere fact that something may result from a given set of circumstances is not enough to establish inherency.

27. I further understand that to anticipate a claim, the elements of the claim must be found in the prior art reference “arranged as in the claim.” I have been informed that this means that the elements of the prior art reference may not be recombined in a way that is not taught in the prior art to arrive at the invention; instead, the prior art must teach the claimed subject matter in the arrangement required by the claims.

28. I understand that if a reference incorporates other documents by reference, the incorporating reference and the incorporated reference(s) should be treated as a single prior art reference for purposes of analyzing anticipation.

29. I understand that it is acceptable to consider evidence other than the information in a particular prior art document to determine if a feature is necessarily present in or inherently described by that reference.

30. I have been informed and understand that subject matter claimed in a patent is obvious under 35 U.S.C. § 103 if a person of ordinary skill in the art at the time the alleged invention was made would have had reason to combine or modify the disclosures of one or more prior art references to arrive at the claimed subject matter. A claim may be unpatentable even if each claim limitation is not present or disclosed in a single prior-art item.

31. I have been informed and understand that, under the doctrine of obviousness, a claim is unpatentable if the differences between the invention and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which the subject matter pertains. A person of ordinary skill in the art is presumed to have knowledge of the relevant prior art at the time of the claimed invention.

32. I have been informed and understand that obviousness is based on the scope and content of the prior art, the differences between the prior art and the claim, the level of ordinary skill in the art and secondary indicia of obviousness and nonobviousness to the extent such indicia exist. I have been advised that the following evidence, when present, must be considered before forming a conclusion

that a claimed invention is obvious: (1) the invention's commercial success, (2) long felt but unresolved needs, (3) the failure of others, (4) skepticism by experts, (5) praise by others, (6) teaching away by others, (7) recognition of a problem, and (8) copying of the invention by competitors. In this instance, however, I am not aware of any evidence of any of these factors. I will of course consider any evidence on these issues which is presented to me.

33. I have been informed and understand the determination of whether the asserted claims would have been obvious to a person of ordinary skill in the art and, therefore, invalid, is not governed by any rigid test or formula. A determination that a claim is obvious is, instead, based on a common-sense determination that the claimed invention is merely a combination of known limitations to achieve predictable results. Any of the following rationales are acceptable justifications to conclude that a claim would have been obvious: (1) the claimed invention is simply a combination of known prior art methods to yield predictable results; (2) the claimed invention is a simple substitution of one known element for another to obtain predictable results; (3) the claimed invention uses known techniques to improve similar devices (methods, or products) in the same way; (4) the claimed invention applies a known technique to a known device (method, or product) ready for improvement to yield predictable results; (5) the claimed invention was “obvious to try”—choosing from a finite number of identified, predictable solutions, with a

reasonable expectation of success; (6) there is known work in one field of endeavor that may prompt variations of it for use in either the same field or a different one based on design incentives or other market forces if the variations would have been predictable to one of ordinary skill in the art; or, (7) there is some teaching, suggestion, or motivation in the prior art that would have led one of ordinary skill in the art to modify the prior art reference to combine prior art teachings to arrive at the claimed inventions.

34. I have been informed and understand that an analysis of whether a claimed invention is obvious must not rely on a hindsight combination of prior art. The analysis must proceed in the context of the time of the invention or claimed priority date and consider whether the invention as a whole would have been obvious to a person of ordinary skill in the art, taking into consideration any interrelated teachings of the prior art, the effects of demands known to the design community or present in the marketplace, and the background knowledge possessed by a person having ordinary skill in the art, all in order to determine whether there was an apparent reason to combine any known elements in the fashion claimed by the patent at issue.

IV. OVERVIEW OF THE 769 PATENT

35. The 769 Patent was based on Appl. No.: 18/331,486 filed June 8, 2023 and issued recently (less than a year ago) on May 13, 2025. It does not claim priority to any previously-filed patent application.

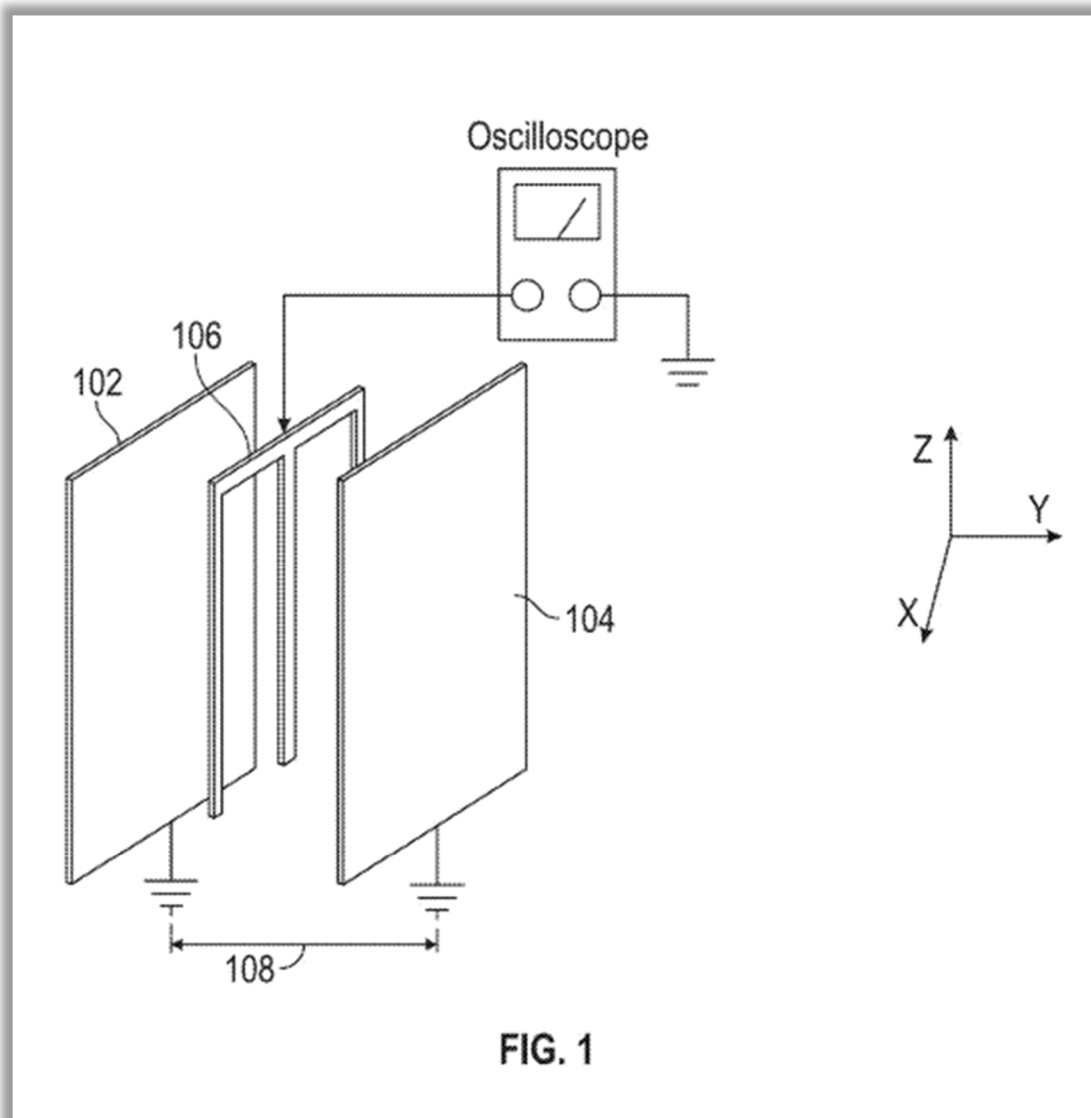
36. Claims 1 and 20 of the 769 Patent describe using structural and functional language a Casimir-effect powered cell.

A. The Disclosures of the 769 Patent

37. The 769 Patent relates to the use of the Casimir phenomenon “formed in [a] quantum vacuum field to generate [electrical] power” and is directed at “[a] battery [that] includes a Casimir-effect powered cell (Casimir cell).” Ex.1001, 11:4-6 and Abstract. The 769 Patent states that electrical power is generated as a result of the interaction between the Casimir cell and the asymmetry formed in the quantum vacuum field in which the asymmetry is created by the interaction between “the Casimir cavity’s physical construction and “the ‘shine’ of the quantum vacuum field.” Ex.1001, 11:4-6 and 15:26-29.

38. The Casimir-effect powered cell, which the 769 Patent describes, is “[a] device that can harvest energy from empty space [/vacuum] into practical electric power” and which “would be of high importance for replacing fossil fuels and for situations where traditional renewable energy (e.g., solar, wind, geothermal, etc.) cannot be used.” Ex.1001, 1:41-45.

39. With reference to Fig. 1, the patent describes the claimed invention as follows:



Ex.1001, Figure 1.

The first conductive wall (102) and the second conductive wall (104) have a same first voltage potential. As shown in FIG. 1, the first conductive wall (102) and the second conductive wall (104) are both grounded, and thus can

be considered as that they have the reference voltage potential of zero. The conductive antenna (106) has a second voltage potential that is different from the first voltage potential. The second voltage potential is produced due to Casimir phenomenon applied to the first conductive wall (102), the second conductive wall (104), and the conductive antenna (106). Accordingly, a voltage that is the difference between the first voltage potential and the second voltage potential and a corresponding electrical current (hereinafter, will be referred to as “current”) will be generated by Casimir phenomenon and can be measured using an oscilloscope. In other words, the Casimir cell generates electric power. As shown in FIG. 1, a terminal of the oscilloscope is connected to the conductive antenna (106) and the other terminal of the oscilloscope is grounded (i.e., connected to the grounded first conductive wall (102) and second conductive wall (104)). ...

The conductive antenna may include one or more antenna elements to generate the second voltage potential resulting from the Casimir phenomenon. For example, the conductive antenna (106) shown in FIG. 1 includes three antenna elements in the form of pillars and disposed parallel with respect to one another. From a cross-sectional view of the Casimir cell perpendicular to the length of the antenna elements (i.e., the view along the Z axis), one or more of the antenna elements may have a round, rectangular, or prismatic shape.

Ex.1001, 3:63-4:28.

40. With respect to fabricating the Casimir cell, the 769 Patent admits that “[t]he Casimir cell was fabricated using deep reactive ion etching equipment ... **commonly used in the semiconductor fabrication industry.**” Ex.1001, 5:59-63.

B. The Prosecution History of 769 Patent

41. I have reviewed the file history of the 769 Patent.

42. On June 8, 2023, Applicant filed Appl. No. 18/331,486 with 20 claims.

43. The 769 Patent issued on May 13, 2025 without a single Office Action rejection on the merits.

44. The Examiner’s reasons for allowance stated that prior art fails to teach or suggest

a conductive antenna disposed in a cavity gap that is a space between the first conductive wall and the second conductive wall, wherein the conductive antenna faces the first conductive wall and the second conductive wall, wherein the first conductive wall and the second conductive wall produce a same first voltage potential, wherein the conductive antenna produces a second voltage potential that is different from the first voltage potential, and wherein a voltage that is the difference between the first voltage potential and the second voltage potential is generated by Casimir phenomenon based on arrangement of the conductive antenna between the first conductive wall and the second conductive wall.

Ex.1002, 112-113.

45. The Examiner mentioned that U.S. Patent Publication No. 2020/0321514 (“Sadr”), U.S. Patent Publication No. 2020/0358375 (“Moddel-375”)¹, U.S. Patent Application 2012/0076162 (“Girlando”), and U.S. Patent Application 2018/0059704 (“Villalobos”) as “closest prior art references of record,” citing to certain passages in the above-mentioned references. Ex.1002, 113.

46. The Examiner’s reasons for allowance proposed minor typographical (spelling) corrections to the Abstract and the Specification. Ex.1002, 109-112. These corrections were also recorded in an Examiner’s Interview Summary dated February 20, 2025. Ex.1002, 84.

V. CLAIM CONSTRUCTION

47. It is my understanding that in order to properly evaluate Challenged Claims, the terms of the claims must first be interpreted. It is my understanding that for the purposes of this *inter partes* review, the claims are to be construed under the so-called *Phillips* standard.

48. It is my opinion that the 769 Patent uses the term “antenna” but does not mean to refer to a conventional radio “antenna” as that term would be understood

¹ Model-375 (or, Ex.1014) is a different publication that the Moddel-812 relied upon in the grounds of the Petition. For example, among other differences, the embodiment disclosed in connection with Figure 9E in Moddel-812 is not in Moddel-375.

colloquially. Consistent with the claim language and the Specification, a POSITA would have understood the meaning of the term:

“a conductive antenna”

as:

“a conductive structure configured to generate an electrical potential when disposed in a cavity gap as a result of the Casimir phenomenon.”

See the language of claim 1 and Ex.1001, 3:48-53 and 4:1-4 (“The conductive antenna ... [disposed in a cavity gap] ... has a ... voltage ... produced due to Casimir phenomenon.)”

VI. IDENTIFICATION OF HOW THE CLAIMS ARE UNPATENTABLE

49. The discussion in this Declaration provides a detailed analysis of how the asserted prior art teaches each limitation of the Challenged Claims.

50. As part of my analysis, I have considered, and discuss in detail, the scope and content of the prior art and any differences between the alleged invention and the prior art.

51. It is my opinion that the alleged invention recited in the Challenged Claims would have been obvious in view of the teachings of the asserted prior art and the knowledge of a POSITA, as I discuss in detail below.

VII. TECHNOLOGY BACKGROUND

52. As I explain next, the technology disclosed and claimed in the 769 Patent was well-known to a POSITA by the earliest possible priority date of the 769 Patent.

A. Casimir Effect

53. The Casimir effect, or Casimir phenomenon, was first predicted in 1948 by the Dutch theoretical physicist Hendrik Casimir. Casimir remarked in a 1948 paper that the force between conducting plates “may be interpreted as a zero point pressure of electromagnetic waves.” Casimir-1948-paper, p.4.

54. A review paper titled “Fifty Years of the Dynamical Casimir Effect” (Ex.1007 or “Dodonov”) published in February 2020, discusses the main achievements in the wide area of “Dynamical Casimir Effect,” which Dodonov defines as:

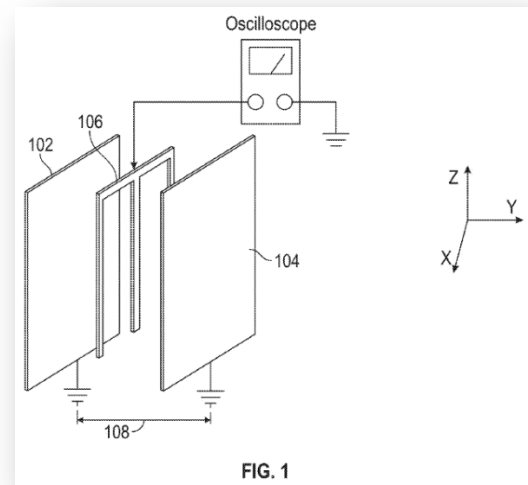
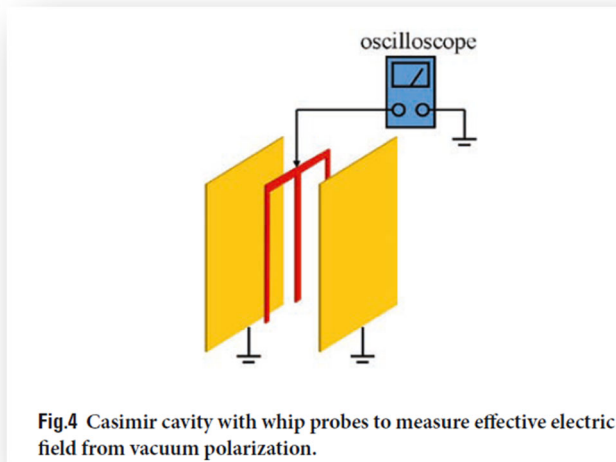
Macroscopic phenomena caused by changes of vacuum quantum states of fields due to fast time variations of positions (or properties) of boundaries confining the fields (or other parameters). Such phenomena include, in particular, the modification of the Casimir force for moving boundaries. However, the most important manifestation is the creation of the field quanta (photons) due to the motion of neutral boundaries. The most important ingredients of the DCE are quantum vacuum fluctuations and macroscopic manifestations.

Ex.1007, p.67. By February 2020, when it published, Dodonov states that “[t]his area became rather large by now: more than 300 papers containing the words “dynamical Casimir” have been published already, including **more than 100 publications** during the past decade.” Ex.1007, p.67.

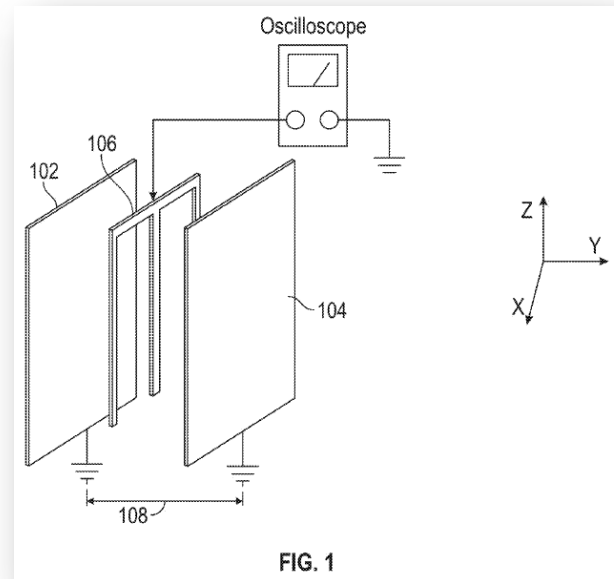
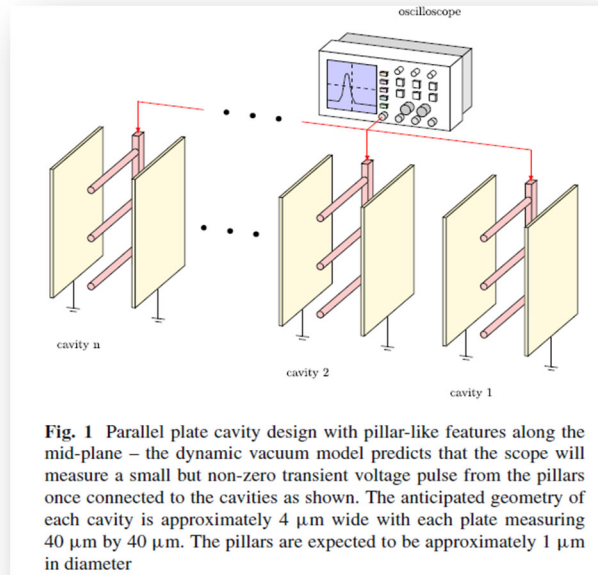
55. Changes of vacuum quantum states, or in other words, fluctuations inside a quantum vacuum produce electromagnetic radiation / energy that “is geometry-dependent, and its density is lower in a Casimir cavity than outside of the Casimir cavity. The use of Casimir cavities therefore opens the possibility of making use of the quantum vacuum fluctuations to drive energy from one location to another.” Ex.1014, [0003].

56. The inventor of the 769 Patent, Harold White, published multiple papers relating to the Casimir effect years before the 769 Patent was filed. For example, one of his papers titled “DYNAMIC VACUUM MODEL and Casimir Cavity Experiments” (Ex.1008 or “White-BIS”) published in July 2020 proposed an experimental implementation to detect the polarization field present in a Casimir cavity. The experimental setup discloses a geometry in which “the cavity ... ha[s] a separation distance of 1 micrometer. The size of the side plates is 1 millimeter long and 0.2 mm tall” and the “electric field present ... is ~-2.86 millivolts.” *See generally* Ex.1008, Section 3.1.

57. It is my opinion that Figure 4 in this paper was copied over with minor changes as Figure 1 of the 769 Patent and largely tracks the language of independent claim 1.



58. Another of Harold White's publications titled "Worldline numerics applied to custom Casimir geometry generates unanticipated intersection with Alcubierre warp metric" (Ex.1005 or "White") that published in 2021 discloses a very similar approach as the afore-mentioned paper. The Wordline Numerics paper states the use of "a standard parallel plate Casimir cavity equipped with pillars arrayed along the cavity mid-plane with the purpose of detecting a transient electric field arising from vacuum polarization conjectured to occur along the midplane of the cavity." Ex.1005, Abstract. Again notably, Figure 1 of the Worldline Numerics paper discloses parallel plate cavity design that is substantively similar to Figure 1 of the 769 Patent which largely tracks the language of independent claim 1.



59. In another example of prior art disclosing devices that make use of Casimir phenomenon, U.S. Pub. No. 2022/0216812 to Garret Model (Ex.1006 or “Model-812”) discloses “devices incorporating Casimir cavities” for harvesting and generating electrical energy “in which the cavity layer comprises a conductor that can be used to carry a flow of electrical power” such that the “charge flow produces a current that provides power to an external element or device.” Ex.1006, Abstract, [0002] and [0088].

60. Additionally, by the time of the claimed invention, it was well-known that there were no restrictions on the size or electrical power output of devices incorporating Casimir cavities. For example, Haisch (issued in 2008) teaches systems and devices “for converting energy from the electromagnetic quantum vacuum available at any point in the universe to usable energy in the form of heat,

electricity, mechanical energy or other forms of power.” Ex.1015, Abstract. The disclosed devices in Haisch “are scalable in size and energy output for applications ranging from replacements for small batteries to power plant sized generators of electricity.” Ex.1015, Abstract.

61. Thus, not only was the Casimir effect well-known but additionally the use of the Casimir effect in generating electrical power was also known by the time of filing of the 769 Patent.

B. Etching

62. Microfabrication techniques developed for the integrated-circuit (IC) semiconductor industry to fabricate devices in the micrometer range typically were used to construct large arrays of individual photodiodes closely spaced together. In the 1980s, microfabrication expanded beyond electronics to create Micro-Electro-Mechanical Systems (MEMS), such as sensors, actuators, and ink-jet printer heads.

63. The history of etching in microfabrication dates back to the early days of semiconductor manufacturing. Initially, wet chemical etching was used, which involved applying liquid chemicals to etch away parts of the substrate. Ex.1013, p.320.

64. As the need for finer and more precise etching grew, dry etching hence plasma etching techniques were developed around 1980. These techniques allowed for anisotropic (directional) etching, which was a significant improvement over the

isotropic etching of chemical methods. For example, Reactive Ion Etching (RIE), Deep Reactive Ion Etching (DRIE), Cryogenic Etching, and Atomic Layer Etching (ALE) are etching techniques that allow creation of increasingly smaller and more complex features with greater precision and control. Ex.1013, pp.320-321.

65. By the time of the filing of the 769 Patent, a POSITA would have understood that etching involves the transfer of a pre-defined design pattern / configuration / connections onto a substrate. For example, Yoo—published in 2017—discloses that: “[a]n etch is performed into [a] production workpiece ... to transfer the pattern of the template mask to the production workpiece.” Ex.1010, Abstract. As another example, Huang—issued in 2025—defines “an etching process is performed to transfer the pattern defined by the ... masking element to an underlying layer. The transferred pattern provides a ... pattern of features.” Ex.1011, 4:4-9.

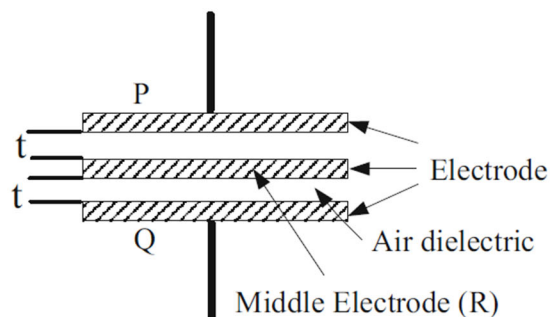
66. In fact, the 769 Patent admits that “[t]he Casimir cell was fabricated using deep reactive ion etching equipment ... **commonly used in the semiconductor fabrication industry.**” Ex.1001, 5:59-63. Thus, etching a substrate to create structures or components on a substrate, as recited in the claims, was well-known in the semiconductor technology industry long before the filing date of the 769 Patent.

C. Three-conductor Geometry and first and second voltage potentials

67. Long before the filing date of the 769 Patent, a three-conductor geometry (e.g., comprising “a first conductive wall,” “a second conductive wall,” and “a conductive antenna”) such that two of the conductors are at “same first voltage potential” and the third conductor is at “a second voltage potential” as claimed in the 769 Patent was well-known.

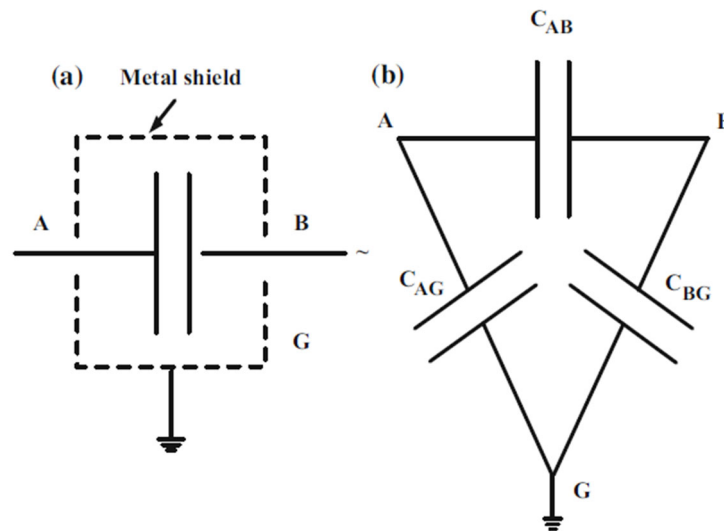
68. For example, Tarikul Islam published a paper in 2017 that discloses a parallel plate capacitor for capacitive sensing comprising “three electrodes with air as the dielectric medium and forms two capacitances C_1 and C_2 with respect to the middle one. Both C_1 and C_2 can be varied either by moving the middle electrode keeping the outer electrodes fixed or by moving the outer electrodes keeping the middle one fixed. At the exact middle position, both the capacitances are equal. But if the middle electrode moves, one of the capacitances will increase, while the other will decrease.” Ex.1012, pp.75-76.

Fig. 2 Three electrodes parallel plate capacitor



Ex.1012, Figure 2.

69. Furthermore, Islam also discloses that the two outer electrodes are at the “*same first voltage potential*” by showing a circuit in which the middle sensing electrode detecting signal positioned between the two outer electrodes.



Ex.1012, Figures 8(a) and 8(b).

70. Referencing Figures 8(a) and 8(b), Islam explains that the metal shield of a three-electrode capacitor has been used for the measurement of the speed of a rotating device like motor [23]. A parallel plate capacitor within a metallic shield can be represented by a three-terminal capacitor as shown in Fig. 8a. C_{AB} is the actual desired capacitance, C_{AG} , and C_{BG} are the parasitic capacitances formed at terminals A and B respectively with respect to the grounded metal shield. [Due to the presence of the shield, the charges accumulated on the shield pass to the ground without affecting the overall capacitance value of the capacitors.]

Ex.1012, p.81. Islam, therefore, shows outer electrodes (e.g., “*a first conductive wall*” and “*a second conductive wall*”) and teaches both outer electrodes are “*at same first voltage potential*” because both electrodes are connected to ground (=0 volt). Additionally, because Islam teaches that the middle electrode (e.g., “*conductive antenna*”) (positioned in between the outer electrodes) functions as a sensing electrode, a POSITA would have understood that the middle electrode is at “*a second voltage potential*,” which therefore, would create a voltage differential (e.g., “*difference between the first voltage potential and the second voltage potential*”) for measurement. *Id.*

VIII. THE PRINCIPAL PRIOR ART

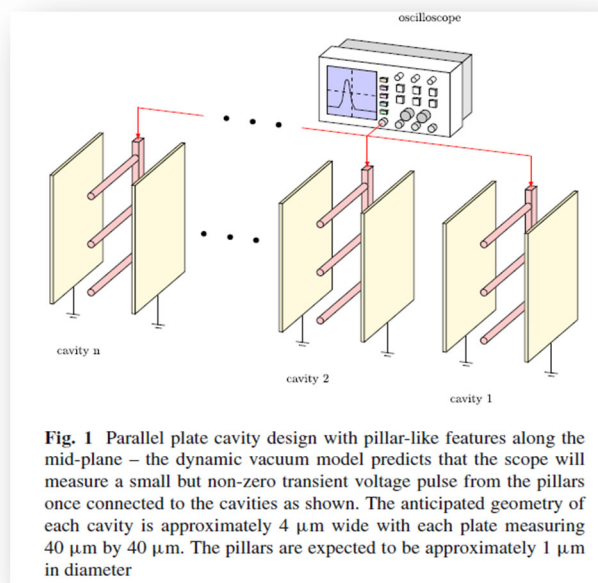
A. White

71. As I explain earlier, White (or, Ex.1005) is a technical article published by Harold White, the inventor listed on the 769 Patent and constitutes inventor’s own prior art. White published July 31, 2021—approximately two years before the filing date of the 769 Patent.

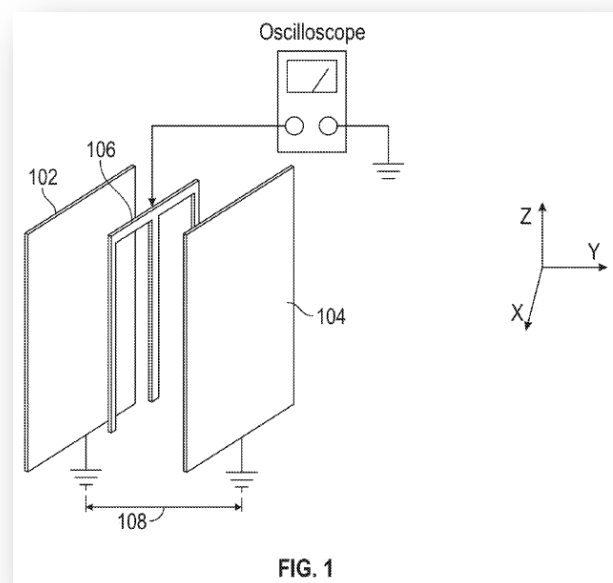
72. White discloses using “a standard parallel plate Casimir cavity equipped with pillars arrayed along the cavity mid-plane ...[for] detecting a transient electric field arising from vacuum polarization ... occur[ing] along the mid-plane of the cavity”—the same purported invention of the 769 Patent. Compare Ex.1001, Abstract with Ex.1005, Abstract.

73. Numerous specification passages and figures from White were copied over verbatim, or nearly so, into the 769 Patent. For example, Figure 1 of White discloses a parallel plate cavity design that is nearly identical to Figure 1 of the 769 Patent and substantively tracks the language of independent claim 1. As depicted below, both figures show a parallel plate cavity design of a Casimir-effect powered device.

74.

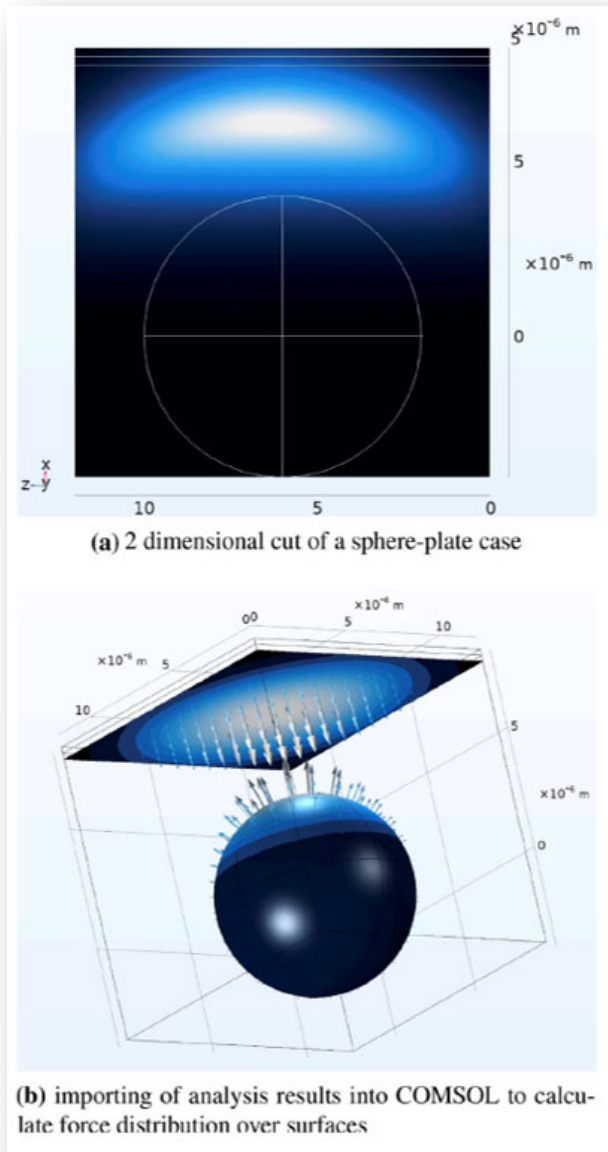


Ex.1005, Figure 1.

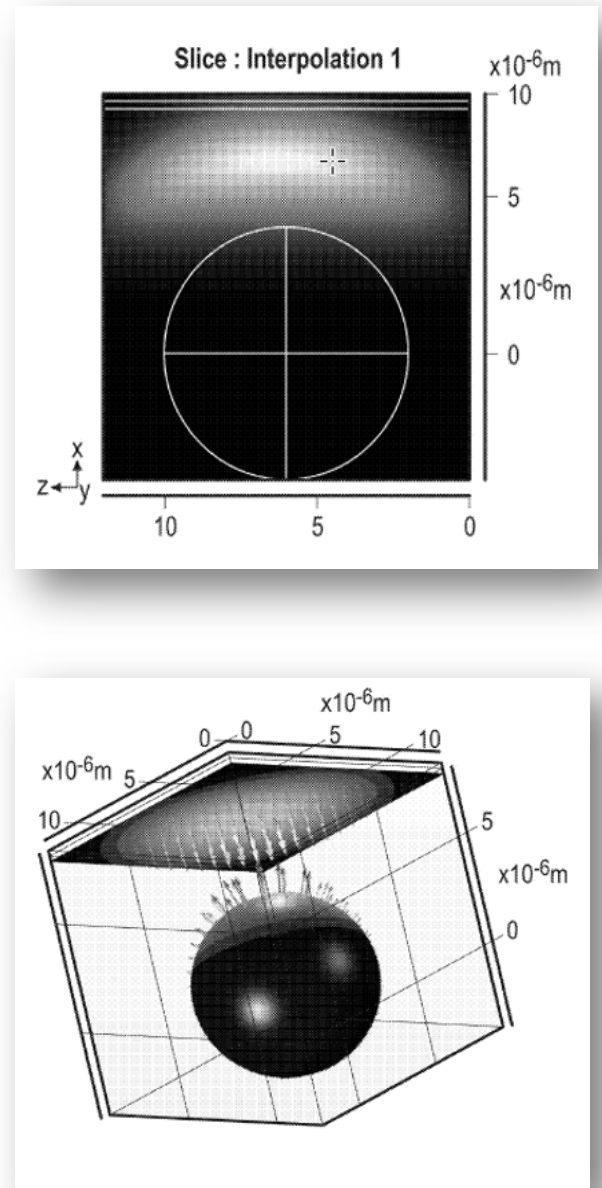


Ex.1001, Figure 1.

75. Additionally, Figures 3(a) and 3(b) from White are identical to the drawings in Figure 11 of the 769 Patent, both of which show the graphical illustration of the numerical worldline technique.



Ex.1008, Figures 3(a) and 3(b).



Ex.1001, Figure 11.

76. Additionally, Figure 4 of White was cropped to become Figure 12 of the 769 Patent, and Figure 5 of White became Figures 13A and 13B of the 769 Patent.

77. Furthermore, the “numerical methods approach used to model and quantify the vacuum response to the cavity structure” in the 769 Patent is the same

“worldline numerics” technique discussed in White to “numerically assess vacuum response to [a] custom Casimir cavity.” Compare Ex.1001, 15:30-45 and Abstract with Ex.1005, Title and Abstract.

78. As another example, the section titled Synopsis of Casimir Worldline Numerics Method, which is common to both White and the 769 Patent include largely identical disclosures. Compare Ex.1001, 15:63-18:44 and Ex.1005, pp.3-5.

79. It is therefore my opinion that the 769 Patent and White have striking similarities in their disclosures.

B. Moddel-812

80. U.S. Pub. No. 2022/0216812 (“Moddel-812”) relates to “devices incorporating Casimir cavities [which] create energy differences within layers or device to drive energy from or to a portion of a layer ... by modifying the quantum vacuum mode distribution ... on one portion of the layer to be different from the quantum vacuum mode distribution ... on another portion of the layer.” Ex.1006, Abstract. Moddel-812 was based on application number 17/570,059, filed January 6, 2022 and published July 7, 2022 (approximately two years before the filing date of the 769 Patent). Moddel-812 was not cited during prosecution and does not appear on the face of the 769 Patent.

IX. THE CHALLENGED CLAIMS ARE UNPATENTABLE

A. Ground 1: White anticipates claims 1, 3-4, 9, 11-13, 18, and 20.

1. Claim 1

- a. [1.0] A battery that comprises a Casimir-effect powered cell (Casimir cell), the Casimir cell comprising:

81. White teaches a device (“a battery”) comprising “a standard parallel plate Casimir cavity equipped with pillars arrayed along the cavity mid-plane” configured to generate “a ... [detectable] voltage signal” (“a Casimir-effect powered cell (Casimir cell)”) and further explains that, when fabricated at smaller sizes and assembled in large numbers of cavities, the device (“a battery”) can provide detectable stored energy. Ex.1005, p.1, p.2, and p.6.

For example, White teaches:

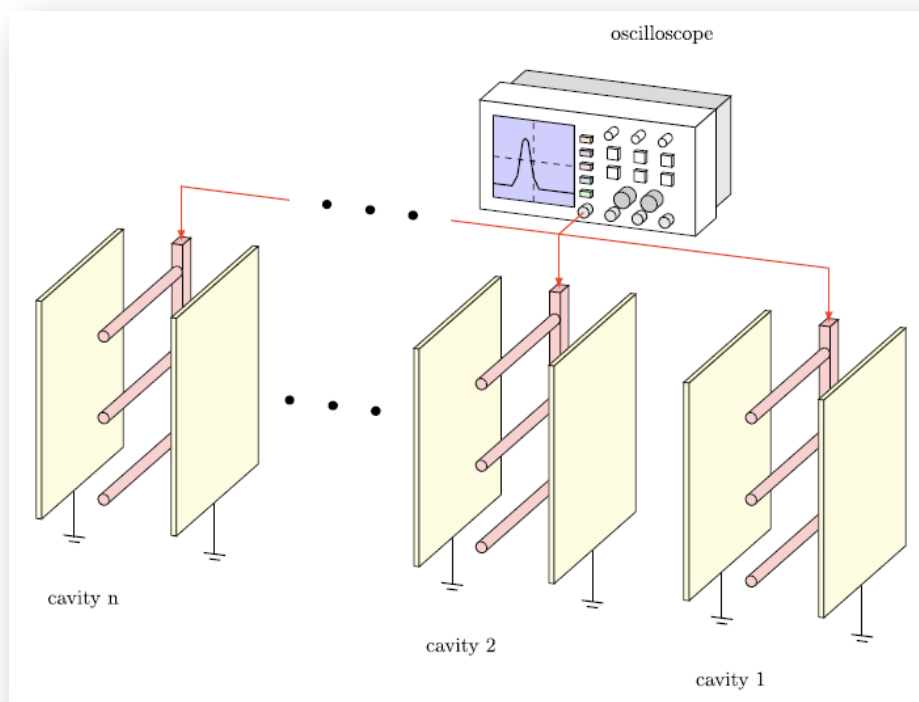
The ... geometry ... consists of a standard parallel plate Casimir cavity equipped with pillars arrayed along the cavity mid-plane ... [for] detecting a transient electric field arising from vacuum polarization conjectured to occur along the midplane of the cavity.

If these cavities can be made small enough and arrayed together in large enough numbers to increase the stored energy, the magnitude and duration of this predicted transient voltage signal may be detectable in a laboratory setting. A ... calculation for a Casimir cavity with a 4 μm gap

predicts a magnitude of the electrostatic potential arising from the polarization of the vacuum fluctuations along the mid-plane of the cavity to be ~ 0.7 mV.

[Therefore, there is] a need for more cavities to **provide enough stored energy such that the duration of the transient voltage signal will last long enough for detection.**

Ex.1005, p.1, p.2, and p.6.



Ex.1005, Figure 1.

82. A POSITA would have understood that the term “battery,” as used in claim 1, does not require any particular measurable level, duration, or continuity of

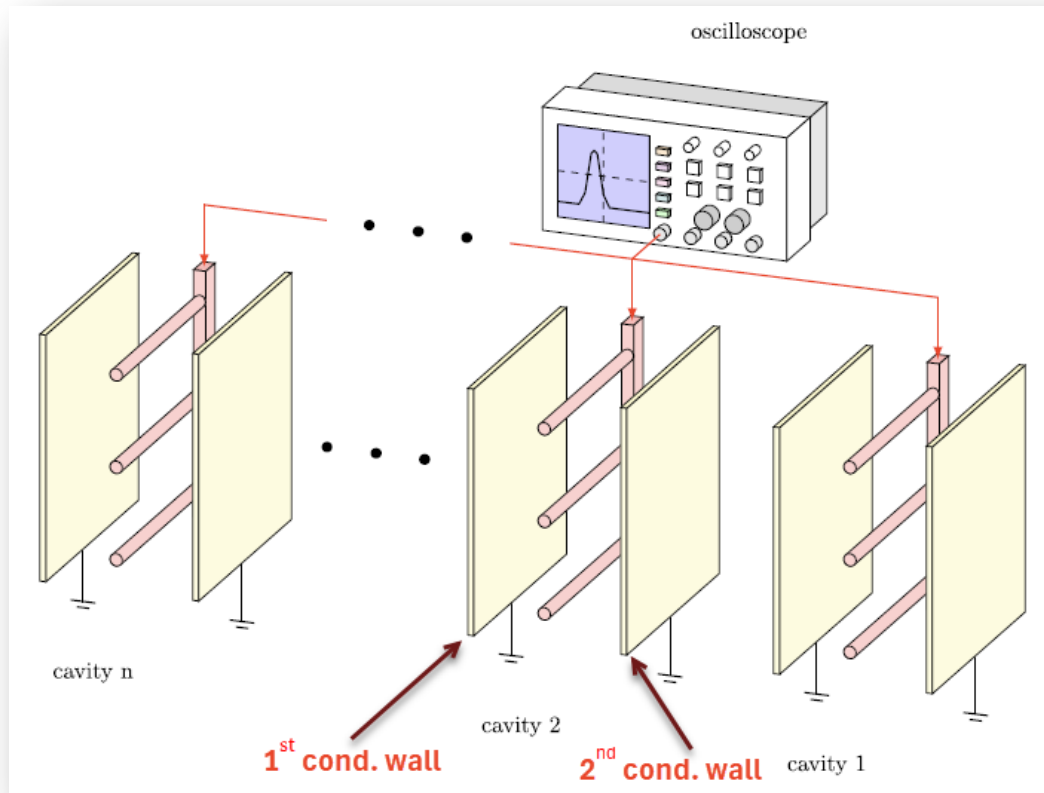
power output, but instead refers broadly to a device capable of producing an electrical potential difference that may be detected or utilized in a circuit. Consistent with this understanding, White’s disclosure of a device capable of generating a voltage signal—whether measurable, transient or otherwise—meets the claimed “battery” limitation.

83. Therefore, White discloses the preamble.

b. [1.1] a first conductive wall ... [and] a second conductive wall that faces the first conductive wall; and

84. White’s device includes “two parallel plates” (“*a first conductive wall [and] a second conductive wall*”) and depicts an illustrative example in which the “two parallel plates” “*face[]*” each other. Ex.1005, p.1 and Figure 1. Specifically, in White, “[t]he ... geometry ... consists of a **standard parallel plate Casimir cavity** equipped with pillars arrayed along the cavity mid-plane” Ex.1005, p.1; see also Figure 1 description (“Parallel plate cavity design with pillar-like features

along the mid-plane”).



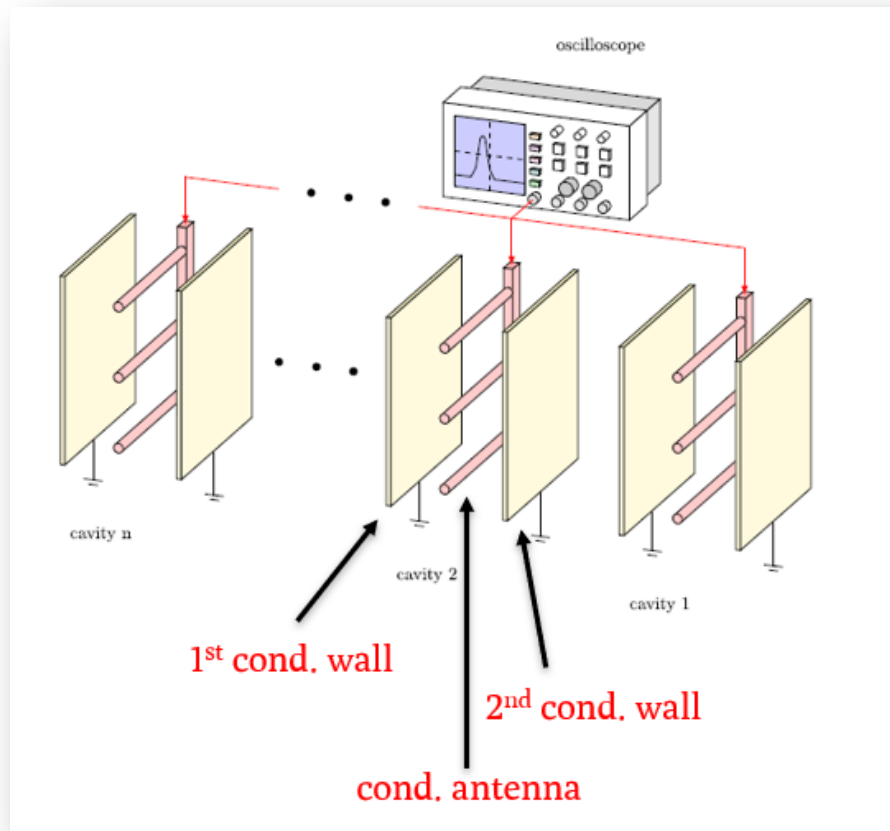
Ex.1005, Figure 1 (annotated).

- c. [1.2] a conductive antenna disposed in a cavity gap that is a space between the first conductive wall and the second conductive wall, wherein the conductive antenna faces the first conductive wall and the second conductive wall,

85. White's device includes "a standard parallel plate Casimir cavity equipped with pillars arrayed along the cavity mid-plane" Ex.1005, p.1; *see also*

Figure 1 description (“Parallel plate cavity design with pillar-like features along the mid-plane”).

86. Therefore, the structure comprising “pillars placed at the midplane of a Casimir cavity” as depicted in the illustrative example of Fig. 1 serves as “*a conductive antenna disposed in a cavity gap that is a space between the first conductive wall and the second conductive wall, wherein the conductive antenna faces the first conductive wall and the second conductive wall.*” Ex.1005, p.1; see also Ex.1005, p.10 (“small pillars placed at the midplane of a Casimir cavity”).



Ex.1005, Figure 1 (annotated).

d. [1.3] wherein the first conductive wall and the second conductive wall produce a same first voltage potential,

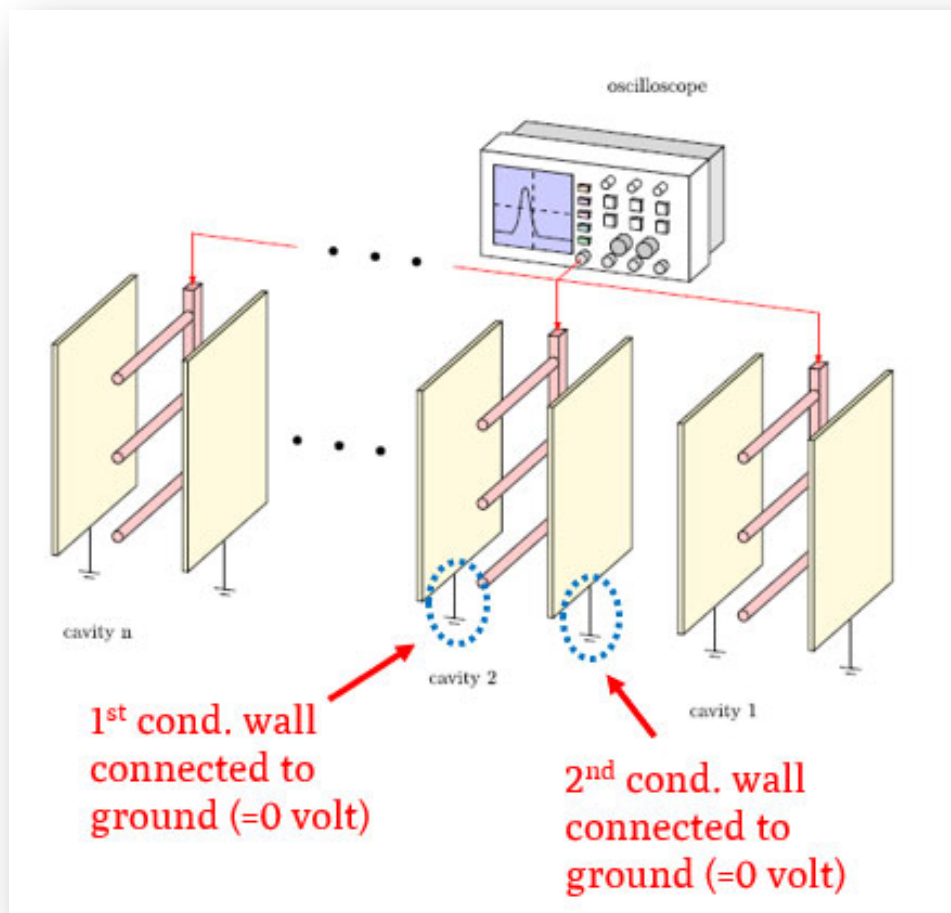
87. White teaches that the “two parallel plates” (“*the first conductive wall and the second conductive wall*”) or equivalently, “cavity walls” are “grounded” (e.g., have “*a same first voltage potential*”).

[T]he energy density structure in a Casimir cavity is coupled to a small polarization field in the vacuum fluctuations resulting in a small but non-zero

electrostatic field originating along the cavity mid-plane and terminating at the **grounded cavity walls**.

Ex.1005, p.1.

88. It is my opinion that by disclosing “grounded cavity walls,” White teaches that that the cavity walls / both parallel plates are connected to ground, or equivalently are at 0 volt (e.g., “*a same first voltage potential*”).



Ex.1005. Figure 1 (annotated).

89. The meaning of the term “voltage potential” is very well understood in the art: For example, Microsoft Computer dictionary defines “*voltage / potential*” as “[t]he force that causes movement in charge carriers ... in a conductor” and “current” as “[t]he flow of electric charge through a conductor”). Ex.1016, 558, 415, 188, and 137.

voltage *n.* See electromotive force.

potential *n.* See electromotive force.

electromotive force *n.* The force that causes movement in charge carriers (the electrons) in a conductor. *Acronym:* EMF. *Also called:* potential, voltage. *See also* ampere, coulomb.

current *n.* The flow of electric charge through a conductor, or the amount of such flow. Current is measured in amperes. *See also* ampere, coulomb. *Compare* volt.

90. When two conductive structures are described as “grounded,” this means they are electrically connected to a common reference electrical reservoir and therefore share the same electrical potential. As explained above, this is a fundamental principle of circuit theory. White’s disclosure of “grounded cavity walls” discloses that the first conductive wall and the second conductive wall are at

the same voltage potential, as required by the claim. Therefore, White discloses limitation [1.3].

e. [1.4] wherein the conductive antenna produces a second voltage potential that is different from the first voltage potential, and

91. White teaches that “a transient ... voltage signal” (“*a second voltage potential*”) detected (“*produce[d]*”) from “the pillar” (“*the conductive antenna*”).

[W]hen the pillar channel is sampled by a high impedance oscilloscope, the scope would detect a transient non-zero voltage signal that would rapidly go to zero as the stored energy in the polarization field is depleted from the measurement process.

Ex.1005, p.1 and Figure 1 description (“the scope will measure a small but non-zero transient voltage pulse from the pillars once connected to the cavities”).

92. Because White expressly teaches in the aforementioned passage that the “transient ... voltage signal” (“*second voltage potential*”) is “non-zero” and, as explained in [1.3], “*the first voltage potential*” of the parallel plates is zero, therefore, the “*second voltage potential*” is “different from” “*the first voltage potential*.”

93. White characterizes the voltage signal as “transient” which does not negate that it constitutes a “voltage potential” within the meaning of the claim. From the perspective of a POSITA, a voltage need not be continuous or measurable given existing precision metrology to qualify as a voltage potential; rather, any electrical potential difference, including one that varies in time or decays after measurement,

satisfies this requirement. The claims do not impose any requirement that the second voltage potential be constant, sustained, or capable of delivering continuous power.

Therefore, White discloses limitation [1.4].

- f. **[1.5] wherein a voltage that is the difference between the first voltage potential and the second voltage potential is generated by Casimir phenomenon based on arrangement of the conductive antenna between the first conductive wall and the second conductive wall.**

94. As explained in [1.3] and [1.4], in White, the “transient ... voltage signal” corresponds to “*the second voltage potential*” and ground(=0volt) corresponds to “*the first voltage potential.*”

95. Therefore, White’s “transient ... voltage signal” corresponds to “*a voltage that is the difference between the first voltage potential and the second voltage potential*” (Ex.1005, p.1) and which “aris[es] from” (“*is generated by*”) “vacuum polarization ... occur[ing] along the midplane of the cavity” (“*Casimir phenomenon*”) in an environment that includes (“*based on*”) “a standard parallel plate Casimir cavity equipped with pillars arrayed along the cavity mid-plane” (“*arrangement of the conductive antenna between the first conductive wall and the second conductive wall*”). Ex.1005, p.1.

96. For the following additional reasons, White teaches “*a voltage that is the difference between the first voltage potential and the second voltage potential is generated by Casimir phenomenon.*”

97. White explains “construct[ing] a customized **Casimir cavity** [comprising two parallel plates] equipped with small pillars placed at the mid-plane [between the plates],” describes an experiment “measur[ing] the presence of structure in the negative vacuum energy density within a customized **Casimir cavity**,” and notes that “the presence of pillars might affect the predicted Casimir energy density distribution within the cavity,” which further teaches “*a voltage that ... is generated by Casimir phenomenon based on arrangement of the conductive antenna between the first conductive wall and the second conductive wall.*” Ex.1005, p.1, p.6, Figure 1, and its description.

98. White describes an example in which “[*the*] voltage ... generated by Casimir phenomenon” is ~0.7 mV and is “based on” “a Casimir cavity with a 4 μm gap” (e.g., “*arrangement of the conductive antenna between the first conductive wall and the second conductive wall*”).

A ... calculation for a Casimir cavity with a 4 μm gap predicts a magnitude of the electrostatic potential arising from the polarization of the vacuum fluctuations along the mid-plane of the cavity to be ~ 0.7 mV.

Ex.1005, p.2.

2. Claim 20

99. As a preliminary matter, aside from claim 20 reciting a method that includes steps for “*etching*,” claim 20 is substantively comparable to claim 1 which

recites a battery. It is my opinion that at the time of the claimed invention, a POSITA would have understood that etching involves the transfer of a pre-defined design pattern / configuration / connections onto a substrate. Ex.1003, ¶¶62-66. Notably, the 769 Patent itself acknowledges that usage of “deep reactive ion etching equipment,” e.g., for the “etching” step, was common in the semiconductor fabrication industry. Ex.1001, 5:59-63. Specifically, the 769 Patent states that “[t]he Casimir cell ... fabricated “using deep reactive ion etching equipment ... **commonly used in the semiconductor fabrication industry.**” Ex.1001, 5:59-63.

100. Accordingly, my analysis of claim 1 set forth above is incorporated herein for claim 20, and specific disclosures from the prior art relevant to the “*etching*” steps are additionally provided in the explanation below.

a. [20.0] A method for making a Casimir-effect powered cell comprising:

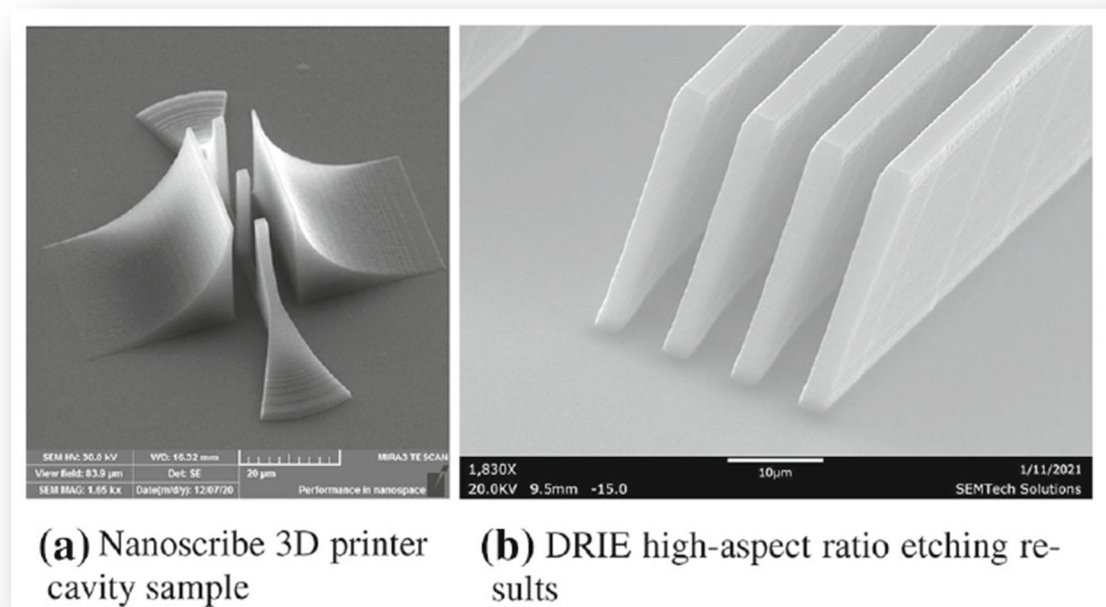
101. As explained in [1.0], White teaches “*a Casimir-effect powered cell comprising:*.”

102. Furthermore, for the reasons set forth below, White teaches “[*a*] *method for making*” such a cell.

103. For example, referencing Figure 2(b), White describes “etching” (e.g., “[*a*] *method for making*”) examples utilizing “Deep Reactive Ion Etching (DRIE) equipment to etch the high-aspect ratio cavity planes into a silicon wafer substrate.”

Ex.1005, p.2. White's approach "uses standard SiO₂ wafer materials ... [and] the final concepts ... have a metallic layer added by means of evaporation." *Id.*

104. Additionally, with reference to Figure 2(a), White teaches examples of nanofabrication ("*[a] method for making*") techniques "utilizing a Nanoscribe 3d printer to evaluate a range of cavity gaps and pillar sizes. The material ... used in the manufacture is SU-8 2025 permanent epoxy negative photoresist. After printing and curing, the cavities ... undergo electroless plating to add a layer of Ag to the outer surfaces." Ex.1005, p.2.



Ex.1005, Figures 2(a) and 2(b). Therefore, White teaches "*[a] method for making a Casimir-effect powered cell comprising:*"

- b. [20.1] etching a substrate to create a first conductive wall on the substrate ... [and] etching the substrate to create a second conductive wall on the substrate such that the second conductive wall faces the first conductive wall; and**

105. As explained in [1.1], White teaches “*a Casimir-effect powered cell*” including “*a first conductive wall ... [and] ... a second conductive wall ... such that the second conductive wall faces the first conductive wall.*”

106. Additionally, White teaches “*etching a substrate to create*” “*a [first / second] conductive wall on the substrate.*”

For example, White teaches using “Deep Reactive Ion Etching (DRIE) equipment” to “etch” (“*etch[]*”) “a silicon wafer substrate” (“*a substrate*”) for “achieving” (“*to create*”) cavity planes formed using “two parallel plates” (“*a first conductive wall [and] a second conductive wall*”). Ex.1005, p.2. Thus, White’s fabrication disclosures include the claimed “*etching*” steps because such steps are required to produce the disclosed geometries.

107. Therefore, White teaches each aspect of this claim limitation.

- c. [20.2] etching the substrate to create a conductive antenna disposed in a cavity gap that is a space between the first conductive wall and the second conductive wall,**

108. As explained in [1.2], White teaches “*a Casimir-effect powered cell*” including “*a conductive antenna disposed in a cavity gap that is a space between the*

first conductive wall and the second conductive wall, wherein the conductive antenna faces the first conductive wall and the second conductive wall.”

109. Additionally, White teaches “*etching the substrate to create a conductive antenna.*”

110. For example, White teaches using “Deep Reactive Ion Etching (DRIE) equipment” to “etch (*etch[]*)” “a silicon wafer substrate” (“*a substrate*”) and “incorporates masking” (e.g., “*to create*”) the structure comprising “pillars” (“*a conductive antenna*”). Ex.1005, p.2.

111. Therefore, White teaches each aspect of this claim limitation.

d. [20.3] wherein the first conductive wall and the second conductive wall are etched to be electrically connected and have a same first voltage potential, and

112. As explained in [1.3], White teaches “*a Casimir-effect powered cell*” in which “*the first conductive wall and the second conductive wall are ... electrically connected and have a same first voltage potential.*”

113. And additionally, the feature: “*the first conductive wall and the second conductive wall are etched*” is explained in [20.1].

e. [20.4] wherein the conductive antenna is etched to have a second voltage potential that is different from the first potential.

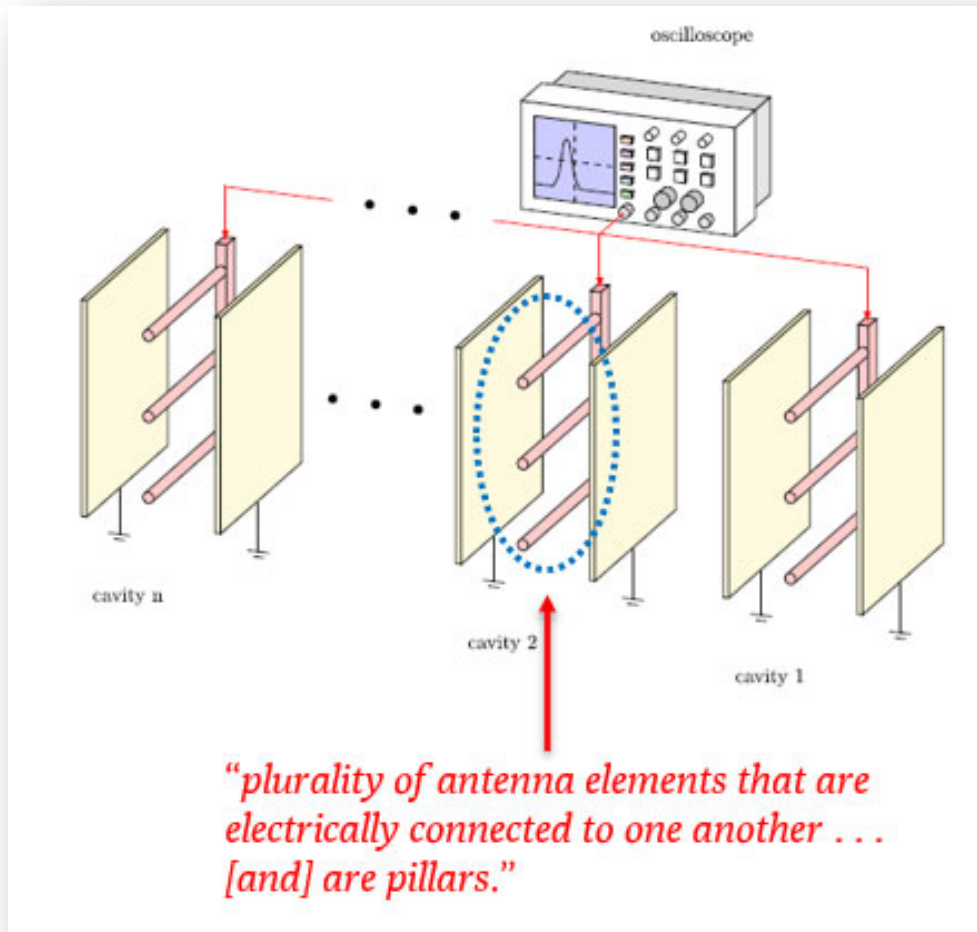
114. As explained in [1.4], White teaches “a Casimir-effect powered cell” in which “*the conductive antenna ... [has] a second voltage potential that is different from the first potential.*”

115. And additionally, the feature: “*the conductive antenna is etched*” is explained in [20.2].

3. Claim 3

- a. **[3.0] The battery of claim 1, wherein the conductive antenna comprises a plurality of antenna elements that are electrically connected to one another and have the second voltage potential, and**
- b. **[3.1] wherein one or more of the plurality of antenna elements are pillars.**

116. With reference to Figure 1, White teaches an example in which its structure comprises a “*plurality of antenna elements*” formed as three “*pillars*” that are “*electrically connected to one another*” and accordingly “*have the second voltage potential.*”



Ex.1005, Figure 1 (annotated). Therefore, White discloses claim 3.

4. Claim 4

- a. [4.0] The battery of claim 1, wherein, from a cross-sectional view of the Casimir cell perpendicular to a plane of substrate on which the Casimir cell is disposed, one or more of the plurality of antenna elements have a round, rectangular, or prismatic shape.

117. White teaches etching the cavity planes into “a silicon wafer substrate,” (“a plane of substrate”) such that “a standard parallel plate Casimir cavity equipped

with pillars arrayed along the cavity mid-plane,” (*“the Casimir cell”*) is “etch[ed]” (*“disposed”*) and depicts an example in which pillars (*“the plurality of antenna elements”*) have a “round ... shape” when the device comprising *“the Casimir cell”* is viewed “*from a cross-sectional view ... perpendicular to a plane of substrate on which the Casimir cell is disposed.*” Ex.1005, p.1.

118. Therefore, White discloses claim 4.

5. Claim 9

- a. **[9.0] The battery of claim 1, wherein the cavity gap has a width of not more than 10 micrometers.**

119. White teaches an example in which “a Casimir cavity ...[has] a 4 μm gap” and that “[t]he ... geometry of each cavity is approximately 4 μm wide,” which satisfies the requirement of *“the cavity gap ha[ving] a width of not more than 10 micrometers.”* Ex.1005, p.2.

120. Therefore, White discloses claim 9.

6. Claim 11

- a. **[11.0] The battery of claim 1, wherein a first distance between the conductive antenna and the first conductive wall is the same as a second distance between the conductive antenna and the second conductive wall.**

121. White teaches using “a standard parallel plate Casimir cavity equipped with pillars arrayed along the cavity **mid-plane**,” (Ex.1005, Abstract) which satisfies the required “*a first distance between the conductive antenna and the first conductive*

wall is the same as a second distance between the conductive antenna and the second conductive wall.” See also, Ex.1005, p.1 (“a customized Casimir cavity equipped with small pillars placed at the mid-plane as depicted in Fig. 1).

7. Claim 12

- a. [12.0] The battery of claim 1, wherein the first conductive wall, the second conductive wall, and the conductive antenna contain the same material.**

122. White teaches etching utilizing “Deep Reactive Ion Etching (DRIE) equipment to etch the high-aspect ratio cavity planes into a silicon wafer substrate.” Ex.1005, p.2. This approach “uses standard SiO₂ wafer materials ... [and] the final concepts ... have a metallic layer added by means of evaporation.” *Id.*

123. Additionally, White teaches examples of nanofabrication techniques “to evaluate a range of cavity gaps and pillar sizes” in which “[t]he material ... used in the manufacture is SU-8 2025 permanent epoxy negative photoresist. After printing and curing, the cavities ... undergo electroless plating to add a layer of Ag to the outer surfaces.” Ex.1005, p.2.

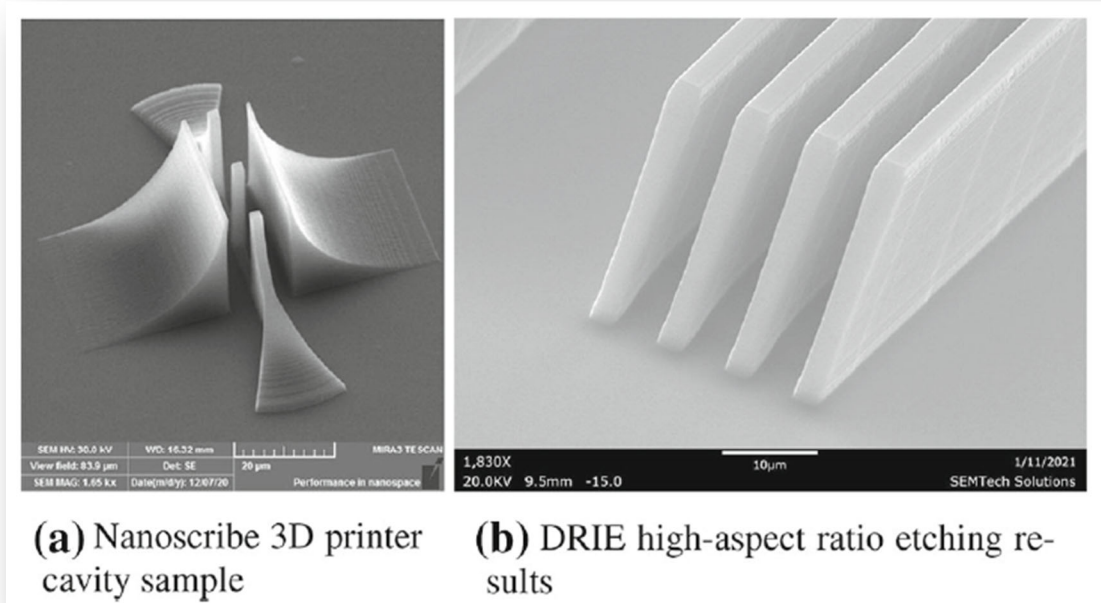
124. In White’s nanofabrication trials to create a parallel plate Casimir cavity, White uses the same material for the cavity walls (“*the first conductive wall [and] ... the second conductive wall*”) and the structure comprising pillars (“*the conductive antenna*”) because White’s goal is “to evaluate a range of cavity gaps and pillar sizes.” Ex.1005, Figure 2 description. White does not state the use of different

materials for the cavity walls (“*the first conductive wall [and] ... the second conductive wall*”) and the structure comprising pillars (“*the conductive antenna*”), and therefore, meets “*the same material*” requirement.

8. Claim 13

- a. [13.0] The battery of claim 1, wherein the first conductive wall, the second conductive wall, and the conductive antenna are disposed vertically with respect to a substrate on which the Casimir cell is disposed.**

125. White teaches “etching results using Deep Reactive Ion Etching (DRIE) equipment to etch the high-aspect ratio cavity planes into a silicon wafer substrate,” and depicts an example in which the “two parallel plates” (“*the first conductive wall ... [and] the second conductive wall*”) “and” the structure comprising “pillars placed at the midplane of a Casimir cavity” (“*the conductive antenna*”) “are” “*disposed vertically with respect to a substrate.*” Ex.1005, p.1, p.10, and Figure 2 description.



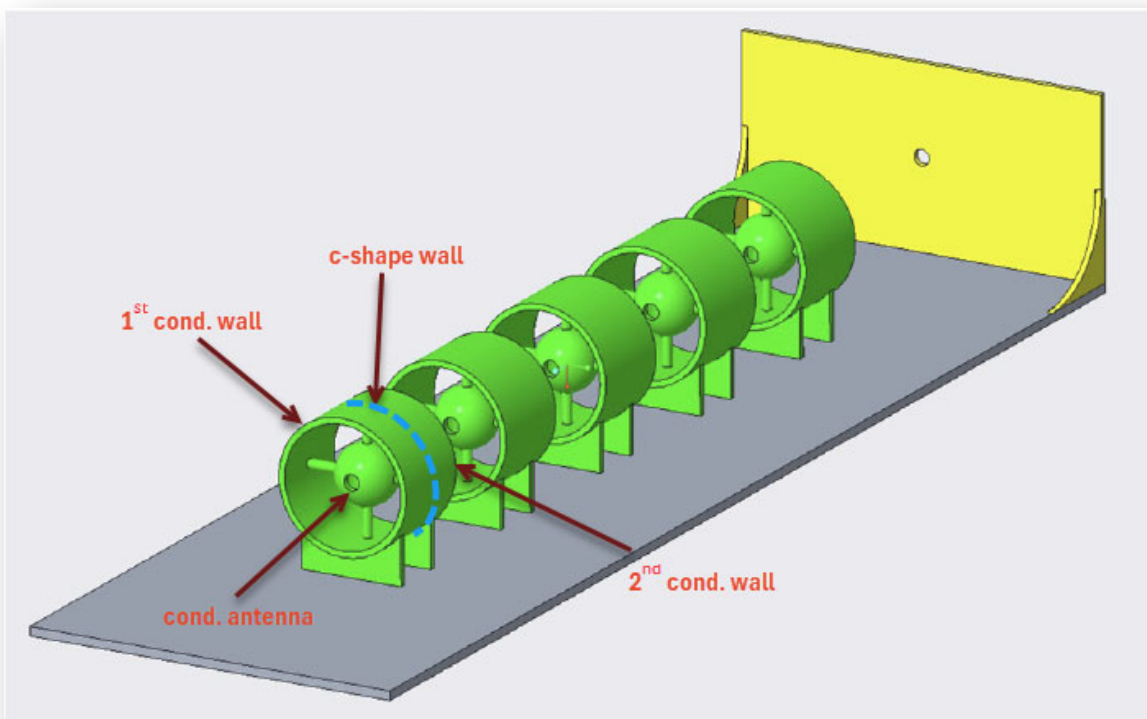
Ex.1005, Figures 2(a) and 2(b) (showing vertically disposed configuration on substrate).

126. Therefore, White discloses claim 13.

9. Claim 18

- a. [18.0] The battery of claim 1, wherein the Casimir cell comprises a c-shape wall that comprises the first conductive wall and the second conductive wall,
- b. [18.1] wherein the first conductive wall and the second conductive wall are opposite walls of the c-shape wall, and
- c. [18.2] wherein the conductive antenna is disposed inside the c-shape wall in between the first conductive wall and the second conductive wall.

127. With reference to Figure 10(b), White teaches a device (*“the battery”*) comprising “an array of sphere-cylinder constructions [of] nano-spheres suspended in nano-tubes” (*“Casimir cell[s]”*) in which “a 1 μm diameter sphere [is] suspended in the middle of a 4 μm diameter cylinder” which comprises a curvature surface (*“a c-shape wall”*) enclosed within two walls (*“the first conductive wall and the second conductive wall”*) in which “the center of the sphere(s)” includes “a ... conductor” (*“[a] conductive antenna”*). Ex.1005, Figure 10(b), its description, and p.8.



Ex.1005, Figure 10(b) (annotated).

128. Therefore, White discloses claim 18.

B. Ground 2: Moddel-812 renders obvious claims 1-2, 5-8, 10, 14-17, and 19-20.

1. Claim 1

a. [1.0] A battery that comprises a Casimir-effect powered cell (Casimir cell), the Casimir cell comprising:

129. Moddel-812 teaches:

[a] device[] incorporating Casimir cavities [*“a battery that comprises a Casimir-effect powered cell[] (Casimir cell[])”*], which modify the quantum vacuum mode distribution within the cavities. **The Casimir cavities can create energy differences** within layers or device to drive energy from or to a portion of a layer disposed adjacent to or contiguous with the Casimir cavity by modifying the quantum vacuum mode distribution incident on one portion of the layer to be different from the quantum vacuum mode distribution incident on another portion of the layer.

Ex.1006, Abstract.

130. Moddel-812 teaches that its devices “use an asymmetry in quantum vacuum fluctuations with respect to an electronic device to drive **a flow of energy** or particles or waves across the electronic device.” Ex.1006, [0005]. Besides having an asymmetry, “another driver for the **flow of charge** is the difference in the optical mode density inside and outside of the cavity.” Ex.1006, [0088].

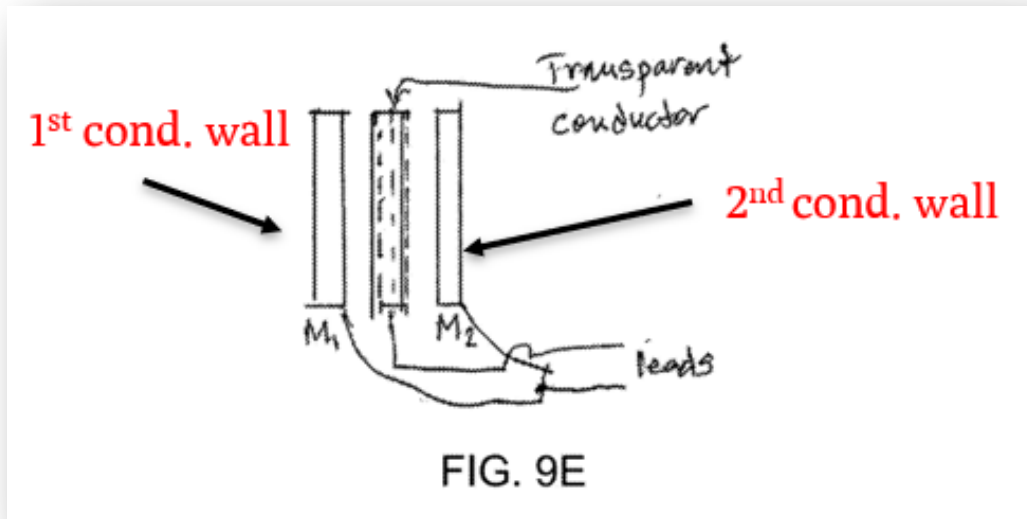
131. Moddel-812 uses the terms “Casimir Cavity (CC) device” or “quantum device” to refer to such devices. Ex.1006, [0002], [0049], [0069], [0088], [0092].

Moddel-812 explains that the “quantum devices for **harvesting and generating electrical energy**” can be arranged such that “multiple devices can be electrically connected to one another ... in a laterally adjacent configuration. ... Alternatively, or in addition, multiple devices can be electrically connected to one another ... in a vertically adjacent configuration,” such that the “charge flow [from the device] produces a current that **provides power to an external element or device.**” Ex.1006, [0002], [0008], and [0088].

132. Therefore, Moddel-812 discloses the preamble of claim 1.

b. [1.1] a first conductive wall [and] a second conductive wall that faces the first conductive wall; and

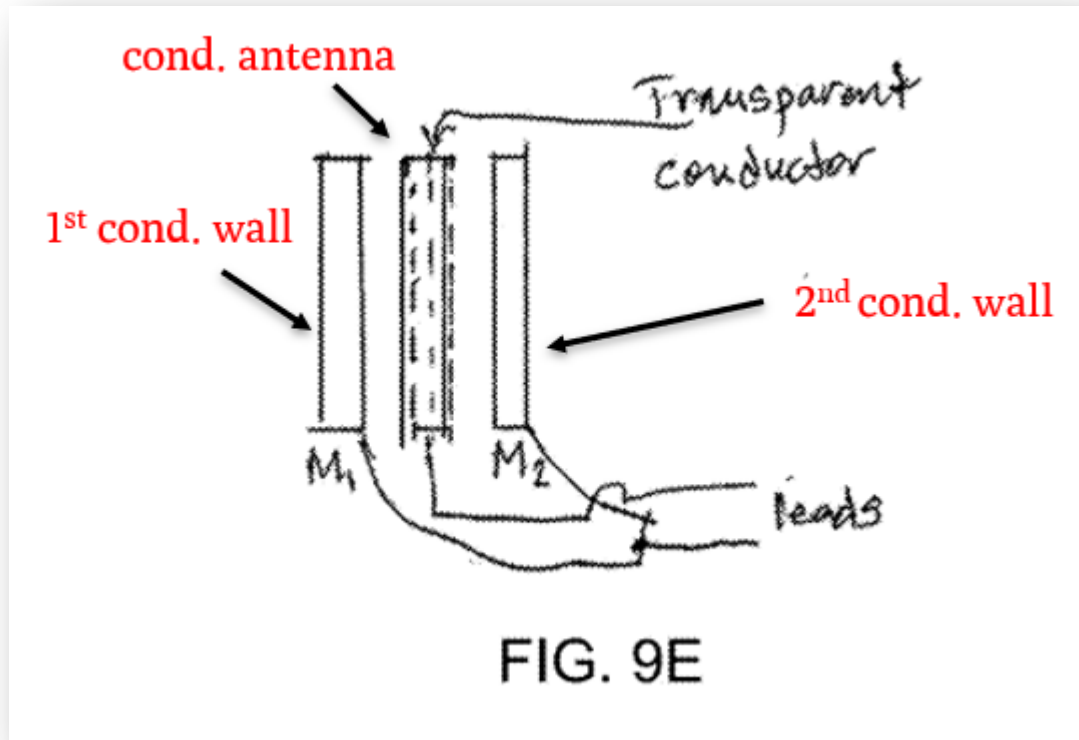
133. Moddel-812 discloses an example “device[] incorporating [a] Casimir cavit[y]” (“*a battery that comprises a Casimir-effect powered cell (Casimir cell)*”) comprising “outer metal layers, M_1 and M_2 ” (“*a first conductive wall [and] a second conductive wall*”) and illustrates that the metal layers “*face[]*” each other. Ex.1006, [0088]; *see also* [0037] (“a Casimir cavity ... formed using two closely-spaced, parallel reflecting plates”).



Ex.1006, Figure 9E (annotated).

- c. [1.2] a conductive antenna disposed in a cavity gap that is a space between the first conductive wall and the second conductive wall, wherein the conductive antenna faces the first conductive wall and the second conductive wall,

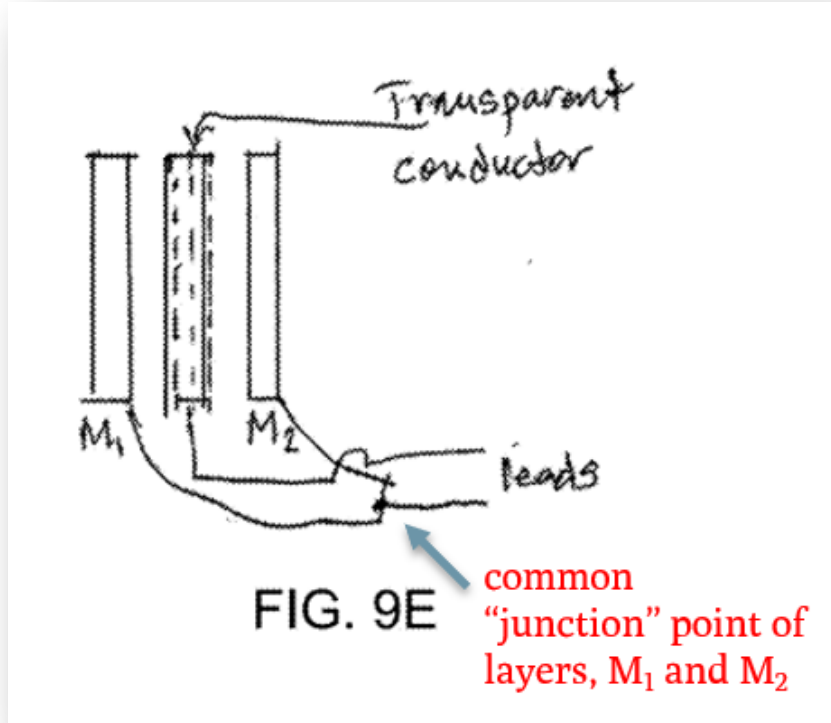
134. Model-812 teaches an example “device[] incorporating [a] Casimir cavit[y]” (“a battery that comprises a Casimir-effect powered cell (Casimir cell)”) includes “a transparent conductor” (“a conductive antenna”) “in the interior of the Casimir cavity” (“disposed in a cavity gap that is a space between the first conductive wall and the second conductive wall”). Ex.1006, [0088].



Ex.1006, Figure 9E (annotated).

- d. [1.3] wherein the first conductive wall and the second conductive wall produce a same first voltage potential,

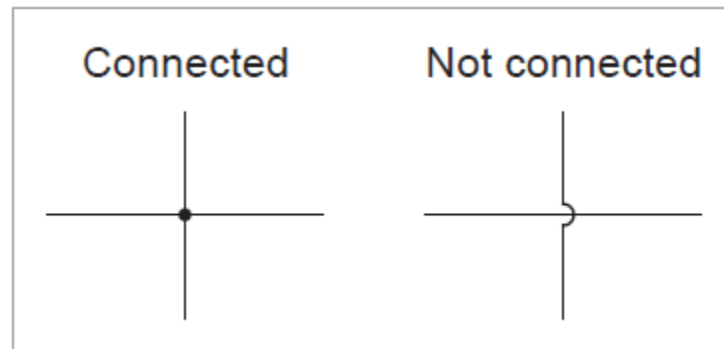
135. Model-812 teaches “charge flowing from at least one of the outer metal layers,” / “the outer metal layers, M_1 and M_2 ” (“the first conductive wall and the second conductive wall”) e.g., as depicted in Figure 9E and further that “[t]his **charge flow produces** a current that provides power to an external element or device.” Ex.1006, [0088].



Ex.1006, Figure 9E (annotated).

136. For the reasons below, it is my opinion that because Model-812 teaches the outer metal layers, M_1 and M_2 allow current to flow and connect at a common / same “junction” point, a POSITA would have understood that “the outer metal layers, M_1 and M_2 ” (“*the first conductive wall and the second conductive wall*”) “*produce a same first voltage potential.*” Equivalently, the common “junction” point in Model-812’s Figure 9E would have “*a ... first voltage potential.*”

137. A POSITA would have understood the common meaning of the symbols used in Moddel-812's Figure 9E. For example, Kuphaldt teaches the “convention[al]” symbols used in circuit schematics:



Ex.1020, 132. Kuphaldt explains that in circuit schematics, “connecting wires unambiguously connected by a dot, and non-connecting wires unambiguously” jumping” over one another with a half-circle mark.” Ex.1020, 132.

138. Thus, a POSITA would have understood that by showing wires from the outer metal layers, M_1 and M_2 meeting at the common junction point, in Moddel-812, the outer metal layers, M_1 and M_2 (“*the first conductive wall and the second conductive wall*”) would “*produce a same first voltage potential.*”

139. Additionally, the meaning of the term “*voltage potential*” is very well understood in the art. For example, Microsoft Computer dictionary defines “*voltage / potential*” as “[t]he force that causes movement in charge carriers ... in a conductor” and “current” as “[t]he flow of electric charge through a conductor”). Ex.1016, 558, 415, and 188:

voltage *n.* See electromotive force.

potential *n.* See electromotive force.

electromotive force *n.* The force that causes movement in charge carriers (the electrons) in a conductor. Acronym: EMF. Also called: potential, voltage. See also ampere, coulomb.

140. A POSITA would have further understood that the existence of current flow in Moddel-812 indicates a corresponding voltage difference between conductive elements, as current cannot flow in the absence of a potential difference. Thus, Moddel-812's disclosure of charge flow and current generation confirms the presence of different voltage potentials between the conductive structures. Therefore, Moddel-812 discloses this claim limitation.

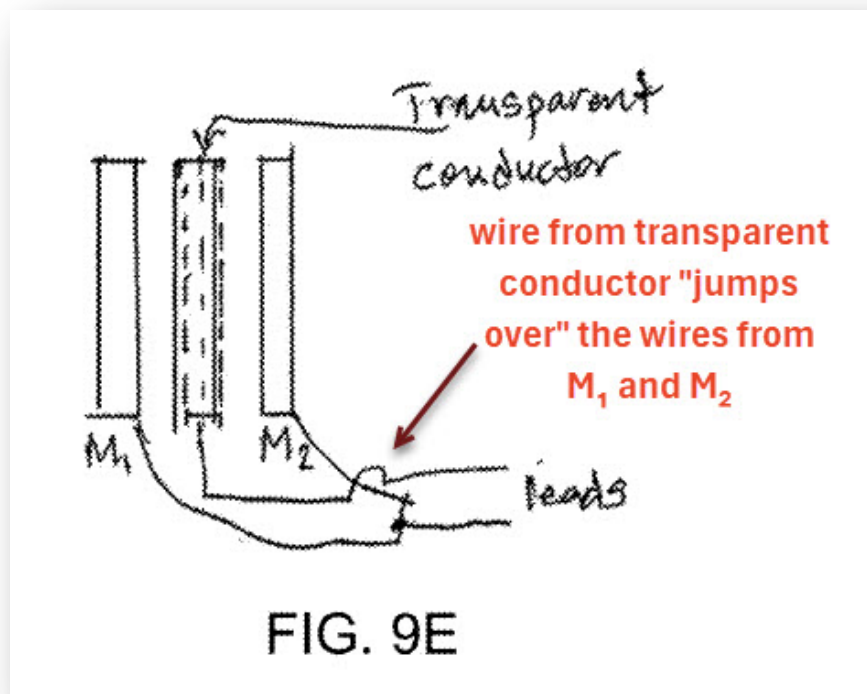
- e. **[1.4] wherein the conductive antenna produces a second voltage potential that is different from the first voltage potential, and**

141. As explained in [1.3], Moddel-812 discloses or suggests that “the outer metal layers, M_1 and M_2 ” (“*the first conductive wall and the second conductive wall*”) produce the “[*same*] first voltage potential.”

142. Moddel-812 also discloses that its “transparent conductor [*the conductive antenna*]” does not block the optical modes, but ... collect[s] injected charge flow[,]” and further that “[t]his charge flow produces a current that provides

power to an external element or device,” which therefore discloses or suggests that the “transparent conductor” [*“the conductive antenna”*] “*produces a second voltage potential.*” Ex.1006, [0088].

143. As I explained earlier in connection with [1.3], a POSITA would have understood the common meaning of the symbols used in Moddel-812’s Figure 9E and that the common “junction” point of layers M_1 and M_2 in Moddel-812’s Figure 9E would have “*a ... first voltage potential.*” See analysis in [1.3].



Ex.1005, Figure 9E (annotated).

144. Additionally, in view of Figure 9E, a POSITA would have understood the “jumping over” of the wire from the “transparent conductor (*“the conductive*

antenna”) to mean that it is unconnected to the common “junction” point of layers M_1 and M_2 , and therefore, the “transparent conductor (*“the conductive antenna”*) is at “*a second voltage potential that is different from the first voltage potential.*”

145. Therefore, Moddel-812 discloses this claim limitation.

- f. [1.5] wherein a voltage that is the difference between the first voltage potential and the second voltage potential is generated by Casimir phenomenon based on arrangement of the conductive antenna between the first conductive wall and the second conductive wall

146. Moddel-812 discloses the return lead for “this device” (*“the battery”*) is connected to one or both of “the outer metal layers, M_1 and M_2 ” (*“the first conductive wall and the second conductive wall”*) through which there is “a charge flow [which] produces a current that provides power to an external element or device.” Ex.1006, [0088]. A POSITA would have understood that such a current is a result of “*a voltage that is the difference between the first voltage potential and the second voltage potential.*”

147. Moddel-812 explains that its “device” (*“battery”*) “use[s] an asymmetry in quantum vacuum fluctuations with respect to an electronic device to drive a flow of energy or particles or waves across the electronic device” which additionally confirms that the afore-mentioned “current” is a result of “*a voltage that is the difference between the first voltage potential and the second voltage potential.*” Ex.1006, [0005].

148. Additionally, Moddel-812 discloses that the “*Casimir phenomenon*” “generate[s]” “[the] voltage that is the difference between the first voltage potential and the second voltage potential” and is “based on arrangement of the conductive antenna between the first conductive wall and the second conductive wall” for the reasons below.

149. For example, Figure 9E depicts a geometric structure (e.g., “arrangement”) of this device in which “a transparent conductor” (“[a] conductive antenna”) is placed “in the interior of the **Casimir cavity**” and bounded by “outer metal layers, M_1 and M_2 ” (“the first conductive wall and the second conductive wall”). Ex.1006, [0088].

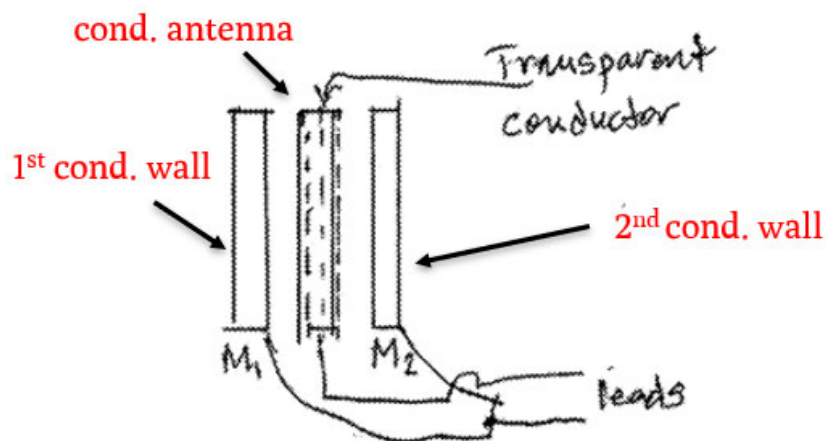


FIG. 9E

Ex.1006, Figure 9E (annotated).

150. Therefore, for at least the above reasons, Model-812 discloses this claim element.

151. Additionally, as I explain in the Background section my Declaration, long before the 769 Patent, a POSITA would have recognized that a three-conductor geometry (e.g., comprising “*a first conductive wall,*” “*a second conductive wall,*” and “*a conductive antenna*”) in which two of the conductors are at the same “*first voltage potential*” and the third conductor is at “*the second voltage potential*” such that there is a “*difference between the first voltage potential and the second voltage potential,*” was well-known in the art. Ex.1003, ¶¶67-70.

152. Therefore, for at least these additional reasons, a POSITA would have understood that Model-812 discloses this claim element.

2. Claim 20

153. Other than claim 20 reciting a method including steps for “*etching,*” claim 20 is substantively similar to claim 1 (which recites a battery).

154. Additionally, at the time of the claimed invention, steps for “*etching*” were well-known in the semiconductor industry. For example, a POSITA would have understood that etching involves the transfer of a pre-defined design pattern / configuration / connections onto a substrate. Ex.1003, ¶¶62-66. Accordingly, the above analysis of claim 1 is incorporated herein for claim 20 and specific disclosures

from the prior art relevant to the “*etching*” steps are additionally provided in the explanation below.

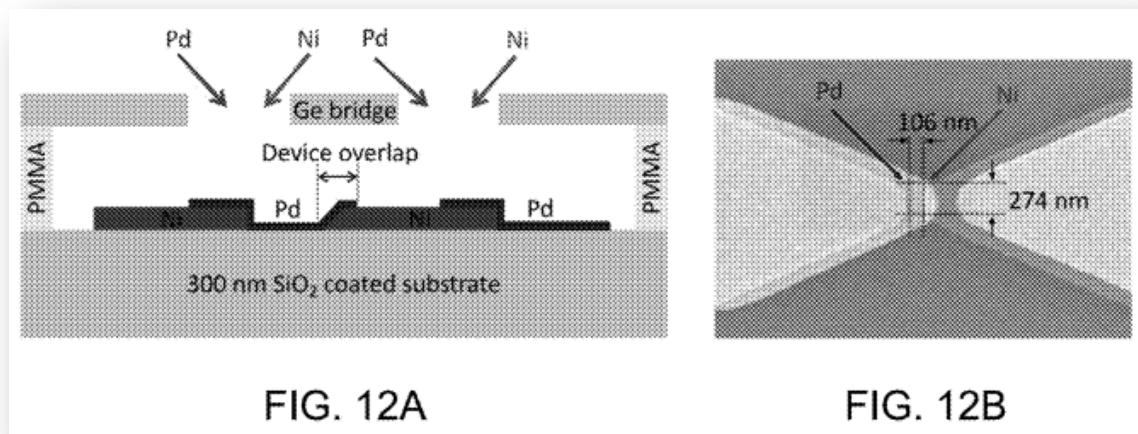
a. [20.0] A method for making a Casimir-effect powered cell comprising:

155. As explained in [1.0], Model-812 discloses “*a Casimir-effect powered cell comprising:*”

156. Furthermore, for the reasons below, Model-812 discloses “[*a method for making*]” such a cell.

Device Fabrication. Two different processes were used to form the devices “[*a method for making a Casimir-effect powered cell*]”. Submicron devices were fabricated using a germanium shadow-mask (GSM) process. ...

Ex.1006, [0102].



Ex.1006, Figures 12A and 12B.

157. Therefore, Model-812 discloses the preamble of claim 20.

- b. **[20.1] etching a substrate to create a first conductive wall on the substrate ... [and] etching the substrate to create a second conductive wall on the substrate such that the second conductive wall faces the first conductive wall; and**

158. As I explained in [1.1], Model-812 discloses “a Casimir-effect powered cell” including “outer metal layers, M_1 and M_2 ” (“a first conductive wall ... [and] a second conductive wall”) and further “that the second conductive wall faces the first conductive wall.”

159. Additionally, Model-812 discloses “etching a substrate to create” “a [first / second] conductive wall on the substrate.”

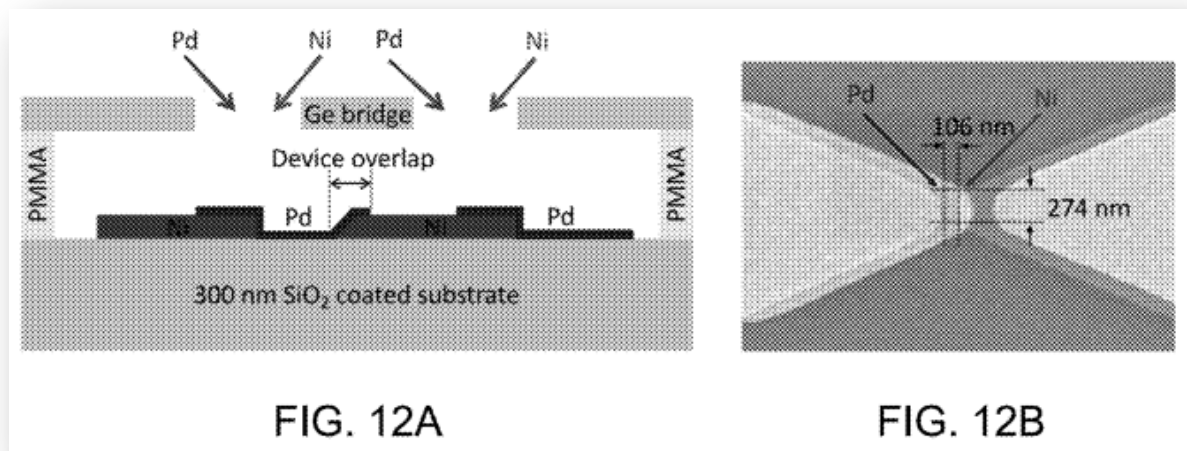
For example, Model-812 teaches the “etching” process in great detail:

Two different processes were used **to form the devices**. Submicron devices were **fabricated using a germanium shadow-mask (GSM) process [“etching a substrate”]**. Using a deep-ultraviolet stepper, a 250 nm wide germanium bridge is formed over an SiO_2 -coated surface of a silicon wafer, as depicted in FIG. 12A. First the nickel base electrode is evaporated under the bridge from one side. This is followed by native NiO_x growth at room temperature, and then by conformal Al_2O_3 deposited by sputtering. After the insulator is formed, the palladium upper electrode is evaporated from the opposite side. The resulting overlap of the two metals forms an ellipse with an area of $0.02 \pm 0.006 \mu\text{m}^2$, as shown in FIG. 12B. After the germanium bridge is removed, a transparent dielectric, spun-on polymethyl methacrylate (PMMA) or sputtered SiO_2 , is deposited to form an optical cavity over the MIM structure. The dielectric layer is then coated with an aluminum mirror.

In addition to providing a reduced density of optical modes, the optical cavity encapsulates and stabilizes the MIM structure, blocking further oxidation. (Note that the use of PMMA to support the germanium bridge, as shown in FIG. 12A, is independent of whether PMMA is also used in a subsequent layer to form an optical cavity.)

Ex.1006, [0102] and Figures 12A and 12B.

160. Because Model-812's "devices" include "outer metal layers, M_1 and M_2 " ("*the first conductive wall [and] the second conductive wall*"), a POSITA would have understood that Model-812's processes (see above) "to form the devices" would be applicable "*to create*" the "outer metal layers, M_1 and M_2 " ("*the first conductive wall [and] the second conductive wall*").



Ex.1006, Figures 12A and 12B.

161. Therefore, Model-812 discloses this claim limitation.

- c. **[20.2] etching the substrate to create a conductive antenna disposed in a cavity gap that is a space between the first conductive wall and the second conductive wall, wherein the conductive antenna faces the first conductive wall and the second conductive wall,**

162. As I explained in [1.2], Model-812 discloses “a Casimir-effect powered cell” including “a conductive antenna disposed in a cavity gap that is a space between the first conductive wall and the second conductive wall, wherein the conductive antenna faces the first conductive wall and the second conductive wall.”

Additionally, Model-812 discloses “*etching the substrate*”:

Two different processes were used to form the devices. Submicron devices were **fabricated using a germanium shadow-mask (GSM) process** [*“etching the substrate”*]. Using a deep-ultraviolet stepper, a 250 nm wide germanium bridge is formed over an SiO₂-coated surface of a silicon wafer, as depicted in FIG. 12A. First the nickel base electrode is evaporated under the bridge from one side. This is followed by native NiO_x growth at room temperature, and then by conformal Al₂O₃ deposited by sputtering. After the insulator is formed, the palladium upper electrode is evaporated from the opposite side. The resulting overlap of the two metals forms an ellipse with an area of 0.02±0.006 μm², as shown in FIG. 12B. After the germanium bridge is removed, a transparent dielectric, spun-on polymethyl methacrylate (PMMA) or sputtered SiO₂, is deposited to form an optical cavity over the MIM structure. The dielectric layer is then coated with an aluminum mirror. In addition to providing a reduced density of optical modes, the optical cavity encapsulates and stabilizes the MIM structure, blocking further oxidation.

(Note that the use of PMMA to support the germanium bridge, as shown in FIG. 12A, is independent of whether PMMA is also used in a subsequent layer to form an optical cavity.)

Ex.1006, [0102].

163. Because Moddel-812's "devices" include "a transparent conductor" ("*[a] conductive antenna*") "in the interior of the Casmir cavity," a POSITA would have understood that processes described "to form the devices" in Moddell-812 would apply "*to create*" the "transparent conductor" ("*[the] conductive antenna*").
Ex.1006, [0088].

164. Therefore, Moddel-812 discloses this claim limitation.

d. [20.3] wherein the first conductive wall and the second conductive wall are etched to be electrically connected and have a same first voltage potential, and

165. As I explained in [1.3], Moddel-812 discloses "a *Casimir-effect powered cell*" in which "*the first conductive wall and the second conductive wall are ... electrically connected and have a same first voltage potential.*"

166. Further, a POSITA would have understood that Moddel-812's processes, describing "*[etching] the first conductive wall and the second conductive wall*" as explained in [20.1], results in "*the first conductive wall and the second conductive wall ... etched to be electrically connected and have a same first voltage potential.*"

- e. **[20.4] wherein the conductive antenna is etched to have a second voltage potential that is different from the first potential.**

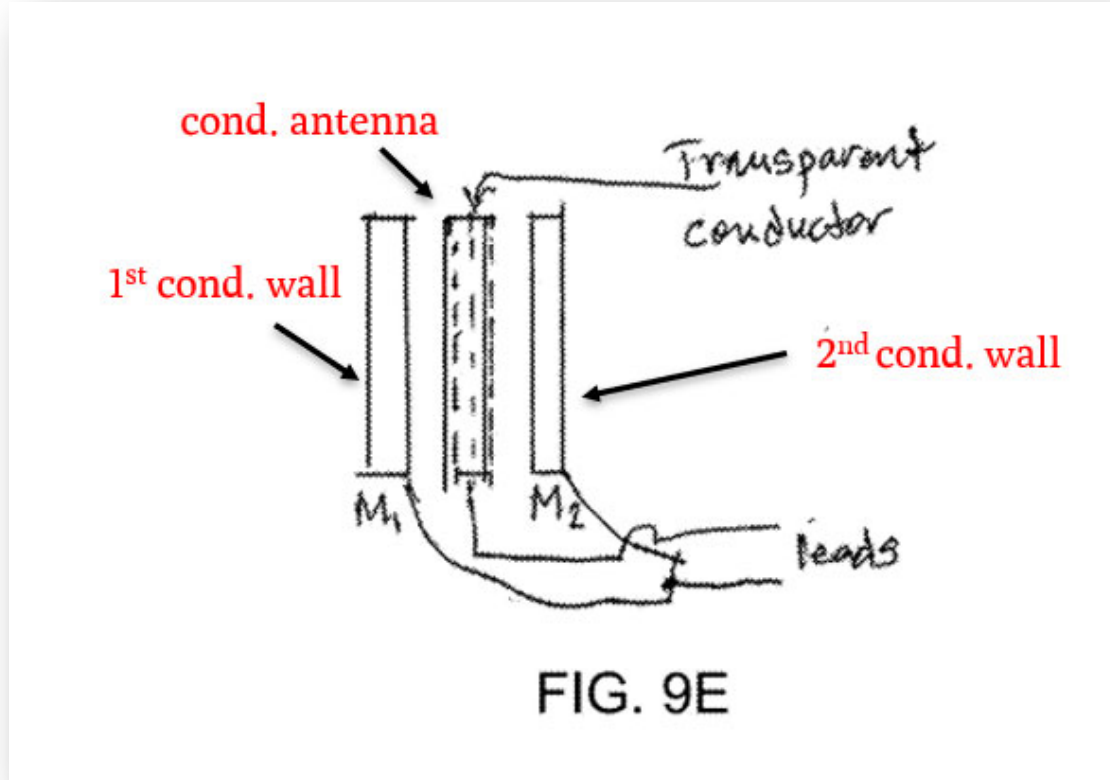
167. As I explained in [1.4], Moddel-812 discloses “a Casimir-effect powered cell” in which “*the conductive antenna ... [has] a second voltage potential that is different from the first potential.*”

168. Further, a POSITA would have understood that Moddel-812’s processes, describing “[*etching*] *the conductive antenna*” as explained in [20.2], results in “*the conductive antenna ... etched to have a second voltage potential that is different from the first potential.*”

3. Claim 2

- a. **[2.0] The battery of claim 1, wherein the conductive antenna comprises a flat block, and the flat block is at least semi-transparent in at least a region of optical frequencies.**

169. Moddel-812 teaches an example illustrating that the “transparent conductor” (“*the conductive antenna*”) “*comprises a flat block.*”



Ex.1006, Figure 9E (annotated).

170. Additionally, Model-812 explains that “[t]his **transparent** conductor [“the conductive antenna”] **does not block the optical modes**, but can collect injected charge flowing from at least one of the outer metal layers,” which meets the requirement that it “*is at least semi-transparent in at least a region of optical frequencies.*” Ex.1006, [0088]; *see also* [0041] and [0043] (“gap 325 [or, cavity layer] may be filled with ... at least **partially transparent optical material** for at least some wavelengths of electromagnetic radiation”).

171. Therefore, Model-812 discloses claim 2.

4. Claim 5

- a. **[5.0] The battery of claim 1, wherein the first conductive wall comprises a material selected from the group consisting of gold (Au), silver (Ag), platinum (Pt), aluminum (Al), copper (Cu), palladium (Pd), iridium (Ir), titanium nitride (TiN), molybdenum (Mo), silicon (Si), and graphene.**

172. Model-812 discloses “[the] device” (*“the battery”*) comprising “a conductive layer,” “wherein the conductive layer comprises a metal, [such as outer metallic layer M₁ (*“the first conductive wall”*)] nichrome, nickel, **silver, copper, or graphene.**” Ex.1006, [0120] and [0130].

173. Therefore, Model-812 discloses claim 5.

5. Claim 6

- a. **[6.0] The battery of claim 1, wherein the first conductive wall comprises a doped semiconductor of a first polarity, and the conductive antenna comprises a doped semiconductor of a second polarity that is opposite of the first polarity.**

174. First, Model-812 discloses “*the conductive antenna comprises a doped semiconductor.*” Model-812 expressly teaches the use of “doped PEDOT:PSS” (e.g., “*a doped semiconductor*”) “for the transparent conductor.” Ex.1006, [0080]-[0083]. It was well-known in the art that PEDOT:PSS is a semiconductor. For example, Zhang identifies that “PEDOT:PSS is a ... p-type semiconductor.” Ex.1018, 014911-1.

175. Second, for the reasons below, Moddel-812 teaches “*the first conductive wall comprises a ... semiconductor.*”

176. Moddel-812 teaches “a first conductive layer” (“*the first conductive wall*”), such as “conductive layer 305” in Figure 3 “*comprises*” “semiconductor[.]” (“*semiconductor*”) and further that “semiconductors have ... Seebeck coefficients.” Ex.1006, [0042] and [0064].

177. Moddel-812 also teaches that Seebeck coefficient, which is used to characterize “*a ... semiconductor,*” having a positive or negative polarity. For example, Moddel-812 teaches:

a first conductive layer [*“the first conductive wall”*] [*comprises a ... semiconductor*] having a first Seebeck coefficient of one polarity [*“a first polarity”*] ... and ... a second conductive layer [e.g., “*the conductive antenna*”] [*comprises a doped semiconductor*] that has a second Seebeck coefficient of opposite polarity as the first Seebeck coefficient [*“a second polarity that is opposite of the first polarity”*].

Ex.1006, [0009], [0011], [0064], and [0135].

178. At the time of the claimed invention, the Seebeck coefficient was well-known in the art. For example, Jouhara describes that the Seebeck coefficient, which is tied to the “Seebeck effect” is a “thermoelectric effect” where “a temperature differential produces a voltage.” Ex.1019, 3.

179. Jouhara describes the Seebeck coefficient sign (i.e., a positive or negative polarity) in the following manner:

The Seebeck coefficient sign shows that the material is a p-type or n-type conductor, the positive sign indicates the p-type, the negative indicates the n-type material. The Seebeck coefficient (S), which is responsible for allowing the current to move while the temperature gradient is present, is the relation between the theoretical differential created and the temperature gradient applied.

Ex.1019, 3.

180. Thus, “a ... *semiconductor*” material, e.g., comprised in a first conductive layer (“*the first conductive wall*”) or a second conductive layer (e.g., “*the conductive antenna*”) in Moddel-812 is characterized by Seebeck coefficients, which in view of the supported teachings of the prior art, a POSITA would have understood is represented with a coefficient sign (e.g., a positive or negative polarity) or equivalently, “*a first polarity*” and “*a second polarity that is opposite of the first polarity.*”

181. Therefore, Moddel-812 discloses or suggests this claim limitation.

182. To the extent one asserts Moddel-812 does not expressly disclose that the “*semiconductor*” “*comprise[d]*” in “*the first conductive wall*” is a “*doped semiconductor,*” it would have been obvious to a POSITA to use a doped semiconductor (such as doped PEDOT:PSS) as the material of “*the first conductive*

layer” (“*the first conductive wall*”) because of at least the following reasons: (1) it would result in larger voltages produced by the device, (2) it would lead to greater efficiency based on more free electrons, and (3) it would reduce the likelihood of electrical shorting. Ex.1006, [0009], [0011], [0052], [0064].

183. Moddel-812 expressly states the benefits of using doped semiconductors (such as doped PEDOT:PSS). For example, Moddel-812 explains teaches that “the [transparent conductor] TC is ... PEDOT:PSS” which in some examples, “may exhibit ... a relatively lower density of electrons that scatter the incoming hot electron, so that the hot electron path is longer and slower, which **can reduce the efficiency. To counteract such a phenomenon, examples may use doped PEDOT:PSS to have more free electrons.**” Ex.1006, [0082]-[0083].

184. Further, Moddel-812 teaches that “[s]emiconductors have large Seebeck coefficients” and “materials that have a large Seebeck coefficient (SC) can exhibit a large vacuoelectric effect” “and in doing so **produce a [large] voltage difference.**” Ex.1006, [0064] and [0052].

185. Also, Moddel-812 explains that “[a]dvantageously,” a doped semiconductor like doped PEDOT:PSS is “more forgiving than metal electrodes, and **less likely to be shorted** out by small pinholes,” which as Moddel-812 describes, is an undesired formation and leads to degradation of “MIM structures ... over time.” Ex.1006, [0082].

186. Therefore, Moddel-182 provides sufficient reasons to a POSITA for using a doped semiconductor (such as doped PEDOT:PSS) as the material of “*the first conductive layer*” (“*the first conductive wall*”).

187. Therefore, for the afore-mentioned reasons, it would have been obvious to a POSITA that the “*semiconductor*” “*comprise[d]*” in “*the first conductive wall*” is a “*doped semiconductor.*”

6. Claim 7

- a. **[7.0] The battery of claim 1, wherein an intervening space between the first conductive wall and the conductive antenna comprises a material selected from a group consisting of a gas dielectric, a liquid dielectric, and a solid dielectric.**

188. Moddel-812 discloses “[the] device” (“*the battery*”) comprising “a Casimir cavity” (“*an intervening space between the first conductive wall and the conductive antenna*”) “formed ... using” (“*comprises*”) “a dielectric stack” (“*a material...[such as] ... a solid dielectric*”), *e.g.*, formed using “alternating dielectric layers ... such as ... a stack with alternating layers of SiO₂ and Al₂O₃.” Ex.1006, [0045].

189. Therefore, Moddel-812 discloses or suggests claim 7.

7. Claim 8

- a. **[8.0] The battery of claim 1, wherein an intervening space between the first conductive wall and the conductive antenna is a solid dielectric that is selected**

from a group consisting of silicon dioxide (SiO₂), aluminum oxide (Al₂O₃), tantalum pentoxide (Ta₂O₅), cerium oxide (CeO₂), hafnium oxide (HfO₂), Niobium pentoxide (Nb₂O₅), Niobium dioxide (NbO₂), titanium dioxide (TiO₂), titanium oxide (TiO or Ti₃O₅), Yttrium oxide (Y₂O₃), zirconium dioxide (ZrO₂), and zirconium oxide (ZrO).

190. Model-812 discloses “[the] device” (*“the battery”*) comprising “a Casimir cavity” (*“an intervening space between the first conductive wall and the conductive antenna”*) “formed ... using” (*“is”*) “a dielectric stack” (e.g., comprising *“a solid dielectric”*) of **“SiO₂ and Al₂O₃.”** Ex.1006, [0045].

191. Therefore, Model-812 discloses claim 8.

8. Claim 10

- a. [10.0] The battery of claim 1, wherein a width of the conductive antenna along a width of the cavity gap is not less than half of the width of the cavity gap.**

192. For example, Model-812 discloses that “the transparent conductor layer” (*“the conductive antenna”*) which forms “much of the optically transparent medium of the cavity” has “a thickness” (*“a width of the conductive antenna along a width of the cavity gap”*) of “10 nm to 2 μm” and that “the transport layer” (*“the cavity gap”*) has a thickness of from “0.3 nm to 50 nm.” Ex.1006, [0080] and [0140].

193. A POSITA would have understood from these disclosures that Model-812 contemplates multiple thickness variations of its “transparent conductor layer” (*“conductive antenna”*) and its *“cavity gap.”* For example, a POSITA would have

understood that the transparent conductor disposed within the Casimir cavity would have any manufacturable proportion of the Casimir cavity width, such as half or more. As such, a POSITA would have understood that Model-812's disclosures serve as suggesting or teaching "*a width of the conductive antenna along a width of the cavity gap is not less than half of the width of the cavity gap.*"

9. Claim 14

- a. [14.0] The battery of claim 1, wherein the battery comprises an array of Casimir cells,**
- b. [14.1] wherein the array of Casimir cells is grouped into a plurality of groups of Casimir cells, each group comprising a plurality of Casimir cells,**
- c. [14.2] wherein the groups of Casimir cells are connected in parallel to one another, and**
- d. [14.3] wherein the plurality of Casimir cells within each group are connected in series to one another.**

194. Model-812 teaches multiple devices [e.g., comprising "*the array of Casimir cells ... grouped into a plurality of groups of Casimir cells*"] can be electrically connected to one another [*"the plurality of Casimir cells within each group"*] ... in a laterally adjacent configuration [*"connected in series"*]. ... Alternatively, or in addition, multiple devices [e.g., comprising "*the groups of Casimir cells*"] can be electrically connected to one another ... in a vertically adjacent configuration [*"connected in parallel"*]. Ex.1006, [0008].

195. At the time of the claimed invention, it would have been obvious to a POSITA that cells (such as “[a] plurality of Casimir cells within [a] ... group”) can be connected “in series to one another.” For example, Kuphaldt explains that when cells having voltages $E_1, E_2 \dots E_n$ are connected in a series circuit, the “[t]otal voltage ... is equal to the sum of the individual voltage drops. $E_{\text{total}} = E_1 + E_2 \dots + E_n$.” Ex.1020, 3.

196. Therefore, Moddel-812 discloses or suggests this limitation.

10. Claim 15

- a. [15.0] The battery of claim 1, wherein the battery comprises an array of Casimir cells,
- b. [15.1] wherein the array of Casimir cells is grouped into a plurality of groups of Casimir cells, each group comprising a plurality of Casimir cells,
- c. [15.2] wherein the groups of Casimir cells are connected in series to one another, and
- d. [15.3] wherein the plurality of Casimir cells within each group are connected in parallel to one another.

197. Moddel-812 teaches multiple devices [e.g., comprising “the array of Casimir cells ... grouped into a plurality of groups of Casimir cells”] can be electrically connected to one another [e.g., comprising “the groups of Casimir cells”] ... in a laterally adjacent configuration [“connected in series”]. ... Alternatively, or in addition, multiple devices [e.g., comprising “the plurality of Casimir cells within

each group”] can be electrically connected to one another ... in a vertically adjacent configuration [“*connected in parallel*”]. Ex.1006, [0008].

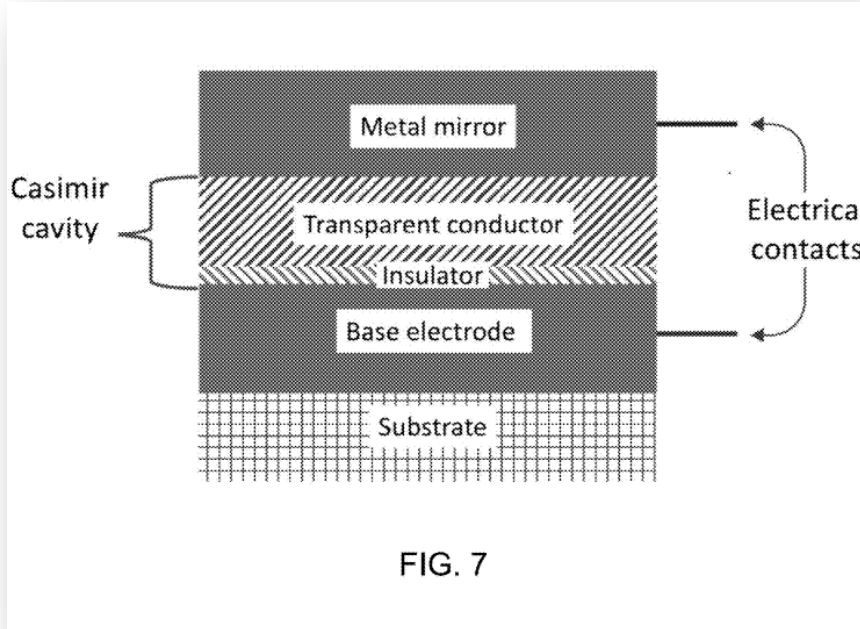
198. At the time of the claimed invention, it would have been obvious to a POSITA that cells (such as “[*a*] plurality of Casimir cells Casimir cells within [*a*] ... group”) can be connected “*in parallel to one another.*” For example, Kuphaldt explains that when cells having voltages $E_1, E_2 \dots E_n$ are connected in a parallel circuit, each cell “in a parallel circuit share[s] the same voltage. $E_{\text{total}} = E_1 = E_2 \dots = E_n$.” Ex.1020, 3.

199. Therefore, Moddel-812 discloses or suggests this limitation.

11. Claim 16

- a. **[16.0] The battery of claim 1, wherein the first conductive wall, the second conductive wall, and the conductive antenna are disposed horizontally with respect to a substrate on which the Casimir cell is disposed.**

200. Moddel-812 illustrates an example “device” (“*battery*”) comprising “base electrode” (“*the first conductive wall*”), “metal mirror” (“*the second conductive wall*”) “and” “transparent conductor” (“*the conductive antenna*”) “disposed horizontally with respect to “a substrate” (“*a substrate*”).

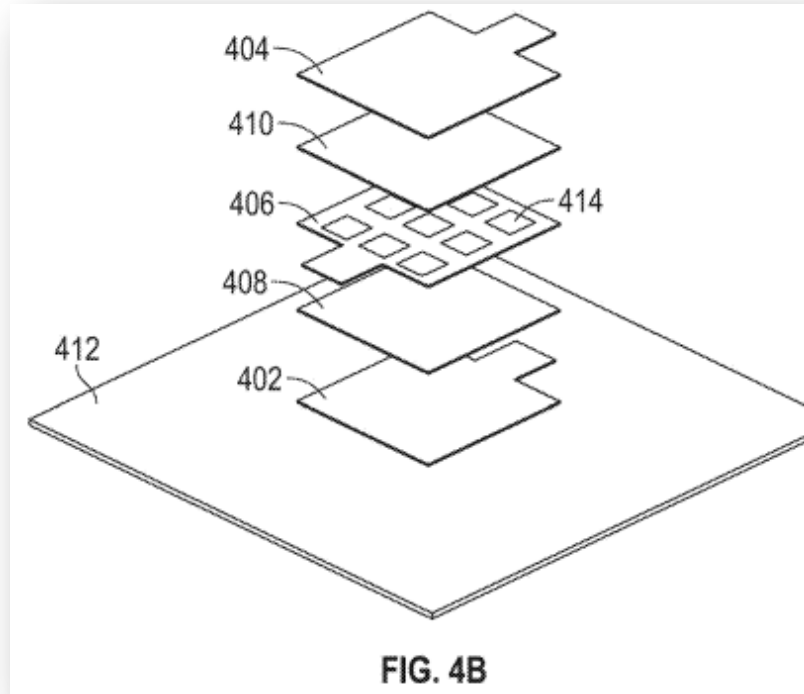


Ex.1006, Figure 7; *see also* Ex.1006, [0080].

12. Claim 17

- a. [17.0] The battery of claim 16, wherein the conductive antenna is a grid.

201. Preliminarily, the 769 Patent describes “a horizontal Casimir cell on a substrate (412) where the conductive antenna (406) is a grid [that] ... includes holes (414)” which “enable a larger surface area for the conductive antenna and thus a larger current generated by the Casimir cell.” *See generally* Ex.1001, 7:52-61 and Figure 4B.



Ex.1001, Figure 4B.

202. As explained in claim 16, Model-812 provides an example of a horizontal configuration disposed on a substrate and explains that “[s]uch a configuration has an **advantage that a much larger area can be used to produce the current.**” Ex.1006, [0069].

203. To the extent one may assert that Model-812 does not expressly disclose the “transparent conductor” (“*the conductive antenna*”) “*is a grid,*” it would have been obvious to a POSITA to use a **grid-shaped** transparent conductor because it would result in a greater surface area, which is one of Model-812’s goals, as explained above. *Id.*

204. Additionally, A POSITA would have also understood that a greater conducting surface area of a grid-shaped transparent conductor (compared to e.g., a pillar- or slab-shaped conductor) would lead to a larger current and therefore provide greater power “to an external element or device.” Ex.1006, [0088]. And, further, a POSITA would have understood a **grid-shaped** conductor / antenna is supported by the teachings of the contemporaneous art. For example, Wu teaches using a waffle-shaped antenna structure. Ex.1017, Abstract (describing an antenna] array structure comprising “[a] waffle grid mounted on top ... to increase effective aperture areas and reduce grating lobes”)).

205. Therefore, Model-812 discloses or suggests claim 17.

13. Claim 19

a. [19.0] The battery of claim 1, wherein the Casimir cell is exposed to light.

206. Model-812 teaches “[a] device[] incorporating Casimir cavities” (“*a battery that comprises ... Casimir-effect powered cells (Casimir cells)*”) including “[a] **transparent** conductor” (“*the conductive antenna*”) which “**does not block the optical modes,**” and that the “cavity layer comprises a material having a **transmittance of** greater than 20% for at least some wavelengths of **light** from 100 nm to 10 μm,” which therefore meets “*the Casimir cell is exposed to light*” requirement. Ex.1006, [0088] and [0142].

207. Therefore, Model-812 discloses claim 19.

C. Ground 3: The combination of Model-812 and White renders obvious claims 1-20.

1. The “Model-812/White” Combination

208. For the reasons below and those provided *infra* §IX.D.1, it would have been obvious to a POSITA to incorporate White’s teachings relating to Casimir cavity geometries when designing Casimir cells such as those taught in Model-812, for example, in order to optimize the geometry of the cavity and internal conductive structures that influence Casimir-effect interactions. Doing so would enable the resulting Casimir-energy devices to benefit from White’s modeling and analysis of how cavity geometry affects Casimir forces.

209. Both references are analogous art to the 769 Patent. First, both references are directed toward the same field of endeavor by the 769 Patent—Casimir-effect powered devices and structures designed to harness or manipulate vacuum-fluctuation energy within conductive cavities. Ex.1001, Abstract. Second, both references are and reasonably pertinent as the problem addressed by the 769 Patent—voltage generated by Casimir phenomenon based on geometries of conductive structures. *Id.*

210. For example, White analyzes Casimir-effect behavior within engineered cavity geometries and describes conductive structures arranged between

opposing conductive surfaces to influence Casimir energy distributions. Ex.1005, Abstract. White explains that the geometry and placement of conductive structures within a cavity affects the resulting energy distribution and electromagnetic behavior within the cavity to produce detectable electrical potentials associated with Casimir interactions. *Id.*

211. Similarly, Moddel-812 describes Casimir-effect powered devices comprising conductive surfaces separated by a cavity gap. Because both references address the design and configuration of conductive structures within Casimir cavities to influence resulting energy behavior, a POSITA would have considered both references when seeking to design or improve Casimir-effect powered cells.

212. Second, a POSITA would have been motivated to combine the teachings of White and Moddel-812 because White focuses on the principles/theory of Casimir geometry design and Moddel-812 provides practical Casimir cell implementation techniques. For example, White analyzes Casimir-effect interactions in cavities having customized internal geometries using worldline numerical simulations. White explains that introducing conductive structures within a cavity influences Casimir energy distributions and resulting forces or potentials within the cavity. Ex.1005, p.1.

213. Therefore, White's guidance regarding how internal conductive structures (e.g., their configuration and placement) positioned between conductive

surfaces affect the resulting Casimir energy distribution would enhance a POSITA's understanding of Casimir cell structures (*e.g.*, Model-812's Casimir cell embodiment having a transparent conductor in the interior of a Casimir cavity). Specifically, a POSITA would have understood that combining White's teachings in Model-812's Casimir cell structures would improve Model-812's Casimir cell by providing increased charge flow (or, equivalently increased current) to an external element or device. Ex.1006, [0088].

214. Model-812, by contrast, describes practical device implementations for harvesting electrical energy from Casimir interactions and discloses details of fabrication methods (including etching) to design devices comprising Casimir cells. Ex.1006, [0101]-[0102]. Therefore, while White focuses on theoretical and analytical modeling of Casimir cells, Model-812 provides detailed practical implementations and structures of Casimir-effect powered cells capable of generating electrical potential differences.

215. A POSITA would have understood that combining the teachings of White and Model-812 involves applying known design principles regarding Casimir cavity geometry to known Casimir-effect device structures. Both references rely on the same physical phenomenon—the Casimir effect arising from vacuum fluctuations between conductive surfaces—and both involve conductive structures arranged within cavity gaps. Ex.1005, Abstract and Ex.1006, Abstract.

216. Accordingly, implementing White's cavity geometries within Model-812's Casimir cell structures would have represented the application of known design principles to a known device architecture, yielding predictable results. Because both references rely on the same physical phenomenon, a POSITA would have had a reasonable expectation that implementing White's cavity geometries within Model-812's device structures would operate as expected.

217. Further, because both references recognize that geometric parameters of the cavity structure (e.g., geometries of Casimir cells and conductive structures placed therein) influence device performance in producing electric potential / charge flow (Ex.1005, Abstract and Ex.1006, [0088]), a POSITA designing Casimir-effect energy harvesting cells would have been motivated to optimize those parameters to improve such charge flows. Applying White's teachings regarding cavity geometries to the device structures disclosed in Model-812 would therefore represent the routine optimization of known design parameters to improve device performance (e.g., electric potential / charge flow).

218. Moreover, both references describe conductive cavity structures that may be fabricated using conventional microfabrication techniques. Accordingly, implementing White's geometries within Model-812's device architecture would have been well within the skills of POSITAs working in microelectromechanical systems (MEMS), nanofabrication, and Casimir-effect device engineering.

Practitioners in such fields routinely modify structural geometries—including cavity dimensions, electrode placement, and internal conductive elements—to improve device performance.

219. Implementing White's teachings within the Casimir cell architectures disclosed in Model-812 would require only routine design modifications. Model-812 already teaches two different fabrication processes to form the devices. Ex.1006, [0102] and Figures 12A and 12B. A POSITA would therefore understand that modifying the geometry or configuration of such conductive structures in accordance with White's teachings would involve only routine engineering adjustments to known microfabrication designs. E.g., the 769 Patent admits that deep reactive ion etching equipment was commonly used in the semiconductor industry. Ex.1001, 5:59-63.

2. Claims 1-20

220. Model-812 and White, individually and in a combination, teach(es) or suggest(s) all of the elements of claims 1-20 for the same reasons demonstrated above with respect to Grounds 1 and 2, as incorporated below.

Claims	Taught or Suggested by
1	<u>Model-812</u> (See Ground 2) and <u>White</u> (See Ground 1)
20	<u>Model-812</u> (See Ground 2) and <u>White</u> (See Ground 1)

3-4, 9, 11-13, 18	<u>White</u> (See Ground 1)
2, 5-8, 10, 14-17, and 19	<u>Model-812</u> (See Ground 2)

D. Ground 4: The combination of White and Model-812 renders obvious claims 1-20.

1. The “White/Model-812” Combination

221. For the reasons below and those provided *supra* §IX.C.1, it would have been obvious to a POSITA to incorporate Model-812’s teachings relating to device fabrication architectures when implementing Casimir cavity geometries such as those analyzed in White, for example, in order to realize those geometries in practical microfabricated Casimir-effect devices. Doing so would have been a predictable application of known semiconductor fabrication processes to structures governed by well-understood Casimir-effect physics.

222. White, Model-812, and the 769 Patent are analogous art or the reasons already demonstrated above. §IX.C.1.

223. A POSITA would have recognized to implement White’s Casimir cells based on Model-812’s teachings of structural configurations / semiconductor fabrication methodologies. Because White demonstrates that Casimir energy behavior depends on the arrangement and type of materials of conductive structures within a cavity, a POSITA designing Casimir-based energy devices would have

sought to implement such geometries using Model-812's teachings of practical device architectures in the micron or sub-micron regime, which is exactly the scale associated with MEMS devices and Casimir cells capable of generating electrical output.

224. Model-812 provides exactly such device architectures. By incorporating Model-812's conductive wall structures, various type of internal conductive elements, electrical configurations, and fabrication techniques into the cavity geometries analyzed in White, a POSITA would have been able to convert the Casimir energy distributions identified in White into usable electrical potentials.

225. Implementing Model-812's structural teachings within the cavity geometries analyzed in White would have required only routine engineering modifications. Both references involve conductive structures arranged within nanoscale cavities and rely on the same physical phenomenon—the Casimir effect arising from quantum vacuum fluctuations between conductive surfaces.

226. Because Model-812, just like White, already discloses conductive walls, cavity gaps, and internal conductive structures capable of producing electrical potentials from Casimir interactions, incorporating Model-812's structural teachings into the cavity geometries analyzed in White would involve only straightforward design choices regarding placement, configuration, and type of conductive elements within the cavity.

227. Accordingly, incorporating Model-812's conductive wall and internal conductive element configurations into the Casimir cavity geometries analyzed in White would have been well within the ordinary skill of practitioners in the field and would have been expected to operate according to the same Casimir-effect principles described in both references.

228. Accordingly, a POSITA would have recognized that combining the references would yield predictable benefits. Specifically, the resulting device would incorporate the geometrical Casimir structures studied in White together with the energy-harvesting architecture disclosed in Model-812, enabling the Casimir interactions described by White to produce electrical output as described in Model-812.

2. Claims 1-20

229. White and Model-812, individually and in a combination, teach(es) or suggest(s) all of the elements of claims 1-20 for the same reasons demonstrated above with respect to Grounds 1 and 2, as incorporated below.

Claims	Taught or Suggested by
1	<u>White</u> (See Ground 1) and <u>Model-812</u> (See Ground 2)
20	<u>White</u> (See Ground 1) and <u>Model-812</u> (See Ground 2)
3-4, 9, 11-13, 18	<u>White</u> (See Ground 1)

2, 5-8, 10, 14-17, and 19	<u>Moddel-812</u> (<i>See</i> Ground 2)
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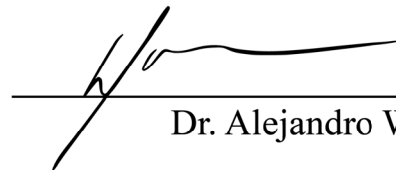
X. OBJECTIVE INDICIA OF NON-OBVIOUSNESS

230. I am not aware of any objective indicia of non-obviousness that would change my opinion that the challenged claims of the 769 Patent are obvious in view of the prior art discussed above in this declaration. It is my opinion that any potential objective indicia of non-obviousness would not overcome the clear disclosures in the prior art showing that the subject matter of these claims would have been obvious to a POSITA as of the earliest priority date of the 769 Patent. However, I reserve the right to supplement my opinions Patent Owner alleges or offers any purported evidence of objective indicia of non-obviousness.

VI. CONCLUSION

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

Dated: [09/02], 2026



Dr. Alejandro W. Rodriguez

CLAIM LISTING

Claim 1	
[1.0]	A battery that comprises a Casimir-effect powered cell (Casimir cell), the Casimir cell comprising:
[1.1]	a first conductive wall; [and] a second conductive wall that faces the first conductive wall; and
[1.2]	a conductive antenna disposed in a cavity gap that is a space between the first conductive wall and the second conductive wall, wherein the conductive antenna faces the first conductive wall and the second conductive wall,
[1.3]	wherein the first conductive wall and the second conductive wall produce a same first voltage potential,
[1.4]	wherein the conductive antenna produces a second voltage potential that is different from the first voltage potential, and
[1.5]	wherein a voltage that is the difference between the first voltage potential and the second voltage potential is generated by Casimir phenomenon based on arrangement of the conductive antenna between the first conductive wall and the second conductive wall.
Claim 2	
[2.0]	The battery of claim 1, wherein the conductive antenna comprises a flat block, and the flat block is at least semi-transparent in at least a region of optical frequencies.
Claim 3	
[3.0]	The battery of claim 1, wherein the conductive antenna comprises a plurality of antenna elements that are electrically connected to one another and have the second voltage potential, and
[3.1]	wherein one or more of the plurality of antenna elements are pillars.
Claim 4	
[4.0]	The battery of claim 1, wherein, from a cross-sectional view of the Casimir cell perpendicular to a plane of substrate on which the Casimir cell is disposed, one or more of the plurality of antenna elements have a round, rectangular, or prismatic shape.
Claim 5	
[5.0]	The battery of claim 1, wherein the first conductive wall comprises a material selected from the group consisting of gold (Au), silver (Ag), platinum (Pt), aluminum (Al), copper (Cu), palladium (Pd), iridium (Ir), titanium nitride (TiN), molybdenum (Mo), silicon (Si), and graphene.

Claim 6	
[6.0]	The battery of claim 1, wherein the first conductive wall comprises a doped semiconductor of a first polarity, and the conductive antenna comprises a doped semiconductor of a second polarity that is opposite of the first polarity.
Claim 7	
[7.0]	The battery of claim 1, wherein an intervening space between the first conductive wall and the conductive antenna comprises a material selected from a group consisting of a gas dielectric, a liquid dielectric, and a solid dielectric.
Claim 8	
[8.0]	The battery of claim 1, wherein an intervening space between the first conductive wall and the conductive antenna is a solid dielectric that is selected from a group consisting of silicon dioxide (SiO ₂), aluminum oxide (Al ₂ O ₃), tantalum pentoxide (Ta ₂ O ₅), cerium oxide (CeO ₂), hafnium oxide (HfO ₂), Niobium pentoxide (Nb ₂ O ₅), Niobium dioxide (NbO ₂), titanium dioxide (TiO ₂), titanium oxide (TiO or Ti ₃ O ₅), Yttrium oxide (Y ₂ O ₃), zirconium dioxide (ZrO ₂), and zirconium oxide (ZrO).
Claim 9	
[9.0]	The battery of claim 1, wherein the cavity gap has a width of not more than 10 micrometers.
Claim 10	
[10.0]	The battery of claim 1, wherein a width of the conductive antenna along a width of the cavity gap is not less than half of the width of the cavity gap.
Claim 11	
[11.0]	The battery of claim 1, wherein a first distance between the conductive antenna and the first conductive wall is the same as a second distance between the conductive antenna and the second conductive wall.
Claim 12	
[12.0]	The battery of claim 1, wherein the first conductive wall, the second conductive wall, and the conductive antenna contain the same material.
Claim 13	
[13.0]	The battery of claim 1, wherein the first conductive wall, the second conductive wall, and the conductive antenna are disposed vertically with respect to a substrate on which the Casimir cell is disposed.

Claim 14	
[14.0]	The battery of claim 1, wherein the battery comprises an array of Casimir cells,
[14.1]	wherein the array of Casimir cells is grouped into a plurality of groups of Casimir cells, each group comprising a plurality of Casimir cells,
[14.2]	wherein the groups of Casimir cells are connected in parallel to one another, and
[14.3]	wherein the plurality of Casimir cells within each group are connected in series to one another.
Claim 15	
[15.0]	The battery of claim 1, wherein the battery comprises an array of Casimir cells,
[15.1]	wherein the array of Casimir cells is grouped into a plurality of groups of Casimir cells, each group comprising a plurality of Casimir cells,
[15.2]	wherein the groups of Casimir cells are connected in series to one another, and
[15.3]	wherein the plurality of Casimir cells within each group are connected in parallel to one another.
Claim 16	
[16.0]	The battery of claim 1, wherein the first conductive wall, the second conductive wall, and the conductive antenna are disposed horizontally with respect to a substrate on which the Casimir cell is disposed.
Claim 17	
[17.0]	The battery of claim 16, wherein the conductive antenna is a grid.
Claim 18	
[18.0]	The battery of claim 1, wherein the Casimir cell comprises a c-shape wall that comprises the first conductive wall and the second conductive wall,
[18.1]	wherein the first conductive wall and the second conductive wall are opposite walls of the c-shape wall, and
[18.2]	wherein the conductive antenna is disposed inside the c-shape wall in between the first conductive wall and the second conductive wall.
Claim 19	
[19.0]	The battery of claim 1, wherein the Casimir cell is exposed to light.
Claim 20	
[20.0]	A method for making a Casimir-effect powered cell comprising:
[20.1]	etching a substrate to create a first conductive wall on the substrate; [and] etching the substrate to create a second conductive wall on the substrate such that the second conductive wall faces the first conductive wall; and

[20.2]	etching the substrate to create a conductive antenna disposed in a cavity gap that is a space between the first conductive wall and the second conductive wall, wherein the conductive antenna faces the first conductive wall and the second conductive wall,
[20.3]	wherein the first conductive wall and the second conductive wall are etched to be electrically connected and have a same first voltage potential, and
[20.4]	wherein the conductive antenna is etched to have a second voltage potential that is different from the first potential.