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Application Number: 18331486

Document Date: 06/08/2023

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|-----------------------------------------------------------------|--|------------------------------------------|--|
| <b>UTILITY<br/>PATENT APPLICATION<br/>TRANSMITTAL</b>           |  | Attorney Docket No. <b>19077-002001</b>  |  |
|                                                                 |  | First Named Inventor <b>Harold White</b> |  |
|                                                                 |  | Title <b>CASIMIR POWER CELL</b>          |  |
| (Only for new nonprovisional applications under 37 CFR 1.53(b)) |  | Priority Mail Express®<br>Label No.      |  |

|                                                                                                     |                                                                                              |
|-----------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|
| <b>APPLICATION ELEMENTS</b><br>See MPEP chapter 600 concerning utility patent application contents. | <b>ADDRESS TO:</b><br>Commissioner for Patents<br>P.O. Box 1450<br>Alexandria, VA 22313-1450 |
|-----------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1. <input type="checkbox"/> <b>Fee Transmittal Form</b><br>(PTO/SB/17 or equivalent)<br>2. <input checked="" type="checkbox"/> <b>Applicant asserts small entity status.</b><br>See 37 CFR 1.27<br>3. <input type="checkbox"/> <b>Applicant certifies micro entity status.</b> See 37 CFR 1.29.<br>Applicant must attach form PTO/SB/15A or B or equivalent.<br>4. <input checked="" type="checkbox"/> <b>Specification</b> [Total Pages <b>34</b> ]<br>Both the claims and abstract must start on a new page.<br>(See MPEP § 608.01(a) for information on the preferred arrangement)<br>5. <input checked="" type="checkbox"/> <b>Drawing(s)</b> (35 U.S.C. 113) [Total Sheets <b>14</b> ]<br>6. <b>Inventor's Oath or Declaration</b> [Total Pages <b>3</b> ]<br>(including substitute statements under 37 CFR 1.64 and assignments<br>serving as an oath or declaration under 37 CFR 1.63(e))<br>a. <input checked="" type="checkbox"/> Newly executed (original or copy)<br>b. <input type="checkbox"/> A copy from a prior application (37 CFR 1.63(d))<br>7. <input checked="" type="checkbox"/> <b>Application Data Sheet</b> * See note below.<br>See 37 CFR 1.76 (PTO/AIA/14 or equivalent)<br>8. <b>CD-ROM or CD-R</b><br>in duplicate, large table, or Computer Program (Appendix)<br><input type="checkbox"/> Landscape Table on CD<br>9. <b>Nucleotide and/or Amino Acid Sequence Submission</b><br>(if applicable, items a. – c. are required)<br>a. <input type="checkbox"/> Computer Readable Form (CRF)<br>b. <input type="checkbox"/> Specification Sequence Listing on:<br>i. <input type="checkbox"/> CD-ROM or CD-R (2 copies); or<br>ii. <input type="checkbox"/> Paper<br>c. <input type="checkbox"/> Statements verifying identity of above copies | <b>ACCOMPANYING APPLICATION PAPERS</b><br>10. <input type="checkbox"/> <b>Assignment Papers</b><br>(cover sheet & document(s))<br><div style="border: 1px solid black; height: 40px; margin-top: 5px;"></div> Name of Assignee<br>11. <input type="checkbox"/> <b>37 CFR 3.73(c) Statement</b> (when there is an assignee) <input type="checkbox"/> <b>Power of Attorney</b><br>12. <input type="checkbox"/> <b>English Translation Document</b> (if applicable)<br>13. <input type="checkbox"/> <b>Information Disclosure Statement</b><br>(PTO/SB/08 or PTO-1449)<br><input type="checkbox"/> Copies of citations attached<br>14. <input type="checkbox"/> <b>Preliminary Amendment</b><br>15. <input type="checkbox"/> <b>Return Receipt Postcard</b><br>(MPEP § 503) (Should be specifically itemized)<br>16. <input type="checkbox"/> <b>Certified Copy of Priority Document(s)</b><br>(if foreign priority is claimed)<br>17. <input type="checkbox"/> <b>Nonpublication Request</b><br>Under 35 U.S.C. 122(b)(2)(B)(i). Applicant must attach form PTO/SB/35<br>or equivalent.<br>18. <input type="checkbox"/> <b>Other:</b> <div style="border: 1px solid black; height: 40px; margin-top: 5px;"></div> |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

**\*Note:** (1) Benefit claims under 37 CFR 1.78 and foreign priority claims under 1.55 **must** be included in an Application Data Sheet (ADS).  
 (2) For applications filed under 35 U.S.C. 111, the application must contain an ADS specifying the applicant if the applicant is an assignee, person to whom the inventor is under an obligation to assign, or person who otherwise shows sufficient proprietary interest in the matter. See 37 CFR 1.46(b).

|                                                                                               |                     |                                                          |                                   |
|-----------------------------------------------------------------------------------------------|---------------------|----------------------------------------------------------|-----------------------------------|
| <b>19. CORRESPONDENCE ADDRESS</b>                                                             |                     |                                                          |                                   |
| <input checked="" type="checkbox"/> The address associated with Customer Number: <b>22511</b> |                     | OR <input type="checkbox"/> Correspondence address below |                                   |
| Name                                                                                          |                     |                                                          |                                   |
| Address                                                                                       |                     |                                                          |                                   |
| City                                                                                          | State               | Zip Code                                                 |                                   |
| Country                                                                                       | Telephone           | Email                                                    |                                   |
| Signature                                                                                     | /Thomas K. Scherer/ |                                                          | Date                              |
| Name (Print/Type)                                                                             | Thomas K. Scherer   |                                                          | Registration No. (Attorney/Agent) |
|                                                                                               |                     | June 8, 2023                                             |                                   |
|                                                                                               |                     | 45,079                                                   |                                   |

## DECLARATION AND ASSIGNMENT – WORLDWIDE

Whereas, the undersigned individual(s) (referred to herein as the "INVENTOR(S)") has/have invented:

☒ The attached application to be filed as a United States application or PCT international application, or  
☐ United States application or PCT international application number \_\_\_\_\_ filed on \_\_\_\_\_; and, entitled: CASIMIR POWER CELL

Regarding that application, each of the INVENTOR(S) declares the following:

- The above-identified application was made or authorized to be made by me.
- I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.
- I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

For good and valuable consideration, the receipt and sufficiency of which are hereby acknowledged, the INVENTOR(S) hereby assign, transfer, and set over to:

Limitless Space Institute  
having the following address:  
16441 Space Center Blvd.  
Bldg. D-200  
Houston, TX 77058

(referred to herein as "COMPANY"), its successors, and assigns, the entire right, title, and interest, worldwide, in and to the invention described in the patent application identified above (referred to herein as "INVENTION"), together with said patent application, all divisions, continuations, continuations-in-part, reissues, and extensions thereof, and all Letters Patent (domestic and foreign) that may be granted therefor. Such interest represents the entire ownership of said applications and Letters Patent when granted and is to be owned by COMPANY, its successors, and assigns, or their legal representatives, for the full and entire term for which such Letters Patent may be granted or extended, as fully and entirely as the same would have been enjoyed by the INVENTOR(S) if this assignment had not been made.

In addition, the undersigned INVENTOR(S) each hereby agrees:

1. To sign and execute any further documents that may be necessary or desirable, lawful, and proper in connection with the prosecution of all applications for patent(s) on the INVENTION in the United States, including without limitation said application and all divisions, continuations, continuations-in-part, amendments thereof, and all interference proceedings associated therewith, or otherwise necessary or desirable to secure the title thereto to COMPANY;
2. To execute all papers and documents and to perform all lawful acts that may be necessary in connection with claims to priority or otherwise under the International Convention for the Protection of Industrial Property or similar treaties or agreements;



3. To perform all lawful affirmative acts that may be necessary to obtain the grant of valid and enforceable patents to COMPANY.

The undersigned INVENTOR(S) each hereby authorizes and requests the Commissioner of Patents and Trademarks in the United States to issue any and all Letters Patent resulting from said application, including without limitation any division, continuation, continuation-in-part, or reissue thereof to COMPANY.

The undersigned INVENTOR(S) each hereby grants to the firm of OSHA BERGMAN WATANABE & BURTON LLP the power to insert on this Assignment any further identification that may be necessary or desirable in order to comply with the rules of the United States Patent and Trademark Office for the recordation of this document.

IN WITNESS WHEREOF, this Assignment has been executed by each of the undersigned individuals on the date appearing by such individual's signature:

6/5/23  
Date  
1<sup>st</sup> Inventor Signature: [Signature]  
Print or Type Name: Harold WHITE

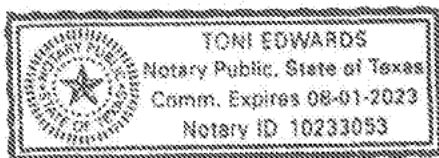
\_\_\_\_\_  
Date  
2<sup>nd</sup> Inventor Signature: \_\_\_\_\_  
Print or Type Name: \_\_\_\_\_

\_\_\_\_\_  
Date  
3<sup>rd</sup> Inventor Signature: \_\_\_\_\_  
Print or Type Name: \_\_\_\_\_

\_\_\_\_\_  
Date  
4<sup>th</sup> Inventor Signature: \_\_\_\_\_  
Print or Type Name: \_\_\_\_\_

This Assignment may be signed before either:  
(a) a Notary Public for one of the States of the United States, or (b) two witnesses who sign below:

**NOTARY PUBLIC**  
State of Texas  
County of Harris  
Before me personally appeared: Harold White  
\_\_\_\_\_  
1<sup>st</sup> Inventor  
\_\_\_\_\_  
2<sup>nd</sup> Inventor  
\_\_\_\_\_  
3<sup>rd</sup> Inventor  
\_\_\_\_\_  
4<sup>th</sup> Inventor  
each of whom acknowledged the foregoing instrument to be a free act and deed and also represented that he/she is authorized to execute this Assignment.  
Dated: 6/5/2023  
Toni Edwards  
Notary Public  
My commission expires: 8-1-2023



WITNESSES

6/5/2023

Date

Signature of Witness:

Andre' Sylvester

Print or Type Name:

Andre' Sylvester

6/5/2023

Date

Signature of Witness:

Janice W. Campbell

Print or Type Name:

Janice W. Campbell

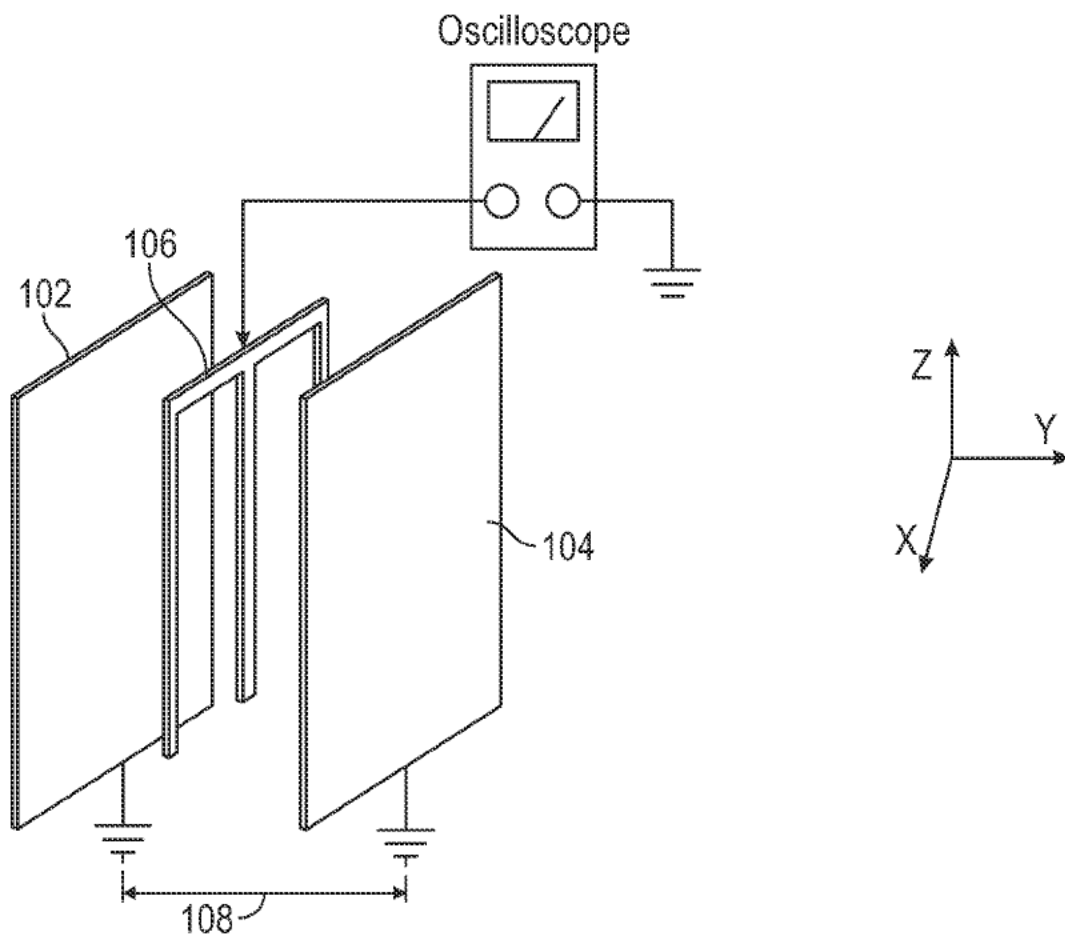


FIG. 1

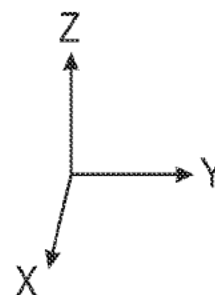
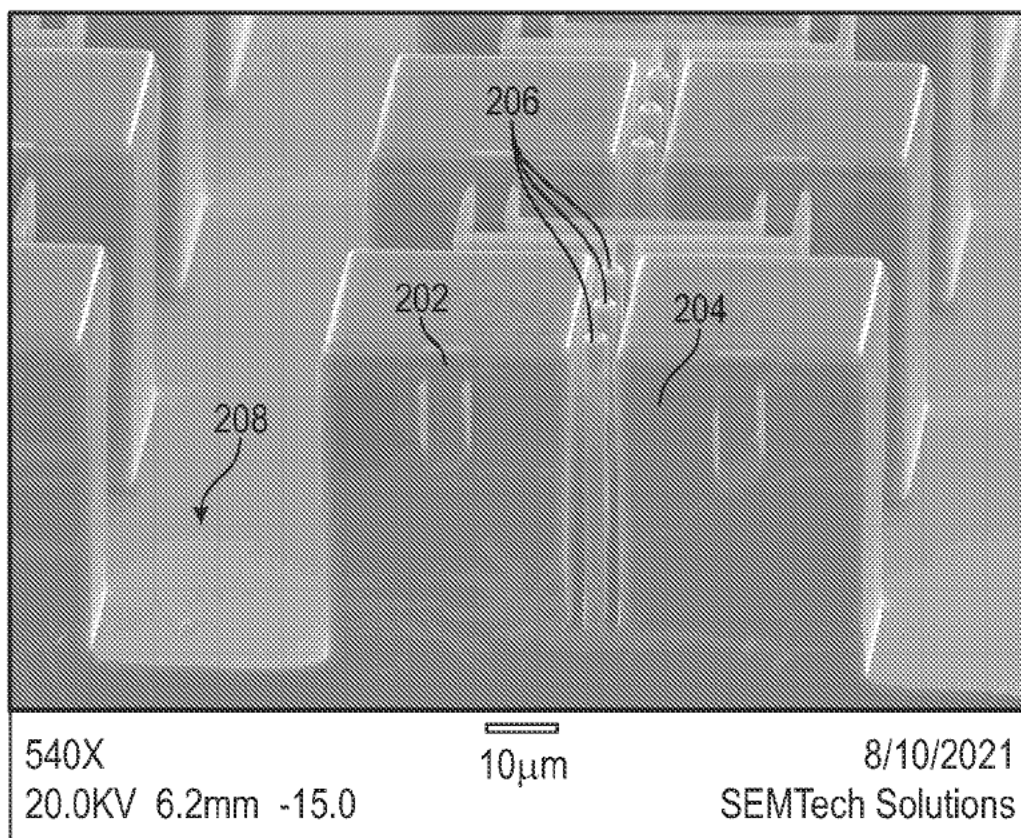


**FIG. 2**

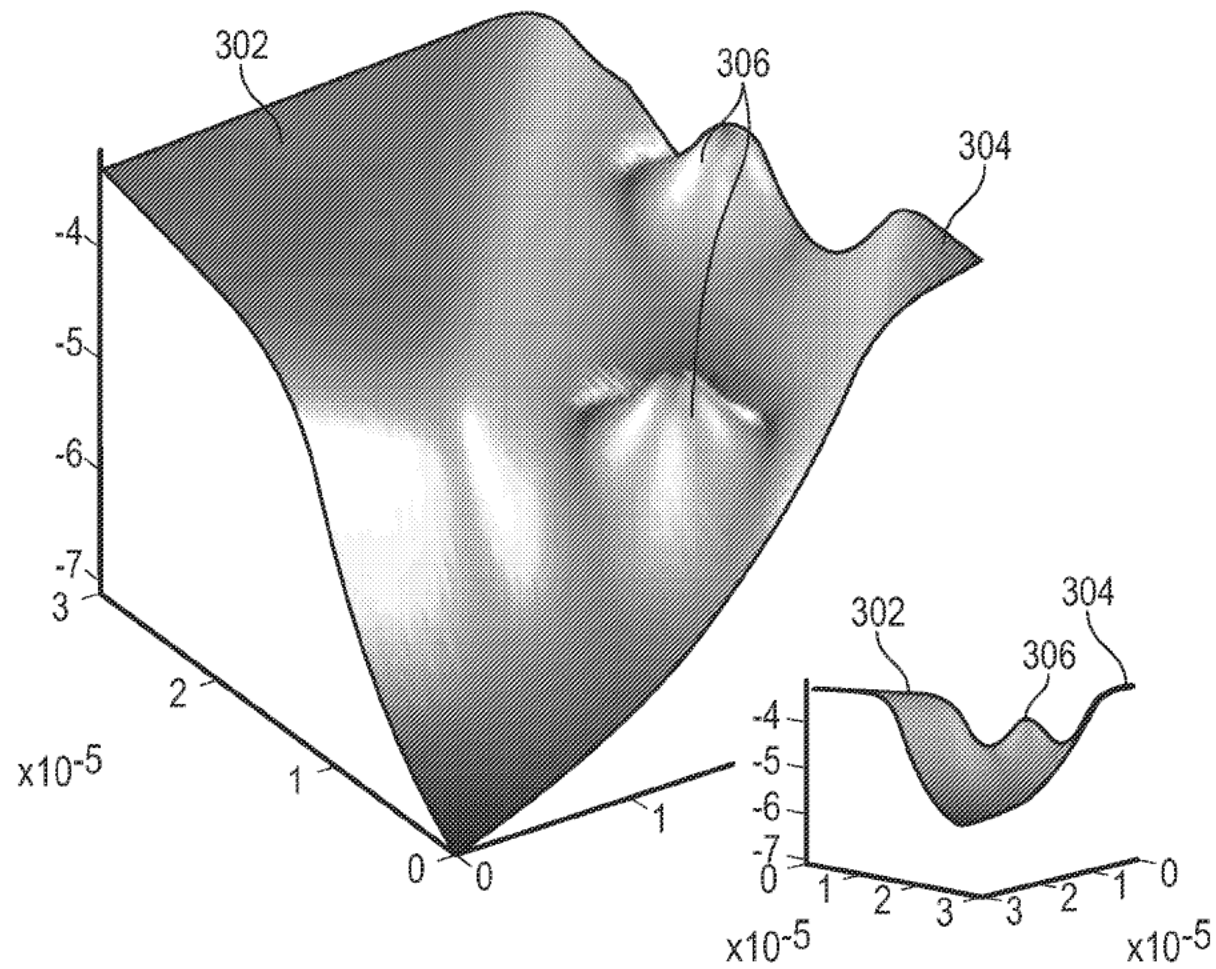


FIG. 3

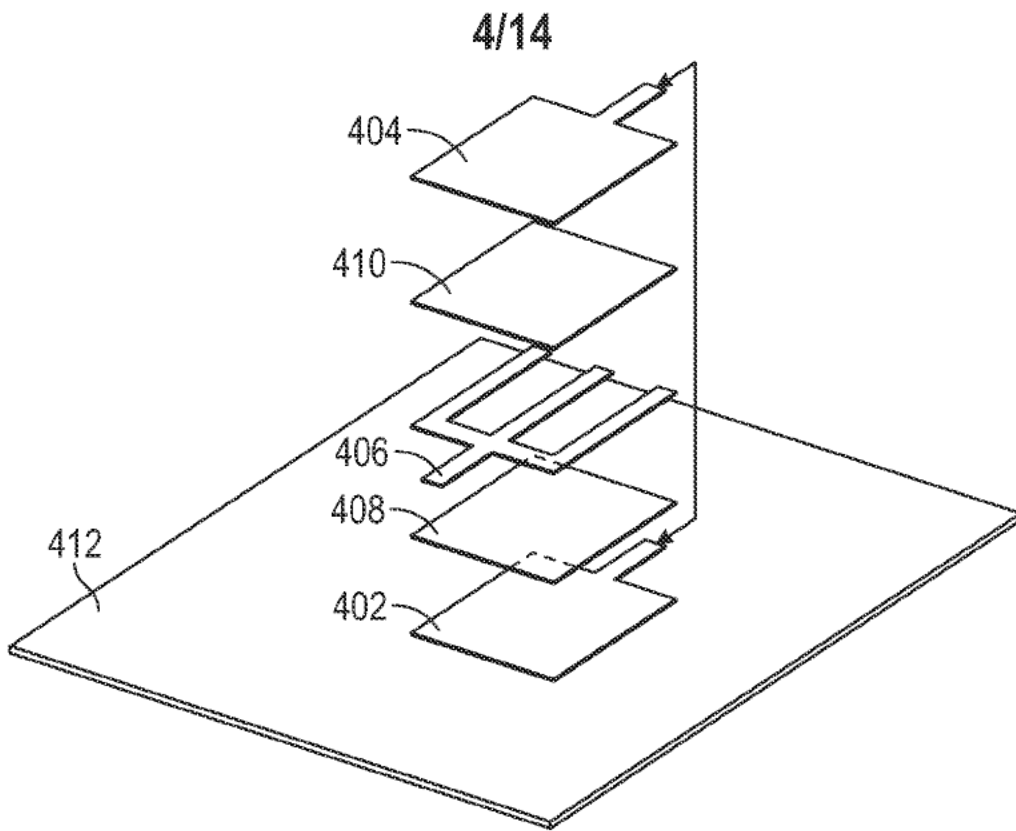


FIG. 4A

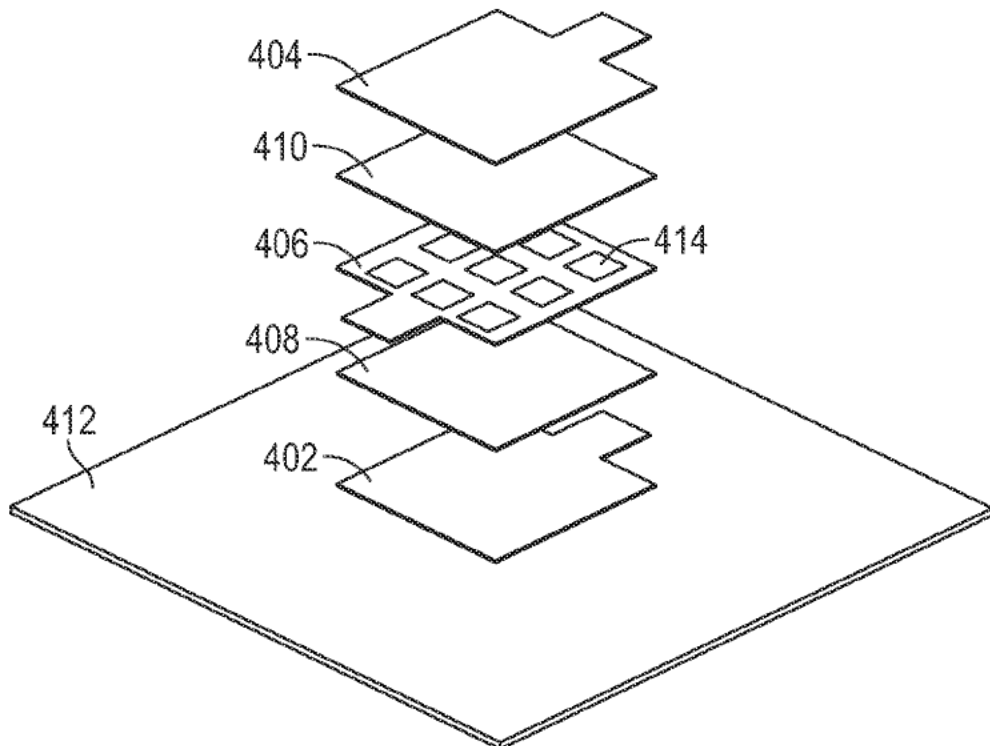


FIG. 4B

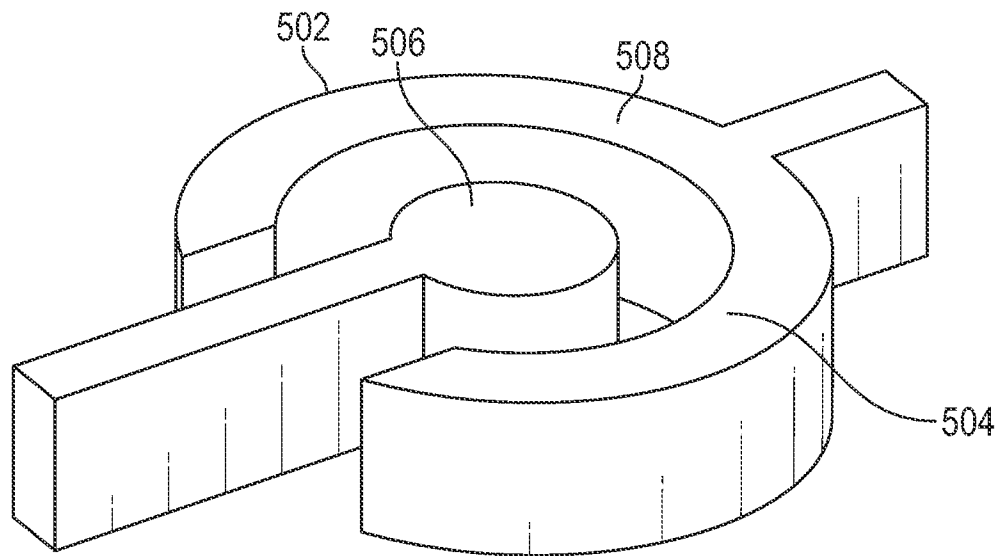


FIG. 5

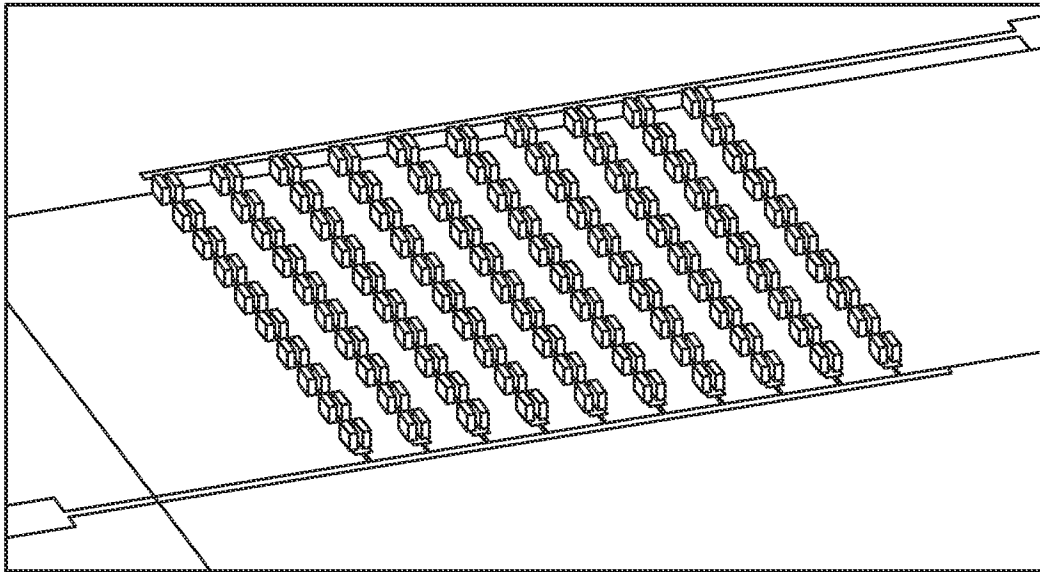


FIG. 6

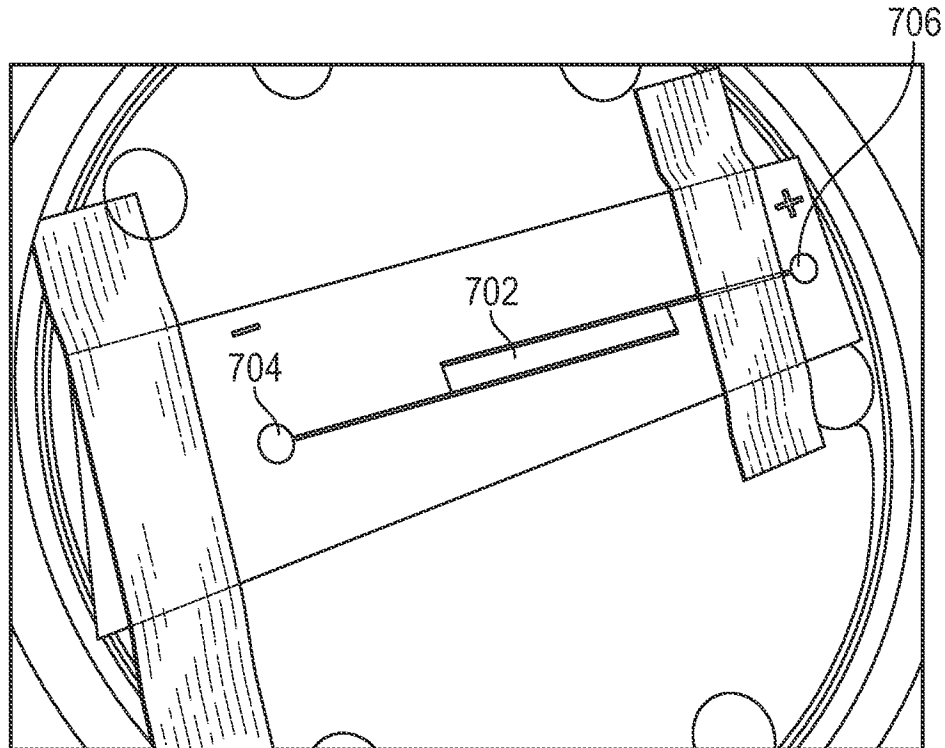


FIG. 7

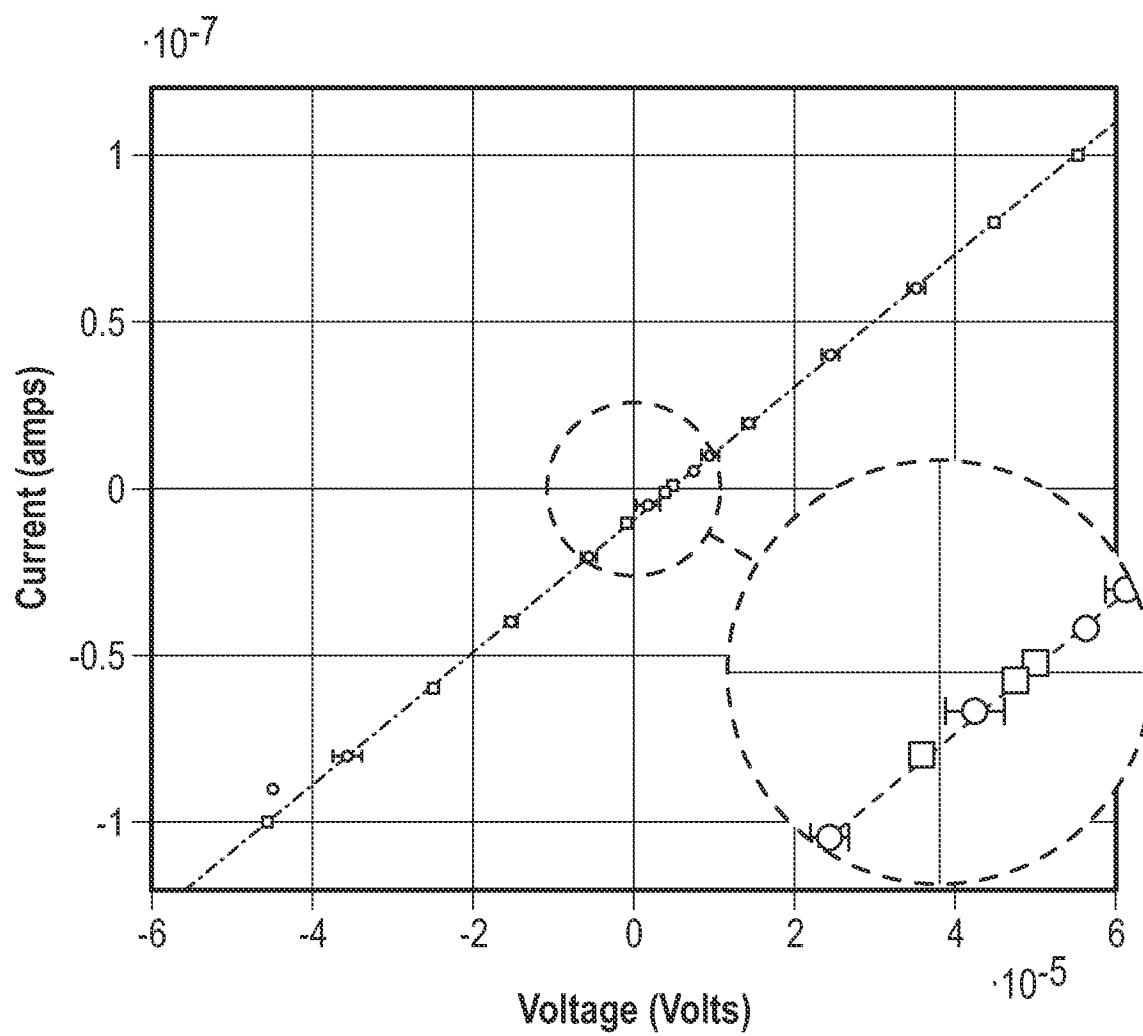


FIG. 8A

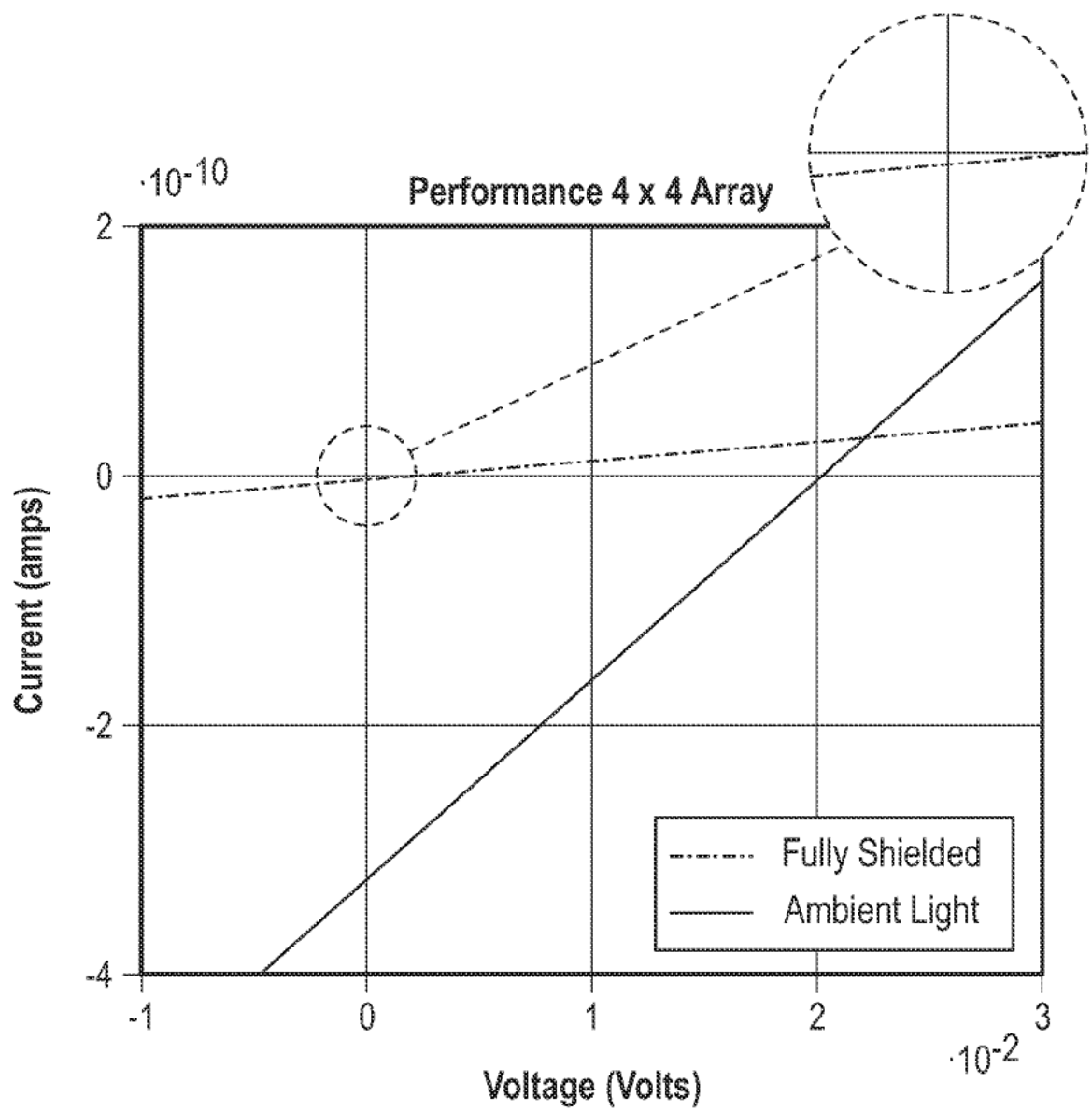


FIG. 8B

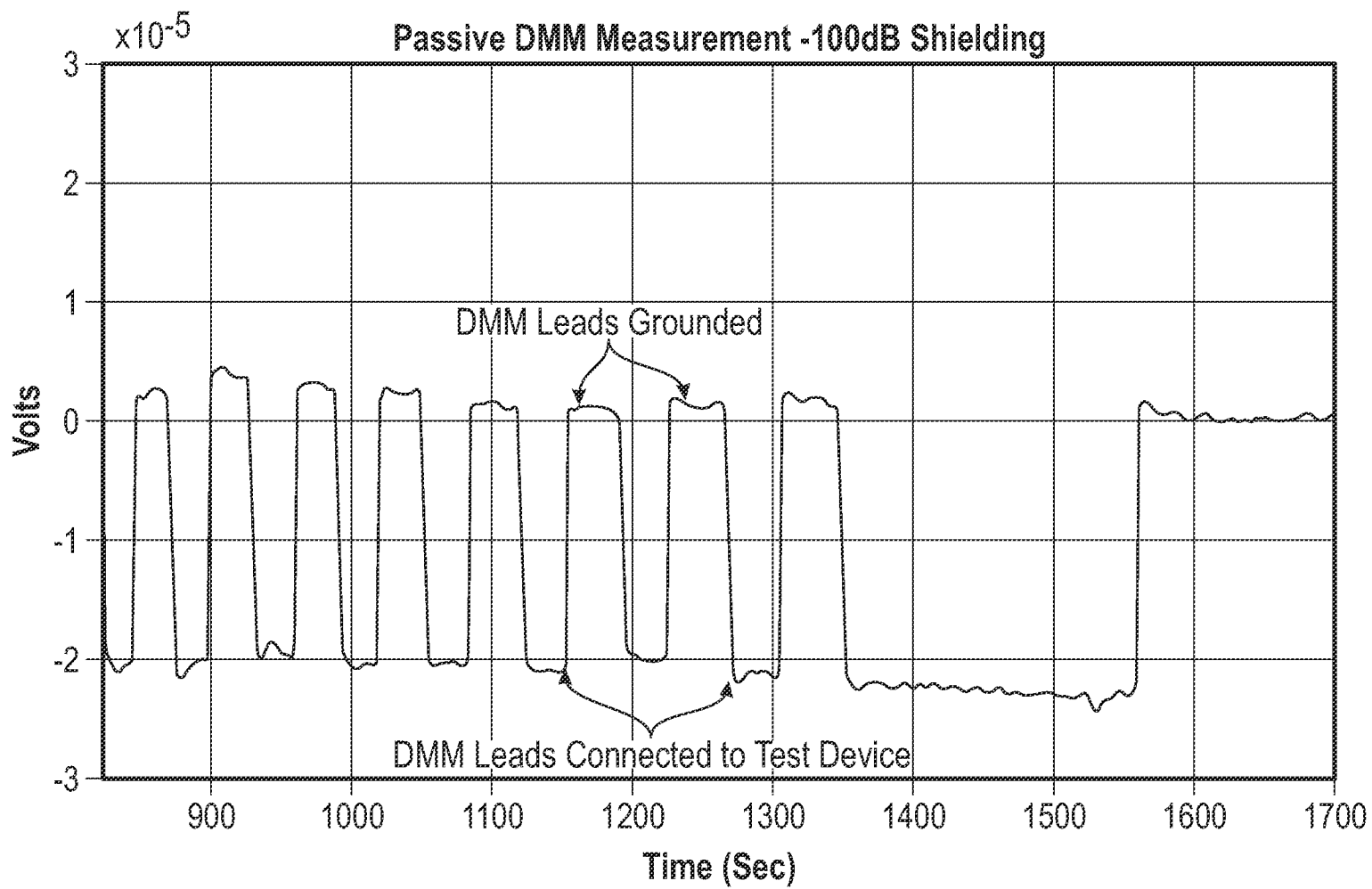


FIG. 9

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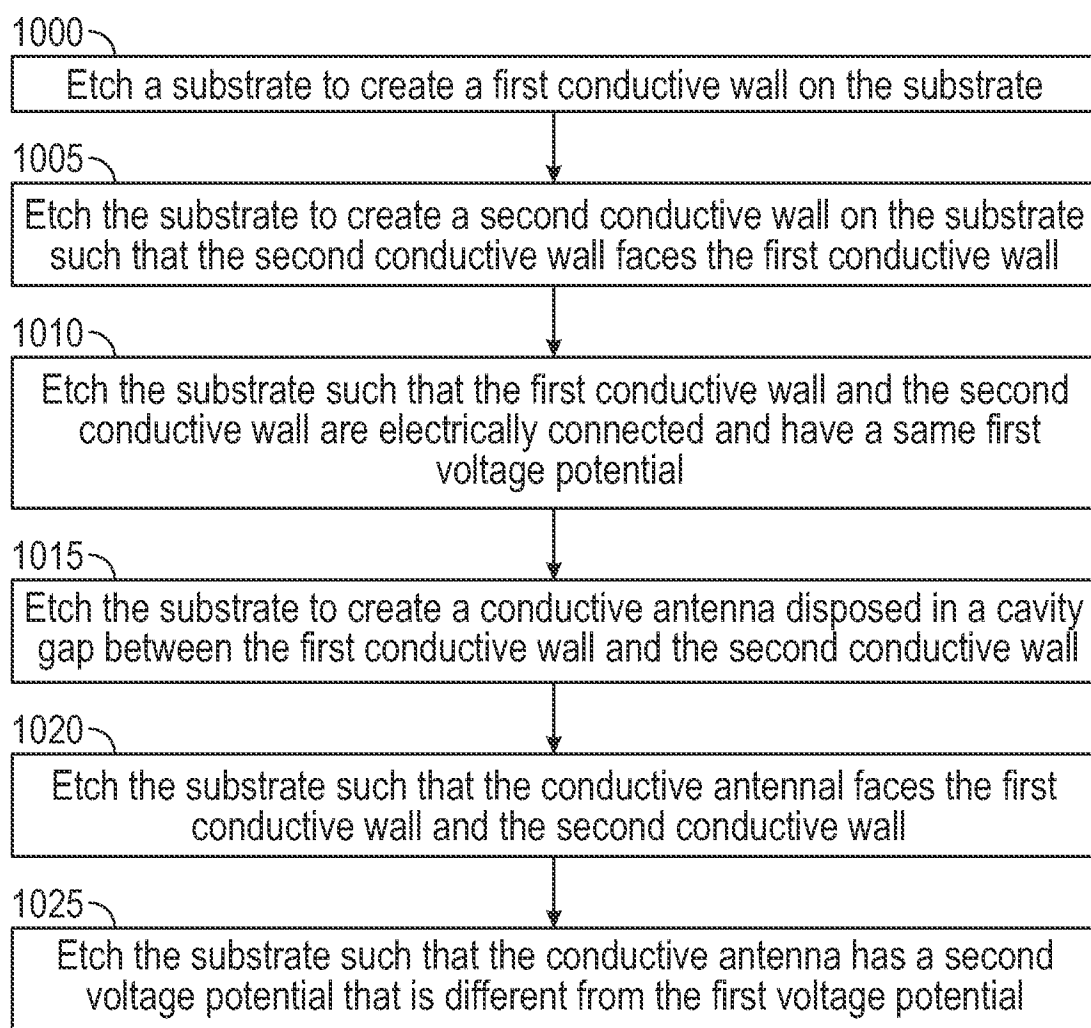


FIG. 10

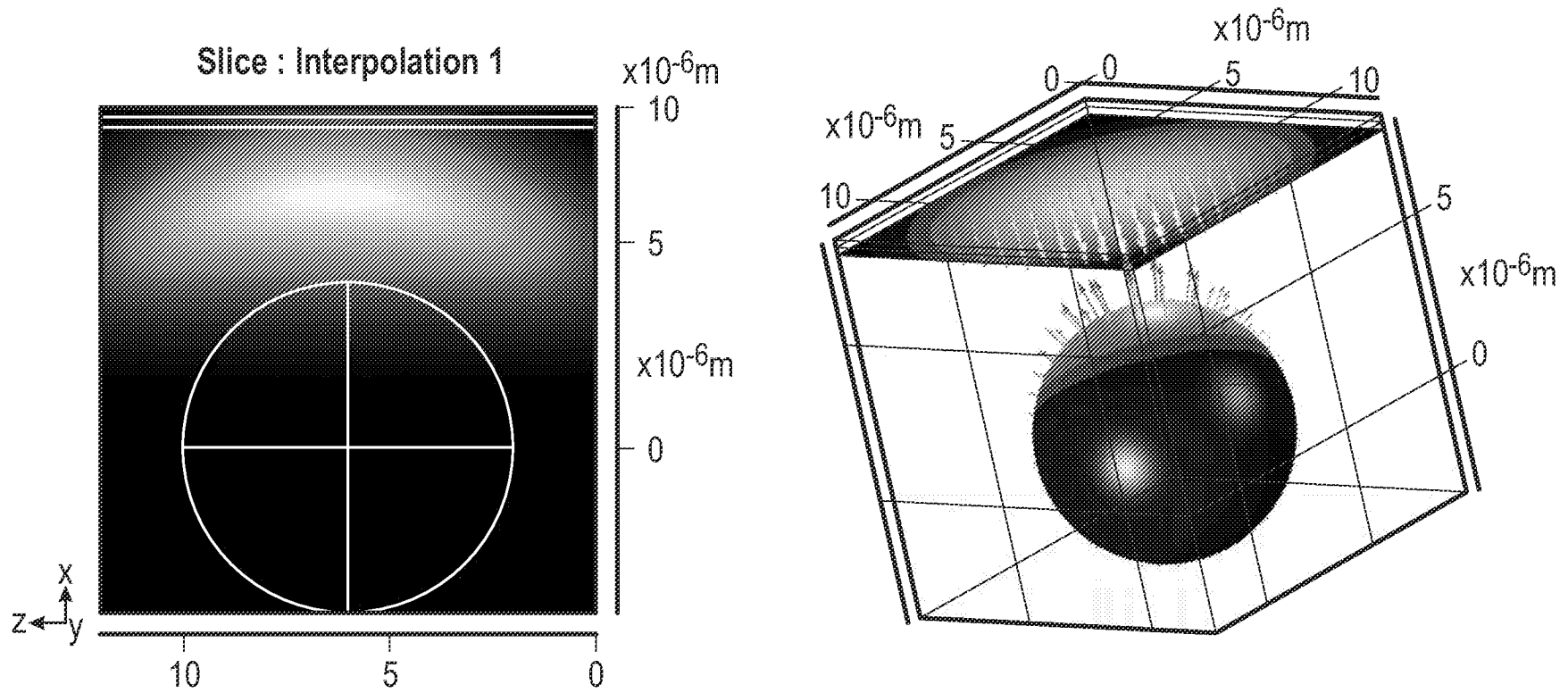


FIG. 11

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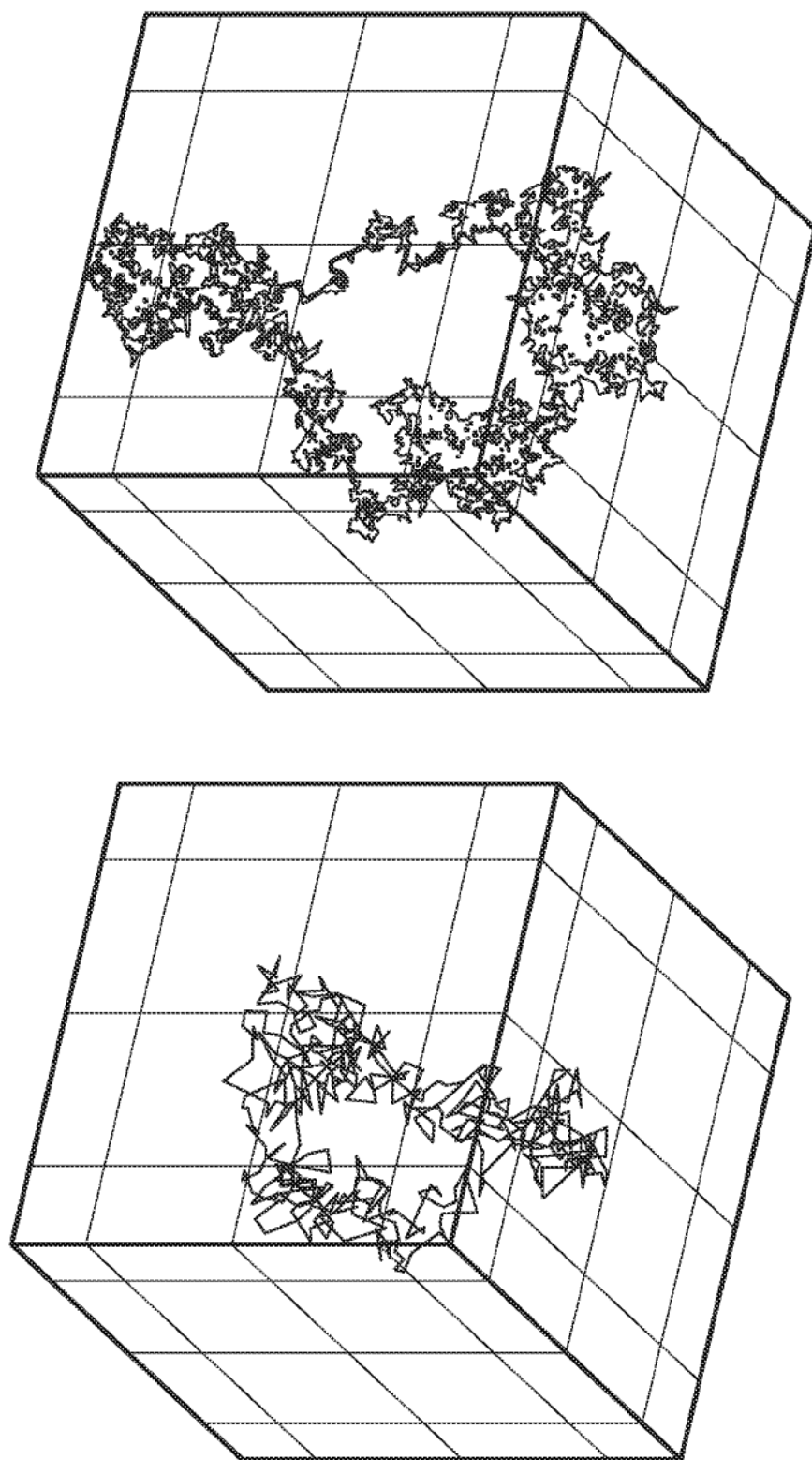
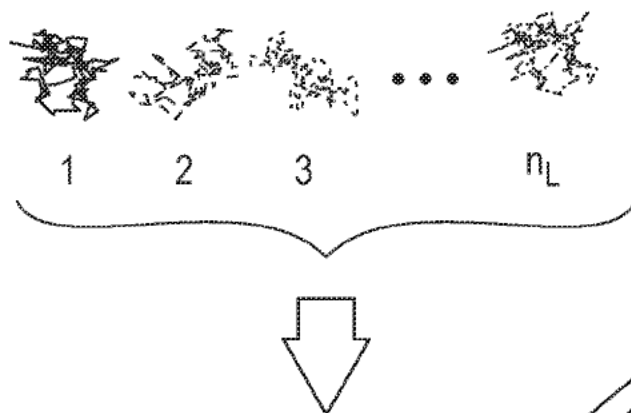


FIG. 12

Generate Ensemble of Random  $n_L$  Unit  
Loops with Each having  $n_p$  Points in Loop



Transport the Ensemble of Unit  
Loops to Each Point of Interest in  
Geometric Model

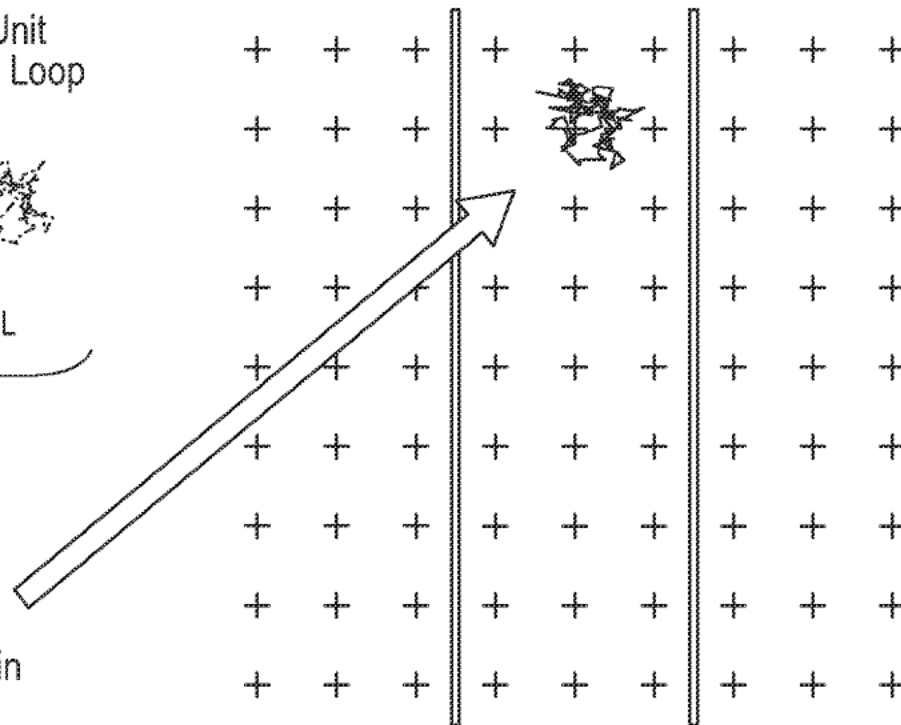


FIG. 13A

For Each Loop in the Ensemble, Transport  
to a Grid Point, Scale Loop to Determine  
Proper Time for which Loop Pierces 2+  
Bodies

This Defines the Support,  $S_l$ , of the  
Loop that Sets the Integral Limits for  
Integration

The Energy Density at the Point is then  
Increased by a Loop-Weighted Amount

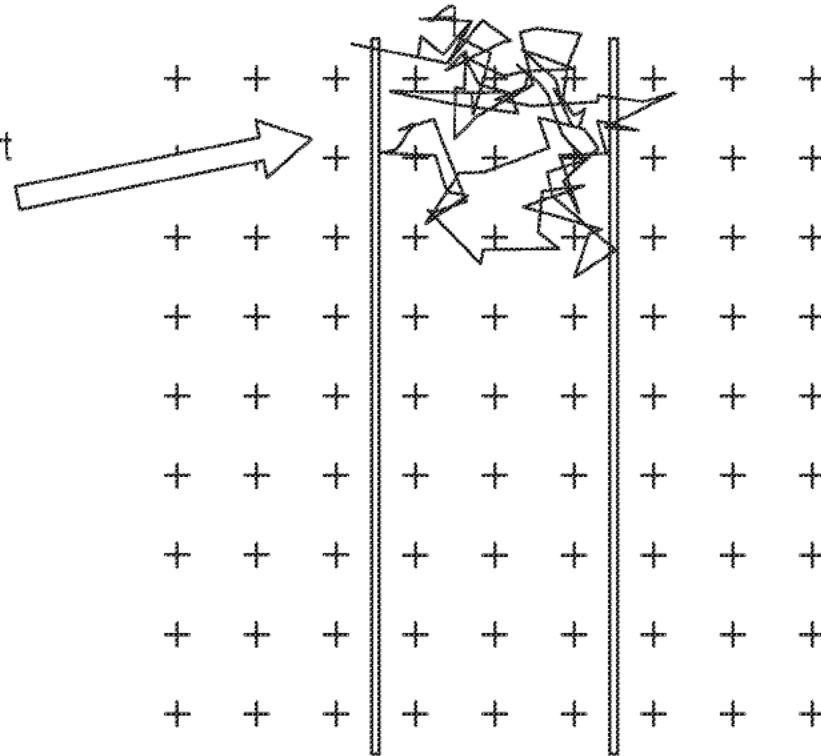


FIG. 13B

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## ELECTRONIC PAYMENT RECEIPT

APPLICATION #  
18/331,486

RECEIPT DATE / TIME  
06/08/2023 02:22:41 PM ET

ATTORNEY DOCKET #  
19077-002001

### Title of Invention

CASIMIR POWER CELL

### Application Information

APPLICATION TYPE Utility - Nonprovisional Application  
under 35 USC 111(a)

PATENT # -

CONFIRMATION # 2626

FILED BY Joicelynn Maddux

PATENT CENTER # 62232518

AUTHORIZED BY Thomas Scherer

CUSTOMER # 22511

FILING DATE -

CORRESPONDENCE  
ADDRESS -

FIRST NAMED  
INVENTOR Mr. Harold White

### Payment Information

PAYMENT METHOD  
CARD / 2120

PAYMENT TRANSACTION ID  
E202368E23467909

PAYMENT AUTHORIZED BY  
Joicelynn Maddux

| FEE CODE         | DESCRIPTION                                   | ITEM PRICE(\$) | QUANTITY | ITEM TOTAL(\$) |
|------------------|-----------------------------------------------|----------------|----------|----------------|
| 2111             | UTILITY PATENT APPL. SEARCH<br>FEE            | 280.00         | 1        | 280.00         |
| 4011             | BASIC FILING FEE- UTILITY                     | 64.00          | 1        | 64.00          |
| 2311             | EXAMINATION OF ORIGINAL<br>PATENT APPLICATION | 320.00         | 1        | 320.00         |
| TOTAL<br>AMOUNT: |                                               |                |          | \$664.00       |

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

**New Applications Under 35 U.S.C. 111**

If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

**National Stage of an International Application under 35 U.S.C. 371**

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

**New International Application Filed with the USPTO as a Receiving Office**

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.



## ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #  
**18/331,486**

RECEIPT DATE / TIME  
**06/08/2023 02:22:41 PM ET**

ATTORNEY DOCKET #  
**19077-002001**

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PATENT CENTER # 62232518

FILING DATE -

CUSTOMER # 22511

FIRST NAMED INVENTOR Mr. Harold White

CORRESPONDENCE ADDRESS -

AUTHORIZED BY Thomas Scherer

### Documents

**TOTAL DOCUMENTS: 5**

| DOCUMENT                                             | PAGES | DESCRIPTION                                 | SIZE (KB) |
|------------------------------------------------------|-------|---------------------------------------------|-----------|
| 7_ADS_fillable_19077002001.pdf                       | 8     | Application Data Sheet                      | 2173 KB   |
| 3_AppInTransmittal_19077002001.pdf                   | 1     | Transmittal of New Application              | 32 KB     |
| 4_Specification_19077002001-APP.TEXT.docx            | 34    | Application body structured text document   | 61 KB     |
| Warning: Bookmarks were found and have been removed. |       |                                             |           |
| 5_Drawings_19077002001.pdf                           | 14    | Drawings-only black and white line drawings | 3953 KB   |

|                               |   |                           |         |
|-------------------------------|---|---------------------------|---------|
| 6_Declaration_19077002001.pdf | 3 | Oath or Declaration filed | 2816 KB |
|-------------------------------|---|---------------------------|---------|

## Digest

| DOCUMENT                                  | MESSAGE DIGEST(SHA-512)                                                                                                          |
|-------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------|
| 7_ADS_fillable_19077002001.pdf            | AED265E9E7A1C282D2E202AC4A7EDDB31053375B3D7A78058AFF6F108FE21B4D2728CDE254204C3743DE49F8A2F831B2C603727FC60DE0748AA0D7BEBB0B3B19 |
| 3_ApplnTransmittal_19077002001.pdf        | B6E35B54B61E445CFDF35D53E276C07551FF5164FE17F7F828D583D174B6231B91CC5FF2225A718A8D036241E48C5C33743020AD754756B796BC71E5880830AC |
| 4_Specification_19077002001-APP.TEXT.docx | 2B0B50BD751CA47EEC9041F25941AE05E7B4B63646DBBA9786AC828CC4DAD0A1ABD18EE9D4AE1184A08197FBD280572ED159F53E9E65AD49ACEE0E58249422A1 |
| 5_Drawings_19077002001.pdf                | 9D67C4A07FFCD2194290C5366652C96D41E49499BCF03A7AB42443532AB47695A7DC029190BC62D5B14C682EFBFF6FFAF964DABED212215BEAE975BA23D6067C |
| 6_Declaration_19077002001.pdf             | 089E5E25551F8E46FA31A5E29A1B0C08239BA81D5EC167F0EF077E06C10355E47F66ED5D7892C04FDCCEB99EEC26B9A1AE353FADE7C0D161CD76E5F66D9B6F72 |

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**APPLICATION**  
**FOR**  
**UNITED STATES LETTERS PATENT**

**TITLE: CASIMIR POWER CELL**

**INVENTOR(S): Harold WHITE**

## CASIMIR POWER CELL

### BACKGROUND

[0001] If one were to understand the natural world as a Venn diagram, the diagram would consist of two circles touching at a tangent point. In the two-circle diagram, one circle would be General Relativity (GR) and the other circle would be Quantum Field Theory (QFT). These two circles represent the two standard models of physics that can explain the natural world. GR is the study of the macroscopic world at the cosmological scale and helps to understand how stars and galaxies move. QFT, on the other hand, is the study of the microscopic world; how atoms and electrons behave; how light interacts with matter; a scale where matter exhibits both properties of particles and waves. The fact that these two circles touch at a tangent point is an indication that QFT has been made relativistic by means of the Dirac Equation, whereby Special Relativity (SR) is incorporated. This current state-of-affairs of the Venn diagram suggests that there is a larger circle that circumscribes the existing circles whereby a more complete and generalized understanding of the natural world is represented.

[0002] The concept of a generalized and comprehensive understanding of nature is often referred to as Grand Unified Theory (GUT). However, in smaller steps, a model developed in the literature called the dynamic vacuum model is a possible illustration of expanding the Venn diagram. This enhanced Venn diagram would now consist of three circles like a two-dimensional projection of Borromean rings, with the additional qualifier that two of the three rings only touch at a tangent point. In this scenario, the dynamic vacuum model circle partly intersects both the GR and QFT circles, but also encircles a region not enclosed by either of the GR and QFT circles. With this situation, the dynamic vacuum model can explain physical properties that neither GR nor QFT does.

[0003] One concept that the dynamic vacuum model can explain is harvesting energy from empty space in microscopic scale. This is different from the case of solar cells where photons excite electron-hole pairs and generate electricity. A device that can harvest energy from empty space into practical electric power 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.

## SUMMARY

**[0004]** This summary is provided to introduce a selection of concepts that are further described below in the detailed description. This summary is not intended to identify key or essential features of the claimed subject matter, nor it is intended to be used as an aid in limiting the scope of the claimed subject matter.

**[0005]** This disclosure presents, in accordance with one or more embodiments, a battery that includes a Casimir-effect powered cell (Casimir cell). The Casimir cell includes: a first conductive wall; a second conductive wall that faces the first conductive wall; and a conductive antenna disposed in a cavity gap that is a space between the first conductive wall and the second conductive wall. The conductive antennal faces the first conductive wall and the second conductive wall. The first conductive wall and the second conductive wall produce a same first voltage potential. The conductive antenna produces a second voltage potential that is different from the first voltage potential. 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 second conductive wall.

**[0006]** In another aspect, this disclosure also presents, in accordance with one or more embodiments, a method for making a Casimir cell. The method includes: etching a substrate to create a first conductive wall on the substrate; etching the substrate to create a second conductive wall on the substrate such that the second conductive wall faces the first conductive wall; and 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. The conductive antennal faces the first conductive wall and the second conductive wall. The first conductive wall and the second conductive wall are etched to be electrically connected and have a same first voltage potential. The conductive antenna is etched to have a second voltage potential that is different from the first voltage potential.

[0007] Other aspects and advantages of the invention will be apparent from the following description and the appended claims.

## BRIEF DESCRIPTION OF DRAWINGS

[0008] Specific embodiments of the disclosed technology will now be described in detail with reference to the accompanying figures. Like elements in the various figures are denoted by like reference numerals for consistency. The sizes and relative positions of elements in the drawings are not necessarily drawn to scale. For example, the shapes of various elements and angles are not necessarily drawn to scale, and some of these elements may be arbitrarily enlarged and positioned to improve drawing legibility. Further, the particular shapes of the elements as drawn are not necessarily intended to convey any information regarding the actual shape of the particular elements and have been solely selected for ease of recognition in the drawing.

[0009] FIG. 1 shows a Casimir-effect power cell (Casimir cell), in accordance with one or more embodiments disclosed herein.

[0010] FIG. 2 shows a scanning electron microscope image of a vertical Casimir cell, in accordance with one or more embodiments disclosed herein.

[0011] FIG. 3 shows a voltage potential map of a Casimir cell, in accordance with one or more embodiments disclosed herein.

[0012] FIG. 4A shows a horizontal Casimir cell, in accordance with one or more embodiments disclosed herein.

[0013] FIG. 4B shows a horizontal Casimir cell, in accordance with one or more embodiments disclosed herein.

[0014] FIG. 5 shows a c-shape Casimir cell, in accordance with one or more embodiments disclosed herein.

[0015] FIG. 6 shows an array of Casimir cells connected in series and in parallel, in accordance with one or more embodiments disclosed herein.

- [0016] FIG. 7 shows an array of Casimir cells connected in series and in parallel, in accordance with one or more embodiments disclosed herein.
- [0017] FIG. 8A shows a voltage-current diagram of the array of Casimir cells shown in FIG. 7, using a four-point probe, in accordance with one or more embodiments disclosed herein.
- [0018] FIG. 8B shows a voltage-current diagram of an array of Casimir cells, in accordance with one or more embodiments disclosed herein.
- [0019] FIG. 9 shows a real-time voltage measurement of the array of Casimir cells shown in FIG. 7, using a Digital Display Multimeter, in accordance with one or more embodiments disclosed herein.
- [0020] FIG. 10 shows a flow chart for fabricating a Casimir cell, in accordance with one or more embodiments disclosed herein.
- [0021] FIG. 11 shows a simulation plot, in accordance with one or more embodiments disclosed herein.
- [0022] FIG. 12 shows a simulation plot, in accordance with one or more embodiments disclosed herein.
- [0023] FIGs. 13A and 13B show modeling diagrams, in accordance with one or more embodiments.

## DETAILED DESCRIPTION

- [0024] In the following detailed description of embodiments of the disclosure, numerous specific details are set forth in order to provide a more thorough understanding of the disclosure. However, it will be apparent to one of ordinary skill in the art that the disclosure may be practiced without these specific details. In other instances, well-known features have not been described in detail to avoid unnecessarily complicating the description.
- [0025] Throughout the disclosure, ordinal numbers (e.g., first, second, third, etc.) may be used as an adjective for an element (i.e., any noun in the application). The use of ordinal

numbers is not to imply or create any particular ordering of the elements nor to limit any element to being only a single element unless expressly disclosed, such as using the terms “before”, “after”, “single”, and other such terminology. Rather, the use of ordinal numbers is to distinguish between the elements. By way of an example, a first element is distinct from a second element, and the first element may encompass more than one element and succeed (or precede) the second element in an ordering of elements. In addition, throughout the disclosure, “or” is interpreted as “and/or,” unless stated otherwise.

### **Physical Embodiment(s)**

**[0026]** One or more embodiments disclosed herein describe a Casimir-effect power cell (hereinafter, will be referred to as Casimir cell) and a battery that includes one or more of the Casimir cells. In one or more embodiments, even one Casimir cell or one Casimir cell array may be referred to as a battery. The Casimir cell is a power cell that generates electrical power by using the Casimir phenomenon that will be described further below, in accordance with one or more embodiments disclosed herein. In this disclosure, the Casimir cell is also referred to as “Casimir cavity.”

**[0027]** FIG. 1 schematically shows a Casimir cell that includes a first conductive wall (102), a second conductive wall (104) that faces the first conductive wall (102), and a conductive antenna (106) disposed in a cavity gap (108) that is the space between the first conductive wall (102) and the second conductive wall (104). The conductive antennal (106) faces the first conductive wall (102) and the second conductive wall (104). In one or more embodiments, a first distance between the conductive antenna (106) and the first conductive wall (102) is the same as a second distance between the conductive antenna (106) and the second conductive wall (104). In this disclosure, the first conductive wall and second conductive wall are also referred to as the conductive walls. In addition, in this disclosure the first and second conductive walls are also referred to as “cavity walls.”

**[0028]** 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)). Further below in the following sections, the underlying physics involved in the generation of electric power is described.

**[0029]** 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.

**[0030]** In one or more embodiments, the first conductive wall, second conductive wall, and conductive antenna may be made of the same material. Alternatively, the first conductive wall, second conductive wall, and conductive antenna may be made of different materials. The material(s) may be, but are not limited to, gold (Au), silver (Ag), platinum (Pt), aluminum (Al), copper (Cu), palladium (Pd), iridium (Ir), titanium nitride (TiN), molybdenum (Mo), silicon (Si), or graphene. In one or more embodiments, n-doped and p-doped semiconductors may be used for the first conductive wall, second conductive wall, and conductive antenna. For example, the first conductive wall and second conductive wall may be a p-doped semiconductor material and the conductive antenna may be an n-doped semiconductor, or vice versa. This arrangement facilitates formation of a depletion region between two adjacent Casimir cells where the conductive walls of one Casimir cell are connected to the conductive antenna of an adjacent Casimir cell. This material

approach may be utilized to increase the realizable voltage magnitude for a given Casimir cell design. In some embodiments, one or two of the first conductive wall, second conductive wall, and conductive antenna may be made of metal and the rest of these features may be made of a conductive semiconductor (e.g., a doped semiconductor).

**[0031]** In one or more embodiments, the intervening spaces between the conductive antenna and the conductive walls may be vacuum, air, or filled with a gas dielectric or a liquid dielectric. Alternatively, the intervening spaces may be filled with a solid dielectric that may be, but is not limited to, silicon dioxide ( $\text{SiO}_2$ ), aluminum oxide ( $\text{Al}_2\text{O}_3$ ), tantalum pentoxide ( $\text{Ta}_2\text{O}_5$ ), cerium oxide ( $\text{CeO}_2$ ), hafnium oxide ( $\text{HfO}_2$ ), Niobium pentoxide ( $\text{Nb}_2\text{O}_5$ ), Niobium dioxide ( $\text{NbO}_2$ ), titanium dioxide ( $\text{TiO}_2$ ), titanium oxide ( $\text{TiO}$  or  $\text{Ti}_3\text{O}_5$ ), Yttrium oxide ( $\text{Y}_2\text{O}_3$ ), zirconium dioxide ( $\text{ZrO}_2$ ), or zirconium oxide ( $\text{ZrO}$ ). Using a solid dielectric with a high breakdown voltage, such as  $\text{HfO}_2$ , may improve the Casimir cell's ability of generating electricity, by reducing tunneling current or preventing discharge between the conductive antenna and the conductive walls. As it will be explained below, when the cavity gap becomes smaller, the voltage generated by the Casimir cell becomes larger.

**[0032]** In one or more embodiments, the cavity gap (for example cavity gap (108)) may be 10 micrometers or smaller to generate practical electricity by the Casimir cell. In one or more embodiments, the cavity gap is 90 nanometers (nm). Further, in one or more embodiments, the cavity gap may be 10 nm. In one or more embodiments, the cavity gap may be even smaller, for example 3nm or 1 nm. The manufacturing offset from the targeted cavity gap of 90 nm or lower depends on current nanofabrication technology and equipment limits/errors. While decreasing the cavity gap to lower than these numbers (e.g., sub-nanometer region) may improve the voltage, it may be limited by manufacturing capabilities and tunneling current.

**[0033]** FIG. 2 shows a scanning electron microscope (SEM) image of an array of vertical Casimir cells, in accordance with one or more embodiments disclosed herein. Each Casimir cell includes a first conductive wall (202), a second conductive wall (204) that faces the first conductive wall (202), and a conductive antenna (206) disposed in the cavity

gap between the first conductive wall (202) and the second conductive wall (204). The conductive antenna (206) is disposed at the mid-plane between the first conductive wall (202) and the second conductive wall (204), for optimal voltage generation. In one or more embodiments, the array of the Casimir cells is grouped into a plurality of groups of Casimir cells. Each group includes a plurality of Casimir cells that are connected to one another in parallel such that all of the conductive walls (202, 204) of the group are connected to one another and produce a same first voltage potential, for example the electrical ground, and all of the conductive antennas (206) of the group are connected to one another and produce a second voltage potential that is different from the first voltage potential. This way the current generated by the array will be the current generated by the group that is the sum of the currents generated by all of the Casimir cells in the group. The plurality of groups are connected in series to one another. This way, the voltage generated array will be the sum of the voltages generated by all of the groups. Accordingly, by determining the number of the Casimir cells connected in parallel in each group and by determining the number of the groups that are connected in series, the current and voltage of the array can be determined, respectively.

**[0034]** The conductive antenna (206) includes a plurality of pillars. In one or more embodiments, the diameter of each pillar is half of the size of the gap between the first conductive wall (202) and second conductive wall (204). Each of the first conductive wall (202) and second conductive wall (206) are 40 micrometers by 40 micrometers in length and height and the cavity gap between the conductive walls (202, 204) is 10 micrometers. In FIG. 2, the length of the conductive walls (202, 204) is along the X axis, the height of the conductive walls (202, 204) is along the Z axis, and width of the conductive walls (202, 204) as well as the cavity gap are along the Y axis. The pillars inside the cavity gap are 5 micrometers in diameter and 40 micrometers tall, spanning the entire height of the cavity gap. The Casimir cell was fabricated using deep reactive ion etching equipment commonly used in the semiconductor fabrication industry. While these are the dimensions of the fabricated Casimir cell, the invention is not limited to these dimensions.

**[0035]** In one or more embodiments, the magnitude of the voltage increases as the distance between the conductive wall and the pillars decreases. An analytic treatment of the Casimir

cavity suggests that the voltage magnitude can increase proportionally to  $\frac{1}{d^2}$ , where “d” is the distance between the first and second conductive walls, which is the overall width of the Casimir cavity. For example, in FIG. 1 “d” is the width of the cavity gap (108).

**[0036]** As shown in FIG. 2, the vertical Casimir cell stands orthogonal with respect to the substrate (208). To achieve this arrangement, the conductive walls (202, 204) and the conductive antenna (206) are etched onto a conductive semiconductor wafer such that the conductive walls (202, 204) and conductive antenna (206) form from the conductive semiconductor that is on an insulator layer. To this end, for example, a semiconductor on insulator wafer may be used. The orientation of the conductive walls and conductive antenna to the substrate may be envisioned as books arrayed vertically on a bookshelf in a library where the spines of the books are aligned in an upward direction.

**[0037]** From a circuit element perspective, each individual Casimir cell is manufactured such that its conductive walls are electrically connected while also being electrically isolated from the conductive antenna. The voltage magnitude of a given Casimir cell depends on the cavity gap where a smaller cavity gap will increase the voltage magnitude. The diameter or dimensions of the antenna structure can also affect the voltage magnitude, and numerical analysis can be used to determine the optimal ratio of antenna size with respect to the cavity gap. The tunneling current magnitude of a given Casimir cell depends on the cavity gap and increases as the dimension of the cavity gap decreases. The tunneling current magnitude also depends on the cross-sectional area of the conductive walls and conductive antenna, and increases with larger areas (i.e., longer length or height).

**[0038]** In one or more embodiments, a larger surface area for the first and second conductive walls (e.g., longer length or height of the conductive walls in FIG. 2) generates a larger current in terms of power generation for an individual Casimir cell, considering everything else would be equal. The manufacturing challenge for etching a vertical Casimir cell, an example of which is shown in FIG. 2, is the aspect ratio of the vertical etch depth versus the cavity gap.

**[0039]** In one or more embodiments, an Oxford Instruments Cypher S Atomic Force Microscope (AFM) was used to measure the electrostatic polarization field on the Casimir

cell shown in FIG. 2 with the conductive wall surface area of 40 micrometers by 40 micrometers and the cavity gap of 10 micrometers. The Kelvin Probe Force Microscopy (KPFM) mode of the AFM was used to measure the electrostatic fields manifested on the different elements of the Casimir cell. The KPFM technique uses the AFM equipped with a conducting AFM tip. Each line of a KPFM scan of a test article includes an AC-tap mode run to establish a topographical map of the device under test. The AFM uses the AC-tap mode to develop an internal map of the underlying mechanical location of the surface being scanned. On the return of the scan line, the AFM uses the topographical map to fly the AFM tip at an offset to the test surface to avoid contact with the test surface just previously tapped – this is called nap mode. During this return scan, the AFM tip is driven with an AC signal while the amplitude of the AFM tip oscillation is monitored. This oscillation magnitude is fed into a control algorithm that changes a DC offset to the AC voltage signal such that the control algorithm seeks to minimize the magnitude of the oscillation. This DC voltage is equivalent to the voltage potential that exists on the structure exactly beneath the AFM tip. This is how the AFM system was able to construct a two-dimensional mapping of the electrostatic charges that exist on the surface of the Casimir cell.

[0040] FIG. 3 shows an isometric view and elevation of the averaged KPFM data set of a 30 micrometer by 30 micrometer footprint of the Casimir cell identical to those depicted in the SEM image of FIG. 2. In this surface plot, the height of the data is not representative of the physical height of the scanned structure, rather it represents the voltage potential of the scanned test surface. The isometric view clearly shows the conductive walls (302, 304) and the pillars of the conductive antenna (306) in the cavity gap, and the elevation view in the inset of FIG. 3 illustrates that the voltage potential of the pillars is clearly less than the voltage potential of the conductive walls. In other words, the pillars are at a negative voltage potential with respect to the surrounding conductive walls.

[0041] In one or more embodiments, the Casimir cell may be horizontally aligned relative to a supporting non-conducting substrate. This arrangement can be considered analogous to printer papers stacked in a printer paper feed tray. This horizontal arrangement may facilitate making the cavity gap between the first conductive wall and the second

conductive wall ultra small, for example in nanometers regime or less, compared to the vertical Casimir cell described above with reference to FIG. 2.

**[0042]** FIG. 4A shows an example of the horizontal arrangement, in accordance with one or more embodiments. Specifically, in the horizontal arrangement a first conductive wall (402) is disposed horizontally on a substrate (412), a first dielectric (408) is disposed horizontally on the first conductive wall (402), a conductive antenna (406) is disposed horizontally on the first dielectric (408), a second dielectric (410) is disposed horizontally on the conductive antenna (406), and a second conductive wall (404) is disposed horizontally on the second dielectric (410). Accordingly, the conductive antenna (406) is encapsulated in between the first conductive wall (402) and second conductive wall (404). The conductive antenna (406) is electrically isolated from the first conductive wall (402) and second conductive wall (404) via the first dielectric (408) and second dielectric (410) and have a second voltage potential while the first conductive wall (402) and second conductive wall (404) are electrically connected and have a same first voltage potential that is different from the second voltage potential.

**[0043]** In one or more embodiments, the horizontal arrangement may enable Casimir cells with large conductive wall areas, which result in more current capability, and smaller cavity gaps, which result in higher voltage capability, than those may be achieved by the vertical Casimir cells. In addition, the horizontal arrangement may be more compatible with manufacturing capabilities used across the Integrated Circuit (IC) industry than the vertical Casimir cells.

**[0044]** According to one or more embodiments, in the horizontal arrangement the conductive antenna may be a grid (e.g., a waffle grid) in lieu of parallel pillars. This may enable a larger surface area for the conductive antenna and thus a larger current generated by the Casimir cell, while maintaining the balance of preserving the optical transparency of the encapsulating Casimir cell. FIG. 4B shows an example of a horizontal Casimir cell on a substrate (412) where the conductive antenna (406) is a grid. The grid includes holes (414) where a dielectric spacer (e.g., first dielectric (408) and second dielectric (410)) may be disposed. Similar to the example described with reference to FIG. 4A, the Casimir cell

of FIG. 4B includes a first dielectric (408) and a second dielectric (410) to provide a space between the conductive antenna (406) and each of the first and second conductive walls (402, 404), respectively.

**[0045]** In one or more embodiments, the conductive antenna may be a continuous flat plane and its dielectric/optical properties are such that the conductive antenna is semi-transparent to a large fraction of the electromagnetic/optical frequencies that may manifest in a given Casimir cell design.

**[0046]** In one or more embodiments, if the antenna structure would be a non-transparent structure with no perforations, such as a continuous metal plate, then the antenna structure will create two adjacent Casimir cavities in lieu of a single Casimir cavity with a discontinuous structure at the midplane placed to establish the polarization field.

**[0047]** In one or more embodiments, the Casimir cell may have a nested c-shape as shown in FIG. 5. Specifically, in the Casimir cell of FIG. 5, the conductive antenna (506) is the inner cylinder that is a singular pillar. The outer nested and concentric wall is the conductive wall (508) and can be considered to include a first conductive wall (502) and a second conductive wall (504) that are on opposite sides of the conductive antenna (506).

**[0048]** In one or more embodiments, a plurality of Casimir cells may be arranged in circuit topologies such that they are arrayed in series to increase effective voltage magnitude and arrayed in parallel to increase effective current. These circuit topologies may be arranged with a blend of parallel and series circuit element approaches to tailor the integrated system voltage magnitude and current capability for the intended application. FIG. 6 shows an array of Casimir cells that includes 100 vertical Casimir cells on one substrate. In the arrangement of the array of Casimir cells shown in FIG. 6, the plurality of Casimir cells are grouped into 10 groups that are connected to one another in parallel. The in parallel connection of the groups multiplies the current by the number of groups. Within each group, 10 Casimir cells are connected in series, which multiplies the voltage by the number of Casimir cells within the group. Accordingly, the current of the array of Casimir cells shown in FIG. 6 would be 10 times (i.e., the number of the groups connected in parallel) of the current of an individual Casimir cell among the plurality of Casimir cells and the

voltage of the array of Casimir cells would be 10 times (i.e., the number of Casimir cells connected in series within one group) of the voltage of the individual Casimir cell. The number of groups of Casimir cells and the number of Casimir cells within each group is not limited to the numbers disclosed in this example and can vary depending on a specific design or function of the array of Casimir cells.

**[0049]** Alternatively, in one or more embodiments an array of Casimir cells may be grouped into a plurality of groups such that the groups are connected in series with one another, and Casimir cells of each group are connected in parallel to one another. This way, the current of the array of Casimir cells would be proportional to the number of the Casimir cells within each group and the voltage of the array of Casimir cells would be proportional to the number of groups.

**[0050]** FIG. 7 shows a prototype array of Casimir cells (702), in accordance with one or more embodiments. The prototype array of Casimir cells (702) includes 100 groups of Casimir cells and the groups are connected in parallel to one another. Each group includes 10 Casimir cells that are connected in series to one another. The prototype array of Casimir cells (702) was used in four-point probe testing to determine its voltage-current (V-I) performance. FIG. 8A is a plot of V-I data collected for the prototype array of Casimir cells (702) shown in FIG. 7. The data is plotted with 5- $\sigma$  error bars. Error bars of the current are not discernible whereas error bars of the voltage are occasionally visible. The inset magnified view of the plot shows that as the V-I line crosses the voltage and current axes, there is a non-zero short-circuit current (ISC) and a non-zero open-circuit voltage (VOC). The ISC and VOC are characteristics of an electric power generator that also can be seen in solar cells.

**[0051]** In accordance with one or more embodiments disclosed herein, light exposure to the Casimir cell can enhance the generated power by the Casimir cell. For example, FIG. 8B is a plot of V-I data collected for a staggered Casimir cell array of 4×4 Casimir cells for when the array is fully shielded from ambient light and for when the array is exposed to ambient light. Each of the Casimir cells in the Casimir cell array is a horizontal Casimir cell, similar to the horizontal Casimir cell described above with reference to FIG. 4A. The

larger circle in FIG. 8B shows a close-up view of the smaller circle on the V-I plot. The conductive walls and conductive antenna for the tested Casimir cell array are made of aluminum, in this example.

**[0052]** As shown in FIG. 8B, the Casimir cell array generates more ISC and VPC when the Casimir cell array is exposed to ambient light compared to when the Casimir cell array is fully shielded from ambient light. In other words, the voltage that is the difference between the voltage potential of the conductive walls and the voltage potential of the conductive antenna is also generated by the Casimir cells' exposure to light, based on the arrangement of the conductive antenna between the conductive walls. According to this data, the power generation is increased by about three orders of magnitude for when the Casimir cell array is exposed to ambient light compared to when the Casimir cell array is fully shielded from ambient light. In addition, the Casimir cell array has higher conductivity (lower electrical resistance), by about one order of magnitude, when the Casimir cell array is exposed to ambient light compared to when the Casimir cell array is fully shielded from ambient light.

**[0053]** In view of the above, in accordance with one or more embodiments, in addition to generating electric power via the Casimir phenomenon, the Casimir cell may also generate electric power via solar energy. In accordance with one or more embodiments, the Casimir cell may be exposed to light so as to increase the generated voltage. Further, in accordance with one or more embodiments, because of the light sensitivity of the Casimir cells, the Casimir cells may be configured to be used as light sensors.

**[0054]** FIG. 9 shows a real-time voltage measurement of the prototype array of Casimir cells (702) shown in FIG. 7, using a Digital Display Multimeter (DDM), in accordance with one or more embodiments disclosed herein. Voltage sensitivity of the DDM is in microvolts. To eliminate environmental noise, the testing was conducted in an RF-shielded vault located on the NASA Johnson Space Center. FIG. 9 shows data collected from this test where the steps in the data indicate the difference between the detected voltage for when two probes of the DMM being connected to opposite contacts (704, 706) of the prototype array of Casimir cells (702) and when the DMM leads are grounded to one

another. The shielded environment and test approach ensured that the voltage signal produced by the prototype array of Casimir cells (702) is the voltage generated by Casimir phenomenon in the Casimir cells.

**[0055]** The Casimir cell design can be combined in an assembly to replace existing batteries. For example, a CR2032 battery cell provides 3V voltage potential with current capability of ~10mA. An equivalent battery that includes an array of the Casimir cells and can provide similar voltage potential and current can be a 1 centimeter (cm) by 1 cm wafer populated with an array of 200 by 200 Casimir cells. This wafer can be arranged such that there are 4000 Casimir cells in series in each group (e.g., in the form of a rail) with 10 groups being in parallel. To this end, the wafer may be shaved down to 30 micrometers thick and layered with another 24 identical wafer making for a 24 die stack assembly. This assembly may be used to replace the entire inner chemical contents of the CR2032 battery resulting in a Casimir CR2032 power battery that will no longer need to recharge. This same approach may be used for all other forms of batteries including, but not limited to, AA, AAA, D, C, 9V, or 4689 battery. Additionally, the power generating capability disclosed in one or more embodiments will introduce new approaches such as self-powered Integrated Circuit (IC) implementations, remote sensors, self-powered medical devices, smart packaging, smart clothing, or home power systems. This would allow for possibility to generate electricity in areas that do not have access to a power grid or traditional renewable energy sources.

**[0056]** FIG. 10 shows a flow chart for fabricating a Casimir cell, in accordance with one or more embodiments disclosed herein. In one or more embodiments, one or more of the steps shown in FIG. 10 may be omitted, repeated, and/or performed in a different order than the order shown in FIG. 10. Accordingly, the scope of the invention should not be considered limited to the specific arrangement of the steps shown in FIG. 10. The steps shown in FIG. 10 are explained below.

**[0057]** In Step 1000, a substrate is etched to create a first conductive wall on the substrate.

**[0058]** In Step 1005, the substrate is etched to create a second conductive wall on the substrate such that the second conductive wall faces the first conductive wall.

- [0059] In Step 1010, the substrate is etched such that the first conductive wall and the second conductive wall are electrically connected and have a same first voltage potential.
- [0060] In Step 1015, the substrate is etched to create a conductive antenna disposed in a cavity gap that is a space between the first conductive wall and the second conductive wall.
- [0061] In Step 1020, the substrate is etched such that the conductive antennal faces the first conductive wall and the second conductive wall.
- [0062] In Step 1025, the substrate is etched such that the conductive antenna has a second voltage potential that is different from the first voltage potential.
- [0063] Examples of the above steps are described above, for example with reference to FIGs. 1-7.
- [0064] In accordance with one or more embodiments, one or more of Step 1000 through Step 1025 may be performed at the same time. For example, the substrate may be etched to create the first conductive wall, the second conductive wall, and the conductive antenna at the same time or from the same material.
- [0065] In accordance with one or more embodiments, the method described with reference to FIG. 10 for fabricating a Casimir cell may include the following steps. Initially, an SiO<sub>2</sub> masked pattern may be disposed on a substrate to mask the leads heading to the conductive walls and heading to the conductive antenna. These leads will also serve as the foundation for the conductive walls and conductive antenna. Then, a photoresist pattern for the conductive walls and conductive antenna is disposed on top of the SiO<sub>2</sub> mask, while ensuring proper alignment between the photoresist pattern and SiO<sub>2</sub> mask. Then, etching operation(s) are performed to achieve desired height for the conductive walls and antenna, while maintaining the leads into and out of the Casimir cell. In one or more embodiments, this approach may be used to achieve an array of  $a \times b$  Casimir cells in series and parallel arrangements as desired based on specific applications. Here, “a” is the number of rows in the array of Casimir cells and “b” is the number of columns in the array of Casimir cells.
- [0066] Further, as described below in detail, the Casimir cell interacts with the asymmetry formed in the quantum vacuum field to generate power. The theory for the results and

characteristics of the Casimir cell shown above are described below, in accordance with one or more embodiments.

### **Dynamic Vacuum Model Synopsis**

**[0067]** The Copenhagen interpretation of the physical world at a microscopic level is that the nature of reality is probabilistic and not deterministic. While the Copenhagen interpretation may be considered the distinction of being the favored line of thinking, it is not without alternatives. One of the alternative lines of thinking in the ontological debate of the nature of reality at the microscopic level is a group of pilot wave theories. The pilot wave theories are a family of realist/deterministic interpretation of quantum mechanics that make the conjecture that the statistical nature of the formalism of quantum mechanics is due to an ignorance of an underlying more fundamental real dynamics, and that microscopic particles follow real trajectories over time just like larger classical bodies do. The first pilot wave theory was proposed by de Broglie in 1923 where he proposed that a particle can interact with an accompanying guiding wave field, or pilot wave, and this interaction is responsible for guiding the particle along its trajectory orthogonal to the surfaces of constant phase. Later in 1952, Bohm published a pilot wave theory where the guiding wave is equivalent to the solution of the Schrödinger equation and a particle's velocity is equivalent to the quantum velocity of probability. A more recent conjecture put forward in the literature considers the vacuum as a form of quantum fluid that can sustain both spatial and temporal variations, and therefore as a dynamic vacuum. In the dynamic vacuum model, the vacuum fluctuations play the role of the guiding wave, specifically the vacuum fluctuations (e.g., virtual fermions and virtual photons) serve as the dynamic medium that guides a real particle (e.g., unpaired vacuum fluctuation) on its way.

**[0068]** Recently, researchers showed a deep and explicit connection between the Schrödinger equation and the Quantum potential, and this discovery led to the detailed derivation of the acoustic wave equation for the quantum medium. Armed with the insight that this quantum medium may be viewed as a spatially and temporally varying quantum fluid, the researchers showed the development of a numerical model of the hydrogen atom. The model includes the assumptions of a quantum fluid surrounding the proton, a density

distribution of the fluid, and a velocity field describing the spatially varying speed of propagation of disturbances in the density field. In this dynamic system, acoustic-like resonances could be established describing the electron orbitals as determined by the Helmholtz wave equation. It was shown by the numerical analysis that the acoustic eigenfrequencies of the system matched closely with observed hydrogen orbital energy states ( $\psi_{100}$  error < 1%). This is the explicit difference in this approach versus the standard approach of using the Schrödinger equation with the Copenhagen interpretation. This is a deterministic approach modeling of the vacuum as a fluid in which longitudinal waves can manifest. In contrast, in Copenhagen interpretation nothing is explicitly waving and the Schrödinger wave equation only describes probabilities.

**[0069]** For a medium to manifest an acoustic resonance, it must be capable of manifesting the longitudinal waves that comprise the acoustic resonance. As part of the process of understanding the implications of this, it is useful to consider the generally understood properties of an acoustic/longitudinal wave. In an acoustic wave expressed in air, water, or some other familiar dynamical medium, the unperturbed state of the medium is such that individual particles are arranged with some nominal spacing yielding an average number density of particles. In the presence of an acoustic wave disturbance, the particles are alternately compressed and rarefied about the unperturbed number density as the wave transits through the medium. In other words, the specks of mass of the medium are moved closer together and farther apart by the transit of the wave, as compared to their rest state. Applying the concept to the hydrogen atom case mentioned above, it is conjectured that the individual components of the medium are, to first order, ephemeral fermion-antifermion pairs appearing and disappearing in their individual bubbles of Heisenberg uncertainty, and that there is an average unperturbed separation of these bubbles. In addition to temporal variations imposed on the medium due to the acoustic wave, the number density is also spatially affected by the energy density associated with any fields expressed in the medium such as the proton's electrostatic potential. This view may be considered complementary to the Copenhagen interpretation in that the density and velocity fields play the role of hidden variables within the pilot wave interpretation. It should be noted that this view also provides a potential answer to the question, "What is

waving?” at the heart of all quantum theories involving any form of wave equation. As such, in addition to being complimentary to the Copenhagen interpretation, this view can derive useful insights into the physical reality not obtained if one only considers the time-independent form of the Schrödinger equation. In other words, this view will make predictions beyond those of QFT.

### **Casimir Connection**

[0070] At the macroscopic scale, the idea of the vacuum is intuitively simple/straightforward – empty space is empty and void of any matter/energy. However, at the quantum/microscopic scale the idea of the vacuum is more complicated owing to the mathematical nature of the Heisenberg uncertainty principle. At the microscopic scale, empty space is not empty - rather, it includes individual components that are, to the first order, ephemeral fermion-antifermion pairs appearing and disappearing within their individual bubbles of Heisenberg uncertainty.

[0071] The Casimir phenomenon is an observable consequence of the quantum vacuum. The textbook illustration of the Casimir phenomenon includes two parallel/conducting plates placed less than 1 micrometer apart forming a cavity. The presence of these closely spaced plates in the quantum vacuum restricts which vacuum fluctuation modes can be in the cavity. Integrating the energy density of these fluctuations over all possible wavelengths inside and outside the cavity predicts that there is a negative pressure inside the cavity resulting an attractive force, the Casimir phenomenon, that works to pull the plates together.

[0072] The dynamic vacuum model predicts that the negative vacuum energy density present in the cavity is not isotropic. Rather, there is a larger magnitude negative vacuum energy density concentrated along the cavity mid-plane that relaxes non-linearly to the unperturbed state at the cavity boundaries. It is speculated that the energy density structure in a Casimir cavity is coupled to a small electrostatic polarization field in the vacuum fluctuations.

## Casimir Power Cell

[0073] The perturbed density field of the quantum vacuum state inside a Casimir cavity has  $\frac{1}{d^4}$  dependency, where “d” is the width of the cavity gap. Similarly, the dynamic vacuum model of the hydrogen atom discussed above has a density field of the quantum fluid around the proton with  $\frac{1}{r^4}$  dependency suggesting a possible connection with the Casimir phenomenon for a parallel plate (wall) cavity. One could derive the effective average energy density for a given electron orbital of hydrogen by taking the energy  $E_n$  of a given electron orbital with primary quantum number  $n$  and average that energy across a spherical volume defined by the corresponding Bohr radius  $r_n$  allowed for that state. Turning to the Casimir cavity scenario, it was then reasoned that an analogue could be envisioned where a hypothetical Casimir cavity could be envisioned with a cavity gap equal to the Bohr diameter of the aforementioned electron orbital state. Calculating the energy density of this Casimir analogue matches calculated electron-orbital average energy density.

[0074] The correlation between the density function for the quantum fluid around the nucleus of the atom and the Casimir cavity calculation motivates further considerations. One can envision that the density equation derived from the electric field can provide a prediction for the shape and structure of the electric field inside the Casimir cavity. Typically, the density of the quantum vacuum within a Casimir cavity is assumed to be isotropic and unchanging, the conductive walls are at the same potential (usually grounded in an experiment), and there is no anticipated electric field expressed in the Casimir cavity. However, the cavity has the capacity to manifest an electrostatic polarization field. In this scenario, the field originates at the midplane of the cavity and extends outward to the plates in an analogous manner to what is found around the nucleus of the atom in the form of the radial electric field. In one or more embodiments, the polarization field present in the Casimir cavity can be detected.

[0075] One direct approach may be to construct a Casimir cavity that includes an electric field probe located along the midplane of the cavity, in accordance with one or more embodiments. For example, a probe may be a single whip probe or a fork-like probe that

has three or more whip probes (e.g., pillars) or may be a waffle grid. The constraint for the whip probes (or equivalent) would be that their cross section would be minimal when compared to the size of the cavity gap so that their effects on the vacuum energy density are negligible from an experimental view. In another words, one must ensure that the evanescent fields within the material structure that makes up the pillars do not decay to the unperturbed state such that the pillars in effect self-screen themselves from the very phenomenon they are being used to be detected. FIG. 1 shows a representation of the Casimir cavity concept.

**[0076]** The Casimir cavity shown in FIG. 1, when properly designed and connected to appropriately sensitive measurement equipment, is able to produce a DC voltage signal with sustained current capability. In another word, the Casimir cavity is able to produce power. Some critical design parameters to make the concept measurable in the lab and scalable to applications are the cavity gap, pillar size, conductive wall area, dielectric material used in cavity gap, and materials used for the conductive walls and pillars. As noted earlier, the perturbed density field in the cavity has  $\frac{1}{r^4}$  dependency, and the useful operational cavity gap is expected to start at maximum of ~10 micrometers down to the nanometer level and further if manufacturing ability allows. The voltage magnitude of a singular Casimir cavity measured across the conductive walls and pillars is small, ranging from nanovolt to microvolt for cavities with gaps measured in the micrometer to nanometer range, respectively. The current capability for an individual Casimir cavity is a function of the area of the conductive walls and the cavity gap. The size of the conductive walls allows for a larger cross-sectional area that is then coupled to the tunneling current capability between the conductive walls and the pillars. All things being equal, larger conductive wall area increases the current capability of an individual cavity. Decreasing the cavity gap will increase the magnitude of the voltage field (bias voltage) present between the conductive walls and the pillars, thus increasing the tunneling current for the given cavity design.

**[0077]** A Casimir cavity manifests a perturbed (less-energetic) state of the quantum vacuum field in the region enclosed by the cavity walls. This means in principle that there

are fewer vacuum fluctuations being manifested inside the cavity volume than there are in the surrounding region not encapsulated by the cavity walls. The evanescent fields of the perturbed vacuum state into the cavity walls also predict that the vacuum fluctuation density within the cavity walls is higher than the fluctuation density within the cavity. In addition, the density of vacuum fluctuations (e.g., virtual photons) that may occur within the cavity wall materials is higher than the density of vacuum fluctuations that may occur within the pillar materials that are located at the midplane of the cavity. Accordingly, there will be a disproportionate number of vacuum fluctuations that occur within the cavity walls and the pillars. This higher flux of vacuum fluctuations will, in effect, realize a larger number of electron holes in the Casimir cavity walls as compared to the pillars.

**[0078]** An electron is excited in the cavity wall by a vacuum fluctuation such that it tunnels across the cavity gap to the isolated pillars at the cavity midplane. The pillars are in a reduced flux of vacuum fluctuations and are statistically less likely to reverse or reciprocate the phenomenon. This generates a situation where there is an imbalance of electron holes and electrons across the structure. This resultant asymmetry of electron holes and electrons is the root of the manifestation of this electrostatic polarization field. When the cavity walls and the pillars of a Casimir cavity are connected by means of a conducting wire, the excess electrons in the pillar structure are then able to move back to the cavity walls eliminating the imbalance. This current flow capability coupled with the voltage potential allows this device to generate power by means of the “shine” of the quantum vacuum field.

**[0079]** A terrestrial analog to illustrate the asymmetry of the dynamic vacuum field that helps realize the asymmetry of electron holes and electrons may be to envision a small pacific atoll island that has a ring-like structure and encircles a protected lagoon that is very quiescent and peaceful while the ocean outside the atoll island by comparison is quite tumultuous. In a similar vein, the Casimir cavity walls realize a quiescent state of the quantum vacuum inside the cavity, a “vacuum lagoon.” The pillars placed within the cavity midplane, or “lagoon,” have considerably less wave energy by comparison than the bounding cavity walls representative of the encircling atoll island. The Casimir cavity disclosed in accordance with one or more embodiments works in effect by creating an

asymmetry in how the structural elements perceive and interact with the effective “shine” of the quantum vacuum field.

**[0080]** An analogue can be drawn between the interaction of the Casimir cavity with the “shine” of the quantum vacuum field and the interaction of a common solar cell construction with a real photon field. In a common solar cell structure, there is an n-doped region sandwiched to a p-doped region. When a light source provides a flux of photons that interact with the depletion zone of the cell between the n-doped and p-doped regions, this photovoltaic process generates electron-hole pairs where the electrons migrate to the n-doped region and the electron holes migrate to the p-doped region. When the n-doped region is connected to the p-doped region by means of a conducting wire, excess electrons in the n-doped region flow through the wire to the p-doped region and eliminate the imbalance. In the Casimir cavity, the Casimir cavity’s physical construction allows for an asymmetry in the structure’s interaction with the “shine” of the quantum vacuum field. And this asymmetry can generate power.

#### **Worldline Numerics**

**[0081]** The numerical methods approach used to model and quantify the vacuum response to the cavity structure is known as worldline numerics. This technique provides a high-fidelity prediction of the perturbed vacuum state inside a model geometry (e.g., the evanescent fields in a structure) along with predictions for the perturbed vacuum state within the cavity gap. An additional benefit of the worldline numerics method for studying the Casimir effect is that it can be used to address any type of geometry with effectively no restrictions on curvature or lack of smoothness. Due to the similarities with the dynamic vacuum model and its computational flexibility coupled with maturity, the worldline numerics technique has been implemented to consider Casimir cavities and determine the negative vacuum energy density distribution in the cavities and within the pillars. FIG. 11 depicts the numerical analysis results from an implementation of the worldline approach considering a three-dimensional sphere with a radius of 4 micrometers separated from an infinite flat plate with a separation of 4 micrometers. The approach was implemented using Open MPI-enabled c-code and the analysis was run on

one hundred 2.40 GHz Intel Skylake CPUs. The model grid was a 50×50×50 grid with a 2000 unit-loop ensemble. The left panel shows a two-dimensional section cut of the predicted distribution to the negative vacuum energy density between the two bodies where it should also be noted that the field gradients extend into both the body of the sphere and the flat plate in the form of evanescent fields. The right panel shows the distribution of forces across the surfaces of the model and was generated using COMSOL. The following section provides a summary of the details behind the worldline numerics analytic approach.

### Synopsis of Casimir Worldline Numerics Method

**[0082]** The string theory inspired worldline numerics approach to determine the Casimir effect, and the critical aspects of the analysis technique are briefly summarized here for convenience. With the objective of evaluating the Casimir interaction energy  $E_{\text{Casimir}}$  (e.g. normalized) arising from the coupling of a real scalar quantum field  $\phi$  of finite mass  $m$  with a background potential  $V(x)$  that represents the Casimir geometry, the key equation is Eq. 1:

$$\text{Eq. 1:} \quad \Gamma[V] = -\frac{1}{2(4\pi)^2} \int_{1/\Lambda^2}^{\infty} \frac{dT}{T^3} e^{-m^2 T} \int d^4x [\langle W_V[y(t); x] \rangle_y - 1].$$

**[0083]** The expectation value in Eq. 2 is the average of the loop ensemble over all closed loops with Gaussian walks:

$$\text{Eq. 2:} \quad \langle W_V[y(t); x] \rangle_y = \frac{\int_{y(0)=y(1)} \mathcal{D}y W_V[y(t); x] e^{-\int_0^1 dt \dot{y}^2/4}}{\int_{y(0)=y(1)} \mathcal{D}y e^{-\int_0^1 dt \dot{y}^2/4}},$$

where the following “Wilson loop” identity has been introduced with  $y$  representing the (unit) loop path,  $x$  representing the position shift of the unit loop in model space, and  $T$  denoting the proper time and serves to scale the unit loops:

$$\text{Eq. 3:} \quad W_V[y(t); x] = \exp[-T \int_0^1 dt V(x + \sqrt{T}y(t))].$$

**[0084]** Equipped with this information, one can calculate the (unrenormalized) Casimir energy as  $\mathcal{E} = \Gamma/\int dx_0$  where the integral represents the “volume” in the time direction.

When considering the Casimir phenomenon, the portion of the Casimir energy that has a dependency on the relative positions of the bounding geometries can be obtained by subtracting the energies of the single objects from the total Casimir energy:

$$\text{Eq. 4: } E_{\text{Casimir}} = \mathcal{E}_{V_1+V_2+\dots} - \mathcal{E}_{V_1} - \mathcal{E}_{V_2} - \dots.$$

[0085] The Casimir phenomenon can be obtained by taking the negative spatial derivative of this interaction energy, and further, this process has removed any UV divergences. In the Dirichlet limit  $\lambda \rightarrow \infty$  and for a massless scalar field with Dirichlet boundaries in  $D = 3+1$ , the worldline representation of the Casimir interaction energy boils down to:

$$\text{Eq. 5: } E_{\text{Casimir}} = -\frac{1}{2(4\pi)^2} \int_0^\infty \frac{dT}{T^3} \int d^3x_{\text{CM}} \langle \Theta_\Sigma[\mathbf{x}(\tau)] \rangle_x.$$

[0086] The worldline functional  $\Theta_\Sigma[\mathbf{x}(\tau)] = 0$  if the re-scaled unit loop does not intersect any Casimir geometry and  $\Theta_\Sigma[\mathbf{x}(\tau)] = 1 - n$  if the re-scaled loop intersects  $n \geq 1$  Casimir geometry. The numerical evaluation process requires two discretization steps. The first is the discretization of the path integral into an ensemble of  $n_L$  random paths  $\mathbf{x}(\tau)$ ,  $\ell = 1, \dots, n_L$  with each path forming a closed spacetime loop. The second is the discretization of the proper time interval  $\tau \in [0, T]$  into  $N$  steps such that an individual closed loop consists of  $N$  points per loop:  $\mathbf{x}_{\ell k} = \mathbf{x}_\ell(k \cdot T/N)$ ,  $k = 1, \dots, N$ . Transporting and rescaling the ensemble of unit loops to a point  $\mathbf{x}_{\text{CM}}$  in the model takes the following form:  $\mathbf{x}_{\ell k} = \mathbf{x}_{\text{CM}} + \sqrt{T}\mathbf{y}_{\ell k}$ . Applying these two discretizations to the Casimir interaction energy in Eq. 5 yields the following form:

$$\text{Eq. 6: } E_{\text{Casimir}} = -\frac{1}{2(4\pi)^2} \int_0^\infty \frac{dT}{T^3} \int d^3x_{\text{CM}} \frac{1}{n_L} \sum_{\ell=1}^{n_L} \Theta_\Sigma[\mathbf{x}_{\text{CM}} + \sqrt{T}\mathbf{y}_\ell].$$

[0087] As the worldline numeric approach for the Casimir phenomenon is based on (massless) scalar fields, the technique may currently only assess idealized behavior for bounding geometry and cannot assess any frequency dependence of materials. Additionally, the approach does not account for the impacts of temperature. However, it is still a very capable and appealing technique in that it can provide quick and fairly accurate assessments for very complicated geometries where analytic techniques are not practical.

## Generating Unit Loops and Computational Approach

[0088] The developers of the worldline numerics for the Casimir phenomenon have explored numerous ways to generate ensembles of unit loops with Gaussian distribution ranging from a heat bath kernel to random walks, and finally landing on a technique denoted as the “v-loop” algorithm. The “v-loop” technique was selected as it can computationally generate an ensemble of  $n_L$  each having  $N$  points per loop without having to perform multiple iterations on each loop to realize a closed random walk/worldline with the required statistical characteristics. FIG. 12 shows examples of Gaussian distributed closed unit-loops generated by the v-loop methodology. The algorithm will generate ensemble of  $n_L$  unit loops to be scaled and applied at each geometric point of interest in a physical model. The left side of FIG. 12 is 500-point unit loop and the right side of FIG. 12 is 5000-point unit loop. A summary of the computational procedure steps are provided herein to facilitate understanding of the “v-loop” approach:

1. generate  $N - 1$  numbers  $w_i$  ( $i = 1, \dots, N - 1$ ) with a Gaussian distribution  $e^{-w_i^2}$  (e.g. using Box-Müller method);
2. calculate  $N - 1$  numbers  $\bar{v}_i$  by normalizing  $w_i$ :

$$\begin{aligned} \bar{v}_1 &= \sqrt{\frac{2}{N}} w_1, \\ \text{Eq. 7:} \quad \bar{v}_i &= \frac{2}{\sqrt{N}} \sqrt{\frac{N+1-i}{N+2-i}} w_i, i = 2, \dots, N - 1; \end{aligned}$$

3. calculate  $v_i$  for  $i = 2, \dots, N - 1$  with the following:

$$\begin{aligned} v_i &= \bar{v}_i - \frac{1}{N+2-i} v_{i-1,1}, \\ \text{Eq. 8:} \quad &\text{where } v_{i-1,1} = \sum_{j=2}^{i-1} v_j; \end{aligned}$$

4. a unit loop  $\mathbf{y}$  can now be created by using:

$$\begin{aligned} \text{Eq. 9:} \quad y_1 &= \frac{1}{N} (\bar{v}_1 - \sum_{i=2}^{N-1} (N - i + \frac{1}{2}) v_i), \\ y_i &= y_{i-1} + v_i, i = 2, \dots, N - 1, \\ y_N &= -\sum_{i=1}^{N-1} y_i; \text{ and} \end{aligned}$$

5. this procedure is repeated  $n_L$  times to create the unit loop ensemble  $\mathbf{y}_\ell$  with  $\ell = 1, \dots, n_L$ .

[0089] This numeric worldline approach may be used to address any type of geometry while other approaches such as Proximity-Force Approximation (PFA) are not as flexible. Additionally, the numeric worldline approach has no dependency on the choice of model grid spacing or grid choice. The answer for a single point of interest in space does not have any interdependency on any other model grid points and may be calculated in total isolation, if that is all that is needed. FIGs. 13A and 13B provide a pictorial representation of the analysis process for a parallel plate Casimir cavity. Specifically, FIG. 13A shows the unit loop ensemble being moved to a geometric point of interest in the model. FIG. 13B shows scaling of one of the unit loops from the ensemble to the point that it intersects 2+ bodies of the model. This establishes the support  $\mathcal{S}_\ell$  to be used in integration and determining the weighted contribution of the loop to the Casimir energy density of the vacuum at this point in the model.

[0090] While FIGs. 13A and 13B depict a regularized model grid for communication purposes, the computational result at an individual model point is not dependent on adjacent points making the technique independent of grid choice. As indicated in FIGs. 13A and 13B, once the loop ensemble has been generated, the computational process to calculate the Casimir interaction energy follows the below enumerated steps:

1. The loop ensemble is moved to each model grid point of interest and scaled using proper time until 2+ bodies in the model are pierced;
2. The scale at which an individual loop pierces 2+ bodies defines the integral limits for the Casimir interaction energy integral;
3. The energy at the geometric point of interest in the model is increased based on wavelength (loop scale) and loop weight factor;
4. This scaling process is repeated for each loop in the ensemble at a geometric point of interest in the model; and
5. The above steps are repeated for each geometric point of interest in the model.

- [0091] Validation of the implementation of the numeric worldline approach was done on a plate-plate case and a corresponding plate-sphere case and was compared to documented results in the literature. In the validation effort, it is confirmed that the model predicts the correct Casimir phenomenon for a given plate-plate or sphere place scenario.
- [0092] This worldline numerics approach described is used to analyze a given custom Casimir cavity design to arrive at a predicted vacuum energy density distribution. This vacuum energy density is equated to an electric field magnitude, and COMSOL software (or equivalent) is used to convert this electric field into a charge density using the standard differential form of Gauss' Law  $\vec{\nabla} \cdot \vec{E} = \rho/\epsilon_0$ . This charge density distribution is then used to calculate an electrostatic potential which provides the anticipated voltage potential of the device design.
- [0093] Although only a few example embodiments have been described in detail above, those skilled in the art will readily appreciate that many modifications are possible in the example embodiments without materially departing from this invention. Accordingly, all such modifications are intended to be included within the scope of this disclosure as defined in the following claims.

## CLAIMS

What is claimed is:

1. A battery that comprises a Casimir-effect powered cell (Casimir cell), the Casimir cell comprising:
  - a first conductive wall;
  - a second conductive wall that faces the first conductive wall; and
  - 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.
2. 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.
3. 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
  - wherein one or more of the plurality of antenna elements are pillars.

4. 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.
5. 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.
6. 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.
7. 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.
8. 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<sub>2</sub>), aluminum oxide (Al<sub>2</sub>O<sub>3</sub>), tantalum pentoxide (Ta<sub>2</sub>O<sub>5</sub>), cerium oxide (CeO<sub>2</sub>), hafnium oxide (HfO<sub>2</sub>), Niobium pentoxide (Nb<sub>2</sub>O<sub>5</sub>), Niobium dioxide (NbO<sub>2</sub>), titanium dioxide (TiO<sub>2</sub>), titanium oxide (TiO or Ti<sub>3</sub>O<sub>5</sub>), Yttrium oxide (Y<sub>2</sub>O<sub>3</sub>), zirconium dioxide (ZrO<sub>2</sub>), and zirconium oxide (ZrO).
9. The battery of claim 1, wherein the cavity gap has a width of not more than 10 micrometers.
10. 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.

11. 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.
12. The battery of claim 1, wherein the first conductive wall, the second conductive wall, and the conductive antenna contain the same material.
13. 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.
14. The battery of claim 1,  
wherein the battery comprises an array of Casimir cells,  
wherein the array of Casimir cells is grouped into a plurality of groups of Casimir cells,  
each group comprising a plurality of Casimir cells,  
wherein the groups of Casimir cells are connected in parallel to one another, and  
wherein the plurality of Casimir cells within each group are connected in series to one another.
15. The battery of claim 1,  
wherein the battery comprises an array of Casimir cells,  
wherein the array of Casimir cells is grouped into a plurality of groups of Casimir cells,  
each group comprising a plurality of Casimir cells,  
wherein the groups of Casimir cells are connected in series to one another, and  
wherein the plurality of Casimir cells within each group are connected in parallel to one another.
16. 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.

17. The battery of claim 16, wherein the conductive antenna is a grid.

18. 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,

wherein the first conductive wall and the second conductive wall are opposite walls of the  
c-shape wall, and

wherein the conductive antenna is disposed inside the c-shape wall in between the first  
conductive wall and the second conductive wall.

19. The battery of claim 1, wherein the Casimir cell is exposed to light.

20. A method for making a Casimir-effect powered cell comprising:

etching a substrate to create a first conductive wall on the substrate;

etching the substrate to create a second conductive wall on the substrate such that the  
second conductive wall faces the first conductive wall; and

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 antennal faces the first conductive wall and the second conductive  
wall,

wherein the first conductive wall and the second conductive wall are etched to be  
electrically connected and have a same first voltage potential, and

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

## **ABSTRACT**

A battery includes a Casimir-effect powered cell (Casimir cell). The Casimir cell includes a first conductive wall; a second conductive wall that faces the first conductive wall; and a conductive antenna disposed in a cavity gap that is a space between the first conductive wall and the second conductive wall. The conductive antenna faces the first conductive wall and the second conductive wall. The first conductive wall and the second conductive wall produce a same first voltage potential. The conductive antenna produces a second voltage potential that is different from the first voltage potential. 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.

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| Title of Invention                        | CASIMIR POWER CELL |                        |              |

**Filing By Reference:**

Only complete this section when filing an application by reference under 35 U.S.C. 111(c) and 37 CFR 1.57(a). Do not complete this section if application papers including a specification and any drawings are being filed. Any domestic benefit or foreign priority information must be provided in the appropriate section(s) below (i.e., "Domestic Benefit/National Stage Information" and "Foreign Priority Information").

For the purposes of a filing date under 37 CFR 1.53(b), the description and any drawings of the present application are replaced by this reference to the previously filed application, subject to conditions and requirements of 37 CFR 1.57(a).

|                                                        |                          |                                            |
|--------------------------------------------------------|--------------------------|--------------------------------------------|
| Application number of the previously filed application | Filing date (YYYY-MM-DD) | Intellectual Property Authority or Country |
|                                                        |                          |                                            |

**Publication Information:**

☐ Request Early Publication (Fee required at time of Request 37 CFR 1.219)

☐ **Request Not to Publish.** I hereby request that the attached application not be published under 35 U.S.C. 122(b) and certify that the invention disclosed in the attached application **has not and will not** be the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.

**Representative Information:**

Representative information should be provided for all practitioners having a power of attorney in the application. Providing this information in the Application Data Sheet does not constitute a power of attorney in the application (see 37 CFR 1.32). Either enter Customer Number or complete the Representative Name section below. If both sections are completed the customer Number will be used for the Representative Information during processing.

|                    |                                                  |                                              |                                                         |
|--------------------|--------------------------------------------------|----------------------------------------------|---------------------------------------------------------|
| Please Select One: | <input checked="" type="radio"/> Customer Number | <input type="radio"/> US Patent Practitioner | <input type="radio"/> Limited Recognition (37 CFR 11.9) |
| Customer Number    | 22511                                            |                                              |                                                         |

**Domestic Benefit/National Stage Information:**

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, 365(c), or 386(c) or indicate National Stage entry from a PCT application. Providing benefit claim information in the Application Data Sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78.

When referring to the current application, please leave the "Application Number" field blank.

|                          |                 |                          |                                    |
|--------------------------|-----------------|--------------------------|------------------------------------|
| Prior Application Status |                 | <a href="#">Remove</a>   |                                    |
| Application Number       | Continuity Type | Prior Application Number | Filing or 371(c) Date (YYYY-MM-DD) |
|                          |                 |                          |                                    |

Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the **Add** button.

[Add](#)

|                                           |                    |                        |              |
|-------------------------------------------|--------------------|------------------------|--------------|
| <b>Application Data Sheet 37 CFR 1.76</b> |                    | Attorney Docket Number | 19077-002001 |
|                                           |                    | Application Number     |              |
| Title of Invention                        | CASIMIR POWER CELL |                        |              |

## Foreign Priority Information:

This section allows for the applicant to claim priority to a foreign application. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55. When priority is claimed to a foreign application that is eligible for retrieval under the priority document exchange program (PDX)<sup>i</sup> the information will be used by the Office to automatically attempt retrieval pursuant to 37 CFR 1.55(i)(1) and (2). Under the PDX program, applicant bears the ultimate responsibility for ensuring that a copy of the foreign application is received by the Office from the participating foreign intellectual property office, or a certified copy of the foreign priority application is filed, within the time period specified in 37 CFR 1.55(g)(1).

| Application Number | Country <sup>i</sup> | Filing Date (YYYY-MM-DD) | Access Code <sup>j</sup> (if applicable) |
|--------------------|----------------------|--------------------------|------------------------------------------|
|                    |                      |                          |                                          |

Additional Foreign Priority Data may be generated within this form by selecting the **Add** button.

## Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications

☐ This application (1) claims priority to or the benefit of an application filed before March 16, 2013 and (2) also contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013.

NOTE: By providing this statement under 37 CFR 1.55 or 1.78, this application, with a filing date on or after March 16, 2013, will be examined under the first inventor to file provisions of the AIA.

|                                           |                    |                        |              |
|-------------------------------------------|--------------------|------------------------|--------------|
| <b>Application Data Sheet 37 CFR 1.76</b> |                    | Attorney Docket Number | 19077-002001 |
|                                           |                    | Application Number     |              |
| Title of Invention                        | CASIMIR POWER CELL |                        |              |

## Authorization or Opt-Out of Authorization to Permit Access:

When this Application Data Sheet is properly signed and filed with the application, applicant has provided written authority to permit a participating foreign intellectual property (IP) office access to the instant application-as-filed (see paragraph A in subsection 1 below) and the European Patent Office (EPO) access to any search results from the instant application (see paragraph B in subsection 1 below).

Should applicant choose not to provide an authorization identified in subsection 1 below, applicant **must opt-out** of the authorization by checking the corresponding box A or B or both in subsection 2 below.

**NOTE:** This section of the Application Data Sheet is **ONLY** reviewed and processed with the **INITIAL** filing of an application. After the initial filing of an application, an Application Data Sheet cannot be used to provide or rescind authorization for access by a foreign IP office(s). Instead, Form PTO/SB/39 or PTO/SB/69 must be used as appropriate.

### 1. Authorization to Permit Access by a Foreign Intellectual Property Office(s)

**A. Priority Document Exchange (PDX)** - Unless box A in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the European Patent Office (EPO), the Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), the State Intellectual Property Office of the People's Republic of China (SIPO), the World Intellectual Property Organization (WIPO), and any other foreign intellectual property office participating with the USPTO in a bilateral or multilateral priority document exchange agreement in which a foreign application claiming priority to the instant patent application is filed, access to: (1) the instant patent application-as-filed and its related bibliographic data, (2) any foreign or domestic application to which priority or benefit is claimed by the instant application and its related bibliographic data, and (3) the date of filing of this Authorization. See 37 CFR 1.14(h)(1).

**B. Search Results from U.S. Application to EPO** - Unless box B in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the EPO access to the bibliographic data and search results from the instant patent application when a European patent application claiming priority to the instant patent application is filed. See 37 CFR 1.14(h)(2).

The applicant is reminded that the EPO's Rule 141(1) EPC (European Patent Convention) requires applicants to submit a copy of search results from the instant application without delay in a European patent application that claims priority to the instant application.

### 2. Opt-Out of Authorizations to Permit Access by a Foreign Intellectual Property Office(s)

☐ A. Applicant **DOES NOT** authorize the USPTO to permit a participating foreign IP office access to the instant application-as-filed. If this box is checked, the USPTO will not be providing a participating foreign IP office with any documents and information identified in subsection 1A above.

☐ B. Applicant **DOES NOT** authorize the USPTO to transmit to the EPO any search results from the instant patent application. If this box is checked, the USPTO will not be providing the EPO with search results from the instant application.

**NOTE:** Once the application has published or is otherwise publicly available, the USPTO may provide access to the application in accordance with 37 CFR 1.14.

|                                           |                    |                        |              |
|-------------------------------------------|--------------------|------------------------|--------------|
| <b>Application Data Sheet 37 CFR 1.76</b> |                    | Attorney Docket Number | 19077-002001 |
|                                           |                    | Application Number     |              |
| Title of Invention                        | CASIMIR POWER CELL |                        |              |

## Applicant Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

|                  |   |                        |
|------------------|---|------------------------|
| <b>Applicant</b> | 1 | <a href="#">Remove</a> |
|------------------|---|------------------------|

If the applicant is the inventor (or the remaining joint inventor or inventors under 37 CFR 1.45), this section should not be completed. The information to be provided in this section is the name and address of the legal representative who is the applicant under 37 CFR 1.43; or the name and address of the assignee, person to whom the inventor is under an obligation to assign the invention, or person who otherwise shows sufficient proprietary interest in the matter who is the applicant under 37 CFR 1.46. If the applicant is an applicant under 37 CFR 1.46 (assignee, person to whom the inventor is obligated to assign, or person who otherwise shows sufficient proprietary interest) together with one or more joint inventors, then the joint inventor or inventors who are also the applicant should be identified in this section.

[Clear](#)

|                                           |                                          |                |
|-------------------------------------------|------------------------------------------|----------------|
| <input checked="" type="radio"/> Assignee | Legal Representative under 35 U.S.C. 117 | Joint Inventor |
|-------------------------------------------|------------------------------------------|----------------|

|                                                     |                                                  |
|-----------------------------------------------------|--------------------------------------------------|
| Person to whom the inventor is obligated to assign. | Person who shows sufficient proprietary interest |
|-----------------------------------------------------|--------------------------------------------------|

If applicant is the legal representative, indicate the authority to file the patent application, the inventor is:

Name of the Deceased or Legally Incapacitated Inventor:

If the Applicant is an Organization check here. ☒

|                   |                           |
|-------------------|---------------------------|
| Organization Name | Limitless Space Institute |
|-------------------|---------------------------|

**Mailing Address Information For Applicant:**

|               |                          |                |       |
|---------------|--------------------------|----------------|-------|
| Address 1     | 16441 Space Center Blvd. |                |       |
| Address 2     | Bldg. D-200              |                |       |
| City          | Houston                  | State/Province | TX    |
| Country       | US                       | Postal Code    | 77058 |
| Phone Number  |                          | Fax Number     |       |
| Email Address |                          |                |       |

Additional Applicant Data may be generated within this form by selecting the Add button. [Add](#)

## Assignee Information including Non-Applicant Assignee Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

|                                           |                    |                        |              |
|-------------------------------------------|--------------------|------------------------|--------------|
| <b>Application Data Sheet 37 CFR 1.76</b> |                    | Attorney Docket Number | 19077-002001 |
|                                           |                    | Application Number     |              |
| Title of Invention                        | CASIMIR POWER CELL |                        |              |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                           |                |       |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|----------------|-------|
| Assignee                                                                                                                                                                                                                                                                                                                                                                                                                                               | 1                         |                |       |
| Complete this section if assignee information, including non-applicant assignee information, is desired to be included on the patent application publication. An assignee-applicant identified in the "Applicant Information" section will appear on the patent application publication as an applicant. For an assignee-applicant, complete this section only if identification as an assignee is also desired on the patent application publication. |                           |                |       |
| <div>Remove</div>                                                                                                                                                                                                                                                                                                                                                                                                                                      |                           |                |       |
| If the Assignee or Non-Applicant Assignee is an Organization check here. <input checked="" type="checkbox"/>                                                                                                                                                                                                                                                                                                                                           |                           |                |       |
| Organization Name                                                                                                                                                                                                                                                                                                                                                                                                                                      | Limitless Space Institute |                |       |
| <b>Mailing Address Information For Assignee including Non-Applicant Assignee:</b>                                                                                                                                                                                                                                                                                                                                                                      |                           |                |       |
| Address 1                                                                                                                                                                                                                                                                                                                                                                                                                                              | 16441 Space Center Blvd.  |                |       |
| Address 2                                                                                                                                                                                                                                                                                                                                                                                                                                              | Bldg. D-200               |                |       |
| City                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Houston                   | State/Province | TX    |
| Country i                                                                                                                                                                                                                                                                                                                                                                                                                                              | US                        | Postal Code    | 77058 |
| Phone Number                                                                                                                                                                                                                                                                                                                                                                                                                                           |                           | Fax Number     |       |
| Email Address                                                                                                                                                                                                                                                                                                                                                                                                                                          |                           |                |       |
| Additional Assignee or Non-Applicant Assignee Data may be generated within this form by selecting the Add button. <div>Add</div>                                                                                                                                                                                                                                                                                                                       |                           |                |       |

**Signature:**

Remove

**NOTE:** This Application Data Sheet must be signed in accordance with 37 CFR 1.33(b). However, if this Application Data Sheet is submitted with the INITIAL filing of the application and either box A or B is not checked in subsection 2 of the "Authorization or Opt-Out of Authorization to Permit Access" section, then this form must also be signed in accordance with 37 CFR 1.14(c).

This Application Data Sheet **must** be signed by a patent practitioner if one or more of the applicants is a **juristic entity** (e.g., corporation or association). If the applicant is two or more joint inventors, this form must be signed by a patent practitioner, **all** joint inventors who are the applicant, or one or more joint inventor-applicants who have been given power of attorney (e.g., see USPTO Form PTO/AIA/81) on behalf of **all** joint inventor-applicants.

See 37 CFR 1.4(d) for the manner of making signatures and certifications.

|                                                                                                    |                     |           |                   |                     |        |
|----------------------------------------------------------------------------------------------------|---------------------|-----------|-------------------|---------------------|--------|
| Signature                                                                                          | /Thomas K. Scherer/ |           | Date (YYYY-MM-DD) | 2023-06-08          |        |
| First Name                                                                                         | Thomas              | Last Name | Scherer           | Registration Number | 45,079 |
| Additional Signature may be generated within this form by selecting the Add button. <div>Add</div> |                     |           |                   |                     |        |

|                                           |                    |                        |              |
|-------------------------------------------|--------------------|------------------------|--------------|
| <b>Application Data Sheet 37 CFR 1.76</b> |                    | Attorney Docket Number | 19077-002001 |
|                                           |                    | Application Number     |              |
| Title of Invention                        | CASIMIR POWER CELL |                        |              |

This collection of information is required by 37 CFR 1.76. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 23 minutes to complete, including gathering, preparing, and submitting the completed application data sheet form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

## Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

- 1 The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these records.
- 2 A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
- 3 A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
- 4 A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
- 5 A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
- 6 A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
- 7 A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
- 8 A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.
- 9 A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.



## ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #  
**18/331,486**

RECEIPT DATE / TIME  
**06/20/2023 06:46:39 PM ET**

ATTORNEY DOCKET #  
**19077-002001**

### Title of Invention

CASIMIR POWER CELL

### Application Information

APPLICATION TYPE Utility - Nonprovisional Application  
under 35 USC 111(a)

PATENT # -

CONFIRMATION # 2626

FILED BY Mary Ehlers

PATENT CENTER # 62304794

FILING DATE -

CUSTOMER # 22511

FIRST NAMED INVENTOR Mr. Harold White

CORRESPONDENCE ADDRESS -

AUTHORIZED BY Thomas Scherer

### Documents

**TOTAL DOCUMENTS: 2**

| DOCUMENT                      |       | PAGES | DESCRIPTION        | SIZE (KB) |
|-------------------------------|-------|-------|--------------------|-----------|
| 19077_002001_POA.pdf          |       | 2     | -                  | 364 KB    |
| 19077_002001_POA-TRAN.LET.pdf | (1-1) | 1     | Transmittal Letter | 270 KB    |
| 19077_002001_POA-PA...pdf     | (2-2) | 1     | Power of Attorney  | 93 KB     |

### Digest

DOCUMENT

MESSAGE DIGEST(SHA-512)

|                                   |                                                                                                                                          |
|-----------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|
| 19077_002001_POA.pdf              | BD33BBD6A3ACCE6724F3D7C269FA07E0A27919720A2E81BC<br>ADF81D78A7EC5A2A35E5F9C2DE247124A011B81303FD93A5F<br>D3A1F9D8F71977B373911523DF19D06 |
| 19077_002001_POA-<br>TRAN.LET.pdf | C011352BBE1D26452393417D8814B2D6B54F892C01AC679F57<br>3DD704AE51D7FDE0ECA5EAAAE3F823E7C85D7A9F9F60DFE<br>0BEABB5A0C336792F5BD36C0F3B9AF1 |
| 19077_002001_POA-PA...pdf         | 1BC12E8FEA99C16AE1EFF972D920A16C8CB5C646BD39D69E<br>E3410C4B94096654E4A274A4679F65BC47A0183DA40B376942<br>488261EF518A9C4D07E14B168129D9 |

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

#### **New Applications Under 35 U.S.C. 111**

If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application

#### **National Stage of an International Application under 35 U.S.C. 371**

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

#### **New International Application Filed with the USPTO as a Receiving Office**

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

## TRANSMITTAL FOR POWER OF ATTORNEY TO ONE OR MORE REGISTERED PRACTITIONERS

NOTE: This form is to be submitted with the Power of Attorney by Applicant form (PTO/AIA/82B) to identify the application to which the Power of Attorney is directed, in accordance with 37 CFR 1.5, unless the application number and filing date are identified in the Power of Attorney by Applicant form. If neither form PTO/AIA/82A nor form PTO/AIA/82B identifies the application to which the Power of Attorney is directed, the Power of Attorney will not be recognized in the application.

|                        |                    |
|------------------------|--------------------|
| Application Number     | 18/331,486         |
| Filing Date            | June 8, 2023       |
| First Named Inventor   | Harold White       |
| Title                  | CASIMIR POWER CELL |
| Art Unit               | N/A                |
| Examiner Name          | Not Yet Assigned   |
| Attorney Docket Number | 19077-002001       |

### SIGNATURE of Applicant or Patent Practitioner

|                                                    |                     |                     |               |
|----------------------------------------------------|---------------------|---------------------|---------------|
| Signature                                          | /Thomas K. Scherer/ | Date (Optional)     | June 20, 2023 |
| Name                                               | Thomas K. Scherer   | Registration Number | 45,079        |
| Title (if Applicant is a juristic entity)          |                     |                     |               |
| Applicant Name (if Applicant is a juristic entity) |                     |                     |               |

**NOTE:** This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4(d) for signature requirements and certifications. If more than one applicant, use multiple forms.

☐

\*Total of 1 forms are submitted.

## POWER OF ATTORNEY BY APPLICANT

I hereby revoke all previous powers of attorney given in the application identified in either the attached transmittal letter or the boxes below.

| Application Number | Filing Date  |
|--------------------|--------------|
| 18/331,486         | June 8, 2023 |

(Note: The boxes above may be left blank if information is provided on form PTO/AIA/82A.)

☒ I hereby appoint the Patent Practitioner(s) associated with the following Customer Number as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the application referenced in the attached transmittal letter (form PTO/AIA/82A) or identified above:

22511

OR

☐ I hereby appoint Practitioner(s) named in the attached list (form PTO/AIA/82C) as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the patent application referenced in the attached transmittal letter (form PTO/AIA/82A) or identified above. (Note: Complete form PTO/AIA/82C.)

Please recognize or change the correspondence address for the application identified in the attached transmittal letter or the boxes above to:

☒ The address associated with the above-mentioned Customer Number

OR

☐ The address associated with Customer Number:

OR

☐ Firm or Individual Name

Address

City

State

Zip

Country

Telephone

Email

I am the Applicant (if the Applicant is a juristic entity, list the Applicant name in the box):

Limitless Space Institute

☐ Inventor or Joint Inventor (title not required below)

☐ Legal Representative of a Deceased or Legally Incapacitated Inventor (title not required below)

☒ Assignee or Person to Whom the Inventor is Under an Obligation to Assign (provide signer's title if applicant is a juristic entity)

☐ Person Who Otherwise Shows Sufficient Proprietary Interest (e.g., a petition under 37 CFR 1.46(b)(2) was granted in the application or is concurrently being filed with this document) (provide signer's title if applicant is a juristic entity)

### SIGNATURE of Applicant for Patent

The undersigned (whose title is supplied below) is authorized to act on behalf of the applicant (e.g., where the applicant is a juristic entity).

Signature

*Brian Kelly*

Date (Optional)

06/14/23

Name

Title

**NOTE:** Signature - This form must be signed by the applicant in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications. If more than one applicant, use multiple forms.

☐ Total of 1 forms are submitted.



# UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE  
United States Patent and Trademark Office  
Address: COMMISSIONER FOR PATENTS  
P.O. Box 1450  
Alexandria, Virginia 22313-1450  
www.uspto.gov

| APPLICATION<br>NUMBER | FILING or<br>371(c) DATE | GRP ART<br>UNIT | FIL FEE REC'D | ATTY. DOCKET NO | TOT CLAIMS | IND CLAIMS |
|-----------------------|--------------------------|-----------------|---------------|-----------------|------------|------------|
| 18/331,486            | 06/08/2023               |                 | 664           | 19077-002001    | 20         | 2          |

CONFIRMATION NO. 2626

22511

OSHA BERGMAN WATANABE & BURTON LLP

Enterprise Plaza

1100 Louisiana, Suite 4900

HOUSTON, TX 77002

## FILING RECEIPT



0000000058712588

Date Mailed: 06/28/2023

Receipt is acknowledged of this non-provisional utility patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF FIRST INVENTOR, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection.

**Please verify the accuracy of the data presented on this receipt.** If an error is noted on this Filing Receipt, please submit a written request for a corrected Filing Receipt, including a properly marked-up ADS showing the changes with strike-through for deletions and underlining for additions. If you received a "Notice to File Missing Parts" or other Notice requiring a response for this application, please submit any request for correction to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections provided that the request is grantable.

### Inventor(s)

Harold White, Houston, TX;

### Applicant(s)

Limitless Space Institute, Houston, TX;

### Assignment For Published Patent Application

Limitless Space Institute, Houston, TX

**Power of Attorney:** The patent practitioners associated with Customer Number 22511

### Domestic Applications for which benefit is claimed - None.

*A proper domestic benefit claim must be provided in an Application Data Sheet in order to constitute a claim for domestic benefit. See 37 CFR 1.76 and 1.78.*

**Foreign Applications** for which priority is claimed (You may be eligible to benefit from the **Patent Prosecution Highway** program at the USPTO. Please see <http://www.uspto.gov> for more information.) - None.

*Foreign application information must be provided in an Application Data Sheet in order to constitute a claim to foreign priority. See 37 CFR 1.55 and 1.76.*

**Permission to Access Application via Priority Document Exchange:** Yes

**Permission to Access Search Results:** Yes

Applicant may provide or rescind an authorization for access using Form PTO/SB/39 or Form PTO/SB/69 as appropriate.

**If Required, Foreign Filing License Granted:** 06/26/2023

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 18/331,486**

**Projected Publication Date:** 12/12/2024

**Non-Publication Request:** No

**Early Publication Request:** No

**\*\* SMALL ENTITY \*\***

**Title**

CASIMIR POWER CELL

**Preliminary Class**

**Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications:** No

## **PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES**

Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing of patent applications on the same invention in member countries, but **does not result** in a grant of "an international patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

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page 2 of 4

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# PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875

Application or Docket Number  
18/331,486

## APPLICATION AS FILED - PART I

| (Column 1)                                                                |                                                                                                                                                                                                                               | (Column 2)   | SMALL ENTITY |         | OR | OTHER THAN SMALL ENTITY |         |
|---------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|--------------|---------|----|-------------------------|---------|
| FOR                                                                       | NUMBER FILED                                                                                                                                                                                                                  | NUMBER EXTRA | RATE(\$)     | FEE(\$) |    | RATE(\$)                | FEE(\$) |
| BASIC FEE<br>(37 CFR 1.16(a), (b), or (c))                                | N/A                                                                                                                                                                                                                           | N/A          | N/A          | 64      |    | N/A                     |         |
| SEARCH FEE<br>(37 CFR 1.16(k), (l), or (m))                               | N/A                                                                                                                                                                                                                           | N/A          | N/A          | 280     |    | N/A                     |         |
| EXAMINATION FEE<br>(37 CFR 1.16(o), (p), or (q))                          | N/A                                                                                                                                                                                                                           | N/A          | N/A          | 320     |    | N/A                     |         |
| TOTAL CLAIMS<br>(37 CFR 1.16(i))                                          | 20 minus 20 =                                                                                                                                                                                                                 | *            | x            | = 0     | OR |                         |         |
| INDEPENDENT CLAIMS<br>(37 CFR 1.16(h))                                    | 2 minus 3 =                                                                                                                                                                                                                   | *            | x            | = 0     |    |                         |         |
| APPLICATION SIZE FEE<br>(37 CFR 1.16(s))                                  | If the specification and drawings exceed 100 sheets of paper, the application size fee due is \$310 (\$155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s). |              |              | 0       |    |                         |         |
| MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))                         |                                                                                                                                                                                                                               |              |              | 0       |    |                         |         |
| * If the difference in column 1 is less than zero, enter "0" in column 2. |                                                                                                                                                                                                                               |              | TOTAL        | 664     |    | TOTAL                   |         |

## APPLICATION AS AMENDED - PART II

|             | (Column 1)                                                      | (Column 2)                       | (Column 3)                         | SMALL ENTITY    |          | OR                 | OTHER THAN SMALL ENTITY |                    |
|-------------|-----------------------------------------------------------------|----------------------------------|------------------------------------|-----------------|----------|--------------------|-------------------------|--------------------|
|             |                                                                 | CLAIMS REMAINING AFTER AMENDMENT | HIGHEST NUMBER PREVIOUSLY PAID FOR | PRESENT EXTRA   | RATE(\$) | ADDITIONAL FEE(\$) | RATE(\$)                | ADDITIONAL FEE(\$) |
| AMENDMENT A | Total<br>(37 CFR 1.16(i))                                       | *                                | Minus                              | **              | x        | =                  | x                       | =                  |
|             | Independent<br>(37 CFR 1.16(h))                                 | *                                | Minus                              | ***             | x        | =                  | x                       | =                  |
|             | Application Size Fee (37 CFR 1.16(s))                           |                                  |                                    |                 |          |                    |                         |                    |
|             | FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j)) |                                  |                                    |                 |          |                    |                         |                    |
|             |                                                                 |                                  |                                    | TOTAL ADD'L FEE |          | OR                 | TOTAL ADD'L FEE         |                    |
| AMENDMENT B | Total<br>(37 CFR 1.16(i))                                       | *                                | Minus                              | **              | x        | =                  | x                       | =                  |
|             | Independent<br>(37 CFR 1.16(h))                                 | *                                | Minus                              | ***             | x        | =                  | x                       | =                  |
|             | Application Size Fee (37 CFR 1.16(s))                           |                                  |                                    |                 |          |                    |                         |                    |
|             | FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j)) |                                  |                                    |                 |          |                    |                         |                    |
|             |                                                                 |                                  |                                    | TOTAL ADD'L FEE |          | OR                 | TOTAL ADD'L FEE         |                    |

\* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.

\*\* If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".

\*\*\* If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".

The "Highest Number Previously Paid For" (Total or Independent) is the highest found in the appropriate box in column 1.

|                                                                                                     |                        |                  |
|-----------------------------------------------------------------------------------------------------|------------------------|------------------|
| <b>INFORMATION DISCLOSURE<br/>STATEMENT BY APPLICANT</b><br>( Not for submission under 37 CFR 1.99) | Application Number     | 18331486         |
|                                                                                                     | Filing Date            | 2023-06-08       |
|                                                                                                     | First Named Inventor   | Harold White     |
|                                                                                                     | Art Unit               | N/A              |
|                                                                                                     | Examiner Name          | Not Yet Assigned |
|                                                                                                     | Attorney Docket Number | 19077-002001     |

| U.S.PATENTS       |         |               |                        |            |                                                 | Remove                                                                 |
|-------------------|---------|---------------|------------------------|------------|-------------------------------------------------|------------------------------------------------------------------------|
| Examiner Initial* | Cite No | Patent Number | Kind Code <sup>1</sup> | Issue Date | Name of Patentee or Applicant of cited Document | Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear |
|                   | 1       | 11133758      | B2                     | 2021-09-28 | Moddel, Garret                                  |                                                                        |
|                   | 2       | 11463026      | B2                     | 2022-10-04 | Moddel, Garret                                  |                                                                        |

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| Examiner Initial*                   | Cite No | Publication Number | Kind Code <sup>1</sup> | Publication Date | Name of Patentee or Applicant of cited Document | Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear |
|                                     | 1       | 20210135600        | A1                     | 2021-05-06       | THIBADO et al.                                  |                                                                        |

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| Examiner Initial*        | Cite No | Foreign Document Number <sup>3</sup> | Country Code <sup>2i</sup> | Kind Code <sup>4</sup> | Publication Date | Name of Patentee or Applicant of cited Document | Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear | T <sup>5</sup> |
|                          | 1       |                                      |                            |                        |                  |                                                 |                                                                        |                |

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# **INFORMATION DISCLOSURE STATEMENT BY APPLICANT** ( Not for submission under 37 CFR 1.99)

|                        |                  |
|------------------------|------------------|
| Application Number     | 18331486         |
| Filing Date            | 2023-06-08       |
| First Named Inventor   | Harold White     |
| Art Unit               | N/A              |
| Examiner Name          | Not Yet Assigned |
| Attorney Docket Number | 19077-002001     |

| Examiner Initials* | Cite No | Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published. | T <sup>5</sup> |
|--------------------|---------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
|                    | 1       | White, H. et al.; "A discussion on a dynamic vacuum model: Derivation of Helmholtz equation from Schrödinger equation"; ELSEVIER, Physics Open, Vol. 1, December 2019 (8 pages)                                                                                 |                |
|                    | 2       | White, H. et al.; "Worldline numerics applied to custom Casimir geometry generates unanticipated intersection with Alcubierre warp metric"; The European Physical Journal C, Vol. 81, No. 677, July 31, 2021 (10 pages)                                         |                |
|                    | 3       | White, H., et al.; "Dynamic Vacuum Model and Casimir Cavity Experiments" Journal of the British Interplanetary Society, General Interstellar Issue, Vol. 73, No. 7, July 2020, pp. 268-272 (44 pages)                                                           |                |
|                    | 4       | Moddel, G. et al.; "Optical-Cavity-Induced Current"; symmetry, Vol. 13, No. 517, January 7, 2021 (16 pages)                                                                                                                                                     |                |
|                    | 5       | Moddel, G. et al.; "Casimir-cavity-induced conductance changes"; Physical Review Research, Vol. 3, Issue 2, April 2021, pp. L022007-1-L022007-7 (7 pages)                                                                                                       |                |

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## **EXAMINER SIGNATURE**

|                    |                      |                 |                      |
|--------------------|----------------------|-----------------|----------------------|
| Examiner Signature | <input type="text"/> | Date Considered | <input type="text"/> |
|--------------------|----------------------|-----------------|----------------------|

\*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

<sup>1</sup> See Kind Codes of USPTO Patent Documents at [www.USPTO.GOV](http://www.USPTO.GOV) or MPEP 901.04. <sup>2</sup> Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). <sup>3</sup> For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. <sup>4</sup> Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. <sup>5</sup> Applicant is to place a check mark here if English language translation is attached.

**INFORMATION DISCLOSURE  
STATEMENT BY APPLICANT**  
( Not for submission under 37 CFR 1.99)

|                        |                  |
|------------------------|------------------|
| Application Number     | 18331486         |
| Filing Date            | 2023-06-08       |
| First Named Inventor   | Harold White     |
| Art Unit               | N/A              |
| Examiner Name          | Not Yet Assigned |
| Attorney Docket Number | 19077-002001     |

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Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

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**OR**

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See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

A certification statement is not submitted herewith.

**SIGNATURE**

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

|            |                     |                     |            |
|------------|---------------------|---------------------|------------|
| Signature  | /Thomas K. Scherer/ | Date (YYYY-MM-DD)   | 2023-07-11 |
| Name/Print | Thomas K. Scherer   | Registration Number | 45,079     |

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. **DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

## Electronic Acknowledgement Receipt

|                                             |                             |
|---------------------------------------------|-----------------------------|
| <b>EFS ID:</b>                              | 48280441                    |
| <b>Application Number:</b>                  | 18331486                    |
| <b>International Application Number:</b>    |                             |
| <b>Confirmation Number:</b>                 | 2626                        |
| <b>Title of Invention:</b>                  | CASIMIR POWER CELL          |
| <b>First Named Inventor/Applicant Name:</b> | Harold White                |
| <b>Customer Number:</b>                     | 22511                       |
| <b>Filer:</b>                               | Jonathan P. Osha/Gina Vega  |
| <b>Filer Authorized By:</b>                 | Jonathan P. Osha            |
| <b>Attorney Docket Number:</b>              | 19077-002001                |
| <b>Receipt Date:</b>                        | 11-JUL-2023                 |
| <b>Filing Date:</b>                         | 08-JUN-2023                 |
| <b>Time Stamp:</b>                          | 17:02:24                    |
| <b>Application Type:</b>                    | Utility under 35 USC 111(a) |

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| 1               | Information Disclosure Statement (IDS) Form (SB08) | 002_ids.pdf | 1263855                                  | no               | 4                |
|                 |                                                    |             | a89275867465ef2dfd97f5368b60947bc5d2f8dd |                  |                  |

### Warnings:

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| 2                            | Non Patent Literature | 002_NPL_1_white.pdf | 1195129                                  | no | 8  |
|                              |                       |                     | a1d2c04ad8e9c964542ee3707baf092bd30baeb4 |    |    |
| Warnings:                    |                       |                     |                                          |    |    |
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| 3                            | Non Patent Literature | 002_NPL_2_white.pdf | 984564                                   | no | 10 |
|                              |                       |                     | 40e89eeffaaf417bc652799b6101da9f9843a23e |    |    |
| Warnings:                    |                       |                     |                                          |    |    |
| Information:                 |                       |                     |                                          |    |    |
| 4                            | Non Patent Literature | 002_NPL_3_white.pdf | 2304990                                  | no | 44 |
|                              |                       |                     | ecb7bdfd10b986700b10b82c48f56f26873351bc |    |    |
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| Information:                 |                       |                     |                                          |    |    |
| 5                            | Non Patent Literature | 002_NPL_4_model.pdf | 1451072                                  | no | 16 |
|                              |                       |                     | 1ff80f71b2b92c3915b434ba646f7df901143ec8 |    |    |
| Warnings:                    |                       |                     |                                          |    |    |
| Information:                 |                       |                     |                                          |    |    |
| 6                            | Non Patent Literature | 002_NPL_5_model.pdf | 584743                                   | no | 7  |
|                              |                       |                     | 3259b5694d5d2b989a93aec93e981719df1b9e03 |    |    |
| Warnings:                    |                       |                     |                                          |    |    |
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**If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.**

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**New International Application Filed with the USPTO as a Receiving Office**

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| APPLICATION NUMBER | FILING OR 371(C) DATE | FIRST NAMED APPLICANT | ATTY. DOCKET NO./TITLE |
|--------------------|-----------------------|-----------------------|------------------------|
| 18/331,486         | 06/08/2023            | Harold White          | 19077-002001           |

**CONFIRMATION NO. 2626**

22511  
OSHA BERGMAN WATANABE & BURTON LLP  
Enterprise Plaza  
1100 Louisiana, Suite 4900  
HOUSTON, TX 77002

## PUBLICATION NOTICE



\*OC000000081859333\*

Date Mailed: 12/13/2024

**Title:**CASIMIR POWER CELL

**Publication No.**US-2024-0415034-A1

**Publication Date:**12/12/2024

## NOTICE OF PUBLICATION OF APPLICATION

The above-identified application will be electronically published as a patent application publication pursuant to 37 CFR 1.211, et seq. The patent application publication number and publication date are set forth above.

The publication may be viewed using the USPTO's publicly available Searchable Databases via the Patent Public Search tool at [www.uspto.gov](http://www.uspto.gov). The direct link to access the Patent Public Search tool is currently <https://ppubs.uspto.gov/pubwebapp/static/pages/ppubsbasic.html>.

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|                                                    |                                      |                                      |                                                   |                       |
|----------------------------------------------------|--------------------------------------|--------------------------------------|---------------------------------------------------|-----------------------|
| <b><i>Examiner-Initiated Interview Summary</i></b> | <b>Application No.</b><br>18/331,486 | <b>Applicant(s)</b><br>White, Harold |                                                   |                       |
|                                                    | <b>Examiner</b><br>KEVIN J COMBER    | <b>Art Unit</b><br>2838              | <b>AIA (First Inventor to File) Status</b><br>Yes | <b>Page</b><br>1 of 1 |

| <b>All Participants</b> (applicant, applicants representative, PTO personnel) | <b>Title</b>     | <b>Type</b> |
|-------------------------------------------------------------------------------|------------------|-------------|
| KEVIN J COMBER                                                                | Primary Examiner | Telephonic  |
| Thomas Scherer                                                                | Attorney         |             |

**Date of Interview:** 20 February 2025

**Issues Discussed:**

**Proposed Amendment(s)**

Examiner proposed amending the Abstract, Specification, and Claims to fix a typo. The Abstract, Specification, and Claims all recite the word "antennal" which is supposed to be "antenna". Applicant's representative agreed to have all instances of "antennal" be changed to "antenna" by Examiner's Amendment.

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| /KEVIN J COMBER/<br>Primary Examiner, Art Unit 2838                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |  |
| <p><b>Applicant is reminded that a complete written statement as to the substance of the interview must be made of record in the application file. It is the applicants responsibility to provide the written statement, unless the interview was initiated by the Examiner and the Examiner has indicated that a written summary will be provided. See MPEP 713.04</b></p> <p>Please further see:<br/>MPEP 713.04<br/>Title 37 Code of Federal Regulations (CFR) § 1.133 Interviews, paragraph (b)<br/>37 CFR § 1.2 Business to be transacted in writing</p> |  |

**Applicant recordation instructions:** It is not necessary for applicant to provide a separate record of the substance of interview.

**Examiner recordation instructions:** Examiners must summarize the substance of any interview of record. A complete and proper recordation of the substance of an interview should include the items listed in MPEP 713.04 for complete and proper recordation including the identification of the general thrust of each argument or issue discussed, a general indication of any other pertinent matters discussed regarding patentability and the general results or outcome of the interview, to include an indication as to whether or not agreement was reached on the issues raised.

|                                          |                                       |  |                                                             |             |
|------------------------------------------|---------------------------------------|--|-------------------------------------------------------------|-------------|
| <b><i>Notice of References Cited</i></b> | Application/Control No.<br>18/331,486 |  | Applicant(s)/Patent Under<br>Reexamination<br>White, Harold |             |
|                                          | Examiner<br>KEVIN J COMBER            |  | Art Unit<br>2838                                            | Page 1 of 1 |

**U.S. PATENT DOCUMENTS**

| * |   | Document Number<br>Country Code-Number-Kind Code | Date<br>YYYY-MM-DD | Name                  | CPC Classification | US Classification |
|---|---|--------------------------------------------------|--------------------|-----------------------|--------------------|-------------------|
| * | A | US-20180059704-A1                                | 2018-03-01         | Villalobos; Victor M. | H02J7/345          | 1/1               |
| * | B | US-20120076162-A1                                | 2012-03-29         | GIRLANDO; Giovanni    | H02S99/00          | 372/36            |
| * | C | US-20200358375-A1                                | 2020-11-12         | Model; Garret         | H02N11/008         | 1/1               |
| * | D | US-20200321514-A1                                | 2020-10-08         | Sadr; Ramin           | H10N30/2042        | 1/1               |
|   | E |                                                  |                    |                       |                    |                   |
|   | F |                                                  |                    |                       |                    |                   |
|   | G |                                                  |                    |                       |                    |                   |
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|   | L |                                                  |                    |                       |                    |                   |
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**FOREIGN PATENT DOCUMENTS**

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**NON-PATENT DOCUMENTS**

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|---|---|-------------------------------------------------------------------------------------------|
|   | U |                                                                                           |
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|------------------------------------------------------------------------------------------------------------------|----------------------------------------------|-----------------------------------------------------------------|
| <b>Issue Classification</b><br> | <b>Application/Control No.</b><br>18/331,486 | <b>Applicant(s)/Patent Under Reexamination</b><br>White, Harold |
|                                                                                                                  | <b>Examiner</b><br>KEVIN J COMBER            | <b>Art Unit</b><br>2838                                         |

|               |   |    |   |             |                |
|---------------|---|----|---|-------------|----------------|
| <b>CPC</b>    |   |    |   |             |                |
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| H10N          | / | 99 | / | 05          | F 2023-02-01   |

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|----------------------------------------------------------------------------------------------|--|-------------------------------------------|---------------------|
| NONE<br><br>(Assistant Examiner) _____ (Date) _____                                          |  | <b>Total Claims Allowed:</b><br>20        |                     |
| /KEVIN J COMBER/<br>Primary Examiner, Art Unit 2838<br>(Primary Examiner) _____ (Date) _____ |  | 20 February 2025<br>O.G. Print Claim(s) 1 | O.G. Print Figure 1 |

|                                                                                                                  |                                              |                                                                 |
|------------------------------------------------------------------------------------------------------------------|----------------------------------------------|-----------------------------------------------------------------|
| <b>Issue Classification</b><br> | <b>Application/Control No.</b><br>18/331,486 | <b>Applicant(s)/Patent Under Reexamination</b><br>White, Harold |
|                                                                                                                  | <b>Examiner</b><br>KEVIN J COMBER            | <b>Art Unit</b><br>2838                                         |

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|-------------------------------------|---|----|------|
| <b>INTERNATIONAL CLASSIFICATION</b> |   |    |      |
| <b>CLAIMED</b>                      |   |    |      |
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| <b>NON-CLAIMED</b>                  |   |    |      |
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| <b>US ORIGINAL CLASSIFICATION</b> |                 |
| <b>CLASS</b>                      | <b>SUBCLASS</b> |
| 361                               | 233             |

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|----------------------------|------------------------------------------|--|--|--|--|--|
| <b>CROSS REFERENCES(S)</b> |                                          |  |  |  |  |  |
| <b>CLASS</b>               | <b>SUBCLASS (ONE SUBCLASS PER BLOCK)</b> |  |  |  |  |  |
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| NONE                                                                      |                            | <b>Total Claims Allowed:</b> |                        |
| (Assistant Examiner)                                                      | (Date)                     | 20                           |                        |
| /KEVIN J COMBER/<br>Primary Examiner, Art Unit 2838<br>(Primary Examiner) | 20 February 2025<br>(Date) | O.G. Print Claim(s)<br>1     | O.G. Print Figure<br>1 |

|                                                                                                                  |                                              |                                                                 |
|------------------------------------------------------------------------------------------------------------------|----------------------------------------------|-----------------------------------------------------------------|
| <b>Issue Classification</b><br> | <b>Application/Control No.</b><br>18/331,486 | <b>Applicant(s)/Patent Under Reexamination</b><br>White, Harold |
|                                                                                                                  | <b>Examiner</b><br>KEVIN J COMBER            | <b>Art Unit</b><br>2838                                         |

|                                                                                                                                                                                              |          |       |          |       |          |       |          |       |          |       |          |       |          |       |          |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|-------|----------|-------|----------|-------|----------|-------|----------|-------|----------|-------|----------|-------|----------|
| <input checked="" type="checkbox"/> Claims renumbered in the same order as presented by applicant <input type="checkbox"/> CPA <input type="checkbox"/> T.D. <input type="checkbox"/> R.1.47 |          |       |          |       |          |       |          |       |          |       |          |       |          |       |          |
| <b>CLAIMS</b>                                                                                                                                                                                |          |       |          |       |          |       |          |       |          |       |          |       |          |       |          |
| Final                                                                                                                                                                                        | Original | Final | Original | Final | Original | Final | Original | Final | Original | Final | Original | Final | Original | Final | Original |
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|                                                                                                                                                                                              | 5        |       | 14       |       |          |       |          |       |          |       |          |       |          |       |          |
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|                                                                                                                                                                                              | 8        |       | 17       |       |          |       |          |       |          |       |          |       |          |       |          |
|                                                                                                                                                                                              | 9        |       | 18       |       |          |       |          |       |          |       |          |       |          |       |          |

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|                                                                                                                 |                                              |                                                                 |
|-----------------------------------------------------------------------------------------------------------------|----------------------------------------------|-----------------------------------------------------------------|
| <b><i>Search Notes</i></b><br> | <b>Application/Control No.</b><br>18/331,486 | <b>Applicant(s)/Patent Under Reexamination</b><br>White, Harold |
|                                                                                                                 | <b>Examiner</b><br>KEVIN J COMBER            | <b>Art Unit</b><br>2838                                         |

| CPC - Searched* |            |          |
|-----------------|------------|----------|
| Symbol          | Date       | Examiner |
| H10N 99/05      | 02/20/2025 | kc       |
| Y02E 60/10      | 02/20/2025 | kc       |

| CPC Combination Sets - Searched* |      |          |
|----------------------------------|------|----------|
| Symbol                           | Date | Examiner |
|                                  |      |          |

| US Classification - Searched* |          |            |          |
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| Class                         | Subclass | Date       | Examiner |
| 361                           | 233      | 02/20/2025 | kc       |

\* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

| Search Notes                                                   |            |          |
|----------------------------------------------------------------|------------|----------|
| Search Notes                                                   | Date       | Examiner |
| Inventor name double patenting search                          | 02/20/2025 | kc       |
| Text search of above cited class/subclass and groups/subgroups | 02/20/2025 | kc       |
| Text search of Casimir, battery, antenna, etc.                 | 02/20/2025 | kc       |
| Applicant name search                                          | 02/20/2025 | kc       |
| Combined citation search                                       | 02/20/2025 | kc       |

|                                                     |  |
|-----------------------------------------------------|--|
| /KEVIN J COMBER/<br>Primary Examiner, Art Unit 2838 |  |
|-----------------------------------------------------|--|

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| <b><i>Search Notes</i></b><br> | <b>Application/Control No.</b><br>18/331,486 | <b>Applicant(s)/Patent Under Reexamination</b><br>White, Harold |
|                                                                                                                 | <b>Examiner</b><br>KEVIN J COMBER            | <b>Art Unit</b><br>2838                                         |

| Interference Search |                       |            |          |
|---------------------|-----------------------|------------|----------|
| US Class/CPC Symbol | US Subclass/CPC Group | Date       | Examiner |
| 361                 | 233                   | 02/20/2025 | kc       |
| H10N                | 99/05                 | 02/20/2025 | kc       |
| Y02E                | 60/10                 | 02/20/2025 | kc       |
| USPGPub, USPAT      | text search of claims | 02/20/2025 | kc       |

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Doc code: IDS

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# **INFORMATION DISCLOSURE STATEMENT BY APPLICANT** ( Not for submission under 37 CFR 1.99)

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| Application Number     | 18331486         |
| Filing Date            | 2023-06-08       |
| First Named Inventor   | Harold White     |
| Art Unit               | N/A              |
| Examiner Name          | Not Yet Assigned |
| Attorney Docket Number | 19077-002001     |

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| Examiner Initial*                                                                           | Cite No | Patent Number | Kind Code <sup>1</sup> | Issue Date | Name of Patentee or Applicant of cited Document | Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear |
| /K.C/                                                                                       | 1       | 11133758      | B2                     | 2021-09-28 | Moddel, Garret                                  |                                                                        |
| /K.C/                                                                                       | 2       | 11463026      | B2                     | 2022-10-04 | Moddel, Garret                                  |                                                                        |
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| /K.C/                                                                                                      | 1       | 20210135600        | A1                     | 2021-05-06       | THIBADO et al.                                  |                                                                        |
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| First Named Inventor   | Harold White     |
| Art Unit               | N/A              |
| Examiner Name          | Not Yet Assigned |
| Attorney Docket Number | 19077-002001     |

| Examiner Initials* | Cite No | Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published. | T <sup>5</sup> |
|--------------------|---------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| /K.C./             | 1       | White, H. et al.; "A discussion on a dynamic vacuum model: Derivation of Helmholtz equation from Schrödinger equation"; ELSEVIER, Physics Open, Vol. 1, December 2019 (8 pages)                                                                                 |                |
| /K.C./             | 2       | White, H. et al.; "Worldline numerics applied to custom Casimir geometry generates unanticipated intersection with Alcubierre warp metric"; The European Physical Journal C, Vol. 81, No. 677, July 31, 2021 (10 pages)                                         |                |
| /K.C./             | 3       | White, H., et al.; "Dynamic Vacuum Model and Casimir Cavity Experiments" Journal of the British Interplanetary Society, General Interstellar Issue, Vol. 73, No. 7, July 2020, pp. 268-272 (44 pages)                                                           |                |
| /K.C./             | 4       | Moddel, G. et al.; "Optical-Cavity-Induced Current"; symmetry, Vol. 13, No. 517, January 7, 2021 (16 pages)                                                                                                                                                     |                |
| /K.C./             | 5       | Moddel, G. et al.; "Casimir-cavity-induced conductance changes"; Physical Review Research, Vol. 3, Issue 2, April 2021, pp. L022007-1-L022007-7 (7 pages)                                                                                                       |                |

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## EXAMINER SIGNATURE

|                    |                  |                 |            |
|--------------------|------------------|-----------------|------------|
| Examiner Signature | /KEVIN J COMBER/ | Date Considered | 02/20/2025 |
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\*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

<sup>1</sup> See Kind Codes of USPTO Patent Documents at [www.USPTO.GOV](http://www.USPTO.GOV) or MPEP 901.04. <sup>2</sup> Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). <sup>3</sup> For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. <sup>4</sup> Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. <sup>5</sup> Applicant is to place a check mark here if English language translation is attached.

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( Not for submission under 37 CFR 1.99)

|                        |                  |
|------------------------|------------------|
| Application Number     | 18331486         |
| Filing Date            | 2023-06-08       |
| First Named Inventor   | Harold White     |
| Art Unit               | N/A              |
| Examiner Name          | Not Yet Assigned |
| Attorney Docket Number | 19077-002001     |

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Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

☒ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

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See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

A certification statement is not submitted herewith.

### SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

|            |                     |                     |            |
|------------|---------------------|---------------------|------------|
| Signature  | /Thomas K. Scherer/ | Date (YYYY-MM-DD)   | 2023-07-11 |
| Name/Print | Thomas K. Scherer   | Registration Number | 45,079     |

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6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

## PE2E SEARCH - Search History (Prior Art)

| Ref # | Hits    | Search Query                     | DBs                                                                                                                                                                                                     | Default Operator | Plurals | British Equivalents | Time Stamp          |
|-------|---------|----------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|---------|---------------------|---------------------|
| L1    | 1       | 18/331486.app.                   | (US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO); DERWENT) | OR               | ON      | ON                  | 2025/02/20 09:42 AM |
| L2    | 1718    | 361/233                          | (US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO); DERWENT) | OR               | ON      | ON                  | 2025/02/20 09:43 AM |
| L3    | 1514491 | H10N99/05.cpc.<br>Y02E60/10.cpc. | (US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO); DERWENT) | OR               | ON      | ON                  | 2025/02/20 09:43 AM |
| L4    | 1516207 | 2 3                              | (US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO); DERWENT) | OR               | ON      | ON                  | 2025/02/20 09:43 AM |
| L5    | 94      | 4 AND casimir                    | (US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO); DERWENT) | OR               | ON      | ON                  | 2025/02/20 09:43 AM |
| L6    | 28      | 4 AND casimir SAME               | (US-PGPUB; USPAT;                                                                                                                                                                                       | OR               | ON      | ON                  | 2025/02/20          |

|     |    |                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                      |    |    |    |                     |
|-----|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|----|----|---------------------|
|     |    | battery                                                                                                                                                                                                                                                                                                 | USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO); DERWENT)                                                                                                                                |    |    |    | 09:44 AM            |
| L7  | 14 | 4 AND casimir SAME battery AND antenna                                                                                                                                                                                                                                                                  | (US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO); DERWENT)                                                                                                              | OR | ON | ON | 2025/02/20 09:44 AM |
| L8  | 3  | 4 AND casimir SAME battery SAME antenna                                                                                                                                                                                                                                                                 | (US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO); DERWENT)                                                                                                              | OR | ON | ON | 2025/02/20 09:45 AM |
| L9  | 5  | 4 AND casimir SAME battery AND antenna SAME (wall side\$1wall barrier)                                                                                                                                                                                                                                  | (US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO); DERWENT)                                                                                                              | OR | ON | ON | 2025/02/20 09:46 AM |
| L10 | 36 | (Artificial Intelligence) More like doc: US-20200358375-A1<br>Text: (EP-3966926-A1 OR US-20200358375-A1 OR WO-2020229945-A1 OR US-11258379-B2 OR CN-114128127-A OR WO-2020229944-A1 OR EP-3966925-A1 OR US-20200358376-A1 OR WO-2022150473-A1 OR US-11133758-B2 OR US-20220006399-A1 OR US-20140158887- | (US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB) | OR | ON | ON | 2025/02/20 09:47 AM |

|     |    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                             |    |    |    |                        |
|-----|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|----|----|----|------------------------|
|     |    | A1 OR US-<br>20140092520-A1 OR<br>RU-2021136297-A OR<br>US-20140158906-A1<br>OR US-20100237198-<br>A1 OR US-11563388-<br>B2 OR WO-<br>2013071100-A1 OR<br>US-20140092521-A1<br>OR WO-2008039176-<br>A2).did.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                             |    |    |    |                        |
| L11 | 3  | ("11133758"<br>"11463026"<br>"20210135600").pn.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | (US-PGPUB; USPAT;<br>USOCR) | OR | ON | ON | 2025/02/20<br>09:48 AM |
| L12 | 65 | ("5590031"   "6424418"<br>  "6477028"   "6593566"<br>  "6650527"   "6665167"<br>  "6782179"   "6842326"<br>  "6920032"   "7043134"<br>  "7110154"   "7177515"<br>  "7184641"   "7379286"<br>  "7411772"   "7760421"<br>  "7773228"   "8039368"<br>  "8317137"   "8803340"<br>  "8913366"   "9581142"<br>  "9634158"   "9983354"<br>  "10199414"  <br>"10222550"  <br>"10612971"  <br>"10996379"  <br>"11133758"  <br>"11239073"  <br>"11251723"  <br>"11258379"  <br>"20030179974"  <br>"20030206708"  <br>"20050151973"  <br>"20060027709"  <br>"20070007393"  <br>"20070116420"  <br>"20070241470"  <br>"20070273959"  <br>"20080296437"  <br>"20090322221"  <br>"20100142259"  <br>"20100237198"  <br>"20120212375"  <br>"20130283797"  <br>"20140092520"  <br>"20140092521"  <br>"20140158887"  <br>"20140158906"  <br>"20140353577"  <br>"20140374865"  <br>"20170199078"  <br>"20170338355"  <br>"20180059704" | (US-PGPUB; USPAT;<br>USOCR) | OR | ON | ON | 2025/02/20<br>09:48 AM |

|     |    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                             |    |    |    |                        |
|-----|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|----|----|----|------------------------|
| L13 | 43 | "20190139760"  <br>"20190207537"  <br>"20200011978"  <br>"20200357997"  <br>"20200358375"  <br>"20200358376"  <br>"20200395872"  <br>"20220006399"  <br>"20220098477").pn. OR<br>("11463026").urpn.<br>AND (PGPB   USPT  <br>USOC).dbnm.<br>("5590031"   "6477028"<br>  "6593566"   "6650527"<br>  "6665167"   "6842326"<br>  "6920032"   "7379286"<br>  "7411772"   "8039368"<br>  "8317137"   "8803340"<br>  "8913366"   "9581142"<br>  "9634158"  <br>"10199414"  <br>"10612971"  <br>"20060027709"  <br>"20070007393"  <br>"20070241470"  <br>"20080296437"  <br>"20090322221"  <br>"20100142259"  <br>"20100237198"  <br>"20130283797"  <br>"20140092520"  <br>"20140092521"  <br>"20140158887"  <br>"20140158906"  <br>"20140353577"  <br>"20140374865"  <br>"20170199078"  <br>"20170338355"  <br>"20180059704"  <br>"20190207537"  <br>"20200011978"  <br>"20200357997"  <br>"20200358375"  <br>"20200395872").pn. OR<br>("11133758").urpn.<br>AND (PGPB   USPT  <br>USOC).dbnm. | (US-PGPUB; USPAT;<br>USOCR) | OR | ON | ON | 2025/02/20<br>09:48 AM |
| L14 | 2  | (16/855892).APP.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | (US-PGPUB; USPAT;<br>USOCR) | OR | ON | ON | 2025/02/20<br>09:48 AM |
| L15 | 2  | (16/855890).APP.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | (US-PGPUB; USPAT;<br>USOCR) | OR | ON | ON | 2025/02/20<br>09:49 AM |
| L17 | 1  | (16/472430).APP.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | (USPAT; USOCR)              | OR | ON | ON | 2025/02/20<br>09:49 AM |
| L18 | 21 | ("7279686"   "7839058"<br>  "9142857"  <br>"20070276444"                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | (US-PGPUB; USPAT;<br>USOCR) | OR | ON | ON | 2025/02/20<br>09:49 AM |

|     |    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                             |    |    |    |                        |
|-----|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|----|----|----|------------------------|
|     |    | "20120267899"  <br>"20120283807"  <br>"20120312102"  <br>"20130140950"  <br>"20130193930"  <br>"20130214875"  <br>"20130313943"  <br>"20150115331"  <br>"20150115767"  <br>"20150188030"  <br>"20150249257"  <br>"20160111978"  <br>"20160211828"  <br>"20160315561"  <br>"20160346556"  <br>"20190386584"  <br>"20210336480").pn. OR<br>("12163508").urpn.<br>AND (PGPB   USPT  <br>USOC).dbnm.                                                                                                                                   |                             |    |    |    |                        |
| L19 | 2  | ("20200321514"<br>"20120076162").pn.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | (US-PGPUB; USPAT;<br>USOCR) | OR | ON | ON | 2025/02/20<br>09:50 AM |
| L20 | 4  | (13/175235  <br>16/378520).APP.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | (US-PGPUB; USPAT;<br>USOCR) | OR | ON | ON | 2025/02/20<br>09:50 AM |
| L21 | 29 | ("6477028"   "6593566"<br>  "6650527"   "6665167"<br>  "6842326"   "6920032"<br>  "7379286"   "7411772"<br>  "8317137"   "8436700"<br>  "8627721"   "8680514"<br>  "8975805"   "9691500"<br>  "10680176"  <br>"20080296437"  <br>"20100141095"  <br>"20100253184"  <br>"20110084345"  <br>"20110163636"  <br>"20120095721"  <br>"20130320807"  <br>"20140331368"  <br>"20160197261"  <br>"20170200815"  <br>"20190207537"  <br>"20200358375"  <br>"20200358376").pn. OR<br>("11283003").urpn.<br>AND (PGPB   USPT  <br>USOC).dbnm. | (US-PGPUB; USPAT;<br>USOCR) | OR | ON | ON | 2025/02/20<br>09:50 AM |
| L22 | 14 | ("3970839"   "4445050"<br>  "6756649"   "6927387"<br>  "7126151"   "7728538"<br>  "20040050415"  <br>"20060261433"  <br>"20070240757"  <br>"20080044979"  <br>"20080216883"                                                                                                                                                                                                                                                                                                                                                        | (US-PGPUB; USPAT;<br>USOCR) | OR | ON | ON | 2025/02/20<br>09:50 AM |

|     |     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                   |    |    |    |                        |
|-----|-----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|----|----|------------------------|
| L23 | 123 | "20090108202"  <br>"20090136657"  <br>"20090308443").pn. OR<br>("9083278").urpn. AND<br>(PGPB   USPT  <br>USOC).dbnm.<br>12 13 18 20 21 22                                                                                                                                                                                                                                                                                                                                                                                          | (US-PGPUB; USPAT;<br>USOCR)                                                                                                                                                                                                                                                                                                                                       | OR | ON | ON | 2025/02/20<br>11:05 AM |
| L24 | 33  | 23 AND casimir AND<br>(cell battery)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | (US-PGPUB; USPAT;<br>USOCR)                                                                                                                                                                                                                                                                                                                                       | OR | ON | ON | 2025/02/20<br>11:05 AM |
| L26 | 40  | (Artificial Intelligence)<br>More like doc:<br><u>US-20180059704-A1</u><br>Text:<br>(US-20180059704-A1<br>OR US-10515749-B2<br>OR US-1816676-A OR<br>EP-3698382-A1 OR<br>WO-2009061615-A1<br>OR MX-PA02002591-A<br>OR EP-3482796-A2 OR<br>RU-2019110893-A OR<br>CA-2657386-A1 OR<br>US-20200251266-A1<br>OR EP-0354079-A1 OR<br>US-6617814-B1 OR<br>US-438602-A OR US-<br>20200412210-A1 OR<br>US-8698584-B2 OR<br>WO-2004103042-A1<br>OR US-20190122796-<br>A1 OR BE-453861-A<br>OR DE-3823778-A1 OR<br>WO-2019079789-<br>A1).did. | (US-PGPUB; USPAT;<br>USOCR; FIT (AU, AP,<br>AT, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, OA, RU, SU, WO,<br>MC, MD, MY, NL, NO,<br>NZ, PH, PL, PT, RO,<br>RS, SE, SG, SI, SK,<br>TH, TN, TR, TW, UA,<br>VN); FPRS; EPO;<br>JPO; DERWENT;<br>IBM_TDB) | OR | ON | ON | 2025/02/20<br>11:22 AM |
| L27 | 17  | 4 AND (zpe casimir)<br>AND (power\$4 cell<br>battery) AND (antenna<br>rectenna)                                                                                                                                                                                                                                                                                                                                                                                                                                                     | (US-PGPUB; USPAT;<br>USOCR)                                                                                                                                                                                                                                                                                                                                       | OR | ON | ON | 2025/02/20<br>11:29 AM |
| L28 | 6   | casimir SAME battery<br>AND antenna SAME<br>(wall side\$1wall barrier)                                                                                                                                                                                                                                                                                                                                                                                                                                                              | (US-PGPUB; USPAT;<br>USOCR; FIT (AU, AP,<br>AT, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, OA, RU, SU, WO);<br>DERWENT)                                                                                                                                | OR | ON | ON | 2025/02/20<br>11:43 AM |
| L29 | 39  | casimir AND battery<br>AND antenna SAME<br>(wall side\$1wall barrier)                                                                                                                                                                                                                                                                                                                                                                                                                                                               | (US-PGPUB; USPAT;<br>USOCR; FIT (AU, AP,<br>AT, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,                                                                                                                                                                                               | OR | ON | ON | 2025/02/20<br>11:43 AM |

|     |     |                                                                 |                                                                                                                                                                                                                                  |    |    |    |                     |
|-----|-----|-----------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|----|----|---------------------|
| L30 | 1   | ((("LIMITLESS") near3 ("SPACE") near3 ("INSTITUTE"))).AS,AA NM. | IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO); DERWENT)<br>(US-PGPUB; USPAT)                                                                                                                                                       | OR | ON | ON | 2025/02/20 12:23 PM |
| L31 | 209 | ((("WHITE") near3 ("Harold"))).INV.                             | (US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)                                                                                                                                                                                      | OR | ON | ON | 2025/02/20 12:24 PM |
| L32 | 1   | ((("LIMITLESS") near3 ("SPACE") near3 ("INSTITUTE"))).AS,AA NM. | (US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB) | OR | ON | ON | 2025/02/20 12:24 PM |
| L33 | 353 | ((("WHITE") near3 ("Harold"))).INV.                             | (US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB) | OR | ON | ON | 2025/02/20 12:24 PM |
| L34 | 353 | 32 33                                                           | (US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB) | OR | ON | ON | 2025/02/20 12:24 PM |
| L35 | 2   | 34 AND casimir                                                  | (US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB) | OR | ON | ON | 2025/02/20 12:24 PM |
| L36 | 2   | 34 AND (casimir zpe                                             | (US-PGPUB; USPAT;                                                                                                                                                                                                                | OR | ON | ON | 2025/02/20          |

|  |  |                                               |                                                                                                                                                                                                                                           |  |  |  |          |
|--|--|-----------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|----------|
|  |  | "zero point energy"<br>zero\$1point\$1energy) | USOCR; FIT (AU, AP,<br>AT, BE, BG, BR, BY,<br>CA, CH, CN, CS, CU,<br>CZ, DD, DE, DK, EA,<br>EE, EP, ES, FI, FR, GB,<br>HR, HU, ID, IE, IL, IS,<br>IT, JP, KR, LT, LU, LV,<br>MA, OA, RU, SU, WO);<br>FPRS; EPO; JPO;<br>DERWENT; IBM_TDB) |  |  |  | 12:24 PM |
|--|--|-----------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|----------|

## PE2E SEARCH - Search History (Interference)

| Ref # | Hits   | Search Query                                                    | DBs               | Default Operator | Plurals | British Equivalents | Time Stamp          |
|-------|--------|-----------------------------------------------------------------|-------------------|------------------|---------|---------------------|---------------------|
| N1    | 19     | (casimir AND (cell battery)).clm.                               | (US-PGPUB; USPAT) | OR               | ON      | ON                  | 2025/02/20 11:13 AM |
| N2    | 27     | (casimir AND (power\$4 cell battery)).clm.                      | (US-PGPUB; USPAT) | OR               | ON      | ON                  | 2025/02/20 11:14 AM |
| N3    | 7      | (casimir AND (power\$4 cell battery) AND (antenna finger)).clm. | (US-PGPUB; USPAT) | OR               | ON      | ON                  | 2025/02/20 11:15 AM |
| N5    | 1335   | 361/233                                                         | (US-PGPUB; USPAT) | OR               | ON      | ON                  | 2025/02/20 11:43 AM |
| N6    | 180549 | H10N99/05.cpc.<br>Y02E60/10.cpc.                                | (US-PGPUB; USPAT) | OR               | ON      | ON                  | 2025/02/20 11:43 AM |

## Bibliographic Data

Application No: 18/331,486

Foreign Priority claimed: ☐ Yes ☒ No

35 USC 119 (a-d) conditions met: ☐ Yes ☒ No ☐ Met After Allowance

Verified and Acknowledged: /KEVIN J COMBER/

Examiner's Signature

Initials

Title: CASIMIR POWER CELL

---

| FILING or 371(c) DATE | CLASS | GROUP ART UNIT | ATTORNEY DOCKET NO. |
|-----------------------|-------|----------------|---------------------|
| 06/08/2023            | 361   | 2838           | 19077-002001        |
| RULE                  |       |                |                     |

### APPLICANTS

Limitless Space Institute, Houston, TX, UNITED STATES

### INVENTORS

Mr. Harold White, Houston, TX, UNITED STATES

### CONTINUING DATA

### FOREIGN APPLICATIONS

### IF REQUIRED, FOREIGN LICENSE GRANTED\*\*

06/26/2023

\*\* SMALL ENTITY \*\*

### STATE OR COUNTRY

UNITED STATES

### ADDRESS

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HOUSTON, TX 77002

UNITED STATES

### FILING FEE RECEIVED

\$664



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## NOTICE OF ALLOWANCE AND FEE(S) DUE

22511 7590 03/12/2025  
OSHA BERGMAN WATANABE & BURTON LLP  
Enterprise Plaza  
1100 Louisiana, Suite 4900  
HOUSTON, TX 77002

| EXAMINER        |              |
|-----------------|--------------|
| COMBER, KEVIN J |              |
| ART UNIT        | PAPER NUMBER |
| 2838            |              |

DATE MAILED: 03/12/2025

| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|-----------------|-------------|----------------------|---------------------|------------------|
| 18/331,486      | 06/08/2023  | Harold White         | 19077-002001        | 2626             |

TITLE OF INVENTION: CASIMIR POWER CELL

| APPLN. TYPE    | ENTITY STATUS | ISSUE FEE DUE | PUBLICATION FEE DUE | PREV. PAID ISSUE FEE | TOTAL FEE(S) DUE | DATE DUE   |
|----------------|---------------|---------------|---------------------|----------------------|------------------|------------|
| nonprovisional | SMALL         | \$516         | \$0.00              | \$0.00               | \$516            | 06/12/2025 |

**THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.**

**THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.**

### HOW TO REPLY TO THIS NOTICE:

I. Review the ENTITY STATUS shown above. If the ENTITY STATUS is shown as SMALL or MICRO, verify whether entitlement to that entity status still applies.

If the ENTITY STATUS is the same as shown above, pay the TOTAL FEE(S) DUE shown above.

If the ENTITY STATUS is changed from that shown above, on PART B - FEE(S) TRANSMITTAL, complete section number 5 titled "Change in Entity Status (from status indicated above)".

For purposes of this notice, small entity fees are 40% the amount of undiscounted fees, and micro entity fees are 20% the amount of undiscounted fees.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

**IMPORTANT REMINDER: Maintenance fees are due in utility patents issuing on applications filed on or after Dec. 12, 1980. It is patentee's responsibility to ensure timely payment of maintenance fees when due. More information is available at [www.uspto.gov/PatentMaintenanceFees](http://www.uspto.gov/PatentMaintenanceFees).**

## PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), by mail or fax, or via the USPTO patent electronic filing system.

By mail, send to: Mail Stop ISSUE FEE  
Commissioner for Patents  
P.O. Box 1450  
Alexandria, Virginia 22313-1450

By fax, send to: (571)-273-2885

**INSTRUCTIONS:** This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications. **Because electronic patent issuance may occur shortly after issue fee payment, any desired continuing application should preferably be filed prior to payment of this issue fee in order not to jeopardize copendency.**

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

**Certificate of Mailing or Transmission**

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being transmitted to the USPTO via the USPTO patent electronic filing system or by facsimile to (571) 273-2885, on the date below.

|                         |
|-------------------------|
| (Typed or printed name) |
| (Signature)             |
| (Date)                  |

22511 7590 03/12/2025  
OSHA BERGMAN WATANABE & BURTON LLP  
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| nonprovisional | SMALL         | \$516         | \$0.00              | \$0.00               | \$516            | 06/12/2025 |

| EXAMINER        | ART UNIT | CLASS-SUBCLASS |
|-----------------|----------|----------------|
| COMBER, KEVIN J | 2838     | 361-233000     |

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

☐ Change of correspondence address (or Change of Correspondence Address form PTO/AIA/122 or PTO/SB/122) attached.

☐ "Fee Address" indication (or "Fee Address" Indication form PTO/AIA/47 or PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list

(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,

1 \_\_\_\_\_

(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

2 \_\_\_\_\_

3 \_\_\_\_\_

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document must have been previously recorded, or filed for recordation, as set forth in 37 CFR 3.11 and 37 CFR 3.81(a). Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE

(B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent): ☐ Individual ☐ Corporation or other private group entity ☐ Government

4a. Fees submitted: ☐ Issue Fee ☐ Publication Fee (if required)

4b. Method of Payment: (Please first reapply any previously paid fee shown above)

☐ Electronic Payment via the USPTO patent electronic filing system ☐ Enclosed check ☐ Non-electronic payment by credit card (Attach form PTO-2038)

☐ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment to Deposit Account No. \_\_\_\_\_

5. Change in Entity Status (from status indicated above)

☐ Applicant certifying micro entity status. See 37 CFR 1.29

☐ Applicant asserting small entity status. See 37 CFR 1.27

☐ Applicant changing to regular undiscounted fee status.

NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.

NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.

NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature \_\_\_\_\_

Date \_\_\_\_\_

Typed or printed name \_\_\_\_\_

Registration No. \_\_\_\_\_



# UNITED STATES PATENT AND TRADEMARK OFFICE

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| 22511                              | 7590        | 03/12/2025           | EXAMINER            |                  |
| OSHA BERGMAN WATANABE & BURTON LLP |             |                      | COMBER, KEVIN J     |                  |
| Enterprise Plaza                   |             |                      | ART UNIT            |                  |
| 1100 Louisiana, Suite 4900         |             |                      | PAPER NUMBER        |                  |
| HOUSTON, TX 77002                  |             |                      | 2838                |                  |
| DATE MAILED: 03/12/2025            |             |                      |                     |                  |

## Determination of Patent Term Adjustment under 35 U.S.C. 154 (b) (Applications filed on or after May 29, 2000)

The Office has discontinued providing a Patent Term Adjustment (PTA) calculation with the Notice of Allowance.

Section 1(h)(2) of the AIA Technical Corrections Act amended 35 U.S.C. 154(b)(3)(B)(i) to eliminate the requirement that the Office provide a patent term adjustment determination with the notice of allowance. See Revisions to Patent Term Adjustment, 78 Fed. Reg. 19416, 19417 (Apr. 1, 2013). Therefore, the Office is no longer providing an initial patent term adjustment determination with the notice of allowance. The Office will continue to provide a patent term adjustment determination with the Issue Notification Letter that is mailed to applicant approximately three weeks prior to the issue date of the patent, and will include the patent term adjustment on the patent. Any request for reconsideration of the patent term adjustment determination (or reinstatement of patent term adjustment) should follow the process outlined in 37 CFR 1.705.

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

## OMB Clearance and PRA Burden Statement for PTOL-85 Part B

The Paperwork Reduction Act (PRA) of 1995 requires Federal agencies to obtain Office of Management and Budget approval before requesting most types of information from the public. When OMB approves an agency request to collect information from the public, OMB (i) provides a valid OMB Control Number and expiration date for the agency to display on the instrument that will be used to collect the information and (ii) requires the agency to inform the public about the OMB Control Number's legal significance in accordance with 5 CFR 1320.5(b).

The information collected by PTOL-85 Part B is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 30 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450. Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

### Privacy Act Statement

**The Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. The United States Patent and Trademark Office (USPTO) collects the information in this record under authority of 35 U.S.C. 2. The USPTO's system of records is used to manage all applicant and owner information including name, citizenship, residence, post office address, and other information with respect to inventors and their legal representatives pertaining to the applicant's/owner's activities in connection with the invention for which a patent is sought or has been granted. The applicable Privacy Act System of Records Notice for the information collected in this form is COMMERCE/PAT-TM-7 Patent Application Files, available in the Federal Register at 78 FR 19243 (March 29, 2013).

<https://www.govinfo.gov/content/pkg/FR-2013-03-29/pdf/2013-07341.pdf>

Routine uses of the information in this record may include disclosure to:

- 1) law enforcement, in the event that the system of records indicates a violation or potential violation of law;
- 2) a federal, state, local, or international agency, in response to its request;
- 3) a contractor of the USPTO having need for the information in order to perform a contract;
- 4) the Department of Justice for determination of whether the Freedom of Information Act (FOIA) requires disclosure of the record;
- 5) a Member of Congress submitting a request involving an individual to whom the record pertains, when the individual has requested the Member's assistance with respect to the subject matter of the record;
- 6) a court, magistrate, or administrative tribunal, in the course of presenting evidence, including disclosures to opposing counsel in the course of settlement negotiations;
- 7) the Administrator, General Services Administration (GSA), or their designee, during an inspection of records conducted by GSA under authority of 44 U.S.C. 2904 and 2906, in accordance with the GSA regulations and any other relevant (i.e., GSA or Commerce) directive, where such disclosure shall not be used to make determinations about individuals;
- 8) another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c));
- 9) the Office of Personnel Management (OPM) for personnel research purposes; and
- 10) the Office of Management and Budget (OMB) for legislative coordination and clearance.

If you do not furnish the information requested on this form, the USPTO may not be able to process and/or examine your submission, which may result in termination of proceedings, abandonment of the application, and/or expiration of the patent.

|                               |                                      |                                      |                                 |
|-------------------------------|--------------------------------------|--------------------------------------|---------------------------------|
| <b>Notice of Allowability</b> | <b>Application No.</b><br>18/331,486 | <b>Applicant(s)</b><br>White, Harold |                                 |
|                               | <b>Examiner</b><br>KEVIN J COMBER    | <b>Art Unit</b><br>2838              | <b>AIA (FITF) Status</b><br>Yes |

**-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--**

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to Application filed 06/08/2023.  
☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on \_\_\_\_\_.

2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on \_\_\_\_\_; the restriction requirement and election have been incorporated into this action.

3. ☒ The allowed claim(s) is/are 1-20. As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see [http://www.uspto.gov/patents/init\\_events/pph/index.jsp](http://www.uspto.gov/patents/init_events/pph/index.jsp) or send an inquiry to [PPHfeedback@uspto.gov](mailto:PPHfeedback@uspto.gov).

4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

**Certified copies:**

a) ☐ All      b) ☐ Some\*      c) ☐ None of the:

1. ☐ Certified copies of the priority documents have been received.

2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.

3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

\* Certified copies not received: \_\_\_\_\_.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.  
**THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.**

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.  
☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date \_\_\_\_\_.

**Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).**

6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

**Attachment(s)**

|                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                         |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1. <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)<br>2. <input checked="" type="checkbox"/> Information Disclosure Statements (PTO/SB/08),<br>Paper No./Mail Date <u>07/11/2023</u> .<br>3. <input type="checkbox"/> Examiner's Comment Regarding Requirement for Deposit<br>of Biological Material _____.<br>4. <input checked="" type="checkbox"/> Interview Summary (PTO-413),<br>Paper No./Mail Date. <u>20250220</u> . | 5. <input checked="" type="checkbox"/> Examiner's Amendment/Comment<br>6. <input checked="" type="checkbox"/> Examiner's Statement of Reasons for Allowance<br>7. <input type="checkbox"/> Other _____. |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|                                                     |  |
|-----------------------------------------------------|--|
| /KEVIN J COMBER/<br>Primary Examiner, Art Unit 2838 |  |
|-----------------------------------------------------|--|

## DETAILED ACTION

### *Notice of Pre-AIA or AIA Status*

1. The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA.
2. Claims 1-20 are pending in this application.

### *Information Disclosure Statement*

3. The information disclosure statement(s) (IDS) submitted on 07/11/2023 is/are in compliance with the provisions of 37 C.F.R. § 1.97. Accordingly, the IDS has/have been considered by the examiner.

## EXAMINER'S AMENDMENT

4. An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it MUST be submitted no later than the payment of the issue fee.

Authorization for this examiner's amendment was given in an interview with Thomas Scherer on 02/20/2025.

5. The application has been amended as follows:

**The Abstract is amended to recite:** A battery includes a Casimir-effect powered cell (Casimir cell). The Casimir cell includes a first conductive wall; a second conductive wall that faces the first conductive wall; and a conductive antenna disposed in a cavity gap that is a space between the first conductive wall and the second conductive wall. The conductive ~~antenna~~ antenna faces the first conductive wall and the second conductive wall. The first conductive wall and the second conductive wall produce a same first voltage potential. The conductive antenna produces a second voltage potential that is different from the first voltage potential. 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.

**[0005] of the Specification is amended to recite:** This disclosure presents, in accordance with one or more embodiments, a battery that includes a Casimir-effect powered cell (Casimir cell). The Casimir cell includes: a first conductive wall; a second conductive wall that faces the first conductive wall; and a conductive antenna disposed in a cavity gap that is a space between the first conductive wall and the second conductive wall. The conductive ~~antenna~~antenna faces the first conductive wall and the second conductive wall. The first conductive wall and the second conductive wall produce a same first voltage potential. The conductive antenna produces a second voltage potential that is different from the first voltage potential. 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 second conductive wall.

**[0006] of the Specification is amended to recite:** In another aspect, this disclosure also presents, in accordance with one or more embodiments, a method for making a Casimir cell. The method includes: etching a substrate to create a first conductive wall on the substrate; etching the substrate to create a second conductive wall on the substrate such that the second conductive wall faces the first conductive wall; and 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. The conductive ~~antenna~~antenna faces the first conductive wall and the second conductive wall. The first conductive wall and the second conductive wall are etched to be electrically connected and have a same first voltage potential. The conductive antenna is etched to have a second voltage potential that is different from the first voltage potential.

**[0027] of the Specification is amended to recite:** FIG. 1 schematically shows a Casimir cell that includes

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a first conductive wall (102), a second conductive wall (104) that faces the first conductive wall (102), and a conductive antenna (106) disposed in a cavity gap (108) that is the space between the first conductive wall (102) and the second conductive wall (104). The conductive ~~antenna~~antenna (106) faces the first conductive wall (102) and the second conductive wall (104). In one or more embodiments, a first distance between the conductive antenna (106) and the first conductive wall (102) is the same as a second distance between the conductive antenna (106) and the second conductive wall (104). In this disclosure, the first conductive wall and second conductive wall are also referred to as the conductive walls. In addition, in this disclosure the first and second conductive walls are also referred to as “cavity walls.”

**[0061] of the Specification is amended to recite:** In Step 1020, the substrate is etched such that the conductive ~~antenna~~antenna faces the first conductive wall and the second conductive wall.

**Claim 1 is amended to recite:** A battery that comprises a Casimir-effect powered cell (Casimir cell), the Casimir cell comprising:

a first conductive wall;

a second conductive wall that faces the first conductive wall; and

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~~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

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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.

**Claim 20 is amended to recite:** A method for making a Casimir-effect powered cell comprising:

etching a substrate to create a first conductive wall on the substrate;

etching the substrate to create a second conductive wall on the substrate such that the second conductive wall faces the first conductive wall; and

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~~ antenna faces the first conductive wall and the second conductive wall,

wherein the first conductive wall and the second conductive wall are etched to be electrically connected and have a same first voltage potential, and

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

***Allowable Subject Matter***

6. Claims 1-20 are allowed.

7. The following is an examiner's statement of reasons for allowance: Claims 1-20 are allowable because prior art fails to teach or suggest, either alone or in combination all of the limitations of claim 1, especially 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. The closest prior art references of record are Sadr U.S. Patent Application 2020/0321514 (hereinafter "Sadr"), Moddel U.S. Patent Application 2020/0358375 (hereinafter "Moddel"), Girlando U.S. Patent Application 2012/0076162 (hereinafter "Girlando"), and Villalobos U.S. Patent Application 2018/0059704 (hereinafter "Villalobos"). Regarding claim 1, Sadr teaches a battery (i.e. energy harvesting system 140)(fig.2A) that comprises a Casimir-effect powered cell (Casimir cell) (refer to [0001], [0048], [0049] and [0068]), the Casimir cell comprising: a first conductive wall (i.e. electrode plate 210)(fig.2A); a second conductive wall (i.e. electrode plate 215)(fig.2A) that faces the first conductive wall (implicit); however, Sadr does not teach 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. Moddel (figure 4B), Girlando (figures 17 and 18), and Villalobos (figures 100d and 100e) teach similar devices, however they do not teach 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. It would not have been obvious to a person of ordinary skill in the art before the effective filing date of the claimed invention to modify the battery of Sadr, Moddel, Girlando, and/or Villalobos to arrive at the claimed invention. Claim 20 is allowed mutatis mutandis the reasons for claim 1 above. Claims 2-19 are allowed based on their dependency on claim 1.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

#### ***Conclusion***

8. Any inquiry concerning this communication or earlier communications from the examiner should be directed to KEVIN J COMBER whose telephone number is (571)272-6133. The examiner can normally be reached Monday - Friday, 9:00 am - 5:00 pm EST.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at <http://www.uspto.gov/interviewpractice>.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Thienvu V. Tran can be reached on 571-270-1276. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of published or unpublished applications may be obtained from Patent Center. Unpublished application information in Patent Center is available to registered users. To file and manage patent submissions in Patent Center, visit: <https://patentcenter.uspto.gov>. Visit <https://www.uspto.gov/patents/apply/patent-center> for more information about Patent Center and

Art Unit: 2838

<https://www.uspto.gov/patents/docx> for information about filing in DOCX format. For additional questions, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/KEVIN J COMBER/

Primary Examiner, Art Unit 2838

Docket No.: 19183-002001  
(PATENT)

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

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In re Patent Application of:  
Harold White

Allowed: March 12, 2025

Application No.: 18/331,486

Confirmation No.: 2626

Filed: June 8, 2023

Art Unit: 2838

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For: CASIMIR POWER CELL

Examiner: K. J. Comber

**AMENDMENT AFTER ALLOWANCE UNDER 37 C.F.R. § 1.312**

MS Issue Fee  
Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

Dear Madam:

**INTRODUCTORY COMMENTS**

Prior to issuance of the patent, applicant respectfully requests entry of this amendment under 37 C.F.R. 1.312 for the above-referenced patent application.

**AMENDMENTS TO THE SPECIFICATION**

Please amend paragraph [0034] of the original specification as follows. No new matter is added.

[0034]           The conductive antenna (206) includes a plurality of pillars. In one or more embodiments, the diameter of each pillar is half of the size of the gap between the first conductive wall (202) and second conductive wall (204). Each of the first conductive wall (202) and second conductive wall (204) ~~(206)~~ are 40 micrometers by 40 micrometers in length and height and the cavity gap between the conductive walls (202, 204) is 10 micrometers. In FIG. 2, the length of the conductive walls (202, 204) is along the X axis, the height of the conductive walls (202, 204) is along the Z axis, and width of the conductive walls (202, 204) as well as the cavity gap are along the Y axis. The pillars inside the cavity gap are 5 micrometers in diameter and 40 micrometers tall, spanning the entire height of the cavity gap. The Casimir cell was fabricated using deep reactive ion etching equipment commonly used in the semiconductor fabrication industry. While these are the dimensions of the fabricated Casimir cell, the invention is not limited to these dimensions.

**REMARKS**

Please reconsider this application in view of the above minor amendments and the following remarks. Applicant thanks the Examiner for carefully considering this application and for issuing the Notice of Allowance.

Applicant makes minor amendments to the specification to correct a minor informality. Specifically, paragraph [0034] of the original specification is amended to recite “second conductive wall (204)” in lieu of “second conductive wall (206).” No new matter is added. This amendment is fully supported by the original specification and drawings, which widely disclose “second conductive wall (204).”

Applicant respectfully asserts that the application will remain in condition for allowance because the amendments only clarify a minor informality in the specification. Accordingly, upon payment of the issue fee, issuance of the patent with the amended specification is respectfully requested.

If it is determined that a telephone conference would expedite prosecution of this application, the Examiner is invited to telephone the undersigned or his associates at the number given below. Please apply any charges not covered, or any credits, to Deposit Account No. 50-0591, under Order No. 19183-002001 from which the undersigned is authorized to draw.

Dated: April 2, 2025

Respectfully submitted,

By: /Thomas K. Scherer/

Thomas K. Scherer

Registration No.: 45,079

OSHA BERGMAN WATANABE & BURTON LLP

1100 Louisiana Street, Suite 4900

Houston, Texas 77002

(713) 228-8600

(713) 228-8778 (Fax)

Attorney/Agent For Applicant

UNITED STATES  
PATENT AND TRADEMARK OFFICEP.O. Box 1450  
Alexandria, VA 22313 - 1450  
www.uspto.gov**ELECTRONIC ACKNOWLEDGEMENT RECEIPT**APPLICATION #  
**18/331,486**RECEIPT DATE / TIME  
**04/02/2025 05:02:52 PM Z ET**ATTORNEY DOCKET #  
**19183-002001****Title of Invention**

CASIMIR POWER CELL

**Application Information**APPLICATION TYPE    Utility - Nonprovisional Application  
under 35 USC 111(a)

PATENT #    -

CONFIRMATION #    2626

FILED BY    Edward Janacek

PATENT CENTER #    69847893

FILING DATE    06/08/2023

CUSTOMER #    22511

FIRST NAMED  
INVENTOR    Mr. Harold WhiteCORRESPONDENCE  
ADDRESS    -

AUTHORIZED BY    Thomas Scherer

**Documents****TOTAL DOCUMENTS: 3**

| DOCUMENT         |       | PAGES | DESCRIPTION                                      | SIZE<br>(KB) |
|------------------|-------|-------|--------------------------------------------------|--------------|
| 002_312.pdf      |       | 4     | -                                                | 24 KB        |
| 002_312-A.NA.pdf | (1-1) | 1     | Amendment after Notice of Allowance (Rule 312)   | 16 KB        |
| 002_312-SPEC.pdf | (2-2) | 1     | Specification                                    | 16 KB        |
| 002_312-REM.pdf  | (3-4) | 2     | Applicant Arguments/Remarks Made in an Amendment | 18 KB        |

**Digest**

| DOCUMENT    | MESSAGE DIGEST(SHA-512)                                                                                 |
|-------------|---------------------------------------------------------------------------------------------------------|
| 002_312.pdf | 6126F82865F445788F5DB0B294E87A7FE3281A63379E0D8A20<br>41537AD2086E21102529A914C6523F596CB681C913E4FEC9E |

EVERWAVE - Exhibit 1002

EVERWAVE v. LIMITLESS SPACE INSTITUTE - IPR2026-00469

Page 120 of 133

F99F3F3E5C13F68DBDBF17448998D

002\_312-A.NA.pdf

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002\_312-REM.pdf

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#### **New Applications Under 35 U.S.C. 111**

If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application

#### **National Stage of an International Application under 35 U.S.C. 371**

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

#### **New International Application Filed with the USPTO as a Receiving Office**

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

## PART B-FEE(S) TRANSMITTAL

Complete and send this form, together with the applicable fee(s), by mail or fax, or via the USPTO patent electronic filing system.

By mail, send to: Mail Stop ISSUE FEE  
Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

By fax, send to: (571) 273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications. **Because electronic patent issuance may occur shortly after issue fee payment, any desired continuing application should preferably be filed prior to payment of this issue fee in order not to jeopardize copendency.**

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

OSHA BERGMAN WATANABE & BURTON LLP  
1100 Louisiana Street, Suite 4900  
Houston, Texas 77002

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

## Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being transmitted to the USPTO via the USPTO patent electronic filing system or by facsimile to (571) 273-2885, on the date below.

|                         |
|-------------------------|
| (Typed or printed name) |
| (Signature)             |
| (Date)                  |

| APPLICATION NO | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO | CONFIRMATION NO |
|----------------|-------------|----------------------|--------------------|-----------------|
| 18/331,486     | 06/08/2023  | Harold White         | 19183-002001       | 2626            |

TITLE OF INVENTION: CASIMIR POWER CELL

| APPLN: TYPE    | ENTITY STATUS | ISSUE FEE DUE | PUBLICATION FEE DUE | PREV. PAID ISSUE FEE | TOTAL FEE(S) DUE | DATE DUE   |
|----------------|---------------|---------------|---------------------|----------------------|------------------|------------|
| nonprovisional | SMALL         | \$516.00      | \$0.00              | \$0.00               | \$516.00         | 06/12/2025 |

| EXAMINER     | ART UNIT | CLASS-SUBCLASS |
|--------------|----------|----------------|
| K. J. Comber | 2838     | 361-233000     |

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363)

- ☐ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.
- ☐ "Fee Address" indication (or "Fee Address" Indication form PTO/AIA/47 or PTO/SB/47; Rev 03-09 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list

- (1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
- (2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1. Osha Bergman Watanabe &amp; Burton LLP

2.

3.

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document must have been previously recorded, or filed for recordation, as set forth in 37 CFR 3.11 and 37 CFR 3.81(a). Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE

(B) RESIDENCE: (CITY and STATE or COUNTRY)

Limitless Space Institute

Houston, Texas

Please check the appropriate assignee category or categories (will not be printed on the patent):

☐ Individual ☒ Corporation or other private group entity ☐ Government4a. Fees Submitted: ☒ Issue Fee ☐ Publication Fee (if required)

4b. Method of Payment (Please first reapply any previously paid fee shown above):

- ☒ Electronic Payment via the USPTO patent electronic filing system ☐ Enclosed check ☐ Non-electronic payment by credit card (Attach form PTO-2038)
- ☒ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment to Deposit Account No. 50-0591

5. Change of Entity Status (from status indicated above)

- ☐ Applicant certifying micro entity status. See 37 CFR 1.29.
- ☐ Applicant asserting small entity status. See 37 CFR 1.27.
- ☐ Applicant changing to regular undiscounted fee status.

NOTE: Absent a valid Certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.

NOTE: If the application was previously under micro entity status, checking this box will be taken as a notification of loss of entitlement to micro entity status.

NOTE: Checking this box will be taken as a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature

/Thomas K. Scherer/

Date April 4, 2025

Typed or printed name

Thomas K. Scherer

Registration No.

45,079



UNITED STATES  
PATENT AND TRADEMARK OFFICE

P.O. Box 1450  
Alexandria, VA 22313 - 1450  
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## ELECTRONIC PAYMENT RECEIPT

|                                    |                                                           |                                          |
|------------------------------------|-----------------------------------------------------------|------------------------------------------|
| APPLICATION #<br><b>18/331,486</b> | RECEIPT DATE / TIME<br><b>04/04/2025 10:44:47 AM Z ET</b> | ATTORNEY DOCKET #<br><b>19183-002001</b> |
|------------------------------------|-----------------------------------------------------------|------------------------------------------|

### Title of Invention

CASIMIR POWER CELL

### Application Information

|                           |                                                             |                         |                  |
|---------------------------|-------------------------------------------------------------|-------------------------|------------------|
| APPLICATION TYPE          | Utility - Nonprovisional Application<br>under 35 USC 111(a) | PATENT #                | -                |
| CONFIRMATION #            | 2626                                                        | FILED BY                | Mary Ehlers      |
| PATENT CENTER #           | 69872976                                                    | AUTHORIZED BY           | Thomas Scherer   |
| CUSTOMER #                | 22511                                                       | FILING DATE             | 06/08/2023       |
| CORRESPONDENCE<br>ADDRESS | -                                                           | FIRST NAMED<br>INVENTOR | Mr. Harold White |

### Payment Information

|                                      |                                                   |                                             |
|--------------------------------------|---------------------------------------------------|---------------------------------------------|
| PAYMENT METHOD<br><b>CARD / 2120</b> | PAYMENT TRANSACTION ID<br><b>E202544A45368404</b> | PAYMENT AUTHORIZED BY<br><b>Mary Ehlers</b> |
|--------------------------------------|---------------------------------------------------|---------------------------------------------|

| FEE CODE                 | DESCRIPTION       | ITEM PRICE(\$) | QUANTITY | ITEM TOTAL(\$)  |
|--------------------------|-------------------|----------------|----------|-----------------|
| 2501                     | UTILITY ISSUE FEE | 516.00         | 1        | 516.00          |
| <b>TOTAL<br/>AMOUNT:</b> |                   |                |          | <b>\$516.00</b> |

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#### New Applications Under 35 U.S.C. 111

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EVERWAVE - Exhibit 1002  
EVERWAVE v. LIMITLESS SPACE INSTITUTE - IPR2026-00469  
Page 123 of 133

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UNITED STATES  
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## ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #  
**18/331,486**

RECEIPT DATE / TIME  
**04/04/2025 10:44:47 AM Z ET**

ATTORNEY DOCKET #  
**19183-002001**

### Title of Invention

CASIMIR POWER CELL

### Application Information

APPLICATION TYPE    Utility - Nonprovisional Application  
under 35 USC 111(a)

PATENT #    -

CONFIRMATION #    2626

FILED BY    Mary Ehlers

PATENT CENTER #    69872976

FILING DATE    06/08/2023

CUSTOMER #    22511

FIRST NAMED  
INVENTOR    Mr. Harold White

CORRESPONDENCE  
ADDRESS    -

AUTHORIZED BY    Thomas Scherer

### Documents

**TOTAL DOCUMENTS: 1**

| DOCUMENT                     | PAGES | DESCRIPTION                 | SIZE<br>(KB) |
|------------------------------|-------|-----------------------------|--------------|
| 19183_002001_Part_B_form.pdf | 1     | Issue Fee Payment (PTO-85B) | 38 KB        |

### Digest

| DOCUMENT                     | MESSAGE DIGEST(SHA-512)                                                                                                                  |
|------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|
| 19183_002001_Part_B_form.pdf | 3DDD9721254E87D587EAF488E09CA001AE74340BEFBCFEE4<br>EC8FBEDA732E1C35EED3EE5333A0A95D3CF99BA6EEFCD17<br>7924483C1212D85171F1F3907C9EA5A57 |

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# UNITED STATES PATENT AND TRADEMARK OFFICE

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| APPLICATION NO.                    | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|------------------------------------|-------------|----------------------|---------------------|------------------|
| 18/331,486                         | 06/08/2023  | Harold White         | 19183-002001        | 2626             |
| 22511                              | 7590        | 04/10/2025           |                     |                  |
| OSHA BERGMAN WATANABE & BURTON LLP |             |                      | EXAMINER            |                  |
| Enterprise Plaza                   |             |                      | COMBER, KEVIN J     |                  |
| 1100 Louisiana, Suite 4900         |             |                      |                     |                  |
| HOUSTON, TX 77002                  |             |                      |                     |                  |
|                                    |             |                      | ART UNIT            | PAPER NUMBER     |
|                                    |             |                      | 2838                |                  |
|                                    |             |                      | NOTIFICATION DATE   | DELIVERY MODE    |
|                                    |             |                      | 04/10/2025          | ELECTRONIC       |

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The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

docketing@obwbip.com  
escobedo@obwbip.com



Docket No.: 19183-002001  
(PATENT)

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

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In re Patent Application of:  
Harold White

Allowed: March 12, 2025

Application No.: 18/331,486

Confirmation No.: 2626

Filed: June 8, 2023

Art Unit: 2838

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For: CASIMIR POWER CELL

Examiner: K. J. Comber

**AMENDMENT AFTER ALLOWANCE UNDER 37 C.F.R. § 1.312**

MS Issue Fee  
Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

Dear Madam:

**INTRODUCTORY COMMENTS**

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| APPLICATION NO. | ISSUE DATE | PATENT NO. | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|-----------------|------------|------------|---------------------|------------------|
| 18/331,486      | 05/13/2025 | 12302769   | 19183-002001        | 2626             |

22511 7590 04/30/2025

OSHA BERGMAN WATANABE &amp; BURTON LLP

Enterprise Plaza  
1100 Louisiana, Suite 4900  
HOUSTON, TX 77002

## ISSUE NOTIFICATION

The projected patent number and issue date are specified above. The patent will issue electronically. The electronically issued patent is the official patent grant pursuant to 35 U.S.C. § 153. The patent may be accessed on or after the issue date through Patent Center at <https://patentcenter.uspto.gov/>. The patent will be available in both the public and the private sides of Patent Center. Further assistance in electronically accessing the patent, or about Patent Center, is available by calling the Patent Electronic Business Center at 1-888-217-9197.

The USPTO is implementing electronic patent issuance with a transition period, during which period the USPTO will mail a ceremonial paper copy of the electronic patent grant to the correspondence address of record. Additional copies of the patent (i.e., certified and presentation copies) may be ordered for a fee from the USPTO's Certified Copy Center at <https://certifiedcopycenter.uspto.gov/index.html>. The Certified Copy Center may be reached at (800)972-6382.

### **Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)** (application filed on or after May 29, 2000)

The Patent Term Adjustment is 195 day(s). Any patent to issue from the above-identified application will include an indication of the adjustment on the front page.

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Center (<https://patentcenter.uspto.gov>).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Application Assistance Unit (AAU) of the Office of Patents Stakeholder Experience (OPSE), Stakeholder Support Division (SSD) at (571)-272-4200.

**INVENTOR(s)** (Please see PATENT CENTER site <https://patentcenter.uspto.gov> for additional inventors):

Mr. Harold White, Houston, TX;

**APPLICANT(s)** (Please see PATENT CENTER site <https://patentcenter.uspto.gov> for additional applicants):

Limitless Space Institute, Houston, TX;

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| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|-----------------|-------------|----------------------|---------------------|------------------|
| 18/331,486      | 06/08/2023  | Harold White         | 19183-002001        | 2626             |

22511 7590 05/13/2025  
OSHA BERGMAN WATANABE & BURTON LLP  
Enterprise Plaza  
1100 Louisiana, Suite 4900  
HOUSTON, TX 77002

|          |
|----------|
| EXAMINER |
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COMBER, KEVIN J

|          |              |
|----------|--------------|
| ART UNIT | PAPER NUMBER |
|----------|--------------|

2838

|                   |               |
|-------------------|---------------|
| NOTIFICATION DATE | DELIVERY MODE |
|-------------------|---------------|

05/13/2025

ELECTRONIC

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docketing@obwbip.com  
escobedo@obwbip.com

| APPLICATION NO. | ISSUE DATE  | PATENT NO. |
|-----------------|-------------|------------|
| 18/331,486      | 13-May-2025 | 12302769   |

OSHA BERGMAN WATANABE & BURTON LLP  
Enterprise Plaza  
HOUSTON, TX 77002

## EGRANT NOTIFICATION

Your electronic patent grant (eGrant) is now available, which can be accessed via Patent Center at <https://patentcenter.uspto.gov>

The electronic patent grant is the official patent grant under 35 U.S.C. 153. For more information, please visit <https://www.uspto.gov/electronicgrants>