

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

INDUCTEV, INC.
Petitioner,

v.

WITRICITY CORPORATION,
Patent Owner.

Case IPR2024-00105
Patent 10,027,184

**DECLARATION OF DR. MARK N. HORENSTEIN IN SUPPORT OF
PATENT OWNER'S RESPONSE**

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I. INTRODUCTION

1. I have been retained on behalf of WiTricity Corporation to provide my opinions regarding U.S. Patent No. 10,027,184 (Ex. 1001, “the ‘184 patent”) and the patentability of the claims challenged by InductEV (“Petitioner”). In this declaration, I provide my opinions regarding the applicability of prior-art references put forth by Petitioner and the failure of these references to invalidate the challenged claims. I also offer my rebuttal opinions regarding the October 23, 2023 Declaration of Dr. Mark Allen “(Ex. 1003, Allen” Decl.), expert on behalf of InductEV, in this matter. I herein provide my opinions in consideration of the state of the art at the time of the claimed inventions and the knowledge that a person having ordinary skill in the art (POSA) would have had at the time of the claimed invention.

2. My opinions and views set forth in this declaration are based on my education, training, and experience in the field of electrical engineering, inductive energy transfer, battery-powered electric vehicles (“EV”) and related technical areas, as well Petitioner’s Exhibits 1001-1033 and other materials that are cited and discussed herein.

3. It is my understanding that Petitioner is challenging independent claims 1 and 16 of the ‘184 patent, and dependent claims 2-13. Claims 1-13 are apparatus claims, whereas claim 16 is a method claim. In my opinion, as discussed herein, Petitioner and Dr. Allen have failed to show that each of the elements of the

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challenged claims appears in the cited prior art or in the mind of a person of ordinary skill in the art (POSA) at the time of the patent filing. In particular, Petitioner has, at minimum, failed to establish that the prior art teaches, or renders obvious, at least one magnetic field sensor “positioned within the magnetic field of the wireless energy transfer system, as appearing in claim 1.” Petitioner also fails to establish that the prior art teaches, or renders obvious, “performing a health and/or status check of a source resonator of the wireless energy transfer system”, as appearing in claim 16. I discuss these and other issues in more detail in the sections below.

II. BACKGROUND

4. I am a Professor of Electrical Engineering in the Department of Electrical and Computer Engineering at Boston University (now Emeritus) where I have been a faculty member since 1979. In addition to my primary academic appointment, I held various administrative positions at Boston University, including the Associate Dean for Graduate Programs and Research for the College of Engineering (1999-2007), Associate Chair for Undergraduate Programs for the ECE Department (1990-1998 and 2012-2015), as well as appointments at the ranks of Associate Professor (1985-2000) and Assistant Professor (1979-1985).

5. I have a Ph.D. in Electrical Engineering from the Massachusetts Institute of Technology (MIT), which I earned in 1978 while working in the Electric Power Systems Engineering Laboratory. I also hold an M.S. degree in Electrical

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Engineering from the University of California at Berkeley (1975), and an S.B. degree in Electrical Engineering from MIT (1973).

6. I am a Life Fellow of the Institute of Electrical and Electronic Engineers (IEEE) and have been a Registered Professional Engineer (Electrical) in the Commonwealth of Massachusetts. I hold certification from the National Association of Radio and Telecommunications Engineers.

7. I am the author of two textbooks: Microelectronic Circuits and Devices, 2nd Ed. (Prentice-Hall 1996) and Design Concepts for Engineers, 5th Ed. (Pearson Education, 2016). I have authored book chapters in two reference books related to electrical engineering. I have authored or co-authored over 70 journal articles on a variety of topics in my fields of expertise, and approximately 125 conference papers. I have advised various Ph.D. students performing research in my fields of expertise; these students have gone on to hold positions in industry and academia.

8. The courses that I taught over the 40 years I spent as a regular faculty member at Boston University encompassed electromagnetics, antennas, and radio communication, as well as basic electrical circuits, analog and digital electronics, control circuits, power electronics, electric motors, electric machines, microcontrollers, robotics, and engineering design. I was named "Teacher of the Year" in Engineering at Boston University four times.

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9. I am a named inventor on six U.S. patents. I have also provided technical expertise in the design and analysis of consumer and industrial electronic products, integrated circuits, power supplies, DC/DC converters, and electromagnetic devices.

10. I have considerable experience in the areas of transformers, antennas, wireless charging devices, battery charging methods, and power circuits in general. I also have extensive experience in the design, analysis, and testing of consumer electrical products, including power supplies, battery chargers, microcontroller-based systems, and control systems of all types. In support of my research in deformable mirror systems, I designed two different analog-multiplexed, high-voltage storage arrays.

11. Similarly, as part of my work in developing self-cleaning solar panels, I have designed switching power supplies that produce low-frequency, 3-phase, 1.5-kV outputs which in turn are powered by low-voltage DC/DC power converters.

12. As part of my work overall in applied electromagnetics, I have designed DC power controllers for thermal management systems, power-amplifier circuits, and analog amplifiers. I also have designed and used transformers of all types, including ferromagnetic, ferrite, and air-core varieties. I have practical knowledge of wiring methods and have wired numerous residential and industrial electric supplies,

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both indoor and outdoor. I have considerable hands-on experience in electrical wiring (e.g., 12-V DC, 120 VAC and 240 VAC) for commercial and residential purposes and a working knowledge of the National Electric Code (NEC) published by the National Fire Protection Association (NFPA-70).

13. At Boston University, I initiated and taught our department's course in power electronics which I devised and designed over a period of nine years. In support of this activity, I designed circuits for laboratory experiments in power electronics, including solar battery-charging circuits, buck and boost converters and controllers, H-bridge DC/AC switching converters, and DC-to-AC grid-interface circuitry. Each year, my assigned capstone project has been the design (from basic parts) of an interface between a photovoltaic panel and the AC power grid.

14. My curriculum vitae ("vita"), which includes a summary of my background, experience, publications, and expert-witness experience is marked as Exhibit 2006.

15. My training and profession encompass broad areas of engineering. The opinions I express in this declaration involve the application of my engineering knowledge, expertise, and experience to the evaluation the '184 patent with respect to various claim terms found therein.

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16. The opinions proffered in this declaration are based on the documents I have reviewed, my experience and background in the field, my knowledge of electrical engineering, and my professional judgment. In the course of conducting my analysis and forming my opinions, I have reviewed the references and materials cited herein, including those listed below.

17. I am being compensated for services provided in this matter. I was recruited for this engagement by Cahn Litigation Services which is billing my time at a rate of \$400 per hour. I am also being reimbursed for reasonable expenses, such as travel expenses, should any arise. My compensation is not contingent on my opinions, on the outcome of any aspects of this matter, or on any of the technical positions that I explain in this declaration. I have no financial interest in Petitioner InductEV, the Patent Owner (who I understand to be WiTricity Corporation), or the '184 patent.

18. The opinions set forth in this declaration are my own. My opinions are based on my review of the materials cited throughout this Declaration; my educational background; my experience working in the areas of inductive coupling and wireless charging, and my experience as a technical consultant providing expert testimony in numerous cases involving similar and/or related technology.

III. UNDERSTANDING OF LEGAL STANDARDS

19. I am not an attorney or a legal expert and offer no opinion on the law. For the purpose of preparing this Declaration, I have been informed about certain aspects of the law that are relevant to my analysis and opinions, as set forth below.

20. I understand that for an invention claimed in a patent to be valid and patentable, it must be, among other things, new and not obvious in light of what was known and came before it. That which was known or came before the claimed invention is generally referred to as “prior art.”

21. I understand that there are two ways in which prior art may render a patent claim unpatentable. First, the prior art can be shown to “anticipate” the claim. Second, the prior art can show that the claim would have been “obvious” to a person of ordinary skill in the field of the invention at the time the invention was made.

A. Anticipation

22. It is my understanding that anticipation is a question of fact that is determined from the perspective of a person of ordinary skill in the art (a “POSA”) at the time of the claimed invention. I also understand that the standard for anticipation in an *inter partes* review proceeding is “by a preponderance of the evidence.” My understanding of this burden of proof is that it requires that there be a greater than 50% chance that something is true. It is my further understanding that a

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claim is anticipated only if each and every element in the claim is found, expressly or inherently, in a single prior-art reference.

23. I understand that if a prior-art reference does not expressly set forth a particular claim element, the prior art may still anticipate a claim if that element is “inherent” in its disclosure. My understanding of the inherency standard is the evidence must make it clear that the missing descriptive matter is necessarily present in the thing described in the reference. It is my further understanding that inherency may not be established by probabilities or possibilities. In other words, the mere fact that a certain thing may result from a given set of circumstances is not sufficient to establish inherency.

24. I understand that if a claim recites alternatives, for example in the format “selected from the group consisting of A, B, and C,” or “at least one of”, then anticipation of the entire claim limitation can be achieved through prior art that discloses just one alternative, for example, a prior art reference that simply discloses B.

25. I also have been advised that if a prior-art reference discloses one feature of a challenged claim, the reference can anticipate a claimed invention if the feature is described in another document that has been incorporated by reference into the patent of the challenged claim.

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B. Obviousness

26. It is my understanding that obviousness is a question of law with underlying factual inquiries that are determined from the perspective of a POSA at the time of the claimed invention. I also understand that the standard for obviousness in an *inter partes* review proceeding is again “by a preponderance of the evidence”.

27. It is my further understanding that a claimed invention is obvious if the differences between the claimed invention and the prior art are such that the claimed invention as a whole would have been obvious to a POSA prior to the effective filing date of the claimed invention to which the claimed invention pertains. I understand that a POSA is presumed to have knowledge of all relevant prior art. In order to show obviousness, there must be a motivation to combine two or more prior-art references. Even when obviousness is based on a single prior art reference, there must be a showing of a suggestion or motivation to modify the teachings of that reference.

28. It is my understanding is that obviousness requires consideration of the following underlying factual inquiries:

- determining the scope and content of the prior art;
- ascertaining the differences between the claimed invention and the prior art;
- resolving the level of ordinary skill in the art; and

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- evaluating “objective evidence” or “secondary considerations” of non-obviousness, such as commercial success, long-felt but unresolved needs, failure of others, industry praise, and unexpected results.

29. I understand, however, that for such “objective evidence” or “secondary considerations” to be relevant to the obviousness of a claim, there must be a causal relationship (called a “nexus”) between the claim and the evidence. I also understand that this nexus must be based on a novel element of the claim rather than on something in the prior art. I further understand that there are instances in which secondary considerations are unable to overcome primary evidence of obviousness (e.g., motivation to combine with predictable results) that is sufficiently strong.

30. It is my understanding that a reference must be analogous art to the claimed invention in order to be properly considered for use in an obviousness inquiry. It is my understanding that a reference is analogous art to the claimed invention if:

- the reference is from the same field of endeavor as the claimed invention (even if it addresses a different problem); or
- the reference is reasonably pertinent to the problem faced by the inventor (even if it is not in the same field of endeavor as the claimed invention).

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31. It is my understanding that whether a reference is reasonably pertinent depends on how the problem faced by the inventor is reflected, either explicitly or implicitly, in the specification.

32. It also is my understanding that a patent claim is not proved obvious merely by demonstrating that each of its elements was independently known in the prior art. An obviousness determination requires finding both that a skilled artisan would have been motivated to combine the teachings of the prior art references to achieve the claimed invention, and that the skilled artisan would have had a reasonable expectation of success in doing so. It is my further understanding that it is important to be careful not to allow hindsight reconstruction of references to produce the claimed invention without any explanation as to how or why the references would have been combined by a of ordinary skill in the art to produce the claimed invention.

33. It is my understanding that the following are exemplary rationales for combining references that may support a conclusion of obviousness:

- a) Combining prior-art elements according to known methods to yield predictable results;
- b) Simple substitution of one known element for another to obtain predictable results;

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- c) Use of a known technique to improve a similar method or product in the same way;
- d) Applying a known technique to a known method or product ready for improvement to yield predictable results;
- e) "Obvious to try", i.e., choosing from a finite number of identified, predictable solutions with a reasonable expectation of success;
- f) Known work in one field of endeavor may prompt variations of it for use in either the same field or a different one based on design incentives or other market forces if the variations would have been predictable to one of ordinary skill in the art; and
- g) Some teaching, suggestion, or motivation in the prior art or in the POSA's knowledge that would have led one of ordinary skill to modify the prior-art reference or to combine prior-art reference teachings to arrive at the claimed invention.

34. In addition to the above, it is my further understanding that a POSA could have resorted to logic, judgment and common sense available to him or her at the time of the invention to find a claim feature obvious, even if the prior art relied on did not explicitly state or teach that feature. It is also my understanding that when

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common sense is relied on to find a feature obvious, the reasoning for that conclusion must be articulated with sufficient clarity.

35. It is my understanding that an element recited in a dependent claim must have a proper antecedent basis. In other words, the term must be defined in such a way that a person of ordinary skill in the art would have understood what that term is referencing.

C. Person of Ordinary Skill in the Art

36. In my opinion, a person having ordinary skill in the art (POSA) in the time frame of the '184 patent would have had at least a Bachelor's degree in electrical engineering, or a Master's degree in electrical engineering, with both including coursework in electromagnetics and a focus on electrical systems and circuits, plus one or two years as an engineer working in a related industrial field.

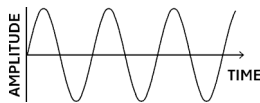
IV. OVERVIEW OF THE '184 PATENT

37. U.S. Patent 10,027,184 (Ex. 1001, "the '184 patent"), entitled "Foreign Object Detection in Wireless Energy Transfer Systems", was filed on June 1, 2016 and issued on July 17, 2018. It claims priority date as a continuation of an application filed on September 10, 2012, which claims priority to a provisional patent application filed on September 9, 2011. The patent describes "a wireless energy transfer system" that includes "a foreign object debris detection system." ('184 Patent, Abstract).

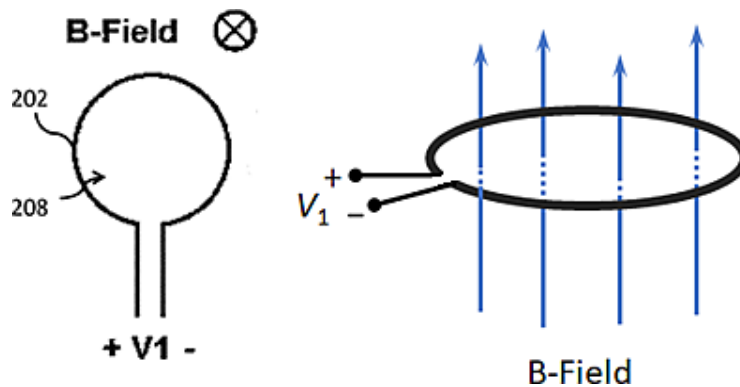
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38. In the '184 patent, the wireless energy transfer system relies on an oscillating magnetic field and detects foreign object debris (FOD) using a single loop of wire or one or more “field gradiometer[s]” that are positioned with the oscillating magnetic field. (*Id.* 2:20-32). It relies on the principle that a wire loop produces a voltage when intersected by an oscillating magnetic field.¹ (*Id.* 2:45-49, 8:5-9). One embodiment of magnetic field sensor disclosed in the '184 patent thus includes the simple wire loop depicted in Fig. 2, shown below. (*Id.* 5:39-41). The depiction in the right-hand figure shows a magnetic field (“B-field”²) intersecting the loop and inducing the voltage V_1 :

¹ “Oscillating” indicates a periodically varying field whose amplitude follows a sinusoidal pattern over time:



² The symbol “B” for magnetic field (technically, “magnetic flux density”) was introduced by James Clerk Maxwell in the 1850’s as he progressed between letters A through H to describe electromagnetic phenomena. It does not stand for anything is particular, but the symbol “B” and the term “B-field” is used universally to refer to magnetic fields.



Left: '184 Patent, portion of Fig. 2. Right: Oscillating B-field intersecting wire loop at right angles and inducing voltage V_1 .

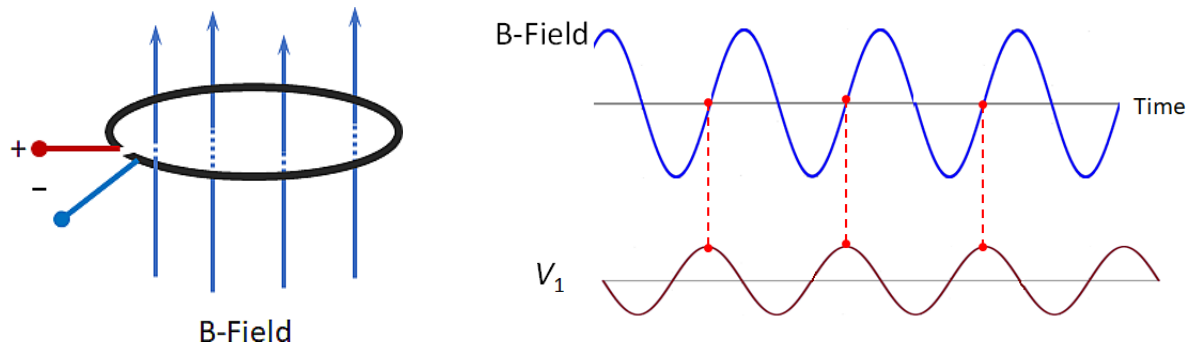
39. The $\otimes$ symbol in Fig. 2 represents the tail of the magnetic field in a 2-D drawing. The symbol $\otimes$ (tail of the arrow) means the field points *into* the page. The alternative (not shown in any of the '184 figures) is a circle-dot $\odot$ which depicts a field pointing *out* of the page. The figure below summarizes this graphical convention:



40. It is a well-known law of physics that a time-varying magnetic field passing through a wire loop will induce a time-varying voltage across the terminals of the loop. (Carstens (Ex. 2007) 130-131). Thus, for example, if the loop is placed within the oscillating magnetic field of a source resonator in a power-transfer system, the magnetic field will induce a sinusoidal voltage at the terminals of the

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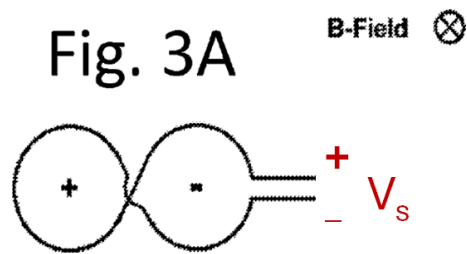
loop. ('184 Patent, Fig. 9A, 2:26-34, 5:45-47, 10:64 – 11:6). This scenario is depicted below.



41. The plot on the right shows the time-varying B-field (blue) and the induced voltage V_1 (red). Consistent with the laws of magnetic induction, V_1 reaches its peak at the upward-slope zero-crossing of the B-field (red dotted lines).³ In this sense, although it varies sinusoidally in time, V_1 has a “polarity” in that the positive peak of V_1 always occurs at the same point in the oscillatory cycle of the B-field. The (+) and (–) signs for V_1 in the diagram represent the polarity of V_1 at the moment that the B-field crosses through zero (red dots).

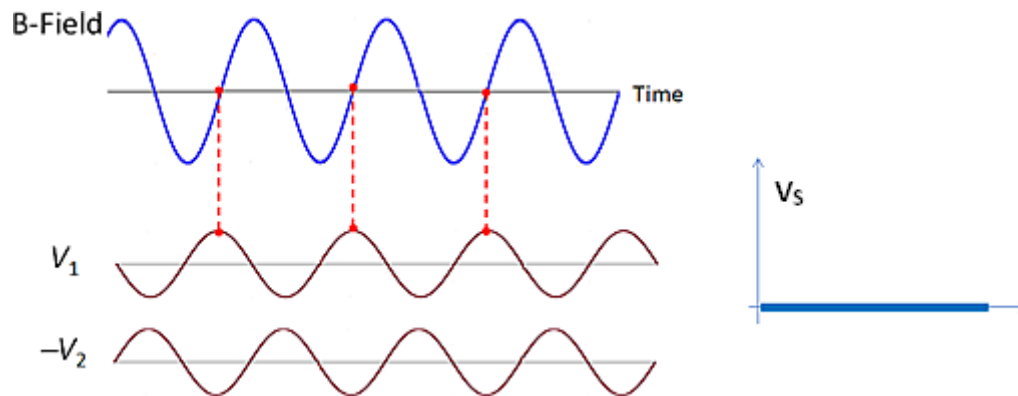
42. The '184 patent also discloses a “gradiometer” embodiment of a magnetic field sensor. (See, e.g., '184 Patent, Abstract; 2:20-26; 2:59-62). The disclosed gradiometer includes two or more identical loops “cross connected”, as in Fig. 3A below (also shown in Figs. 3B-3D):

³ This is a consequence of the physical law of induction.



'184 Patent, Fig. 3A; annotated

43. If the oscillating magnetic field ("B-field") is uniform with position, the loops of the gradiometer will intersect the same flux, and their induced voltages will cancel, yielding an approximately zero net output. (*Id.* 5:47-52, 6:43-59). This concept is illustrated below, where V_1 and V_2 are the respective voltage outputs of the individual wire loops:

Case where B-field is uniform and $V_1 = V_2$

44. If, however, the B-field varies with position, then the loops will be intersected by different values of field, i.e., the loops will intersect different amounts

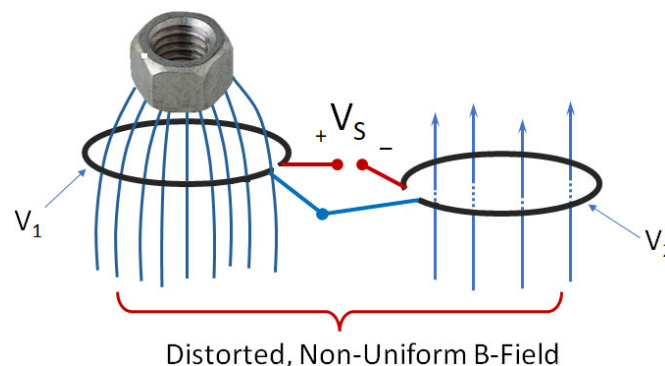
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of magnetic flux, such that the net output V_S (the difference between V_1 and V_2) will be non-zero:

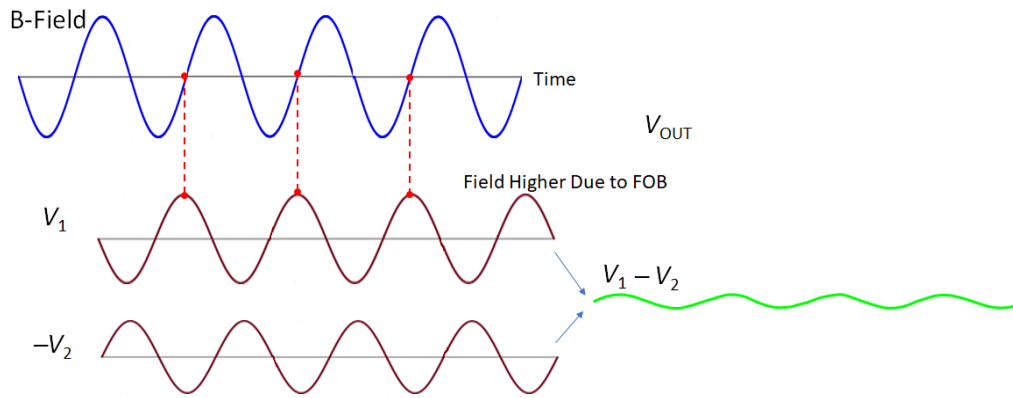
$$V_S = V_1 - V_2$$

(See *id.* 5:53-63).

45. In general, the magnetic field will be distorted when a piece of metallic debris is present on the source resonator. (*Id.*). In the case of a single wire loop magnetic field sensor, the change in magnetic field can be detected by the change in induced voltage V_1 . For the two-loop gradiometer embodiment of Fig. 3A, the B-field distortion will occur over only one of the loops. (*Id.*). In such a case, the induced loop voltages V_1 and V_2 are no longer equal, such that their difference $V_S = V_1 - V_2$ will be non-zero. (*Id.*). The V_S signal is easily amplified and fed to a signal processing element. (*Id.* 8:9-44). This scenario is depicted below:



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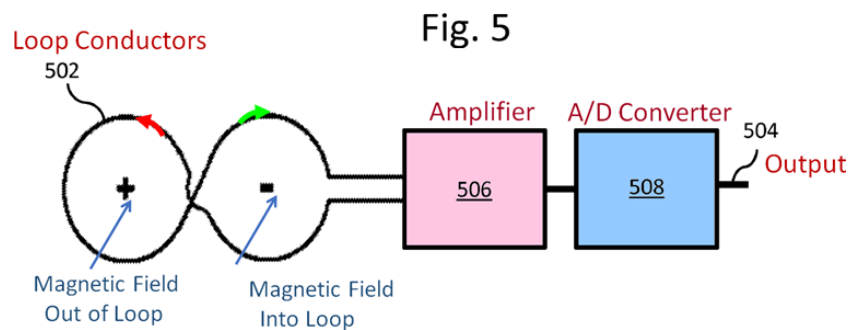
46. The wire-loop embodiment of magnetic-field sensor disclosed in the '184 patent has the following properties:

- Obtains signals via induction directly from the B-field of the source resonator.
- Acts as a passive sensor, i.e., no power is required.
- In the case of the single loop sensor: measures the change ΔV_1 in induced loop voltage.
- In the case of the gradiometer: measures the difference between two voltages and can thus discern small perturbations due to foreign object debris (FOB).

47. An exemplary system including a gradiometer magnetic field sensor and signal processing circuitry is shown in Fig. 5 of the '184 patent, reproduced below. The oscillating magnetic field produced by the transmitting resonator of the wireless energy transfer system enters the two wire-loop magnetic-field sensors, one with a “right-hand-rule” (RHR) direction out of the page (+) and the other with a RHR sense into the page (–). As explained above, the magnetic field induces an AC

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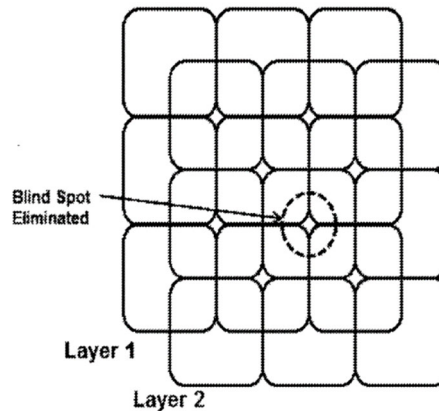
voltage in each loop. The reverse winding direction of the series connected loops means that only the difference between their voltages is applied to amplifier 506 (pink) which passes its signal to an analog-to-digital (A/D) converter. The presence of a piece of foreign-object debris (FOD) over one of the loops will distort the magnetic field entering the loop, leading to a measurable differential voltage at the amplifier input terminals.



Two-loop magnetic-field sensor 502 feeding amplifier (red) and analog-to-digital converter (blue). ('184 Patent, Fig. 5; annotated)

48. The '184 patent also contemplates more complex matrices of loop conductors to both spread the FOD detection area and improve sensitivity. One such complex embodiment is shown in Fig. 4B of the '184 patent, reproduced below:

Fig. 4B



49. Claim 1 of the '184 patent requires that the claimed magnetic-field sensor be positioned within the magnetic field of the wireless energy transfer system, i.e., within the oscillating magnetic field that the source resonator is configured to generate. (*Id.*, Abstract, 3:24-31, 12:20-22). The '184 patent is also explicit in explaining that the purpose of the claimed invention is to detect foreign object debris (FOD) on the surface of the transmitting resonator:

“A wireless energy transfer system includes a foreign object debris detection system.” (*Id.*, Abstract).

“This disclosure relates to wireless energy transfer and methods for detecting foreign object debris (FOD) on wireless power transmission systems.” (*Id.* 1:17-19).

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50. As would have been understood by a POSA, the wire loop embodiments of Figs. 2-5 derive their signals from the magnetic field of the source resonator, and monitoring this signal enables the detection of foreign object debris.

51. The wire loop embodiments of magnetic field sensor sense directly the field of the resonator in order to detect foreign object debris. No external power is required to enable the sensor itself.

V. PETITIONER FAILS TO SHOW THAT THE CHALLENGED CLAIMS WOULD HAVE BEEN OBVIOUS

52. Petitioner asserts that claims 1, 8 and 11 the '184 patent would have been obvious over U.S. Pat. Pub. No. 2010/0084918 (Ex. 1005, "Fells") (Ground 1). Petitioner asserts that claims 2-7, 9, 10 and 16 would have been obvious over Fells and U.S. Pat. Pub. No. 2009/0299918 (Ex. 1006, "Cook") (Ground 2). Petitioner also asserts that claim 12 would have been obvious over Fells alone or with U.S. Pat. No. 6,075,433 (Ex. 1007, "Ono") (Ground 3), and Petitioner asserts that claim 13 would have been obvious over Fells and Cook and/or Chwei-Sen Wang, *Design Considerations for Inductively Coupled Power Transfer Systems* (2004) (Ph.D. thesis, University of Auckland) (Ex. 1008, "Wang Thesis").

53. In my opinion, Petitioner's obviousness analysis fails for several reasons. First, with respect to Ground 1 addressing claims 1, 8 and 11, the analysis fails because Fells does not disclose or render obvious the claim requirement that at

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least one magnetic field sensor be positioned within the magnetic field of the wireless energy transfer system.

54. Second, Ground 2, addressing claims 2-7, 9 and 10, likewise fails because Cook does not cure the deficiencies of Fells. Similarly, the Ground 3, addressing claim 12; and Ground 4, addressing claim 13, also fail because Ono, Cook and/or Wang Thesis do not cure the deficiencies of Fells.

55. Third, Ground 2, addressing claims 4, 5, 6 and 16, also fails because Fells and Cook does not disclose or render obvious performing the health and/or status check of each of these claims.

56. Fourth, Ground 3 also fails because the combination of Fells and Ono does not disclose or render obvious that the foreign object debris detection system is integrated into an enclosure housing at least a portion of the wireless energy transfer source.

57. Thus, for at least these reasons, which are explained in further detail below, it is my opinion that the prior art cited by Petitioner does not render the challenged claims unpatentable for obviousness.

A. Overview of the Prior Art

1. U.S. Pat. Pub. No. 2010/0084918 ("Fells")

58. The Fells publication, entitled "Power System", was filed on October 2, 2009 and published on April 8, 2010. The focus of Fells is on "... methods and

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apparatus for reducing power consumption”, principally by “... detecting the presence of an object, identifying whether the object is a valid device, and restricting power if its [sic] not a valid device.” (Fells Abstract, [0007]). Fells itself does not focus on the detection of foreign object debris. Rather, Fells detects “devices.” All examples of “device” in Fells are of the handheld type, e.g., “portable devices.” (*Id.* [0001]). A central theme of Fells is determining the validity of the portable device. Fells does not discuss the nature of an invalid device but discusses in detail the steps taken to affirm validity of the device using a “ping” method. (*Id.* [0237-0238], [0251-0253]).

59. Fells incorporates by reference GB2414121 (Ex. 1016, “Stevens”) (*See* Fells [0192]). Stevens contrasts the difference between foreign objects and valid devices as, respectively, those having “... the parasitic load associated with foreign metal objects 542, ‘friendly parasitics’ of metal associated with host object (portable device) to be powered 541 and the current load associated with all the secondary devices 540.” (Stevens, 27:29-31).

60. The embodiments and specification of Fells indicate that the intended use of its disclosed invention is for “mobile phone[s]” and “cell phone[s]” (Fells [0004]), a “portable device” with “charger” (*Id.* [0189]), and near-field communication applications such as “smart cards” or RFID tags (*Id.* [0302] –

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[0303]). At no point does Fells mention or consider the wireless charging of cars and trucks, i.e., “vehicles”.

61. Fells describes how high-voltage DC power is down-converted to a lower voltage which then is used to drive an inverter.⁴ (*Id.* [0189]). The output of the inverter is an AC voltage which is applied to a “... tank circuit, or resonator, made of a capacitor and a primary coil.” (*Id.*) The portable device in Fells includes its own secondary coil which couples to the primary coil (*Id.*)

62. The purpose of the sensing circuit in Fells is to detect when an object is placed in proximity to the wireless power supply (WPS). As explained in Fells, the control circuit determines if the object placed in proximity to the WPS is a valid device to which power should be transferred, or whether a foreign object has been placed in proximity: “The Sense Circuit 206 detects when an object is placed in (or removed from) the proximity of the Wireless power supply 200, but does not determine whether or not the object is a legitimate object, such as a valid secondary device, nor whether or not it desires power.” (*Id.* [0191]).

63. Fells explains that if a valid device requiring power is present, and no foreign object is present, the control unit of the WPS will activate the inverter 210 to supply current to the tank circuit, which includes the primary coil 212 and capacitor

⁴ An “inverter” converts DC power into AC power.

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214, to deliver power to the portable device. (*Id.*). Of note, Fells teaches that foreign objects must be detected before the resonator coils are energized for the transfer of power. (*Id.*). This approach to scanning for FOD means that the sensor does not measure the resonator field. This is the opposite of the wire loops in the '184 patent that measure the resonator field.

64. Fells also describes a circuit calibration feature of its disclosed system. Specifically, "... the system performs a calibration inductance measurement." (*Id.* [0196]). A POSA would have understood this calibration step to be the method used to set the baseline for the measured inductance against which future readings can be compared so as to detect a change in inductance to ascertain the presence of an object. (*Id.*). In other words, the "calibration inductance measurement" of Fells sets the object detection level to zero. When the sensing coil is approached by an object, the change in inductance relative to the calibration value will be indicative of the proximity of the object. This baseline of the inductive proximity sensor signal is explicitly explained in Fells: "This is the inductance measurement that subsequent measurements will be compared to in order to trigger the Sense Circuit 206." (*Id.*).

2. U.S. Pat. Pub. No. 2009/0299918 ("Cook")

65. The Cook publication, entitled "Wireless Delivery of Power to a Mobile Powered Device," was filed on May 28, 2008 and published on December 3, 2009. Cook is directed primarily to a validation and accounting system for the wireless

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charging of automobiles: “A system that automatically detects the presence of an automobile that can operate wirelessly to recharge the battery therein, and detects account information associated with that automobile.” (Cook, Abstract).

66. Cook does not disclose any sensors for measuring magnetic fields. In fact, the only context in which Cook mentions magnetic fields is in describing the basic function of a wireless power-transfer system (WPTS). (See, e.g., *Id.* [0001], [0013]). What Cook does disclose is a billing system such as the one depicted by the flowchart of Fig. 2:

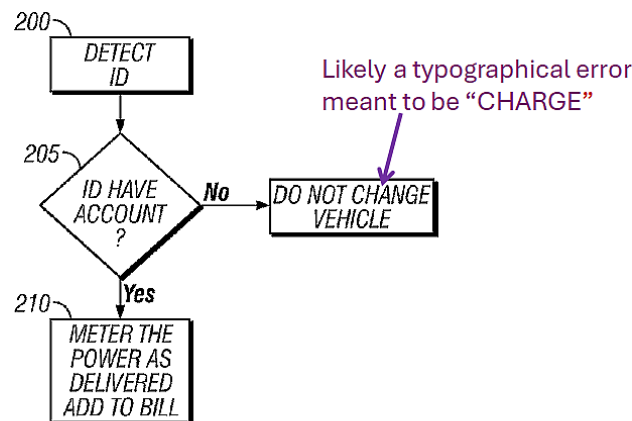


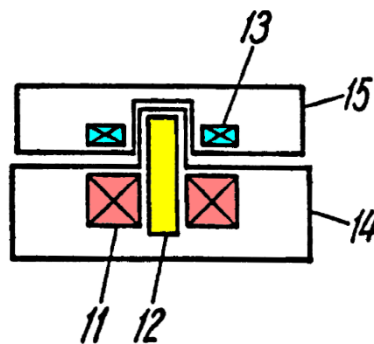
FIG. 2

Cook Fig. 2; annotated

67. Given that the primary focus of Cook is a user validity system, rather than the details of a wireless power-transfer system, I do not believe that a POSA would have been motivated to combine Fells with Cook.

3. U.S. Pat. No. 6,075,433 (“Ono”)

68. The Ono patent was filed on March 12, 1999 and issued on June 13, 2000. Ono discloses a power supply that functions as a “non-contact type power supply unit”. (Ono, Abstract). This power supply unit is summarized in Ono Fig. 1, shown below.

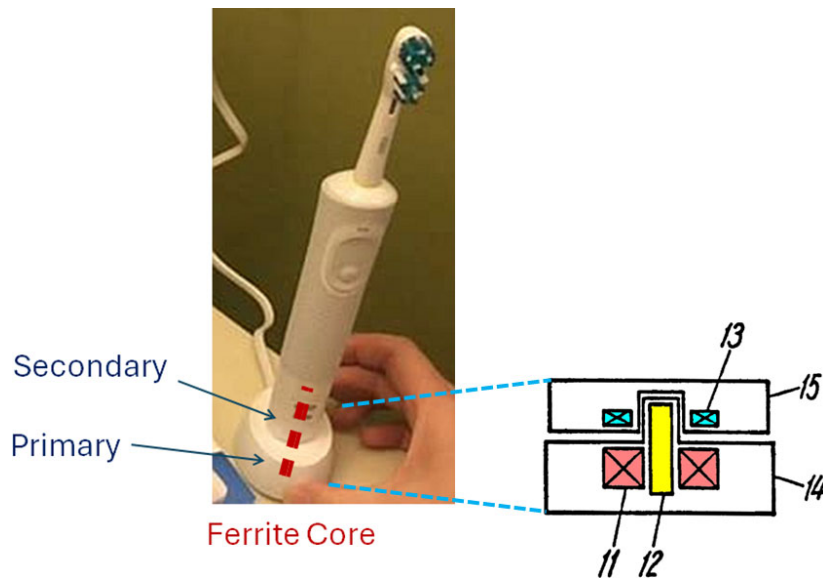


Ono Fig. 1, annotated

The power supply includes a primary coil 11 (red) “that is fed with pulsated currents,” a secondary coil 13 (blue), and a ferrite core 12 (yellow) ... “disposed so as to extend from the primary coil towards the secondary coil” (*Id.*).

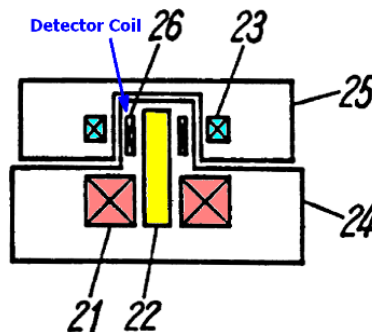
69. A POSA would have recognized the structure including primary, secondary, and ferrite core to be a transformer that inductively couples the primary and secondary windings 11 and 13. (*Id.* 2:55-57). The POSA would have found this structure to represent the base of wirelessly-charged electric toothbrush, like the one shown below:

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Left: Electric toothbrush and charger; Right: Ono Fig. 1

70. Ono discloses “installing a detector coil” for detecting foreign objects by monitoring it for changes in coil voltage. (*Id.* 4:6-19). This extra coil is shown in Ono Fig. 2, reproduced below.

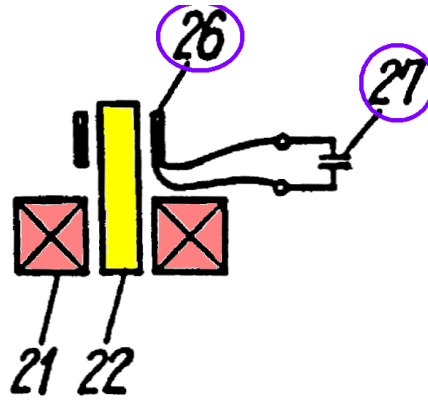


Ono Fig. 2, annotated

71. When a capacitor is connected across the detector coil 26, as in Fig. 3 below, the combination (elements 26 and 27) becomes a resonant *LC* circuit. (*Id.*

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4:31-36). A POSA would, of course, recognize this arrangement as an inductive proximity sensor, much like the one disclosed in Fells.



Ono Fig. 3, annotated

72. A POSA would have recognized that the scale and overall design considerations for a charger for a portable device such as a mobile phone (Fells) versus a toothbrush charger (Ono) would have been very different. On this basis alone, I do not believe that POSA would have been motivated to combine Fells with Ono.

4. Chwei-Sen Wang, *Design Considerations for Inductively Coupled Power Transfer Systems* (2004) (Ph.D. thesis, University of Auckland) (“Wang Thesis”)

73. Wang Thesis states that it was authored in 2004. Wang Thesis discloses the use of inductively coupled power transfer (ICPT) systems with a focus the design of wireless power-transfer systems where “both the primary and secondary coils are compensated by capacitors.” (Wang Thesis, Abstract). Wang Thesis

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provides an extensive explanation of why one might want to use compensation capacitors. Specifically, the design of system with “smaller size, less weight, lower cost, greater power and better efficiency.” (*Id.*).

74. As Wang Thesis explains, achieving power supplies that are smaller and lighter in weight generally require the use of small transformers and inductors which, in turn, necessitates the use of very high switching and excitation frequencies. Higher frequencies cause inductive impedances to be higher as well, thereby limiting the amount of current that can flow in the power supply. As Wang Thesis explains, compensation capacitors, which cause inductors to resonate, reduces the overall impedance of the inductor-capacitor system, so that larger currents can flow while still permitting the use of higher frequencies at large currents. (*Id.* 15-21). Wang Thesis discloses nine common configurations for series- and parallel-compensated wireless power-transfer systems. (*Id.* 24).

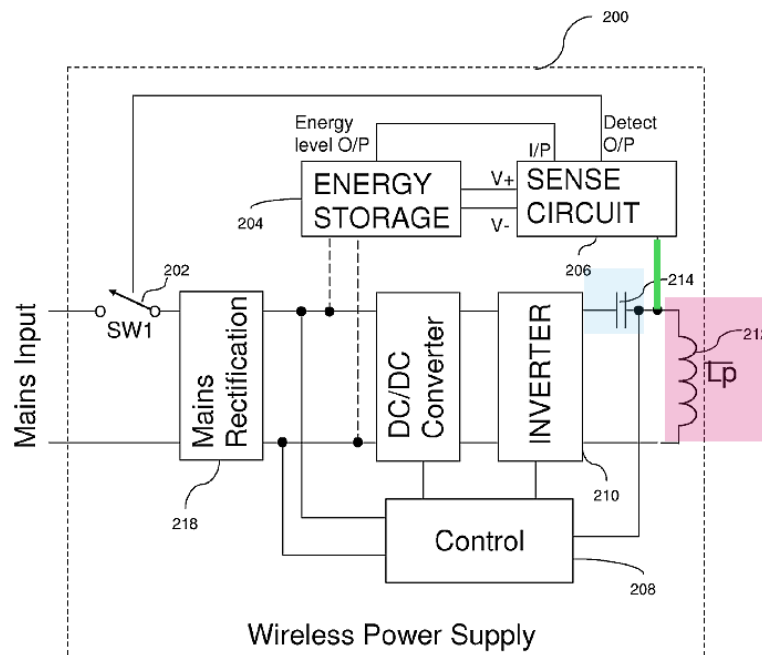
B. Ground 1 (Claims 1, 8, and 11) Should Be Denied

75. Petitioner asserts that claims 1, 8, and 11 of the '184 patent would have been obvious in light of the Fells publication. I disagree. In my opinion, Petitioner has not satisfied its burden of proof to show that these claims would have been obvious. In the paragraphs to follow, I provide the bases for my opinions.

1. Element 1[a]: *source resonator*

76. Figure 2 of Fells is shown below. Petitioner correctly identifies the inductor L_p (red) as the primary coil of the wireless transfer system. Together with capacitor 214 (blue), L_p forms a resonant circuit, or “tank circuit”. (Pet. 11). Of note, the sense circuit in Fig. 2 is connected to the tank circuit by a wire connection (green). That is, in Fig. 2, the sense circuit 206 is connected to the primary coil 212 and functions by detecting a change in inductance of the primary coil. (Fells [0193], [0197]). In this manner, Fells’ sense circuit and primary coil function as an inductive proximity sensor. (See Carstens 250; Staugaard (Ex. 2008) 8-25; Petruzella (Ex. 2009) 102; Rabiee (Ex. 2010) 75; Carr (Ex. 2011) 191).

Fig. 2



Fells Fig. 2, annotated

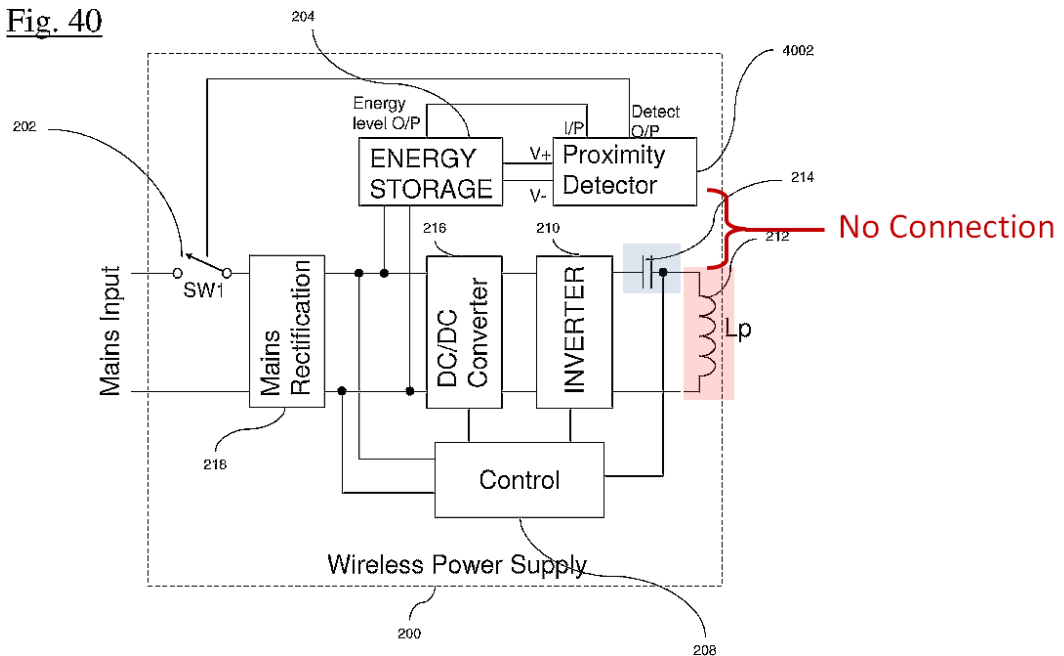
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77. According to Fells, “The Sense Circuit 206 detects when an object is placed in (or removed from) the proximity of the wireless power supply 200” (*Id.* [0191]). Fells describes how sense circuit 206 detects a change in inductance (referring Fig. 3): “Periodically, the sense circuit 206 powers up to see if an inductance change has occurred since the previous measurement.” (*Id.* [0194]). In the context of Fig. 2, the “inductance” would be the primary coil L_P . (*See Id.* [0197]).

78. In Fig. 40, Fells discloses an embodiment that includes a proximity detector to “detect that a device or foreign object has been placed in the vicinity of the wireless power supply 200.” (*Id.* [0288]).

79. Petitioner alleges that “Fig. 40 is the same circuit as Fig. 2.” (Pet. 15). I disagree. In fact, the circuits of Figs. 2 and 40 are not the same. In Fig. 2, sense circuit 206 is connected to the L_P inductor of the tank circuit. As shown in Fig. 40, reproduced below, Fells identifies a proximity detector 4002 that is not connected to the L_P tank circuit.

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Fig. 40

Fells Fig. 40, annotated

According to Fells, in Fig. 40, the “Proximity Detector 4002 is completely separate from the primary coil 212 and therefore not connected to it.” (*Id.* [0288]). Fells further discloses that proximity detector 4002 could be an inductive proximity sensor “formed using another coil in the wireless power supply 200 which is independent of the coil used to transfer power.” (*Id.* [0289]).

2. Element 1[c]: *at least one magnetic field sensor*

80. Petitioner asserts that “Fells discloses ‘at least one magnetic field sensor’”, as required of claim 1 (Pet. 14). Petitioner and Petitioner’s declarant, Dr. Allen, describe sensing circuit 206 in Fells as a “proximity detector” (Pet. 14 or

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“proximity sensor” at 15). They likewise categorize a Hall Effect sensor or inductive proximity sensor as a proximity detector. (*Id.*)

81. As stated by Petitioner, Fells discloses that its “proximity detector” may be a “Hall Effect sensor” or “an inductive proximity sensor.” Petitioner alleges that either of the preceding constitutes the “at least one magnetic field sensor” element of claim 1. (Pet. 15-17). I disagree.

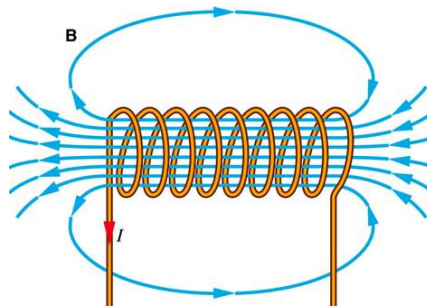
82. Petitioner asserts that an inductive proximity sensor is a magnetic field sensor, because “inductors respond to changes in magnetic fields.” (*Id.* 16). In the context of Fells, however, this is incorrect. Both an inductive proximity sensor and a magnetic field sensor rely on magnetic principles, but a POSA would not have considered an inductive proximity sensor to be a magnetic field sensor.

83. As would have been understood by a POSA, an inductive proximity sensor includes a sensing coil that is part of an *LC* resonant circuit, where a change in the inductance of the sensing coil caused by a metallic (conductive) object will change the value of the inductance, and, in turn, the resonant frequency of the *LC* circuit. (*See* Carstens 250; Staugaard 8-25). Rather than “responding the changes in magnetic fields”, as Petitioner has stated, an inductive proximity sensor as in Fells *produces* a magnetic field and responds to changes in its inductance value caused by

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metallic objects. (See Carstens 250; Staugaard 8-25; Petruzella 102; Rabiee 75; Carr 191.).

84. To further understand the way in which an inductive proximity sensor works, consider for illustrative purposes the field produced by sensing coil carrying an AC current, for example the current that results when the sensing coil is part of a resonant LC circuit. The magnetic field lines within and at the ends of the sensing coil will have a field pattern similar to the following:

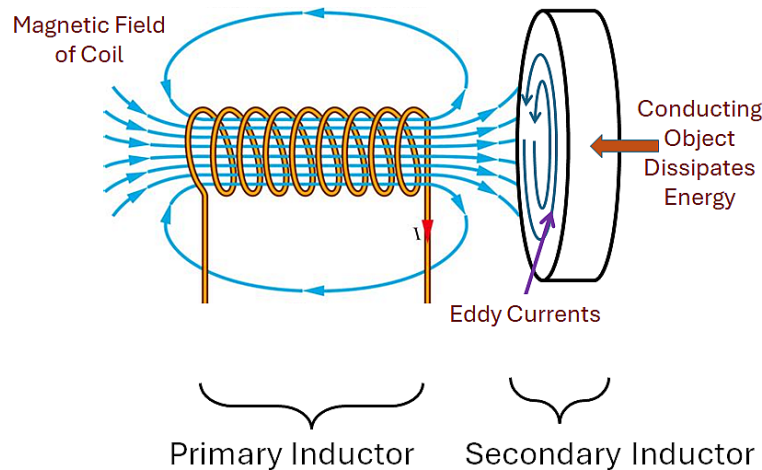


Magnetic field produced by current flowing through a sensing coil

85. For simplicity of analysis, but without loss of generality, consider a metallic object in the shape of a flat disk, as shown below. The AC magnetic field produced by the sensing coil will induce circulating eddy currents in the disk. These currents will cause energy to be dissipated by the resistance of the disk. This loss of energy will result in a change in the resonant frequency of the resonant LC circuit that includes the sensing coil. One can thus model the disk as a lossy inductor

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(inductor and resistor in series) that is coupled to the sensing coil.⁵ The physical coupling between the sensing coil and the metallic (conducting) object is illustrated below.



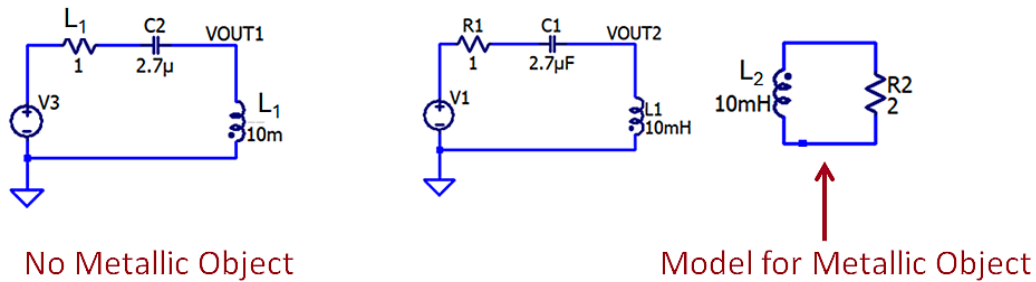
86. The shift in resonant frequency of the sensing coil when the disk is in proximity can easily be demonstrated using the industry-standard circuit-simulator program LTSPICE. Shown below are two circuits; the one on the left depicts the “*LC* tank” circuit of an inductive proximity sensor with no object (e.g., disk) present. The circuit on the right models the same circuit but with the disk in proximity, such that the sensing coil L_1 , is coupled to the disk L_2 . The value of resistance R_2 for the foreign object is chosen to represent the resistivity of a common metal such as

⁵ While the foreign object is modeled here as a flat cylinder, the model can be applied to a metallic foreign body of any size or shape.

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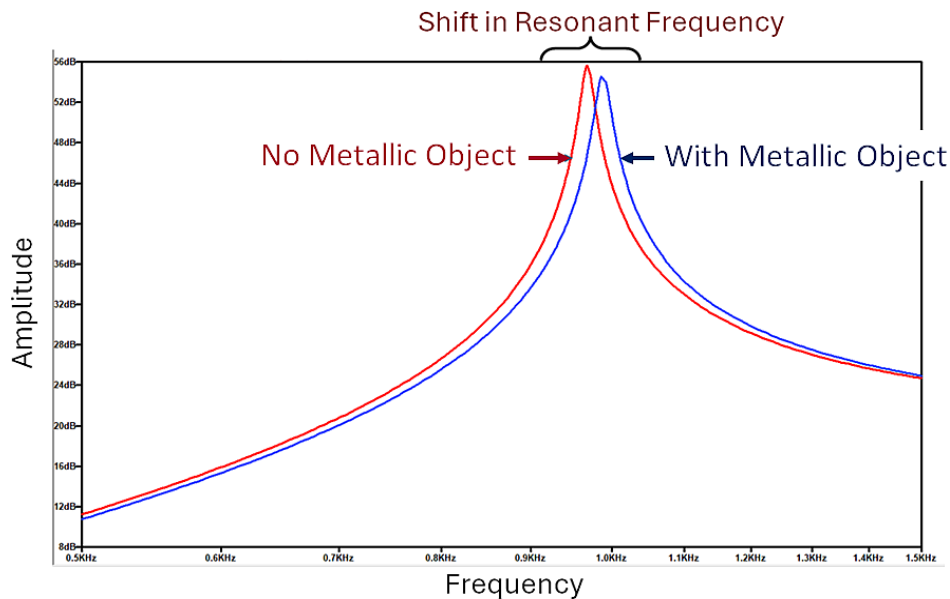
aluminum. The sensing coil L_1 and disk L_2 are assigned a coupling coefficient of 0.95:

Resonant LC Circuit:



87. The figure below shows the frequency response of the two circuits, where the resonant frequency in each case occurs at the apex of the plot. The red plot is from the circuit with no metallic object in proximity; the blue plot includes the object. As can be seen, adding the electrical equivalent of a metallic object raises the resonant frequency of the LC circuit. The energy dissipated in the disk also causes the resonant peak to be smaller in magnitude, consistent with a loss of energy:

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88. The effect of the metallic object coupled to the sensing coil is to lower the net value of inductance and thus raise the resonant frequency of the LC circuit. A POSA would have understood that the inductive proximity sensor of Fells is not a magnetic field sensor, because it produces its own magnetic field and dissipates energy in the object. In contrast, a magnetic field sensor like the ones disclosed in the '184 patent, senses the *external* magnetic field produced by another source, and does not dissipate any energy.

89. As a POSA would have understood, an inductive proximity sensor *produces* a magnetic field, but the inductive proximity sensor cannot *sense* a magnetic field, because any externally applied magnetic field will not change the inductance value of the sensing coil. In other words, neither the resonant frequency

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of an *LC* circuit nor the phase of an inductance bridge can be altered by an externally applied magnetic field.

90. In contrast to an inductive proximity sensor, for which the “readout circuit” must measure an inductance that is independent of the magnetic field of the resonator, a magnetic-field sensor such as the wire-loop sensor disclosed in the '184 patent can measure an oscillating magnetic field directly, in particular the field produced by the resonator. For the wire loop antenna structures disclosed in the '184 patent, this measurement is made possible by the voltage induced at the terminals of the wire loops by the resonator field (via Faraday's Law of induction). This (or these) voltage(s) can be monitored by any of a number of suitable circuits.

91. As a POSA would have understood at the time, no current flows through a wire-loop magnetic-field sensor. Rather, the output signal is simply the open-circuit voltage of the loop. The latter is measured by a readout circuit connected to the terminals of the loop.

92. Unlike an inductive proximity sensor, which requires power to operate (e.g., power to produce the resonating *LC* tank circuit current), the magnetic-field sensors disclosed in the '184 patent are passive elements that require no current or power. While not a requirement of claim 1, this distinction between the two types of

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sensors adds further support to my opinion that Fells does not disclose the “magnetic field sensor” element of claim 1 of the '184 patent.

3. Element 1[e]: *magnetic field sensor positioned within the magnetic field of the wireless energy transfer system*

93. In my opinion, Petitioner has failed to establish that Fells discloses or renders obvious “the at least one magnetic field sensor is positioned within the magnetic field of the wireless energy transfer system” requirement of claim 1 of the '184 patent. As I have explained above, Fells discloses a proximity detector that may be implemented by an inductive proximity sensor or a Hall Effect sensor. A POSA would have found it neither obvious nor feasible to position either of these types of sensors within the magnetic field of the wireless power supply.

94. Irrespective of the fact that Fells inductive proximity sensor is not a magnetic field sensor, in the case where the resonator coil is used as the proximity sensor's inductor as, for example, in Fells Fig. 2, it would not be possible to position the sensor “*within* the magnetic field” of the wireless power supply, because the resonator coil L_P would be *producing* the magnetic field and thus incapable of being placed within its own magnetic field.

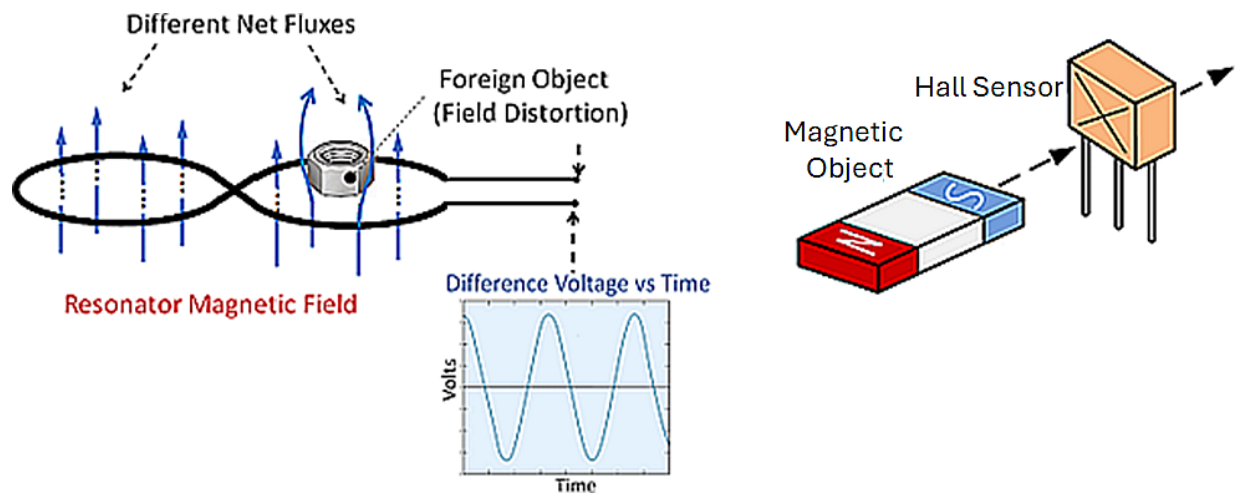
95. Using the methodology of Fells, a POSA would not have positioned either an inductive proximity sensor (formed using another coil) or a Hall Effect sensor within the magnetic field of the wireless power supply to measure or sense

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that magnetic field. Fells discloses that the wireless power supply is turned only *after* the sensor detects an object. (*See* Fells [0191].) Thus, it would not be possible for such a sensor to produce a change in voltage in response to a change in the magnetic field of the wireless power supply. This is because there is no magnetic field of the wireless power supply when the sensor detects an object.

96. Any disclosure of a Hall Effect sensor in Fells would refer to its use in measuring the presence of a magnetized object, such as a ferrite core around which a coil is wound to produce a magnetic field. (*See* Fells [0289]; *see also* Wiley Dictionary-2 (Ex. 2013) 280 (defining “ferrite core”), 444 (defining “magnetic core,” “magnetic core,” and “magnetic coil”)). Fells discloses such a ferrite core within the portable device, which is what the proximity detector (Hall Effect sensor) is intended to detect. (Fells [0289]). It could accomplish this task irrespective of the presence of any resonator field. This difference between the claimed magnetic-field sensor, as contemplated by the '184 patent, and the Hall sensor, is illustrated conceptually in the figure below:

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Left: Magnetic field sensor: Foreign object debris distorts magnetic field of resonator causing imbalance in voltages induced in the two wire loops;
 Right: Hall Effect sensor detects field produced by a magnetic object.

97. As would have been understood by a POSA, Fig. 40 is a block diagram that shows various components and their interconnections within the circuitry. The figure is not intended to show how the components are physically arranged relative to one another, or how the components are arranged relative to the magnetic field generated by the primary coil.

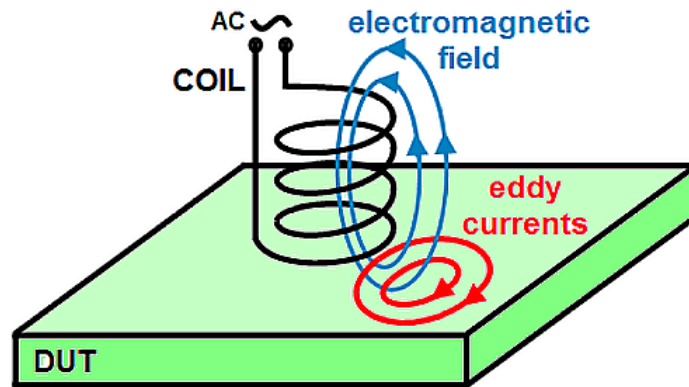
98. A POSA would also have understood that the Hall Effect sensor in Fells need not be positioned *within* the magnetic field of the wireless power supply in order to detect foreign objects in the “vicinity” of the wireless power supply. Of note, detection of a foreign object in the vicinity of the wireless power supply does not require that the foreign object be “on or over” the wireless power supply. (See Merriam-Webster Dictionary (Ex. 2014) 1312 (defining “vicinity” as “the quality or

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state of being near”)). Rather, Fells can detect a foreign object in the vicinity of the wireless power supply, before the foreign object reaches the magnetic field of the wireless power supply.

99. It is also my opinion that a POSA would not have positioned Fells' proximity detector within the magnetic field of the wireless power supply, because the proximity detector would become a foreign object that Fells seeks to detect and avoid.

100. In order for a Hall Effect sensor to operate, for example, a current must be injected across a conducting Hall element. If a B-field is incident perpendicular to the Hall element, a voltage will be generated at right angles to the flow of current. If the incident B-field is an oscillating field, circulating eddy currents will be induced in the plane of the Hall Effect sensor's conducting element, as well as in readout circuitry and any other supporting circuitry within the Hall Effect sensor. (*See Wiley Dictionary-2 226 (defining “eddy current”)*). This phenomenon is illustrated below. In this sense, the Hall Effect sensor *becomes* the foreign object:



AC magnetic field lines (blue) induced eddy currents (red)
in conducting plane (green)

The same would be true of supporting circuitry of an inductive proximity sensor positioned within the magnetic field of the wireless power supply, again, irrespective of the fact that Fells inductive proximity sensor is not a magnetic field sensor.

101. In my opinion, a POSA would instead have positioned Fells' proximity detector outside of (but in proximity to) the magnetic field. In this configuration, Fells can detect objects in the "vicinity" of the wireless power supply. It also avoids the negative impact of the proximity detector itself becoming a foreign object to the wireless power supply. Outside the magnetic field, the proximity detector may falsely trigger on an object that does not encroach into the magnetic field. According to Fells, however, a false trigger does not have a dramatic impact because the control unit confirms that a valid device is present without a foreign object before delivering power. (See Fells [0193], [0262], [0290]).

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102. In light of the above, it is my opinion that Petitioner has failed show that Fells discloses element 1[e] or renders element 1[e] obvious.

C. Ground 2 (Claims 2-7, 9-10, and 16) Should be Denied

103. In Ground 2, Petitioner asserts that claims 2-7, 9-10, and 16 would have been obvious over Fells and Cook. I disagree.

1. Dependent Claims 2-7, 9 and 10

104. It has been explained to me that the ground of rejection of claims 2-7, 9 and 10 (of Ground 2) depends on the ground of rejection of independent claim 1 (of Ground 1). In my opinion, Cook fails to cure the deficiencies of Fells described above with respect to independent claim 1. Cook adds nothing that augments Ground 1, because Cook discloses mainly an accounting system for the purpose of billing for charger use. Cook discloses no sensor of any type other than those needed to detect user information. As such, it is my further opinion that the Ground 2 fails as to claims 2-7, 9 and 10 for at least the same reasons as given above for independent claim 1.

2. Dependent Claims 4-6

105. Dependent claim 4 depends from dependent claim 3 (which depends from dependent claim 2) and recites that the foreign object debris detection system is configured to perform a health and/or status check of the wireless energy transfer source before the vehicle (introduced in claim 2) is positioned over the source

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resonator. Dependent claims 5 and 6 depend from claim 4. As I also discuss in the context claim 16, Petitioner attempts to equate the “calibration inductance measurement” of Fells with the required health and/or status check.

“Fells’ ‘wireless power supply’ performs a ‘sense circuit calibration’ (also called a ‘calibration inductance measurement’) that corresponds to the claimed ‘health and/or status check’ of the source resonator. ... This calibration is a status check of the source resonator, for example, because it prepares for the arrival of a future device or vehicle to be charged by the resonator” (Pet. 40-41)

I disagree.

106. The health and/or status check of claims 4-6 (and similarly claim 16) is performed on the wireless energy transfer source comprising the source resonator, and the word “check” would indicate to a POSA that a test is performed to verify the functioning status of the wireless energy transfer source / source resonator. Wiley Dictionary-2 108 (defining “check” as “[t]he verifying or testing of the accuracy, function, indications, or results of a component, device, instrument, system, or process”)

107. In contrast, the calibration inductance measurement in Fells is performed to set the baseline for the measured inductance against which future readings can be compared so as to detect a change in inductance to ascertain the presence of an object. (Fells at [0196]). Performing the calibration returns no

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information about the functioning status of the wireless energy transfer source / source resonator. Rather, it simply sets a baseline inductance measurement to which further measurements can be compared.

108. In claims 4-6 of the '184 patent, the foreign object debris detection system is configured to perform the health and/or status check, and the foreign object debris detection system comprises at least one magnetic field sensor (claim 1). Petitioner alleges that the foreign object debris detection system with the magnetic field sensor is satisfied by Fells' Fig. 40 that includes a proximity detector. In Fells, the sense circuit calibration is specific to the embodiment in Fig. 2, where the sense circuit is connected to the primary coil and detects an object by a change in inductance across the primary coil. (Fells Fig. 2, 3(a)-3(c), 18-21, [0193] – [0196], [0248] – [0253]). During the sense circuit calibration, a calibration inductance measurement of the primary coil is performed to determine measurement threshold limits, which are then used by the sense circuit to check for an object. (*Id.* [0193], [0196], [0207], [0211], [0223], [0225], [0232], [0237], [0238]).

109. In contrast Fig. 2, the embodiment shown in Fig. 40 includes a proximity detector, but the proximity detector is not connected to the primary coil. (*Id.* [0288]). Fells does not disclose that the proximity detector performs a sense circuit calibration or has use for a calibration inductance measurement of the

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primary coil. A Hall Effect sensor in particular does not detect an object based on a change in inductance of the primary coil. (*See id.* [0289]).

110. Petitioner further tries to tie Fells' monitoring of its energy storage element to the claimed health and/or status check: "The wireless power supply contains an 'energy storage element', which can be a 'supercapacitor' or 'battery,' and is monitored so that it does not deplete fully, preventing operation of the sense circuit." (Pet. 41). Petitioner further asserts that, "Checking that the energy storage element is not fully depleted provides the health and/or status of the resonator, as the resonator is incapable of being turned on by the sense circuit if the energy storage element is depleted." (*Id.* at 42). I disagree.

111. As a POSA would have understood, checking the charge level of the energy storage element provides no information about the health or status of wireless energy transfer source / source resonator. The ability of the wireless energy transfer source / source resonator to deliver power depends on the sense circuit being functional to detect an object and close SW1. The check of the energy storage element's energy level only ensures that the sense circuit can potentially be triggered.

112. The analogy to Petitioner's assertion would be equating the checking of the charge level of flashlight batteries (e.g., with a multimeter) with assurance that

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the flashlight bulb is operable (e.g., not burned out), and that the flashlight's on/off switch is likewise operable. Neither of these conditions would be indicated by measuring the battery charge level with a multimeter.

113. As a POSA would also have understood, Fells' sense circuit does not "turn on" or "activate" the resonator, but instead closes SW1 to allow the wireless power supply to draw power from the AC electrical mains input. (Fells [0191]). The control unit determines that an object detected by the sense circuit is a valid device that desires power, and the control unit (not the sense circuit) turns on the resonator (activates the inverter to supply current to the tank circuit). (*Id.*).

114. Fells also does not allow the energy storage element to fully deplete, instead recharging the energy storage element when its energy level falls below a threshold. (*Id.* [0203], [0246]). If the energy level of the energy storage element decreases to below a threshold, SW1 is closed to allow the energy storage element to be recharged from the main circuit. (*Id.* [0246], [0248]).

115. The outcome of the check of the energy storage element has no impact on resonator's ability to be turned on. The resonator is capable of being turned on by the control unit either way. As would have been understood by a POSA, if the energy storage element's energy level is above the threshold, the sense circuit may be triggered by detection of an object to close SW1. (*Id.* [0191], [0248]). Likewise,

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if the energy level is below the threshold, the sense circuit is triggered to close SW1 to recharge the energy storage element. (*Id.* [0246], [0248]). In this case, the wireless power supply is still allowed to draw mains power, which enables the control circuit to detect a valid device that desires power, and turn on the resonator. The check of the energy level of the energy storage element therefore does not provide any check of the health and/or status of the resonator.

116. Similar to claims 4-6, claim 16, requires a health and/or status check of the wireless energy transfer source / source resonator. Petitioner has failed to show any such check is performed by the Fells system. Thus, Petitioner has failed to show that claims 4-6 would have been obvious over the combination of Fells and Cook.

3. Independent Claim 16

117. With respect to claim 16, Petitioner also fails its burden of proof to show that each and every element of the claim is present in the cited prior art. Petitioner relies on the “sense circuit calibration” and check of the energy level in the energy storage element in claim 16, similar to claims 4-6. (Pet. 40-42, 52-53). As explained above, however, the sense circuit calibration and check of the energy storage element do not provide any information on the health and/or status of the source resonator, as required by claim 16.

118. Petitioner further alleges that Fells performs validation checks as part of the calibration inductance measurement. (Pet. 41). Fells states that the calibration

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inductance measurement “may take longer than a normal measurement as it is important to make sure that the calibration measurement is a valid one and not a rogue measurement.” (Fells [0196]). A POSA would have understood , however, that taking more time is not “a validation check,” and Fells does not describe a validation check being performed during the increased time. Fells instead discloses several ways in which inductance can be measured in a longer time that do not involve a validation check. (*Id.* [0197], [0222], [0266], [0268]).

119. Fells discloses counting a number of pulses of a signal within a defined time interval to perform a relative measurement of inductance. (*Id.* [0197]). As would have been understood by a POSA, increasing the defined time interval over which the number of pulses is counted allows for the accumulation of more pulses, which improves statistical accuracy and reduces the impact of random fluctuations or noise. Fells also discloses that the sense circuit “first allows the oscillator signal to settle,” which would increase the time of a calibration inductance measurement, but also allow for any initial fluctuations, overshoots or noise to dissipate before the measurement is taken. (*Id.* [0268]). In at least these examples, the acquisition time for an inductance measurement is increased in a manner that does not involve any “validation check.”

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D. Ground 3 (Claim 12) Should be Denied

120. In Ground 3, Petitioner asserts that claim 13 would have been obvious over Fells in and Ono. I disagree.

1. Ono Does Not Cure the Deficiencies of Fells

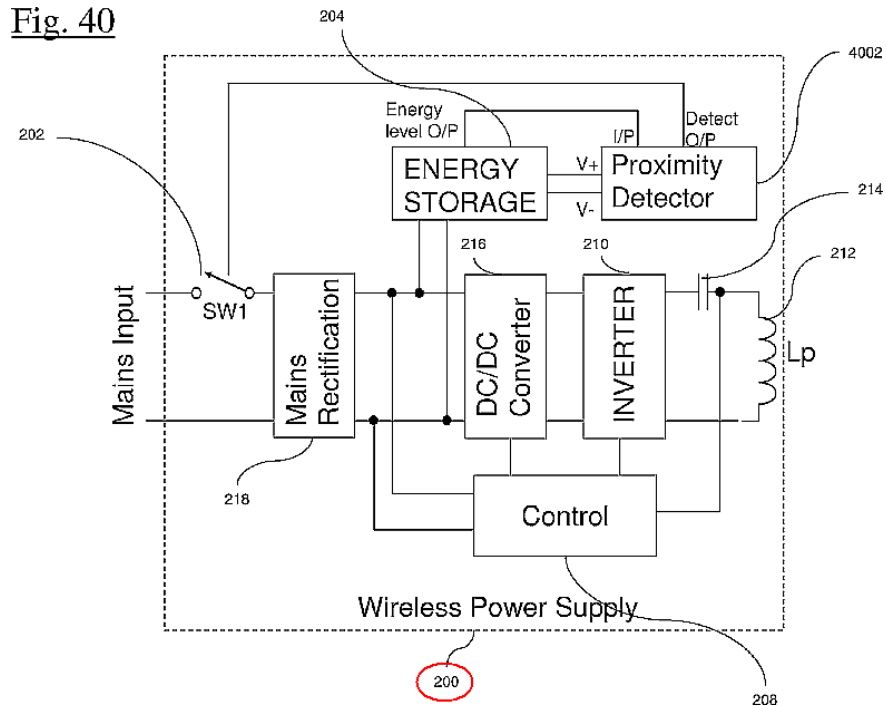
121. It has been explained to me that the ground of rejection of claim 12 (of Ground 3) depends on the ground of rejection of independent claim 1 (of Ground 1). In my opinion, Ono fails to cure the deficiencies of Fells described above with respect to independent claim 1. Cook adds nothing that augments Ground 1, because Ono discloses similar subject matter without adding any new features relevant to claim 1. As such, it is my further opinion that the Ground 3 fails as to claim 12 for at least the same reasons as given above for independent claim 1.

2. Fells and Ono Do Not Disclose The Foreign Object Debris Detection System Integrated into the Enclosure

122. It is also my opinion that Fells and Ono do not disclose that “the foreign object debris detection system is integrated into the enclosure,” as required by claim 12. Petitioner argues that Fells discloses integration of the foreign object debris detection system into the enclosure, relying on the dotted lines shown in Fig. 40. (Pet. 61-62). According to Petitioner, “[a] POSA would have understood that the dotted lines in Fells’ diagrams indicate an ‘integrated’ enclosure encompassing all components within the dotted lines.” (*Id.* 62). I disagree.

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123. Again, Fig. 40 of Fells is a block diagram that shows various components and their interconnections within the wireless power supply.

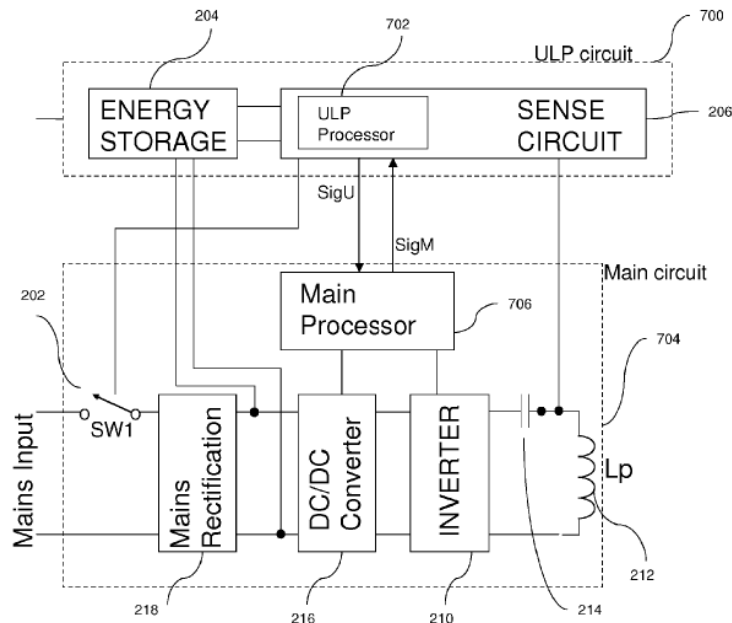


Fells Fig. 40, annotated

In Fig. 40, the dotted line boundary is identified by reference number 200 (red) which Fells refers to as a wireless power supply, primary unit or wireless power unit. (Fells [0191], [0203]). Fells does not describe the wireless power supply, primary unit or wireless power unit as an enclosure, or as including an enclosure.

124. As noted by Petitioner, Fells includes several diagrams with dotted line boundaries, but Petitioner's proposition that "the dotted lines in Fells' diagrams indicate an 'integrated' enclosure encompassing all components within the dotted

lines,” is contrary to the explicit teachings of Fells. In Fig. 7, for example, Fells illustrates the wireless power supply organized into a ULP circuit 700 and a main circuit 704, each of which is shown by a boundary of dotted lines. (*Id.* [0206]).



Fells Fig. 7

125. Fig. 7 includes two dotted line boundaries identified by reference numbers 700 and 704. (*Id.* [0206]). In the corresponding description, Fells refers to reference number 700 as the ULP circuit, and Fells refers to reference number 704 as the main circuit. (*Id.*). Fells also refers to reference number 704 (for one of the dotted line boundaries) as a *circuit board*. (*Id.* [0236]). A POSA would therefore

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have not understood that the dotted lines in Fells' diagrams indicate an "integrated enclosure," as argued by Petitioner.

126. It is also my opinion that Ono does not disclose "the foreign object debris detection system is integrated into the enclosure," and Petitioner fails to establish that a POSA would have been motivated to integrate Fells circuitry into an enclosure based on the teachings of Ono. Even if a POSA would have considered it obvious to place Fells' wireless power supply within a primary enclosure according to Ono, Petitioner still fails to establish that the combination of Fells and Ono discloses that the foreign object debris detection system is *integrated* into the enclosure, as required by claim 12.

127. As would have been understood by a POSA, in the context of claim 12, the foreign object debris detection system integrated into the enclosure means that the foreign object debris detection system is united with the enclosure to form a functioning or unified whole. (Merriam-Webster Dictionary 606 (defining "integrate" as "to form, coordinate, or blend into a functioning or unified whole")). This is more than simply housing the foreign object debris detection system in the enclosure, which a POSA would have understood to mean that the foreign object debris detection system is simply enclosed in the enclosure. (*Id.* 561 (defining "house" to as "to encase, enclose, or shelter as if by putting in a house"))).

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128. Petitioner fails to establish that Ono, or Fells and Ono in combination, discloses that the foreign object debris detection system is *integrated into* the enclosure. As I explained above, Ono discloses a transformer including a primary coil mounted inside a primary enclosure, and a detector coil that is also within the primary enclosure. (Ono Fig. 2, 3:38-43, 4:6-8). Ono at best discloses that the primary enclosure houses or encloses the primary coil and the detector coil. Ono does not disclose that the detector coil is integrated into the primary enclosure.

E. Ground 4 (Claim 13) Should be Denied

129. It has been explained to me that the ground of rejection of claim 13 (of Ground 4) depends on the ground of rejection of independent claim 1 (of Ground 1). In my opinion, Cook and/or Wang Thesis fail to cure the deficiencies of Fells described above with respect to independent claim 1. Again, Cook adds nothing that augments Ground 1, because Cook discloses mainly an accounting system for the purpose of billing for charger use. Cook discloses no sensor of any type other than those needed to detect user information. The Wang Thesis does not disclose any sensors, and hence cannot meet the requirements of claim 1. As such, it is my further opinion that the Ground 4 fails as to claim 13 for at least the same reasons as given above for independent claim 1.

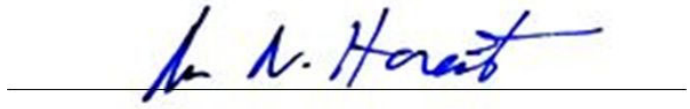
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VI. CONCLUSION

130. For the reasons set forth above, it is my opinion that the prior art cited by Petitioner does not render obvious the challenged claims of the '184 patent.

Executed on September 12, 2024 in the city of Boston, Massachusetts.



Dr. Mark N. Horenstein