

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

INDUCTEV, INC.,
Petitioner,

v.

WITRICITY CORPORATION,
Patent Owner.

IPR2024-00105
Patent 10,027,184 B2

Before JAMESON LEE, CHRISTOPHER L. OGDEN, and
SCOTT RAEVSKY, *Administrative Patent Judges*.

OGDEN, *Administrative Patent Judge*.

JUDGMENT
Final Written Decision
Determining All Challenged Claims Unpatentable
35 U.S.C. § 318(a)

I. INTRODUCTION

InductEV, Inc. (“Petitioner”) filed a Petition (Paper 2, “Pet.”) under 35 U.S.C. §§ 311–319 requesting *inter partes* review (“IPR”) of claims 1–13 and 16 of U.S. Patent No. 10,027,184 B2 (Ex. 1001, “the ’184 patent”). WiTricity Corporation (“Patent Owner”) filed a Patent Owner Response (Paper 21, “PO Resp.”), Petitioner filed a Reply to the Patent Owner Response (Paper 31, “Pet. Reply”), and Patent Owner filed a Sur-reply (Paper 34, “PO Sur-reply”).

We held a combined oral hearing in this proceeding and IPR2024-00140 on March 5, 2025, and the transcript is entered into the record. Paper 37 (“Tr.”).

This is a final written decision under 35 U.S.C. § 318(a) as to whether the claims challenged in the *inter partes* review are unpatentable. For the reasons below, we conclude that all the challenged claims are unpatentable.

II. BACKGROUND

A. THE ’184 PATENT (EX. 1001)

The ’184 patent describes “[a] wireless energy transfer system” that “includes a foreign object debris^[1] detection system.” Ex. 1001, code (57). According to the patent disclosure, in prior-art systems of wireless energy transfer “that rely on an oscillating magnetic field between two coupled

¹ The ’184 patent refers to “foreign object debris” as “FOD,” and we use that abbreviation in our decision. Ex. 1001, 1:18.

resonators,” any “[m]etallic objects and/or other objects inserted between the resonators may interact with the magnetic field of the wireless power transfer system in a way that causes the metallic and/or other objects to perturb the wireless energy transfer and/or to heat up substantially.” *Id.* at 1:45–49. This could “block or reduce the magnetic fields used for energy transfer, or may create a fire . . . or burning hazard.” *Id.* at 2:3–5.

The ’184 patent proposes to detect such FOD using sensors, including magnetic field sensors. Ex. 1001, 7:66–8:4. These are used for “measuring small changes in the magnetic field in the proximity of the FOD objects.” *Id.* at 5:28–29. For example, “two small wire loops . . . may be placed on or near the resonators used for wireless energy transfer,” and “[e]ach individual loop develops a voltage proportional to the amount of magnetic flux threading the inside of each loop.” *Id.* at 5:39–47. FOD can be detected by measuring the difference between the voltages developed in each loop. *See id.* at 5:47–63.

B. CHALLENGED CLAIMS AND GROUNDS

Independent claim 1 is as follows:

- 1[pre] 1. A wireless energy transfer system with foreign object debris detection, the system comprising:
 - 1[a] a wireless energy transfer source comprising a source resonator configured to generate an oscillating magnetic field; and
 - 1[b] a foreign object debris detection system comprising:
 - 1[c] at least one magnetic field sensor; and
 - 1[d] at least one readout circuit configured to measure one or more electrical parameters of at the at least one magnetic field sensor,

- 1[e] wherein the at least one magnetic field sensor is positioned within the magnetic field of the wireless energy transfer system; and
- 1[f] wherein the foreign object debris detection system is configured to verify that foreign object debris has not moved onto or over the source resonator during generation of the oscillating magnetic field.

Ex. 1001, 12:10–26 (Petitioner’s reference numbers added).

Petitioner argues four grounds for *inter partes* review, as summarized in the following table (*see* Pet. 2):

Claim(s) Challenged	35 U.S.C. §	Reference(s)/Basis
1, 8, 11	103(a) ²	Fells, ³
2–7, 9, 10, 16	103(a)	Fells, Cook, ⁴
12	103(a)	Fells, Ono ⁵
13	103(a)	Fells, Cook, Wang ⁶

C. DECLARATORY TESTIMONY

Petitioner submits two declarations by Dr. Mark Allen. Exs. 1003, 1037. Patent Owner submits a declaration by Dr. Mark N. Horenstein. Ex. 2005.

² 35 U.S.C. § 103(a) (2006), *amended by* Leahy–Smith America Invents Act (“AIA”), Pub. L. No. 112-29 § 103, sec. (n)(1), 125 Stat. 284, 287, 293 (2011) (effective Mar. 16, 2013). Petitioner applies the pre-AIA version of the statute. *See* Pet. 7, 32, 60, 64 (asserting that references are prior art under pre-AIA § 102 for use in §103(a)).

³ Fells et al., US 2010/0084918 A1, published Apr. 8, 2010 (Ex. 1005).

⁴ Cook et al., US 2009/0299918 A1, published Dec. 3, 2009 (Ex. 1006).

⁵ Ono et al., US 6,075,433, issued June 13, 2000 (Ex. 1007).

⁶ Chwei-Sen Wang, Design Considerations for Inductively Coupled Power Transfer Systems (2004) (Ph.D. thesis, University of Auckland) (Ex. 1008).

D. RELATED PROCEEDINGS

As a related matter, the parties identify *WiTricity Corp. v. InductEV, Inc.*, No. 23-cv-01099 (E.D. Penn. filed Mar. 21, 2023); *transferred*, No. 24-cv-00406 (D. Del. Apr. 1, 2024). Pet. 72; Paper 4, 1.

III. ANALYSIS

A. LEVEL OF ORDINARY SKILL IN THE ART

The level of ordinary skill in the pertinent art at the time of the invention is a factor in how we construe patent claims. *See Phillips v. AWH Corp.*, 415 F.3d 1303, 1312–13 (Fed. Cir. 2005) (en banc). It is also one of the factors we consider when determining whether a patent claim is obvious over the prior art. *See Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).

To assess the level of ordinary skill, we construct a hypothetical “person of ordinary skill in the art,” from whose vantage point we assess obviousness and claim interpretation. *See In re Rouffet*, 149 F.3d 1350, 1357 (Fed. Cir. 1998). This legal construct “presumes that all prior art references in the field of the invention are available to this hypothetical skilled artisan.” *Id.* (citing *In re Carlson*, 983 F.2d 1032, 1038 (Fed. Cir. 1993)).

Petitioner argues that a person of ordinary skill in the art “would have had . . . a bachelor’s degree in electrical engineering, microelectronics, or equivalent, and . . . two to three years of industry or research experience,” and “a higher level of education or skill might make up for less experience, and vice-versa.” Pet. 6 (citing Ex. 1003 ¶¶ 39–44).

Patent Owner “does not disagree with Petitioner’s definition of the level of ordinary skill in the art,” but “does not believe that resolution of the

Petition depends on the precise definition of the level of ordinary skill.”

PO Resp. 12.

Petitioner’s proposed articulation is supported by testimonial evidence and appears consistent with the types of problems and solutions in the ’184 patent. *See* Ex. 1001, 1:15–2:53. As it is uncontested, we adopt it for this decision.

B. CLAIM CONSTRUCTION

In an *inter partes* review, we construe a patent claim “using the same claim construction standard that would be used to construe the claim in a civil action under 35 U.S.C. 282(b).” 37 C.F.R. § 42.100(b). This generally includes “construing the claim in accordance with the ordinary and customary meaning of such claim as understood by one of ordinary skill in the art and the prosecution history pertaining to the patent.” *Id.* The ordinary and customary meaning of a claim term “is its meaning to the ordinary artisan after reading the entire patent” and “as of the effective filing date of the patent application.” *Phillips*, 415 F.3d at 1313, 1321.

The parties agree that the terms of the contested claims should be given their ordinary and customary meaning, but neither party argues that we should construe any claim terms explicitly. Pet. 6 (citing Ex. 1003 ¶¶ 62–63); PO Resp. 12.

We agree with the parties that, for this decision, we do not need to construe any of the terms explicitly. *See Realtime Data, LLC v. Iancu*, 912 F.3d 1368, 1375 (Fed. Cir. 2019) (“The Board is required to construe ‘only those terms . . . that are in controversy, and only to the extent necessary to resolve the controversy.’” (quoting *Vivid Techs., Inc. v. Am. Sci & Eng’g*,

Inc., 200 F.3d 795, 803 (Fed. Cir. 1999))). However, the meaning of certain terms are contested, including most notably “magnetic field sensor,” and we discuss those terms below in the context of the prior art.

C. ALLEGED OBVIOUSNESS OF CLAIMS 1, 8, AND 11 OVER FELLS

In its first ground, Petitioner argues that claims 1, 8, and 11 are unpatentable under § 103(a) as obvious over Fells. Pet. 2, 6–31.

A claim is unpatentable under § 103(a) if the differences between the claimed subject matter and the prior art are “such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains.” *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). When a ground in a petition is based on a combination of references, we consider “whether there was an apparent reason to combine the known elements in the fashion claimed by the patent at issue.” *Id.* at 418 (citing *In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006)).

We base our obviousness inquiry on factual considerations including (1) the scope and content of the prior art, (2) any differences between the claimed subject matter and the prior art, (3) the level of skill in the art, and (4) any objective indicia of obviousness or non-obviousness that may be in evidence. *See Graham*, 383 U.S. at 17–18.

Considering these factors,⁷ we determine that Petitioner has shown by a preponderance of the evidence that claims 1, 8, and 11 are unpatentable for the reasons explained below.

1. Overview of Fells

Fells describes measures for “reducing power consumption in a wireless power supply,” which includes “detecting the presence of an object within proximity of a primary unit.” Ex. 1005 ¶¶ 7–8. As background, Fells discusses wireless power units that “have a standby mode,” and a unit may come out of the standby mode if it “detects a valid device that is requesting power and determines that there are no foreign objects that would get hot or hinder power transfer in the vicinity.” *Id.* ¶ 2. Like these earlier systems, Fells describes a similar system that detects foreign objects using a sense circuit and delivers power via a primary coil to a portable device. *Id.* ¶ 191.

Figure 40, reproduced below, depicts an embodiment of this wireless power-transfer system:

⁷ Neither party argues that there are objective indicia of obviousness or non-obviousness, so this factor is not part of our analysis.

Fig. 40

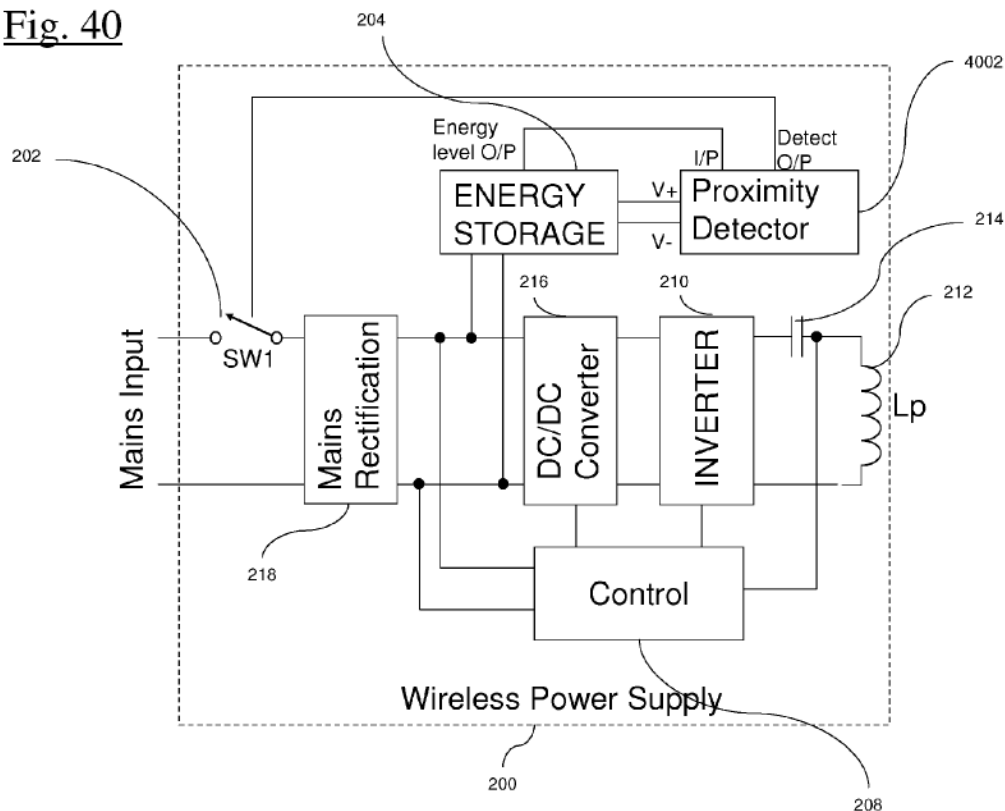


Figure 40 depicts power supply 200, which includes Mains Rectifier 218, DC/DC Converter 216, Inverter 210, capacitor 214, primary coil 212, control unit 208, switch 202 (“SW1”), Energy Storage 204 unit, and Proximity Detector 4002. Ex. 1005 ¶ 288; *see also id.* ¶ 191 (describing nearly identical Figure 2).

Proximity Detector 4002 is a sense circuit (corresponding to Sense Circuit 206 in Figure 2) that is “used to initially detect that a device or foreign object has been placed in the vicinity of the wireless power supply 200.” Ex. 1005 ¶¶ 182 (“FIG. 40 shows an embodiment of FIG. 2 using a proximity sensor.”), 288. It also detects if a device or foreign object is removed from the wireless power supply 200. *Id.* ¶ 191.

If the sense circuit (Sense Circuit 206 or Proximity Detector 4002) “detects that an object has been placed on (or in proximity to) the wireless

power supply 200, then SW1 202 is closed allowing the circuits in the wireless power supply 200 to receive power.” Ex. 1005 ¶ 191. “If there is a valid device requiring power and no foreign objects present, then the control unit 208 will activate the Inverter 210 to supply current to the tank circuit, which includes the primary coil 212 and capacitor 214, to deliver power to the portable device (not shown).” *Id.*

Figure 18, reproduced below, is a flowchart illustrating a method of checking for foreign objects:

Fig. 18

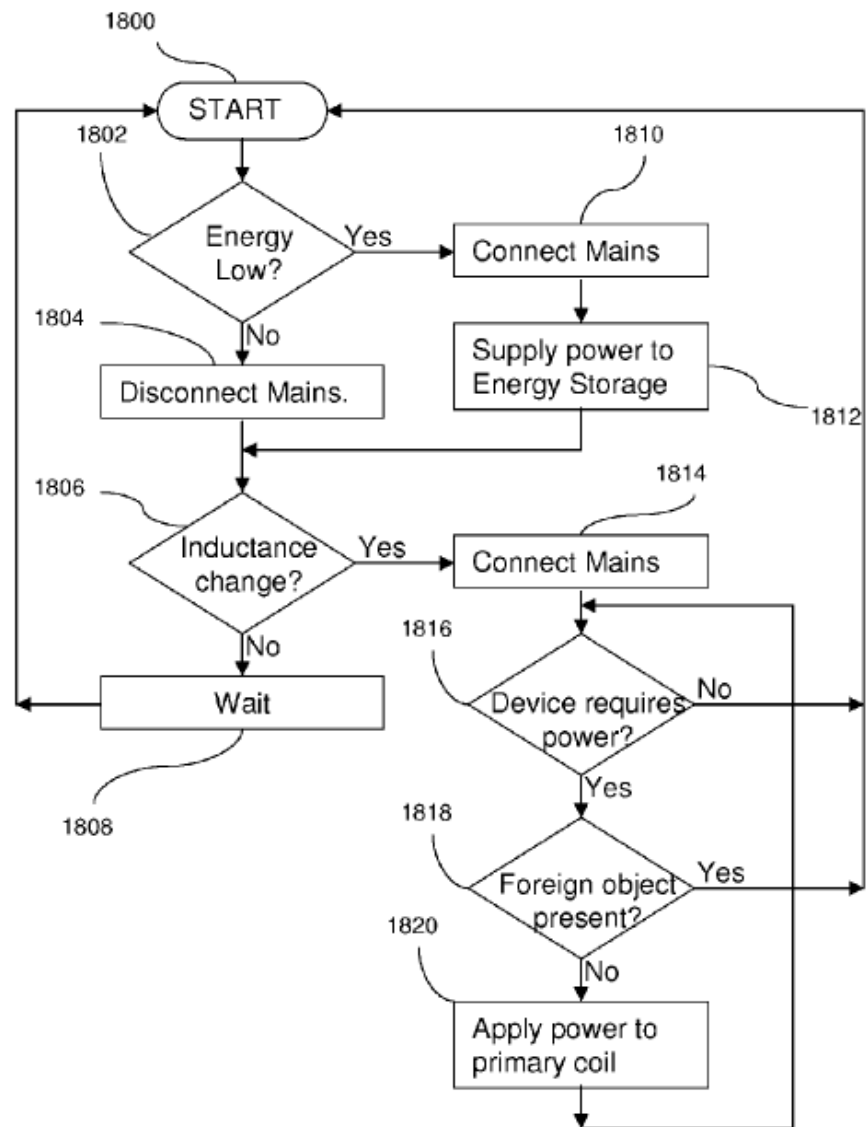


Figure 18 illustrates an ultra-low-power mode in which the mains input (depicted on the left side of Figure 40) are only connected when Energy Storage unit 204 is low in energy and needs to be recharged, and otherwise loops until the system senses an inductance change (steps 1800, 1802, 1804, 1806, 1808, 1810, and 1812). Ex. 1005 ¶ 248. If so (step 1806), the system connects the mains input and determines whether there is a device that requires power (step 1816). *Id.* “If there is, the system checks to see if there is a foreign object present 1818 (this may have been placed at the same time as the device),” and if not, “then the system delivers power to the primary coil 1820 to supply power to the portable device.” *Id.* The system “continues to check that the device is still requiring power 1816 and only goes back to the start 1800 when the device no longer requires power or if a foreign object 1818 is placed on the wireless power supply.” *Id.*; *see also id.* ¶¶ 194–196, Figs. 3(a)–(c).

For additional disclosures related to detecting foreign objects, Fells incorporates by reference Stevens et al., GB 2 414 121 A (published Nov. 16, 2005) (“Stevens,” Ex. 2016). Ex. 1005 ¶ 192.

2. *Claim 1*

(a) Preamble

The preamble of claim 1 recites “[a] wireless energy transfer system with foreign object debris detection.” Ex. 1001, 12:10–11.

Petitioner argues that, to the extent the preamble is limiting, Fells discloses the recited wireless energy transfer system, and that the system includes facilities to detect FOD. Pet. 8–9 (citing Ex. 1005 ¶ 191, Fig. 2; Ex. 1003 ¶¶ 66–71, 96–101).

Patent Owner does not specifically contest Petitioner’s arguments. *See* PO Resp. We agree with Petitioner’s argument that Fells discloses the preamble; thus, we need not decide whether the preamble is limiting. *See* Ex. 1005 ¶¶ 191, Fig. 2.

(b) Limitation 1[a]

Limitation 1[a] recites a system that comprises, in part, “a wireless energy transfer source comprising a source resonator configured to generate an oscillating magnetic field.” Ex. 1001, 12:12–14.

Petitioner argues that the recited “wireless energy transfer source” corresponds to wireless power supply 200, and the recited “source resonator” corresponds to the circuit comprising capacitor 214, primary coil 212, which form a “tank circuit.” Pet. 10–11 & n.4 (citing Ex. 1005 ¶¶ 191, 190, 198–200, 206, 273, Fig. 2; Ex. 1003 ¶¶ 103–108; Ex. 1023, 2101; Ex. 1026; Ex. 1015, 17:66–18:4; Ex. 1014, 2:51–63, 18:18–35).

Petitioner also argues that this alleged source resonator generates an oscillating magnetic field, which is how wireless power supply 200 provides power to a portable device. Pet. 12–13 (citing Ex. 1005 ¶¶ 108, 189–192, 195, 248, 295, Fig. 2; Ex. 1003 ¶¶ 109–111; Ex. 1024, 186; Ex. 1026, 391; Ex. 1001, 1:36–41).

Patent Owner does not specifically contest Petitioner’s arguments. *See* PO Resp. For the reasons given in the Petition, we agree with Petition that Fells discloses limitation 1[a].

(c) Limitation 1[b]

Limitation 1[b] recites a system comprising, in part, “a foreign object debris detection system.” Ex. 1001, 12:15.

Petitioner argues that Fells discloses an FOD detection system including sense circuit 206, control element 208, and related circuitry. Pet. 13–14 (citing Ex. 1005 ¶¶ 191–195, Fig. 2; Ex. 1003 ¶¶ 113–115).

Patent Owner does not specifically contest Petitioner’s arguments. *See* PO Resp.

For the reasons given in the Petition, we agree with Petitioner that Fells discloses limitation 1[b].

(d) Limitation 1[c]

Limitation 1[c] recites “at least one magnetic field sensor” as part of the recited FOD detection system. Ex. 1001, 12:16.

Petitioner argues that, according to Fells, sense circuit 206 can act as a proximity sensor, and can take the form of a Hall-effect sensor or an inductive proximity sensor, both of which are magnetic field sensors. Pet. 14–15 (citing Ex. 1005 ¶¶ 182, 288–291, Fig. 40, claim 11; Ex. 1003 ¶¶ 116–121). Patent Owner contends that the magnetic field sensor may not be construed to include an inductive proximity sensor. PO Resp. 25–29; PO Sur-reply 3, 13–14; We address these claim-construction arguments below, before turning to whether Fells discloses the limitation in light of that construction.

(1) *Whether a Hall-effect Sensor is a Magnetic Field Sensor*

First, Petitioner argues that a Hall-effect sensor is a magnetic field sensor because it produces a voltage change in response to a change in a magnetic field, and that it was well known in the art as a magnetic field

sensor. Pet. 16 (citing Ex. 1005 ¶¶ 289–290; Ex. 1018, 219; Ex. 1022, 973, 979–80; Ex. 1027, 215; Ex. 1003 ¶ 120).

Patent Owner does not specifically contest this argument in its Response. *See* PO Resp. 25–29. However, at the oral hearing, Patent Owner argued for the first time that a Hall effect sensor is not a “magnetic field sensor” Ex. 37, 49:12–50:6, 58:16–24. Patent Owner’s argument was untimely because it was not included in either the Response or the Sur-reply.⁸

Even if Patent Owner had raised the issue on time, the evidence of record supports Petitioner’s argument that a person of ordinary skill in the art would have understood a Hall-effect sensor to be “magnetic field sensor” as recited in limitation 1[c]. Although Dr. Horenstein opined in his declaration that there were differences between a Hall-effect sensor and a magnetic field sensor, on cross-examination he agreed with counsel that “a Hall[-]effect transistor is a magnetic field sensor” because, in his words, it can “detect a DC magnetic field.” Ex. 1038, 34:15–21. Petitioner’s argument in the Petition is also persuasive (Pet. 16), including its citation to Lenz, a journal article from 1990 that lists “Hall-effect” as one of “the most common technologies used for magnetic field sensing” (Ex. 1022, 973). *See also* Ex. 2007, 119 (a 1993 textbook describing the “Hall effect transistor” as one of four magnetic field-sensing devices”).

⁸ Patent Owner made a related argument in the Sur-reply that a person of ordinary skill in the art would not have used a Hall-effect sensor because it can only detect magnetized FOD. We address the timeliness of that argument below. *See infra* Section III.C.2(f)(3).

(2) *Whether an Inductive Proximity Sensor is a Magnetic Field Sensor*

Alternatively, Petitioner argues that an ordinarily skilled artisan would have recognized an inductive proximity sensor to be a magnetic field sensor because it “responds to changes in magnetic fields.” Pet. 16–17 (citing Ex. 1001, 2:20–42; Ex. 1005 ¶¶ 288–289; Ex. 1024, 186; Ex. 1003 ¶ 121).

In response, Patent Owner argues that a person of ordinary skill in the art would have understood that a magnetic field sensor is not simply a sensor that responds to changes in magnetic fields. PO Resp. 25 (citing Ex. 1003 ¶¶ 80–82). According to Patent Owner, a magnetic field sensor must “respond to *external* magnetic fields” and not, for example, eddy-current fields “produced by the inductive proximity sensor itself.” *Id.* at 25–29 (citing Ex. 1001, 2:26–31, 5:29–34, 5:39–49; Ex. 1003 ¶ 121 (Petitioner’s expert Dr. Allen allegedly describing Fells’s system as consistent with an eddy-current sensor); Ex. 2007, 119, 130–131 (a textbook describing the theory of operation of an inductive pickup coil” such as a magnetic tape head); Ex. 2008, 8-25–8-26 (a 1998 textbook describing an inductive proximity sensor that measures induced eddy currents); Ex. 2009, 102 (same, in a 2005 textbook); Ex. 2010, 75 (same, in a 2009 textbook); Ex. 2011, 191 (same, in a 1993 textbook); Ex. 2012, 679 (dictionary defining “eddy-current sensor”); Ex. 2015, 33:13–21, 34:9–35:6 (Dr. Allen stating on cross-examination that an eddy-current sensor would be a type of inductive proximity sensor that is not a magnetic field sensor); Ex. 2005 ¶¶ 80–92); *see also* PO Sur-reply 6–7 (arguing that an inductive proximity sensor does not meet claim 1 because it is not “passive, requiring no power”); *id.* at 14–15 (reiterating arguments in the Response).

In its Reply, Petitioner argues it is uncontested that an inductive proximity sensor “rel[ies] on magnetic principles” and “detect[s] the presence of a metallic object by . . . monitoring changes in an electromagnetic field,” which “makes it a magnetic field sensor, and should be dispositive.” Pet. Reply 3 (alterations in original) (quoting PO Resp. 26; then quoting *id.* at 27) (citing Ex. 1037 ¶¶ 20–29). Petitioner contends that nothing in the claims requires the magnetic field sensor to only measure *external* magnetic fields, and to the extent that the ’184 patent refers specifically to external magnetic fields, this should not be imported into limitation 1[c]. Pet. 3–4 (citing Ex. 1001, 2:20–26 (the FOD detection system “may measure perturbations in the magnetic field”); *id.* at 5:25–29, 5:34–38 (the FOD detection system may “comprise sensors for measuring small changes in the magnetic field in the proximity of the FOD objects . . . by measuring magnetic field changes, variations, gradients, and the like”), 5:39–49 (an example that measures external magnetic fields is “exemplary and non-limiting”); Ex. 1037 ¶¶ 9–17).

Petitioner also argues that Patent Owner’s extrinsic evidence, in the form of “a series of textbooks,” does not support Patent Owner’s argument that a “magnetic field sensor” is something that measures only external magnetic fields because (1) extrinsic evidence of claim construction does not outweigh intrinsic evidence and (2) nothing in the references suggest that the sensors they describe are not magnetic field sensors. Pet. Reply 4–6 (citing Ex. 1005 ¶¶ 288–290; Ex. 1038 34:22–35:4 (Patent Owner’s expert Dr. Horenstein agreeing that an inductive pickup coil is a magnetic field sensor because “[i]t’s capable of detecting AC magnetic fields that are produced by a source that is exclusive of the inductive pickup coil”); Ex. 2007, 119, 130;

Ex. 1008, 8–25; Ex. 2011, 191; Ex. 1037 ¶¶ 13, 22–24, 26). Petitioner argues that even in an eddy-current sensor, “what is being detected is a magnetic field ‘create[d]’ by an external object—the foreign metal object, meeting Patent Owner’s ‘external’ definition.” *Id.* at 6 (alteration in original) (quoting Ex. 2008, 8-25).

Finally, Petitioner argues that despite Dr. Allen’s deposition testimony purportedly agreeing that an eddy-current sensor is not a magnetic field sensor, he “confirmed that even an eddy-current sensor that does not ‘directly sens[e] a magnetic field,’ nonetheless ‘generates a magnetic field in the presence of a conductor that is then sensed.’” Pet. Reply 6–7 (alteration in original) (quoting Ex. 2015, 33:13–21) (citing Ex. 1037 ¶¶ 14–16, 25–29 (Dr. Allen discussing his cross-examination testimony and opining that even an inductive proximity sensor that detects eddy-currents would be a magnetic field sensor))).

We disagree with Patent Owner’s argument that the ordinary and customary meaning of “magnetic field sensor” refers to a device that measures only *external* magnetic fields. There is nothing in the claim language to suggest such a limitation: the plain language simply refers to a “magnetic field sensor,” without regard to how the sensor works or where it senses magnetic fields from. Ex. 1001, 12:16. In fact, the claim does not explicitly require sensing anything at all using the magnetic field sensor, merely reciting a “foreign object debris detection system” comprising the sensor and that the “foreign object debris detection system is configured to verify” the presence of FOD. The very general nature of how the magnetic field sensor is recited, without any explicit recitation of how its output may be used, undermines Patent Owner’s overly restrictive interpretation.

Although the '184 patent specification includes examples of measuring external magnetic fields to detect FOD, Patent Owner has not pointed to anything in the specification indicating an intent to restrict the term “magnetic field sensor” to only those sensors that measure external magnetic fields. Nor is there intrinsic evidence that an “eddy-current sensor” would not also be a magnetic field sensor, given that it senses magnetic fields. Indeed, as Petitioner persuasively argues, an eddy-current sensor still measures external magnetic fields—albeit magnetic fields generated within FOD through interaction with a powered sensor. Pet. 6–7; Ex. 1037 ¶¶ 14–16, 25–29.

Turning to the conflicting testimonial evidence, we find Dr. Allen’s testimony more credible than that of Dr. Horenstein. Dr. Horenstein originally testified that a person of ordinary skill in the art would not have considered an inductive proximity sensor to be a magnetic field sensor. Ex. 2005 ¶¶ 82–92. On cross-examination, he undermined this by testifying that an inductive pickup coil⁹ is a magnetic field sensor because “[i]t’s capable of detecting AC magnetic fields that are produced by a source that is exclusive of the inductive pickup coil” Ex. 1038 34:22–35:4.

Dr. Allen has consistently testified that an inductive proximity sensor is, at least in general, a type of magnetic field sensor. Ex. 1003 ¶ 121; Ex. 1037 ¶¶ 14–16, 25–29; Ex. 2015, 30:6–33:12. When asked, during cross-examination, if he could think of any inductive proximity sensors that “do not constitute magnetic field sensors,” Dr. Allen suggested that “an [e]ddy-

⁹ An inductive pickup coil is a type of inductive proximity sensor. *See* Ex. 2007, 130.

current sensor, I suppose, could be something loosely like that,” but he qualified this by noting that an eddy-current sensor still indirectly senses a magnetic field. Ex. 2015, 33:13–21, 34:9–35:6.

To the extent that Dr. Allen’s testimony suggests that an eddy-current sensor is not a magnetic field sensor, we do not find this credible, given that according to the evidence of record, an eddy-current sensor still senses external magnetic fields (including fields external to the extensor itself). Moreover, Dr. Allen maintains “that an inductive proximity sensor, including the type that detects eddy currents, is a magnetic field sensor,” which we find credible considering all the other evidence of record. Ex. 1037 ¶ 14.

(3) *Application to Fells*

It is undisputed that Fells discloses the use of an inductive proximity sensor and a Hall-effect sensor. *See* Ex. 1005 ¶¶ 288–289; PO Resp. 20 (acknowledging that in Fells, “[t]he proximity detector may be an inductive proximity detector[or] a Hall Effect sensor”). For the reasons discussed above, we determine that either of Fells’s sensors discloses the magnetic field sensor recited in limitation 1[c]. Ex. 1003 ¶ 121; Ex. 1037 ¶ 22–29.

For the above reasons, we determine that Petitioner has shown that Fells discloses limitation 1[c], either in the form of a Hall-effect sensor or an inductive proximity sensor.

(e) Limitation 1[d]

Limitation 1[d] recites “at least one readout circuit configured to measure one or more electrical parameters of at the at least one magnetic field sensor” as part of the recited FOD detection system. Ex. 1001, 12:17–19.

Petitioner argues that (1) if the sense circuit in Fells is a Hall-effect sensor, the system reads a change in voltage; (2) if the sense circuit is an inductive proximity sensor, the system reads a change in inductance; and (3) either voltage or inductance is an electrical parameter as recited in limitation 1[d]. Pet. 17–20 (citing Ex. 1005 ¶¶ 182, 191, 193, 197–202, 257–259, 263, 288–289, Fig. 40, claims 11, 56; Ex. 1001, 2:31–53; Ex. 1003 ¶¶ 122–129). Alternatively, Petitioner argues that it would have been obvious to implement Fells’s “proximity detector” using an amplifier as a readout circuit to measure either the voltage of the Hall-effect sensor or the inductance of the inductive proximity sensor, because according to Fells, using amplifiers in sense circuit 206 can result in greater sensitivity. Pet. 19–20 (citing Ex. 1005 ¶¶ 11, 191, 197–202, 257–259, 263, 266, 288–290, Figs. 4–6; Ex. 1003 ¶¶ 127–129).

Patent Owner does not specifically contest Petitioner’s arguments. *See* PO Resp. For the reasons given in the Petition, we agree that Fells discloses limitation 1[d].

(f) Limitation 1[e]

Limitation 1[e] states that “the at least one magnetic field sensor is positioned within the magnetic field of the wireless energy transfer system.” Ex. 1001, 12:21–22.

For this limitation, Petitioner argues that a person of ordinary skill in the art would have understood that the recited proximity detector 4002 (or sense circuit 206) in Fells must be within the magnetic field of the wireless energy transfer system because this is how the Hall effect would provide a change in voltage in response to changes in the magnetic field, or how the inductive proximity sensor would provide a change in inductance. Pet. 20–

21 (citing Ex. 1005 ¶¶ 289; Ex. 1023 (definition of “Hall effect”); Ex. 1003 ¶¶ 130–135). Petitioner also argues that in the figures of Fells, sense circuit 206 and its equivalent “proximity detector” circuit are depicted near primary coil Lp 212. Pet. 21–22 (citing Ex. 1005, Figs. 2, 40; Ex. 1003 ¶ 132). Also, according to Petitioner, a person of ordinary skill in the art would have understood that the claimed system would not be able to accomplish the stated purpose of detecting a foreign object in the vicinity of the wireless power supply unless the sense circuit is within the magnetic field of the wireless power supply. Pet. 22–23 (citing Ex. 1005 ¶¶ 2, 288; Ex. 1003 ¶¶ 131–133, 135).

Patent Owner responds that Petitioner has not shown Fells’s proximity detector to be within the magnetic field of the wireless energy transfer system because (1) Fells’s detector cannot be responsive to the source resonator’s magnetic field because the source resonator is turned off whenever the detector is operating, and (2) Fells does not disclose the location of the sensor or provide a motivation to modify Fells as recited in limitation 1[e]. PO Resp. 29–37. We address these arguments below.

(1) *Whether Petitioner Must Show that Fells’s Proximity Detector Is Engaged at the Same Time as the Energy Transfer System*

Patent Owner argues that Fells’s proximity detector would not have been positioned within the magnetic field of the wireless energy transfer system because in Fells, the magnetic field is turned off, and the system is in an ultra-low-power (“ULP”) mode to conserve power until the system detects the absence of any FOD. PO Resp. 30–31 (citing Ex. 1003 ¶¶ 69–70; Ex. 1005 ¶ 191; Ex. 2015, 20:4–11, 23:7–17, 24:5–16; Ex. 2005 ¶¶ 63, 95).

Thus, according to Patent Owner, when Fells’s sensor is detecting FOD, the magnetic field of the wireless power supply must be turned off and the detector cannot be within that field or responsive to that field. *Id.* at 31–32 (citing Ex. 1005 ¶¶ 194–195, 288; Ex. 2005 ¶¶ 63, 95); *see also* PO Sur-reply 11–12 (arguing that Fells’s proximity detector 4002 is separate from primary coil 212).

Because Fells’s primary coil is allegedly not generating a magnetic field, Patent Owner contends that a person of ordinary skill in the art would have understood that Fells’s proximity detector only detects ferrite cores which generate their *own* magnetic fields. PO Resp. 32–33 (citing Ex. 2013, 280, 244 (dictionary defining “ferrite core,” “magnetic core,” and “magnetic coil”); Ex. 1025, 11–12; Ex. 2005 ¶ 96).

In its Reply, Petitioner argues that because the sensors in Fells’s system work by measuring changes in the magnetic field (i.e., the magnetic field of the primary resonator coil), a person of ordinary skill in the art would have understood that the sensors must operate within the magnetic field of the power coil. Pet. Reply 9 (citing Ex. 1005 ¶ 289; Ex. 2007, 123, 130; Ex. 1003 ¶ 131). Petitioner disagrees that Fells only measures the magnetic field of ferrite cores within the FOD, because according to Fells, “[t]he presence of a ferrite core or other material with similar properties within the portable device may result in *altering the magnetic field*.” *Id.* at 9–10 (alteration and emphasis in original) (quoting Ex. 1005 ¶ 289). According to Petitioner, this statement assumes there is already a magnetic field near the primary coil for the ferrite core to alter. *Id.* at 10 (citing Ex. 1005 ¶ 295; Pet. 23–30; Ex. 1037 ¶ 40).

Petitioner also argues that limitation 1[e] does not require the magnetic field sensor to be active while the wireless power supply is active, only that the sensor (active or not) is positioned within the magnetic field. Pet. Reply 10.

In its Sur-reply, Patent Owner once again argues that Fells cannot meet limitation 1[e] “because the resonator is *not* producing a magnetic field (i.e., no power to resonator) until *after* the magnetic field sensor senses an object and then SW1 closes.” PO Sur-reply 8–9 (citing Ex. 1005 ¶¶ 191, 206, 246, 288–289, Fig. 40; Ex. 1022, 979 (teaching that a Hall-effect sensor requires power to operate); Ex. 2005 ¶¶ 95–96, 110, 113).

Patent Owner also acknowledges that, according to Fells, an approaching ferrite core “may result in altering the magnetic field,” PO Sur-reply 10 (quoting Ex. 1005 ¶ 289). But Patent Owner contends this magnetic field is not the magnetic field of the primary coil, but the magnetic field produced by the ferrite core itself, as seen by the Hall-effect device. *Id.* at 10–11 (citing Ex. 1005 ¶ 290; Ex. 2005 ¶¶ 60, 72, 93, 96). Patent Owner also argues that, in one embodiment, Fells discloses including a permanent magnet in a portable device to be charged, to facilitate detection by the proximity sensor. *Id.* at 12 (citing Ex. 1005 ¶ 289). According to Patent Owner, a person of ordinary skill in the art would have interpreted this embodiment to mean that Fells’s proximity sensor only detects changes in magnetic fields generated by devices, not changes in the field generated by the primary coil.

We agree with Petitioner that limitation 1[e] does not require the magnetic field sensor to necessarily be operable at the same time the magnetic field of the wireless energy transfer system is being generated. It

only requires that the “sensor is positioned within the magnetic field.” Ex. 1001, 12:20–21. Nevertheless, Fells discloses using the sensor to continually monitor for FOD while applying power to the primary coil. *See* Ex. 1005 ¶ 248, Fig. 18. It does not matter whether the sensor and the primary coil are literally active at the same time, or if the system switches back and forth between powering the coil and checking for FOD. What matters for limitation 1[e] is where the proximity sensor is located, not when it is active.

We also disagree with Patent Owner’s argument that it matters, for limitation 1[e], whether the magnetic field sensor (in the case of a Hall-effect sensor) can only sense devices that generate their own magnetic field. Claim 1 does not explicitly limit the types of FOD that may be detected to only non-magnetic FOD, and Patent Owner has not pointed to any evidence suggesting that the ordinary and customary meaning of “foreign object debris” would exclude magnetic items. *See, e.g.*, PO Sur-reply 13 (arguing that detection of non-magnetized FOD is the “primary purpose” of the claimed invention, but not making a claim-construction argument).

Likewise, the evidence of record, and the plain language of claim 1, do not suggest that it matters whether Fells’s proximity sensor detects magnetic fields that originate from the primary coil or from the FOD itself, so long as the magnetic field sensor is able to detect whether FOD enters the area on or over the source resonator as per limitation 1[f] (discussed below in Section III.C.2(g)).

(2) *Whether Petitioner Has Shown that Fells Discloses or Motivates Placing the Proximity Sensor Within the Magnetic Field*

Next, Patent Owner argues that Petitioner has not shown that Fells discloses, or motivates a modification to Fells suggesting, that the proximity sensor is within the magnetic field of the wireless power supply. PO Resp. 33–37. First, Patent Owner argues that Figure 40 is not intended to show the relative physical arrangement of components and provides no support for Petitioner’s position. *Id.* at 33–34 (citing Ex. 2015, 43:24–44:1 (Dr. Allen acknowledging that Figure 40 does not depict the system’s magnetic field); Ex. 2005 ¶ 97).

Patent Owner also disagrees with Petitioner that Fells’s Hall-effect sensor must be positioned within the wireless energy transfer system’s magnetic field so that it can detect FOD in the vicinity of that field. PO Resp. 34 (citing Ex. 2014, 1312 (dictionary defining “vicinity” as “the quality or state of being near”)). Patent Owner contends that Fells would have been able to detect FOD “that would get hot or hinder power transfer by detecting the foreign object in the vicinity of the wireless power supply, before the foreign object reaches the magnetic field of the wireless power supply.” *Id.* (citing Ex. 2005 ¶ 98). But according to Patent Owner, the purpose of Fells’s proximity detector is not to detect objects that would get hot or hinder power transfer, but “instead to enable a lower standby power in which the wireless power supply is only connected to AC electrical mains when an object is in the vicinity of the wireless power supply.” *Id.* at 35 (citing Ex. 1005 ¶ 191).

Finally, Patent Owner argues that Petitioner has failed to show a motivation to modify Fells to locate a proximity detector within the

magnetic field of the wireless energy power supply. PO Resp. 35. According to Patent Owner, a person of ordinary skill in the art would have believed that a magnetic field sensor, which contains circuitry, would itself become FOD if it were placed within the magnetic field, so the skilled artisan would have placed the detector outside the field but in its vicinity. *Id.* at 35–37 (citing Ex. 1005 ¶¶ 2, 189; Ex. 2013, 226; Ex. 2005 ¶¶ 99–101); *see also* PO Sur-reply 13 (arguing that Hall-effect sensors “placed on top of the resonator would themselves become foreign object debris and heat up).

In its Reply, Petitioner argues that Fells’s “design goals are directed to the detection of ‘foreign objects that would get hot or hinder power transfer’ or ‘otherwise interfere with the system.’” Pet. Reply 7 (quoting Ex. 1005 ¶ 2) (citing Ex. 1005 ¶ 189; Ex. 1016, 2:8–13 (disclosing that foreign objects within the proximity of the primary coil will have induced eddy currents that will cause the object to heat)). Accordingly, Petitioner argues that “the proximity sensor would be placed within the magnetic field of the wireless power supply.” *Id.* at 7–8 (citing Ex. 1005 ¶¶ 288–289; Ex. 1003 ¶¶ 131–133; Ex. 1037 ¶ 36).

Petitioner disagrees that a person of ordinary skill in the art would only have placed a proximity sensor *in the vicinity*, but not *within*, the magnetic field of the wireless power supply. Pet. Reply 8. According to Petitioner, when Fells refers to the “vicinity” of the wireless power supply, it is referring to the area encompassed by the magnetic field. *Id.* (citing Ex. 1016, 24:26–28 (“In the operating mode, the primary coil . . . generates an electromagnetic field in the vicinity of the primary unit.”) (incorporated by reference into Fells, *see* Ex. 1005 ¶ 192)); *id.* at 1:10–18, 2:8–10, 4:1–12, 17:12–26; Ex. 1037 ¶¶ 31–34). Petitioner also argues that unless the

proximity sensor is placed within the magnetic field of the primary source coil, the sensor would not be able to detect FOD that would interfere with the coil's magnetic field. *Id.* at 8–9 (citing Ex. 1038, 81:21–82:11 (acknowledging that it “would be a problem” if the proximity detector was located on one side of the primary coil but FOD approached from the other and thus made it to the coil's magnetic field without detection); Ex. 1037 ¶¶ 32–35, 39); *see also id.* at 10–11 (citing Ex. 1005 ¶¶ 2, 189, 194–195, 248, 250, 259, 267–268, 288; Ex. 1016, 2:8–20, 24:26–28; Ex. 1037 ¶¶ 32–33, 36, 53).

Finally, Petitioner argues that, to the extent Fells does not disclose placing the proximity sensor within the primary coil's magnetic field, that modification would have been obvious because that was the most effective place to detect FOD. Pet. Reply 11–12 (citing Ex. 1037 ¶¶ 50–54).

According to Petitioner, the area within the magnetic field is “the area with the highest concentration of magnetic flux during charging, and therefore the area that presents the highest concern of ‘foreign objects that would get hot or hinder power transfer’ or ‘otherwise interfere with the system.’” *Id.* at 12 (quoting Ex. 1005 ¶ 2).

Petitioner disagrees that a person of ordinary skill in the art would have believed that placing a proximity sensor within the primary coil's magnetic field would have resulted in the sensor, itself, becoming FOD. Pet. Reply 12. According to Petitioner, Fells's proximity sensor is intentionally designed to be at its designated location, and Fells (via Stevens) discloses accounting for friendly parasitic loads in the form of electronic devices that are present in the magnetic field but are not foreign objects and should not be treated as such. *Id.* at 13 (citing Ex. 1016, 21:13–30, 25:25–31, 27:35–

28:8, 32:12–30, Fig. 4; Ex. 1037 ¶¶ 45–48). Petitioner also contends that the idea of a sensor detecting itself is illogical, “otherwise no proximity sensor would ever function correctly.” *Id.* (Ex. 1037 ¶ 48).

We find Petitioner’s arguments persuasive that to effectively sense FOD within the magnetic field of the wireless energy transfer system, a person of ordinary skill in the art would have had reason to place the magnetic field sensor within the magnetic field. We disagree with Patent Owner’s argument that a skilled artisan would have placed the sensor *outside* the field. As Dr. Horenstein conceded on cross-examination, such outlying placement would have allowed at least some FOD to enter the magnetic field undetected, which would have been undesirable. Ex. 1038, 81:8–82:11. We are persuaded that a person of ordinary skill in the art would have recognized this and placed the sensor within the magnetic field where it would have been most effective. The known consequence of failing to detect FOD within the magnetic field of the wireless energy transfer system is that the FOD may “get hot or hinder power transfer . . . or otherwise interfere with the system.” Ex. 1005 ¶ 2.

We also disagree with Patent Owner that a person of ordinary skill in the art would have believed that a Hall-effect sensor or inductive proximity sensor would become FOD if placed within the magnetic field of Fells’s source resonator. The sensor would not, itself, be a foreign object, and a person of ordinary skill in the art would have had the ability and motivation to prevent the sensor (like any other circuitry near Fells’s primary coil 212) from overheating in the presence of the primary charging field. We find credible Dr. Allen’s testimony that in view of Fells, a person of ordinary skill would have known how to design a system that included non-FOD

electronic devices inside the magnetic field of the primary coil. Ex. 1037 ¶¶ 45–47 (citing Ex. 1016 21:13–30, 25:25–31, 27:35–28:8, 32:12–30, Fig. 4).

(3) *New Sur-reply Arguments*

Patent Owner makes two new arguments in its Sur-reply. First, Patent Owner argues that “to obtain full debris detection coverage with Hall Effect sensors, one would have to use large numbers of Hall Effect sensors and spread them over the face of the resonator,” which would obstruct the resonator and make the use of Hall-effect sensors difficult if not impossible. PO Sur-reply 12–13 (citing Ex. 2005 ¶ 100). This argument is untimely because Patent Owner did not make the argument in its Response and it is not responsive to an argument made in the Reply. 37 C.F.R. § 42.23(b) (“A sur-reply may only respond to arguments raised in the corresponding reply”). But even if the argument were timely, Patent Owner does not cite any evidentiary support: paragraph 100 of Dr. Horensetein’s declaration does not directly support this argument. Thus, we do not find the argument credible.

Second, Patent Owner argues for the first time in its Sur-reply that a person of ordinary skill in the art would not have used a Hall-effect sensor to detect FOD because it “only senses *magnetized* objects like a portable device (mobile phone),” and “would *not* detect non-magnetized FOD.” PO Sur-reply 3; *see also id.* at 13–14 (citing Ex. 1001, 5:25–6:42, 2:11–13 (mentioning non-magnetized debris such as metal-foil paper gum wrappers, food wrappers, metal objects, and cats); Ex. 1005 ¶ 289; Ex. 1022, 979).

At the oral hearing, Petitioner argued that this argument is untimely. Tr. 7:12–15. Patent Owner responded that its expert Dr. Horenstein mentioned the issue in his declaration. Tr. 48:24–50:6 (citing Ex. 2005 ¶ 96).

Patent Owner also contended that it raised the issue on pages 35–37 of its response. Tr. 58:16–24.

Although Horenstein touches on the issue in paragraph 96 of his declaration (Ex. 2005), Patent Owner did not raise the issue in its Response. Pages 35–37 of the Patent Owner Response discuss Hall-effect sensors and cite various passages of Dr. Horenstein’s declaration, but this passage does not cite paragraph 96 of the declaration and does not specifically argue that a person of ordinary skill in the art would not have used a Hall-effect sensor because it can only detect magnetic FOD. *See* PO Resp. 35–37. Thus, we determine that Patent Owner’s Sur-reply argument is untimely. 37 C.F.R. § 42.23(b).

(4) Conclusion for Limitation 1[e]

For the above reasons, we determine that Petitioner has shown that Fells discloses or teaches limitation 1[e]. To the extent that Fells does not explicitly teach limitation 1[e], Petitioner has shown that modifying Fells to achieve Fells’s objectives would have been an obvious matter of selecting the most logical and efficient location for placing the magnetic field sensor, which a person of ordinary skill in the art would have understood to be within the magnetic field of the wireless energy transfer system.

(g) Limitation 1[f]

Limitation 1[f] recites a system wherein “the foreign object debris detection system is configured to verify that foreign object debris has not moved onto or over the source resonator during generation of the oscillating magnetic field.” Ex. 1001, 12:23–26.

Petitioner argues that in Fells’s system, there is a loop in which sense circuit 206 continuously checks to see if there are foreign objects present, and only allows power transfer to continue if there is no such foreign object in the vicinity. Pet. 23–27 (citing Ex. 1005 ¶¶ 160–161, 167, 182, 191–195, 248–253, 262–263, Figs. 18–19, 25; Ex. 1003 ¶¶ 136–150). Petitioner also argues that a reference incorporated into Fells teaches repeatedly checking for foreign objects during power generation, so applying this to Fells would have been the application of a known technique to gain a predictable improvement by reducing system interference while charging, due to the presence of foreign objects. Pet. 27–30 (citing Ex. 1016, 2:18–20, Fig. 8; Ex. 1005 ¶¶ 2, 189, 192, 248–252, 262–263, Figs. 18–19, 25; Ex. 1003 ¶¶ 144–150).

Patent Owner does not specifically contest Petitioner’s arguments. *See* PO Resp. For the reasons given in the Petition, we agree with Petitioner that Fells discloses limitation 1[f].

3. *Claims 8 and 11*

Claim 8 depends from claim 1 and further recites “wherein the foreign object debris detection system is configured to verify that foreign object debris has not moved onto or over the source resonator prior to generation of the oscillating magnetic field.” Ex. 1001, 12:57–60.

Petitioner argues that Fells discloses this added limitation because its wireless power supply determines whether there are “no foreign objects present” as a precondition to the control unit activating inverter 210 to supply current to the tank circuit. Pet. 30–31 (quoting Ex. 1005 ¶ 191) (citing Ex. 1005 ¶¶ 194–196, Figs. 3, 18, 19, 25; Ex. 1003 ¶¶ 152–153).

Claim 11 depends from claim 1 and further recites “wherein the foreign object debris detection system is integrated into the wireless energy transfer source.” Ex. 1001, 12:65–67.

Petitioner argues that in Fells, the circuitry for sensing foreign objects is “part of (‘in’) and therefore integrated into the ‘wireless power supply,’ which is the claimed wireless energy transfer source.” Pet. 31 (quoting Ex. 1005 ¶ 191) (citing Ex. 1005 ¶ 288, Figs. 2, 40; Ex. 1003 ¶ 155).

Patent Owner does not specifically contest Petitioner’s arguments. *See* PO Resp. 37.¹⁰ For the reasons given in the Petition, we agree with Petitioner that Fells discloses the limitations of claims 8 and 11.

4. Conclusion

For the above reasons, we determine that Petitioner has shown, by a preponderance of the evidence, that Fells discloses or teaches all the limitations of claims 1, 8, and 11, and that a person of ordinary skill in the art would have had reason to combine the features described in Fells in the manner recited in each of these claims. We therefore determine that claims 1, 8, and 11 are unpatentable under § 103(a) as obvious over Fells.

D. ALLEGED OBVIOUSNESS OF CLAIMS 2–7, 9, 10, AND 16 OVER FELLS AND COOK

In its second ground, Petitioner argues that claims 2–7, 9, 10, and 16 are unpatentable under § 103(a) as obvious over Fells in view of Cook. Pet.

¹⁰ Patent Owner does argue that the alleged foreign object debris detection system is not integrated into the “enclosure” as recited in claim 12. We address that argument below. *See infra* Section III.E.

2, 32–60. Considering the *Graham* factors, we determine that Petitioner has shown by a preponderance of the evidence that these claims are unpatentable for the reasons explained below.

1. Overview of Cook

Cook describes a system for wirelessly delivering power to a mobile powered device. Ex. 1006, code (54). It “automatically detects the presence of an automobile [and] can operate wirelessly to recharge the battery therein.” *Id.* at code (570).

2. General Motivation to Combine Fells with Cook

Petitioner argues that in view of Cook, it would have been obvious to modify Fells by applying its wireless energy transfer system in the context of charging an automobile. Pet. 33–39. According to Petitioner, at the time of the claimed invention, “wireless electric vehicle charging systems were already well-known, and increasing in popularity,” and were known to provide high reliability, low maintenance, and the convenience of wireless charging. Pet. 34–35 (citing Ex. 1003 ¶¶ 157–167).

Petitioner also argues that a person of ordinary skill in the art “would have had a reasonable expectation of success in implementing Fells to charge an electric vehicle as contemplated by Cook, as the charging systems of Fells and Cook use the same well-known components and principles of operation.” Pet. 36–39 (citing Ex. 1003 ¶¶ 168–179)

Patent Owner does not specifically challenge Petitioner’s proposed general motivation to combine Fells with Cook. *See* PO Resp. We find it persuasive.

3. *Dependent Claims 2, 3, 7, 9, and 10*

Claims 2, 3, 7, 9, and 10 depend directly or indirectly from claim 1, and read as follows:

2. The system of claim 1, wherein the wireless energy transfer source is configured to generate the oscillating magnetic field to transfer energy to a vehicle.

3. The system of claim 2, wherein the foreign object debris detection system is configured to verify that foreign object debris has not moved onto or over the source resonator prior to a transfer of energy from the source resonator to the vehicle.

7. The system of claim 2, wherein the foreign object debris detection system is configured to verify that foreign object debris has not moved onto or over the source resonator after the vehicle is positioned over the source resonator and prior to a transfer of energy from the source resonator to the vehicle.

9. The system of claim 1, wherein the wireless energy transfer source is a component of a vehicle charging station.

10. The system of claim 9, further comprising a device module configured to be mounted on an electric vehicle.

Ex. 1001, 12:27–34, 12:51–56, 12:61–64. These claims apply the wireless energy transfer system of claim 1 to “a vehicle” and provide further details about the transfer source and the FOD detection system. *See id.*

For each of these claims, Petitioner provides reasons why a person of ordinary skill in the art would have relied on the combined teachings of Fells and Cook, supporting the arguments with citations to the record and declaratory testimony of Dr. Allen. *See* Pet. 51–52, 58–60.

Patent Owner does not specifically contest any of these arguments, and simply argues that Cook does not cure the alleged deficiencies of Fells. PO Resp. 38 (citing Ex. 2005 ¶ 104).

We find Petitioner’s arguments persuasive, for all the reasons provided in the Petition for these claims. We therefore determine that Petitioner has shown, by a preponderance of the evidence, that claims 2, 3, 7, 9, and 10 are unpatentable under § 103(a) as obvious over Fells and Cook.

4. *Independent Claim 16 and Dependent Claims 4–6*

Independent claim 16 is as follows:

- 16[pre] 16. A method of detecting foreign object debris in a wireless energy transfer system, the method comprising:
- 16[a] performing a health and/or status check of a source resonator of the wireless energy transfer system;
 - 16[b] verifying that no foreign object debris has moved onto or over the source resonator;
 - 16[c] positioning a vehicle over the source resonator;
 - 16[d] verifying that no foreign object debris has moved onto or over the source resonator;
 - 16[e] generating an oscillating magnetic field using the source resonator to transfer energy wirelessly to the vehicle to charge a battery of the vehicle; and
 - 16[f] verifying that no foreign object debris has moved onto or over the source resonator during the transfer of energy.

Ex. 1001, 14:9–23. Claim 16 is a method claim generally like claim 1, but additionally includes steps of “performing a health and/or status check of the source resonator of the wireless energy transfer system” (16[a]) and “positioning a vehicle over the source resonator” (16[c]).

Claims 4–6 depend directly or indirectly from claim 3, and read as follows:

- 4. The system of claim 3, wherein 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 is positioned over the source resonator.

5. The system of claim 4, wherein the foreign object debris detection system is configured to perform the health and/or status check less frequently than the verification that foreign object debris has not moved onto or over the source resonator prior to a transfer of energy from the source resonator to the vehicle.

6. The system of claim 4, wherein the foreign object debris detection system is configured to periodically perform the health and/or status check and the verification that foreign object debris has not moved onto or over the source resonator prior to a transfer of energy from the source resonator to the vehicle.

Ex. 1001, 12:35–50. Like claim 16, claims 4–6 include limitations relating to performing “a health and/or status check of the wireless energy transfer source,” although these dependent claims include additional limitations on when the check occurs, which must be “before the vehicle is positioned over the source resonator” (claims 4–6), “less frequently than the verification that foreign debris has not moved onto or over the source resonator prior” (claim 5), or “periodically” (claim 6).

For the parts of claim 16 other than limitation 16[a], Petitioner generally relies on the same arguments as for claim 1, in conjunction with a rationale for applying the teachings of Fells in the context of a vehicle in view of Cook. *See* Pet. 40, 42–51 (citing Ex. 1003 ¶¶ 135–150, 157–220). Patent Owner does not contest these arguments. *See* PO Resp. 44–49. We have considered Petitioner’s arguments and find them persuasive.

For limitation 16[a], Petitioner argues that when there are no devices requiring power, Fells performs a “sense circuit calibration” (also called “calibration inductance measurement”) which “prepares for the arrival of a

future device or vehicle to be charged by the resonator (by checking the current induction status) and establishes a baseline induction measurement that the sense circuit will compare future induction measurements to, in order to determine when to activate the resonator.” Pet. 40–41 (citing Ex. 1005 ¶ 196; Ex. 1003 ¶¶ 184–191). According to Petitioner, in one embodiment, sense circuit 206 uses the same coil for detection as used for the transfer of power (that is, Lp 212), so in that embodiment, the baseline induction measurement would occur by measuring the inductance across primary coil 212. Pet. 41 (citing Ex. 1005 ¶ 259; Ex. 1003 ¶ 188).¹¹

Petitioner makes similar arguments for claims 4–6 as for limitation 16[a], including that Fells conducts a “sense circuit calibration.” *See* Pet. 52–53 (citing Ex. 1037 ¶¶ 200–207, 226).¹²

In its Response, Patent Owner disagrees with Petitioner that Fells’s sense circuit calibration may be considered a “health and/or status check” as

¹¹ Petitioner also discusses checks performed in other embodiments of Fells that do not necessarily involve primary coil 212, which we do not need to address in this decision. Pet 41 (citing Ex. 1005 ¶ 196; Ex. 1003 ¶ 187); *see also* PO Resp. 46–48 (responding to these arguments). Also, for claim 4–6 and 16, Petitioner alternatively argues that Fells teaches a check of the energy level in the energy storage element. Pet. 41–42, 52–53 (citing Ex. 1003 ¶¶ 192–196; 225–227); *see also* PO Resp. 41–44, 48–49 (contesting this argument). Because we find Petitioner’s other argument persuasive, we need not address this alternative argument.

¹² Petitioner also addresses the timing limitations in claims 4–6, citing teachings in Fells and providing declaratory support from Dr. Allen. Pet. 53–54 (citing Ex. 1005 ¶¶ 191–196, 200, 222, 238, 246, 250, 251, 260, 279, 293, Figs. 3(a)–(c), 25; Ex. 1003 ¶¶ 227–238). Patent Owner does not specifically address the additional timing limitations in claims 4–6 (*see* PO Resp. 38–44), and we find Petitioner’s arguments persuasive.

recited in claims 4–6 and 16. PO Resp. 39–41, 45–48. According to Patent Owner, Fells discloses its sense circuit calibration in the context of an embodiment associated with Figure 2, whereas Petitioner relies on Figure 40 for its arguments for parent claims 1–3, which is missing an important feature. *Id.* at 39–40 (citing Pet. 14–17; Ex. 1003 ¶¶ 117–121; Ex. 2005 ¶¶ 76–79, 108–109). Patent Owner contends that sense circuit 206 of Figure 2 is directly connected to primary coil 212, whereas proximity detector 4002 in Figure 40 has no such connection, thus, proximity detector 4002 is unable to participate in a sense circuit calibration involving primary coil 212. *Id.* at 40–41 (citing Ex. 1005 ¶¶ 288–289; Ex. 2005 ¶¶ 78–79, 109).

Patent Owner also argues that “a status check of a source resonator is a test to verify the functioning status of that source resonator,” and Petitioner has not explained how conducting a sense circuit calibration, or establishing a baseline induction measurement, is a status check under that definition. PO Resp. 45–46 (citing Ex. 2013, 108 (defining “check” as the “verifying or testing of the accuracy, function, indications, or results of a component, device, instrument, system, or process”); Ex. 2005 ¶¶ 106–107).

In its Reply, Petitioner argues that the sense circuit calibration in Fells is a “health and/or status check” even under Patent Owner’s proposed definition because it “determines whether the sense circuit is functional, without which the resonator is not ready to operate.” Pet. Reply 18–19 (citing Ex. 1005 ¶¶ 191, 196, Fig. 3; Ex. 1003 ¶ 188; Ex. 1037 ¶ 63).

Petitioner also focuses on the embodiment of Fell’s sense circuit 206 that directly uses primary coil 212, and thus the sense circuit calibration “can be performed by the resonator itself (i.e. primary coil 212 of the LC tank circuit). Pet. Reply 19 (citing Ex. 1005 ¶ 259; Ex. 1037 ¶ 64). According to

Petitioner, when the system performs the sense circuit calibration, “it can do so by measuring the inductance across primary coil LP 212—the same coil that forms the resonator.” *Id.* (citing Ex. 1005 PP 196; Ex. 1037 ¶ 64). So a person of ordinary skill in the art would have understood that the sense circuit calibration is a “status check of the resonator, in that it uses the resonator to set a baseline inductance measurement and determine if devices are present. *Id.* (citing Ex. 1005 ¶¶ 196; Ex. 1037 ¶ 64).

Petitioner also disagrees that a person of ordinary skill in the art would have understood that the recited “status check” must verify the functioning status of the source resonator, given that the ’184 patent does not disclose such a check. Pet. Reply 19–20 (citing Ex. 1001, 11:42–45 (“Low-power diagnostic tests can be performed without the vehicle present to check the health and status of the charging station”); *id.* at 10:50–55 (discussing “diagnostic testing” but by a dielectric sensor rather than a resonator))).

In its Sur-reply, Patent Owner contends that Petitioner has still “failed to address that, as understood by a [person of ordinary skill in the art], a status check of a source resonator is a test to verify the functioning status of that source resonator.” PO Sur-reply 17 (citing Ex. 2005 ¶ 106–107).

We disagree. In both the Petition and the Reply, Petitioner relies on an embodiment of Fells in which “Sense Circuit 206 uses the same coil for detection as used for the transfer of power, Lp 212,” and measures inductance directly on primary coil 212. Ex. 1005 ¶ 259; *see also id.* at Fig. 24 (depicting this embodiment). In this embodiment, the sense circuit calibration described in Fells would directly measure a baseline inductance on primary coil 212, and thus would directly check the status of the source resonator. We find Dr. Allen’s testimony on this point credible. Ex. 1037

¶ 64. We also find credible his testimony that a person of ordinary skill in the art would have regarded a sense circuit calibration (at least when performed using primary coil 212) as a “health and/or status check of the source resonator” as recited in limitation 16[a] and similarly in claims 4–6. *Id.*

¶ 64–64. Thus, we determine that Petitioner has shown that Fells discloses these limitations.

Thus, for the reasons above, we determine that Petitioner has shown, by a preponderance of the evidence, that claims 4–6 and 16 are unpatentable under § 103(a) as obvious over the combination of Fells and Cook.

E. ALLEGED OBVIOUSNESS OF CLAIM 12 OVER FELLS AND ONO

In its third ground, Petitioner argues that claim 12 is unpatentable under § 103(a) as obvious over Fells in view of Ono. Pet. 2, 60–63.

Claim 12 depends from claim 1 and further recites “an enclosure housing at least a portion of the wireless energy transfer source, wherein the foreign object debris detection system is integrated into the enclosure.”

Ex. 1001, 13:1–4.

Ono describes a “non-contact type power supply unit,” in which “electric power is transmitted from [a] primary coil to [a] secondary coil.” Ex. 1007, 2:40–53; Ex. 1003 ¶¶ 80–82. Ono also describes installing a detector coil to avoid abnormal heating of foreign objects, and presents an embodiment in Figure 2, reproduced below:

Fig. 2

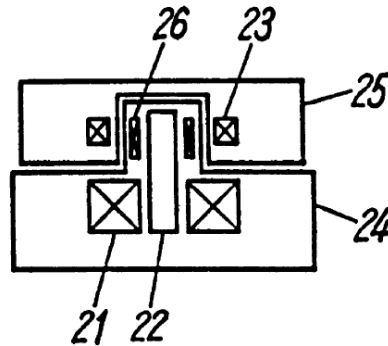


Figure 2 depicts detector coil 26 “installed . . . at a position which is off the primary coil 21 and closer to a secondary coil 23 on a ferrite core 22.”

Ex. 1007, 4:6–8. Primary coil 21 is installed within primary enclosure 24, while secondary coil 23 is installed within secondary enclosure 25. *Id.* at 4:25–26.

Petitioner argues that Ono’s detector coil 26 is integrated into primary enclosure 24, and that a person of ordinary skill in the art would have had reason “to place Fells’ wireless power supply, including the proximity detector, control unit, and tank circuit, within a primary enclosure as taught by Ono.” Pet. 63 (citing Ex. 1007, 3:64–4:26, Fig. 2; Ex. 1003 ¶ 247).

According to Petitioner, “an enclosure was a well-known method of encasing electronic components to prevent them from malfunctioning, including for wireless charging systems and foreign object detection systems.” Pet. 64 (citing Ex. 1007, 4:3–47, Fig. 2; Ex. 1011, 8:19–42, Figs. 2–3 (describing a charging pad for charging a vehicle is within an outer housing); Ex. 1012, 16:59–62 (teaching that shield enclosures mitigate interference); Ex. 1003 ¶ 248). Also, a housing would protect Fells’s wireless power supply from “environmental contaminants . . . while also

shielding the coil and related circuitry from damage” that could cause shorts or electrical shock. *Id.* (citing Ex. 1003 ¶ 249).¹³

Patent Owner argues that Ono’s detection system is not integrated into an enclosure. PO Resp. 54–56 (citing Ex. 2005 ¶¶ 126–128). According to Patent Owner, “integrated into the enclosure” requires not just being housed within an enclosure, but “that the foreign object debris detection system is united with the enclosure to form a functioning or unified whole.” *Id.* at 55 (citing Ex. 2005 ¶ 127; Ex. 2014, 606 (defining “integrate” as “to form, coordinate, or blend into a functioning or unified whole”); *id.* at 561 (defining “house” to as “to encase, enclose, or shelter as if by putting in a house”)); *see also* PO Sur-reply 22–23 (reiterating the arguments). Patent Owner also argues that claim 12 uses the word “housing” in addition to “integrated into,” so these terms must mean something different. *Id.* (citing *CAE Screenplates, Inc. v. Heinrich Fiedler GmbH & Co.*, 224 F.3d 1308, 1317 (Fed. Cir. 2000); Ex. 2005 ¶ 126).

In its Reply, Petitioner argues that in the context of claim 12, the word “integrate” means “to unite with something else” or “to incorporate into a larger unit.” Pet. Reply 22 (quoting Ex. 2014, 4 (dictionary definitions); Ex. 1037 ¶¶ 71–74). According to Petitioner, this is consistent with disclosures in the ’184 patent which state that the “FOD detector system (not shown) can be integrated into the system in a variety of places” including

¹³ Alternatively, Petitioner argues that in Figure 40 of Fells, the dotted line around the system represents an enclosure that includes proximity detector 4002. Pet. 61–62; *see also* PO Resp. 50–54 (responding). Because we find Petitioner’s combination of Fells and Ono persuasive, we need not address this argument.

being “integrated . . . into the housings or enclosures of the source resonator and the like.” *Id.* (quoting Ex. 1001, 11:4–10) (citing Ex. 1001, 4:24–28 (“increasing a resonator size may not be practical owing to the . . . desire to integrate a resonator into a system of a specified volume”); Ex. 1037 ¶ 73).

As to Patent Owner’s term-differentiation argument, Petitioner contends that “the phrase ‘wherein the foreign object debris detection system is integrated into the enclosure’ already means something other than merely within an enclosure: it means incorporated into the same larger enclosure that already houses the wireless energy transfer source.” *Id.*

To the extent that Patent Owner is proposing that “integrated into the enclosure” means that the sensors would have to be “formed” or “molded” into the plastic housing of the resonator, as Dr. Horenstein opined on cross-examination (Ex. 1038, 116:14–117:17), we disagree. We also disagree that the FOD detection system would need to be “united with the enclosure to form a functioning or unified whole” in the sense that the FOD detection system is unified with the enclosure. PO Resp. 55.

Based on the evidence of record, the ordinary and customary meaning of “integrated into” is not as limited as Patent Owner proposes. For example, when the ’184 patent discloses that “FOD systems may be integrated into the Source Module, into the source resonator, into the housings or enclosures of the source resonator and the like,” or “may be integrated on the device side of the system,” or “implemented on both the source and device sides of the . . . system,” this passage appears to simply be indicating some of the *locations* in which the FOD system can be placed or implemented. Ex. 1001, 11:4–12. None of these examples would require molding or forming in the way Patent Owner appears to be arguing.

In a parallel manner to claim 12, claim 11 recites “wherein the foreign object debris detection system is integrated into the wireless energy transfer source.” Ex. 1001, 12:65–67. Yet Patent Owner does not contest Petitioner’s argument that in this context, “integrated into” simply means that the FOD detection system is “in” the wireless power supply. Pet. 31; PO Resp. 37. *See supra* Section III.C.3.

We agree with Petitioner that the use of the term “incorporated” in the ’184 patent is most consistent with dictionary definitions “to unite with something else” or “to incorporate into a larger unit.” Ex. 2014, 4. We also credit Dr. Allen’s opinion consistent with this view. Ex. 1037 ¶ 73.

Based on this interpretation of “integrated into the enclosure,” we find Petitioner’s argument persuasive that Ono’s FOD detection system 26 is incorporated into primary enclosure 24. In addition, Patent Owner does not contest Petitioner’s proposed motivation to combine Fells and Ono (*see* PO Resp. 54–56), and we find it persuasive. Thus, we determine that Petitioner has shown, by a preponderance of the evidence, that claim 12 is unpatentable under § 103(a) as obvious over the combination of Fells and Ono.

F. ALLEGED OBVIOUSNESS OF CLAIM 13 OVER FELLS, COOK, AND WANG

In its fourth ground, Petitioner argues that claim 13 is unpatentable under § 103(a) as obvious over Fells and Cook, Fells and Wang, or Fells, Cook, and Wang. Pet. 2, 64–70.

Claim 13 depends from claim 1 and further recites “wherein the wireless energy transfer source is configured to deliver a power of more than 3.3 kW to a wireless power receiving device.” Ex. 1001, 13:5–7.

Wang is a doctoral thesis describing a wireless power-transfer system. Ex. 1008, i. *See* Ex. 1003 ¶¶ 83–92 (providing an overview of Wang). Wang states that the system “delivers 30kW across a 45mm air gap.” Ex. 1008, 71; *see also id.* at 105 (stating that 30kW is the “required power transfer” of the system).

According to Petitioner, a person of ordinary skill in the art would have been motivated to modify Fells, or Fells and Cook, to implement a system that is configured to deliver 30 kW, which is more than 3.3 kW as recited in claim 13. Pet. 68–70 (citing Ex. 1008, 71–72; Ex. 1028, 57, 59; Ex. 1029 ¶ 531; Ex. 1031, 9; Ex. 1033, 3767; Ex. 1003 ¶¶ 17–179, 254–258).

Patent Owner does not specifically contest Petitioner’s arguments for claim 13. *See* PO Resp. 56–57. We find Petitioner’s arguments persuasive. Thus, we determine that Petitioner has shown, by a preponderance of the evidence, that claim 13 is unpatentable under § 103(a) as obvious over (1) Fells and Wang, (2) Fells and Cook, and (3) Fells, Cook, and Wang.

IV. CONCLUSION¹⁴

For the reasons above, Petitioner has shown by a preponderance of the evidence that claims 1–13 and 16 of the ’184 patent are unpatentable under § 103(a).

¹⁴ Should Patent Owner wish to pursue amendment of claims in a reissue or reexamination proceeding after this decision, we draw attention to the April 2019 *Notice Regarding Options for Amendments by Patent Owner Through Reissue or Reexamination During a Pending AIA Trial Proceeding*. *See* 84

In summary:

Claim(s)	35 U.S.C. §	Reference(s)/ Basis	Claims Shown Unpatentable	Claims Not Shown Unpatentable
1, 8, 11	103(a)	Fells	1, 8, 11	
2–7, 9, 10, 16	103(a)	Fells, Cook	2–7, 9, 10, 16	
12	103(a)	Fells, Ono	12	
13	103(a)	Fells, Cook, Wang	13	
Overall Outcome			1–13, 16	

V. ORDER

It is

ORDERED that claims 1–13 and 16 of the '184 patent are unpatentable; and

FURTHER ORDERED that parties to this proceeding seeking judicial review of our decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

Fed. Reg. 16,654 (Apr. 22, 2019). If Patent Owner chooses to file a reissue application or a request for reexamination of the challenged patent, we remind Patent Owner of its continuing obligation to notify the Board of any such related matters in updated mandatory notices. *See* 37 C.F.R. § 42.8(a)(3), (b)(2).

IPR2024-00105
Patent 10,027,184 B2

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