

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

HESAI TECHNOLOGY CO., LTD.,
Petitioner,

v.

OUSTER, INC.,
Patent Owner.

IPR2023-01422
Patent 11,287,515 B2

Before MEREDITH C. PETRAVICK, KEVIN W. CHERRY, and
JON M. JURGOVAN, *Administrative Patent Judges*.

JURGOVAN, *Administrative Patent Judge*.

DECISION
Final Written Decision
Determining No Challenged Claims Unpatentable
35 U.S.C. § 318(a)

I. INTRODUCTION

Hesai Technology Co., Ltd. (“Petitioner”) filed a Petition (Paper 2, “Pet.”) to institute an *inter partes* review of claims 1–2, 4–9, 11–14, 16–17, and 19–25 of U.S. Patent 11,287,515 B2 (Ex. 1001, “the ’515 patent”). Ouster, Inc. (“Patent Owner”) filed a Preliminary Response (Paper 8, “Prelim. Resp.”). We instituted *inter partes* review under 35 U.S.C. § 314(a). Paper 13 (“Inst. Dec.”).

During the trial, Patent Owner filed a Response (Paper 19, “PO Resp.”), Petitioner filed a Reply (Paper 23, “Pet. Reply”), and Patent Owner filed a Sur-Reply (Paper 26, “PO Sur-Reply”).

Petitioner and Patent Owner (“the parties”) requested oral argument (Papers 28 and 29). A hearing was conducted on December 17, 2024. Paper 32 (“Tr.”).

We have jurisdiction under 35 U.S.C. § 6. This Final Written Decision is entered pursuant to 35 U.S.C. § 318(a). Having reviewed the complete trial record, we determine that Petitioner has *not* shown, by a preponderance of the evidence, that the challenged claims are unpatentable.

II. BACKGROUND

A. *Real Parties in Interest*

Petitioner identifies itself, Hesai Group, and Hesai Inc. as real parties in interest. Pet. 2. Patent Owner identifies itself as the real party in interest. Paper 4, 1.

B. *Related Matters*

Petitioner and Patent Owner identify the following related matters:

- *Ouster, Inc. v. Hesai Group et al.*, No. 23-cv-00406 (D. Del.).

- *Certain LiDAR (Light Detection and Ranging) Systems and Components Thereof*, Inv. No. 337-TA-1363 (USITC) (“the ITC litigation”).

C. *The '515 Patent (Ex. 1001)*

The '515 patent is titled “Rotating Compact Light Ranging System Comprising a Stator Driver Circuit Imparting an Electromagnetic Force on a Rotor Assembly.” Ex. 1001, code (54). Figure 1A of the '515 patent is shown below.

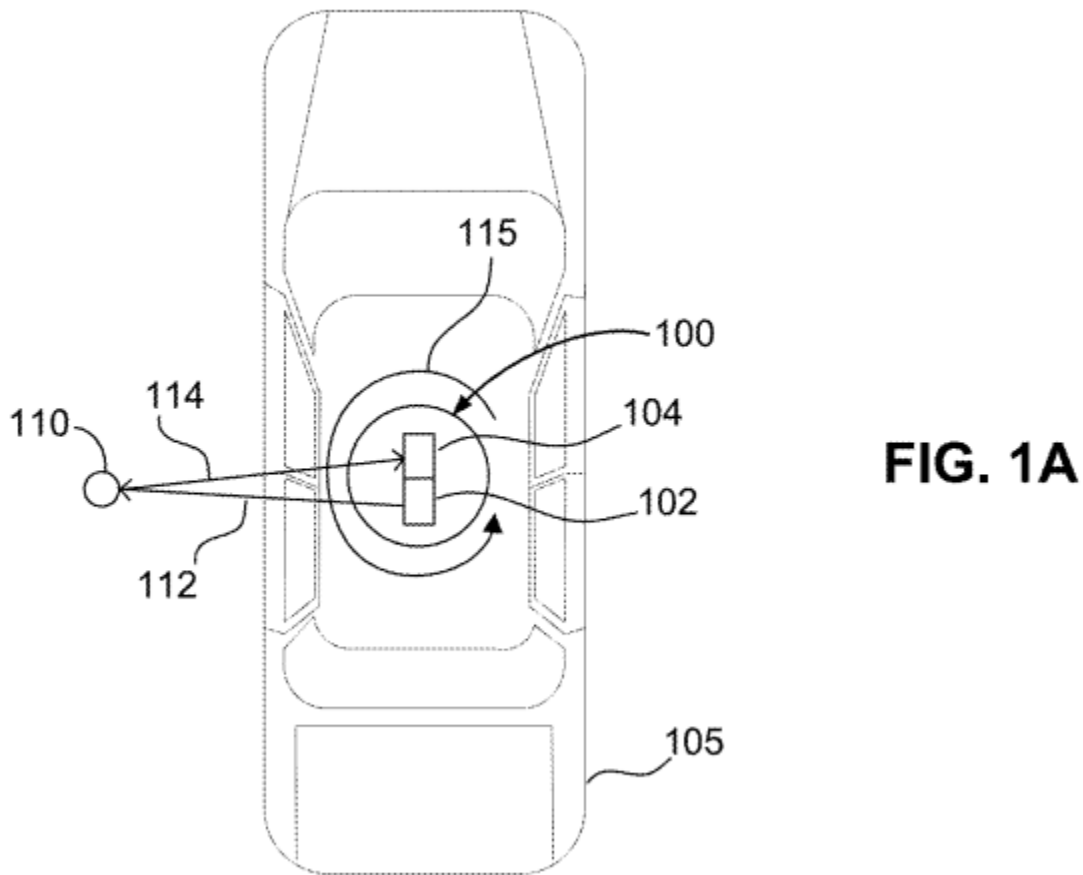


Figure 1A shows a rotating light ranging system, also referred to as a LIDAR¹ system, that can be used in automotive or other applications. *Id.* at

¹ Acronym for “Light Imaging, Detection and Ranging” system. Ex. 1001, 1:31.

14:1–19. LIDAR system 100 includes a light transmission module 102 for emitting laser pulses 112, and a light sensing module 104 for detecting reflected pulses 114 from an object to determine its distance. *Id.* at

14:20–29. The LIDAR system 100 rotates to scan objects in an environment, and produces a three-dimensional (3D) image. *Id.* at 14:1–12.

Figure 2A of the '515 patent is shown below.

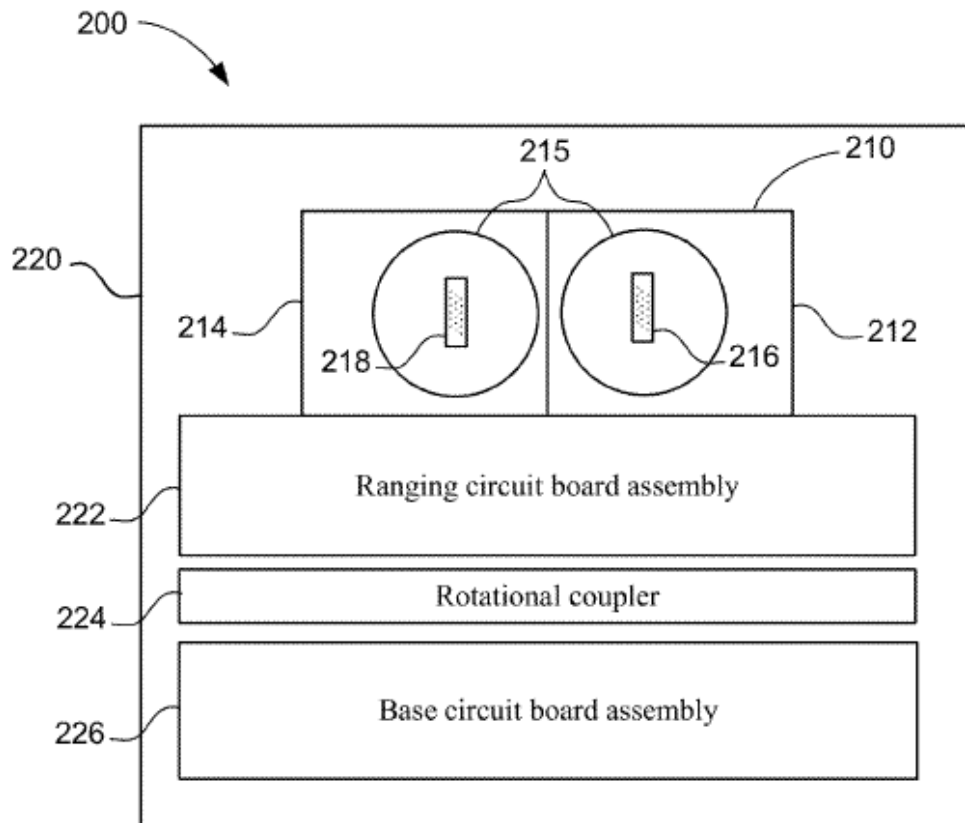


FIG. 2A

Figure 2A shows rotational LIDAR system 200. *Id.* at 15:4–6. Lidar system 200 has a light ranging device 210 that includes a light transmission module 212 and light sensing module 214. *Id.* at 15:7–9. Light ranging device 210 connects to ranging circuit board assembly 222. *Id.* at 15:31–36.

Turret circuit board assembly 222 rotationally couples to base circuit board assembly 226 through a rotational coupler 224. *Id.* at 15:61–63.

Figure 6A is shown below.

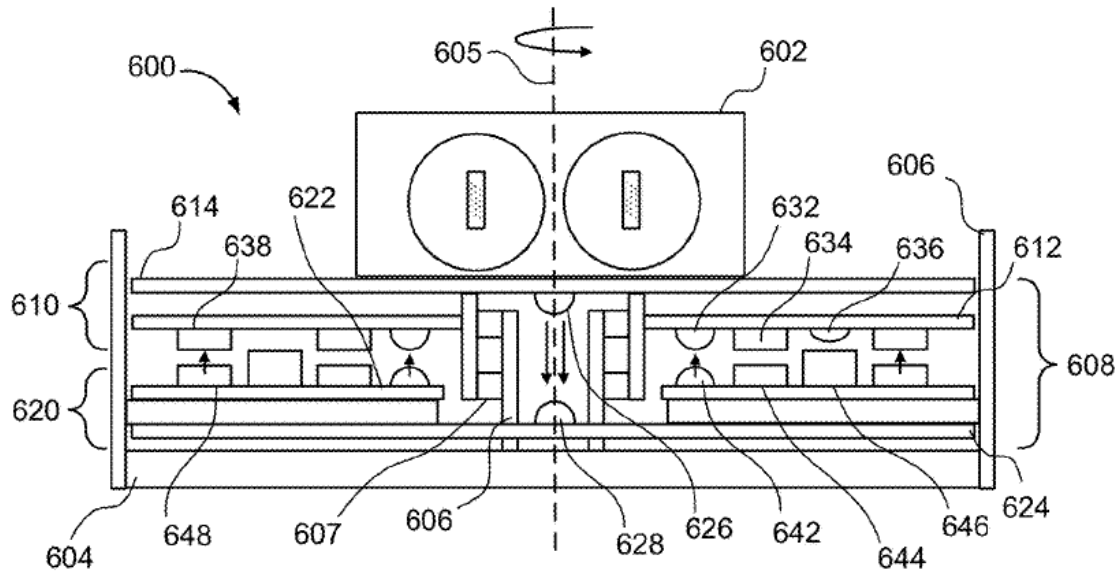


FIG. 6A

Figure 6A shows LIDAR system 600 includes light ranging device 602 and upper and lower circuit board assemblies 610 and 620. *Id.* at 26:19–22.

Upper board assembly 610 rotates with respect to lower board assembly 620 around axis 605 perpendicular to the board assemblies. *Id.* at 26:22–25.

The '515 patent states that the two-piece design of LIDAR system 600 reduces size, increases reliability, and enables the system to be manufactured at reduced cost. *Id.* at 26:28–31.

Light ranging device 602 can be mounted to one of the circuit boards of the upper board assembly 610 enabling the device to rotate with upper board assembly 610. *Id.* at 26:32–34. Lower board assembly 620 can be mounted to base 604 or sidewall 606 of the stationary base of LIDAR system 600. *Id.* at 26:35–37. Rotation of upper circuit board assembly 610

and light ranging device 602 is enabled by bearing system 607 located on hollow shaft 606 centered on rotational axis 605. *Id.* at 26:37–40.

Each of the assemblies 610, 620 can include two or more stacked circuit boards arranged in a parallel relationship. *Id.* at 26:41–43. As shown in Figure 6A, the upper assembly 610 may include rotor communication board 612 and rotor control board 614, and the lower assembly 620 may include stator communication board 622 and stator control board 624. *Id.* at 26:41–47. An electric motor can be integrated on the board assemblies, along with an encoder, a wireless power system, and an optical communication system. *Id.* at 26:47–50. The wireless power system includes wireless power transmitter 648 which can be attached to lower assembly 620, and wireless power receiver 638 which can be attached to upper assembly 610, and each may be composed of a single or multiple coils. *Id.* at 31:20–37.

Figure 6D of the '515 patent is shown below.

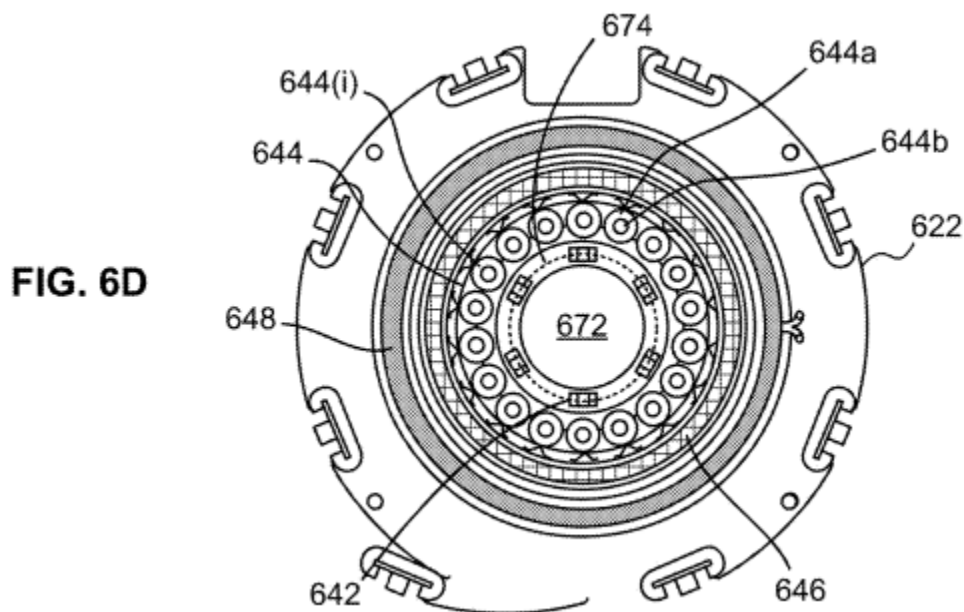


Figure 6D shows a top view of a stator board of the lower circuit board

assembly 620. *Id.* at 9:39–40. The stator board includes a stator assembly 644 with an annular arrangement of multiple stator elements 644(i), e.g., vertically oriented solenoids, affixed to lower circuit board assembly 620, or to a soft magnetic core that is affixed to the lower assembly. *Id.* at 30:15–22. Each stator element 644(i) can include a solenoid coil 644a wound around a core 644b of magnetic material, e.g., ferrite or the like. *Id.* at 30:24–26. The solenoid coils are oriented so that the magnetic fields produced thereby are perpendicular to the plane of the circuit board. *Id.* at 30:26–29.

Figure 6E of the '515 patent is shown below.

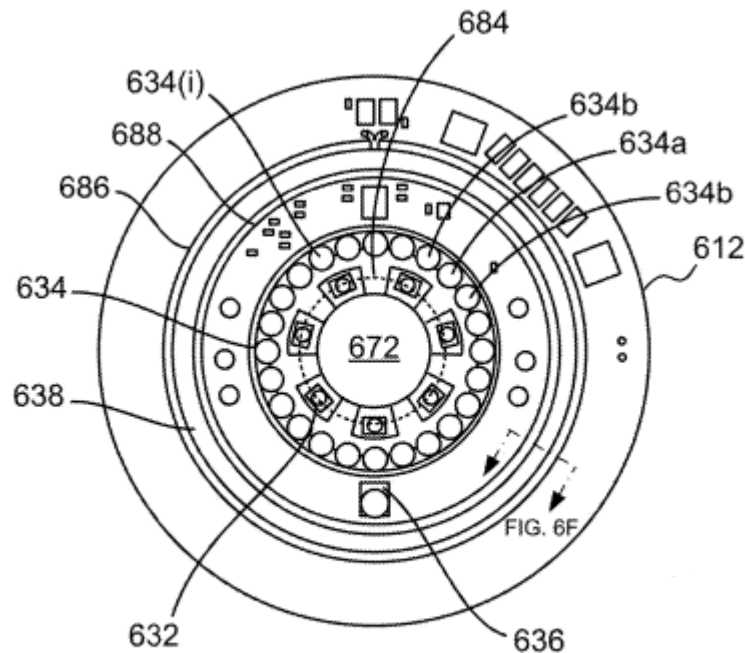


FIG. 6E

Figure 6E is a bottom view of a rotor board of the upper circuit board assembly 610. *Id.* at 9:41–42. A motor rotor assembly 634 is attached to the upper circuit board assembly 610. *Id.* at 30:44–46. Motor rotor assembly

634 includes permanent magnets 634(i) with magnets 634a arranged adjacent to magnets 634b with opposite poles. *Id.* at 30:46–56.

As shown in Figures 6D and 6E, the motor stator assembly 644 and motor rotor assembly 634 form an electric motor with a circular ring shape with both stator and rotor circles having the same radius and center positions centered on the shaft. *Id.* at 30:62–67.

D. Claims

Of the challenged claims, claims 1, 14, and 22 of the '515 patent are independent, and the remaining claims depend directly or indirectly from one of these claims.

Claim 1 is shown below with Petitioner's identifiers in brackets with claim language that we find dispositive for this claim shown in emphasis.

[1(a)] A light ranging system comprising:

[1(b)] an enclosure having a base, a top cover and an optically transparent window disposed between the base and the top cover and extending fully around a periphery of the enclosure;

[1(c)] a shaft disposed within the enclosure and defining an axis of rotation;

[1(d)] a stator circuit board disposed within the enclosure along a first plane perpendicular to the axis of rotation and fixedly coupled to the base of the enclosure;

[1(e)] a support component rotationally coupled to the shaft and comprising a sleeve fitted over the shaft and a plurality of arms extending away from the sleeve;

[1(f)] a rotor circuit board coupled to the support component and disposed within the enclosure along a second plane parallel to the first plane and between the first plane and the top cover;

[1(g)] *a stator assembly* disposed between the first and second planes and *coupled to the stator circuit board*, the stator assembly comprising a plurality of stator elements arranged annularly about the axis of rotation, *each of the plurality of stator elements including a coil wound around a magnetic core*;

[1(h)] a rotor assembly disposed between the first and second planes and coupled to the rotor circuit board, the rotor assembly including an annular arrangement in which a plurality of magnetic poles surround the axis of rotation in an alternating pattern such that each magnetic pole has a polarity opposite a polarity of its adjacent magnetic poles; and

[1(i)] a light ranging device coupled to rotate with the rotor circuit board within the enclosure, the light ranging device comprising a transmit module comprising a bulk transmitting optic and an illumination source operable to transmit pulses of electromagnetic radiation through the bulk transmitting optic and through the window to objects in a surrounding environment, and an receive module comprising a bulk receiver optic and detector circuitry operable to detect reflected portions of the electromagnetic radiation pulses received through the window that are reflected from the objects in the surrounding environment; and

[1(j)] a stator driver circuit disposed within the enclosure and configured to provide a drive signal to the plurality of stator elements, thereby imparting an electromagnetic force on rotor assembly to drive a rotation of the rotor circuit board and the light ranging device about the shaft.

Ex. 1001, 48:20–67.

Claim 14 is shown below with Petitioner's identifiers in brackets with claim language that we find dispositive for this claim shown in emphasis.

[14(a)] A light ranging system comprising:

[14(b)] an enclosure having a base, a top cover and an optically transparent window disposed between the base and the

top cover and extending fully around a periphery of the enclosure;

[14(c)] a shaft disposed within the enclosure and defining an axis of rotation;

[14(d)] a stator circuit board disposed within the enclosure along a first plane perpendicular to the axis of rotation and fixedly coupled to the base of the enclosure;

[14(e)] a support component comprising a sleeve fitted over the shaft and a plurality of arms extending away from the sleeve;

[14(f)] one or more bearings coupled between the shaft and the support component allowing the support component to rotate around the axis of rotation;

[14(g)] a rotor circuit board coupled to rotate with the support component and disposed within the enclosure along a second plane parallel to the first plane and between the first plane and the top cover;

[14(h)] ***a stator assembly coupled to the stator circuit board*** and comprising a plurality of stator elements arranged annularly about the axis of rotation, ***each of the plurality of stator elements including a coil***;

[14(i)] a rotor assembly coupled to the rotor circuit board, the rotor assembly including an annular arrangement in which a plurality of magnetic poles surround the axis of rotation in an alternating pattern such that each magnetic pole has a polarity opposite a polarity of its adjacent magnetic poles; and

[14(j)] a light ranging device coupled to rotate with the rotor circuit board within the enclosure, the light ranging device comprising a transmit module comprising a bulk transmitting optic and an illumination source operable to transmit pulses of

electromagnetic radiation through the bulk transmitting optic and through the window to objects in a surrounding environment, and an receive module comprising a bulk receiver optic and detector circuitry operable to detect reflected portions of the electromagnetic radiation pulses received through the window that are reflected from the objects in the surrounding environment; and

[14(k)] a stator driver circuit disposed within the enclosure and configured to provide a drive signal to the plurality of stator elements, thereby imparting an electromagnetic force on rotor assembly to drive a rotation of the rotor circuit board and the light ranging device about the shaft.

Ex. 1001, 50:1–48.

Claim 22 is shown below with Petitioner’s identifiers in brackets and claim language that we find dispositive for this claim shown in emphasis.

[22(a)] A light ranging system comprising:

[22(b)] an enclosure having a base, a top cover and an optically transparent window disposed between the base and the top cover and extending fully around a periphery of the enclosure;

[22(c)] a shaft disposed within the enclosure and defining an axis of rotation, the shaft including a hollow channel axially aligned with the axis of rotation and extending through a length of the shaft;

[22(d)] a stator circuit board assembly disposed within and coupled to the enclosure in a fixed relationship, ***the stator circuit board assembly comprising:***

[22(d.i)] a first circuit board disposed along a plane perpendicular to the axis of rotation;

[22(d.ii)] a second circuit board disposed parallel to and adjacent to the first circuit board and having a first aperture formed through a central portion of the second circuit board; and

[22(d.iii)] a stator assembly comprising a plurality of stator elements arranged about the axis of rotation;

[22(e)] a rotor circuit board assembly disposed within the enclosure and rotationally coupled to the shaft, the rotor circuit board assembly comprising:

[22(e.i)] a support component having lower and upper surfaces, a sleeve extending away from the lower surface and fitted over the shaft, a plurality of arms extending away from the sleeve, and a plurality of alignment posts extending away from the upper surface;

[22(e.ii)] a ***third circuit board*** coupled to the lower surface of the support component and disposed adjacent to and in an opposing relationship with the second circuit board;

[22(e.iii)] a ***fourth circuit board*** coupled to the upper surface of the support component and ***arranged parallel with the third circuit board*** between the third circuit board and the top cover, the fourth circuit board having a plurality of alignment cutouts sized and shaped to accept the alignment posts; and

[22(e.iv)] a rotor component coupled to the rotor circuit board assembly and spaced apart from and concentric with the stator assembly, the rotor component comprising an annular arrangement in which a plurality of magnetic segments surround the axis of rotation and are distributed along the

annular arrangement in an alternating pattern such that each magnetic pole has a polarity opposite a polarity of its adjacent magnetic poles;

[22(f.i)] a light ranging device coupled to rotate with the rotor circuit board within the enclosure, the light ranging device comprising a transmit module and a receive module, the transmit module comprising a bulk transmitting optic and a light source operable to transmit pulses of electromagnetic radiation through the bulk transmitting optic and through the window to objects in a surrounding environment, the receive module comprising a bulk receiver optic and detector circuitry operable to detect reflected portions of the electromagnetic radiation pulses received through the window that are reflected from the objects in the surrounding environment,

[22(f.ii)] wherein the detector circuitry comprises a plurality of pixels, each pixel comprising a plurality of single photon avalanche detectors (SPADs) and

[22(f.iii)] wherein the light ranging device determines distances to objects in the surrounding environment based on elapsed times between the pulses of electromagnetic radiation emitted from the light source and the detection of reflected portions of the electromagnetic radiation pulses by the detector circuitry

[22(g)] a stator driver circuit disposed within the enclosure and configured to provide a drive signal to the plurality of stator elements, thereby imparting an electromagnetic force on the rotor component to drive a rotation of the second circuit board assembly and the light ranging device about the shaft;

[22(h)] *a wireless power transformer integrated directly onto the stator and rotor circuit boards*, the wireless power transformer comprising a first annular transformer coil disposed on a surface of the stator circuit board and a second annular transformer coil disposed on a surface of the rotor circuit board in an opposing relationship with the first annular transformer coil, *wherein the first transformer coil is* concentric with and *positioned outside an outer perimeter of the plurality of stator elements* and *the second transformer coil is* concentric with and *positioned outside an outer perimeter of the rotor assembly annular arrangement*; and

[22(i)] a communication channel extending through the hollow channel in the shaft and operatively coupled to allow ranging data from the light ranging device to be transmitted to circuitry disposed within the enclosure in a fixed relationship to the stator circuit board assembly.

Ex. 1001, 51:40–52:65.

E. Prior Art and Asserted Challenges to Patentability

Petitioner asserts that claims 1–2, 4–9, 11–14, 16–17, and 19–25 are unpatentable on the following challenges (Pet. 4):

Ground	Claim(s) Challenged	35 U.S.C. § ²	Basis/Reference(s)
1	1–2, 4–9, 11, 14, 16–17, 19	103	Pacala ³ , Johnson ⁴ , Pardhan ⁵ , Zhang ⁶
2	2, 4–6, 17	103	Pacala, Johnson, Pardhan, Zhang, Cai ⁷
3	5–6	103	Pacala, Johnson, Pardhan, Zhang, Cai, Hall ⁸
4	12, 20	103	Pacala, Johnson, Pardhan, Zhang, Spector ⁹
5	13, 21	103	Pacala, Johnson, Pardhan, Zhang, Spector, Droz ¹⁰
6	22–24	103	Pacala, Johnson, Pardhan, Zhang, Droz, Cai, Yan ¹¹
7	25	103	Pacala, Johnson, Pardhan, Zhang, Droz, Cai, Yan, Spector
8	1–2, 4–9, 11–14, 16–17, 19–21	103	Pacala-2017 ¹² , Johnson, Pardhan, Zhang
9	22–25	103	Pacala-2017, Johnson, Pardhan, Zhang, Cai, Yan

² Because the '515 patent issued from a patent application that was filed after March 16, 2013, patentability is governed by the version of 35 U.S.C. § 103 set forth in the Leahy-Smith America Invents Act (“AIA”), Pub L. No. 112–29, 125 Stat. 284 (2011).

³ Pacala et al., U.S. Patent Pub. 2014/0211194 A1, published July 31, 2014 (Ex. 1004). Petitioner contends that Pacala is prior art under § 102(a)(1)–(2). Pet. 10.

⁴ Johnson et al., U.S. Patent 10,790,077 B2, issued Sept. 29, 2020 (Ex. 1005). Petitioner contends that Johnson is prior art under § 102(a)(1)–(2). Pet. 11.

In support of its proposed challenges, Petitioner relies on Declarations from Dr. Michael Lebby. *See* Ex. 1003; Ex. 1050. Patent Owner relies on the Declaration of Dr. Jason Janét. Ex. 2004. The Declarants were deposed during the trial, and the transcripts from those depositions are included in the record. Ex. 1051 (Janét); Ex. 2005 (Lebby).

III. ANALYSIS

A. *Legal Standards*

A claim is unpatentable under 35 U.S.C. § 103 if “the differences between the [claimed invention] and the prior art are such that the [claimed invention] as a whole would have been obvious [before the effective filing date of the claimed invention] to a person having ordinary skill in the art to

⁵ Pardhan et al., U.S. Patent 10, 749,308 B2, issued Aug. 18, 2020 (Ex. 1006). Petitioner contends that Pardhan is prior art under § 102(a)(1)–(2). Pet. 14.

⁶ Zhang et al., International Application WO 2018/201567 A1, published Nov. 8, 2018 (Ex. 1007). Petitioner contends that Zhang is prior art under § 102(a)(1)–(2). Pet. 15.

⁷ Cai et al., China Patent CN 205027903 U, issued Feb. 2, 2016 (Ex. 1008). Petitioner contends that Cai is prior art under § 102(a)(1)–(2). Pet. 56.

⁸ Hall et al., U.S. Patent 11,723,762 B2, issued Aug. 15, 2023 (Ex. 1009). Petitioner contends that Hall is prior art under § 102(a)(2). Pet. 66.

⁹ Spector, U.S. Patent 10, 473,766 B2, issued Nov. 12, 2019 (Ex. 1010). Petitioner contends that Spector is prior art under § 102(a)(2). Pet. 74.

¹⁰ Droz et al., U.S. Patent 10,605,984 B2, issued Mar. 31, 2020 (Ex. 1011). Petitioner contends that Droz is prior art under § 102(a)(1)–(2). Pet. 78.

¹¹ Yan, U.S. Patent Pub. US 2018/0003823 A1, published Jan. 4, 2018 (Ex. 1012). Petitioner contends that Yan is prior art under § 102(a)(1). Pet. 81.

¹² Pacala et al., U.S. Patent Pub. 2017/0289524 A1, published Oct. 5, 2017 (Ex. 1013). Petitioner contends that Pacala-2017 is prior art under § 102(a)(1)–(2). Pet. 97.

which [the claimed invention] pertains.” *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). The question of obviousness is resolved on the basis of underlying factual determinations, 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) objective evidence of nonobviousness, i.e., secondary considerations. *See Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).

In conducting an obviousness analysis, one must determine whether the claimed elements are present in the prior art. *PAR Pharm., Inc. v. TWI Pharms., Inc.*, 773 F.3d 1186, 1194–1198 (Fed. Cir. 2014) (citing *Medichem, S.A. v. Rolabo, S.L.*, 437 F.3d 1157, 1164 (Fed.Cir.2006)). However, a patent claim “is not proved obvious merely by demonstrating that each of its elements was, independently, known in the prior art.” *KSR*, 550 U.S. at 418. 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.’” *Intelligent Bio-Sys., Inc. v. Illumina Cambridge Ltd.*, 821 F.3d 1359, 1367–68 (Fed. Cir. 2016) (citation omitted); *see KSR*, 550 U.S. at 418. Further, an assertion of obviousness “cannot be sustained by mere conclusory statements; instead, there must be some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness.” *KSR*, 550 U.S. at 418; *In re NuVasive, Inc.*, 842 F.3d 1376, 1383 (Fed. Cir. 2016) (a finding of a motivation to combine “must be supported by a ‘reasoned explanation’”).

“In an [*inter partes* review], the petitioner has the burden from the onset to show with particularity why the patent it challenges is unpatentable.” *Harmonic Inc. v. Avid Tech., Inc.*, 815 F.3d 1356, 1363 (Fed. Cir. 2016) (citing 35 U.S.C. § 312(a)(3)); *see also Intelligent Bio-Sys.*, 821 F.3d at 1369. Therefore, to prevail in an *inter partes* review, Petitioner must explain how the proposed combinations of prior art would have rendered the challenged claims unpatentable. We determine whether the information presented in the Petition shows there is a reasonable likelihood that Petitioner would prevail in establishing that at least one of the challenged claims would have been obvious over the proposed combinations of prior art.

B. Level of Ordinary Skill in the Art

The person of ordinary skill in the art is a hypothetical person who is presumed to know the relevant prior art. *In re GPAC Inc.*, 57 F.3d 1573, 1579 (Fed. Cir. 1995) (citing *Custom Accessories, Inc. v. Jeffrey–Allan Indus., Inc.*, 807 F.2d 955, 962 (Fed. Cir. 1986)). In determining the skill level, the Board may consider various factors including “the type of problems encountered in the prior art; prior art solutions to those problems; rapidity with which innovations are made; sophistication of the technology; and educational level of active workers in the field.” *Id.* In a given case, every factor may not be present, and one or more factors may predominate. *Id.*

Petitioner asserts that a person of ordinary skill in the art would have had an undergraduate degree in mechanical or electrical engineering and two to three years of work experience with electro-optical and electro-mechanical devices or systems.

Less work experience may be compensated by a higher level of education or vice versa.

Pet. 9 (citing Ex. 1003 ¶¶ 39–41).

Patent Owner argues that “Petitioner’s proposed POSITA would be acceptable if it included the caveat that ‘at a minimum, at least one year of work experience was with LiDAR designs, including LiDAR designs implemented on a rotor-stator structure specifically.’” PO Resp. 7–8 (citing Ex. 2004 ¶ 66). Patent Owner argues that its “proposed addendum to Petitioner’s proposal would not require any *additional* work experience of a POSITA” but “merely recognizes that the POSITA should have some relevant experience.” *Id.* at 8 (citing Ex. 2004 ¶¶ 67–68).

Petitioner does not dispute Patent Owner’s addendum to Petitioner’s proposed level of ordinary skill in the art. *See generally* Pet. Reply.

Considering the applicable factors in light of the parties’ contentions, we adopt the following level of ordinary skill in the art, which we apply in this Decision:

A person of ordinary skill in the art would have had an undergraduate degree in mechanical or electrical engineering and two to three years of work experience with electro-optical and electro-mechanical devices or systems, relevant to light ranging systems. Less work experience would have been compensated by a higher level of education or vice versa. The work experience would have included at least one year relevant to light ranging systems including LIDAR with a rotor-stator structure.

We determine that this level of skill is consistent with the problems and solutions identified in the ’515 patent and the prior art. *See, e.g., Okajima v. Bourdeau*, 261 F.3d 1350 (Fed. Cir. 2001); Ex. 1001, 1:30–3:48; Ex. 1004 ¶¶ 3–10; Ex. 1005, 1:1–2:31; Ex. 1006, 1:1–2:60; Ex. 1007, 1. We

also determine that the proposed level of skill is reflective of the education and experience a person of ordinary skill would have had. Ex. 1003

¶¶ 39–41; Ex. 2004 ¶¶ 67–68.

C. Claim Construction

In an *inter partes* review, claims are construed 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); *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005). This standard 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.” 37 C.F.R. § 42.100(b). “Any prior claim construction determination concerning a term of the claim in a civil action, or a proceeding before the International Trade Commission, that is timely made of record in the *inter partes* review proceeding will be considered.” *Id.*

“The Board is required to construe ‘only those terms . . . that are in controversy, and only to the extent necessary to resolve the controversy.’” *Realtime Data, LLC v. Iancu*, 912 F.3d 1368, 1375 (Fed. Cir. 2019) (quoting *Vivid Techs., Inc. v. Am. Sci. & Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999)).

1. Limitations 1(g) and 14(h): “Stator Assembly [. . .] Coupled to the Stator Circuit Board” (Claims 1 and 14); Limitation 22(d): “Stator Circuit Board Assembly . . . Comprising . . . First Circuit Board . . ., Second Circuit Board . . ., and Stator Assembly. . .” (Claim 22)

Claim 1’s limitation 1(g) recites in part “a stator assembly . . . coupled to the stator circuit board.” Ex. 1001, 48:37–38. Similarly, claim 14’s

limitation 14(h) recites “a stator assembly coupled to the stator circuit board.” *Id.* at 50:21. Claim 22’s limitation 22(d) recites “a stator circuit board assembly” comprising “a first circuit board,” a “second circuit board,” and “a stator assembly.” *Id.* at 51:49–59.

The dispute presented by the parties in relation to these claim limitations is whether the “stator assembly” should be construed as separate and distinct from the “circuit board(s)” in these claims. PO Resp. 9–10; Pet. Reply 1–2; PO Sur-Reply 1–4. We determine that it should be so construed for reasons explained below.

Initially, Petitioner contended that it “does not believe any terms require construction to resolve the patentability disputes” presented in this proceeding. Pet. 9. Petitioner noted that, in the ITC litigation, the parties and ITC staff exchanged preliminary constructions, but the claims were not finally construed. *Id.* (citing Exs. 1020–1022). The construction proposed by the ITC staff was that the claim language would be given its plain and ordinary meaning. Ex. 1020, 5. Petitioner proposed that the claim language means that the “stator assembly . . . is attached or mounted directly . . . to the stator circuit board.” Ex. 1022, 4. Patent Owner proposed that “coupled” in this claim language means “directly or indirectly coupled.” Ex. 1021, 4.

In its Preliminary Response, Patent Owner contended that no claim construction was necessary to resolve the parties’ patentability dispute. Prelim. Resp. 11. Consequently, as the parties did not present any dispute over claim language in the preliminary proceeding for this case, we did not expressly construe any claim term. Inst. Dec. 14–15.

In its Response, however, Patent Owner asserted that “coupled to” means that “the ‘stator assembly’ and ‘stator circuit board’ *must* be distinct

elements such that the ‘stator assembly’ cannot simply be a subcomponent of the ‘stator circuit board.’” PO Resp. 9–10.

In its Reply, Petitioner argued that “[t]he plain meaning of ‘coupled to’ encompasses ‘anything joining two things together or otherwise associating or uniting the stator assembly and circuit board.’” Pet. Reply 1 (citing Ex. 1049; Ex. 1050 ¶ 27). Petitioner further contended that the ’515 patent teaches coupling the assembly and circuit board to one another in the way that Patent Owner is attempting to read out of the claims. *Id.* (citing Ex. 1001, 4:28–31 (“...rotor and stator elements built onto the circuit boards themselves”), 4:19–22 (“...stator and rotor elements integrated on” circuit boards))). Petitioner argued that Patent Owner’s construction thus “conflicts with the intrinsic evidence.” *Id.*

In its Sur-Reply, Patent Owner argued that “[i]t is well-established that for two structures to be ‘coupled to’ one another, they must be two physically distinct components.” PO Sur-Reply 1–2 (citing *Wi-LAN Inc. v. Sharp Elecs. Corp.*, 992 F.3d 1366, 1378 (Fed. Cir. 2021)). Patent Owner asserted that *Wi-LAN* “mandates that where a specification consistently uses ‘coupled’ to ‘refer to components that are not sub-components of each other,’ the claim phrase ‘coupled to’ requires two separate components.”

Sur-Reply 2. Patent Owner further contended that

[c]onsistent with this rule, the ’515 patent specification uses “coupled to” when referring to two mechanically distinct components such as “a bearing system coupled to the hollow shaft” (Ex. 1001, 5:11-13), “a second circuit board assembly rotationally coupled to the shaft” (*id.*, 4:57-59), “a first circuit board assembly disposed within and coupled to the housing” (*id.*, 5:42-44), and “a light ranging device electrically connected to and coupled to rotate with the second circuit board assembly” (*id.*, 5:56-57).

Sur-Reply 2. Patent Owner further argued that even if Petitioner was correct that the '515 patent's description of "stator and rotor elements integrated on upper and lower circuit boards" and "rotor and stator elements built onto the circuit boards themselves" (Ex. 1001, 4:19-31) refers to an alternative embodiment, the '515 patent's claims use the "coupled to" language, not the "integrated on" or "built onto" language that Petitioner prefers. *Id.* at 2–3.

We determine that the claimed "stator circuit board" and "stator assembly" are separate and distinct elements in claims 1 and 14 because they are set forth as separate elements in these claims. *See* Ex. 1001, 48:27–29, 48:37–42, 50:8–10. Similarly, claim 22 recites "a stator circuit board assembly" that includes as subcomponents "a first circuit board," "a second circuit board," and a "stator assembly" which are separate and distinct sub-elements. *Id.* at 51:49–59. "Where a claim lists elements separately, 'the clear implication of the claim language is that those elements are 'distinct component[s]' of the invention.'" *Becton, Dickinson and Co. v. Tyco Healthcare Gr., LP*, 616 F.3d 1249, 1254 (Fed. Cir. 2010) (citing *Gaus v. Conair Corp.*, 363 F.3d 1284, 1288 (Fed. Cir. 2004); *Engel Indus., Inc. v. Lockformer Co.*, 96 F.3d 1398, 1404–05 (Fed. Cir. 1996)).

This construction is confirmed by the '515 patent's specification. For example, the specification states that stator assembly 644 is affixed to circuit board 622, and, consistent with this statement, Figures 6A and 6D show them as separate elements joined together. Ex. 1001, 28:28–31, 30:16–24. Contrary to Petitioner's contention, the specification's stating that the stator elements are "built onto" or "integrated on" circuit boards (or assemblies containing them) does not mean that the stator assembly and circuit board are the same thing. Pet. Reply 1 (citing Ex. 1001, 4:19–22, 4:28–31).

Rather, the specification describes the stator elements as part of the stator assembly which is coupled to a circuit board, as follows:

VII. Integrated Electric Motor

According to certain embodiments, an electric rotary motor can be integrated directly onto the circuit boards. The motor can have a "pancake" or "axial" design having a planar rotor assembly on a rotor board that opposes a planar stator assembly on an opposing stator board. The stator and rotor assemblies of the electric motor can be integrated onto the boards of the rotary actuator 608, i.e., the elements of the electric motor are one of many components on the surface of the printed circuit boards and thus a separate motor module is not required for LIDAR system 600. For example, referring back to FIG. 6D, stator assembly 644 can include an annular arrangement of multiple stator elements 644(i), e.g., vertically oriented solenoids (having their longitudinal axes perpendicular to the surface of the board) that are affixed (e.g., using an adhesive) to a board of the lower circuit board assembly 620 (e.g., board 622) or to a soft magnetic core that is then affixed to the lower circuit board assembly 620.

Ex. 1001, 30:16–22. Thus, the '515 patent's specification expressly states that the stator elements of the stator assembly can be affixed to a printed circuit board, and thus the stator assembly is not the same thing as the board. Other parts of the specification are consistent with this view. *See, e.g., id.* at 4:54–57, 5:14–18, 6:50–53, 16:22–25.

Furthermore, although the examiner did not specifically address this issue in the prosecution history of the '515 patent, the examiner implicitly recognized that the claims recite the “stator circuit board” and “stator assembly” as separate and distinct elements. Ex. 1002, 129 (Examiner's reasons for allowance listing claim elements separated by semicolons, as recited in the claims).

Because the intrinsic evidence is clear that the “stator circuit board” and “stator assembly” are considered separate and distinct elements in the ’515 patent, we find it unnecessary to resort to any extrinsic evidence to resolve the parties’ dispute over this claim language. *See Phillips*, 415 F.3d at 1317 (explaining that extrinsic evidence is less significant than intrinsic evidence); *Seabed Geosolutions (US) Inc. v. Magseis FF LLC*, 8 F.4th 1285, 1287 (Court of Appeals gives primacy to intrinsic evidence and resorts to extrinsic evidence only if consistent with intrinsic evidence); *Sequoia Tech., LLC v. Dell, Inc.*, 66 F.4th 1317, 1324 (Court of Appeals stating that its “decision rests solely on the intrinsic evidence”).

2. Limitation 1(g): “Each of the Plurality of Stator Elements Including a Coil Wound around a Magnetic Core”

Claim 1’s limitation 1(g) recites “each of the plurality of stator elements including a coil wound around a magnetic core.” Ex. 1001, 48:40–42. The parties dispute the meaning of this limitation. PO Resp. 10–12; Pet. Reply 2–3; PO Sur-Reply 4–5. We determine that the intrinsic evidence supports that this limitation means that each stator element includes a coil and a magnetic core, not a magnetic core which is shared by multiple coils.

In the preliminary proceeding for this case, Petitioner and Patent Owner initially contended that claim construction was not required for any claim term to resolve the parties’ patentability dispute. Pet. 9; Prelim. Resp. 11. Accordingly, we did not construe any claim term in the preliminary proceeding. Inst. Dec. 14–15. Petitioner mentioned in its Petition that the parties and ITC staff exchanged preliminary constructions in the ITC litigation, but none of those proposed constructions relate to the claim limitation discussed in this section. Pet. 9.

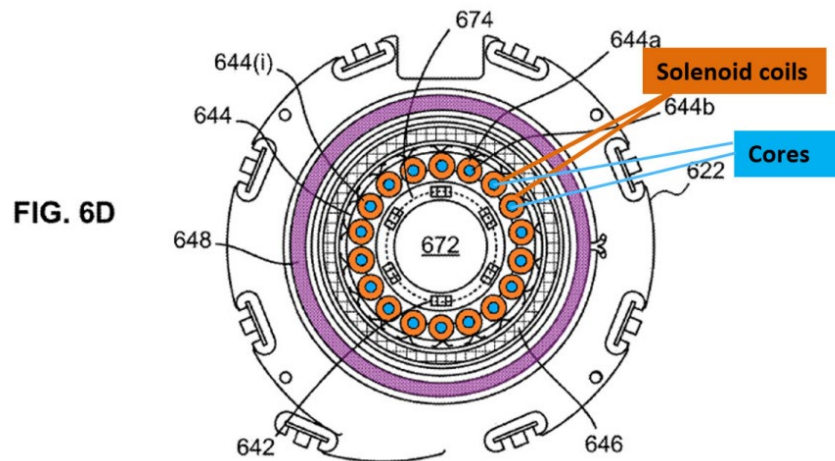
During the trial phase of this proceeding, Patent Owner contended that the above-noted limitation “requires multiple magnetic cores (i.e., one for each of the multiple coils).” PO Resp. 10–12; PO Sur-Reply 4–5. Petitioner disagreed, asserting that the limitation means “that each stator element has a coil and that the coil is wound around a core (whether it be a core that is shared with other coils or one that is not).” Pet. Reply 2–3.

In their claim construction arguments, the parties cited numerous cases which are nonprecedential, and therefore are not binding. PO Resp. 9–10; Pet. Reply 1–2; PO Sur-Reply 1–4. Furthermore, the cited cases involve claim language in patents unrelated to the one at issue here. *See Sequoia*, 66 F.4th at 1325 (“extrinsic evidence of what other inventors chose to do cannot surmount the intrinsic evidence of what the inventors chose here; context is key in claim construction”).

Turning to the intrinsic evidence in this case, the ’515 patent’s specification describes the stator elements of the stator assembly as follows:

For example, referring back to FIG. 6D, stator assembly 644 can include an annular arrangement of multiple stator elements 644(i), e.g., vertically oriented solenoids (having their longitudinal axes perpendicular to the surface of the board) that are affixed (e.g., using an adhesive) to a board of the lower circuit board assembly 620 (e.g., board 622) or to a soft magnetic core that is then affixed to the lower circuit board assembly 620. Examples of the stator elements are shown in the top view of FIG. 6D. Each stator element 644(i) can include a solenoid coil 644a wound around a core 644b of magnetic material, e.g., ferrite or the like.

Ex. 1001, 30:15–26. This passage describes Figure 6D, as shown in Patent Owner’s annotated version below.



PO Resp. 11. The annotated version of Figure 6D above shows that stator elements 644(i) each have a coil (orange) wound around a core (blue), as described in the specification. Ex. 1001, 30:24–26.

If we were to construe limitation 1(d) as Petitioner proposes to describe an alternative embodiment than that shown in Figure 6D where the solenoid coils share a common core, this embodiment would not fit the claim language that requires that the “stator assembly . . . is coupled to the stator circuit board.” *Id.* at 48:37–38. The stator assembly would instead be affixed to the soft magnetic core which is affixed to the lower circuit board assembly, which is not what is claimed. *Id.* at 30:15–22.

Furthermore, an Office rule requires that the “drawing in a nonprovisional application must show every feature of the invention specified in the claims.” 37 C.F.R § 1.83(a). We find no instance in which solenoid coils are wound around a shared core, either in Figure 6D or the other figures of the ’515 patent.

In addition, the interpretation that Petitioner argues for would require different claim language than exists in claim 1. Specifically, the language would have a comma after “coil” and before “wound” so that it would be

recited as “each of the plurality of stator elements including a coil, wound around a magnetic core.” But the claim is not so recited.

Petitioner argues that Patent Owner’s reliance on Figure 6D is misplaced because this figure is an “example” used in “some embodiments.” Pet. Reply 3 (citing Ex. 1001, 26:15–18, 30:15–23, 31:12–19). Petitioner contends that “[t]he Board should not import limitations of an embodiment.” *Id.* (citing *Hill-Rom Servs., Inc. v. Stryker Corp.*, 755 F.3d 1367, 1371–72 (Fed. Cir. 2014)).

Although Petitioner is correct that the Figure 6D configuration is an “example” used in some embodiments of the ’515 patent (Ex. 1001, 26:15–18), and that there are alternative embodiments described in the ’515 patent’s specification (Ex. 1001, 31:1–19), by its express language, claim 1 is directed to the Figure 6D embodiment. The only mention of “coil” and “magnetic core” together in the specification occurs in describing the Figure 6D configuration. Ex. 1001, 30:15–26. And the specification expressly contrasts the Figure 6D embodiment from the alternative embodiments. *Id.* at 31:1–19. Furthermore, the alternative embodiments do not fit the language of claim 1 which recites that the stator elements each include a coil and magnetic core, not a permanent magnet. *Id.* at 31:6–7. Nor does claim 1 mention using “electromagnets” per se rather than permanent magnets in the rotor and stator elements. *Id.* at 31:9–12. The statement that “any non-contact configuration of solenoid coils and permanent magnet elements can be employed” is not sufficiently specific to convey to a POSITA a configuration in which stator elements are wound around a shared magnetic core. *Id.* at 31:15–16.

Unlike the case on which Petitioner relies, *Hill-Rom, supra*, the issue presented here is not one of importing from the specification a limitation that is missing from the claim, but one of interpreting the claim language that is expressly present in the claim. *See, e.g., Phillips*, 415 F.3d at 1315 (citing *Vitronics Corp. v. Conceptronic, Inc.*, 90 F.3d 1576, 1582 (Fed. Cir. 1986)) (“the specification is always highly relevant to the claim construction analysis. Usually, it is dispositive; it is the single best guide to the meaning of a disputed term.”)). *Hill-Rom* is thus inapposite to this case.

The prosecution history (Ex. 1002) does not reveal anything useful in deciding the proper construction of this limitation of claim 1. *See* Ex. 1002.

The parties rely on extrinsic evidence in support of their respective positions. PO Resp. 11 (citing Ex. 2004 ¶ 145); Pet. Reply 2 (Ex. 1050 ¶ 32); PO Sur-Reply 4. We do not find it necessary or helpful to rely on this extrinsic evidence to determine the meaning of this limitation. *See, supra, Phillips*, 415 F.3d at 1317; *Seabed*, 8 F.4th at 1287; *Sequoia*, 66 F.4th at 1324.

For the foregoing reasons, we determine that claim 1’s limitation reciting that “each of the plurality of stator elements including a coil wound around a magnetic core” means that each stator element includes a coil and a magnetic core, not a magnetic core that is shared by multiple coils.

D. Ground 1: Alleged Obviousness Over Pacala, Johnson, Pardhan, and Zhang

Petitioner contends claims 1–2, 4–9, 11, 14, 16–17, and 19 would have been obvious over the combination of Pacala, Johnson, Pardhan, and Zhang. Pet. 10–56; Pet. Reply 3–26. Patent Owner contends that these claims would not have been obvious. PO Resp. 14–53; PO Sur-Reply 5–23.

We discuss the disclosures of Pacala, Johnson, Pardhan, and Zhang below. In addition, we discuss claim's limitation 1(g) and explain why it is not met by Petitioner's combination. Accordingly, we determine that Petitioner met its burden to show by a preponderance of the evidence that claim 1 is unpatentable over the prior art combination.

1. *Pacala (Ex. 1004)*

Pacala is titled "Cost-Effective LIDAR Sensor for Multi-Signal Detection, Weak Signal Detection and Signal Disambiguation and Method of Using Same." Ex. 1004, code (54). Pacala's Figure 1 is shown below.

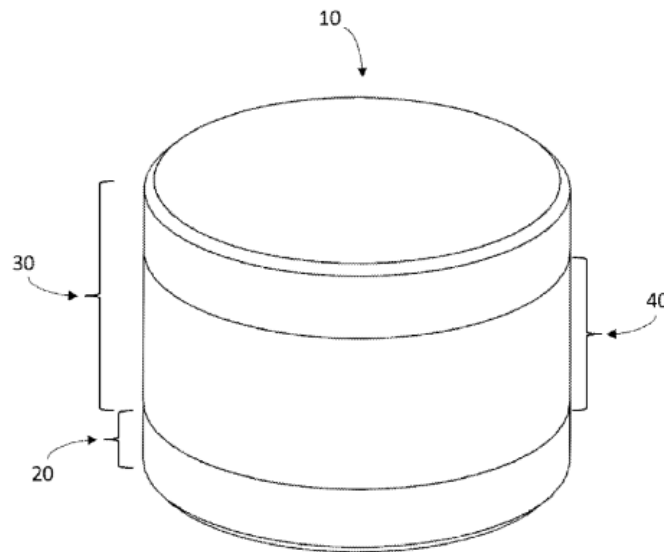


Fig. 1

Figure 1 shows a lidar sensor 10 with static base 20 and static head assembly 30 including window 40 that is transparent to the laser wavelength used in each transmitter. *Id.* ¶ 12.

Pacala's Figure 2 is shown below.

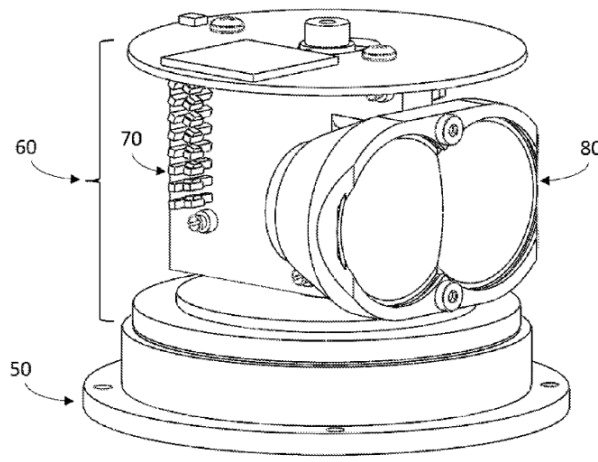


Fig. 2

Figure 2 shows an internal view of the lidar sensor with static base 50 including a motor and distributed electronics, and a spinning turret 60 that contains optoelectronic components 70 including optical transmitters and receivers, collimation and focusing lenses 80, and distributed electronics. *Id.* ¶ 13.

2. *Johnson (Ex. 1005)*

Johnson is titled “Device and Methods for an Electromagnetic Coil.” Ex. 1005, code (54). Johnson discloses a rotary joint device for sensor applications such as LIDAR. *Id.* at 6:51–57, 7:22–27. The rotary joint device permits rotation of a rotor relative to a fixed stator. *Id.* at 6:51–53.

Johnson's Figure 2 is shown below.

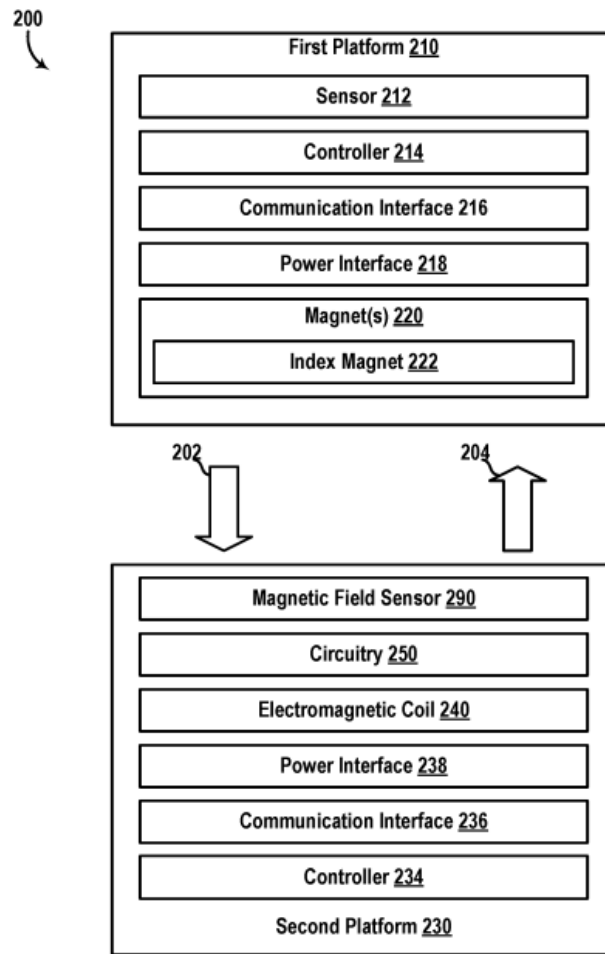


FIG. 2

Figure 2 shows a device 200 with a rotary joint, that includes first platform 210 and second platform 230. *Id.* at 6:60–63. First platform 210 includes a rotor and is configured to rotate relative to second platform 230. *Id.* at 6:64–67. First platform 210 includes sensor 212, controller 214, communication interface 216, power interface 218, and magnets 220. *Id.* at 7:1–5. First platform 210 may include a printed circuit board (PCB) with components mounted thereon. *Id.* at 7:6–15.

Sensor 212 may include a LIDAR sensor. *Id.* at 7:22–27. Controller 214 operates one or more components of first platform 210, and can receive

and provide sensor data to communication interface 216. *Id.* at 7:40–46. Communication interface 216 can be an optical interface that emits modulated light signal 202 for receipt by a light detector of second platform 230. *Id.* at 7:51–55. Power interface 218 may include transformer coils arranged to receive magnetic flux through transformer coils to power components of the first platform 210. *Id.* at 7:64–8:4. The transformer coils of first platform 210 are arranged opposite to corresponding transformer coils of second platform 230. *Id.* at 8:4–7. Magnets 220 can be arranged in a circular arrangement around the axis of rotation of first platform 210, and adjacent magnets may be magnetized in opposite directions. *Id.* at 8:20–30. Magnets 220 can include index magnet 222. *Id.* at 8:49–53.

Second platform 230 includes a controller 234, a communication interface 236, a power interface 238, electromagnetic coil 240, circuitry 250, and magnetic field sensor 290. *Id.* at 8:58–62. Platform 230 may comprise a circuit board that mounts components of device 200. *Id.* at 8:65–67. Controller 234 can operate communication interface 236 to transmit signal 204 indicating transmission of data or instructions to components of first platform 210, or receive a signal therefrom. *Id.* at 9:3–15. Power interface 238 operates in conjunction with power interface 218 to transmit power between platforms 210 and 230, and may comprise a transformer coil to induce current in corresponding transformer coil of power interface 218. *Id.* at 9:19–31. Circuitry 250 causes electrical current to flow through electromagnetic coil 240 to produce a magnetic field that interacts with the magnetic field of first platform 210, resulting in torque that rotates the first platform 210 relative to the second platform 230. *Id.* at 9:35–42. Circuitry 250 may adjust the current to control direction or rate of rotation of first

platform 210. *Id.* at 9:45–47. Magnetic field sensor 290 measures the magnetic field of magnets 220 of first platform 210. *Id.* at 9:48–51. Device 200 can use the output from sensor 290 to determine the orientation or position of platform 210 about its axis of rotation. *Id.* at 10:1–3.

Johnson's Figure 3A is shown below.

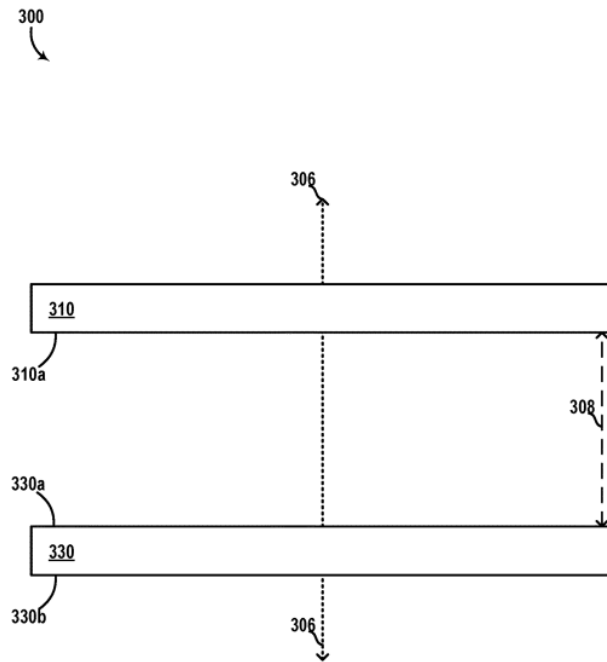


FIG. 3A

Figure 3A shows a side view of device 300 that includes a rotary joint with rotor platform 310 and stator platform 330 that may be similar to platforms 210 and 230. *Id.* at 10:48–52. Sides 310a and 330a of platforms 310 and 330 are spaced by distance 308. *Id.* at 10:52–54. Rotor platform 310 rotates relative to stator platform 330 about axis of rotation 306. *Id.* at 10:55–58.

Johnson's Figure 3B is shown below.

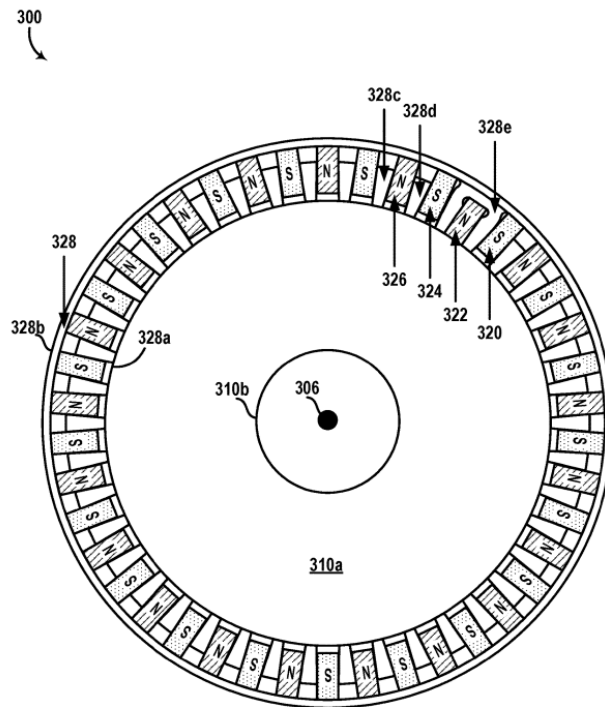


FIG. 3B

Figure 3B shows a cross-section of device 300 with axis of rotation 306 extending through the page. *Id.* at 10:63–64. As shown, device 300 includes a mount 328 on platform 310 to support a plurality of magnets exemplified by magnets 320, 322, 324, 326. *Id.* at 10:64–67, 11:16–21. The magnets are mounted in a circular arrangement, and adjacent magnets are magnetized in opposite directions indicated by “N” and “S” designations. *Id.* at 11:1–10.

Johnson's Figure 3C is shown below.

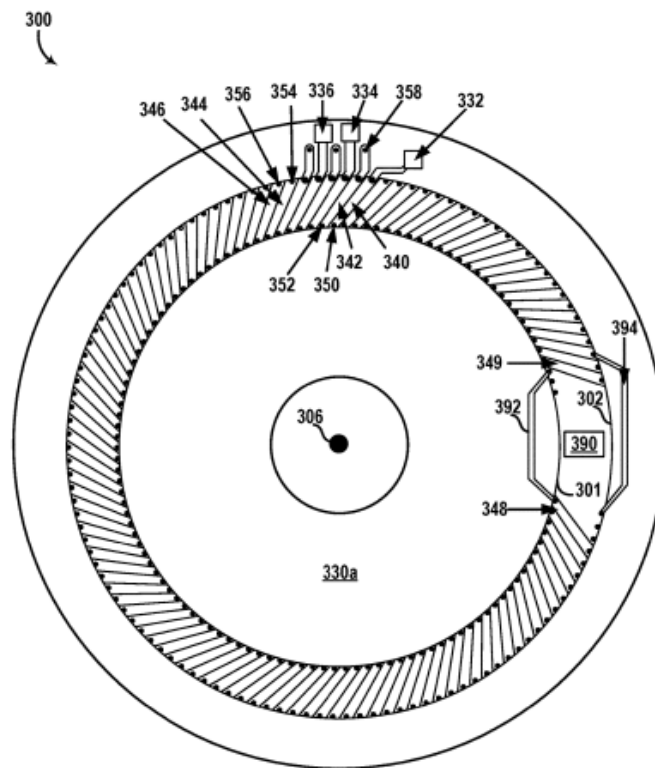


FIG. 3C

Johnson's Figure 3C depicts a cross-section of device 300 showing a side 330a of lower platform 330. *Id.* at 11:66–12:3. In Figure 3C, device 300 includes conductive structures 340, 342, 344, 346, 348, 349, and interconnects 350, 352, 354, 356, 358, among other components. *Id.* at 12:18–25. The interconnects extend through lower platform 330 to connect to corresponding conductive structures on the other side of lower platform 330 (*see* Figure 3D). *Id.* at 13:14–25. Contacts 332, 334, 336 electrically couple the conductive structures to circuitry 350 and may receive a 2- or 3-phase AC signal to control the magnetic field of lower platform 330. *Id.* at 12:28–43.

3. *Pardhan (Ex. 1006)*

Pardhan is titled “Thermal Rotary Link.” Ex. 1006, code (54).
Pardhan’s Figure 4 is shown below.

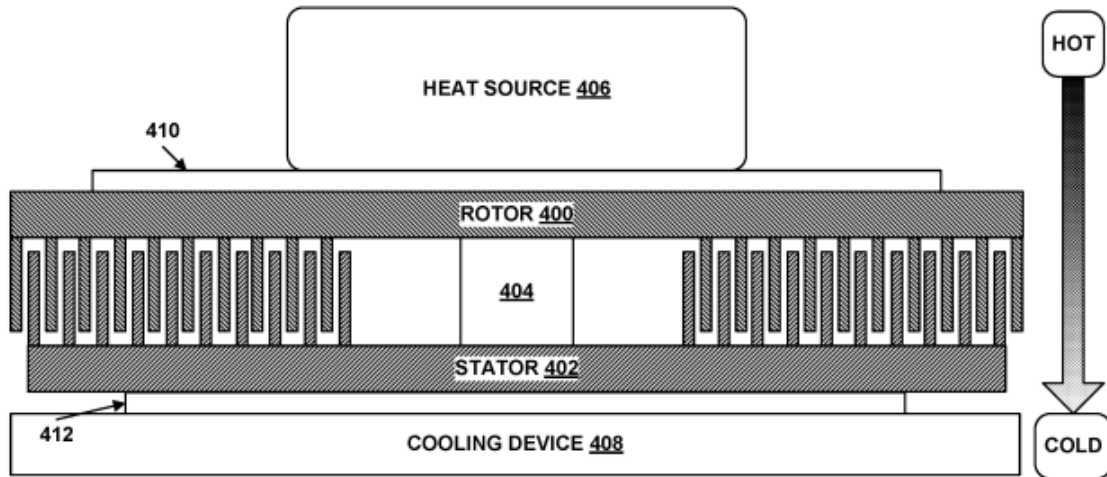


FIG. 4

Figure 4 shows a cross-section of a thermal rotary link for transferring heat from a heat source 406 to a cooling device 408. *Id.* at 16:49–51. The thermal rotary link includes rotor 400 and stator 402 with rotational joint 404 to provide rotation of rotor 400 relative to stator 402. *Id.* at 16:51–54. Heat source 406 (e.g., a LIDAR device) is coupled to rotor 400 by coupling 410, and stator 402 is coupled to cooling device 408 (e.g., cold plate) by coupling 412. *Id.* at 16:65–17:5. Rotor 400 and stator 402 have interposed fins that transfer heat from heat source 406 to cooling device 408. *Id.* at 16:60–64.

Pardhan's Figure 7A is shown below.

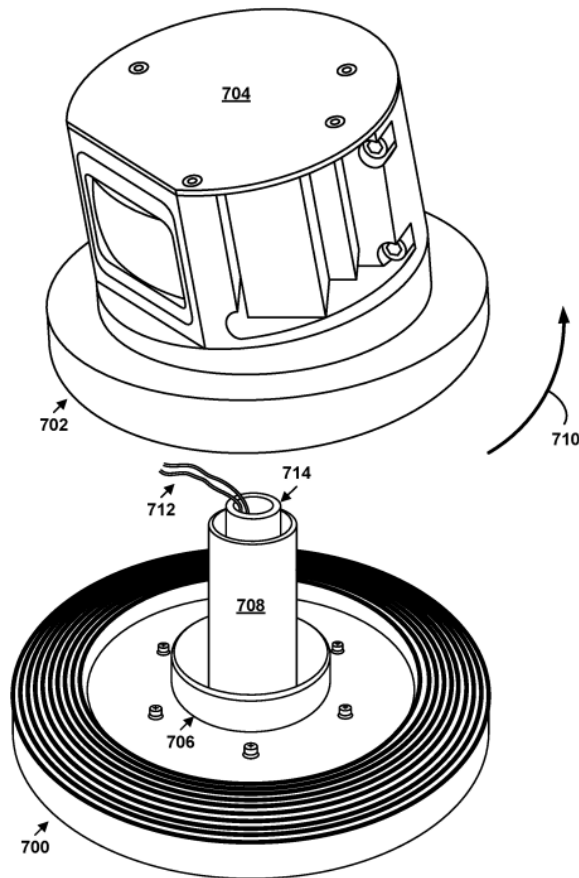


FIG. 7A

Figure 7A shows rods/shafts 708 and 714 extending through stator 700 with wires for power and data connections 712 to connect the LIDAR device to a power source and computing device. *Id.* at 20:30–35. One or more bearings may be used to rotatably mount rod 714 inside rod 708. *Id.* at 20:24–25. A motor may be connected to rod 714 to rotate rod 714 relative to rod 708, and hence LIDAR device 704, relative to stator 700. *Id.* at 20:25–27.

4. *Zhang (Ex. 1007)*

Zhang is titled “Rotating Structure for Laser Radar.” Ex. 1007, 2

(code (54)). Zhang's Figure 1 is shown below.

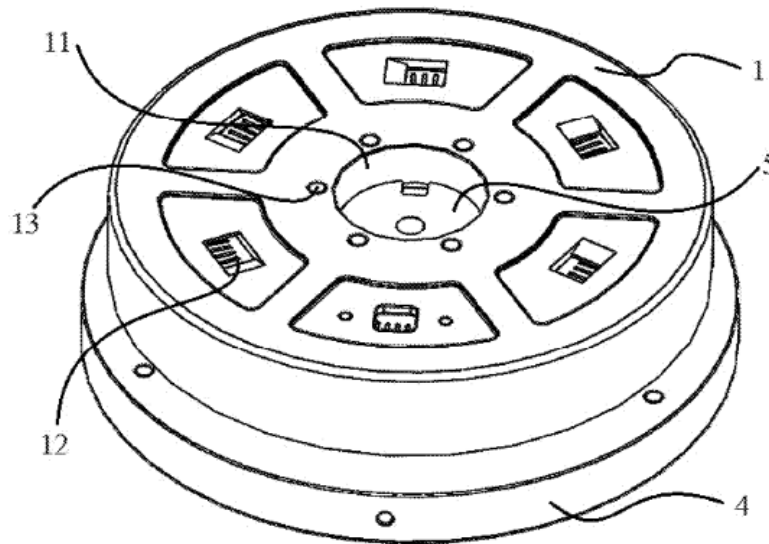


Figure 1

Figure 1 shows rotor 1 connected to stator 4. *Id.* at 4. One or more bearings support the rotation of the rotor 1. *Id.* The rotor 1 is configured with heat dissipation holes 12 with a fan structure to “increas[e] the operating life of the rotating structure.” *Id.* at 6.

5. Analysis of Independent Claim 1

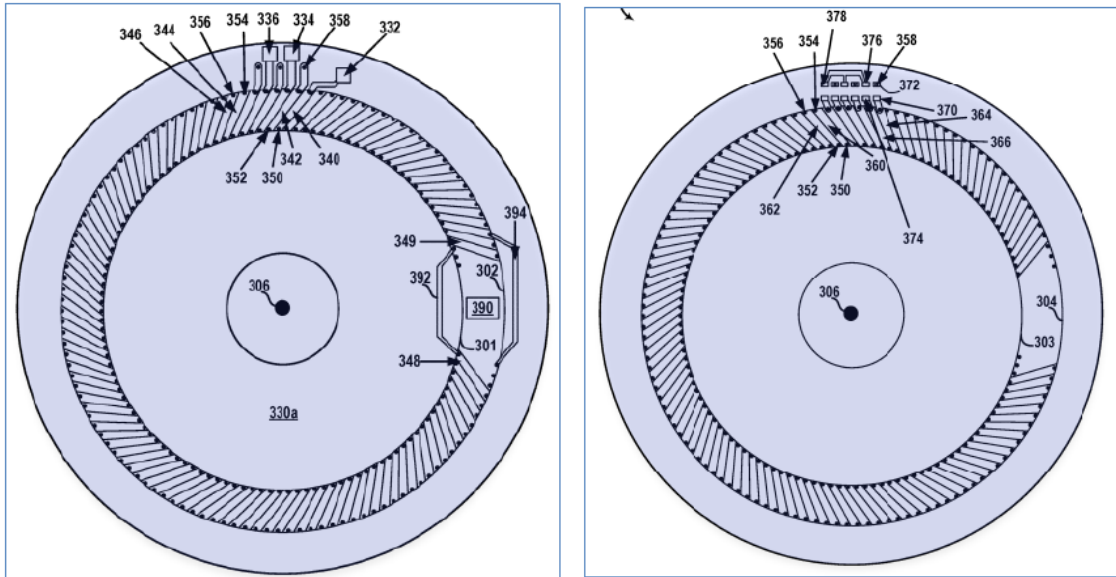
In this section, we explain why the asserted prior art does not satisfy the claim 1 with respect to two limitations: “a stator assembly . . . coupled to the stator circuit board” (limitation 1(g)) (Ex. 1001, 48:37–38); and “each of the plurality of stator elements including a coil wound around a magnetic core” (limitation 1(g)) (Ex. 1001, 48:40–42).

a) Limitation 1(g): “Stator Assembly . . . Coupled to the Stator Circuit Board”

Petitioner contends that Johnson discloses a stator assembly mounted to a stator circuit board as recited in part of Claim 1’s limitation 1(g).

Pet. 36–37 (citing *id.* § IX.E.1(h) (discussing similar limitation 14(h)). In

support of its contentions, Petitioner provides colorized versions of Johnson's Figures 3C and 3D as shown below.



Id. at 32. Petitioner contends that “Figures 3C-3D are layers of Johnson’s stator circuit board that include ‘conductive structures’ (e.g., 340) ‘in a circular arrangement around axis 306,’ contacts (e.g., 332), interconnects (e.g., 350) and a Hall sensor (390).” Petitioner asserts that “[t]he stator elements are ‘mounted to’ the stator circuit board (*id.* at 15:34-42, 11:66-12:18, 8:62-68), such that they are ‘coupled to’ the circuit board under any proposed construction.” *Id.* (citing Ex. 1003 ¶ 182¹³).

Patent Owner argues that Petitioner improperly maps the “stator assembly” to *subcomponents* of Johnson’s “stator circuit board” rather than to a separate and distinct element coupled to the stator circuit board. PO Resp. 28–29 (citing Ex. 2004 ¶¶ 138–139; Pet. 31–33); PO Sur-Reply 18–

¹³ Ex. 1003 ¶ 182 addresses the “rotor assembly” not the “stator assembly.” Ex. 1003 ¶ 178 discussing the “stator assembly” may have been the intended cite, which is similar to the Petition’s language.

19. Specifically, Patent Owner asserts that Johnson discloses a stator platform 330 that is electrically conductive material(s) (e.g., tracks, traces, copper, etc.) patterned on each side of the circuit board, which define “coil windings.” *Id.* at 28–29 (citing Ex. 1005, 11:66–12:16, 12:37–39, Figs. 3C–3D).

In its Reply, Petitioner contends that “Johnson teaches that the conductive structure ‘can be disposed along a mounting surface (e.g., top or bottom layer) of a circuit board’ . . . such that the stator assembly is distinct from the mounting surface of the circuit board and both are coupled.” Pet. Reply 14 (citing Ex. 1005, 3:57–64; Ex. 1050 ¶¶ 27–29). Petitioner asserts that Patent Owner’s “arguments to the contrary improperly seek to exclude stator assemblies built onto the circuit board. Pet. Reply 14 (citing *id.* § I.A; Ex. 1001, 4:28–31, 4:19–22). Petitioner further argues that “Johnson teaches embodiments where the stator assembly is comprised of wires wound around a magnetic core, rather than interconnected conductive structures built onto a multi-layer circuit board.” *Id.* at 14–15 (citing Ex. 1005, 3:30–39, 4:56–5:7; Ex. 1050 ¶ 30).

We have construed claim 1’s limitation 1(g) to require “stator circuit board” and “stator assembly” that are separate and distinct elements. *See* § III.C.1, *supra*. Johnson discloses coil windings that are formed by patterning interleaved structures in a multi-layered printed circuit board (PCB) forming the stator platform 330, and interconnecting them in groups with vias filled with conductive material. Ex. 1005, 11:66–13:57. Figs. 3C–3D; Ex. 2004 ¶¶ 138–139. We agree with Patent Owner that a POSITA would have considered the coil windings to be subcomponents of Johnson’s stator platform 330, which do not define a separate and distinct

“stator assembly . . . coupled to a stator circuit board.” Ex. 2004 ¶ 139. In other words, the “printed” conductive tracks and traces would have been considered part of the PCB, not something separate. *Id.*

Although Petitioner contends that Johnson discloses other embodiments in which a stator assembly is comprised of wires wound around a magnetic core (Pet. Reply 14–15 (citing Ex. 1005, 3:30–39, 4:56–5:7; Ex. 1050 ¶ 30)), Petitioner does not show that Johnson discloses that those embodiments are coupled to a stator circuit board as recited in claim 1’s limitation 1(g).

Petitioner did not rely on Pacala, Pardhan, nor Zhang to cover the deficiencies of Johnson.

Accordingly, for the above reasons, we determine that Petitioner has not shown by a preponderance of the evidence that Johnson discloses “a stator assembly . . . coupled to a stator circuit board” as recited in claim 1’s limitation 1(g).

b) Limitation 1(g): “Each of the Plurality of Stator Elements Including a Coil Wound around a Magnetic Core”

Petitioner contends that Johnson’s conductive structures are coupled to one another to form coil windings. Pet. 32, 36 (citing Ex. 1005, 4:56–5:8, 13:14–50). Specifically, apparently in reference to Johnson’s Figures 3C and 3D, Petitioner states the following:

For example, “a first coil winding” may comprise “structure 340, interconnect 350, structure 360, interconnect 354, structure 344, etc., through structure 364” and a “second coil winding” may comprise “structure 342, interconnect 352, structure 362, interconnect 356, structure 346, etc., through structure 366.”

Pet. 32–33 (citing Ex. 1005, 13:26–40).

According to Petitioner, “Johnson also teaches that the coils are wound around a magnetic core.” Pet. 37 (citing Ex. 1005, 5:41–56, 14:1–10, Figs. 3C–3D; Ex. 1003 ¶¶ 205–206); PO Reply 15 (citing Ex. 1003 ¶¶ 178–180; Pet. 31–32). Specifically, Petitioner contends that “Johnson teaches that ‘a magnetically permeable core’ can be inserted between the two layers of [Figures] 3C and 3D’ to ‘enhance[] the stator-platform magnetic field.’” *Id.* (citing Ex. 1005, 5:41–46, 14:1–10).

Patent Owner argues that “Johnson’s disclosure of a plurality of coil windings wound around a single, ring-shaped core shared by all coil windings does not teach or suggest a plurality of stator elements each including a coil wound around a magnetic core.” PO Resp. 31 (citing Ex. 1001, 30:15–35; Ex. 2004 ¶ 146). Patent Owner asserts that Petitioner’s view of the claim language removes the requirement that each stator element has a magnetic core, and directly conflicts with the ’515 patent’s specification. PO Sur-Reply 4–5 (citing Ex. 1001, 30:24–26, Fig. 6D).

We determined that the proper construction of “each of the plurality of stator elements including a coil wound around a magnetic core” in claim 1’s limitation 1(g) means that each stator element includes a coil and a magnetic core, not a magnetic core that is shared by multiple coils. *See* § III.C.2, *supra*. Petitioner does not contend nor show that Johnson discloses the claimed feature as construed.

Petitioner did not rely on Pacala, Pardhan, nor Zhang to cover the deficiencies of Johnson.

Consequently, we determine that Petitioner has not shown by a preponderance of the evidence that Johnson discloses “each of the plurality

of stator elements including a coil wound around a magnetic core” as recited in claim 1’s limitation 1(g).

c) Conclusion for Claim 1

For the above reasons, Petitioner has not shown that the combination of Pacala, Johnson, Pardhan, and Zhang discloses the above-noted limitations of claim 1.

6. Analysis of Dependent Claim 4

Dependent claim 4 depends from claim 1 and recites

a third circuit board fixedly coupled to the base and arranged in a plane parallel with the first plane and disposed between the enclosure base and the stator circuit board; and

a fourth circuit board coupled to rotate with the rotor circuit board between the enclosure top and the rotor circuit board and arranged in a plane parallel with the first plane.

Ex. 1001, 49:10–19.

Petitioner contends that the “third circuit board” and the “fourth circuit board” of claim 4 would have been obvious. Pet. 40–43; Pet. Reply 15–19. Patent Owner disagrees with Petitioner’s assertion. PO Resp. 39–45; PO Sur-Reply 19–20.

Specifically, Petitioner asserts that Johnson teaches a stator platform has electronics on top and bottom sides, which may be considered the “stator circuit board” and “third circuit board,” respectively. Pet. 41.

Petitioner further asserts that Johnson teaches an outer layer of a circuit board that may be regarded a “rotor circuit board,” and an inner layer or “other circuit board” that may be considered the “fourth circuit board.” Pet. 41 (citing Ex. 1005, 10:57–62, 11:61–65; Ex. 1006, 6:35–41; Ex. 1003 ¶ 220).

Petitioner argues that implementing Johnson’s multi-layer PCB using separate circuit boards is a “straightforward design choice” supported by Johnson’s teaching that a “multi-layer PCB” is “one implementation” and that “other implementations are possible.” *Id.* at 42 (citing Ex. 1005, 12:4–18, 19:66–20:4; Ex. 1040); Pet. Reply 15. Petitioner contends that Johnson teaches that its LIDAR devices may include components not shown, which would necessitate additional circuit boards for these components. Pet. Reply 16 (citing Ex. 1005, 10:36–48, 11:61–62; Ex. 1003 ¶ 223). In addition, Petitioner asserts that its proposed modification of Johnson is the simple substitution of one known element (a multi-layered PCB) for another (separate PCBs) to obtain predictable results (electronics mounted on separate circuit boards). *Id.* (citing Ex. 1003 ¶ 222).

Moreover, Petitioner argues that a POSITA would have recognized that LIDAR electronics may not fit on a single stator and rotor circuit board, such that additional circuit boards are needed, as taught by U.S. Patent No. 9,606,230 (“Nubling”). *Id.* at 42–43 (citing Ex. 1043, 2:62–3:3, 3:36–40, 6:1–8, Fig. 3; Ex. 1003 ¶ 223); Pet. Reply 16–18.

Furthermore, Petitioner argues that Patent Owner’s contention that an additional circuit board would disrupt Pardhan’s heat transfer amounts to a “bodily incorporation” argument, and that Patent Owner does not explain why the additional circuit board causes a problem in Pardhan but not in the ’515 patent. Pet. Reply 18–19.

Patent Owner asserts that the plain language of claim 4 “requires separate circuit boards, not different layers of the same board.” PO Resp. 40 (citing Ex. 2004 ¶¶ 161, 165). Patent Owner argues that Johnson does not

disclose or suggest an inner layer for the rotor circuit board. *Id.* at 41 (citing Ex. 2004 ¶¶ 166–168).

Furthermore, Patent Owner argues that Johnson’s toroidal coil windings are formed in separate layers of a multi-layer PCB bridged by interconnect elements, and separating Johnson’s layers into separate circuit boards would mean that limitation 1(g) requiring a coil wound around a magnetic core, is no longer satisfied. *Id.* (citing Ex. 2004 ¶ 174).

Patent Owner further argues that Johnson only discloses the multi-layer PCB in relation to the stator, not the rotor, so Petitioner’s alternative argument is inapplicable to the rotor. *Id.* at 42 (citing Ex. 2004 ¶¶ 166–167).

In addition, Patent Owner argues that Nubling’s and Hall’s additional (rotor) circuit board is perpendicular to Johnson’s rotor platform, not parallel to it as required by claim 4. *Id.* (citing Pet. 42–43; Ex. 1009, 7:3–9, Fig. 4; Ex. 1043, 5:50–52, Fig. 3; Ex. 2004 ¶ 177); PO Sur-Reply 19.

Moreover, Patent Owner argues that Petitioner’s proposed placement of a “fourth circuit board” under the LIDAR “heat source” would disrupt heat flow in Pardhan’s heat transfer scheme, and prevent the LIDAR device from obtaining Pardhan’s objective of maintaining a stable operating temperature. PO Resp. 42–45; PO Sur-Reply 19–20.

We find Patent Owner’s arguments persuasive in demonstrating that claim 4 would not have been obvious over the combination of Pacala, Johnson, Pardhan, and Zhang. PO Resp. 39–45; PO Sur-Reply 19–20. Contrary to Petitioner’s contention, a POSITA would *not* have considered the different layers of Johnson’s stator board to be separate circuit boards, but instead parts of the same circuit board. Pet. 41–42; PO Resp. 40; Ex. 2004 ¶¶ 161–165. Nor has Petitioner adequately explained how the

conductive structures of multiple layers forming the coil windings on Johnson's stator circuit board would remain interconnected to form coils if the conductive structures were separately implemented on different circuit boards. Pet. 42–43; PO Resp. 40; Ex. 2004 ¶ 163.

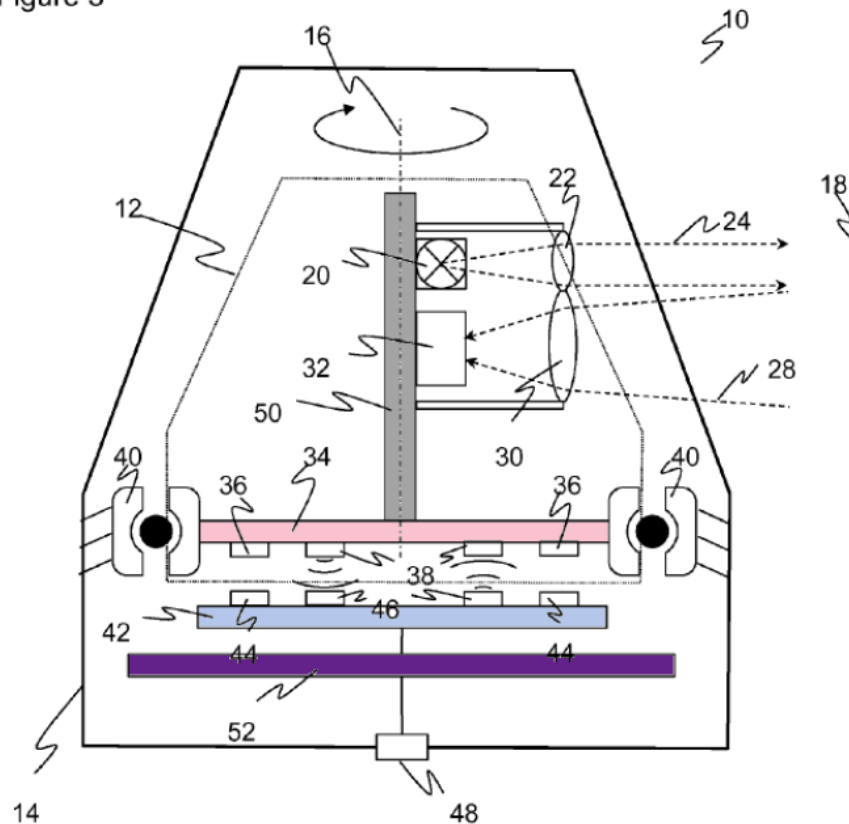
As support for the “fourth circuit board,” Petitioner relies on Johnson's stating “mount 328 can be arranged along a periphery of a printed circuit board (PCB) *or other circuit board*.” Ex. 1005, 11:62–64. However, Petitioner has not adequately explained why the emphasized language is not referring to a different type of circuit board than one that is “printed,” as opposed to a separate circuit board.

We further agree with Patent Owner that Nubling¹⁴ shows additional (rotor) circuit board 50 perpendicular to the first (rotor) circuit board 34, and thus runs afoul of the language of claim 4 requiring the circuit boards to be positioned in parallel planes. PO Resp. 42; Pet. 42–43; Ex. 1043, 4:22–24, 4:52–54, 5:50–56, Figure 3 (showing circuit boards 34, 42 and additional circuit boards 50, 52).

¹⁴ Nubling is not asserted in any challenge ground. However, Petitioner contends that Nubling reflects the general knowledge in the art. Pet. 42–43.

To explain our view, we reproduce Petitioner's colorized version of Nubling's Figure 3 below.

Figure 3



Pet. Reply 17. Nubling's colorized Figure 3 above shows a first (rotor) circuit board 34 (red), a second (stator) circuit board 42 (blue), a third (stator) circuit board (purple) 52, and a fourth (rotor) circuit board (gray) 50 which is perpendicular to the first circuit board.

Although Petitioner asserts that Nubling states that this “should only serve as an example for the additional circuit boards” (Ex. 1043, 5:47–56), Petitioner assumes too much in inferring that this means that the additional rotor circuit board would be reoriented to be parallel with the first rotor circuit board. The purpose of Nubling's Figure 3 embodiment is to eliminate the mirror of Nubling's Figure 1 embodiment. Ex. 1043, 5:60.

Nubling's Figure 1 and Figure 3 embodiments each show that the optical axes of the light transmitter 20 and light receiver 32 are perpendicular to the circuit boards to which they are attached, which is why the fourth circuit board 50 must be oriented to be perpendicular to rotor circuit board in the Figure 3 embodiment. In addition, as shown in Nubling's Figure 3 above, base unit 14 narrows from top to bottom such that there is more space to position an additional circuit board in the direction perpendicular to first (rotor) circuit board than there is in the direction parallel to it.

Thus, for the reasons stated for claim 1, from which claim 4 depends, and for the reasons stated in this section, we determine that the limitations of claim 4 are not disclosed by the combination of Pacala, Johnson, Pardhan, and Zhang.

7. Analysis of Independent Claim 14

Claim 14's limitation 14(d) recites "a stator circuit board . . ." and limitation 14(h) recites "a stator assembly coupled to the stator circuit board." Ex. 1001, 50:8, 21. Petitioner contends that the combination of Pacala, Johnson, Parhan, and Zhang discloses limitations 14(d) and 14(h). Pet. 21–23, 31–33; Pet. Reply 14–15. Patent Owner disagrees. PO Resp. 28–30; PO Sur-Reply 18–19.

For similar reasons as explained in § III.D.5.a, we find that Petitioner has not shown by a preponderance of the evidence that the combination of Pacala, Johnson, Pardhan, and Zhang satisfies these limitations of claim 14 due to the deficiencies of Johnson which discloses coils printed on a PCB, not a separate stator assembly coupled to a stator circuit board.

8. *Dependent Claim 17*

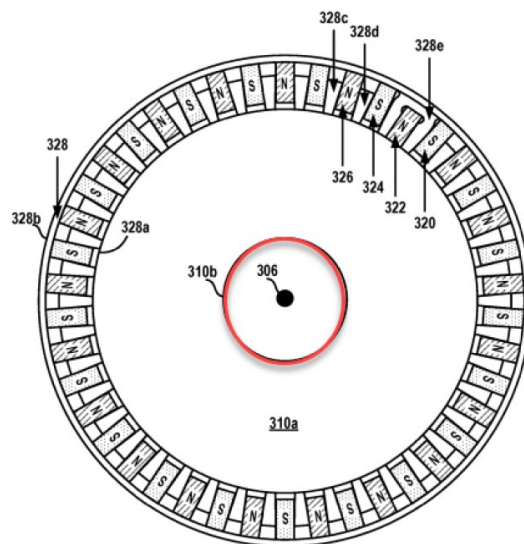
Claim 17 depends from claim 14 and recites

a wireless power transformer integrated directly onto the stator and rotor circuit boards, the wireless power transformer comprising a first annular transformer coil disposed on a surface of the stator circuit board and a second annular transformer coil disposed on a surface of the rotor circuit board in an opposing relationship with the first annular transformer coil, wherein the first transformer coil is concentric with and positioned outside an outer perimeter of the plurality of stator elements and the second transformer coil is concentric with and positioned outside an outer perimeter of the rotor assembly annular arrangement.

Ex. 1001, 50:60–51:19.

Petitioner contends that claim 17 is met by the combination of Pacala, Johnson, Pardhan, and Zhang. Pet. 48–51; Pet. Reply 21–23; Ex. 1003 ¶¶ 243–247. Patent Owner argues that claim 17 is not disclosed by the combination. PO Resp. 45–53.

Petitioner provides a modified version of Johnson’s Figure 3B, as shown below:



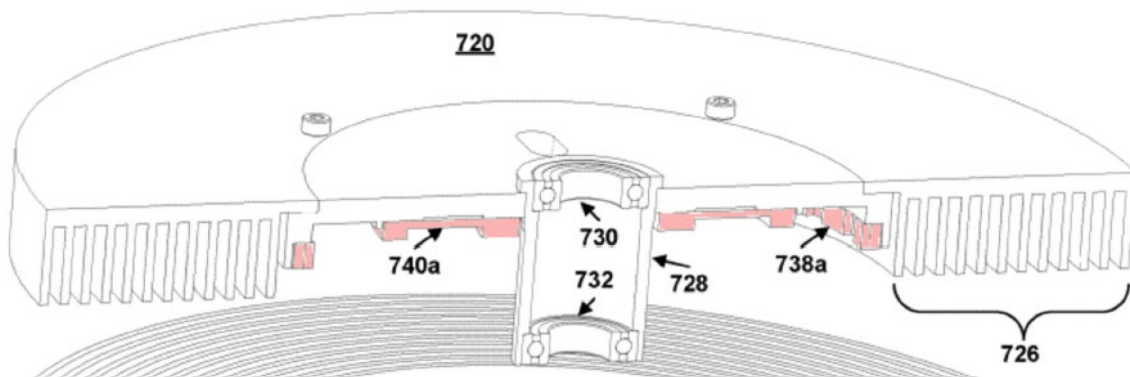
Pet. 50. In Johnson’s Figure 3B above, Petitioner indicates with a red circle a transformer coil 310b of Johnson’s rotor platform 310. *Id.* (citing Ex. 1005, 11:51–60, Fig. 3B). Petitioner argues that Johnson’s Figures 3B–3C disclose transformer coils on the inside of stator and rotor elements in Figures 3B–3C, but teaches that “[o]ther configurations are possible.” Pet. 50 (citing Ex. 1005, 8:14–15). Petitioner argues that positioning transformer coils outside of the stator and rotor elements is “one of a limited number of obvious design choices” and that the region in the center of the circuit board has limited space, so that it would be “logical and common to place the transformer coils on the outside of the rotor/stator elements.” *Id.* at 50–51.

Petitioner further argues that “the perimeter of the motor magnets and windings depends on the size of the motor, and a LiDAR system with a smaller motor will have less space in the center of the circuit board.” *Id.* at 54 (citing Ex. 1003 ¶ 255). Petitioner asserts that a “LiDAR system may also need larger transformer coils to increase the power transfer distance in some application, and the transformer coils may be too large for the limited center region space” and a “POSITA would thus have understood that the position of the transformer coils relative to the rotor and stator elements is a simple design choice with no novel or unexpected results.” *Id.* at 54–55.

Patent Owner argues that “Petitioner admits that none of the references relied upon by Petitioner teach first and second transforme[r] coils positioned as claimed.” PO Resp. 45. Specifically, Patent Owner contends that Johnson, Zhang, and Pardhan all disclose the transformer coils in the inside of the motor and thus in the opposite position as that claimed. *Id.* at 45–53. Patent Owner contends that Pardhan teaches the desirability of

a smaller transformer (PO Resp. 46 (citing Ex. 1006, 21:9–13, Fig. 7B (annotated); Ex. 2004 ¶¶ 182–183)); that Zhang teaches that providing its transformer on the inner side of a shaft system is a technical advantage (PO Resp. 47–48 (citing Ex. 1007, 3–6, Fig. 2 (annotated); Ex. 2004 ¶ 184)); and that Johnson’s transformer coils are placed inside of its rotor and stator elements to maximize torque while maintaining a compact design (PO Resp. 48–51 (citing Ex. 1005, 11:51–60, Figs. 3B–3C; Ex. 2004 ¶¶ 187–188)).

In support of its argument, Patent Owner provides the following annotated partial view of Pardhan’s Figure 7B:



PO Resp. 52. Patent Owner argues that “a POSITA attempting to utilize oversized transformer coils *against* the express teachings of Johnson, Pardhan, and Zhang, would find no room for them to be positioned outside the rotor magnets due to Pardhan’s fins 726 [as shown above], which Petitioner asserts are necessary ‘to avoid[] overheating.’” *Id.* (citing Pet. 30; Ex. 2004 ¶ 189).

Patent Owner further notes that Petitioner’s declarant, Dr. Lebby, opined that “a POSITA . . . *could have* certainly designed another embodiment where the magnets and transform windings would have been outside the coils” but that he “can’t predict how a POSITA would *like* to design a system.” *Id.* (citing Ex. 2005, 100:22–101:4, 103:15–16) (emphasis

Patent Owner’s). Patent Owner asserts that “obviousness concerns whether a skilled artisan not only *could have made* but *would have been motivated to make* the combinations or modifications of prior art to arrive at the claimed invention.” *Id.* (quoting *Belden Inc. v. Berk-Tek LLC*, 805 F. 3d 1064, 1073 (Fed. Cir. 2015)) (emphasis Patent Owner’s).

Patent Owner’s arguments are persuasive. Johnson, Pardhan, and Zhang all disclose transformer coils positioned inside of the rotor/stator elements of the motor. Specifically, Johnson’s Figure 3B shows a transformer coil 310b positioned inside rotor elements (magnets 320, 322, 324, 326), and Figure 3C shows the corresponding transformer coil (unnumbered) inside of the stator coils defined by conductive structures. Ex. 1005, 11:51–60, 13:26–40. Similarly, Pardhan shows in Figure 7B a transformer 740a, 740b positioned inside of rotor/stator elements 738a, 738b, and suggests that a smaller rotary transformer is desirable. Ex. 1006, 20:64–21:13. Likewise, Zhang’s Figures 2 and 3 show an electrical power transmission unit including first coupling coil (5) and second coupling coil (unnumbered) positioned inside of motor coil (2). Ex. 1007, 4–5.

Against the teachings of Johnson, Pardhan, and Zhang, Petitioner argues that putting the transformer coils outside of the stator coils would have been an obvious design choice. Pet. 50–51, 54–55. However, as Patent Owner noted, “merely stating that a particular placement of an element is a design choice does not make it obvious.” PO Resp. 50 (citing *Polaris Indus., Inc. v. Arctic Cat, Inc.*, 882 F.3d 1056, 1067–70, 1069 n.4 (Fed. Cir. 2018); Ex. 2004 ¶ 186). That Johnson, Pardhan, and Zhang all disclose the transformer coils inside of the rotor/stator elements of the motor suggests that there were good reasons for doing this in their configurations.

Zhang expressly teaches that one such reason is to avoid interference with power transmission.¹⁵ Ex. 1007, 3. Thus, according to Zhang, moving transformer coils outside of the rotor/stator elements in Petitioner's combination would undesirably interfere with power transmission such that a POSITA would not have pursued the combination.

Accordingly, we find that claim 22's limitation 22(h) is missing from the combination of Pacala, Johnson, Pardhan, and Zhang.

9. Dependent Claims 2, 5 –9, 11, 16, and 19

Claims 2, 5–9, 11, 16, and 19 depend from either claim 1 or claim 14, directly or indirectly. In addition, claims 5 and 6 depend from claim 4, which depends from claim 1. Because we determine that limitations of claims 1, 4, and 14 are missing from the combination of Pacala, Johnson, Pardhan, and Zhang, we likewise conclude they are missing from these dependent claims.

10. Motivation to Combine and Reasonable Expectation of Success

As the above-noted limitations of the claims are missing from the prior art combination, we do not reach the issues of motivation to combine and reasonable expectation of success beyond what is already discussed herein. *PAR*, 773 F.3d at 1194 (citing *Medichem*, 437 F.3d at 1164 (stating that we consider motivation to combine and reasonable expectation of success only “if all the elements of an invention are found in a combination

¹⁵ It may also have been done to prevent magnetic flux from the primary transformer coil from adversely affecting the motor and circuit board electronics.

of prior art references”)). Pet. 51–56; PO Resp. 15–18; Pet. Reply 22–28; PO Sur-Reply 5–17.

11. Secondary Considerations

In light of the claim limitations missing from the prior art combination as discussed above, and because the secondary considerations would only weigh, if at all, toward non-obviousness of the claims, we do not address the secondary considerations further in this decision. PO Resp. 73–78; Pet. Reply 28–30; PO Sur-Reply 26–27.

12. Conclusion for Ground 1

For the foregoing reasons, Petitioner has *not* shown by a preponderance of the evidence that claims 1–2, 4–9, 11, 14, 16–17, and 19 would have been obvious over the combination of Pacala, Johnson, Pardhan, and Zhang.

E. Ground 2: Alleged Obviousness Over Pacala, Johnson, Pardhan, Zhang, and Cai

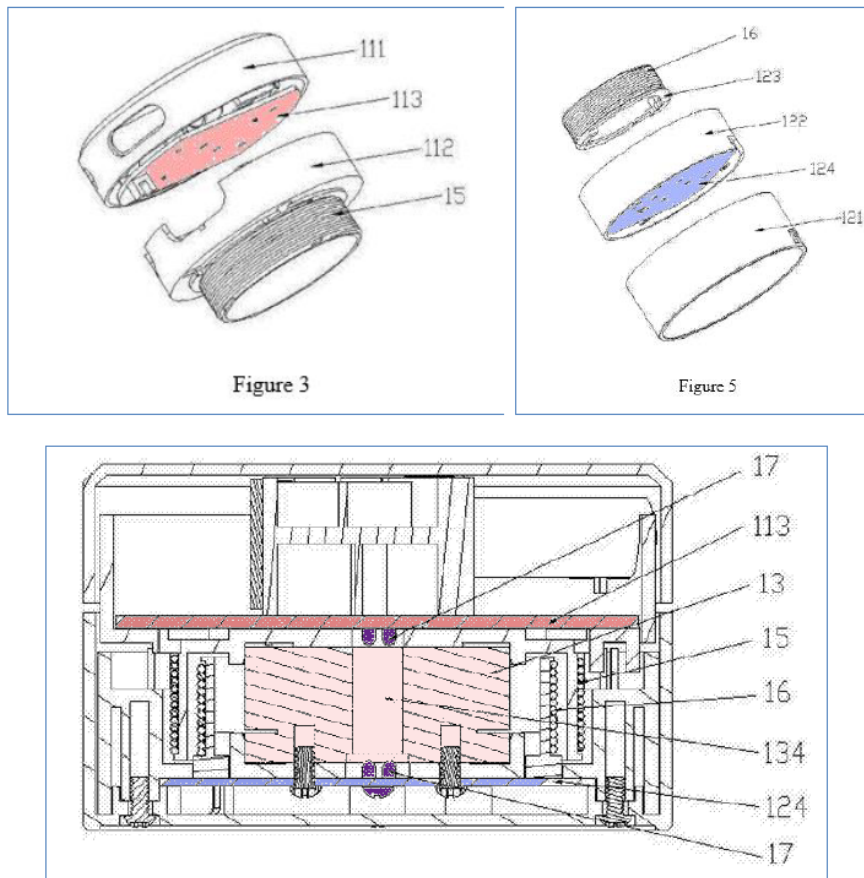
Claims 2 and 4–6 depend from claim 1, and claim 17 depends from claim 14, and thus incorporate their respective limitations. Ex. 1001, 49:1–6, 49:20–36, 50:60–51:4.

Petitioner contends that claims 2, 4–6, and 17 would have been obvious over the combination of Pacala, Johnson, Pardhan, Zhang, and Cai. Pet. 56–66; Pet. Reply 15–24. Patent Owner asserts that these claims would not have been obvious over the combination. PO Resp. 53–57.

Petitioner relies on Cai as disclosing “transceivers are mounted on additional ‘third’ and ‘fourth’ circuit boards above and below the rotor-stator elements so as to form a wireless communication channel through the hollow shaft.” Pet. 59. Petitioner does not rely on Cai to cover the above-

noted deficiencies of Johnson with respect to claim 1's limitation 1(g) or claim 14's limitation 14(h). *See* §§ III.D.5–12.

Regarding claim 4, Petitioner argues that “Cai teaches placing additional circuit boards (113/124) above and below the motor for mounting transceivers (17).” Pet. 61. Petition reproduces colorized versions of Cai's Figure 3, 5, and 8 as shown below.



Pet. 62. Cai's Figures 3, 5, and 8 above show circuit board 113 (red) on the rotor side, and circuit board 124 (blue) on the stator side. Pet. 61–62 (citing Ex. 1008 ¶ 25; Ex. 1003 ¶¶ 267–268).

Petitioner contends the following:

When applying the teachings of Cai to Johnson and Pardhan, Cai's “circuit board 124” would be fixedly coupled to the base

and positioned below the stator circuit board that is part of the motor. EX1003, ¶269. Similarly, Cai’s “circuit board (113)” would be positioned atop the motor (and on top of Johnson’s rotor platform), such that it is between the enclosure top and the rotor circuit board and arranged in a plane parallel with the first plane (defined by the stator circuit board). *Id.*

Pet. 62–63.

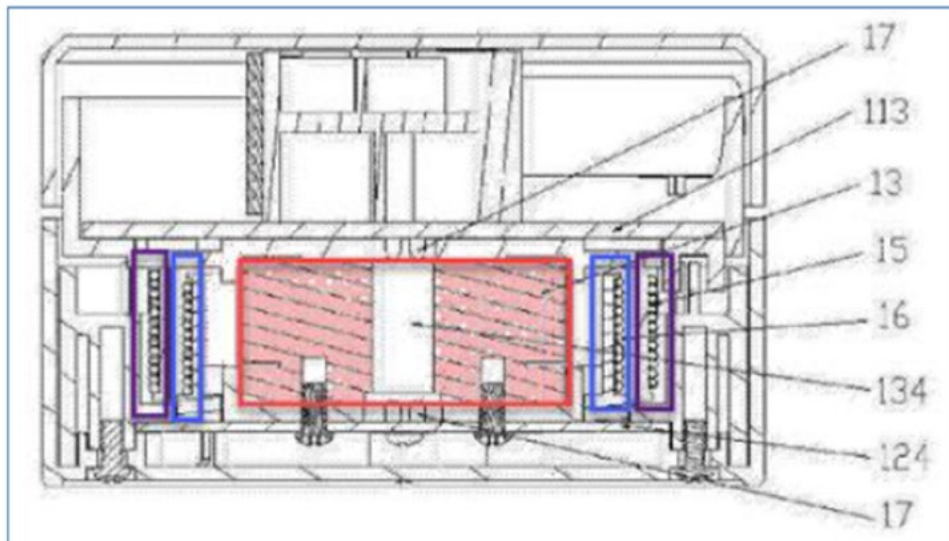
Patent Owner argues that “Johnson already teaches a means for communication between its rotor and stator circuit boards: placing a communications interface on the circuit boards within its motor.” PO Resp. 54 (citing Ex. 1005, 7:8–21, 8:54–67, 9:4–18; Ex. 2004 ¶¶ 196–197). Patent Owner asserts that “[t]his renders Cai redundant” and that “Cai’s similar use of transceivers to form a communications interface on its only two circuit boards illustrates that *only* two circuit boards are needed for a communications interface, already achieved by Johnson.” *Id.* Patent Owner further argues that Petitioner’s motivation to combine relied on Johnson for its compactness, so a POSITA would not increase the size of Johnson’s system by adding circuit boards to provide a redundant feature.” *Id.* at 54–55.

We agree with Patent Owner’s arguments. A POSITA looking at Johnson and Cai would have considered both to teach using only two circuit boards. Ex. 1005, 7:8–21, 8:54–67; Ex. 1008 ¶¶ 26, 28, Fig. 8 [113, 124]; Ex. 2004 ¶¶ 196–197. Moreover, as Patent Owner argues, Johnson already has a communication interface (Ex. 1005, 9:4–18), and Petitioner has not identified sufficiently what would be gained by the combination to justify the increase in size and complexity that would result from adding redundant circuit boards. As additional space would be needed in the device resulting from the combination to house additional circuit boards, “compactness”

would suffer, contrary to one of the stated motivations for the combination.
See, e.g., Pet. 11, 21, 31, 52.

Accordingly, Petitioner has not shown by a preponderance of the evidence that claim 4 would have been obvious over the combination of Pacala, Johnson, Pardhan, Zhang, and Cai.

Regarding claim 17, Petitioner contends that Johnson “does not expressly teach that annular transformer coils are on the inside [perimeter] of the rotor-stator elements.”¹⁶ Pet. 63 (citing *id.* § IX.E.11). Petitioner provides the following annotated version of Cai’s Figure 8.



Pet. 64. Petitioner argues that Cai’s Figure 8 above, as annotated, shows the transformer coils 15, 16 (purple and blue) are positioned outside of the motor (red). Petitioner argues that applying Cai’s teaching to Johnson

¹⁶ Because Johnson does disclose transformer coils inside of the perimeter of rotor/stator elements (Ex. 1005, Figs. 3B [310b], 3C–3D [unnumbered circles]), this sentence appears to be a mistake in the Petition. We assume that Petitioner meant to acknowledge here that Johnson does teach transformer coils inside of the perimeter formed by its motor’s rotor/stator elements.

would result in transformer coils positioned outside of the stator and rotor elements of Johnson's motor. *Id.* at 65; Ex. 1003 ¶¶ 272–275.

Patent Owner argues that Johnson, Pardhan, and Zhang all teach that the transformer coils should be inside of the motor, and there is no room to move them outside as Cai teaches due to Pardhan's fins. PO Resp. 55. Patent Owner further asserts that the claims require that the wireless power transfer is "integrated directly onto" the surfaces of the stator and rotor circuit boards, which Cai does not teach. *Id.* at 56–57 (citing Ex. 2004 ¶¶ 202–203).

We agree with Patent Owner's assertions. As explained in § III.D.8 discussing claim 17, Johnson, Pardhan, and Zhang all disclose transformer coils positioned inside of the rotor/stator elements of the motor, and Zhang states this is done so as not to interfere with power transmission. Ex. 1007, 3. Although Cai's Figure 8 above shows the transformer coils 15, 16 (purple and blue) are positioned outside of the motor (red), they are not shown to be connected directly to the surfaces of circuit boards 113, 124. Hence, Cai's coils are not "integrated directly onto the stator and rotor circuit boards" or "disposed on" their surfaces, as required by claim 17. Ex. 1008 ¶¶ 25–28.

Consequently, for the reasons stated for limitation 1(g) of claim 1, claim 4, limitation 14(h) of claim 14, and claim 17 in §§ III.D.5–8, and for the reasons stated in this section, Petitioner does not show by a preponderance of the evidence that claims 2, 4–6, and 17 would have been obvious over the combination of Pacala, Johnson, Pardhan, Zhang, and Cai.

F. Ground 3: Alleged Obviousness Over Pacala, Johnson, Pardhan, Zhang, Cai, and Hall

Claims 5 and 6 depend from claim 1, and thus include its limitations. Ex. 1001, 49:20–36.

Petitioner contends that claims 5 and 6 would have been obvious over the combination of Pacala, Johnson, Pardhan, Zhang, Cai, and Hall. Pet. 66–74; Pet. Reply 26. Patent Owner asserts that these claims are not obvious. PO Resp. 53–57.

Petitioner asserts that “Hall further confirms that the arrangement of transmit and receive modules recited in claims 5-6 was obvious.” Pet. 68. Petitioner does not rely on Hall to cover the above-noted deficiencies of Johnson with respect to claim 1’s limitation 1(d) or claim 4 from which claims 5 and 6 depend. *See* §§ III.D.5–6, III.D.12, and III.E.

Consequently, Petitioner does not show by a preponderance of the evidence that claims 5 and 6 would have been obvious over the combination of Pacala, Johnson, Pardhan, Zhang, Cai, and Hall.

G. Ground 4: Alleged Obviousness Over Pacala, Johnson, Pardhan, Zhang, and Spector

Claim 12 depends from claim 1, and claim 20 depends from claim 14, and thus incorporate their respective limitations. Ex. 1001, 49:55–64, 51:26–36.

Petitioner contends that claims 12 and 20 would have been obvious over the combination of Pacala, Johnson, Pardhan, Zhang, and Spector. Pet. 74–78; Pet. Reply 26. Patent Owner asserts that these claims would not have been not obvious. PO Resp. 53–57.

Petitioner relies on Spector to disclose “fields-of-view of different emitters and receivers of Pacala’s LiDAR device are ‘non-overlapping’ and

so that each emitter's beam is 'coincident with' a pixel.'" Pet. 76. Petitioner does not rely on Spector to cover the above-noted deficiencies of Johnson with respect to claim 1's limitation 1(g) and claim 14's limitation 14(h). *See* §§ III.D.5, III.D.7, and III.D.12.

Consequently, Petitioner does not show by a preponderance of the evidence that claims 5 and 6 would have been obvious over the combination of Pacala, Johnson, Pardhan, Zhang, and Spector.

H. Ground 5: Alleged Obviousness Over Pacala, Johnson, Pardhan, Zhang, Spector, and Droz

Claim 13 depends from claim 1, and claim 21 depends from claim 14, and thus incorporate their respective limitations. Ex. 1001, 49:65–67, 51:37–39.

Petitioner contends that claims 13 and 21 would have been obvious over the combination of Pacala, Johnson, Pardhan, Zhang, Spector, and Droz. Pet. 78–81; Pet. Reply 25–26. Patent Owner asserts that these claims are not obvious. PO Resp. 57–59.

Petitioner modifies the combination with Droz as disclosing "light detector arrays that each comprise a plurality of single photon avalanche diodes (SPADs)." Pet. 79–80. Petitioner does not rely on Droz to cover the above-noted deficiencies of Johnson with respect to claim 1's limitation 1(g) and claim 14's limitation 14(h). *See* §§ III.D.5, III.D.7, and III.D.12.

Consequently, Petitioner does not show by a preponderance of the evidence that claims 13 and 21 would have been obvious over the combination of Pacala, Johnson, Pardhan, Zhang, Spector, and Droz.

I. Ground 6: Alleged Obviousness Over Pacala, Johnson, Pardhan, Zhang, Droz, Cai, and Yan

Claim 22 is an independent claim, and claims 23 and 24 are dependent therefrom. Ex. 1001, 51:40–53:3.

Petitioner contends that claims 22–24 would have been obvious over Pacala, Johnson, Pardhan, Zhang, Droz, Cai, and Yan. Pet. 81–96; Pet. Reply 27–28. Patent Owner contends that these claims would not have been obvious. PO Resp. 59–65; PO Sur-Reply 24.

In this section, we discuss the disclosure of Yan and claim 22’s limitations 22(d), 22(e.ii), 22(e.iii), and 22(h), and explain why these limitations are not satisfied in Petitioner’s combination. Accordingly, we determine that Petitioner has not shown by a preponderance of the evidence that claims 22–24 would have been obvious over the prior art combination.

1. Limitation 22(d): “Stator Circuit Board Assembly Comprising: . . . First Circuit Board; . . . Second Circuit Board . . . ; and . . . Stator Assembly”

Claim 22 recites “a stator circuit board assembly” which comprises a “first circuit board,” “second circuit board,” and “stator assembly.” Ex. 1001, 51:40–59. Petitioner contends that these limitations of claim 22 are met by Johnson’s “multi-layered circuit boards,” which allegedly a POSITA would have considered to be separate circuit boards. Pet. 84–86. Patent Owner contends that this ground fails for the same reasons provided for claims 1 and 14 with respect to ground 1. PO Resp. 59.

As Petitioner merely relies on Yan as disclosing alignment posts and cutouts on a support component and circuit board, Yan does not overcome the Johnson’s deficiencies noted for claim 1. *See* § III.D.5, *supra*. Specifically, Petitioner’s combination does not disclose a “stator assembly”

that is a component separate from the “first circuit board” and “second circuit board.” Rather, Johnson discloses that the coils of its stator platform 330 are a part of its circuit board, not something separate. *See, e.g.*, Ex. 1005, 11:66–14:54, Figs. 3C–3D. Nor do we agree with Petitioner’s view that printing multiple layers on a circuit board, e.g., on both sides of it or with an inner layer, somehow turns the single circuit board into multiple circuit boards. Pet. 85.

Although Petitioner relies on Cai as disclosing multiple circuit boards, Petitioner does not rely on Cai to cover the deficiency of Johnson’s stator platform not being coupled to a separate and distinct stator assembly. Pet. 56–66, 83–84. Johnson’s stator coils are defined by printed traces and vias on a circuit board and are thus a part of the circuit board that comprises the stator platform, not something separate that is connected to it. *See* §§ III.C.1 and III.D.5, *supra*.

Thus, Petitioner’s combination does not disclose limitation 22(d).

2. *Limitations 22(e.ii) and 22(e.iii): “Third Circuit Board” and “Fourth Circuit Board”*

Petitioner contends that limitation 22(e.ii) reciting a “third circuit board” is disclosed by the combination of Pacala, Johnson, Pardhan, Zhang, Droz, and Cai. Pet. 90–91. In addition, Petitioner contends that limitation 22(e.iii) reciting a “fourth circuit board” is disclosed by the combination of Pacala, Johnson, Pardhan, Zhang, Droz, Cai, and Yan. Pet. 92–94; Pet. Reply 27. Patent Owner argues that the combination does not disclose limitations 22(e.ii) and 22(e.iii). PO Resp. 61–63.

The parties’ contentions mirror those presented for claim 4 in grounds 1 and 2. *See* §§ III.D.6 and III.E, *supra*. Specifically, Petitioner contended

in ground 1 that the layers of Johnson’s multilayered PCB would have been considered multiple circuit boards or rendered the feature obvious, and that in ground 2, Cai’s circuit boards would be added to Johnson’s as the “third circuit board” and “fourth circuit board.” *Id.*; Pet. 90–94. Patent Owner disagrees with Petitioner’s contentions. Patent Owner argued that Johnson and Cai each disclose only two circuit boards, not four, as Petitioner contends. PO Resp. 61–63.

We agreed with Patent Owner that Johnson and Cai each teach to use only two circuit boards. *See* §§ III.D.6 and III.E, *supra*. We further found that Nubling, which Petitioner asserts to reflect general knowledge in the art, does not teach third and fourth circuit boards, as recited in limitations 22(e.ii) and limitation 22(e.iii), that are parallel to one another. Ex. 1043, Fig. 3 (circuit boards 50, 52 are oriented to be perpendicular to one another).

Accordingly, we likewise determine here that these limitations of claim 22 are not satisfied by the combination of Pacala, Johnson, Pardhan, Zhang, Droz, Cai, and Yan. PO Resp 61–63 (citing Ex. 2004 ¶¶ 224–225).

3. *Limitation 22(h): “Wireless Power Transformer”*

Claim 22’s limitation 22(h) recites

a wireless power transformer integrated directly onto the stator and rotor circuit boards, the wireless power transformer comprising a first annular transformer coil disposed on a surface of the stator circuit board and a second annular transformer coil disposed on a surface of the rotor circuit board in an opposing relationship with the first annular transformer coil, ***wherein the first transformer coil is concentric with and positioned outside an outer perimeter of the plurality of stator elements and the second transformer coil is concentric with and positioned outside an outer perimeter of the rotor assembly annular arrangement.***

Ex. 1001, 52:49–60 (emphases added). Petitioner contends that limitation 22(h) is met by the combination of Pacala, Johnson, Pardhan, Zhang, Droz, Cai, and Yan. Pet. 48–51 (§ IX.E.10), 94¹⁷; Pet. Reply 27; Ex. 1003 ¶ 353. Patent Owner argues that limitation 22(h) is not disclosed by the combination. PO Resp. 45–53, 63–64.

We have already addressed the parties’ contentions concerning this limitation in our discussion of claim 17, which is the same as limitation 22(h). *See* §§ III.D.8, III.D.12, III.E, *supra*. As explained in those sections, Johnson, Pardhan, and Zhang all teach transformer coils inside of the rotor/stator elements, and Zhang states this is done to avoid interference with power transmission. *See, e.g.*, Ex. 1005, 11:51–60, 13:26–40, Figures 3B and 3C; Ex. 1006, 20:64–21:13; Ex. 1007, 3–5. Thus, Johnson, Pardhan, and Zhang do not disclose the part of limitation 22(h) reciting “wherein the first transformer coil is . . . positioned outside an outer perimeter of the plurality of stator elements and the second transformer coil is . . . positioned outside an outer perimeter of the rotor assembly annular arrangement.”

While Cai discloses transformer coils positioned outside of the rotor/stator elements, they are not connected directly to the surfaces of circuit boards 113, 124, and hence, Cai’s coils are not “integrated directly onto the stator and rotor circuit boards” or “disposed on” their surfaces, as required by claim 17. Ex. 1008 ¶¶ 25–28.

¹⁷ Petitioner cites to § IX.E.10 and § X.D.4 of its Petition. Pet. 94. However, § IX.E.10 relates to claim 6, and there is no § X.D.4 in the Petition. Petitioner’s Reply, however, refers to discussions addressing claims 4 and 17 in connection with claim 22. Pet. Reply 27. Thus, Petitioner may have intended to cite § IX.E.4 (claim 4) and § IX.E.11 (claim 17).

Petitioner does not rely on the remaining references, Droz and Yan, to disclose these features of limitation 22(h). *See* Pet. 48–54, 63–65, 94.

Accordingly, we find that claim 22’s limitation 22(h) is missing from the combination of Pacala, Johnson, Pardhan, Zhang, Droz, Cai, and Yan.

4. *Dependent Claims 23 and 24*

Claims 23 and 24 depend from claim 22 and thus include all of its limitations. Because we determine that limitations of claim 22 are missing from the combination of Pacala, Johnson, Pardhan, Zhang, Droz, Cai, and Yan, we likewise conclude they are missing from these dependent claims.

5. *Motivation to Combine and Reasonable Expectation of Success*

Because we find that the above-noted limitation of the claims are missing from the prior art combination, we do not address the issues of issues of motivation to combine or reasonable expectation of success in any further detail beyond what we have already stated herein. *See* § III.D.10, *supra*; Pet. 95–96; PO Resp. 60, 64.

6. *Secondary Considerations*

In light of the claim limitations missing from the prior art combination as discussed above, and because Patent Owner’s proffered secondary considerations would only weigh, if at all, toward non-obviousness of the claims, we do not consider the secondary considerations further in this decision. PO Resp. 73–78; Pet. Reply 28–30; PO Sur-Reply 26–27.

7. *Conclusion for Ground 6*

For the foregoing reasons, Petitioner has not shown by a preponderance of the evidence that claims 22–24 would have been obvious over the combination of Pacala, Johnson, Pardhan, and Zhang.

J. Ground 7: Alleged Obviousness Over Pacala, Johnson, Pardhan, Zhang, Droz, Cai, Yan, Spector

Claim 25 depends from claim 22 and thus incorporates all of its limitations. Ex. 1001, 53:7–13.

Petitioner contends that claim 25 would have been obvious over the combination of Pacala, Johnson, Pardhan, Zhang, Droz, Cai, Yan, and Spector. Pet. 96 (citing *id.* §§ XII, XIV). Patent Owner asserts that claim 25 would not have been obvious. PO Resp. 65.

Petitioner relies on Spector for its teaching of “an emitted illumination pattern that substantially matches the size and geometry of a plurality of non-overlapping fields-of-view of the plurality of pixels across a range of distances from the system emitter beams matching fields of view of detector pixels.” Pet. 96 (citing Ex. 1010, 3:38–41). Petitioner does not rely on Spector to cover the above-noted deficiencies of the combination of Pacala, Johnson, Pardhan, Zhang, Droz, Cai, and Yan with respect to claim 22’s limitation 22(d), 22(e.ii), 22(e.iii), and limitation 22(h). *See* § III.I.

Accordingly, Petitioner does not show by a preponderance of the evidence that claim 25 would have been obvious over the combination of Pacala, Johnson, Pardhan, Zhang, Droz, Cai, Yan, and Spector.

K. Ground 8: Alleged Obviousness Over Pacala–2017, Johnson, Pardhan, and Zhang

Petitioner asserts that claims 1, 2, 4–9, 11–14, 16–17, and 19–21 would have been obvious over the combination of Pacala-2017 (Ex. 1013), Johnson, Pardhan, and Zhang. Pet. 97–105.

Petitioner relies on Pacala-2017 (Ex. 1013) to disclose limitations 1(b)/14(b) and limitations 1(i)/14(j) of respective claims 1 and 14. Pet. 98–100. Petitioner thus relies on Pacala-2017 for the same reasons it relied on

Pacala in grounds 1–7. *See* § III.D, *supra*. Patent Owner contends that claims 1, 2, 4–9, 11–14, 16–17, and 19–21 would not have been obvious over the combination of Pacala-2017, Johnson, Pardhan, and Zhang. PO Resp. 65–71.

For the reasons stated in §§ III.D.5–12, Petitioner has *not* shown by a preponderance of the evidence that claims 1 and 14 would have been obvious over the combination of Pacala-2017, Johnson, Pardhan, and Zhang. Because claims 2, 4–9, 11–13, 16–17, 19–21 depend from respective claims 1 and 14 and thus incorporate their limitations, Petitioner likewise has not established by a preponderance of the evidence that these dependent claims would have been obvious over the combination.

L. Ground 9: Alleged Obviousness Over Pacala–2017, Johnson, Pardhan, Zhang, Cai, and Yan

Petitioner contends that claims 22–25 would have been obvious over the combination of Pacala–2017, Johnson, Pardhan, Zhang, Cai, and Yan. Pet. 105–107.

For the reasons stated for grounds 6–8 in §§ III.I–K, Petitioner has not shown by a preponderance of the evidence that claims 22–25 would have been obvious over the combination of Pacala–2017, Johnson, Pardhan, Zhang, Cai, and Yan.

IV. CONCLUSION

After considering the evidence and arguments presented in the Petition, we determine that Petitioner has not established by a preponderance of the evidence that any of the claims of the '515 patent is unpatentable because of the claim limitations that are missing from the prior art combinations asserted in the challenge grounds.

V. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that, pursuant to 35 U.S.C. § 318(a), claims 1–2, 4–9, 11–14, 16–17, and 19–25 of the '515 patent have *not* been shown to be unpatentable; and

FURTHER ORDERED that any party seeking judicial review must comply with the notice and service requirements of 37 C.F.R. § 90.2.

In summary:

Claim(s)	35 U.S.C. §	Reference(s)/Basis	Claim(s) Shown Unpatentable	Claim(s) Not shown Unpatentable
1–2, 4–9, 11, 14, 16–17, 19	103	Pacala, Johnson, Pardhan, Zhang		1–2, 4–9, 11, 14, 16–17, 19
2, 4–6, 17	103	Pacala, Johnson, Pardhan, Zhang, Cai		2, 4–6, 17
5–6	103	Pacala, Johnson, Pardhan, Zhang, Cai, Hall		5–6
12, 20	103	Pacala, Johnson, Pardhan, Zhang, Spector		12, 20
13, 21	103	Pacala, Johnson, Pardhan, Zhang, Spector, Droz		13, 21
22–24	103	Pacala, Johnson, Pardhan, Zhang, Droz, Cai, Yan		22–24
25	103	Pacala-2017, Johnson, Pardhan, Zhang		25
1–2, 4–9, 11–14, 16–17, 19–21	103	Pacala-2017, Johnson, Pardhan, Zhang, Cai, Yan		1–2, 4–9, 11– 14, 16–17, 19–21
22–25	103			22–25
Overall Outcome				1–2, 4–9, 11– 14, 16–17, 19–25

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