

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

TOYOTA MOTOR CORPORATION,
Petitioner,

v.

GENERAL ELECTRIC COMPANY,
Patent Owner.

IPR2019-00011
Patent 7,723,932 B2

Before JONI Y. CHANG, MICHAEL W. KIM, and
SCOTT B. HOWARD, *Administrative Patent Judges*.

CHANG, *Administrative Patent Judge*.

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

I. INTRODUCTION

Toyota Motor Corporation (“Petitioner”) filed a Petition requesting an *inter partes* review of claims 1–12, 14, 15, 17–32, 34, and 35 (“the challenged claims”) of U.S. Patent No. 7,723,932 B2 (Ex. 1001, “the ’932 patent”). Paper 1 (“Pet.”). General Electric Company (“Patent Owner”) filed a Preliminary Response. Paper 6 (“Prelim. Resp.”). Upon consideration of the Petition and Preliminary Response, we instituted the instant *inter partes* review as to claims 1–12, 14, 15, 17–32, 34, and 35. Paper 7 (“Dec.”).

Subsequent to institution, Patent Owner filed a Response (Paper 12, “PO Resp.”) and Petitioner filed a Reply (Paper 17, “Reply”). Patent Owner also filed a Sur-reply (Paper 20, “Sur-reply”). An oral hearing was held on February 5, 2020, and a transcript has been entered into the record as Paper 27 (“Tr.”).

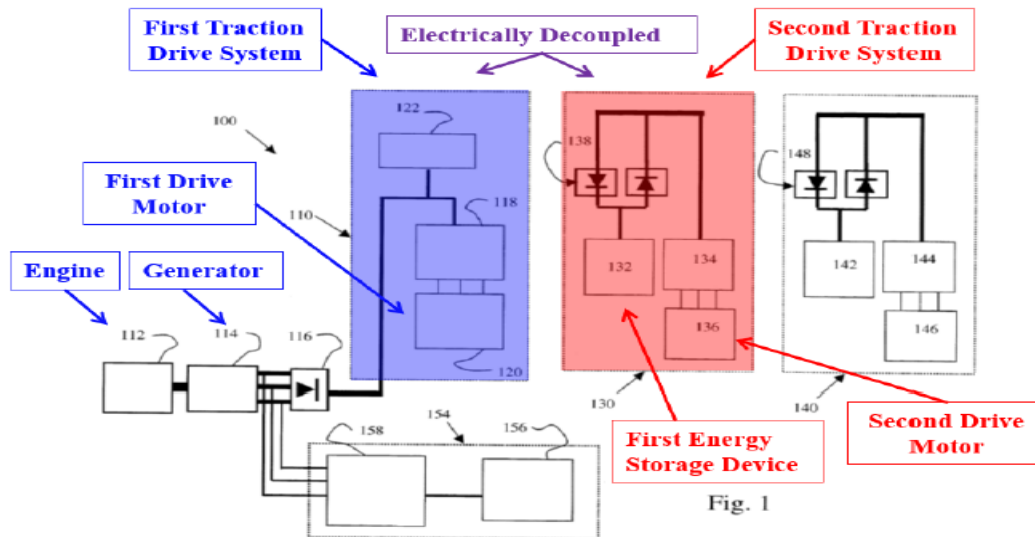
This Final Written Decision is entered pursuant to 35 U.S.C. § 318(a). For the reasons that follow, Petitioner has demonstrated by a preponderance of the evidence that claims 1–12, 14, 15, 17–32, 34, and 35 of the ’932 patent are unpatentable.

A. Related Matters

The parties indicate that they are unaware of any other proceedings involving the ’932 patent. Pet. 2; Paper 3, 1.

B. The '932 patent

The '932 patent discloses a propulsion system for a vehicle.
Ex. 1001, code (57). Figure 1 of the '932 patent is reproduced below with annotations added by Petitioner (Pet. 9).



As shown in annotated Figure 1 above, hybrid locomotive 100 includes first traction drive system 110 (blue) that is coupled to diesel engine 112 via alternator 114, and second traction drive system 130 (red). Ex. 1001, 7:16–34. First traction drive system 110 includes a direct current/alternating current (DC/AC) inverter 118, and an alternating current (AC) motor 120. *Id.* at 7:22–26.

C. Illustrative Claim

Of the challenged claims, claims 1, 24, and 32 are independent. Claims 2–12, 14, 15, 17–23 depend directly or indirectly from claim 1. Claims 25–31 depend directly or indirectly from claim 24. Claims 34 and 35 depend directly from claim 32.

Claim 1 is illustrative:

1. A propulsion system for a vehicle, comprising:
a first traction drive system coupled to an engine and comprising
a first drive motor, wherein the engine is operable to supply
energy to the first drive motor to propel the vehicle; and
a second traction drive system comprising a second drive motor
and a first energy storage device, wherein the second drive motor
is operable to both supply energy to the first energy storage
device and to receive energy from the first energy storage device,
wherein the first drive motor is electrically coupled to only the
first traction drive system.

Ex. 1001, 13:20–31.

D. Prior Art Relied Upon

Petitioner relies upon the references listed below. Pet. 3–4.

Kira	US 2004/0069548 A1	Apr. 15, 2004	(Ex. 1005)
Kumar	US 2003/0150352 A1	Aug. 14, 2003	(Ex. 1006)
Hanyu	US 2006/0164034 A1	July 27, 2006	(Ex. 1007)
Masahiko ¹	JP H11-176487 A	July 2, 1999	(Ex. 1008)
Yamada ²	JP 2004-260904 A	Sept. 16, 2004	(Ex. 1011)
Katsuta ³	JP 2003-134606 A	May 9, 2003	(Ex. 1014)
Suzuki ⁴	JP 2006-115693 A	Apr. 27, 2006	(Ex. 1017)

¹ Citations to Masahiko's written disclosure are to the English translation (Ex. 1009), but citations to Masahiko's figures are to the Japanese document (Ex. 1008).

² Citations to Yamada are to the English translation (Ex. 1012).

³ Citations to Katsuta are to the English translation (Ex. 1015).

⁴ Citations to Suzuki are to the English translation (Ex. 1018).

E. Asserted Grounds of Unpatentability

Petitioner asserts the following grounds of unpatentability (Pet. 4–5)⁵:

	Claim(s) Challenged	35 U.S.C. §	Reference(s)
1	1, 2, 23, 24, 30	102(b)	Kira
2	3	103(a)	Kira
3	4, 18–21	103(a)	Kira, Kumar
4	5, 14, 15, 17, 22	103(a)	Kira, Hanyu
5	6–12	103(a)	Kira, Masahiko
6	24, 25, 30, 32, 35	102(b)	Yamada
7	34	103(a)	Yamada
8	26	103(a)	Yamada, Katsuta
9	27, 28	103(a)	Yamada, Suzuki
10	29, 31	103(a)	Yamada, Hanyu

II. ANALYSIS

A. Claim Construction

The instant Petition was filed prior to the effective date of the rule change that replaces the broadest reasonable interpretation (“BRI”) standard.

⁵ Because the claims at issue have a filing date prior to March 16, 2013, the effective date of the Leahy-Smith America Invents Act, Pub. L. No. 112-29, 125 Stat. 284 (2011) (“AIA”) amendments to 35 U.S.C. §§ 102, 103, we apply the pre-AIA version of 35 U.S.C. §§ 102, 103 in this Decision.

See Changes to the Claim Construction Standard for Interpreting Claims in Trial Proceedings Before the Patent Trial and Appeal Board, 83 Fed. Reg. 51,340, 51,340 (Oct. 11, 2018) (final rule) (“This rule is effective on November 13, 2018 and applies to all IPR, PGR and CBM petitions filed on or after the effective date.”). We, therefore, apply the BRI standard in this proceeding. Under this standard, claim terms in an unexpired patent are given their broadest reasonable construction in light of the specification of the patent in which they appear. 37 C.F.R. § 42.100(b) (2018). The terms are generally given their ordinary and customary meaning, as would have been understood by one of ordinary skill in the art in the context of the Specification. *In re Translogic Tech., Inc.*, 504 F.3d 1249, 1257 (Fed. Cir. 2007).

1. “*propulsion means*”

Claim 32 recites “a propulsion means for supplying energy to a first energy storage device and for receiving energy from the first energy storage device.” Ex. 1001, 16:18–19. Claim 34 recites “a second propulsion means for supplying energy to a second energy storage device and for receiving energy from the second energy storage device.” *Id.* at 16:32–34.

Petitioner asserts that these limitations invoke 35 U.S.C. § 112, 6th paragraph, covering the corresponding structure described in the specification and equivalents thereof. Pet. 13. Patent Owner does not challenge Petitioner’s proposed claim construction as to these limitations. *See generally* Prelim. Resp.; PO Resp. We determined in our Institution Decision that we agree with Petitioner’s proposed constructions. Dec. 8–9.

Subsequent to institution, neither party challenges any aspect of our claim construction for this term. PO Resp. 1–2; *see generally* Reply. Based on the entire record presented during trial, we discern no reason to modify our analysis or claim construction of this claim term in this Final Written Decision.

As we noted in our Institution Decision, these claim elements are written in means-plus-function format and fall within the purview of § 112, 6th paragraph, because: (1) each claim element uses the term “means for”; (2) the term “means for” in each claim element is modified by functional language; and (3) the term “means for” is not modified by any structure recited in the claim to perform the claimed function. *See Personalized Media Commc’ns LLC v. Int’l Trade Comm’n*, 161 F.3d 696, 703–04 (Fed. Cir. 1998) (A claim element using the term “means for” creates a rebuttable presumption that the drafter intended to invoke § 112, ¶ 6.); *Sage Prods. v. Devon Indus., Inc.*, 126 F.3d 1420, 1427–428 (Fed. Cir. 1997) (The presumption is not rebutted if the term “means for” is modified by functional language and is not modified by any structure recited in the claim to perform the claimed function.).

We also note that the first step in construing a means-plus-function claim element is to identify the recited function in the claim element. *Med. Instrumentation & Diagnostics Corp. v. Elekta AB*, 344 F.3d 1205, 1210 (Fed. Cir. 2003). The second step is to look to the specification and identify the corresponding structure for performing that recited function. *Id.*

Here, the recited function is “supplying energy to [an] energy storage device” and “receiving energy from [the] energy storage device,” as recited

in claims 32 and 34. As Petitioner notes (Pet. 13), the only corresponding structure described in the '932 patent that is capable of performing the function of both supplying energy to and receiving energy from an energy storage device are electric drive motors 136, 146, 236, 246, 336, and 346, as shown in Figures 1–3 of the '932 patent. *See, e.g.*, Ex. 1001, code (57) (“The second drive motor both supplies energy to the first energy storage device and receives energy from the first energy storage device”); *id.* at 6:40–47, 13:26–29, 15:10–13, Figs. 1–3.

Therefore, based on the evidence in this entire trial record, we construe the aforementioned “propulsion means” elements to encompass “an electric drive motor for supplying energy to an energy storage device and for receiving energy from the energy storage device.”

2. “*supply energy to the first drive motor*”

The term “supply energy to the first drive motor” is recited in all of the independent claims. For example, claim 1 recites “a first traction drive system coupled to an engine and comprising a first drive motor, wherein *the engine is operable to supply energy to the first drive motor to propel the vehicle.*” Ex. 1001, 13:21–24 (emphasis added).

In its Response, Patent Owner proposes to construe “supply energy to the first drive motor” as “provide the energy required to meet the real-time demands of the first drive motor,” citing Dr. Thomas Keim’s testimony (Ex. 2001 ¶¶ 22–23) and certain portions of the Specification for support (Ex. 1001, 10:16–29, 11:48–57). PO Resp. 2. However, in its Sur-reply, Patent Owner withdraws this proposed claim construction that imports a

“real-time energy demands” limitation into the claim and its related prior art arguments. Sur-reply 5–6 n.2. In light of Patent Owner’s withdrawal, those “real-time energy” arguments are waived.

We note that Patent Owner’s remaining arguments rely upon a portion of Dr. Keim’s testimony (Ex. 2001 ¶¶ 30–33) that rests on Patent Owner’s withdrawn claim construction and repeats the withdrawn “real-time energy” arguments. PO Resp. 6–8 (citing Ex. 2001 ¶¶ 30–33); Sur-reply 5–6 n.2. For example, Dr. Keim testifies that “Kira’s engine is not ‘operable to supply energy to the first drive motor’ because the interposed battery prevents the engine from providing *the real-time energy requirements* of the first drive motor.” Ex. 2001 ¶¶ 30–33 (emphasis added).

To be clear, even if Patent Owner did not withdraw its proposed claim construction, we would decline to adopt that construction because the construction is not supported by the claim language or Specification. It also would import improperly an extraneous limitation into the claims.

“It is improper for a court to add ‘extraneous’ limitations to a claim, that is, limitations added ‘wholly apart from any need to interpret what the patentee meant by particular words or phrases in the claim.’” *Hoganas AB v. Dresser Indus., Inc.*, 9 F.3d 948, 950 (Fed. Cir. 1993) (quoting *E.I. Du Pont de Nemours & Co. v. Phillips Petroleum Co.*, 849 F.2d 1430, 1433 (Fed. Cir. 1988)). The U.S. Court of Appeals for the Federal Circuit (the “Federal Circuit”) also “has repeatedly cautioned against limiting the claimed invention to preferred embodiments or specific examples in the specification.” *Williamson v. Citrix Online, LLC*, 792 F.3d 1339, 1346–47

(Fed. Cir. 2015). “[I]t is the *claims*, not the written description, which define the scope of the patent right.” *Id.* at 1346.

Notably, the plain and ordinary meaning of the term “supply energy to the first drive motor” does not require providing the energy required to meet the *real-time demands* of the first drive motor. Also, as Petitioner explains, the portions of the Specification cited by Patent Owner (Ex. 1001, 10:16–29, 11:48–57) “say nothing about supplying ‘real-time’ energy to a particular drive motor,” but “instead focus on meeting an overall power demand of a hybrid vehicle using *multiple power sources*” and suggest “apportioning power supply between an energy storage device/battery and a prime mover/engine.” Reply 8 (citing Ex. 1001, 10:5–36, 11:37–62) (emphasis added). Hence, Patent Owner’s proposed construction is not supported by the claim language or Specification, and it improperly imports an extraneous limitation into the claims.

Moreover, the portion of Dr. Keim’s testimony (Ex. 2001 ¶¶ 22–23) that repeats Patent Owner’s proposed claim construction is conclusory. Tellingly, Dr. Keim does not cite to the Specification or any other evidence to support his testimony. *Id.* The Federal Circuit has recognized that “extrinsic evidence consisting of expert reports and testimony is generated at the time of and for the purpose of litigation and thus can suffer from bias that is not present in intrinsic evidence.” *Phillips v. AWH Corp.*, 415 F.3d 1303, 1318–19 (Fed. Cir. 2005) (en banc).

In addition, through its prior art arguments and declarant’s testimony, Patent Owner also implicitly construes the claim term “supply energy to the first drive motor” to require the engine to supply energy *directly and*

continuously without transformation to the first drive motor. PO Resp. 6–8; Sur-reply 5–6 n.2 (arguing that “Kira does not disclose an engine that is ‘operable to supply energy to the first drive motor’ due to the battery interposed to supply energy” and “Kira’s battery is incapable of simultaneously supplying and receiving energy”); Ex. 2001 ¶¶ 30–33 (Dr. Keim testifies that “Kira’s engine is not ‘operable to supply energy to the first drive motor’ because the *interposed battery* prevents the engine from providing *the real-time energy requirements* of the first drive motor” and the battery *transforms the electrical energy* “into chemical potential energy” and “*back to electrical energy*” (emphases added)).

Again, Patent Owner improperly attempts to import extraneous limitations into the claims. *Hoganas*, 9 F.3d at 950; *E.I. Du Pont*, 849 F.2d at 1433; *Williamson*, 792 F.3d at 1346–47. Neither the plain and ordinary meaning of the claim term “supply energy to the first drive motor,” nor the Specification, requires the engine to supply energy *directly and continuously* to the first drive motor *without transformation*. Notably, in the preferred embodiment shown in Figure 1 of the ’932 patent (reproduced above in Section I.B), the energy is supplied to first drive motor 120 through DC/AC inverter 118, an intervening component that transforms the energy from direct current to alternating current. Ex. 1001, 7:18–24, Fig. 1. The Specification also contemplates supplying energy via an interposing storage device. *Id.* at 8:43–52 (“electricity that is produced by regenerative braking and stored in one or more energy storage devices can be used to power the optional secondary auxiliary system”), 10:5–49.

Dr. Keim’s testimony (Ex. 2001 ¶¶ 30–33) does not cite to the Specification or any other evidence that would support Patent Owner’s implicit claim construction. Therefore, Dr. Keim’s testimony is entitled to little weight. *Phillips*, 415 F.3d at 1318–19; *see also In re American Academy of Science Tech Center*, 367 F.3d 1359, 1368 (Fed. Cir. 2004) (“[T]he Board is entitled to weigh the declarations and conclude that the lack of factual corroboration warrants discounting the opinions expressed in the declarations.” (internal citations omitted)).

In light of the claim language and Specification, we decline to adopt Patent Owner’s proposed claim construction that construes “supply energy to the first drive motor” as “provide the energy required to meet the real-time demands of the first drive motor.” PO Resp. 2; Ex. 2001 ¶¶ 22–23; Ex. 2001 ¶¶ 22–23. We also decline to adopt Patent Owner’s implicit claim construction that construes “supply energy to the first drive motor” to require the engine to supply energy *directly and continuously* to the first drive motor *without transformation*. PO Resp. 6–8; Sur-reply 5–6 n.2; Ex. 2001 ¶¶ 30–33. Rather, we determine that, in the context of the Specification, the claim term “supply energy to the first drive motor” is given its ordinary and customary meaning as would have been understood by one of ordinary skill in the art to encompass “pass energy *directly or indirectly* to the first drive motor.” *See Translogic*, 504 F.3d at 1257. Our claim construction does not preclude the presence of intervening components, such as a battery, between the engine and the first drive motor.

3. “coupled”

Each independent challenged claim recites the term “coupled.” For example, claim 1 recites “a first traction drive system *coupled* to an engine.” Ex. 1001, 13:21 (emphases added).

Petitioner avers that the term “coupled” should be construed to have its plain and ordinary meaning of “connected to.” Pet. 11–12. In its Preliminary Response, Patent Owner does not challenge Petitioner’s proposed claim construction as to the term “coupled.” *See generally* Prelim. Resp. We determined in our Institution Decision that we agreed with Petitioner’s proposed construction. Dec. 6–8. Subsequent to institution, neither party challenges any aspect of our claim construction for the term “coupled.” PO Resp. 1–2; *see generally* Reply. In its Response, Patent Owner states that it “does not take a position on claim construction in this proceeding but address Petitioner’s arguments in accordance with the Board’s determinations” as to the construction for the term “coupled.” PO Resp. 1–2. Based on the entire record presented during trial, we discern no reason to modify our analysis or claim construction of this claim term.

As we noted in our Institution Decision, the ’932 patent supports our construction because it uses the term “coupled” to describe mechanical and electrical connections between components. Dec. 6–8. Notably, the ’932 patent describes a mechanical connection through “an on-board heat engine *coupled* to an alternator that converts the mechanical output power of the engine into an alternating current (AC) electrical power.” Ex. 1001, 1:43–46 (emphasis added). The ’932 patent also describes an electrical connection through “traction drive system 110 *coupled* to a diesel engine

112 via an alternator 114.” *Id.* at 7:20–21 (emphasis added). Dr. Mahdi Shahbakhti, Ph.D., testifies that an ordinarily skilled artisan would have understood “coupled,” as used in the ’932 patent, to mean “connected to.” Ex. 1002 ¶¶ 30–32. Petitioner’s cited dictionaries further support the plain meaning of “coupled” as “connected to.” MERRIAM-WEBSTER’S COLLEGIATE DICTIONARY, 11TH ED. (2007) (Ex. 1020, 3) (defining “coupled” as “to bring (two electric circuits) into such close proximity as to permit mutual influence” or “to fasten together: LINK”); COLLINS ENGLISH DICTIONARY, 9TH ED. (2007) (Ex. 1021, 6) (defining “coupled” as “to connect (two things) together or to connect (one thing) to (another)”).

Based on the entire record presented during trial, we maintain our claim construction, interpreting “coupled” as “connected to.”

4. “*electrically coupled*”

Claim 32 recites “the propulsion means is *electrically coupled* to the first traction drive system.” Ex. 1001, 16:21–22 (emphases added).

As discuss above, Patent Owner states that it “does not take a position on claim construction in this proceeding but addresses Petitioner’s arguments in accordance with the Board’s determinations” as to the term “coupled.” PO Resp. 1–2. Nonetheless, through its prior art arguments and declarant’s testimony, Patent Owner implicitly construes the claim term “electrically coupled” to require the propulsion means to be connected *directly* to the first traction drive system, and to require electric energy, voltage, or current to be passed *continuously without transformation* between the propulsion means and the first traction drive system. PO Resp.

14–16; Sur-reply 8–11. Patent Owner takes the position that “a battery interposed between two other elements does not make those two elements ‘electrically coupled,’” citing Dr. Keim’s testimony for support.⁶ PO Resp. 15 (citing Ex. 2001 ¶¶ 31–33). Dr. Keim testifies that “[b]atteries do not *simultaneously* receive and supply energy,” and that the interposed battery *transforms the electrical energy* “into chemical potential energy” and “*back to electrical energy.*” Ex. 2001 ¶¶ 31–33 (emphases added).

Again, Patent Owner improperly attempts to import extraneous limitations into the claims to exclude passage of electric energy, voltage, or current via an intervening component. *Hoganas*, 9 F.3d at 950; *E.I. Du Pont*, 849 F.2d at 1433; *Williamson*, 792 F.3d at 1346–47. The plain and ordinary meaning of the term “electrically coupled” does not require the propulsion means to be *directly* connected to the first traction drive system, and it does not require electric energy, voltage, or current to be passed *continuously without transformation* between the propulsion means and the first traction drive system.

Additionally, the Specification does not provide a special meaning to “electrically coupled.” *See generally* Ex. 1001. In the preferred embodiment shown in Figure 2 of the ’932 patent, the second drive motor 236 (a propulsion means) is connected to the first traction drive system through DC/AC inverter 234, an intervening component that transforms the

⁶ Patent Owner relies upon the same testimony of Dr. Keim (Ex. 2001 ¶¶ 31–33) in both of its implicit claim constructions for the term “supply energy to the first drive motor” and “electrically coupled” to exclude an interposed battery.

energy from direct current to alternating current. *Id.* at 8:3–9, Fig. 2. The Specification also contemplates supplying energy via an interposing storage device. *Id.* at 8:43–52 (“electricity that is produced by regenerative braking and stored in one or more energy storage devices can be used to power the optional secondary auxiliary system”), 10:5–49.

Tellingly, neither Patent Owner nor Dr. Keim cites to the Specification or any other intrinsic evidence for support. PO Resp. 14–16; Sur-reply 8–11; Ex. 2001 ¶¶ 30–33. The Specification is “the single best guide to the meaning of a disputed term” and “[u]sually, it is dispositive.” *Phillips*, 415 F.3d at 1315 (quoting *Vitronics*, 90 F.3d at 1582). Therefore, Dr. Keim’s testimony (Ex. 2001 ¶¶ 31–33) is entitled to little weight. *Phillips*, 415 F.3d at 1318–19; *American Academy*, 367 F.3d at 1368.

In its Reply, Petitioner argues that Patent Owner “has adopted Petitioner’s construction of ‘coupled’ to mean ‘connected to.’” Reply 24–25 (citing PO Resp. 1–2). Petitioner takes the position that claim 32 “requires the propulsion means (MG3) to be connected to the first traction drive system (MG1/MG2) through *electric means*.” *Id.* We agree with Petitioner.

In light of the claim language and Specification, we decline to adopt Patent Owner’s implicit claim construction that construes “electrically coupled” to require the propulsion means to be *directly* connected to the first traction drive system, and to require electric energy, voltage, or current to be passed *continuously without transformation* between the propulsion means and the first traction drive system. PO Resp. 14–16; Sur-reply 8–11; Ex. 2001 ¶¶ 31–33. Rather, we determine that, in the context of the Specification and claim 32, the claim term “electrically coupled” is given its

ordinary and customary meaning as would have been understood by one of ordinary skill in the art to encompass “a connection through electric means that allows electric energy, voltage, or current to be passed *directly or indirectly* between the propulsion means and the first traction drive system.” *Translogic*, 504 F.3d at 1257. Our claim construction does not preclude the presence of intervening components, such as a battery, between the propulsion means and the first traction drive system.

B. Principles of Law

To establish anticipation under 35 U.S.C. § 102, each and every element in a claim, arranged as is recited in the claim, must be found in a single prior art reference. *Net MoneyIN, Inc. v. VeriSign, Inc.*, 545 F.3d 1359, 1369 (Fed. Cir. 2008). There is no requirement that the prior art must use the same words to describe a claim element in order to teach or disclose that claim element. Identity of terminology is not required, for a claim element to be anticipated by the prior art. See *In re Gleave*, 560 F.3d 1331, 1334 (Fed. Cir. 2009).

A reference anticipates a claim “if a person of skill in the art, reading the reference would ‘at once envisage’ the claimed arrangement or combination.” *Kennametal, Inc. v. Ingersoll Cutting Tool Co.*, 780 F.3d 1376, 1381 (Fed. Cir. 2015) (quoting *In re Petering*, 301 F.2d 676, 681 (CCPA 1962)). For anticipation, the dispositive question is whether one skilled in the art would reasonably understand or infer from a prior art reference that every claim element is disclosed in that reference. *Eli Lilly*

and Co. v. Los Angeles Biomedical Res. Inst. at Harbor-UCLA Med. Ctr., 849 F.3d 1073, 1074–75 (Fed. Cir. 2017).

A patent claim is unpatentable under 35 U.S.C. § 103(a) if the differences between the claimed subject matter and the prior art are such that the subject matter, as a whole, would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). 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 ordinary skill in the art; and (4) objective evidence of nonobviousness.⁷ *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).

C. Level of Ordinary Skill in the Art

In determining the level of ordinary skill in the art, various factors may be considered, including the “type of problems encountered in the 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.” *In re GPAC, Inc.*, 57 F.3d 1573, 1579 (Fed. Cir. 1995) (internal quotation marks and citation omitted). Petitioner asserts that a person with ordinary skill in the art would have held at least a bachelor’s degree in mechanical or electrical engineering and two years of experience

⁷ Neither party presents evidence or arguments regarding objective evidence of nonobviousness.

with hybrid vehicle propulsion systems or equivalent graduate study. Pet. 11 (citing Ex. 1002 ¶¶ 35–38). Patent Owner does not dispute Petitioner’s assessment. PO Resp. 1. Based on the evidence in this entire trial record, we adopt the level of ordinary skill as articulated by Petitioner because this assessment appears to be consistent with the ’932 patent, the asserted prior art, and is supported by the testimony of Dr. Shahbakhti.

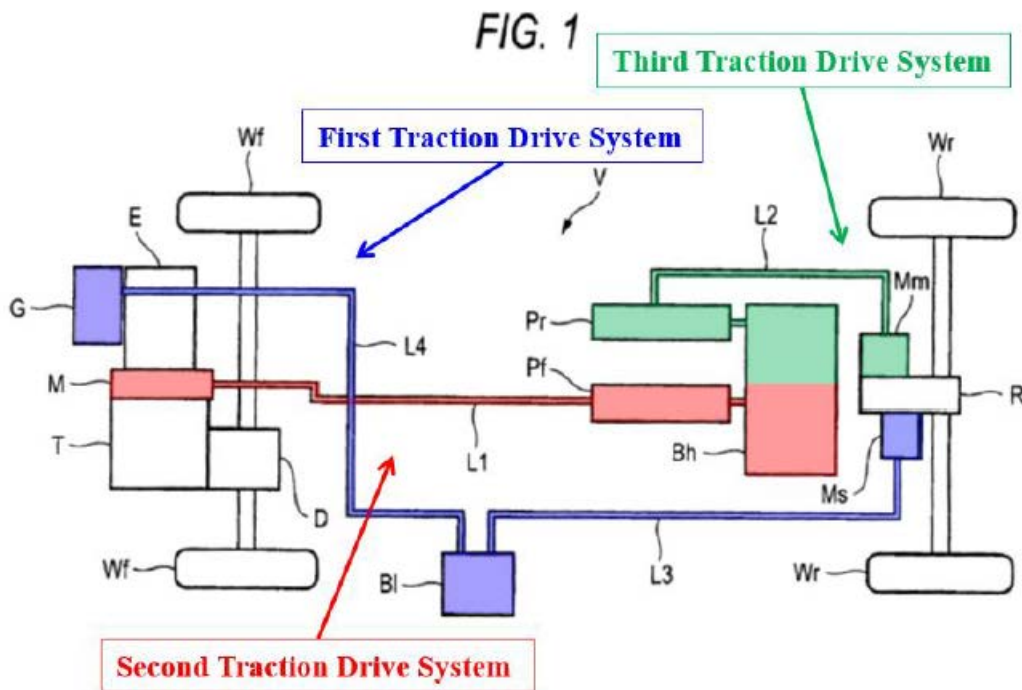
D. Ground 1: Claims 1, 2, 23, 24, and 30 are Anticipated by Kira

Petitioner asserts that claims 1, 2, 23, 24, and 30 are unpatentable under § 102 as anticipated by Kira, citing to Dr. Shahbakhti’s testimony for support. Pet. 14–27; Ex. 1002 ¶¶ 39–40, 53–68. Patent Owner counters that Petitioner fails to show that Kira discloses all of the limitations recited in claims 1 and 24, citing to Dr. Keim’s testimony for support. PO Resp. 2–8; Sur-reply 1–5; Ex. 2001 ¶¶ 24–34.

For the reasons provided below, we determine that Petitioner has demonstrated by a preponderance of the evidence that claims 1, 2, 23, 24, and 30 are anticipated by Kira.

1. Overview of Kira

Kira discloses a hybrid vehicle. Ex. 1005, code (57). Figure 1 of Kira is reproduced below with annotations added by Petitioner (Pet. 14).



According to Petitioner, annotated Figure 1 of Kira above shows first, second, and third traction drive systems for a vehicle. Pet. 14–15. The first traction drive system (blue) includes engine E, generator G, low-voltage battery B1, and sub rear motor Ms for driving rear wheels Wr. Ex. 1005 ¶¶ 37, 38. During operation, “sub rear motor Ms . . . is driven by direct current from the low-voltage battery B1 which is charged by generated output of the generator G driven by the engine E.” *Id.* ¶ 43.

The second traction drive system (red) includes high-voltage battery Bh, power drive unit Pf, and front motor M for driving front wheels Wf. *Id.* ¶¶ 37, 38. The third traction drive system (green) includes main rear motor Mm for driving rear wheels Wr, which is connected to high-voltage battery Bh via power drive unit Pr. *Id.* During operation, “front motor M . . . is driven by converting a direct current of the high-voltage Bh to a three-phase alternating current at the power drive unit Pf, and similarly, the main rear

motor Mm . . . is driven by converting the direct-current of the high-voltage battery Bh to a three-phase alternating-current at the power drive unit Pr.”

Id. ¶ 43.

2. Independent claims 1 and 24

a. *First traction drive system*

Claims 1 and 24 each recite:

A propulsion system for a vehicle, comprising:

a first traction drive system coupled to an engine and comprising
a first drive motor,

wherein *the engine is operable to supply energy to the first drive motor to propel the vehicle.*

Ex. 1001, 13:21–24, 15:5–8 (emphasis added). As discussed above in Section II.A.2, we determine that the term “supply energy to the first drive motor” encompasses “passing energy *directly or indirectly* to the first drive motor.” Our construction does not preclude the presence of intervening components, such as a battery. We decline to adopt Patent Owner’s construction that would improperly import extraneous limitations into the claims

Petitioner asserts that Kira discloses the aforementioned limitations recited in claims 1 and 24. Pet. 14–17, 22. To the extent that the preamble⁸ is treated as limiting, Petitioner asserts that an ordinarily skilled artisan

⁸ “Generally, the preamble does not limit the claims.” *Allen Eng'g Corp. v. Bartell Indus., Inc.*, 299 F.3d 1336, 1346 (Fed. Cir. 2002). Regardless of whether the preamble is limiting, we determine that Petitioner has shown sufficiently that it is disclosed by Kira.

V, because the drive force in sub rear motor Ms comes from engine E via low-voltage battery B1 and generator G. *Id.* (citing Ex. 1002 ¶ 55).

Based on the evidence of record, we are persuaded by Petitioner’s showing that Kira discloses a propulsion system for a vehicle that comprises “a first traction drive system coupled to an engine and comprising a first drive motor, wherein the engine is operable to supply energy to the first drive motor to propel the vehicle,” as recited in claims 1 and 24.

In the Response, Patent Owner advances several arguments. PO Resp. 2–8. In the Sur-reply, however, Patent Owner expressly withdraws its “real-time energy” arguments:

Patent Owner maintains its argument at PO Resp. 6–8 that Kira does not disclose an engine that is “operable to supply energy to the first drive motor” due to the battery interposed to supply energy. However, . . . Patent Owner is prepared to *withdraw its argument* that “supply energy to the first drive motor” should be construed as “provide the energy required to meet the real-time demands of the first drive motor.” PO Resp. 2. *Patent Owner consequently also would withdraw its arguments* “As discussed above, in the context ‘supplying’ energy to something means meeting its *real-time energy demands*” and “Engine E and generator G consequently cannot meet *the real-time energy requirements* of motor Ms. Instead, it is battery B1 that meets these requirements.” PO Resp. 8. Patent Owner otherwise maintains its argument that Kira does not disclose this limitation because Kira’s battery is incapable of simultaneously supplying and receiving energy. *Id.* at 7.

Sur-reply 5–6 n.2 (emphases added). In light of Patent Owner’s withdrawal, the “real-time energy” arguments are waived. We address below Patent Owner’s remaining arguments.

First, Patent Owner argues that “Kira does not disclose an engine that is ‘operable to supply energy to the first drive motor’ due to the battery interposed to supply energy.” Sur-reply 5–6 n.2; PO Resp. 6–8. Patent Owner also argues that “Kira does not disclose this limitation because Kira’s battery is incapable of simultaneously supplying and receiving energy.” Sur-reply 5–6 n.2. Dr. Keim testifies that “Kira’s engine is not ‘operable to supply energy to the first drive motor’ because the interposed battery prevents the engine from providing the real-time energy requirements of the first drive motor” and transforms electrical energy “into chemical potential energy” and “back to electrical energy.” Ex. 2001 ¶¶ 30–33.

Patent Owner’s arguments and Dr. Keim’s testimony are unavailing because they rest upon Patent Owner’s claim construction that improperly imports extraneous limitations into the claims. As discussed above in Section II.A.2, we decline to adopt Patent Owner’s proposed construction that construes “supply energy to the first drive motor” as “provide the energy required to meet the real-time demands of the first drive motor.” We also decline to adopt Patent Owner’s implicit construction that construes “supply energy to the first drive motor” to require the engine to supply energy *directly and continuously* to the first drive motor *without transformation*. Further, Dr. Keim’s testimony repeats Patent Owner’s “real-time energy” arguments that have been withdrawn. Ex. 2001 ¶¶ 30–33; Sur-reply 5–6 n.2.

More importantly, Kira discloses that engine E supplies all the energy required to run motor Ms, regardless of any energy transformations. Ex. 1005 ¶¶ 17–18, 37–39, Fig. 1. Dr. Shahbakhti testifies that an ordinarily

skilled artisan would have understood that Kira's engine E is operable to supply energy to sub rear motor Ms to propel hybrid vehicle V, because the drive force in sub rear motor Ms comes from engine E via low-voltage battery B1 and generator G. Ex. 1002 ¶ 55.

Dr. Shahbakhti's testimony is consistent with Kira's disclosure. Notably, Kira discloses that "sub rear motor Ms . . . is driven by direct current from the low-voltage battery B1 which is charged by generated output of the generator G driven by the engine E." Ex. 1005 ¶ 43, Fig. 1. Kira also discloses that "the power used to drive the sub rear motor Ms is supplied from the generated output of the generator G driven by the engine E," and that motor Ms "performs no regenerative braking." Ex. 1005 ¶¶ 61, 66. Therefore, we credit Dr. Shahbakhti's testimony, as it is consistent with Kira's disclosure. Ex. 1002 ¶ 55; Ex. 1005 ¶¶ 17–18, 37–39, 43, 61, 66, Fig. 1. In short, we find Kira discloses that engine E supplies the energy required to run motor Ms. Ex. 1005 ¶¶ 17–18, 37–39, Fig. 1.

For the foregoing reasons, Patent Owner's arguments and Dr. Keim's testimony that Kira does not disclose "supply[ing] energy to the first drive motor to propel the vehicle" are unavailing. We find that Petitioner has shown that Kira discloses "[a] propulsion system for a vehicle, comprising: a first traction drive system coupled to an engine and comprising a first drive motor, wherein the engine is operable to supply energy to the first drive motor to propel the vehicle," as recited in claims 1 and 24.

Patent Owner also argues that "Kira's disclosure is ambiguous as to whether it supplies direct current or alternating current to motor Ms," citing case law relevant to ambiguous prior art disclosure for support. PO Resp.

2–6; Ex. 2001 ¶¶ 24–29; Sur-reply 1–5 (citing *In re Turlay*, 304 F.2d 893, 899 (CCPA 1962); *In re Hughes*, 345 F.2d 184, 186–87 (CCPA 1965)). According to Patent Owner, Kira is “internally inconsistent as to what form of energy motor Ms receives” because “[i]n paragraph [0043] Kira states that motor Ms receives direct current, but in Figure 3 Kira shows that motor Ms receives three-phase alternating current.” PO Resp. 5 (citing Ex. 2001 ¶¶ 26–27). In Patent Owner’s view, if engine E and generator G are providing direct current, but motor Ms is an alternating current motor, then the direct current cannot be used by motor Ms to propel the vehicle because an alternating current motor will not operate on direct current. *Id.* at 6 (citing Ex. 2001 ¶ 28). Dr. Keim testifies that the three-wire electrical connection symbol between generator G and motor Ms, as shown in Figure 3 of Kira, indicates that motor Ms operates on a three-phase alternating current because the American National Standards Institute (ANSI) graphics standards document discloses that the symbol  indicates a “split-phase induction motor or generator.” Ex. 2002 ¶¶ 26–27 (citing Ex. 2002, 16, 66 (Section 13.5 Applications: Alternating-Current Machines)).

Patent Owner’s argument and Dr. Keim’s testimony that “Kira’s disclosure is ambiguous” are unavailing. PO Resp. 2–6; Ex. 2001 ¶¶ 24–29; Sur-reply 1–5. Both Kira’s written description and Figure 1 expressly and unambiguously disclose motor Ms as a *direct current motor receiving direct current*. Ex. 1005 ¶¶ 37–38, 43, 61–62, Fig. 1.

Dr. Keim concedes that Kira’s written description never describes motor Ms as receiving alternating current. Ex. 1028, 37:2–10. Dr. Keim also admits that Kira repeatedly and consistently describes motor Ms as a

direct current motor and the connection to motor Ms are *direct current wires* L3, L4. Ex. 1028, 14:20–15:22 (admitting that “paragraph 37 does identify motor Ms as direct-current brush motor” and that paragraph 38 describes wires L3 and L4 as direct current wires), 18:9–19:24, 20:18–21:20 (admitting that “[t]he last sentence of paragraph 62 says: Moreover, the sub rear motor Ms, made up of the direct-current brush motor, needs no power drive unit”), 35:20–24, 37:13–19 (admitting that Kira “describe[s] a direct-current connection between battery B1 and motor Ms”).

Indeed, Kira expressly discloses: (1) “a sub rear motor Ms made up of a direct-current brush motor having a small output are connected to the rear wheels Wr” (Ex. 1005 ¶ 37); (2) “sub rear motor Ms for driving the rear wheels Wr, Wr is connected to a low-voltage battery B1 . . . via a direct-current wire L3, and the low-voltage battery B1 is connected to a generator G driven by the engine E via a direct-current wire L4” (*id.* ¶ 38); (3) “sub rear motor Ms made up of the direct-current brush motor is driven by direct current from the low-voltage battery B1 which is charged by generated output of the generator G driven by the engine E” (*id.* ¶ 43); (4) “since the sub rear motor Ms performs no regenerative braking, an inexpensive direct current brush motor can be adopted for the sub rear motor Ms” (*id.* ¶ 61); and (5) “sub rear motor Ms made up of the direct current brush motor needs no power drive unit” (*id.* ¶ 62).

Therefore, contrary to Patent Owner’s argument that “Kira’s disclosure is ambiguous,” we find that Kira unambiguously discloses motor Ms as a *direct current motor receiving direct current*.

Furthermore, Patent Owner’s argument and Dr. Keim’s testimony that, as shown in Figure 3 of Kira, motor Ms receives alternating current, are merely speculative, ignoring Kira’s written disclosure, Figure 1, and parts of Figure 3. PO Resp. 2–6; Ex. 2001 ¶¶ 24–29; Sur-reply 1–5.

Figure 3 of Kira is reproduced below with our highlighting.

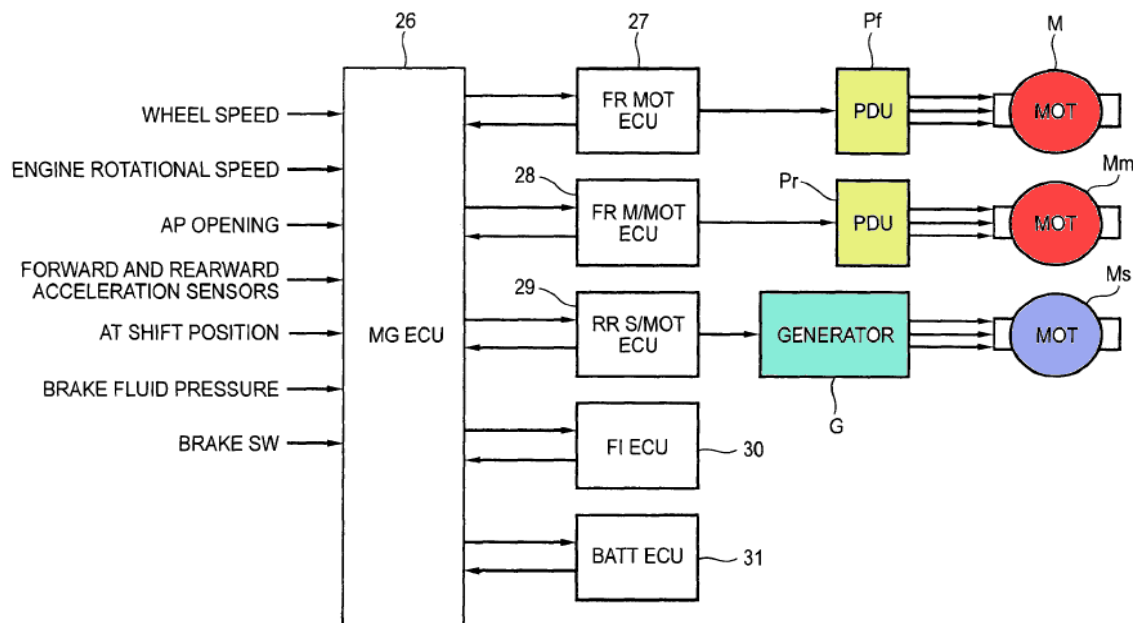


Figure 3 of Kira above shows a control system of motors. Ex. 1005 ¶ 29.

As shown, Figure 3 distinguishes a direct-current motor from an alternating-current motor. Notably, direct-current motor Ms (blue) is shown *without* a power drive unit (“PDU”), whereas alternating-current motors M, Mm (red) are connected to PDUs Pf, Pr (yellow). Figure 3 is consistent with Kira’s written description and Figure 1. Kira unambiguously discloses that “motor Ms made up of the direct-current brush motor needs no power drive unit,” whereas each of motors M and Mm “made up of the three-phase alternating-current motor is driven by converting a direct current of the high-voltage battery Bh to a three-phase alternating current at the power

drive unit.” Ex. 1005 ¶¶ 43, 62. As shown in Figure 1, direct-current motor Ms also is shown *without* a PDU, whereas alternating-current motors M, Mm are connected to PDUs Pf, Pr, consistent with Figure 3.

Dr. Keim also admits that a PDU acts as an inverter, which is needed to drive an alternating current motor because “[t]he function of the inverter is to form AC, which is necessary to drive an alternating current motor.” Ex. 1028, 22:18–23:25. It is undisputed that Figure 3 of Kira does not show a PDU connected to motor Ms. Patent Owner does not explain sufficiently why one of ordinary skill in the art would have understood that motor Ms (with no connection to a PDU to form alternating current) would receive alternating current. PO Resp. 2–6; Sur-reply 1–5; Ex. 2001 ¶¶ 24–29.

Patent Owner and Dr. Keim improperly presume the illustration of three lines *with arrowheads* between generator G (green) and motor Ms, in Kara’s Figure 3, matches the ANSI symbol . PO Resp. 4–5; Sur-reply 1–5; Ex. 2001 ¶¶ 26–28. The ANSI symbol  does not include arrowheads, however. Therefore, the illustration of three lines with arrowheads next to motor Ms, in Kara’s Figure 3, does not match the symbol , much less indicate that motor Ms receives alternating current.

In view of Kira’s disclosure as a whole, the illustration of three lines with arrowheads next to motor Ms, without more, does not support Patent Owner’s position that motor Ms receives alternating current. PO Resp. 2–6; Sur-reply 1–5; Ex. 2001 ¶¶ 24–29. Figure 3 does not have a PDU connected to motor Ms, and Dr. Keim admits that a PDU is needed to form alternating current. Ex. 1028, 22:18–23:25. In short, Patent Owner’s position that Kira

is ambiguous is based only on speculation, not supported by Kira's written disclosure, Figure 1, or Figure 3.

Moreover, none of the cases cited by Patent Owner supports its position because they do not involve unambiguous prior art disclosure, as here. For example, in *Turlay*, a claim to a cylinder block having "a single," interpreted as one and only one, exhaust port was determined to not be anticipated because the reference's figures in cross section could have equally conveyed one or two exhaust ports and there was no planar figure expressly showing the presence of only one exhaust port. *Turlay*, 304 F.2d at 899 (CCPA 1962). In *Hughes*, the claim to "pieced, interleaved-spiral core strips" was found not to be anticipated by a prior art reference that describes the core only as having the "identical position" or "relationship" as an original "wound core" because the claimed "spiral core" was not taught by the prior art. *Hughes*, 345 F.2d at 186–87.

Here, as discussed above, based on the evidence in this entire trial record, we determine that Kira's disclosure, including Figures 1 and 3, unambiguously discloses motor Ms as a *direct current motor receiving direct current*. Ex. 1005 ¶¶ 37–38, 43, 61–62, Figs. 1, 3; Ex. 1028, 14:20–15:22, 18:9–19:24, 20:18–21:20, 22:18–23:25, 37:2–10, 37:13–19. Patent Owner's argument and Dr. Keim's testimony, that Figure 3 shows motor Ms receiving alternating current, are merely speculative, not supported by Kira's disclosure. Therefore, Patent Owner's argument and Dr. Keim's testimony that "Kira's disclosure is ambiguous" are unavailing.

For the foregoing reasons, we determine that Petitioner has shown that Kira discloses a propulsion system for a vehicle that comprises "a first

traction drive system coupled to an engine and comprising a first drive motor, wherein the engine is operable to supply energy to the first drive motor to propel the vehicle,” as recited in claims 1 and 24.

b. Second traction drive system

Claims 1 and 24 each recite:

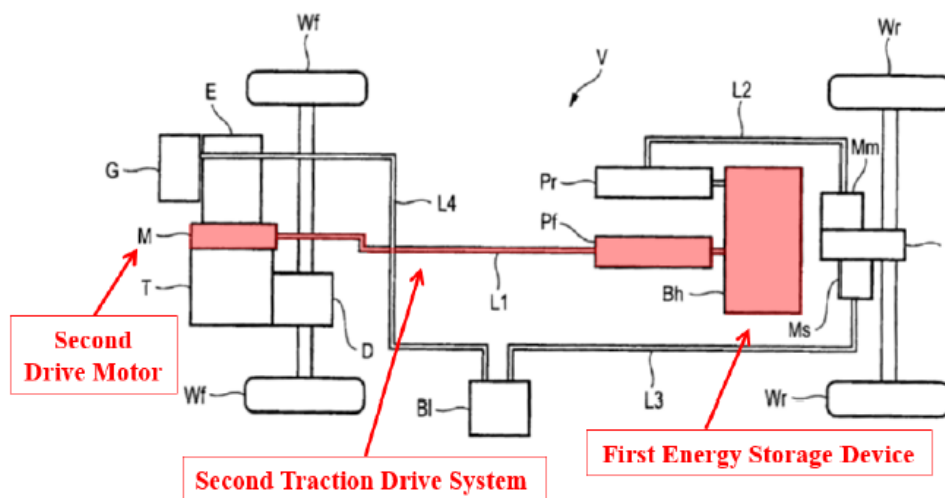
a second traction drive system comprising a second drive motor and a first energy storage device,

wherein the second drive motor is operable to both supply energy to the first energy storage device and to receive energy from the first energy storage device.

Ex. 1001, 13:25–29, 15:9–13.

Petitioner asserts that Kira also discloses these limitations. Pet. 17–18 (citing Ex. 1005 ¶ 43, Fig. 1). Patent Owner does not dispute Petitioner’s contentions regarding these limitations. *See generally* PO Resp.; Sur-reply. As discussed below, we determine that Petitioner has shown that Kira discloses these limitations.

Figure 1 of Kira is reproduced below with Petitioner’s annotations.



Annotated Figure 1 above depicts a hybrid vehicle having a second traction drive system (red). Petitioner explains that Kira's second traction drive system includes front motor M (the "second drive motor") and high-voltage battery Bh (the "first energy storage device"). Pet. 17–18. According to Petitioner, front motor M can receive energy from and supply energy to high-voltage battery Bh. *Id.* (citing Ex. 1005 ¶ 43). Petitioner explains that front motor M is a drive motor "driven by converting a direct current of the high-voltage battery Bh to a three-phase alternating current at the power drive unit Pf." *Id.* (citing Ex. 1005 ¶ 43). Kira discloses that "[w]hen the vehicle is decelerated, the front motor M [is] driven by driving force from the front wheels Wf . . . so that the front motor M [is] made to function as a generator, whereby the high-voltage battery Bh is charged by generated output of the motor M functioning as the generator." Ex. 1005 ¶ 43.

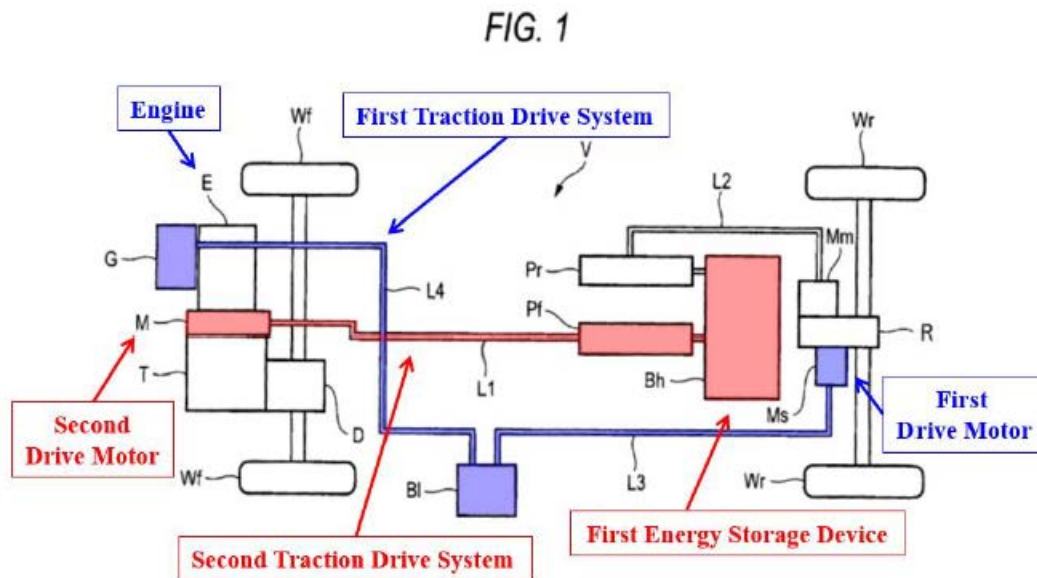
Therefore, Petitioner has shown that Kira discloses "a second traction drive system comprising a second drive motor and a first energy storage device, wherein the second drive motor is operable to both supply energy to the first energy storage device and to receive energy from the first energy storage device," as recited in claims 1 and 24.

c. First drive motor is electrically coupled to only first traction drive system

Claim 1 recites "wherein the first drive motor is electrically coupled to only the first traction drive system." Ex. 1001, 13:30–31. Petitioner asserts that Kira discloses this limitation. Pet. 19–20 (citing Ex. 1005, Fig. 1; Ex. 1002 ¶¶ 58–59). Patent Owner does not dispute Petitioner's contentions regarding this limitation. *See generally* PO Resp.; Sur-reply.

Based on the evidence before us, we are persuaded by Petitioner's showing that Kira discloses this limitation.

Figure 1 of Kira is reproduced below with Petitioner's annotations.



Annotated Figure 1 above shows that sub rear motor Ms is electrically coupled to only low-voltage battery B1 and generator G, and it does not electrically couple to any other component. Pet. 19–20. Dr. Shahbakhti testifies that, although sub rear motor Ms is connected to speed reduction gear set R, one of ordinary skill in the art would have understood that “this is a mechanical connection and not electrical” because the drive motor converts the electrical energy received from low-voltage battery B1 to mechanical rotational energy, which is transferred to the gears in speed reduction gear set R. Ex. 1002 ¶¶ 58, 59.

Based on the evidence of record, we determine that Petitioner has shown that Kira discloses “wherein the first drive motor is electrically coupled to only the first traction drive system,” as recited in claim 1.

d. First and second traction drive systems operate at different voltages

Claim 24 recites “wherein the first traction drive system operates at a first voltage that is a different voltage than a second voltage at which at least a portion of the second traction drive system operates.” Ex. 1001, 15:14–17. Petitioner asserts that Kira also discloses this limitation. Pet. 23–24 (citing Ex. 1005 ¶ 38, Fig. 1; Ex. 1002 ¶ 60). Patent Owner does not challenge Petitioner’s contentions regarding this limitation. *See generally* PO Resp.; Sur-reply. Upon review of the evidence before us, we are persuaded by Petitioner’s showing that Kira discloses this limitation.

As Petitioner notes (Pet. 24), annotated Figure 1 of Kira shows that the first traction drive system provides power via low-voltage battery B1, whereas the second traction drive system provides power via high-voltage battery Bh. Ex. 1005, Fig. 1. Kira also discloses that “low-voltage battery B1 . . . voltage is lower than that of the high-voltage battery Bh.” *Id.* ¶ 38. Moreover, Dr. Shahbakhti testifies that the first and second traction drive systems in Kira operate at two different voltages. Ex. 1002 ¶ 66.

Therefore, we determine that Petitioner has shown that Kira discloses “wherein the first traction drive system operates at a first voltage that is a different voltage than a second voltage at which at least a portion of the second traction drive system operates,” as recited in claim 24.

e. Conclusion as to claims 1 and 24

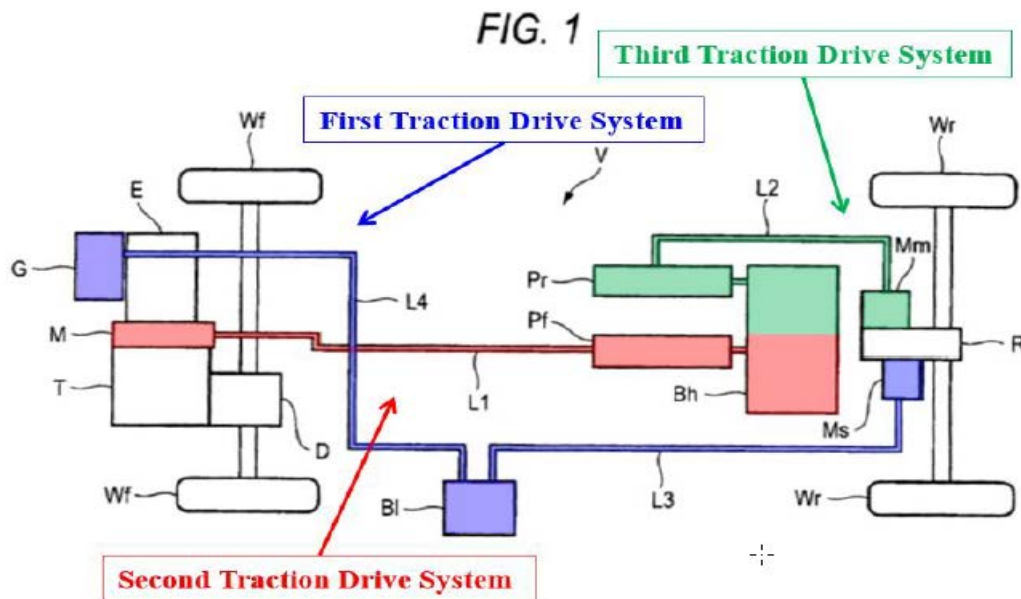
For the foregoing reasons, we determine that Petitioner has demonstrated by a preponderance of the evidence that claims 1 and 24 are anticipated by Kira.

3. Dependent claims 2 and 23

Claim 2 depends from claim 1, and further recites “a third traction drive system comprising a third drive motor and a second energy storage device, wherein the third drive motor is operable to both supply energy to the second energy storage device and to receive energy from the second energy storage device.” Ex. 1001, 13:32–37. Claim 23 depends from claim 2, and further recites “wherein the first energy storage device is the *same as* the second energy storage device.” *Id.* at 15:1–3 (emphasis added).

Petitioner asserts that Kira discloses these limitations. Pet. 20–22. Patent Owner does not challenge Petitioner’s contentions regarding these limitations, but rather relies upon its arguments in connection with claim 1. PO Resp. 2–8. We have addressed those arguments in our analysis above in Section II.D.2 regarding claim 1, and we determine those arguments are unavailing here for the reasons stated above. As discussed above, Petitioner has demonstrated by a preponderance of the evidence that claim 1 is anticipated by Kira. Based on the evidence before us, we are persuaded by Petitioner’s showing that Kira discloses the limitations recited in claims 2 and 23.

Figure 1 of Kira is reproduced below with Petitioner's annotations.



Annotated Figure 1 above shows a third traction drive system (green) that includes main rear motor Mm (the “third drive motor”) and high-voltage battery Bh. Ex. 1005, Fig. 1. Petitioner explains that high-voltage battery Bh is both the first energy storage device in the second traction drive system and the second energy storage device in the third traction drive system, as required by claims 2 and 23. Pet. 22.

Based on the evidence of record, we determine that Petitioner has shown that Kira discloses a third traction drive system, a third drive motor, and a second energy storage device, as recited in claims 2 and 23.

4. Dependent claim 30

Claim 30 depends from claim 24, and further recites:

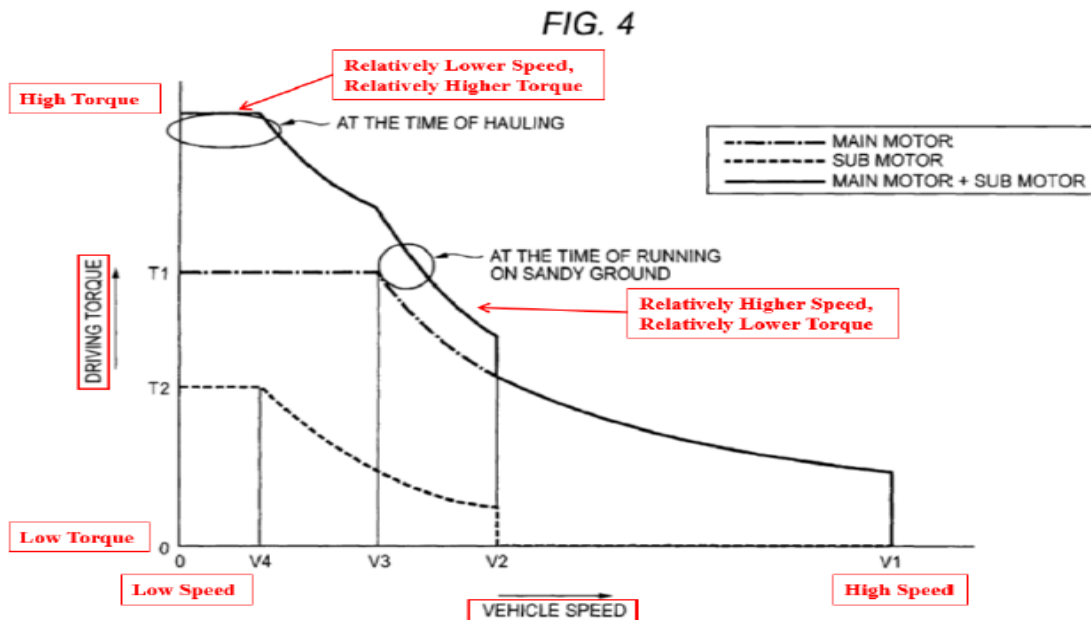
wherein the system can propel the vehicle at relatively lower speed, at relatively higher torque, or a combination of relatively higher torque and lower speed, by using the second traction drive system alone or in combination with the first traction drive

system, and the system can propel the vehicle at relatively lower torque or relatively higher speed by using at least the first traction drive system.

Ex. 1001, 15:37–16:5.

Petitioner asserts that Kira discloses these limitations. Pet. 25–27. Patent Owner does not challenge Petitioner’s contentions regarding these limitations, but rather, Patent Owner relies upon its arguments in connection with claim 24. PO Resp. 2–8. We have addressed those arguments in our analysis above in Section II.D.2, regarding claim 24, and we determine those arguments are unavailing here for the reasons stated above. As discussed above, Petitioner has demonstrated by a preponderance of the evidence that claim 24 is anticipated by Kira. Based the evidence before us, we are persuaded by Petitioner’s showing that Kira discloses the limitations expressly recited in claim 30.

Figure 4 of Kira is reproduced below with Petitioner’s annotations.



Annotated Figure 4 above depicts a graph showing changes in driving torques of main and sub rear motors relative to the vehicle speed. Ex. 1005 ¶ 30. Petitioner explains that Kira discloses that the system can propel the vehicle at a relatively higher torque and a relatively lower speed, or at a relatively lower torque and a relatively higher speed, using the first and second traction drive systems, as required by claim 30. Pet. 25–27 (citing Ex. 1005 ¶¶ 37, 38, Fig. 4; Ex. 1002 ¶¶ 67, 68).

Therefore, we determine that Petitioner has shown that Kira discloses both of the claimed operating modes, as required by claim 30.

5. Conclusion for Ground 1

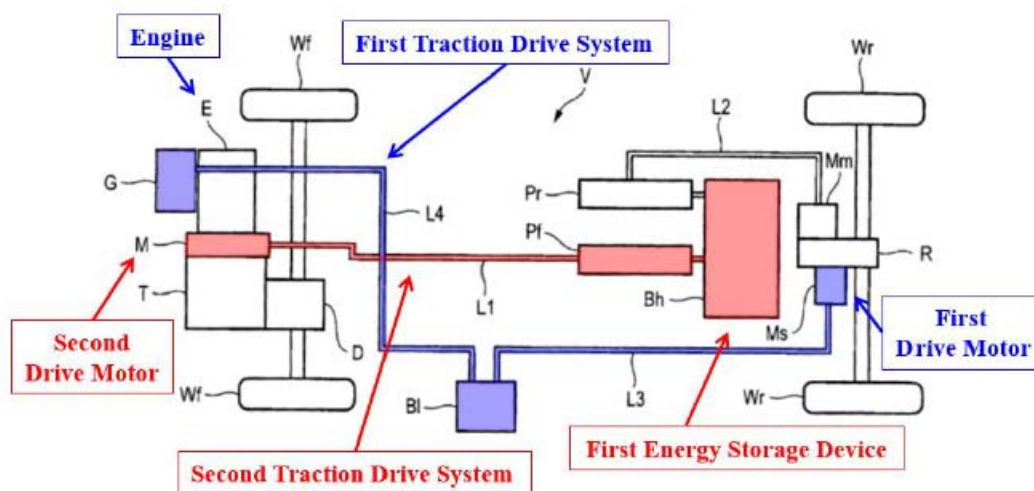
For the foregoing reasons, we determine that Petitioner has demonstrated by a preponderance of the evidence that claims 1, 2, 23, 24, and 30 are unpatentable under § 102 as anticipated by Kira.

E. Ground 2: Claim 3 is Obvious over Kira

Petitioner asserts claim 3 is unpatentable under § 103(a) as obvious over Kira. Pet. 27–29. Claim 3 depends from claims 1 and 2. Patent Owner does not address the limitation expressly recited in claim 3 with separate, specific arguments, but rather relies upon its arguments in connection with independent claim 1. PO Resp. 2–8. We have addressed those arguments in our analysis above in Section II.D, regarding claim 1, and we determine those arguments are unavailing here for the reasons stated above. As discussed above, Petitioner has demonstrated by a preponderance of the evidence that claims 1 and 2 are anticipated by Kira.

Upon consideration of Petitioner's explanation and evidence, we are persuaded by Petitioner's showing that claim 3 is obvious over Kira.

Claim 3 expressly recites "wherein at least one of the second traction drive system or the third traction drive system is *reversibly electrically decoupled* from the first traction drive system." Ex. 1001, 13:38–41 (emphasis added). Petitioner avers that Kira discloses both the second and third traction drive systems are electrically decoupled from the first traction drive system. Pet. 27 (citing Ex. 1002 ¶¶ 70–71). Figure 1 of Kira is reproduced below with Petitioner's annotations added.



Annotated Figure 1 above shows that the only connections between the first and second traction drive systems are through speed reduction gear set R. *Id.* at 28 (citing Ex. 1002 ¶ 70). Dr. Shahbakhti testifies that one of ordinary skill in the art would have understood that the connections are mechanical connections, not electrical, and therefore, the first and second traction drive system are electrically decoupled and, similarly, the first and third traction drive system are electrically decoupled. Ex. 1002 ¶ 70.

Petitioner admits that Kira does not specifically disclose that the first and second traction drive systems are reversibly electrically decoupled. Pet. 28. Nevertheless, Petitioner asserts that it would have been obvious to add a switchable booster or converter to electrically couple and decouple Kira's first and second traction drive systems. *Id.* at 29. Dr. Shahbakhti testifies that switchable boosters and converters, "allowing them to electrically couple and decouple two systems depending on the needs of the system or the preference of the user," were known in the art before the priority date of the '932 patent. Ex. 1002 ¶ 71 (citing Ex. 1018 ¶ 8 ("buck-boost converter device 4 for stepping up or stepping down the voltage"); Ex. 1015 ¶ 3 ("buck-boost converter 6" for "stepping up" and "stepping down")). Dr. Shahbakhti also testifies that one of ordinary skill in the art would have been motivated to implement such components in Kira's system "to avoid low-efficiency operating regions in the electric motors in the traction drive systems and also to allow the sharing of power between the first and second traction drive systems to propel the vehicle." *Id.* ¶ 72.

Based on the evidence of record, we determine that Petitioner has demonstrated by a preponderance of the evidence that claim 3 is obvious over Kira.

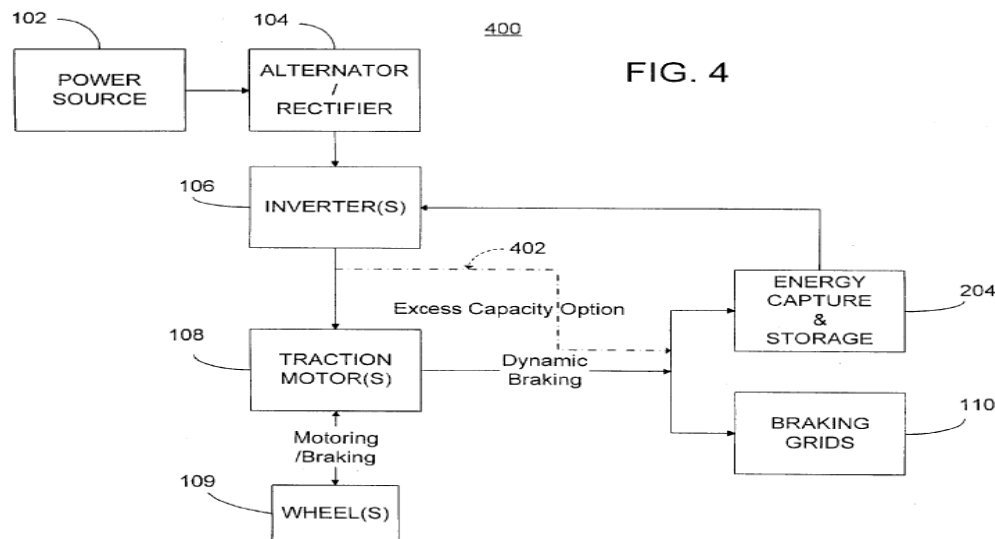
F. Ground 3: Claims 4 and 18–21 are Obvious over Kira and Kumar

Petitioner asserts claims 4 and 18–21 are unpatentable under § 103(a) as obvious over Kira and Kumar. Pet. 29–41. Patent Owner does not address the limitations expressly recited in these dependent claims with separate, specific arguments, but rather relies upon its arguments in

connection with independent claim 1. PO Resp. 2–8. We have addressed those arguments in our analysis above regarding claim 1, and we determine those arguments are unavailing here for the reasons stated above. As discussed above, Petitioner has demonstrated by a preponderance of the evidence that claim 1 is anticipated by Kira. For the reasons set forth below, we are persuaded by Petitioner’s showing that claims 4 and 18–21 are obvious over Kira and Kumar.

1. Overview of Kumar

Kumar discloses a hybrid propulsion system having traction drive systems. Ex. 1006, code (57). Figure 4 of Kumar illustrates an exemplary traction drive system and is reproduced below.



As shown in Figure 4 above, the traction drive system includes traction motors 108 that receive energy from power source 102 and/or energy capture and storage device 204 (battery). *Id.* ¶¶ 56–59. Traction motors 108 are connected to braking grids 110 and are capable of performing dynamic braking. *Id.* ¶ 58. “When traction motors 108 are operated in a dynamic

braking mode, at least a portion of the generated electrical power is routed to an energy storage medium such as energy storage 204.” *Id.* “To the extent that energy storage 204 is unable to receive and/or store all of the dynamic braking energy, the excess energy is routed to braking grids 110 for dissipation as heat energy.” *Id.*

2. Discussion

Upon consideration of Petitioner’s explanation and supporting evidence, we determine that Petitioner has demonstrated that the combination of Kira and Kuma teaches or suggests all the limitations recited in claims 4 and 18–21, and articulated reasons to combine the prior art teachings supported by Dr. Shahbakhti’s un rebutted testimony. Pet. 29–41.

For example, claim 4 depends directly from claim 1, and expressly recites “wherein the first traction drive system further comprises a dynamic brake resistor grid.” Citing to Dr. Shahbakhti’s un rebutted testimony for support, Petitioner asserts that one of ordinary skill in the art would have been motivated to add a dynamic braking grid, as described by Kumar, to Kira’s first traction drive system for absorbing dynamic braking energy when the energy storage battery cannot receive all of the energy, and to prevent overheating of the battery and other components in the drive system. Pet. 30–35 (citing Ex. 1002 ¶¶ 75–77; Ex. 1006 ¶ 48, Fig. 4). Based on the evidence of record, we determine that Petitioner has demonstrated by a preponderance of the evidence that the combination of Kira and Kumar renders claim 4 obvious.

Claim 18 depends directly from claim 1 and recites “an auxiliary electrical system that is electrically connected to the first energy storage device.” Claim 19 depends from claim 18 and recites “wherein the auxiliary electrical system is operable to supplement a prime auxiliary electrical system by supplying electrical energy to the prime auxiliary electrical system.” Claim 20 depends from claim 19 and recites “wherein the auxiliary electrical system is operable to supplement the prime auxiliary electrical system by supplying electrical energy to some subcomponents, and the prime auxiliary electrical system supplies electrical energy to other subcomponents.” Claim 21 depends from claim 18 and requires the auxiliary electrical system to have a plurality of modes of operation for supplying energy to subcomponents, and a controller for switching the mode of operation.

To account for these limitations, Petitioner asserts that Kumar discloses using one or more auxiliary electrical systems to power various electrical components, such as “lighting, air conditioning/heating, blower drives, radiator fan drives, control battery chargers, field exciters, power steering, pumps, and the like.” Pet. 31–33, 35–37 (citing Ex. 1006 ¶ 15). Petitioner also explains that Kumar discloses that the auxiliary electrical systems may receive energy from an energy storage device or electrical bus. *Id.* (citing Ex. 1006 ¶¶ 100, 110, 113, Figs. 9A–G).

Citing to Dr. Shahbakhti’s testimony for support, Petitioner asserts that one of ordinary skill in the art would have been motivated to incorporate Kumar’s auxiliary electrical systems into Kira’s system by connecting them to Kira’s batteries, including the first energy storage device, as required by

claim 18, to allow commonly used devices to receive auxiliary power from the engine and/or the battery. *Id.* (citing Ex. 1002 ¶¶ 78, 79, 81).

For claim 19, Petitioner asserts that it would have been obvious to include an “auxiliary electrical system . . . operable to supplement a prime auxiliary electrical system by supplying electrical energy to the prime auxiliary electrical system,” as recited in claim 19. *Id.* at 37–38. According to Petitioner, although Kumar does not specifically describe a “prime” auxiliary electrical system, Kumar discloses using multiple auxiliary electrical systems that can receive power from various sources, including the prime mover power source or a separate axle-driven generator. *Id.* (citing Ex. 1006 ¶ 15). Citing to Dr. Shahbakhti’s testimony for support, Petitioner avers that because the power for Kumar’s auxiliary systems may come from multiple sources and the specific source does not affect their operation, one of ordinary skill in the art would have understood that the power could be shared between auxiliary electrical systems (i.e., one auxiliary electrical system could supplement another auxiliary electrical system) to reduce the necessary components in the system, as a separate alternator and mechanical linkages would not be required to supply power to the supplemental auxiliary system. *Id.* (citing Ex. 1002 ¶ 82).

As to claims 20 and 21, citing to Dr. Shahbakhti’s testimony for support, Petitioner argues that because each auxiliary electrical system in Kumar supplies power to different electrical components, it would have been obvious that “the auxiliary electrical system is operable to supplement the prime auxiliary electrical system by supplying electrical energy to some subcomponents, and the prime auxiliary electrical system supplies electrical

energy to other subcomponents,” as required by claims 20 and 21. *Id.* at 38–40 (citing Ex. 1002 ¶ 83).

In addition, Petitioner contends that the combination of Kira and Kumar discloses a plurality of modes of operation, as required by claim 21. *Id.* at 39–41 (citing Ex. 1005 ¶ 51). Specifically, Petitioner explains that Kira discloses that “[t]here are two modes available when assisting in driving the rear wheels W_r , W_r in low and middle vehicle speeds (lower than the vehicle speed V_2),” and that a first mode in which “only the main rear motor M_m is driven,” and a second mode in which “both the main rear motor M_m and the sub rear motor M_s are driven.” *Id.* (citing Ex. 1005 ¶ 51, Table 1). Also Kira discloses that main rear motor M_m (the third drive motor) supplies voltage to high-voltage battery B_h (first or second energy storage device) during deceleration. *Id.* (Ex. 1005 ¶ 43). Citing to Dr. Shahbakhti’s testimony for support, Petitioner asserts that one of ordinary skill in the art would have understood that, in either operation mode, where main rear motor M_m is drive, main rear motor M_m would be supplying energy to high-voltage battery B_h . *Id.* (citing Ex. 1002 ¶ 85). Therefore, the combination of Kira and Kumar suggests a plurality of modes, as recited in claim 21.

Petitioner also argues that the combination of Kira and Kumar discloses a controller. *Id.* at 41. Petitioner points out that Kuma discloses an energy management system having an energy management processor, which controls the energy transfer throughout the drive system. *Id.* (citing Ex. 1006 ¶¶ 38, 108). Petitioner also notes that Kira discloses multiple electronic control units (ECU) that can switch the mode of operation of its

drive system. *Id.* (citing Ex. 1005 ¶ 41). Citing to Dr. Shahbakhti's testimony for support, Petitioner asserts that, based on the combined teachings of Kira and Kuma, it would have been obvious to include "a controller that is operable to switch the mode of operation of the auxiliary electrical system," as recited in claim 21. *Id.* (citing Ex. 1002 ¶ 8).

Based on the evidence of record, we determine that Petitioner has demonstrated by a preponderance of the evidence that the combination of Kira and Kumar renders claims 18–21 obvious.

3. Conclusion for Ground 3

In light of the foregoing, we conclude that Petitioner has demonstrated by a preponderance of the evidence that claims 4 and 18–21 are unpatentable under § 103(a) as obvious over Kira and Kumar.

G. Ground 4: Claims 5, 14, 15, 17, and 22 are Obvious over Kira and Hanyu

Petitioner asserts claims 5, 14, 15, 17, and 22 are unpatentable under § 103(a) as obvious over Kira and Hanyu. Pet. 41–49. Petitioner asserts that the combination of Kira and Hanyu teaches or suggests all the limitations recited in these claims, and articulates reasons to combine the prior art teachings. *Id.* Patent Owner disagrees. PO Resp. 8–11. For the reasons set forth below, we are persuaded by Petitioner's showing that claims 5, 14, 15, 17, and 22 are obvious over Kira and Hanyu.

1. Overview of Hanyu

Hanyu discloses a hybrid propulsion system with an engine, a battery, and a plurality of motor generators. Ex. 1007, code (57). Figure 1 of Hanyu is reproduced below with our highlighting.

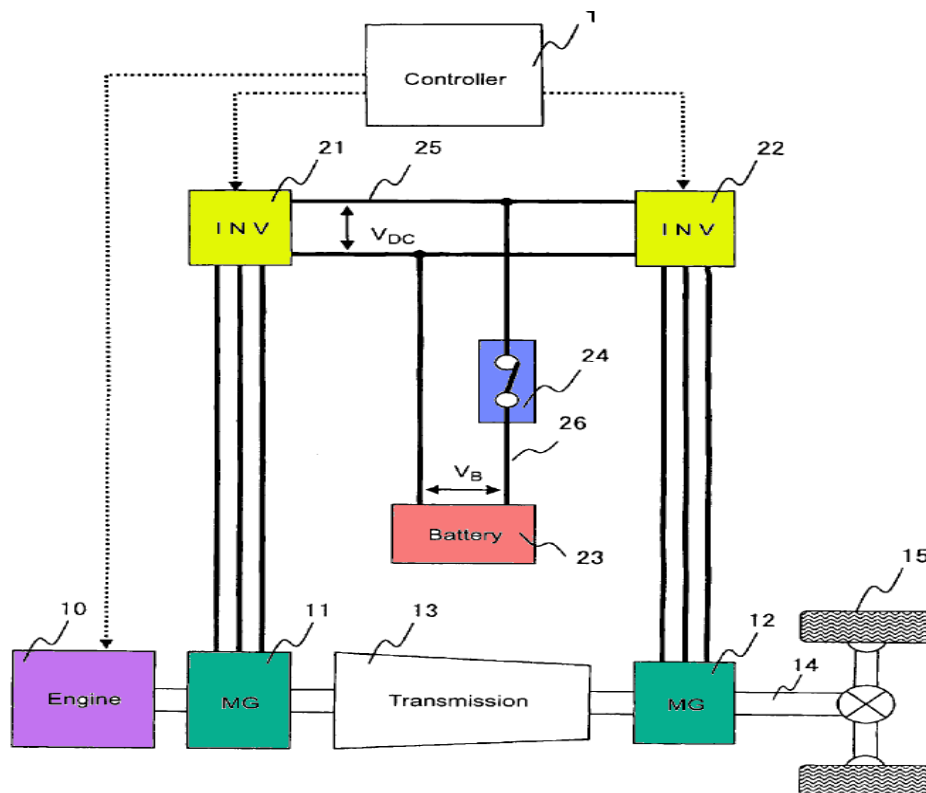


Figure 1 of Hanyu illustrates a hybrid vehicle comprising engine 10 (purple), motor generators 11, 12 (green), inverters 21, 22 (yellow), battery 23 (red), and switch 24 (blue). Ex. 1007 ¶¶ 36–41. Engine 10 generates the driving power to propel the vehicle. *Id.* Motor generators 11, 12 generate electric power when driven by engine 10 or by regeneration of the kinetic energy of the vehicle. *Id.* Either motor generator 11 or 12 can also propel the vehicle by receiving electric power from battery 23 or other motor generators. *Id.* Motor generators 11, 12 are controlled by inverters 21, 22 respectively.

Figure 2 of Hanyu is reproduced below.

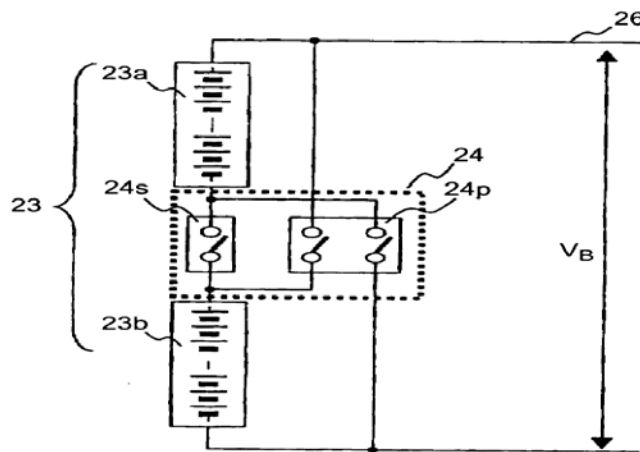


Figure 2 of Hanyu above shows battery 23, which comprises two battery modules 23a and 23b, and switch 24, which serves as a means to change the output voltage V_B of battery 23. *Id.* ¶¶ 40–41. Switch 24 comprises two kinds of switches 24s, 24p, allowing battery modules 23a, 23b to be connected in series or in parallel. *Id.* When switch 24s is closed and switch 24p is opened, battery modules 23a, 23b connect with each other *in series* and *voltage V_B of battery 23 increases*. *Id.* When switch 24p is closed and switch 24s is opened, battery modules 23a, 23b connect with each other *in parallel* and *voltage V_B of battery 23 decreases*. *Id.*

2. Discussion

Petitioner asserts that the combination of Kira and Hanyu teaches or suggests all the limitations of claims 5, 14, 15, 17, and 22, and articulates reasons to combine the prior art teachings. Pet. 41–49.

Claim 5

Claim 5 depends directly from claim 1, and further recites “wherein the *first energy storage device* has a first portion and a second portion, and

the first portion and the second portion are switchable from a first operating mode in which the first portion and the second portion are electrically connected in parallel, and a second operating mode in which the first portion and the second portion are electrically connected in serial.” Ex. 1001, 13:45–51 (emphases added).

Petitioner argues that Hanyu teaches this limitation because Hanyu teaches battery 23 having two separate battery modules 23a and 23b, and switch 24, allowing these modules to be *connected in series or in parallel*, directing our attention to Figure 2 of Hanyu (reproduced above in Section II.G.1). Pet. at 45 (Ex. 1007 ¶¶ 40–41, Fig. 2). Dr. Shahbakhti testifies that this allows the output voltage of the battery to be adjusted. Ex. 1002 ¶ 91 (citing Ex. 1007 ¶ 41).

According to Dr. Shahbakhti, an ordinarily skilled artisan would have understood “the benefits associated with Hanyu’s battery system to include variability in battery output voltages and flexibility in adapting to different operating modes.” *Id.* ¶ 91. Dr. Shahbakhti explains that “[i]ncorporating Hanyu’s teachings into Kira would allow output voltages to be adjusted within a single traction system.” *Id.* ¶ 92. Dr. Shahbakhti testifies that, “[i]nstead of a single battery module, a person of ordinary skill would have incorporated two battery modules with a switch between the battery modules, as taught by Hanyu.” *Id.* ¶ 93.

Patent Owner opposes, advancing three arguments. PO Resp. 8–11; Sur-reply 12–14. First, Patent Owner argues that Petitioner’s reason to modify Kira is vague. PO Resp. 9; Sur-reply 12–13. Patent Owner contends that Petitioner does not explain how the general observation is

relevant to Kira's system. PO Resp. 9; Sur-reply 12–13. Patent Owner also avers that Petitioner does not explain how Kira's system would benefit in any way from additional “flexibility in adapting to different operating modes.” PO Resp. 9; Sur-reply 12–13. Patent Owner further contends that “it would not have been obvious to one of ordinary skill in the art to make a modification to Kira that addresses a non-existent problem,” citing Dr. Keim's testimony for support. PO Resp. 9; Sur-reply 12–13 (citing Ex. 2001 ¶ 36).

However, neither Patent Owner nor Dr. Keim disputes that Kira does not expressly disclose a battery system having two battery modules connected in series or parallel with a switch, allowing *varying voltage within a single traction system*. PO Resp. 8–11; Sur-reply 12–14; Ex. 2001 ¶ 36; Ex. 1005 ¶¶ 37–38, 43, Fig. 1. As discussed above, Dr. Shahbakhti testifies that “[i]ncorporating Hanyu's teachings into Kira would allow output *voltages to be adjusted within a single traction system*.” Ex. 1002 ¶ 92 (emphasis added).

Indeed, as Petitioner points out (Pet. 41–46; Ex. 1002 ¶ 94), Hanyu teaches battery 23 having two battery modules 23a and 23b connected to switch 24, which serves as a means to change the output voltage V_B of battery 23, as shown in Figure 2 of Hanyu (reproduced above). Ex. 1007 ¶¶ 40–41, Fig. 2. Switch 24 comprises two kinds of switches 24s, 24p, allowing battery modules 23a, 23b to be connected in series or parallel. *Id.* When switch 24s is closed and switch 24p is opened, battery modules 23a, 23b connect with each other *in series* and *voltage V_B of battery 23 increases*. *Id.* When switch 24p is closed and switch 24s is opened, battery

modules 23a, 23b connect with each other *in parallel* and *voltage VB of battery 23 decreases*. *Id.* Dr. Shahbakhti explains that this allows the output voltage of the battery to be adjusted. Ex. 1002 ¶ 91 (citing Ex. 1007 ¶ 41).

Dr. Shahbakhti also testifies that, “[i]nstead of a single battery module, a person of ordinary skill in the art would have incorporated two battery modules with a switch between the battery modules, as taught by Hanyu.” *Id.* ¶ 93. Dr. Shahbakhti further testifies that such an artisan would have understood “the benefits associated with Hanyu’s battery system to include variability in battery output voltages and flexibility in adapting to different operating modes.” *Id.* ¶ 91. We credit Dr. Shahbakhti’s testimony (*id.* ¶¶ 91–94) because it is consistent with the prior art teachings. *See, e.g.*, Ex. 1005 ¶¶ 37–38, 43, Fig. 1; Ex. 1007, code (57), ¶¶ 3, 36–46, Figs. 1–2.

Indeed, Hanyu teaches that it was known in the art to vary voltage within a single traction system for achieving simultaneously high efficiency and high power. Ex. 1007, code (57), ¶¶ 3, 45. For example, Hanyu teaches:

As a method of *simultaneously achieving high efficiency and high power*, which is normally a trade-off relationship in an inverter-controlled motor-generator, a method has been known wherein *the voltage of a battery that supplies the power to the motor generator is made variable*. According to this method, *it is possible to reduce the loss and increase the efficiency of the inverter* by using a low battery voltage when the load is low. On the other hand, *if high output is required, high power can be generated by using a high battery voltage*, thus making it possible to run current through the motor-generator while suppressing the counter electromotive force.

Id. ¶ 3 (emphases added). A reason to combine or modify the prior art may be found explicitly or implicitly in market forces, design incentives, the “interrelated teachings of multiple patents,” “any need or problem known in the field of endeavor at the time of invention and addressed by the patent,” and the background knowledge, creativity, and common sense of the person of ordinary skill. *Perfect Web Techs., Inc. v. InfoUSA, Inc.*, 587 F.3d 1324, 1328–29 (Fed. Cir. 2009).

Accordingly, we determine that Petitioner has articulated a sufficient reason to modify Kira’s high-voltage battery to include two battery modules connected in series or parallel with a switch, allowing varying voltage within a single traction system, as taught by Hanyu. Patent Owner’s arguments that Petitioner’s reason to modify Kira is vague, and that the modification addresses a non-existent problem, are unavailing.

Second, Patent Owner argues that the proposed modification would “involve a substantial redesign of Kira’s power delivery system in order to accommodate the significant voltage changes that could be produced by Hanyu’s modular battery.” PO Resp. 10; Sur-reply 13–14. According to Patent Owner, “[a]dditional control systems would be required to allow Kira’s power drive units to accept, handle, and properly convert a wide range of direct-current voltages to the specific three-phase alternating current profile required by front motor M and rear motor component Mm.” *Id.* Patent Owner avers that Petitioner does not explain “how the *rest* of the system must be modified to accommodate a battery that switches between voltage levels,” and “how one of ordinary skill in the art would have known what changes to make, known how to make them, or had a reasonable

expectation of success in modifying Kira to function with a multi-voltage battery,” citing to Dr. Keim’s testimony for support. *Id.* at 10–11 (citing Ex. 2001 ¶ 38).

Patent Owner’s arguments that the modification to Kira would require substantial redesign are unavailing. “It is well-established that a determination of obviousness based on teachings from multiple references does not require an actual, physical substitution of elements.” *In re Mouttet*, 686 F.3d 1322, 1332 (Fed. Cir. 2012). The criterion for obviousness is not whether the references could be combined physically, but whether the claimed invention is rendered obvious by the teachings of the prior art as a whole. *In re Etter*, 756 F.2d 852, 859 (Fed. Cir. 1985) (en banc).

More importantly, “if a technique has been used to improve one device, and a person of ordinary skill in the art would recognize that it would improve similar devices in the same way, using the technique is obvious unless its actual application is beyond his or her skill.” *KSR*, 550 U.S. at 417. Here, the evidence before us shows implementing a battery system having two modules connected in series or parallel with a switch, allowing varying voltage within a single traction system, as taught by Hanyu, is not beyond the skill of a pertinent artisan. *See, e.g.*, Ex. 1007, code (57), ¶¶ 3, 36–46, Figs. 1–2; Ex. 1028, 44:13–45:6, 54:22–55:10.

Notably, Hanyu already teaches how to implement such a battery system in a propulsion system for a hybrid vehicle. Ex. 1007, code (57), ¶¶ 3, 36–46, Figs. 1–2. Moreover, Dr. Keim concedes that an ordinarily skilled artisan would have understood how to design a battery system having two modules connected in series or parallel with a switch, and

converters/inverters to handle the changes in voltage. Ex. 1028, 44:13–45:6 (conceding that “the effect of switching between a series battery configuration and a parallel battery configuration were well-known before 2007” and that “[o]ne of ordinary skill would understand that batteries in parallel would have a lower voltage than the same batteries if in series . . . the same batteries in both configurations”), 54:22–55:10 (conceding that “a person of ordinary skill understood the fundamental concept of series and parallel,” and “[t]hey knew how to design DC converters at . . . various voltage levels, yes”). “[W]hen a patent simply arranges old elements with each performing the same function it had been known to perform and yields no more than one would expect from such an arrangement, the combination is obvious.” *KSR*, 550 U.S. at 418.

Accordingly, Patent Owner’s arguments that the modification to Kira would require substantial redesign are unavailing. PO Resp. 10–11; Ex. 2001 ¶¶ 37–38.

Third, Patent Owner argues that Petitioner fails to explain why the supposed benefits of multiple voltages could not be achieved by Kira’s existing structure. PO Resp. 11; Sur-reply 13. In Patent Owner’s view, Petitioner’s modification adds complexity, expense, and the possibility of additional failure modes to Kira for no benefit. *Id.* (citing Ex. 2001 ¶ 39).

However, as noted above, it is undisputed that Kira does not expressly disclose a battery system having two battery modules connected in series or parallel with a switch, allowing *varying voltage within a single traction system*. PO Resp. 8–11; Sur-reply 12–14; Ex. 2001 ¶ 36; Ex. 1002 ¶¶ 91–94. “[T]he fact that the two disclosed apparatus would not be

combined by businessmen for economic reasons is not the same as saying that it could not be done because skilled persons in the art felt that there was some technological incompatibility that prevented their combination. Only the latter fact is telling on the issue of nonobviousness.” *Orthopedic Equip. Co., Inc. v. United States*, 702 F.2d 1005, 1013 (Fed. Cir. 1983). In light of that fact, we are persuaded that the additional expense would not have discouraged one of ordinary skill in the art from seeking the benefit expected with the additional features. *In re Farrenkopf*, 713 F.2d 714, 718 (Fed. Cir. 1983). Moreover, we are persuaded that the mere fact that different types of batteries—be they simple or complex—offer different advantages or disadvantages does not establish a teaching away sufficient to preclude a conclusion of obviousness. *In re Fulton*, 391 F.3d 1195, 1200 (Fed. Cir. 2004) (explaining that “case law does not require that a particular combination must be the preferred, or the most desirable, combination described in the prior art in order to provide [the] motivation for the current invention”).

Accordingly, Patent Owner’s arguments suggesting that the benefits of *varying voltage within a single traction system* could be achieved by Kira’s existing structure and the proposed modification adds complexity, expense, and the possibility of additional failure modes to Kira for no benefit, are unavailing. PO Resp. 11; Ex. 2001 ¶ 39.

For the foregoing reasons, we determine that Petitioner has articulated a sufficient reason to modify Kira’s high-voltage battery to include two battery modules connected in series or parallel with a switch, allowing

varying voltage within a single traction system, as taught by Hanyu. Patent Owner's arguments do not undermine Petitioner's obviousness showing.

Based on the evidence in this entire trial record, we determine that Petitioner has demonstrated by a preponderance of the evidence that claim 5 is unpatentable under § 103(a) as obvious over Kira and Hanyu.

Claims 14, 15, 17, and 22

Petitioner asserts that the combination of Kira and Hanyu would have rendered claims 14, 15, 17, and 22 obvious. Pet. 41–49. Petitioner provides detailed explanations as to how the combination teaches or suggests every limitation recited in these dependent claims and articulates reasons to combine the prior art teachings, citing Dr. Shahbakhti's testimony for support. *Id.*; Ex. 1002.

Patent Owner relies upon the same arguments presented in connection with claim 5. PO Resp. 8–11. Patent Owner does not make any additional arguments as to claims 14, 15, 17, and 22. We already addressed those arguments in our analysis above regarding claim 5, and we find those arguments unavailing here for the reasons stated above.

Upon review of Petitioner's explanations and evidence, we determine that Petitioner has demonstrated by a preponderance of the evidence that claims 14, 15, 17, and 22 are unpatentable as obvious over Kira and Hanyu.

For example, as to claim 14 that depends directly from claim 1, Petitioner avers that the combination of Kira and Hanyu teaches the limitation "wherein the first energy storage device comprises a plurality of electrically coupled batteries," as recited in claim 14, because Hanyu

discloses a battery system with two battery modules 23a and 23b that are electrically coupled to each other. Pet. 46–47 (citing Ex. 1007 ¶¶ 40–41, Fig. 2; Ex. 1002 ¶ 95).

Claim 15 depends directly from claim 14, and further recites “wherein the first energy storage device comprises an energy battery that has an energy to power ratio that is greater than about 0.5:1.” Petitioner asserts that the combination of Kira and Hanyu would have rendered claim 15 obvious. Pet. 47–48. To support Petitioner’s position, Dr. Shahbakhti testifies that a person of ordinary skill in the art would have understood that “many batteries in hybrid electric vehicles that were commonly used before 2007 had power to energy ratios that were higher than 0.5:1” and that such an artisan would have known “to adjust the energy to power ratio of the first energy storage device depending on particular design considerations.” Ex. 1002 ¶¶ 96–97.

Claim 17 depends directly from claim 15, and further recites “wherein the first energy storage device further comprises a lithium battery, a nickel metal hydride battery, a flywheel, or an ultracapacitor.” Petitioner asserts that the combination of Kira and Hanyu would have rendered claim 17 obvious. Pet. 48–49. Dr. Shahbakhti testifies that a person of ordinary skill in the art would have understood that “these are all very common energy storage devices that have been in electric and hybrid electric vehicles for years.” Ex. 1002 ¶ 98. Dr. Shahbakhti explains that the 2002 textbook on “Electric Vehicle Battery Systems,” for example, describes the use of many of these battery types in electric vehicles, including lithium ion (Li-ion) and a nickel metal hydride (NiMH), and specifically, “Pb-acid, NiMH, and

Li-ion batteries can be configured in the series or parallel configuration, and the “selection of the configuration” of these various types of batteries “is based on the requirements for input voltage and battery pack discharge requirements.” *Id.* (citing Ex. 1022, 41).

Claim 22 depends directly from claim 2, and recites “wherein the first energy storage device differs from the second energy storage device.” Petitioner asserts that a person of ordinary skill in the art would have understood that using two batteries increases flexibility by allowing motors M and Mm in Kira to be controlled separately, and it would further increase the energy available to be supplied to each motor. Pet. 49 (citing Ex. 1002 ¶ 100; Ex. 1007 ¶¶ 40–41).

Upon review of Petitioner’s explanations and supporting evidence, we determine that Petitioner has demonstrated by a preponderance of the evidence that claims 14, 15, 17, and 22 are unpatentable as obvious over Kira and Hanyu.

3. Conclusion for Ground 4

For the foregoing reasons, we determine that Petitioner has demonstrated by a preponderance of the evidence that claims 5, 14, 15, 17, and 22 are unpatentable under § 103(a) as obvious over Kira and Hanyu.

H. Ground 5: Claims 6–12 are Obvious over Kira and Masahiko

Petitioner asserts claim 6–12 are unpatentable under § 103(a) as obvious over Kira and Masahiko. Pet. 50–60. Petitioner argues that the combination of Kira and Hanyu teaches or suggests all the limitations of

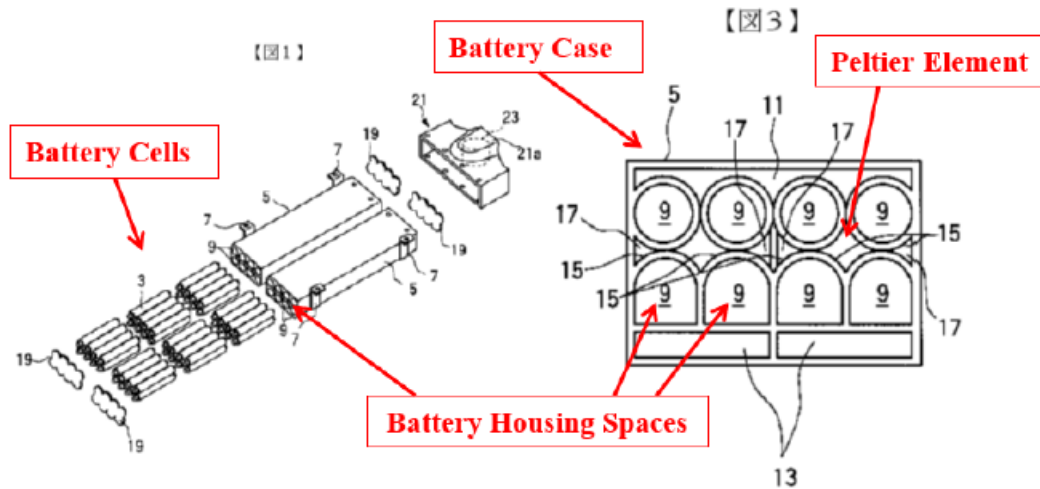
claims 6–12, and a person of ordinary skill in the art would have had a reason to combine the prior art teachings. *Id.*

Patent Owner does not dispute that the combination discloses all of the limitations recited in claims 6–12. PO Resp. 12–13. Nor does Patent Owner dispute that a person of ordinary skill in the art would have been motivated to modify Kira’s high-voltage battery to incorporate Masahiko’s teachings of a temperature control system to arrive at the subject matter recited in claim 6. *Id.* Rather, Patent Owner argues that Petitioner’s rationale for the combination does not address the limitations of claims 7–12. *Id.*; Sur-reply 14.

For the reasons stated below, we determine that Petitioner has demonstrated by a preponderance of the evidence that claim 6–12 are unpatentable under § 103(a) as obvious over the combination of Kira and Masahiko.

1. Overview of Masahiko

Masahiko discloses an electric automobile battery temperature regulation device. Ex. 1009, code (54). Figures 1 and 3 of Masahiko are reproduced below with annotations added by Petitioner. Pet. 50.



Figures 1 and 3 of Masahiko above illustrate a battery retention structure provided with a battery temperature regulation device for an electric automobile. Ex. 1009 ¶¶ 22–26. As shown above, battery case 5 includes multiple battery housing spaces 9 for housing multiple battery cells 3. *Id.* ¶ 24. The device includes Peltier elements 17 that “change temperature by heating or cooling depending on the direction of an electric current supplied by a voltage being impressed, and heat or cool the battery cells 3 to change the temperature of such, and are positioned at each of the battery cells 3 so as to be able to change the temperature of all of the battery cells 3.” *Id.* ¶ 26. The device also includes “battery temperature sensor 39 . . . for detecting the temperature of the battery cell 3” and “temperature control means that acts so as to cause the temperature of the Peltier element 17 to change in accordance with the temperature of the battery cell 3 detected by the battery temperature sensor 39.” *Id.* ¶¶ 31, 34.

2. The scope and content of the prior art

Petitioner asserts that the combination of Kira and Hanyu teaches or suggests all the limitations of claims 6–12, citing Dr. Shahbakhti’s testimony for support. Pet. 53–60; Ex. 1002 ¶¶ 106–114. Patent Owner does not dispute that the prior art discloses these limitations recited in claims 6–12. PO Resp. 12–13; Sur-reply 14. Upon review of the evidence in this entire trial record, we are persuaded by Petitioner’s explanations and Dr. Shahbakhti’s un rebutted testimony.

Claim 6 depends from claim 1, and recites “a *temperature control system* capable of affecting a temperature in the first energy storage device.” Ex. 1001, 13:52–54 (emphasis added). Petitioner asserts that the combination of Kira and Masahiko discloses “a temperature control system capable of affecting a temperature in the first energy storage device.” Pet. 53 (citing Ex. 1009 ¶¶ 26, 31, 34; Ex. 1002 ¶ 106). Petitioner explains that Masahiko teaches a temperature-adjusting device (“a temperature control system”), which includes Peltier elements 17 that “change temperature by heating or cooling depending on the direction of an electric current supplied by a voltage being impressed, and heat or cool the battery cells 3 to change the temperature of such,” shown in Figures 1 and 3 of Masahiko (reproduced above). *Id.* (quoting Ex. 1009 ¶ 26). Based on the evidence before us, we are persuaded by Petitioner’s showing that the combination of Kira and Masahiko discloses a temperature control system, as recited in claim 6.

Claim 7 depends from claim 6, and recites “wherein the first energy storage device comprises a first portion and a second portion, both of which

are disposed in *a common housing*, and the common housing is in operational association with the temperature control system.” Ex. 1001, 13:55–59 (emphasis added). Petitioner asserts that the combination of Kira and Masahiko discloses this limitation because Masahiko teaches “a plurality of battery cells in a common housing in operational association with the temperature-adjusting device.” Pet. 54–55. Petitioner explains that, as shown in Figures 1 and 3 of Masahiko (reproduced above), battery case 5 (a common housing) includes battery housing spaces 9 for housing multiple battery cells 3 that are surrounded by Peltier elements 17, which are parts of the “temperature control system” and are depicted to be “in operational association” with the common housing where they contact battery case 5. *Id.* (citing Ex. 1009 ¶¶ 24, 26, 31, 34; Ex. 1008, Figs. 1, 3; Ex. 1002 ¶ 107). Based on the evidence before us, we determine that Petitioner has established that the combination of Kira and Masahiko discloses the limitation recited in claim 7.

Claim 8 depends from claim 7, and recites “wherein the temperature control system comprises at least one *temperature sensor*, at least one *temperature control device*, and a *thaw controller* that communicates with the sensor and controls the thermal source to change or maintain the environment inside the common housing.” Ex. 1001, 13:60–65 (emphases added). Petitioner asserts that the combination of Kira and Masahiko discloses this limitation recited in claim 8. Pet. 55–56. Petitioner explains that Masahiko discloses battery temperature sensor 39 for detecting the temperature of the battery cell 3 (the claimed “temperature control sensor”), and separate sets of comparators and transistors for lowering the temperature

(the claimed “temperature control device”) and raising the temperature (the claimed “thaw controller”). *Id.* (citing Ex. 1009 ¶¶ 31, 32; Ex. 1002 ¶¶ 108–109). Petitioner notes that Masahiko teaches “temperature control means that acts so as to cause the temperature of the Peltier element 17 to change in accordance with the temperature of the battery cell 3 detected by the battery temperature sensor 39.” *Id.* (quoting Ex. 1009 ¶¶ 31, 34). Masahiko’s temperature control means includes first and second comparators 29 and 35, and first and second transistors 25 and 31, which control the heating and cooling of Peltier element 17 within the battery case 5. Ex. 1009 ¶¶ 32–34. Based on the evidence before us, we are persuaded by Petitioner’s showing that the combination of Kira and Masahiko discloses the limitation recited in claim 8.

Claim 9 depends from claim 6, and recites “wherein the first energy storage device comprises a first portion and a second portion, and the first portion and the second portion are disposed in *a respective first housing and second housing*, and each of the first housing and the second housing is in operational association with the temperature control system.” Ex. 1001, 13:66–14:4 (emphasis added). As Petitioner notes, claim 9 differs from claim 7 only in that claim 9 recites “the first portion and the second portion are disposed in a respective first housing and second housing.” Pet. 57–58.

Petitioner asserts that Figures 1 and 3 of Masahiko (reproduced above) show battery housing spaces 9 for housing battery cells 3. *Id.* (citing Ex. 1008, Figs. 1, 3). Dr. Shahbakhti testifies that a person of ordinary skill in the art would have understood that “separate battery housing and separate temperature devices can be used to adjust battery temperatures more

uniformly” because “having separate/smaller battery packs will make it easier to adjust coolant flow (e.g., air or coolant liquid) to control battery temperature.” Ex. 1002 ¶ 110. Based on the evidence before us, we are persuaded by Petitioner’s showing that the combination of Kira and Masahiko suggests the limitations recited in claim 9.

Claim 10 depends from claim 9, and requires the temperature control system to comprise a *temperature sensor* and *thermal source* in each of the housings and a *thaw controller*. Ex. 1001, 14:5–12. As Petitioner notes, claim 10 differs from claim 8 only in that claim 10 depends from claim 9 instead of claim 6. Pet. 58. Petitioner relies upon its explanations and supporting evidence for claims 8 and 9. *Id.* As discussed above, we determine that Petitioner has shown that the combination of Kira and Masahiko discloses the limitations recited in claims 8 and 9. Therefore, we are persuaded that the prior art combination discloses the limitations recited in claim 10.

Claim 11 depends from claim 10, and recites “wherein the *thaw controller* is operable to initiate a thaw process by controlling the *thermal source* to increase a local environment temperature up to and within an operating temperature range based on determined heat ramp rates.” Ex. 1001, 14:13–17 (emphases added). Petitioner asserts that the combination of Kira and Masahiko teaches this limitation. Pet. 59–60. Petitioner explains that Masahiko discloses controlling Peltier element 17 to increase the temperature within the battery case, by performing a heating-generating action through Peltier element 17 “when the temperature of the battery cell 3 detected by the battery temperature sensor 39 is at least as low

as a second prescribed value lower than the first prescribed value.” *Id.* (citing Ex. 1009 ¶ 33; Ex. 1002 ¶ 112). Dr. Shahbakhti testifies that one of ordinary skill in the art would have understood that “an operating temperature of the batteries in Masahiko would have been above a thawing temperature (i.e., a phase transition temperature).” Ex. 1002 ¶ 112. According to Dr. Shahbakhti, the second predetermined value used in Masahiko would have been greater than a thawing temperature, such that the temperature-adjusting device of Masahiko would thaw the battery if the batteries dropped to below the thawing temperature. *Id.* Dr. Shahbakhti also testifies that, because Masahiko teaches using first and second predetermined values to control a battery temperature, a person of ordinary skill in the art would use heat ramp rates to determine when to heat the battery system, for example, when the battery reaches a thawing temperature. *Id.* ¶ 113 (citing Ex. 1002, 78–79, 136–141 (describing controlling a battery temperature based on, among other things, heat ramp rates)). Based on the evidence before us, we are persuaded by Petitioner’s showing that the combination of Kira and Masahiko suggests the limitations recited in claim 11.

Claim 12 depends from claim 10, and recites “wherein the *thaw controller* is operable to initiate *a cooling process* to control the thermal source to decrease a local environment temperature down to and within an operating temperature range.” Ex. 1001, 14:18–21 (emphases added). Petitioner asserts that the combination of Kira and Masahiko teaches this limitation because Masahiko teaches decreasing the temperatures within the battery case to an operating range using the Peltier elements. Pet. 60 (citing

Ex. 1009 ¶ 32; Ex. 1002 ¶ 114). Specifically, Masahiko discloses performing a heating-absorbing action (i.e., cooling) through the Peltier elements “when the temperature of the battery cell 3 detected by the battery temperature sensor 39 is at least as high as a first prescribed value.”

Ex. 1009 ¶ 32. Based on the evidence before us, we are persuaded by Petitioner’s showing that the combination of Kira and Masahiko suggests the limitation recited in claim 12.

In sum, we determine that Petitioner has demonstrated that the combination of Kira and Masahiko teaches or suggests all the limitations recited in claims 6–12.

3. Rationale to combine Kira and Masahiko

In addition, Petitioner asserts that one of ordinary skill in the art would have had a reason to combine the teachings of Kira and Masahiko. Pet. 51–53. Dr. Shahbakhti testifies that such an artisan would have known that “each battery has a certain operating temperature range for which the battery has been designed.” Ex. 1002 ¶ 104. Petitioner explains that Masahiko teaches a temperature-adjusting device that includes Peltier elements that allow the battery cells to be heated or cooled, and a battery temperature sensor and temperature control means that allow the temperature to be adjusted accordingly. Pet. 52 (citing Ex. 1009 ¶¶ 26, 31, 34). Dr. Shahbakhti testifies that an ordinarily skilled artisan would have been motivated to “modify Kira’s high-voltage battery to incorporate a battery temperature-adjusting device, such as the one described by Masahiko or using Masahiko’s battery temperature control along with other

well-known thermal elements/sources” because “Masahiko’s temperature-adjusting device allows the battery cells to remain within a desired operating temperature range, which optimizes performance and durability.” Ex. 1002 ¶ 104.

Based on the evidence in this entire trial, we determine that Petitioner has articulated a sufficient rationale to combine the teachings of Kira and Masahiko.

As discussed above, Patent Owner does not dispute that a person of ordinary skill in the art would have been motivated to modify Kira’s high-voltage battery to incorporate Masahiko’s teachings of a temperature control system to arrive at the subject matter recited in claim 6. PO Resp. 12–13. Rather, Patent Owner argues that Petitioner’s reasons to combine the prior art teachings rest on the desirability of incorporating Masahiko’s temperature control system into Kira’s system, but fail to address the features recited in claims 7–12. *Id.*; Sur-reply 14.

Patent Owner’s arguments are misplaced. Claims 7–12, which depend from claim 6, merely claim features of claim 6’s temperature control system for the first energy storage device. For example, claim 8 recites “wherein *the temperature control system comprises* at least one temperature sensor, at least one temperature control device, and a thaw controller that communicates with the sensor and controls the thermal source to change or maintain the environment inside the common housing.” Ex. 1001, 13:60–65 (emphases added).

In addition, as discussed above, it is undisputed that Masahiko teaches or suggests a temperature control system, as recited in claim 6, and those

features recited by claims 7–12, as parts of the temperature control system for the storage device. Ex. 1009 ¶¶ 26–34; Ex. 1008, Figs. 1, 3. For example, Petitioner explains that, as shown in Figures 1 and 3 of Masahiko (reproduced above), battery case 5 (a common housing) includes battery housing spaces 9 for housing multiple battery cells 3 that are surrounded by Peltier elements 17, which are parts of the “temperature control system” and are depicted to be “in operational association” with the common housing where they contact battery case 5. Pet. 54–55 (citing Ex. 1009 ¶¶ 24, 26, 31, 34; Ex. 1008, Figs. 1, 3; Ex. 1002 ¶ 107).

Petitioner also explains how each feature functions in Masahiko’s temperature control system. *Id.* at 50–60. For example, Petitioner explains that Masahiko discloses battery temperature sensor 39 for detecting the temperature of the battery cell 3 (the claimed “temperature control sensor”), and separate sets of comparators and transistors for lowering the temperature (the claimed “temperature control device”) and raising the temperature (the claimed “thaw controller”). *Id.* at 55–56 (citing Ex. 1009 ¶¶ 31, 32; Ex. 1002 ¶¶ 108–109). Petitioner also explains that Masahiko teaches “temperature control means that acts so as to cause the temperature of the Peltier element 17 to change in accordance with the temperature of the battery cell 3 detected by the battery temperature sensor 39.” *Id.* (quoting Ex. 1009 ¶¶ 31, 34). And, Masahiko’s temperature control means includes first and second comparators 29 and 35, and first and second transistors 25 and 31, which control the heating and cooling of Peltier element 17 within the battery case 5. Ex. 1009 ¶¶ 32–34. Dr. Shahbakhti also testifies that a person of ordinary skill in the art would have understood that “separate

battery housing and separate temperature devices can be used to adjust battery temperatures more uniformly” because “having separate/smaller battery packs will make it easier to adjust coolant flow (e.g., air or coolant liquid) to control battery temperature.” Ex. 1002 ¶ 110.

More importantly, Dr. Shahbakhti’s un rebutted testimony states that an ordinarily skilled artisan would have been motivated to “modify Kira’s high-voltage battery to incorporate a battery temperature-adjusting device, such as the one described by Masahiko or using Masahiko’s battery temperature control along with other well-known thermal elements/sources,” because “Masahiko’s temperature-adjusting device allows the battery cells to remain within a desired operating temperature range, which optimizes performance and durability.” Ex. 1002 ¶ 104.

Therefore, Patent Owner’s arguments that Petitioner’s reasons to combine Kira and Masahiko fail to address claims 7–12 are misplaced.

For the foregoing reasons, we determine that Petitioner has demonstrated that a person of ordinary skill in the art would have been motivated to combine the teachings of Kira and Masahiko to arrive at the subject matter recited in claims 6–12.

4. Conclusion for Ground 5

Based on the evidence in this entire trial record, we determine that Petitioner has demonstrated by a preponderance of the evidence that claims 6–12 are unpatentable under § 103(a) as obvious over Kira and Masahiko.

I. Ground 6: Claims 24, 25, 30, 32, and 35 are Anticipated by Yamada

Petitioner asserts that claims 24, 25, 30, 32, and 35 are unpatentable under § 102 as anticipated by Yamada. Pet. 60–71. As support, Petitioner cites to the Declaration of Dr. Shahbakhti. Ex. 1002. Patent Owner counters that Petitioner fails to show that: (1) Yamada’s first traction drive system operates at a voltage different from a voltage at which at least a portion of the second traction drive system operates, as recited in claim 24; and (2) Yamada discloses a first traction drive system “electrically coupled to the propulsion means,” as recited in claim 32. Prelim. Resp. 4–11.

For the reasons provided below, we determine that Petitioner has demonstrated a preponderance of evidence that claims 24, 25, 30, 32, and 35 are unpatentable.

1. Overview of Yamada

Yamada discloses a hybrid propulsion system having a multiple traction drive system. Ex. 1012, code (57), ¶ 178, Fig. 20. According to Yamada, “it is an object of the present invention to provide a front and rear wheel drive apparatus that includes a voltage boosting system suitable for vehicles capable of four-wheel-drive running when starting to move.” *Id.* ¶ 14. “[T]he front and rear wheel drive apparatus comprises: a voltage-boosting circuit, and first and second motors.” *Id.* ¶ 17. “The first motor is driven by the boosted voltage output from the voltage-boosting circuit,” and “[t]he second motor is driven by the power supply voltage.” *Id.*

2. Independent claims 24 and 32

a. *First traction drive system, second traction drive system, and propulsion means*

Claim 24 recites:

A propulsion system for a vehicle, comprising:

a first traction drive system coupled to an engine and comprising a first drive motor, wherein the engine is operable to supply energy to the first drive motor to propel the vehicle; and

a second traction drive system comprising a *second drive motor* and a *first energy storage device*,

wherein the second drive motor is operable to both supply energy to the first energy storage device and to receive energy from the first energy storage device.

Ex. 1001, 15:5–13 (emphasis added).

Claim 32 similarly recites:

A propulsion system for a vehicle, comprising:

a first traction drive system comprising an engine and a first drive motor, wherein the engine is operable to supply energy to the first drive motor to propel the vehicle; and

a propulsion means for supplying energy to a first energy storage device and for receiving energy from the first energy storage device.

Id. at 16:14–17 (emphasis added). As discussed above in our claim construction analysis (Section II.A.1), we construe “propulsion means” to encompass “an electric drive motor for supplying energy to an energy storage device and for receiving energy from the energy storage device.”

Petitioner asserts that Yamada discloses a “propulsion system for a vehicle,” as recited in the preambles of claims 24 and 32, because Yamada describes “a drive system of a hybrid vehicle.” Pet. 62, 68 (citing Ex. 1012

¶ 178). Petitioner explains that Yamada’s drive system 200, shown in Figure 20 (reproduced below), includes engine 240 connected to motor generators MG1, MG2, and battery 10 connected to motor generator MG3 for propelling the vehicle. *Id.* (citing Ex. 1012 ¶¶ 178, 179, 214).

Petitioner also asserts that Yamada discloses drive system 200 that includes first and second traction drive systems, as recited in claim 24, and includes a first traction drive system and a propulsion means, as recited in claim 32. *Id.* at 62–65, 68–69 (citing Ex. 1012 ¶¶ 178–180, 191, 193, 214). The first traction drive system includes MG1, which is connected to engine 240 and MG2 (the “first drive motor”). *Id.* (citing Ex. 1012 ¶¶ 178, 179, 191, Fig. 20). MG1 generates electricity through the rotational force of engine 240, and then supplies power to IPM 30, which converts the voltage and drives MG2 to propel the vehicle. *Id.* (citing Ex. 1012 ¶¶ 180, 191). Dr. Shahbakhti testifies that an ordinarily skilled artisan would have understood that engine 240 is operable to supply energy to MG2 to propel the vehicle. Ex. 1002 ¶ 117.

Petitioner also contends that the second traction drive system includes battery 10 (a “first energy storage device”) connected to MG3 (a “second drive motor” or “propulsion means”). Pet. 64–65, 68–69 (citing Ex. 1012 ¶¶ 193, 214, Fig. 20). Petitioner notes that Yamada discloses that IPM 50 converts battery voltage V_b into AC voltage, which is used to drive MG3 so that MG3 drives the rear wheels. *Id.* (citing Ex. 1012 ¶ 193). Yamada also discloses that “in the deceleration/braking mode of the hybrid vehicle, the motor generator MG3 is driven in regeneration mode and the generated electric power is supplied directly to the battery 10.” Ex. 1012 ¶ 214.

Based on the evidence in this entire trial record, we are persuaded that Petitioner has shown that Yamada discloses a “first traction drive system” and a “second traction drive system” including a “first energy storage device,” as recited in claim 24, as well as a “first traction drive system” and a “propulsion means,” including a “first energy storage device,” as recited in claim 32. Patent Owner does not challenge Petitioner’s showing as to these limitations recited in claims 24 and 32. PO Resp. 13–17; Sur-reply 6–12.

b. First and second traction drive systems operate at different voltages

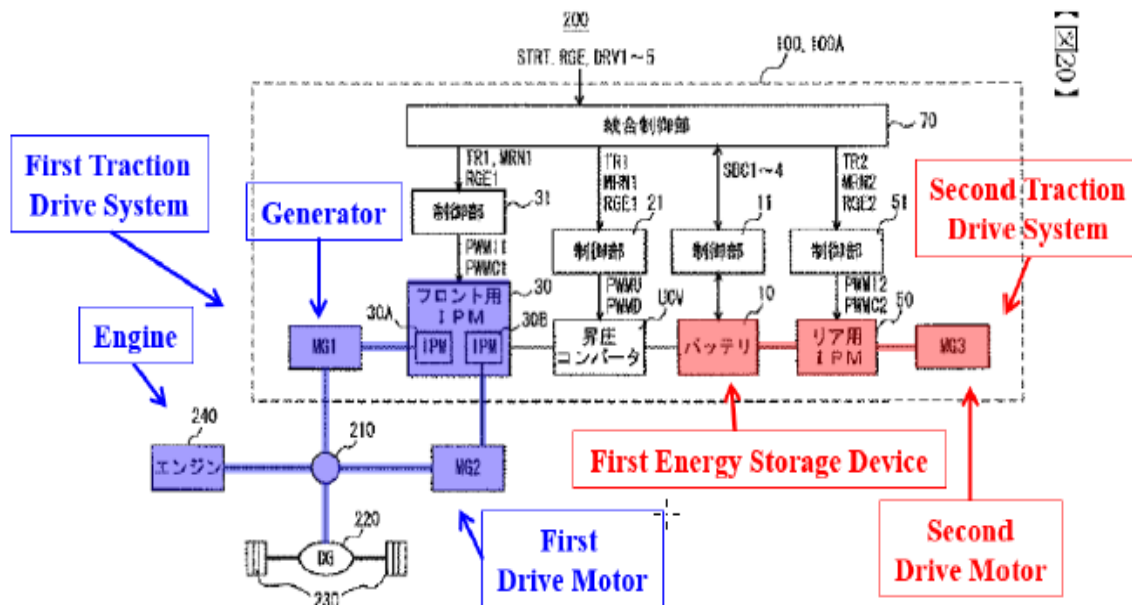
Claim 24 recites:

wherein the first traction system *operates at a first voltage that is a different voltage than a second voltage* at which at least a portion of the second traction drive system operates.

Ex. 1001, 15:14–17 (emphasis added).

Petitioner’s arguments

Petitioner asserts that “Yamada discloses that these two traction drive systems (shown below) operate at two different voltages.” Pet. 65 (citing Ex. 1012 ¶¶ 25, 212). Petitioner’s annotated Figure 20 of Yamada is reproduced below. *Id.*



Petitioner explains that annotated Figure 20 of Yamada above shows drive system 200, which includes a first traction drive system (blue) and a second traction drive system (red). Pet. 62–65. According to Petitioner, “the first traction drive system includes motor generator MG1 connected to engine 240 and motor generator MG2 (the ‘first drive motor’) connected to MG1.” *Id.* (citing Ex. 1012 ¶¶ 178, 179, 191, Fig. 20). Petitioner also explains that “MG1 generates electricity through the rotational force from the engine 240, and then supplies power to ‘Intelligent Power Module’ or IPM 30, which converts the voltage and drives MG2 to propel the vehicle.” *Id.* (citing Ex. 1012 ¶¶ 180, 191).

In addition, Petitioner asserts that the second traction drive system includes battery 10 connected to MG3. *Id.* (citing Ex. 1012 ¶¶ 193, 214, Fig. 20). Petitioner explains that “Yamada states that IPM 50 converts

battery voltage V_b into AC voltage, which is used to drive MG3 so that MG3 drives the rear wheels.” *Id.* (citing Ex. 1012 ¶ 193).

Furthermore, as Petitioner indicates (Pet. 65), Yamada teaches:

In this manner, by applying the front and rear wheel drive apparatus 100 or 100A of the present invention to a hybrid vehicle, it is possible to drive the motor generators MG1 and MG2 positioned on the front side of the hybrid vehicle *using the voltage V_m that is battery voltage V_b that has been boosted*, and it is possible to *drive the motor generator MG3* positioned on the rear side of the hybrid vehicle *through the battery voltage V_b* .

Ex. 1012 ¶ 211 (emphases added).

Yamada also expressly teaches:

In addition, with the present invention, the motor driving method is a motor driving method in a front and rear wheel drive apparatus that includes *a first motor that receives boosted voltage that is power supply voltage that has been boosted* and drives one set of wheels out of the front and rear wheels, and *a second motor that receives the power supply voltage* and drives the other set of wheels out of the front and rear wheels

Id. ¶ 25 (emphases added).

According to Petitioner, Yamada’s “MG2 and MG3 therefore operate at different voltages because MG3 operates at battery voltage V_b , while MG2 operates at voltage V_m that has been *boosted* (i.e., increased) from battery voltage V_b .” Pet. 66 (citing Ex. 1002 ¶ 120).

Upon review of the evidence in this entire trial record, we are persuaded by Petitioner’s showing that Yamada discloses “wherein the first traction system *operates at a first voltage that is a different voltage than a second voltage* at which at least a portion of the second traction drive system operates,” as recited in claim 24.

Patent Owner's arguments

Patent Owner counters that Petitioner fails to show that Yamada's first traction drive system operates at a voltage different from a voltage at which at least a portion of the second traction drive system operates, citing to Dr. Keim's testimony for support. PO Resp. 13–14 (citing Ex. 2001 ¶¶ 41–47); Sur-reply 6–8. According to Patent Owner, MG2 and MG3, which are three-phase AC motors, cannot operate at voltages V_b and V_m which are direct-current voltages. PO Resp. 13–14 (citing Ex. 1012 ¶¶ 184–210); Sur-reply 6–8. Patent Owner contends that “it is entirely within the scope of Yamada's disclosure that the three-phase AC voltage in the first and second traction drive systems are *identical at all times*.” PO Resp. 13–14 (citing Ex. 2001 ¶ 46) (emphasis added); Sur-reply 6–8.

Patent Owner's arguments and Dr. Keim's testimony are unavailing because they ignore one of Yamada's main objectives: providing a “boosted voltage” to one of its two traction drive systems. See Ex. 1012, code (57), ¶¶ 14, 17, 20, 21, 25, 31–35, 211–213.

More importantly, Petitioner's assertion that “Yamada discloses that these two traction drive systems . . . operate at two different voltages” is supported by Yamada's disclosure. Pet. 65. Indeed, as Petitioner indicates (*id.*), Yamada expressly teaches:

In addition, with the present invention, the motor driving method is a motor driving method in a front and rear wheel drive apparatus that includes *a first motor that receives boosted voltage that is power supply voltage that has been boosted* and drives one set of wheels out of the front and rear wheels, and *a second motor that receives the power supply voltage* and drives the other set of wheels out of the front and rear wheels

Ex. 1012 ¶ 25 (emphases added); *see also id.* ¶ 211 (“the motor generators MG1 and MG2 positioned on the front side of the hybrid vehicle using the voltage V_m that is the battery voltage V_b that has been *boosted*” (emphasis added)).

Yamada also consistently and repeatedly recites that the purpose of its invention is “[t]o provide a front and rear wheel driving apparatus that includes a *voltage boosting system* suitable for a vehicle in which four-wheel-drive is possible at the time of starting.” *See, e.g.*, Ex. 1012, code (57); ¶ 14 (disclosing that “it is an object of the present invention to provide a front and rear wheel drive apparatus that includes a *voltage boosting system* suitable for vehicles capable of four-wheel-drive running when starting to move” (emphasis added)); ¶ 20 (disclosing that “[p]referably, the front and rear wheel drive apparatus further comprises first and second drive circuits, and first and second control circuits,” “[t]he first drive circuit receives the *boosted voltage* and drives the first motor,” and “[t]he second drive circuit receives the power supply voltage and drives the second motor” (emphases added)); ¶¶ 34–35 (disclosing the best mode for implementing the invention includes a *voltage-boosting* IPM (Intelligent Power Module)).

Therefore, Patent Owner’s argument and Dr. Keim’s testimony that Petitioner fails to show that Yamada’s first and second traction drive systems operate at a voltage different are unavailing. PO Resp. 13–14; Ex. 2001 ¶¶ 41–47.

Furthermore, Patent Owner’s contention and Dr. Keim’s testimony that “it is entirely within the scope of Yamada’s disclosure that the

three-phase AC voltage in the first and second traction drive systems *are identical at all times*” are unsupported and inconsistent with Yamada’s disclosure. PO Resp. 13–14; Ex. 2001 ¶ 46; Sur-reply 6–8 (emphasis added). Notably, Yamada expressly discloses that “[i]n this invention, two motors are *driven by the power supply voltage and boosted voltage* that is the power supply voltage that has been boosted,” and “the motor driven by the boosted voltage drives either the front or rear wheels, and the motor driven by the power supply voltage drives the other set of wheels.”

Ex. 1012 ¶ 31. Yamada explains that its system ensures “the necessary torque can be easily secured in modes in which the two motors are simultaneously driven,” and at the same time, “the boosted voltage is not supplied to the motor driven by the power supply voltage, so it is possible to lower the withstand voltage needs of the input path to this motor, making it possible to simplify and lower the cost of the system,” and “the motor driven by the power supply voltage can increase the regeneration efficiency of generated power.” *Id.* ¶¶ 32–33; *see also id.* at code (57), ¶¶ 14, 17, 20, 21, 25, 34–35, 211–213.

Therefore, Patent Owner’s contention and Dr. Keim’s testimony that “it is entirely within the scope of Yamada’s disclosure that the three-phase AC voltage in the first and second traction drive systems are identical at all times” are unsupported and inconsistent with Yamada’s disclosure. PO Resp. 13–14; Ex. 2001 ¶ 46; Sur-reply 6–8 (emphasis added).

In its Sur-reply, Patent Owner also argues that Petitioner introduces a new argument, “shift[ing] its argument on Reply to say that it is IPM 30 and IPM 50, not MG2 and MG3, that operate at different voltages, because they

receive voltages V_m and V_b , respectively, and merely ‘convert’ them from DC to AC.” Sur-reply 6–7 (citing Reply 19).

We disagree. Patent Owner narrowly focuses on one sentence in the Petition where Petitioner explains that MG2 and MG3 operate at different voltages, ignoring Petitioner’s other explanations and evidence. In its Petition, Petitioner clearly asserts “Yamada discloses that these *two traction drive systems* . . . operate at two different voltages,” quoting and citing portions of Yamada for support (Ex. 1012 ¶¶ 25, 211, 212). Pet. 65. As discussed above, those portions of Yamada support Petitioner’s assertion.

In its Petition, Petitioner also relies upon the embodiment shown in Figure 20 of Yamada, providing an annotated Figure 20 (reproduced above) showing a “first traction drive system” (highlighted in blue), which includes engine 240, generator MG1, first drive motor MG2, and IPM 30, and a “second traction drive system” (highlighted in red), which includes MG3, battery 10, and IPM 50. Pet. 65. When Petitioner explains how Yamada discloses a “first traction drive system” and a “second traction drive system,” as recited in claim 24, Petitioner explains that “Yamada states that IPM 50 converts battery voltage V_b into AC voltage, which is used to drive MG3 so that MG3 drives the rear wheels” and IPM30 converts the voltage and drives MG2 to propel the vehicle. *Id.* at 63–64 (citing Ex. 1021 ¶¶ 117, 193).

In short, Petitioner’s Reply relies on the same embodiment shown in Figure 20 of Yamada to disclose that the first and second traction drive systems operate at two different voltages (Reply 17–21). *See Apple Inc. v. Andrea Elecs. Corp.*, 949 F.3d 697, 706 (Fed. Cir. 2000) (A party does not

raise a new issue when the paper “does not cite any new evidence or ‘unidentified portions’ of the . . . reference.”); *Chamberlain Grp., Inc. v. One World Techs., Inc.*, 944 F.3d 919, 925 (Fed. Cir. 2019) (“Parties are not barred from elaborating on their arguments on issues previously raised.”). Therefore, Patent Owner’s argument that Petitioner introduces a new argument or shifts its argument on Reply is unavailing. Sur-reply 6–7.

In its Sur-reply, Patent Owner also contends Petitioner’s argument in its Reply that “there is nothing in Yamada to suggest IPM 30 or IPM 50 increases or decrease the voltages to the same level before they reach MG2 and MG3” is a mischaracterization of Yamada, because Yamada discloses that IPM 30 “converts the direct-current voltages received into alternating-current voltage in accordance with the signal PWMI1” and Yamada discloses an analogous arrangement for the control of IPM 50 by signal PWMI2. Sur-reply 7–8 (quoting Ex. 1012 ¶¶ 190–193). According to Patent Owner, Petitioner has not explained how, given these multiple inputs and signals, “it would have been possible for one of ordinary skill in the art to determine the AC voltages to which IPM 30 and IPM 50 are converting V_m and V_b , respectively.” *Id.*

Patent Owner’s arguments are misplaced. As Petitioner explains in its Reply, “[i]n the embodiment discussed throughout the Petition, Yamada explains that MG3 is driven by a battery voltage, while MG2 is driven by a higher, ‘boosted’ voltage level.” Reply 18 (citing Ex. 1012 ¶ 211; Pet. 65–66; Dec. 29). Petitioner also explains that “[a] voltage-boosting converter creates this boosted voltage level, by increasing an input voltage from a shared battery,” and that “[b]y using these two different voltage

levels, Yamada explains that the necessary torques for start-moving or acceleration operation modes can be ‘easily secured.’” *Id.* (citing Ex. 1012 ¶¶ 17, 211–213). Petitioner further explains that “Yamada simply states that the voltage ‘converts’ from DC to AC at IPM 30 and IPM 50,” and that “as Yamada explains, using two different voltages improves efficiency and enhances overall system operation.” *Id.* 18–19 (citing Ex. 1012 ¶¶ 32–33).

Significantly, Petitioner’s explanations are supported by Yamada’s disclosure. Notably, Yamada discloses that “[t]he voltage-boosting circuit boosts the power supply voltage,” and that “[t]he first motor is driven by the *boosted voltage output from the voltage-boosting circuit*,” and “[t]he second motor is *driven by the power supply voltage*.” Ex. 1012 ¶ 17 (emphases added); *see also* ¶ 211 (“drive the motor generators MG1 and MG2 . . . using the *voltage Vm that is the battery voltage Vb that has been boosted*, and . . . drive the motor generator MG3 . . . through the battery voltage Vb”) (emphases added); *see also id.* at code (57), ¶¶ 14, 20, 21, 25, 31–35, 212–213.

Therefore, Patent Owner’s arguments, that Petitioner mischaracterizes Yamada and has not explained how “to determine the AC voltages to which IPM 30 and IPM 50 are converting Vm and Vb,” are misplaced. Sur-reply 7–8 (quoting Ex. 1012 ¶¶ 190–193).

Upon review of the evidence in this entire trial record, we determine Petitioner has shown that Yamada discloses “wherein the first traction drive system operates at a first voltage that is a different voltage than a second voltage at which at least a portion of the second traction drive system operates,” as recited in claim 24. For the reasons stated above, we determine

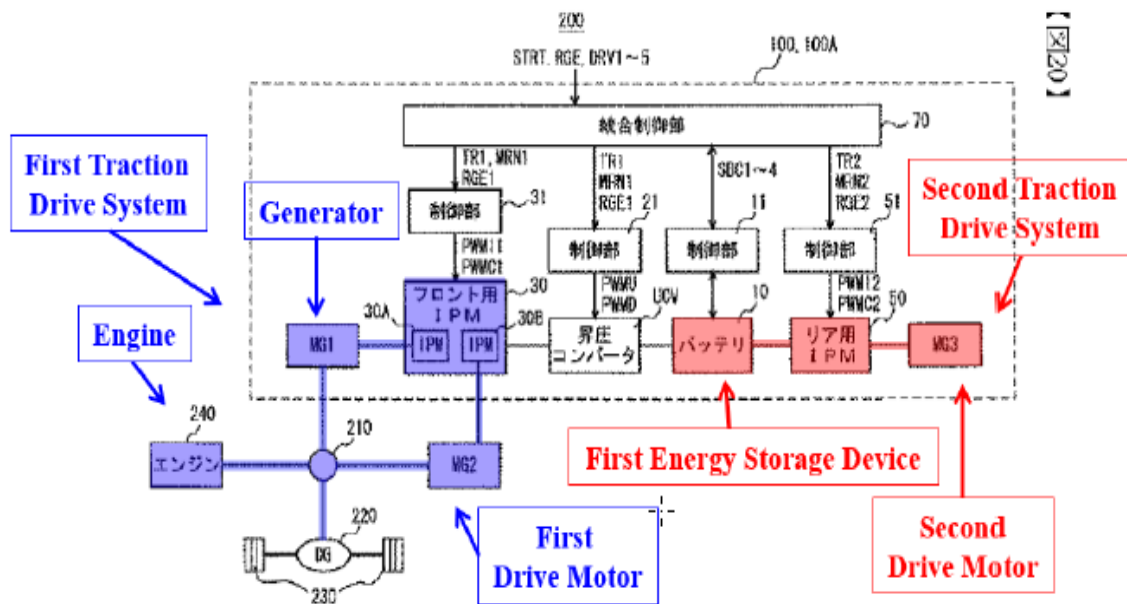
that Patent Owner's arguments and Dr. Keim's testimony do not undermine Petitioner's showing.

c. Propulsion means is electrically coupled to the first traction drive system

Claim 32 recites “wherein the propulsion means is *electrically coupled* to the first traction drive system.” Ex. 1001, 16:21–22 (emphasis added). As discussed above in our claim construction analysis (Section II.A.4), we decline to adopt Patent Owner's claim construction that would improperly import extraneous limitations into the claims, construing “electrically coupled” to require the propulsion means to be connected *directly* to the first traction drive system and to require electric energy, voltage, or current to be passed *continuously without transformation* between the propulsion means and the first traction drive system. PO Resp. 14–16; Sur-reply 8–11; Ex. 2001 ¶¶ 31–33. Rather, the claim term “electrically coupled” is given its ordinary and customary meaning, as would have been understood by one of ordinary skill in the art in the context of the Specification, to encompass “a connection through electric means that allows electric energy, voltage, or current to be passed *directly or indirectly* between the propulsion means and the first traction drive system.” Our claim construction does not preclude the presence of intervening components, such as a battery, between the propulsion means and the first traction drive system.

Petitioner's arguments

Petitioner asserts that “Yamada discloses that the propulsion means (“second drive motor” as shown below) is electrically coupled to the first traction drive system.” Pet. 69–70. Petitioner relies upon the embodiment shown in Figure 20 of Yamada (reproduced below with annotations added by Petitioner). *Id.* at 69.



Annotated Figure 20 of Yamada above shows drive system 200, which includes MG3 (red) as the second drive motor (the propulsion means) and battery 10 (red) as the first energy storage device. As shown, the second traction drive system (red) includes MG3, IPM 50, and battery 10. According to Petitioner, the first drive motor (blue) includes MG1, MG2, engine 240, and IPM 30, which includes IPM 30A and IPM 30B. *Id.*

Petitioner explains that “[a]ccording to Yamada, the voltage boosting converter UCV boosts the battery voltage V_b ” and “supplies the output voltage V_m to the IPM 30A,” which “converts the direct-current voltage

from the voltage boosting converter UCV into alternating-current voltage . . . , and drives the motor generator MG1.” *Id.* at 69–70 (citing Ex. 1012 ¶ 187). Petitioner further explains that battery 10 is electrically coupled to MG1 and MG2, which means that MG3 is likewise electrically coupled to MG1 and MG2 via battery 10. *Id.* (citing Ex. 1002 ¶ 128).

Upon consideration of the evidence in this entire trial record, we determine that Petitioner has established that Yamada discloses that “the propulsion means is electrically coupled to the first traction drive system,” as recited in claim 32.

Patent Owner’s arguments

Patent Owner advances several arguments. First, Patent Owner argues that Petitioner has not shown that the propulsion means is electrically coupled to the first traction system, as required by claim 32, citing Dr. Keim’s testimony for support. PO Resp. 14–16 (citing Ex. 2001 ¶¶ 31–33, 48–51); Sur-reply 8–11 (citing Ex. 2001 ¶ 50). According to Patent Owner, “Petitioner does not explain how interposing a battery between the first traction drive system and the propulsion means renders those two things electrically linked or connected.” PO Resp. 15. Patent Owner also contends that “a battery interposed between two other elements does not make those two elements ‘electrically coupled.’” *Id.* Patent Owner further alleges that “Petitioner identifies no embodiments in Yamada in which battery 10 *simultaneously* supplies power to MG3 and receives power from converter UCV or receives power from MG3 and supplies power to converter UCV,” and that “Dr. Shahbakhti could not identify on

cross-examination any disclosure in Yamada of an embodiment in which MG3 supplies energy to battery 10 *at the same time* that battery 10 supplies energy to boosting converter UCV.” *Id.* at 16 (citing Ex. 2003, 10–11) (emphases added).

Patent Owner’s arguments and Dr. Keim’s testimony are unavailing because they rest on Patent Owner’s implicit claim construction that improperly imports extraneous limitations into the claims. PO Resp. 14–16; Sur-reply 8–11; Ex. 2001 ¶¶ 31–33, 48–51. As discussed in our claim construction analysis (Section II.A.4) above, we decline to adopt Patent Owner’s claim construction that construes the term “electrically coupled” to require the propulsion means to be connected *directly* to the first traction drive system, and to require electric energy, voltage, or current to be passed *continuously without transformation* between the propulsion means and the first traction drive system.

Rather, in the context of claim 32, the claim term “electrically coupled” encompasses “a connection through electric means that allows electric energy, voltage, or current to be passed *directly or indirectly* between the propulsion means and the first traction drive system.” Our claim construction does not preclude the presence of intervening components, such as a battery, between the propulsion means and the first traction drive system.

More significantly, based on the evidence in this entire trial record, we are persuaded by Petitioner’s showing that Yamada discloses that MG3 (a propulsion means) is electrically coupled to the first traction drive system, which includes MG1, MG2, engine 240, and IPM 30.

It is undisputed that Yamada discloses that MG3 generates electric energy and supplies the generated electric energy to MG1, MG2, and IPM30 through battery 10. PO Resp. 14–16; Sur-reply 8–11; Ex. 2001 ¶¶ 31–33, 48–51. As noted in our Decision on Institution (Dec. 30–31), Yamada discloses that MG3 (a propulsion means) supplies the generated electric power directly to battery 10 during the regeneration mode. Ex. 1012 ¶ 214. In addition, battery 10 supplies battery voltage V_b to voltage boosting converter UCV, which “boosts the battery voltage V_b ” and “supplies the output voltage V_m to the IPM 30A,” which “converts the direct-current voltage from the voltage boosting converter UCV into alternating-current voltage . . . , and drives the motor generator MG1”; and “[t]he IPM 30B receives the direct-current voltage from the voltage-boosting converter UCV and the direct-current voltage from the IPM 30A, converts the direct-current voltages received into alternating-current voltage . . . , and drives the motor generator MG2.” *Id.* ¶¶ 179, 187, 191. During cross-examination, Dr. Shahbakhti testifies that “[a] person of ordinary skill in the art can define different operating modes for controller 70, and one of those modes could be to MG3 to provide power to the battery 10 and, at the same time, battery 10 provides energy to the first drive system.” Ex. 2003, 11:16–21. For anticipation, the dispositive question is whether one skilled in the art would reasonably understand or infer from a prior art reference that every claim element is disclosed in that reference. *Eli Lilly*, 849 F.3d at 1074–75. Therefore, Yamada discloses an electrical connection between MG3 (a propulsion means) and MG1 and MG2 (the first traction drive system)

through battery 10, an electric means that allows electric energy generated by MG3 to pass to MG1 and MG2.

In addition, Dr. Keim confirms that electric energy can pass from front motor 40 (a first drive motor in the first traction drive system) to rear motor 60 (a propulsion means), as shown in Figure 1 of Yamada. Ex. 1028, 67:18–23. Dr. Keim also confirms that voltage-boosting IPM 20 “evidently is able to transmit power bidirectionally.” *Id.* at 64:11–21.

Figure 1 of Yamada highlighted by Dr. Keim during cross-examination is reproduced below. Ex. 1027, 53; Ex. 1028, 61:6–64:9.

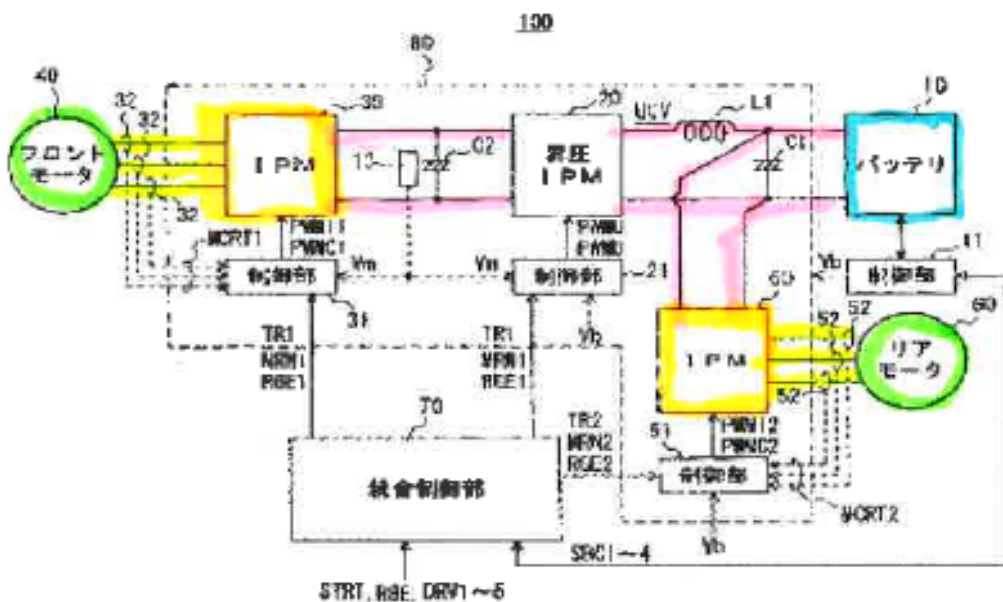


Figure 1 of Yamada highlighted by Dr. Keim above shows that there is an electric energy path from front motor 40 (left green circle) to rear motor 60 (right green circle) either through battery 10 (right blue square) or capacitor C1 (immediate left of battery 10) using AC wires (yellow) and DC wires (pink). Ex. 1012 ¶¶ 178–179, 207–209, Fig. 1.

Figure 1 of Yamada “is a summary block diagram of a front and rear wheel drive apparatus according to a first embodiment,” and Figure 20 of Yamada (reproduced previously) “is a block diagram of a drive system using the front and rear wheel drive apparatus shown in FIG. 1 or FIG. 12.” *Id.* at 48–49 (Brief Description of the Drawings). Referencing Figure 20, Yamada discloses that “[i]n the drive system 200, motor generators MG1 and MG2 correspond to the front motor 40, and a motor generator MG3 corresponds to the rear motor 60,” and that “the IPM 50 drives the motor generator MG3.” *Id.* ¶¶ 178–179. Yamada also discloses that, in the low- μ road riding mode, “a portion of the drive force of the front wheels 230 is transferred to the motor generator MG2” and “the rear wheels are driven through the electric force generated by the motor generator MG2.” *Id.* ¶¶ 207–209. According to Yamada, voltage-boosting IPM 20 supplies the voltage to IPM 50 via capacitor C1. *Id.* Dr. Keim confirms that voltage-boosting IPM 20 “evidently is able to transmit power bidirectionally.” Ex. 1028, 64:11–21.

In short, as confirmed by Dr. Keim’s testimony and Figure 1 highlighted by Dr. Keim, Yamada also discloses an electrical connection between the front motor (MG1 and MG2) and the rear motor (MG3) through capacitor C1, an electric means that allows electric energy generated by the front motor (MG1 and MG2) to pass to the rear motor (MG3).

In light of the foregoing, we determine that Petitioner has demonstrated that Yamada discloses that “the propulsion means is electrically coupled to the first traction drive system,” as recited in claim 32. Accordingly, Patent Owner’s arguments and Dr. Keim’s testimony that

Yamada does not disclose that the propulsion means is electrically coupled to the first traction drive system are unavailing.

Second, in its Sur-reply, Patent Owner argues that “Petitioner again shifts to a new argument on Reply: that it is Yamada Figure 1 operating in ‘low- μ ’ mode, that anticipates.” Sur-reply 8–11.

We disagree. Petitioner’s ground did not change in its Reply; Petitioner relies on the same embodiment (drive system 200) disclosed in Yamada to support the same argument that Yamada discloses the limitation “the propulsion means is electrically coupled to the first traction drive system” recited in claim 32. As discussed above, Figure 1 of Yamada “is a summary block diagram of a front and rear wheel drive apparatus according to a first embodiment,” and Figure 20 “is a block diagram of a drive system using the front and rear wheel drive apparatus shown in FIG. 1.” Ex. 1012, 48–49; *see also id.* ¶¶ 178–179. Therefore, Figure 1 is not directed to a different embodiment, but showing the same embodiment in more detail on certain electrical connections.

During cross-examination, Dr. Keim confirms that, as shown in highlighted Figure 1 of Yamada, electric energy can pass from front motor 40 (which corresponds to MG1 and MG2 shown in Figure 20) to rear motor 60 (which corresponds to MG3 shown in Figure 20). Ex. 1028, 67:18–23; Ex. 1027, 53; Ex. 1012 ¶¶ 178–179, Fig. 1. Dr. Keim also confirms that voltage-boosting IPM 20 “evidently is able to transmit power bidirectionally.” Ex. 1028, 64:11–21.

Furthermore, Yamada discloses several operation modes of drive system 200, including the light load running mode, the intermediate speed

light load running mode, the acceleration/rapid acceleration mode, the low- μ road running mode, and the deceleration/braking mode of the hybrid vehicle, in which MG3 is driven in regeneration mode. Ex. 1012 ¶¶ 184, 214.

Petitioner merely points out that another example mode of operation of the same drive system to rebut Dr. Keim's testimony and Patent Owner's argument, and to further explain why Yamada discloses that the propulsion means is electrically coupled to the first traction drive system.

As the Federal Circuit has held, “[i]t is unreasonable to hold petitioners to such a high standard that, if they choose to rely on one example of an algorithm, they must either discuss all potential permutations of the variable or risk waiving the opportunity to further discuss other relevant examples in their reply.” *Apple*, 949 F.3d at 706; *see also id.* at 706–707 (“As we have regularly held, ‘the petitioner in an inter partes review proceeding may introduce new evidence after the petition stage if the evidence is a legitimate reply to evidence introduced by the patent owner’” (quoting *Anacor Phram., Inc. v. Iancu*, 889 F.3d 1372, 1380–81 (Fed. Cir. 2018))). Therefore, based on the facts and evidence in this case, we do not agree with Patent Owner's argument that Petitioner shifts to a new argument on Reply.

Third, Patent Owner argues Yamada is ambiguous so “it cannot be held to anticipate.” Sur-reply 9–10. According to Patent Owner, Figure 1 and Figure 20 are inconsistent with one another, because “Figure 1 shows battery 10 connected in parallel to the rest of the system . . . , whereas Figure 20 shows battery 10 connected in series.” *Id.* Patent Owner further argues that Figure 1 of Yamada “does not anticipate because it lacks at least the

engine recited in claim 32.” *Id.* at 10. Patent Owner contends that Petitioner does not “explain how electrical coupling can occur ‘through battery 10’ when Figure 1 shows only one pair of wires connecting battery 10 to the IPMs.” *Id.* at 11.

Patent Owner’s arguments are misplaced because Patent Owner ignores the written description of Yamada and narrowly focuses on Figure 1 in isolation. As discussed previously, Yamada discloses an electrical connection between MG3 (a propulsion means) and MG1 and MG2 (the first traction drive system) through battery 10, an electric means that allows electric energy generated by MG3 to pass to MG1 and MG2. Ex. 1012 ¶¶ 179, 187, 191, 214. Yamada also discloses an electrical connection between the front motor (MG1 and MG2) and the rear motor (MG3) through capacitor C1, an electric means that allows electric energy generated by the front motor (MG1 and MG2) to pass to the rear motor (MG3). *Id.*

¶¶ 178–179; 207–209. Dr. Keim confirms during cross-examination that, as shown in highlighted Figure 1 of Yamada, electric energy can pass from front motor 40 (which corresponds to MG1 and MG2 shown in Figure 20) to rear motor 60 (which corresponds to MG3 shown in Figure 20). Ex. 1028, 67:18–23; Ex. 1027, 53; Ex. 1012 ¶¶ 178–179, Figs. 1, 20. Dr. Keim also confirms that voltage-boosting IPM 20 “evidently is able to transmit power bidirectionally.” Ex. 1028, 64:11–21.

Figure 1 of Yamada “is a summary block diagram of a front and rear wheel drive apparatus according to a first embodiment,” and Figure 20 of Yamada “is a block diagram of a drive system using the front and rear wheel drive apparatus shown in FIG. 1 or FIG. 12.” Ex. 1012, 48–49. Figure 1

shows more detail regarding front and rear wheel drive apparatus 100 used in drive system 200 shown in Figure 20. Ex. 1012 ¶¶ 178–179, 207–209.

Moreover, Patent Owner does not dispute that Figure 20 shows that drive system 200 includes engine 240, as required by claim 32. See PO Resp. 13–18; Sur-reply, 6–12. Indeed, as Petitioner notes (Pet. 62–63, 68), Yamada expressly discloses “[r]eferencing FIG. 20, a drive system 200 comprises the front and rear wheel drive apparatus 100 or 100A . . . and an engine 240.” Ex. 1012 ¶¶ 178–180, 191; Ex. 1002 ¶ 117.

Therefore, Patent Owner’s arguments that Yamada is ambiguous and that Figure 1 of Yamada does not anticipate are misplaced.

Finally, Patent Owner argues that, by relying on the low- μ mode, “Petitioner overlooks that the engine must supply energy to the first drive motor ‘to propel the vehicle.’” Sur-reply 11. Patent Owner alleges that “Petitioner does not explain how MG2 is supplied energy by the engine to ‘propel[s] the vehicle’ in low- μ mode.” *Id.*

Patent Owner’s arguments are misplaced. Claim 32 does not require the drive system to perform all of the modes of operation at the same time. Petitioner merely pointing out the low- μ mode as another example mode of operation of the same drive system to rebut Dr. Keim’s testimony and Patent Owner’s argument, and to further explain why Yamada discloses that the propulsion means is electrically coupled to the first traction drive system.

As discussed above, Patent Owner does not dispute that Yamada discloses that drive system 200 includes engine 240 “operable to supply energy to the first drive motor to propel the vehicle,” as required by claim 32. See PO Resp. 13–18; Sur-reply, 6–12; Pet. 62–63, 68; Ex. 1012

¶¶ 178–180, 191; Ex. 1002 ¶ 117. Moreover, Yamada clearly discloses that drive system 200 is capable to perform: “the actions of the drive system 200 at the start time, the start of movement, the light load running mode, the intermediate speed light load running mode, the acceleration/rapid acceleration mode, the low- μ road running mode and the deceleration/braking mode of the hybrid vehicle in which the drive system 200 is installed.” Ex. 1012 ¶ 184; *see also id.* ¶¶ 185–215.

Therefore, Patent Owner’s arguments, that Petitioner overlooks that the engine must supply energy to the first drive motor to propel the vehicle and Petitioner does not explain how MG2 is supplying energy to propel the vehicle in low- μ mode, are misplaced.

Based on the evidence in this entire trial, we determine that Petitioner has shown that Yamada discloses “the propulsion means is electrically coupled to the first traction drive system,” as recited in claim 32. We do not find Patent Owner’s arguments undermine Petitioner’s showing.

d. Conclusion as to claims 24 and 32

For the foregoing reasons, we determine that Petitioner has established by a preponderance of the evidence that claims 24 and 32 are anticipated by Yamada.

3. Dependent claims 25, 30, and 35

Petitioner also asserts that Yamada discloses the limitations recited in dependent claims 25, 30, and 35, citing to Dr. Shahbakhti’s testimony for support. Pet. 66–67, 70–71; Ex. 1002. Patent Owner does not address the limitations expressly recited in these claims with separate, specific

arguments, but rather relies upon its arguments in connection with independent claims 24 and 32. PO Resp. 13–16. We have addressed those arguments in our analysis above regarding claims 24 and 32, and we determine those arguments are unavailing here for the reasons stated above. As discussed above, Petitioner has demonstrated by a preponderance of the evidence that claims 24 and 32 are anticipated by Yamada.

Upon review of Petitioner’s contentions and Dr. Shahbakhti’s unrebutted testimony, we determine that Petitioner has demonstrated that Yamada discloses all of the limitations recited in claims 25, 30, and 35.

For example, for claim 25, Petitioner asserts that Yamada discloses the limitation “wherein the first voltage is variable, and wherein the second voltage is less than the first voltage,” as recited in claim 25. Pet. 66–67. According to Petitioner, MG3 is less than the voltage of MG2, in Yamada, because MG3 operates at battery voltage V_b , while MG2 operates at voltage V_m that has been boosted from battery voltage V_b . *Id.* (citing Ex. 1012 ¶¶ 25, 212). Yamada also discloses that voltage V_m is variable because Yamada states that “it is possible to control the voltage of the power supply line 1 to an arbitrary voltage at least as great as the output voltage of the battery 10.” Ex. 1012 ¶¶ 42, 43, 87, 204. Dr. Shahbakhti explains that voltage V_m may be any voltage greater than or equal to battery voltage V_b . Ex. 1001 ¶ 122. In addition, Yamada discloses that voltage V_m is varied based on a torque command and/or an output of the engine. Ex. 1012 ¶¶ 42, 43, 87, 204. Yamada also discloses that a torque designation value is provided to a controller for generation of a voltage-boosting signal. *Id.* ¶¶ 42, 43. According to Yamada, “during acceleration/rapid acceleration,

the output of the engine 240 is increased.” *Id.* ¶ 204. Dr. Shahbakhti testifies that “[t]hus, according to Yamada, boosted voltage V_m is dependent on both the torque designation value and the engine output, both of which may vary during operation of the vehicle.” Ex. 1002 ¶ 123. Therefore, we are persuaded that Yamada discloses the limitation recited in claim 25.

Based on the evidence in this entire trial record, we are persuaded that Petitioner has established by a preponderance of the evidence that claims 25, 30, and 35 are anticipated by Yamada.

J. Ground 7: Claim 34 is Obvious over Yamada

Petitioner asserts that claim 34, which depends from claim 32, is unpatentable under § 103(a) as obvious over Yamada, citing to Dr. Shahbakhti’s testimony for support. Pet. 71–72. Patent Owner does not address the limitation expressly recited in claim 34 with separate, specific arguments, but rather relies upon its arguments in connection with independent claim 32. PO Resp. 14–16. We have addressed those arguments in our analysis above regarding claim 32, and we determine those arguments are unavailing here for the reasons stated above. As discussed above, Petitioner has demonstrated by a preponderance of the evidence that claim 32 is anticipated by Yamada.

For the reasons set forth below, we are persuaded by Petitioner’s showing that claim 34 is obvious over Yamada.

Claim 34 expressly recites “a second propulsion means for supplying energy to a second energy storage device and for receiving energy from the second energy storage device.” Ex. 1001, 16:31–34. As noted by

Petitioner, claim 34 merely adds a second propulsion means and a second energy storage device that are functionally the same as the first propulsion means and first energy storage device recited in claim 32. Pet. 71.

Dr. Shahbakhti testifies that providing an additional traction drive system, that includes a propulsion means and energy storage device, was well known in the art, as demonstrated by Kira. Ex. 1002 ¶ 133. Dr. Shahbakhti also testifies that merely duplicating the first propulsion means and first energy storage device would have been obvious, depending on required propulsion power and flexibility. *Id.* ¶ 132.

After reviewing Petitioner's contentions and the evidence in this entire trial record, including Kira (Ex. 1005) and Dr. Shahbakhti's unrebutted testimony (Ex. 1002 ¶¶ 132–133), we determine that Petitioner has demonstrated by a preponderance of the evidence that claim 34 is unpatentable as obvious over Yamada.

K. Ground 8: Claim 26 is Obvious over Yamada and Katsuta

Petitioner asserts that claim 26, which depends from claims 24 and 25, is unpatentable under § 103(a) as obvious over Yamada and Katsuta, citing to Dr. Shahbakhti's testimony for support. Pet. 72–75; Ex. 1002 ¶¶ 135–139. Patent Owner does not address the limitation expressly recited in claim 26 with separate, specific arguments, but rather relies upon its arguments in connection with claim 24. PO Resp. 13–14. We have addressed those arguments in our analysis above regarding claim 24, and we determine those arguments are unavailing here for the reasons stated above.

As discussed above, Petitioner has demonstrated by a preponderance of the evidence that claims 24 and 25 are anticipated by Yamada.

Upon consideration of Petitioner's explanation and supporting evidence, we are persuaded by Petitioner's showing that claim 26 is obvious over Yamada and Katsuta.

Claim 26 recites "wherein the first voltage is variable in a range of from about 200 volts to about 350 volts." Ex. 1001, 15:21–23. As discussed above in Section II.I.3, Petitioner has established that Yamada discloses that the first voltage is variable, as recited in claim 25. Petitioner argues that the specific voltage range in claim 26 would have been obvious. Pet. 72–75. Petitioner explains that Katsuta teaches a hybrid vehicle powered by an engine and a battery operating in a voltage range of about 200–300 Volts, and up to 500 Volts with a buck-boost converter. *Id.* (citing Ex. 1015 ¶¶ 15–16). Therefore, the combination of Yamada and Katsuta teaches the limitation recited in claim 26.

Dr. Shahbakhti testifies that one of ordinary skill in the art would have been motivated to modify Yamada's first traction drive system to utilize the voltage ranges taught by Katsuta, because these are known voltage ranges used in hybrid vehicle operations to achieve efficient operation. Ex. 1002 ¶¶ 135–136. Dr. Shahbakhti also testifies that such an artisan would have known to adjust the voltage of the first traction drive system in Yamada depending on the application and voltage needs. *Id.* ¶ 137. We determine that Dr. Shahbakhti has articulated a sufficient reason to combine the teachings of Yamada and Katsuta.

After reviewing Petitioner's contentions and the evidence in this entire trial record, including Dr. Shahbakhti's un rebutted testimony (Ex. 1002 ¶¶ 135–139), we determine that Petitioner has demonstrated by a preponderance of the evidence that claim 26 is unpatentable under § 103(a) as obvious over Yamada and Katsuta.

L. Ground 9: Claims 27 and 28 are Obvious over Yamada and Suzuki

Petitioner asserts that claims 27 and 28, which depend from claims 24 and 25, are unpatentable under § 103(a) as obvious over Yamada and Hanyu, citing to Dr. Shahbakhti's testimony for support. Pet. 75–78; Ex. 1002 ¶¶ 141–144. Patent Owner does not address the limitations expressly recited in claims 27 and 28 with separate, specific arguments, but rather relies upon its arguments in connection with claim 24. PO Resp. 13–14. We have addressed those arguments in our analysis above regarding claim 24, and we determine those arguments are unavailing here for the reasons stated above. As discussed above, Petitioner has demonstrated by a preponderance of the evidence that claims 24 and 25 are anticipated by Yamada. Upon consideration of Petitioner's explanation and supporting evidence, we are persuaded by Petitioner's showing that claims 27 and 28 are obvious over Yamada and Suzuki.

Claim 27 recites “wherein the first voltage is variable in a range of from about 800 volts to about 1500 volts” and claim 28 recites “wherein the first voltage is variable in a range of from about 1500 volts to about 3000 volts.” Ex. 1001, 15:24–29. As discussed above in Section II.K, Petitioner has shown that a person of ordinary skill in the art would have known to

adjust the voltage of the first traction drive system depending on the application and voltage needs. Petitioner argues that the specific voltage ranges recited in claims 27 and 28 would have been obvious. Pet. 75–78. Petitioner explains that Suzuki teaches a drive system for a vehicle having a battery that operates in a voltage range of about 200 to 1,500 Volts. *Id.* 75–77 (citing Ex. 1018, code (57), ¶¶ 8–9). Therefore, the combination of Yamada and Suzuki teaches the limitations recited in claims 27 and 28.

Dr. Shahbakhti testifies that one of ordinary skill in the art would have been motivated to modify Yamada’s first traction drive system to utilize the voltage range taught by Suzuki because this is a known voltage range used to efficiently provide battery powered multi-train vehicle operations. Ex. 1002 ¶¶ 141–142. Dr. Shahbakhti also testifies that such an artisan would have known to adjust the voltage of the first traction drive system in Yamada depending on the application and voltage needs. *Id.* ¶¶ 143–144.

After reviewing Petitioner’s contentions and the evidence in this entire trial record, including Dr. Shahbakhti’s unrebutted testimony (Ex. 1002 ¶¶ 141–144), we determine that Petitioner has demonstrated by a preponderance of the evidence that claims 27 and 27 are unpatentable under § 103(a) as obvious over Yamada and Suzuki.

M. Ground 10: Claims 29 and 31 are Obvious over Yamada and Hanyu

Petitioner asserts that claims 29 and 31, which depend from claim 24, are unpatentable under § 103(a) as obvious over Yamada and Hanyu,⁹ citing

⁹ An overview of Hanyu is provided above in Section II.G.1.

to Dr. Shahbakhti's testimony for support. Pet. 79–81; Ex. 1002

¶¶ 145–153. There is no dispute that the combination of Yamada and Hanyu teaches the limitations expressly recited in claims 29 and 31. PO Resp. 17; Sur-reply 12–14. Rather, Patent Owner relies upon its arguments in connection with claim 24. PO Resp. 13–14. We have addressed those arguments in our analysis above regarding claim 24, and we determine those arguments are unavailing here for the reasons stated above. As discussed above, Petitioner has demonstrated by a preponderance of the evidence that claim 24 is anticipated by Yamada.

Claims 29 and 31 both require that the first energy storage device have a first portion and a second portion. Ex. 1001, 15:27–35. Petitioner argues that the combination of Yamada and Hanyu discloses a first energy storage device having a first portion and a second portion switchable between being electrically connected in series and in parallel through Hanyu's teachings. Pet. 79–81 (citing Ex. 1007 ¶¶ 40–41, Fig. 2). Specifically, Hanyu teaches battery 23 having two battery modules 23a and 23b, and switch 24, allowing the battery modules to be connected in series or parallel. Ex. 1007 ¶¶ 40–41, Fig. 2. Upon consideration of the evidence in this entire trial record, we are persuaded by Petitioner's showing that the combination of Yamada and Hanyu teaches the limitations expressly recited in claims 29 and 31.

As to Petitioner's reasons to combine the teachings of Yamada and Hanyu, Dr. Shahbakhti testifies that a person of ordinary skill in the art "would have been motivated to modify Yamada's battery to include a first portion and a second portion (i.e., two battery modules) as described by

Hanyu” because it would allow “the output voltage of the battery to be adjusted.” Ex. 1002 ¶¶ 147 (citing Ex. 1007 ¶¶ 40–41). Dr. Shahbakhti also testifies that “[i]nstead of a single battery module, a person of ordinary skill would have incorporated two battery modules with a switch between the battery modules.” *Id.* ¶ 149.

Patent Owner essentially relies on its arguments in connection with the combination of Kira and Hanyu that we discussed above in Section II.G.2. PO Resp. 17. According to Patent Owner, “Petitioner argues that it would have been obvious to modify Yamada to include the modular battery Hanyu describes, much as it did for the combination of Kira and Hanyu.” *Id.* (citing Pet. 78–79; Ex. 1002 ¶¶ 145–149; Ex. 2001 ¶ 52). And, “[t]he critiques discussed above . . . for the combination of Kira and Hanyu (vagueness, complexity of modification, and pointless duplication) apply equally to the combination of Yamada and Hanyu.” *Id.*

Dr. Keim testifies that “the rationale to combine Yamada and Hanyu is even weaker than for Kira and Hanyu, because Yamada discloses a system that already provides two different voltages from a single battery 10.” Ex. 2001 ¶ 53. In Dr. Keim’s view, he discerns “no reason at all to modify Yamada’s system, to add a functionality Yamada’s system already achieves with its existing structure.” *Id.*

As Petitioner points out, however, Patent Owner “fails to account for MG3, which receives a fixed voltage from battery 10” in Yamada, and “[i]ncorporating Hanyu’s battery into Yamada’s system would allow the voltage at MG3 to be varied, much like MG2.” Reply 27. Indeed, neither Patent Owner nor Dr. Keim disputes that Yamada does not expressly

disclose a battery system having two battery modules with a switch connecting the modules in series or parallel, *allowing varying voltage within the second traction system that includes MG3*. PO Resp. 17; Sur-reply 12–14; Ex. 2001 ¶¶ 52–54.

Furthermore, as we discussed above in Section II.G.2, one of ordinary skill in the art would have understood “the benefits associated with Hanyu’s battery system to include variability in battery output voltages and flexibility in adapting to different operating modes,” as Dr. Shahbakhti testifies. Ex. 1002 ¶¶ 91, 145–149. Hanyu discloses that its method would “reduce the loss and increase the efficiency of the inverter by using a low battery voltage when the load is low,” and that “if high output is required, high power can be generated by using a high battery voltage,” providing “a method of simultaneously achieving high efficiency and high power.” Ex. 1007, code (57), ¶¶ 3, 36–46, Figs. 1–2.

Therefore, we determine that Petitioner has articulated a sufficient reason, supported by evidence, to modify Yamada’s battery (the first energy storage device) to include two battery modules connected in series or parallel with a switch, allowing varying voltage within the second traction drive system that includes MG3, as taught by Hanyu. *See Perfect Web*, 587 F.3d at 1328–29. Patent Owner’s arguments that Petitioner’s reason to modify Yamada is vague, and that the modification addresses a non-existent problem, do not undermine Petitioner’s obviousness showing.

We also addressed Patent Owner’s complexity of modification arguments above in Section II.G.2. We explain that actual, physical substitution of elements is not required in an obviousness determination.

Mouttet, 686 F.3d at 1332; *Etter*, 756 F.2d at 859; *KSR*, 550 U.S. at 417. Implementing Hanyu’s battery system is not beyond the skill of a pertinent artisan, because Hanyu already teaches how to implement such a battery system in a propulsion system for a hybrid vehicle, and Dr. Keim concedes that such an artisan would have understood how to implement the battery system with converters/inverters to handle the changes in voltage. Ex. 1007, code (57), ¶¶ 3, 36–46, Figs. 1–2; Ex. 1028, 44:13–45:6, 54:22–55:10. The additional expense would not have discouraged one of ordinary skill in the art from seeking the benefit expected with the additional features.

Farrenkopf, 713 F.2d at 718; *Orthopedic*, 702 F.2d at 1013; *Fulton*, 391 F.3d at 1200. “[W]hen a patent ‘simply arranges old elements with each performing the same function it had been known to perform’ and yields no more than one would expect from such an arrangement, the combination is obvious.” *KSR*, 550 U.S. at 418. Therefore, Patent Owner’s complexity of modification arguments are also unavailing here for combining the teachings of Yamada and Hanyu.

For the foregoing reasons, we determine that Petitioner has articulated a sufficient reason, supported by evidence, to modify Yamada’s battery (the first energy storage device) to include two battery modules connected in series or parallel with a switch, allowing varying voltage within the second traction system, as taught by Hanyu. Patent Owner’s arguments do not undermine Petitioner’s obviousness showing.

Based on the evidence in this entire trial record, we determine that Petitioner has demonstrated by a preponderance of the evidence that claims

29 and 31 are unpatentable under § 103(a) as obvious over Yamada and Hanyu.

III. CONCLUSION¹⁰

For the foregoing reasons, we conclude that Petitioner has established by a preponderance of the evidence that claims 1–12, 14, 15, 17–32, 34, and 35 of the '932 patent are unpatentable.

IV. ORDER

For the foregoing reasons, it is

ORDERED that claims 1–12, 14, 15, 17–32, 34, and 35 of the '932 patent have been shown to be unpatentable; and

FURTHER ORDERED that, because this is a Final Written Decision, parties to the proceeding seeking judicial review of the decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

In summary:

¹⁰ Should Patent Owner wish to pursue amendment of the challenged claims in a reissue or reexamination proceeding subsequent to the issuance of this decision, we draw Patent Owner's attention to the April 2019 *Notice Regarding Options for Amendments by Patent Owner Through Reissue or Reexamination During a Pending AIA Trial Proceeding*. See 84 Fed. Reg. 16,654 (Apr. 22, 2019). If Patent Owner chooses to file a reissue application or a request for reexamination of the challenged patent, we remind Patent Owner of its continuing obligation to notify the Board of any such related matters in updated mandatory notices. See 37 C.F.R. § 42.8(a)(3), (b)(2).

Claims	35 U.S.C. §	Reference(s)/Basis	Claims Shown Unpatentable	Claims Not shown Unpatentable
1, 2, 23, 24, 30	102(b)	Kira	1, 2, 23, 24, 30	
3	103(a)	Kira	3	
4, 18–21	103(a)	Kira, Kumar	4, 18–21	
5, 14, 15, 17, 22	103(a)	Kira, Hanyu	5, 14, 15, 17, 22	
6–12	103(a)	Kira, Masahiko	6–12	
24, 25, 30, 32, 35	102(b)	Yamada	24, 25, 30, 32, 35	
34	103(a)	Yamada	34	
26	103(a)	Yamada, Katsuta	26	
27, 28	103(a)	Yamada, Suzuki	27, 28	
29, 31	103(a)	Yamada, Hanyu	29, 31	
Overall Outcome			1–12, 14, 15, 17–32, 34, and 35	

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