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Paper 34
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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

FORD MOTOR COMPANY,
Petitioner,

v.

PAICE LLC and THE ABELL FOUNDATION, INC.,
Patent Owner.

Case IPR2015-00790
Patent 7,237,634 B2

Before SALLY C. MEDLEY, KALYAN K. DESHPANDE, and CARL M. DEFRANCO, *Administrative Patent Judges*.

DESHPANDE, *Administrative Patent Judge*.

FINAL WRITTEN DECISION
35 U.S.C. § 318(a); 37 C.F.R. § 42.73

I. INTRODUCTION

A. Background

Ford Motor Company ("Petitioner") filed a Petition requesting an *inter partes* review of claims 4, 13–15, 25, 28, 29, 32, 67, and 79 of U.S. Patent No. 7,237,634 B2 (Ex. 1650, "the '634 patent"). Paper 1 ("Pet."). Paice LLC and The Abell Foundation, Inc. (collectively, "Patent Owner") filed a Preliminary Response in unredacted and redacted forms. Papers 10, 11 ("Prelim. Resp."). Patent Owner also filed a Motion to Seal. Paper 12 ("Motion to Seal").

Pursuant to 35 U.S.C. § 314, we instituted *inter partes* review of the '634 patent, on November 9, 2015, under 35 U.S.C. § 103(a), as to claims 4 and 28 as obvious over Ibaraki '882,[1] Yamaguchi,[2] and the general knowledge of a person with ordinary skill in the art; claims 13–15 as obvious over Ibaraki '882, Masding/Bumby 1988,[3] and Admitted Prior Art (APA); claim 25 as obvious over Ibaraki '882 and Kawakatsu;[4] claim 29 as

[1] U.S. Patent No. 5,789,882, issued Aug. 4, 1998 (Ex. 1652) ("Ibaraki '882").

[2] U.S. Patent No. 5,865,263, issued Feb. 2, 1999 (Ex. 1653) ("Yamaguchi").

[3] P.W. Masding, J.R. Bumby, and N. Herron, *A Microprocessor Controlled Gearbox for Use in Electric and Hybrid-Electric Vehicles*, TRANSACTIONS OF THE INSTITUTE OF MEASUREMENT AND CONTROL (1988) (Ex. 1654) ("Masding/Bumby 1988").

[4] U.S. Patent No. 4,335,429, issued June 15, 1982 (Ex. 1655) ("Kawakatsu").

obvious over Ibaraki '882 and Vittone;[5] claim 32 as obvious over Ibaraki '882 and Ibaraki '626;[6] and claims 67 and 79 as obvious over Ibaraki '882 and Suga.[7] Paper 13 ("Dec.").

Patent Owner filed a Response (Paper 18, "PO Resp."), and Petitioner filed a Reply (Paper 24, "Pet. Reply").[8] Oral hearing was held on June 28, 2016, and the hearing transcript has been entered in the record. Paper 33 ("Tr.").

The Board has jurisdiction under 35 U.S.C. § 6. This Final Written Decision is issued pursuant to 35 U.S.C. § 318(a) and 37 C.F.R. § 42.73. Pursuant to our jurisdiction under 35 U.S.C. § 6, we conclude, *first*, that Petitioner is estopped from maintaining its challenge in this proceeding against claim 14. For the reasons discussed below, we are persuaded that Petitioner has shown by a preponderance of the evidence that claims 4, 13, 15, 25, 28, 29, 32, 67, and 79 of the '634 patent are unpatentable.

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[5] Oreste Vittone, *Fiat Conceptual Approach to Hybrid Cars Design*, 12TH INTERNATIONAL ELECTRIC VEHICLE SYMPOSIUM (1994) (Ex. 1656) ("Vittone").

[6] U.S. Patent No. 6,003,626, issued Dec. 21, 1999 (Ex. 1657) ("Ibaraki '626").

[7] U.S. Patent No. 5,623,104, issued Apr. 22, 1997 (Ex. 1658) ("Suga").

[8] In addition, Patent Owner filed a Motion for Observation on Cross-Examination (Paper 26) and Petitioner filed a Response to Motion for Observation on Cross-Examination (Paper 29), both of which have been considered.

B. Related Proceedings

The ’634 patent is involved in *Paice LLC v. Ford Motor Co.*, No. 1-14-cv-00492, filed on February 19, 2014, in the United States District Court for the District of Maryland. Pet. 2. Petitioner twice filed an earlier Petition for *inter partes* review of the ’634 patent, and we instituted trial in both proceedings and subsequently entered final written decisions. *Ford Motor Co. v. Paice LLC & The Abell Foundation, Inc.*, Case IPR2014-00904 (Papers 13 and 41), and *Ford Motor Co. v. Paice LLC & The Abell Foundation*, Inc., Case IPR2014-01416 (Papers 9 and 26). The ’634 patent also is involved in the following *inter partes* review proceedings: IPR2015-00606, IPR2015-00722, IPR2015-00758, IPR2015-00784, IPR2015-00785, IPR2015-00787, IPR2015-00791, IPR2015-00799, IPR2015-00800, and IPR2015-00801.

C. The ’634 Patent

The ’634 patent describes a hybrid vehicle with an internal combustion engine, at least one electric motor, and a battery bank, all controlled by a microprocessor that directs torque transfer between the engine, the motor, and the drive wheels of the vehicle. Ex. 1650, 17:17–56, Fig. 4. The microprocessor compares the vehicle’s torque requirements and the engine’s torque output against a predefined setpoint and uses the results of the comparison to control the vehicle’s mode of operation, e.g., straight-electric, engine-only, or hybrid. *Id*. at 40:16–49. The microprocessor utilizes a hybrid control strategy that operates the engine only in a range of high fuel efficiency, which occurs when the instantaneous torque required to drive the vehicle, or road load (RL), reaches a setpoint (SP) of approximately 30% of the engine’s maximum torque output (MTO). *Id*. at

20:61–67; *see also id*. at 13:64–65 ("the engine is never operated at less than 30% of MTO, and is thus never operated inefficiently"). Operating the engine in a range above the setpoint but substantially less than the maximum torque output maximizes fuel efficiency and reduces pollutant emissions of the vehicle. *Id*. at 15:55–58.

D. Illustrative Claim

Petitioner challenges claims 4, 13–15, 25, 28, 29, 32, 67, and 79 of the '634 patent. Pet. 3–59. Although not challenged, claim 1, from which all challenged claims depend, is illustrative of the claims at issue and is reproduced below:

> 1. A hybrid vehicle, comprising:
>
> one or more wheels;
>
> an internal combustion engine operable to propel the hybrid vehicle by providing torque to the one or more wheels;
>
> a first electric motor coupled to the engine;
>
> a second electric motor operable to propel the hybrid vehicle by providing torque to the one or more wheels;
>
> a battery coupled to the first and second electric motors, operable to:
>
> provide current to the first and/or the second electric motors; and
>
> accept current from the first and second electric motors; and
>
> a controller, operable to control the flow of electrical and mechanical power between the engine, the first and the second electric motors, and the one or more wheels;
>
> wherein the controller is operable to operate the engine when torque required from the engine to propel the hybrid vehicle and/or to drive one or more of the first or the second motors to charge the battery is at least equal to a setpoint (SP) above which the torque produced by the engine is efficiently produced, and wherein the torque produced by the

> engine when operated at the SP is substantially less than the maximum torque output (MTO) of the engine.

Ex. 1650, 58:2–27.

II. ANALYSIS

A. Petitioner Estoppel

On December 10, 2015, we rendered a final written decision of claims 1, 14, 16, 18, and 24 of the '634 patent in IPR2014-00904. *Ford Motor Co. v. Paice LLC & The Abell Foundation*, Inc., Case IPR2014-00904 (PTAB December 10, 2015) (Paper 41). Patent Owner argues that, pursuant to 35 U.S.C. § 315(e)(1), Petitioner may not maintain its challenge of claim 14. PO Resp. 16. Petitioner responds that it is not estopped because it was necessary for it to file multiple petitions to address the '634 patent's many dependent claims, such as dependent claims 4 and 28, which depend from independent claim 1. Pet. Reply 2–3. Accordingly, Petitioner argues that the Board "may exercise its discretion in maintaining the current proceeding against claim 1 because it is incorporated within the body of the presently challenged dependent claims 'as a matter of dependency.'" *Id.* at 3.

Under 35 U.S.C. § 315(e)(1), a petitioner who has obtained a final written decision on a patent claim in an *inter partes* review may not maintain a subsequent proceeding with respect to that same claim on a ground that it "reasonably could have raised" in the original proceeding. Specifically, section 315(e)(1) provides:

> (e) Estoppel.—
>
> (1) Proceedings before the office.—The petitioner in an inter partes review of a claim in a patent under this chapter that results in a final written decision under section 318(a) . . . may not request or maintain a proceeding before the Office with respect to that claim on any ground that the

> petitioner raised or reasonably could have raised during that inter partes review.

On December 10, 2015, a Final Written Decision was entered in IPR2014-00904, in which we determined that claims 1, 14, 16, 18, and 24 of the '634 patent are unpatentable. Petitioner in this proceeding is the same Petitioner in IPR2014-00904. The grounds raised by Petitioner in IPR2014-00904 against claim 14 is not the same as the ground raised against claim 14 in this proceeding. Nonetheless, Ibaraki '882 was cited during prosecution that led to the '634 patent and is listed on the face of the '634 patent. Ex. 1650. APA was similar known as it is part of the '634 patent. *Id.* Petitioner does not argue that it reasonably could not have raised its challenge to claim 14 based on Ibaraki '882 in IPR2014-00904. Pet. Reply 2–3. Similarly, Petitioner does not argue that it reasonably could not have raised its challenge to claim 14 based on Masding/Bumby 1988 and APA in IPR2014-00904. *Id.* We determine that Petitioner reasonably could have raised this challenge in IPR2014-00904. Accordingly, Petitioner is estopped under 35 U.S.C. § 315(e)(1) from maintaining the ground based on Ibaraki '882 against claim 14. We dismiss the *inter partes* review with respect to claim 14.

Although Petitioner argues that we can maintain the proceeding with respect to independent claim 1 (*see* Pet. Reply 3), Petitioner has not challenged independent claim 1 in this proceeding under any grounds, and, therefore, we do not provide a final written decision on the merits with respect to claim 1. However, we determine it is necessary to address the parties' contentions with respect to independent claim 1 because claims 4, 13, 15, 25, 28, 29, 32, 67, and 79 depend from claim 1. We do not otherwise

provide a final written decision on the merits with respect to claim 1 or claim 14, or again hold those claims to be unpatentable.

B. Claim Construction

The Board interprets claims of an unexpired patent using the broadest reasonable interpretation in light of the specification of the patent in which they appear. *See* 37 C.F.R. § 42.100(b); *see also Cuozzo Speed Techs. LLC v. Lee*, 136 S. Ct. 2131, 2144–46 (2016) (upholding the use of the broadest reasonable interpretation standard). Under the broadest reasonable interpretation standard, claim terms are given their ordinary and customary meaning, as would be understood by one of ordinary skill in the art in the context of the entire disclosure. *In re Translogic Tech. Inc.*, 504 F.3d 1249, 1257 (Fed. Cir. 2007).

1. "Set Point" or "SP"

The term "setpoint" or "SP" is recited in independent claim 1 and dependent claims 4, 13, 15, 25, 28, 29, 32, 67, and 79. Petitioner proposes that "setpoint" or "SP" be construed, in the context of these claims, as "predetermined torque value." Pet. 12–13. Patent Owner argues that "setpoint" should be construed as "a definite, but potentially variable value at which a transition between operating modes may occur." PO Resp. 7–11.[9]

[9] In our Decision to Institute, and upon taking into consideration the parties' arguments and supporting evidence, we interpreted "setpoint" or "SP" to mean "predetermined torque value that may or may not be reset." Dec. 8–10. Petitioner agrees with that interpretation, while Patent Owner does not. Pet. Reply 2; PO Resp. 7–11.

We agree with Petitioner that the claims compare the setpoint either to an engine torque value or a torque based "road load" value. Pet. 12–13. Claim 1 recites a condition "when torque required from the engine to propel the hybrid vehicle . . . is at least equal to a setpoint (SP)." Ex. 1650, 58:19–27.

Nothing in the Specification precludes a setpoint from being reset, after it has been set. A setpoint for however short a period of time still is a setpoint. Accordingly, we construe "setpoint" and "SP" as "predetermined torque value that may or may not be reset."

Patent Owner argues that the claims and the specification of the '634 patent "make clear that a 'setpoint' is not simply a numerical value divorced from the context of the control system," and that "'setpoint' serves the crucial function of marking the transition from one claimed mode to another, and in particular, the transition from propelling the vehicle with the motor to propelling the vehicle with the engine." PO Resp. 8. This argument is misplaced. Although such use of a setpoint is described by other language in the '634 patent specification, it is not an intrinsic property of a setpoint and is not a necessary and required use of all setpoints. In that regard, we further note the following passage in the '634 patent specification, which supports not reading a mode switching requirement (i.e., transition requirement) into the term "setpoint":

> the values of the sensed parameters in response to which the operating mode is selected may vary . . ., so that *the operating mode is not repetitively switched simply because one of the sensed parameters fluctuates around a defined setpoint*.

Ex. 1650, 19:67–20:6 (emphasis added).

It is improper to add an extraneous limitation into a claim, i.e., one that is added wholly apart from any need for the addition to accord meaning to a claim term. *See, e.g.*, *Hoganas AB v. Dresser Indus., Inc*., 9 F.3d 948, 950 (Fed. Cir. 1993); *E.I. du Pont de Nemours & Co. v. Phillips Petroleum Co*., 849 F.2d 1430, 1433 (Fed. Cir. 1988). It is important not to import into a claim limitations that are not a part of the claim. *Superguide Corp. v. DirecTV Enterprises, Inc.*, 358 F.3d 870, 875 (Fed. Cir. 2004). For example, a particular embodiment appearing in the written description may not be read into a claim when the claim language is broader than the embodiment. *Id.*; *see also In re Van Geuns*, 988 F.2d 1181, 1184 (Fed. Cir. 1993). That is no different even if the patent specification describes only a single embodiment. *Liebel-Flarsheim Co. v. Medrad Inc.*, 358 F.3d 898, 906 (Fed. Cir. 2004).

Patent Owner brings to our attention that the U.S. District Court for the Eastern District of Texas and the U.S. District Court for the District of Maryland both have construed "setpoint" to mean "a definite, but potentially variable value at which a transition between operating modes may occur." PO Resp. 7 n.1. We note that that construction also does not require that an operating mode be changed at a setpoint, as Patent Owner urges. Instead, the construction of the district courts sets forth that a transition between operating modes "may occur" at a setpoint, which is consistent with our construction here.

Patent Owner additionally argues that "setpoint" should not be limited to a torque value, because the Specification makes clear that it also can be the state of charge of a battery. PO. Resp. 11. Patent Owner cites to the following passage in the Specification:

> [T]he microprocessor tests sensed and calculated values for system variables, such as the vehicle's instantaneous torque requirement, i.e., the "road load" RL, the engine's instantaneous torque output ITO, both being expressed as a percentage of the engine's maximum torque output MTO, *and the state of charge of the battery bank BSC*, expressed as a percentage of its full charge, *against setpoints*, and uses the results of the comparisons to control the mode of vehicle operation.

Ex. 1650, 40:22–31 (emphasis added). This argument also is misplaced. As we noted above, independent claim 1 requires a comparison of the setpoint either to an engine torque value or a torque based "road load" value. Thus, in the context of claim 1, and claims dependent therefrom, a setpoint must be a torque value, and not some state of charge of a battery.

For reasons discussed above, we construe "setpoint" and "SP" as "predetermined torque value that may or may not be reset."

2. The "operating" limitations

Patent Owner asserts that the challenged claims require a comparison of the torque required to propel the hybrid vehicle to a setpoint (SP) and also to the maximum torque output (MTO). PO Resp. 11–15. The assertion is based on the requirements in claim 1 of "when torque required to propel the hybrid vehicle . . . is at least equal to a setpoint (SP)." *Id.*

In the above discussion of the construction of setpoint, we already noted that claim 1 requires a comparison of the torque required to propel the hybrid vehicle to a setpoint because of the claim recitations "when torque required from the engine to propel the hybrid vehicle . . . is at least equal to a setpoint (SP)." Petitioner has not advanced any cogent reasoning why no such comparison is required by the claims. We determine that the claims require a comparison of the torque required to propel the hybrid vehicle to a

setpoint (SP) and also to a maximum torque output (MTO). That, however, does not mean the claims exclude the comparison of other parameters.

3. "abnormal and transient conditions"

Dependent claim 32 recites that the controller operates the engine "at torque output levels less than SP under abnormal and transient conditions to satisfy drivability and/or safety considerations." Ex. 1650, 60:54–57.

In our Decision to Institute, we interpreted "abnormal and transient conditions" to include starting the engine and starting the engine. Dec. 9–11. Neither party has indicated that our interpretation was improper and we do not perceive any reason or evidence that now compels any deviation from our initial interpretation. Accordingly, we interpret "abnormal and transient conditions" to include "starting the engine and stopping the engine."

C. Claims 4 and 28 – Obviousness over Ibaraki' 882, Yamaguchi, and the General Knowledge of a Person with Ordinary Skill

Petitioner contends that claims 4 and 28 are unpatentable under 35 U.S.C. § 103(a) as obvious over Ibaraki '882, Yamaguchi, and the knowledge of a person with ordinary skill in the art. Pet. 14–38.

1. Ibaraki '882 (Ex. 1652)

Ibaraki '882 describes a drive control apparatus and method for a hybrid vehicle equipped with two drive power sources consisting of an electric motor and engine such as an internal combustion engine. Ex. 1652, 1:9–14. Drive control apparatus includes controller 128 that includes a drive source selecting means 160. Drive source selecting means is adapted to select one or both of engine 112 and motor 114 as the drive power source or sources according to a drive source selecting data map stored in memory means 162. *Id.* at 20:38–43, Figs. 8 and 9. In particular, controller 128 has

a MOTOR DRIVE mode in which motor 114 is selected as the drive power source, an ENGINE DRIVE mode in which the engine 112 is selected as the drive power mode source, and an ENGINE-MOTOR DRIVE mode in which both the engine 112 and the motor 114 are selected as the drive power sources. *Id.* at 20:43–49.

Figure 11, reproduced below, depicts a graph which represents a predetermined relationship between the vehicle drive torque and running speed V and the three drive modes. *Id.* at 20:50–53.

FIG. 11

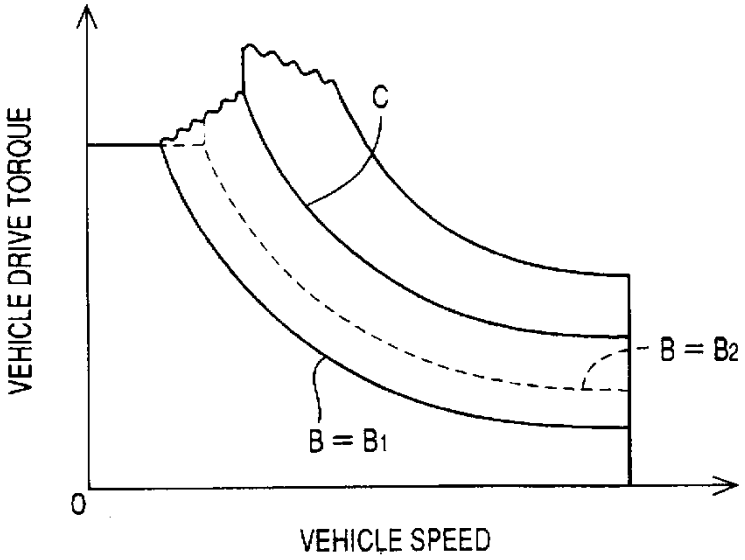

Figure 11 shows a graph which represents a predetermined relationship between the vehicle drive torque and running speed.

Drive source selecting means 160 (Fig. 9) selects the MOTOR DRIVE mode when the vehicle running condition as represented by the current vehicle drive torque and speed V is held within the range below the first boundary line B. When the vehicle running condition is held within the range between the first and second boundary lines B and C, the drive source selecting means 160 selects the ENGINE DRIVE mode. When the vehicle

running condition is in the range above the second boundary line C, the drive source selecting means 160 selects the ENGINE[-MOTOR] DRIVE mode. *Id.* at 20:59–21:1. Ibaraki '882 describes that the boundary line B may be adjusted from B_1 to B_2 so as to enlarge the range in which the MOTOR DRIVE mode is selected. *Id.* at 21:2–4. Ibaraki '882 further describes an ELECTRICITY GENERATING DRIVE mode where the engine provides surplus power that is greater than the vehicle drive torque. The surplus power from the engine is used to operate the electric motor as a generator to regeneratively charge the battery. *Id.* at 23:1–30.

2. Yamaguchi (Ex. 1653)

Yamaguchi discloses a hybrid vehicle driven by a motor and an internal combustion engine. Ex. 1653, 1:6–8. The vehicle includes a control unit for controlling the engine, generator/motor, and driving motor. *Id.* at 4:66–5:2. The vehicle control unit supplies the engine control system with ON/OFF signals in response to various detected conditions. *Id.* at 5:9–14. The vehicle control unit further supplies the generator/motor control unit with a target rotation speed based on the accelerator pedal sensor and supplies the driving motor control unit with a torque signal based on the accelerator pedal sensor. *Id.* at 5:15–29.

3. Analysis

Petitioner contends that claims 4 and 28 are unpatentable under 35 U.S.C. § 103(a) as obvious over Ibaraki '882, Yamaguchi, and the general knowledge of a person with ordinary skill in the art. Pet. 14–38. Petitioner provides a detailed analysis, supported by evidence, demonstrating, by a preponderance of the evidence, that claims 1 and 5 are

obvious over Ibaraki '882, Yamaguchi, and the general knowledge of a person with ordinary skill in the art. *Id.*

As discussed above, we do not provide a written final decision with respect to independent claim 1 because claim 1 has not been challenged in this proceeding. Claims 4, 13, 15, 25, 28, 29, 32, 67, and 79, however, depend from claim 1 and necessarily include all of the limitations of claim 1. Accordingly, we first address the contentions made by Petitioner as to how the combination of Ibaraki '882, Yamaguchi, and the general knowledge of a person with ordinary skill in the art renders obvious claim 1.

Claim 1 recites "[a] hybrid vehicle," the vehicle comprising "one or more wheels" and "an internal combustion engine operable to propel the hybrid vehicle by providing torque to the one or more wheels." Petitioner contends that Ibaraki '882 discloses a hybrid vehicle that is propelled by an internal combustion (IC) engine and an electric motor. Pet. 15 (citing Ex. 1652,[10] 1:9–14; Ex. 1661[11] ¶ 181–184). Petitioner specifically argues that Ibaraki '882 discloses that the engine is controllably coupled to right and left road wheels. *Id.* at 16 (citing Ex. 1652, 11:12–16, 19:18–28, Fig. 8; Ex. 1661 ¶¶ 185–187, 190–191).

Claim 1 further recites "a first electric motor coupled to the engine" and "a second electric motor operable to propel the hybrid vehicle by

[10] Petitioner cites to Exhibit 1552, however, we understand this to be a typographical error because Exhibit 1552 does not exist in this proceeding, and that Petitioner intended to cite to Exhibit 1652, which is Ibaraki '882.

[11] Petitioner cites to Exhibit 1556, however, we understand this to be a typographical error because Exhibit 1556 does not exist in this proceeding, and that Petitioner intended to cite to Exhibit 1661, which is the Declaration of Dr. Davis.

providing torque to the one or more wheels." Petitioner argues that Ibaraki '882 discloses a hybrid vehicle with a "generator" and an "electric motor" as separate components, and the separate electric generator is operated for driving the vehicle. *Id.* at 17–23 (citing Ex. 1652, 5:27–29, 26:34–38; Ex. 1661 ¶¶ 196–201). Petitioner alternatively argues that Ibaraki '882 discloses an embodiment where two or more electric motors drive the wheels, and a person with ordinary skill in the art would have understood the "two or more electric motors" would necessarily be coupled to the engine in order for the engine to generate electricity for the motors. *Id.* at 20 (citing Ex. 1652, 10:20–26, 12:22–75, 17:65–18:1, 27:1–3; Ex. 1661 ¶¶ 203, 205).

Claim 1 also recites "a battery coupled to the first and second electric motors" that is operable to "provide current to the first and/or the second electric motors" and "accept current from the first and second electric motors." Petitioner contends that Ibaraki '882 discloses an electrical energy storage device in the form of a battery, and the battery accepts current from the first motor and the second motor, when the second motor is functioning as a generator. *Id.* at 23–25 (citing Ex. 1652, 11:31–33, 19:55–57; Ex. 1661 ¶¶ 215–227).

Claim 1 additionally recites "a controller, operable to control the flow of electrical and mechanical power between the engine, the first and the second electric motors, and the one or more wheels." Petitioner contends that Ibaraki '882 discloses a controller that includes four modes: (1) MOTOR DRIVE, where the electric motor is selected as the drive power source, (2) ENGINE DRIVE, where the engine is selected as the drive power source, (3) ENGINE-MOTOR DRIVE, where both the engine and electric motor are selected as the drive power sources, and (4) CHARGING,

where electrical energy generated during regenerative braking is transferred to the battery. *Id*. at 25–27 (citing Ex. 1652, 12:8–11, 20:38–49, Fig. 8; Ex. 1661 ¶¶ 230, 232, 233).

Claim 1 further recites "wherein the controller is operable to operate the engine when torque required from the engine to propel the hybrid vehicle and/or to drive one or more of the first or the second motors to charge the battery is at least equal to a setpoint (SP) above which the torque produced by the engine is efficiently produced." Petitioner contends that this limitation includes the language "and/or" and, therefore, this limitation is met because Ibaraki '882 discloses "the controller is operable to operate the engine when torque required from the engine to propel the hybrid vehicle . . . is at least equal to a setpoint (SP) above which the torque produced by the engine is efficiently produced." *Id.* at 27 (citing Ex. 1661 ¶ 235). Specifically, Petitioner contends that Ibaraki '882 discloses a setpoint of engine speed above which the engine torque is efficiently produced, the 70% relative efficiency. *Id*. at 27–29 (citing Ex. 1652, 25:36–26:8, Fig. 5; Ex. 1661 ¶¶ 238–240). Petitioner further contends that Ibaraki '882, in Figure 11, discloses multiple setpoints along boundary line "B." *Id.* at 29–30 (citing Ex. 1652, 20:49–21:20, 24:6–26, Fig. 11; Ex. 1661 ¶¶ 243–244). Petitioner further argues that a person with ordinary skill in the art would have understood that "at a given speed, a torque along boundary line 'B' is a setpoint above which torque produced by the engine is efficiently produced." *Id.* at 30 (citing Ex. 1661 ¶ 244) (emphasis omitted).

Claim 1 also recites "wherein the torque produced by the engine when operated at the SP is substantially less than the maximum torque output (MTO) of the engine." Petitioner further argues that Ibaraki '882 discloses

an energy efficiency map that includes a threshold and multiple setpoints based on the engine speed. Pet. 30–31 (citing Ex. 1652, 25:46–26:8, Fig. 5; Ex. 1558 ¶¶ 250–253). Petitioner asserts that the setpoints represent the point where the hybrid vehicle transitions from motor drive mode to engine drive mode and the engine efficiently produces torque above the setpoint. *Id*. Petitioner argues that Ibaraki '882 similarly discloses a drive source selecting data map that includes a boundary line, along which are setpoints. *Id*. at 31–32 (citing Ex. 1652, 24:6–16, Fig. 11; Ex. 1558 ¶¶254–256). Petitioner argues that these setpoints also represent the point where the hybrid vehicle transitions from motor drive mode to engine drive mode and the engine efficiently produces torque above the setpoint. *Id*. Petitioner explains that although the language "substantially less than" is not "mathematically precise," 70% of the MTO is "substantially less than" the MTO and Ibaraki '882 discloses threshold or setpoint at 70% of the engine's maximum efficiency. *Id*. at 30 (citing Ex. 1652, 25:46–26:8, Fig. 5).

We are similarly persuaded that Petitioner has established by a preponderance of the evidence that claims 4 and 28 are obvious over Ibaraki '882, Yamaguchi, and the general knowledge of a person with ordinary skill in the art. *See* Pet. 33–38. Claim 4 recites "the controller is operable to start the engine via the first electric motor if the engine is not already running." Claim 28 recites "the controller is operable to rotate the engine via the first electric motor before starting the engine such that cylinders of the engine are heated by compression of the air therein." Petitioner specifically argues that Yamaguchi discloses that "the engine speed increases from "0" to a non-zero amount [] before the engine control unit (ECU) turns on the ignition to start the engine." *Id.* at 36–38 (citing Ex. 1661 ¶ 269; Ex. 1653, 8:62–65, Fig. 8)

(emphasis omitted). Petitioner further argues that Yamaguchi discloses that the motor "is rotated in the positive direction [] to allow for rotating the engine before the engine is ignited." *Id.* (citing Ex. 1653, 8:41–44).

Petitioner also articulates reasoning with rational underpinnings on why a person of ordinary skill in the art at the time of the invention would have combined Ibaraki '882, Yamaguchi, and the general knowledge of a person with ordinary skill in the art. *Id*. at 34–36. Petitioner argues that one of ordinary skill in the art would have known and understood that it was well-known to preheat the engine and/or catalyst to reduce engine emissions during a cold start, and one of Ibaraki '882's stated objectives is to reduce "the fuel consumption amount or exhaust gas amount of the engine." *Id.* (citing Ex. 1661 ¶¶ 262–264; Ex. 1652, 2:52–56). Accordingly, Petitioner argues that a person with ordinary skill in the art would have combined the pre-heating method of Yamaguchi to Ibaraki '882's hybrid vehicle in order to effectively reduce the fuel consumption amount or exhaust gas amount of the engine. *Id.* (citing Ex. 1652, 2:52–56; Ex. 1661 ¶¶ 262–264).

Notwithstanding Patent Owner's arguments, which we address below, we are persuaded by Petitioner's showing, which we adopt as our own, that Ibaraki '882 in combination with Yamaguchi and the general knowledge of a person with ordinary skill in the art reasonably would have suggested the elements of claims 4 and 28, which include all of the elements of claim 1, and that the combination would have been obvious for the reasons provided by Petitioner.

Patent Owner argues that (1) Ibaraki '882 does not compare torque requirements to setpoint, (2) Ibaraki '882 does not disclose a setpoint that is substantially less than MTO, and (3) Petitioner fails to establish that a person

with ordinary skill in the art would have been motivated to combine Yamaguchi with Ibaraki '882. PO Resp. 16–39. We address each argument in the order presented by Patent Owner. Patent Owner presents the first two arguments for each of the grounds challenged in the Petition, and, although we only address these arguments with respect to claims 4 and 28, this analysis applies to each of the grounds challenged. *See* PO Resp. 37–52.

a. Comparison of Torque Requirements to Setpoint

Patent Owner argues Ibaraki '882 describes comparing power to power thresholds to determine the operational mode of the vehicle instead of comparing torque requirements to a setpoint, both of which are torque values. *Id.* at 16–34. We have considered all of Patent Owner's arguments and supporting evidence to which we are directed with respect to the contention, but are not persuaded by Patent Owner's arguments.

It is undisputed that "power" is determined as the multiplicative product of "torque" and "speed." Ex. 1661 ¶ 242 n. 22; Ex. 2605 ¶ 46. A comparison directed to a selected power point on Figure 11 of Ibaraki '882 necessarily makes a comparison with regard to the torque value associated with the selected power point on the figure, regardless of whether a comparison also is made with respect to speed. In Ibaraki '882 the drive source selecting means selects the MOTOR DRIVE mode, for example, "*when* the vehicle running condition *as represented by the current vehicle drive torque and speed V* is held within the range below the first boundary line B." Ex. 1652, 20:60–62 (emphasis added). Thus, a comparison ("*when* the vehicle running condition *as represented by*") is made based on the constituent parts of the power value of the current vehicle drive torque and speed. We agree with Patent Owner that the claims require a comparison of

road load (RL) to a setpoint (SP) and also to a maximum torque output (MTO), but that does not mean the claims exclude the comparison of other parameters, such as speed. Indeed, they do not. The scope of these claims does not dictate that the only comparison made is with respect to torque, and that no other types of comparisons are involved.

Ibaraki '882 describes selecting an operating mode based on a drive source selecting data map as illustrated in Figure 11. The drive source selecting means selects the MOTOR DRIVE mode, for example, "when the vehicle running condition as represented by *the current vehicle drive torque and speed V* is held within the range below the first boundary line B." Ex. 1652, 20:60–62 (emphasis added). The point corresponding to the required drive power P_L of Figure 11 (annotated above) satisfies the claimed road load, because P_L includes the constituent parts of torque and speed. Ex. 1661 ¶¶ 242–248. Furthermore, the boundary line B is a line below which the MOTOR DRIVE mode is selected, and thus, the points along boundary line B of torque and speed satisfy the setpoint limitation. *Id.* Again, the claims do not preclude the comparison of more than two components, as long as torque is one of the components.

Patent Owner argues that the '634 patent specification describes that the instantaneous torque necessary to propel the vehicle is independent of vehicle speed. PO Resp. 20–21; Ex. 1650, 12:55–61. But that passage is in the "DISCUSSION OF THE PRIOR ART" section of the '634 patent. Patent Owner has not shown that that description applies to every embodiment described in the '634 patent. In any event, there is nothing in the claims themselves that precludes speed from also being considered in determining the mode of operation of the hybrid vehicle. Indeed, the '634

patent also contemplates including not just the torque value in the comparison, but also speed. *See, e.g.*, Ex. 1650, Fig. 4, 59:3–5.

b. Setpoint is Substantially Less than MTO

Patent Owner argues that Ibaraki '882 does not disclose a setpoint that is substantially less than MTO. PO Resp. 35–38. We disagree with Patent Owner. As discussed by Petitioner, Ibaraki '882 discloses η_{ICEmax} that represents a maximum fuel efficiency and $0.7\eta_{ICEmax}$ that is 70% of the maximum fuel efficiency. Pet. 30–31; Ex. 1652, 13:18–24, 25:46–65, Fig. 5; Ex. 1661 ¶ 252. Dr. Davis explains that a person of ordinary skill in the art would have understood that $0.7\eta_{ICEmax}$ is substantially less than MTO. Ex. 1661 ¶¶ 253–254. Dr. Davis additionally explains that a person with ordinary skill would have understood that Figure 11 illustrates a setpoint along line "B" that is less than MTO. Pet. 31–32; Ex. 1661 ¶¶ 255–258; Ex. 1652, Fig. 11. Dr. Davis explains that a person with ordinary skill in the art would have understood Figure 11 to illustrate that boundary line "C" represents MTO and boundary line "B" represents setpoints, and the setpoints along boundary line "B" are substantially less than a corresponding point along boundary line "C" because, although Figure 11 does not provide any numerical values, the limitation "substantially less than" broadly encompasses the distinction drawn in Figure 11 between boundary line "C" and boundary line "B." *Id.*; Ex. 1661 ¶¶ 256–257. Moreover, Petitioner, directing attention to paragraphs 251–253 of Dr. Davis's declaration, also explains that the Ibaraki '882 setpoint must be substantially less than the MTO because, otherwise, the IC engine would hardly ever be used as a primary drive source for the disclosed vehicle. Pet. 31–32; Ex. 1661 ¶¶ 251–253. We give substantial weight to Dr. Davis' testimony, and are

persuaded that Ibaraki ’882 discloses setpoints that are substantially less than MTO. Thus, we are not persuaded by Patent Owner’s argument.

c. Rationale to combine Ibaraki ’882 and Yamaguchi

Patent Owner argues that Petitioner “fails to establish that a person of ordinary skill in the art would be motivated to combine Yamaguchi’s engine rotation with Ibaraki ’882.” PO Resp. 38–39. We disagree. As discussed in detail above, Petitioner provides a reasonable rationale to combine Yamaguchi’s engine rotation to the Ibaraki ’882 hybrid vehicle. A person having ordinary skill in the art at the time of the invention would have known that rotating the Ibaraki ’882 engine before starting the engine would have led to the predictable result of having a less rich fuel-air mixture at start-up, which would minimize vehicle exhaust emissions and waste less fuel during engine starts. Pet. 34–36; Pet. Reply 14; Ex. 1652, 2:52–56; Ex. 1661 ¶¶ 262–264.

D. Claims 13, 15 – Obviousness over Ibaraki ’882, Masding/Bumby 1988, and Admitted Prior Art (APA)

Petitioner contends that claims 13 and 15 are unpatentable under 35 U.S.C. § 103(a) as obvious over Ibaraki ’882, Masding/Bumby 1998, and APA. Pet. 38–41. Petitioner provides a detailed analysis, supported by the Declaration of Dr. Davis, explaining how the prior art meets each of the claim limitations of claims 13 and 15. *Id.*; Ex. 1661.

Dependent claim 13, which depends from independent claim 1, recites “wherein the SP is at least approximately 20% of the MTO of the engine when normally-aspirated.” Dependent claim 15, which depends from

independent claim 1, recites "wherein the SP is less than approximately 70% of the MTO of the engine when normally-aspirated."

As discussed above, Petitioner contends that Ibaraki '882 discloses η_{ICEmax} that represents a maximum fuel efficiency and $0.7\eta_{ICEmax}$ that is 70% of the maximum fuel efficiency. Pet. 30–31; Ex. 1652, 13:18–24, 25:46–65, Fig. 5; Ex. 1661 ¶¶ 250–253. Dr. Davis explains that a person of ordinary skill in the art would have understood that $0.7\eta_{ICEmax}$ is substantially less than MTO. Ex. 1661 ¶¶ 251–253. Dr. Davis additionally explains that a person with ordinary skill would have understood that Figure 11 illustrates a setpoint along line "B" that is less than MTO. Pet. 31–32; Ex. 1661 ¶¶ 254–256; Ex. 1652, Fig. 11. Dr. Davis explains that a person with ordinary skill in the art would have understood Figure 11 to illustrate that boundary line "C" represents MTO and boundary line "B" represents setpoints, and the setpoints along boundary line "B" are substantially less than a corresponding point along boundary line "C" because, although Figure 11 does not provide any numerical values, the limitation "substantially less than" broadly encompasses the distinction drawn in Figure 11 between boundary line "C" and boundary line "B." *Id.*; Ex. 1661 ¶¶ 256–257. Petitioner further argues that based on the disclosed prior art engines in Masding/Bumby 1988, a person with ordinary skill in the art would have known that Ibaraki '882's 70% relative fuel efficiency correlates to a setpoint that is approximately 33% of MTO. *Id.* at 39 (citing Ex. 1661 ¶¶ 279–285). Petitioner also argues that based on Figures 1 and 2 of the prior art engines of the APA, a person with ordinary skill in the art would have understood that Ibaraki '882's 70% relative fuel efficiency would correspond to 36% and 38% of MTO respectively. *Id.* at 39–40 (citing Ex. 1661 ¶¶ 286–296). Accordingly,

Petitioner concludes that setpoints that are substantially less than MTO are an obvious design choice. *Id.* at 40 (citing Ex. 1661 ¶¶ 285, 299).

Notwithstanding Patent Owner's arguments, we agree with Petitioner's analysis and conclusion, and adopt them as our own.

Patent Owner argues that Petitioner's argument is conclusory and fails to set forth "[h]ow Ford calculated the thirty-three to thirty-eight percent range." PO Resp. 39–40. Patent Owner also argues that Petitioner's argument that using a setpoint that is at least approximately 30% of MTO is an obvious design choice is conclusory. *Id.* (citing *Ex Parte* Gunasekar, Appeal 2009-008345, 2011 WL 3872007 at *5 (BPAI 2011)). We disagree with Patent Owner. We give substantial credit to the testimony of Dr. Davis set forth by Petitioner. Pet. 39–40; Ex. 1661 ¶¶ 277–301. Dr. Davis explains that he has "calculated the 'relative efficiency' values by dividing each absolute efficiency value (for example 29%) by the maximum 32% absolute efficiency, which represents the region [of Ibaraki '882 Figure 5] of 100% relative efficiency." Ex. 1661 ¶ 284. Dr. Davis further explains his calculations and determinations, and concludes that "a person having ordinary skill would have understood that when Ibaraki '882 $0.7\eta_{ICEmax}$ setpoint is applied to conventional prior art engines, the torque produced by the engine would be approximately 33% of MTO (based on Bumby) to about 36–38% of MTO (based on the prior art figures described in the '634 and '970 Patents)." *Id.* ¶ 300; *see* Pet. 30–31, 38–41. Petitioner explains that the prior art engines disclosed in Bumby/Masding 1988, as understood by a person of ordinary skill in the art, use a setpoint of approximately 33% of MTO based on a 70% relative fuel efficiency, and, therefore, a person of ordinary skill in the art would have understood that Ibaraki '882's 70%

relative fuel efficiency equates to setpoints between 33–38% of an engine's MTO. Pet. 38–41 (citing Ex. 1661 ¶¶ 276–304). Dr. Davis concludes that "it would have been an obvious design choice to use a setpoint that 'is at least approximately"' 20% or 30% of MTO, or that is less than approximately 70% of the MTO. Ex. 1661 ¶¶ 301, 303, 305. (emphasis omitted). Accordingly, we do not agree with Patent Owner that Petitioner's explanations of how the limitations of claims 13 and 15 are met, using a setpoint that is at least approximately 20% of MTO, or less than 70% of MTO is an obvious design choice are conclusory.

Patent Owner further argues that "Ford completely ignores a motivation to combine Ibaraki '882 with Masding and 'applicant admitted prior art.'" PO Resp. 41. We disagree with Patent Owner. Petitioner sets forth that a person with ordinary skill in the art would have understood Ibaraki '882's 70% relative fuel efficiency based on the engines disclosed in Masding/Bumby 1988 and APA. Pet. 38–41. That is, Petitioner is relying on Masding/Bumby 1988 and APA to explain the teachings of Ibaraki '882. Furthermore, Dr. Davis explains that a person with ordinary skill in the art would have looked to both the APA and Ibaraki '882 to correlate relative fuel consumption and relative efficiency. Ex. 1661 ¶¶ 277–300. And the modification to use a setpoint that is at least approximately 30% of MTO, as explained by APA, would be nothing more than an obvious design choice. *Id.* As such, we are persuaded by Petitioner that a person with ordinary skill in the art would have found it obvious to use a setpoint that is at least approximately 20% of MTO, or less than 70% of MTO based on the teachings of Ibaraki '882, Masding/Bumby 1988, and APA.

E. Claim 25 – Obviousness over Ibaraki '882 and Kawakatsu

Petitioner contends that claim 25 is unpatentable under 35 U.S.C. § 103(a) as obvious over Ibaraki '882 and Kawakatsu. Pet. 41–45. Petitioner provides a detailed analysis, supported by the Declaration of Dr. Davis, explaining how the prior art meets each of the claim limitations of claim 25. *Id.*; Ex. 1661.

Dependent claim 25, which depends from independent claim 1, recites "wherein total torque available to the one or more wheels from the engine is no greater than total torque available from the first and second electric motors combined." Petitioner argues that Kawakatsu discloses this limitation. *Id*. Petitioner argues that Kawakatsu discloses in Figure 2 operating regions, where region (4) represents the maximum driving torque that can be produced by the engine and region (2) represents an operating mode where torque is provided by a single motor. *Id.* at 42–44 (citing Ex. 1655, 4:31–32, 4:58–5:2; Ex. 1661 ¶¶ 309). Petitioner, therefore, argues that the maximum driving torque in region (2) exceeds the maximum driving torque in region (4). *Id.* (citing Ex. 1661 ¶ 310).

Petitioner also articulates reasoning with rational underpinnings on why a person of ordinary skill in the art at the time of the invention would have combined Ibaraki '882 and Kawakatsu. *Id*. at 44–45. Petitioner argues that Kawakatsu discloses that "the electric motor provides more torque than the engine," and this configuration uses a smaller engine in the hybrid vehicle, thereby reducing fuel use and exhaust. *Id.* (citing Ex. 1661 ¶¶ 311–312). Petitioner argues that Ibaraki '882 explains that reducing the fuel consumption and exhaust gas is an objective. *Id.* (citing Ex. 1652, 2:52–56). Petitioner concludes that a person with ordinary skill in the art would have

recognized the benefit of the configuration of an additional electric motor and a smaller engine in order to permit "effective reduction in the fuel consumption amount or exhaust gas amount of the engine." *Id.*; Ex. 1652, 2:52–56 (emphasis omitted).

Notwithstanding Patent Owner's arguments, we agree with Petitioner's analysis and conclusion, and adopt them as our own.

Patent Owner argues that Petitioner's rationale for combining Kawakatsu with Ibaraki '882 fails to "take into account the entirely differing control strategies Ibaraki '882 and Kawakatsu that would counsel against adopting the disproportionately large motor and small engine of Kawakatsu into Ibaraki '882." PO Resp. 42–44. Patent Owner argues that Petitioner fails to provide explanation as to why a person of skill in the art would have modified Ibaraki '882's control strategy and how a person of ordinary skill in the art would go about making such a modification. *Id.*

We disagree with Patent Owner. Patent Owner's arguments and supporting evidence are narrowly based on incorporating physically all technicalities of Kawakatsu with Ibaraki '882. The test for obviousness is what the combined teachings of the references would have suggested to a person of ordinary skill in the art, not whether one reference may be bodily incorporated into the structure of another reference. *In re Keller*, 642 F.2d 413, 425 (CCPA 1981). Petitioner articulates that a person with ordinary skill in the art would have been motivated to combine Kawakatsu with Ibaraki '882 in order to reduce fuel use and reduce exhaust gas. Pet. 44–45. Accordingly, Petitioner has articulated reasoning with rationale underpinning in support of its conclusion of obviousness. *KSR Int'l Co. v. Teleflex Inc.*, 127 S. Ct. 1727, 1742 (2007).

F. Claim 29 – Obviousness over Ibaraki '882 and Vittone

Petitioner contends that claim 29 is unpatentable under 35 U.S.C. § 103(a) as obvious over Ibaraki '882 and Vittone. Pet. 45–50. Petitioner provides a detailed analysis, supported by the Declaration of Dr. Davis, explaining how the prior art meets each of the claim limitations of claim 29. *Id.*; Ex. 1661.

Dependent claim 29, which depends from independent claim 1, recites "wherein the controller is operable to limit a rate of change of torque produced by the engine, such that combustion of fuel within the engine occurs substantially at a stoichiometric ratio, and wherein if the engine is incapable of supplying an instantaneous torque required, the controller is operable to transfer additional torque from one or more of the first or the second electric motors."

Petitioner argues that Vittone discloses controlling "transients [] to achieve the stoichiometric control over the whole working range." *Id.* at 46 (quoting Ex. 1656, 26) (emphasis omitted). Petitioner further argues that Vittone discloses that the "engine controls during transient conditions include ''steady state' management of the thermal engine' in order to maintain a stoichiometric air-fuel ratio over the whole working range of the engine." *Id.* at 46–47. "Vittone operates the electric motor to provide any shortfall in the drivability torque requirements as a result of limiting the engine's output." *Id.* at 47, 49–50 (citing Ex. 1656, 27; Ex. 1661 ¶ 329).

Petitioner also articulates reasoning with rational underpinnings on why a person of ordinary skill in the art at the time of the invention would have combined Ibaraki '882 and Vittone. *Id*. at 47–49. Petitioner argues that a person with ordinary skill in the art would have recognized the

benefits of controlling the stoichiometric ratio during transient conditions "would lead to reduced exhaust emissions and increased fuel efficiency." *Id.* at 48. Petitioner further argues that a person with ordinary skill in the art would have understood that the combination of Vittone's "controlling the engine such that combustion of fuel within the engine occurs substantially at a stoichiometric ratio" with the hybrid vehicle of Ibaraki '882 would merely require the application of a known technique to a "similar engine in the same way." *Id.*

Notwithstanding Patent Owner's arguments, we agree with Petitioner's analysis and conclusion, and adopt them as our own.

Patent Owner argues that Vittone fails to disclose "limiting a rate of change of torque output of the engine." PO Resp. 45–48. Patent Owner argues that "[t]here is no disclosure in Vittone about a control strategy that *controls* the engine to limit the rate of change of the engine torque output." *Id.* at 47 (citing Ex. 2605 ¶ 98). Patent Owner asserts that "Figure 8 simply shows the ramp-up of the engine due to its inherent transient characteristics" and "Vittone does not explain what is meant for 'steady state' management of the thermal engine," where there are other ways to accomplish the steady state management of the engine. *Id.* (citing Ex. 2306 ¶¶ 98–99).

We disagree with Patent Owner. We substantially credit the testimony of Dr. Davis. Petitioner explains that Vittone discloses a "driving torque management" control strategy that "during the transient period of rapid acceleration demand, the electric motor is used to provide the additional propulsive torque requirements while the engine output is limited between . . . to maintain the stoichiometric ratio." Pet. 49; Pet. Reply 17–19; Ex. 1656, 27; Ex. 1661 ¶¶ 333–335. Dr. Davis opines that one of the

objectives of Vittone is to reduce emissions, and that is accomplished by limiting the rate of torque output of the engine during transient conditions. Ex. 1661 ¶¶ 332–334 (citing Ex. 1656, 27, Fig. 8). Dr. Davis further opines that during a period of rapid increase in the torque required to propel the vehicle, Vittone's control strategy limits the rate of change of the engine torque so that the engine maintains operation at its stoichiometric ratio and supplements the engine with the electric motor to fulfill the increased torque requirements. Ex. 1661 ¶¶ 332, 334 (explaining Ex. 1656, Fig. 8). We credit the testimony of Dr. Davis over Mr. Hannemann's testimony who opines that Figure 8 is not based on a control strategy. Mr. Hannemann's testimony does not take into account the description in Vittone as a whole. Instead, his testimony is based narrowly on certain passages of Vittone. Accordingly, we agree with Petitioner that Vittone discloses "limiting a rate of change of torque output of the engine."

Patent Owner further argues that Petitioner "fails to establish a motivation to combine Vittone with Ibaraki '882." PO Resp. 48–50. We disagree as Petitioner clearly does provide a reasoned rationale for combining Vittone with Ibaraki '882. As explained above, Petitioner explains, with supporting evidence, that a person having ordinary skill in the art would have understood that Vittone's control of the stoichiometric ratio during any transient conditions in the Ibaraki '882 system would have reduced exhaust emissions and increased fuel efficiency, and that the modification would have required a mere change in Ibaraki '882's software. Pet. 47–49; Ex. 1661 ¶¶ 313–323. A person having ordinary skill in the art would have had a reasonable expectation that modifying Ibaraki '882's

controller software to control the stoichiometric ratio as taught by Vittone would have been successful.

Patent Owner disagrees and argues that a person of ordinary skill in the art would not have been motivated to combine Ibaraki '882 with Vittone because Ibaraki '882 and Vittone are directed to very different hybrid control strategies, such that the engine control strategies of Vittone would not have worked with the engine control strategies of Ibaraki '882. PO Resp. 49–50; Ex. 2605 ¶¶ 103–104. Patent Owner's arguments and supporting evidence are narrowly based on incorporating physically all technicalities of Vittone with Ibaraki '882. *See* Pet. Reply 20–21. The test for obviousness is what the combined teachings of the references would have suggested to a person of ordinary skill in the art, not whether one reference may be bodily incorporated into the structure of another reference. *In re Keller*, 642 F.2d 413, 425 (CCPA 1981). In particular, and in support of Patent Owner's arguments, Mr. Hannemann opines that a person of ordinary skill in the art would not have been motivated to modify the power-based engine control strategy of Ibaraki '882 to include the driver-controlled engine control strategy of Vittone. Ex. 2605 ¶ 104. Petitioner, however, does not propose using the whole system of Vittone with the system of Ibaraki '882. Rather, Vittone is relied on for its description of controlling the stoichiometric ratio of the engine during transient conditions to reduce exhaust emissions and increase fuel efficiency. Patent Owner's arguments and the supporting testimony of Mr. Hannemann are premised on the assumption of incorporating all features of Vittone into Ibaraki '882, which is not what Petitioner proposes.

G. Claim 32 – Obviousness over Ibaraki '882 and Ibaraki '626

Petitioner contends that claim 32 is unpatentable under 35 U.S.C. § 103(a) as obvious over Ibaraki '882 and Ibaraki '626. Pet. 51–54. Petitioner provides a detailed analysis, supported by the Declaration of Dr. Davis, explaining how the prior art meets each of the claim limitations of claim 32. *Id.*; Ex. 1661.

Dependent claim 32, which depends from independent claim 1, recites "wherein the controller is operable to start and operate the engine at torque output levels less than SP under abnormal and transient conditions to satisfy drivability and/or safety considerations." Petitioner argues that Ibaraki '626 discloses this limitation. *Id*. at 51–56. Specifically, Petitioner argues that Ibaraki '626 discloses a "normal control routine," and further discloses that a "special control routine . . . is executed in the event of a failure of the electric motor." *Id.* at 52–53 (citing Ex. 1657, 5:25–42, 7:50–52, Fig. 2, Fig. 4; Ex. 1661 ¶¶ 358–362). During the special control routine, "the hybrid vehicle calculates the 'required drive power P_L' and its associated torque value, and 'the engine 12 [is operated] with the calculated required P_L for driving the vehicle, irrespective of the magnitude of the required power P_L." *Id.* at 53 (citing Ex. 1657, 7:50–61).

Petitioner also articulates reasoning with rational underpinnings on why a person of ordinary skill in the art at the time of the invention would have combined Ibaraki '882 and Ibaraki '626. *Id*. at 54–56. Petitioner argues that a person of ordinary skill in the art would have recognized that Ibaraki '882 and Ibaraki '626 disclose "virtually identical control strategies" for operating a parallel hybrid vehicle. *Id.* (citing Ex. 1661 ¶ 341). Petitioner argues that a person with ordinary skill in the art would have

recognized the benefit of Ibaraki '626's control strategy in the event of a failure is to allow the vehicle to maintain regular driving performance allowing for the vehicle to remain safe for driving. *Id.* at 54–56 (citing Ex. 1661 ¶¶ 348–365). Accordingly, Petitioner argues that a person with ordinary skill in the art would have combined Ibaraki '626 with Ibaraki '882 in order to achieve the benefit of allowing the vehicle to remain safe for driving in the event of a failure. *Id.* (citing Ex. 1661 ¶¶ 348–365).

Notwithstanding Patent Owner's arguments, we agree with Petitioner's analysis and conclusion, and adopt them as our own.

Patent Owner argues that Petitioner fails to establish a motivation to combine Ibaraki '882 with Ibaraki '626. PO Resp. 50–51. Patent Owner argues that Petitioner's reasons to combine Ibaraki '626 with the system in Ibaraki '882 amounts to little more than an argument that the two systems relate to control strategies for hybrid vehicles and contain commonly named inventors from Toyota. *Id.* We disagree. Petitioner does articulate a reason for combining, expressed by Ibaraki '626 itself (preventing the undesirable change in the running performance of the vehicle in the event of a failure of the electronic motor). Pet. 54–56. As discussed above, Petitioner establishes that a person with ordinary skill in the art would have recognized that Ibaraki '882 and Ibaraki '626 disclose "virtually identical control strategies" for operating a parallel hybrid vehicle, and Ibaraki '626 further discloses the benefit of maintaining regular driving performance during the event of a failure. *Id.* Accordingly, a person with ordinary skill in the art would have combined Ibaraki '882 and Ibaraki '626 in order to achieve this benefit in Ibaraki '882. *Id.*

H. Claims 67 and 79 – Obviousness over Ibaraki '882 and Suga

Petitioner contends that claims 67 and 79 are unpatentable under 35 U.S.C. § 103(a) as obvious over Ibaraki '882 and Suga. Pet. 56–58. Petitioner provides a detailed analysis, supported by the Declaration of Dr. Davis, explaining how the prior art meets each of the claim limitations of claims 67 and 79. *Id.*; Ex. 1661.

Dependent claim 67 recites "wherein the second electric motor is sufficiently powerful to provide acceleration of said vehicle sufficient to conform to the Federal urban cycle driving fuel mileage test without use of torque from the engine to propel the vehicle." Dependent claim 79 recites "wherein the second electric motor is sufficiently powerful to provide acceleration of said vehicle sufficient to conform the Federal urban cycle driving fuel mileage test without use of torque from the engine to propel the vehicle." Petitioner contends, with supporting evidence, that Suga describes a test apparatus and procedure that determines the electric motor's operating power performance and efficiency. Pet. 56–58 (citing Ex. 1611 ¶¶ 386–392). Petitioner further contends that Suga discloses providing such information by testing the electric motor according to the LA4 drive cycle where acceleration data from moment to moment is based on vehicle speed pattern data. Pet. 56–57 (citing Ex. 1454, 4:6–17). Directing attention to Figure 6 of Suga, which illustrates a two dimensional map of the electric motor output and efficiency, Petitioner argues that that figure illustrates that electric motors existed that were sufficiently powerful to provide the acceleration to conform to the LA4 (FUDS) drive cycle without use of torque from an engine to propel a vehicle. *Id.* at 57–58.

Petitioner also articulates reasoning with rational underpinnings on why a person of ordinary skill in the art at the time of the invention would have combined Ibaraki '882 and Suga. *Id*. at 58–59. Petitioner argues that a person with ordinary skill in the art would have known that "the LA4 drive schedule was designed to evaluate the exhaust gas emissions by simulating a vehicle as though it was being driven along a specified route through downtown Los Angeles." *Id*. (citing Ex. 1661 ¶ 369). Accordingly, Petitioner argues that a person with ordinary skill in the art would have been motivated to combine Suga with Ibaraki '882 in order to reduce exhaust gas emissions, which is an objective of Ibaraki '882. *Id*. (citing Ex. 1652, 2:52–56; Ex. 1661 ¶¶ 382–385).

Notwithstanding Patent Owner's arguments, we agree with Petitioner's analysis and conclusion, and adopt them as our own.

Patent Owner argues that Petitioner fails to establish that Suga's teaching with respect to electric vehicles would somehow inform a person of skill in the art anything about how to choose the power capabilities of the motor in a hybrid system. PO Resp. 52–56. This argument is unpersuasive. As discussed above, Petitioner explains how the vehicle described in Ibaraki '882 has a MOTOR DRIVE mode, in which the electric motor provides the entire torque required to propel the vehicle. Also as discussed above, Petitioner explains that the Federal urban cycle driving fuel mileage test recited in claims 67 and 79 is a test for urban driving. Thus, for its MOTOR DRIVE mode, the hybrid vehicle of Ibaraki '882 is like the all-electric vehicle of Suga, at least insomuch as the FUDS standard or test is concerned.

We are not persuaded by Patent Owner's arguments that the Ibaraki '882 drive control apparatus is designed to operate in MOTOR DRIVE mode only when doing so would minimize the fuel consumption amount, and not designed to operate like an electric vehicle where the motor is sized to provide all of the power requirements. *Id.* at 54–55; Ex. 2605 ¶ 110. In support of the assertion, Mr. Hannemann testifies that Ibaraki '882's Figure 11 shows that the maximum power provided by the motor in the MOTOR DRIVE mode is less than the power provided by the engine and that a person having ordinary skill in the art would not have modified Ibaraki '882 to operate like an electric vehicle where the motor is sized to provide all of the power requirements. Ex. 2605 ¶ 111. We do not give Mr. Hannemann's testimony, in that regard, substantial weight. Ibaraki '882 is not limited to a particular motor driving range for the MOTOR DRIVE mode, and describes that the motor driving range may be enlarged such that the enlarged motor driving range includes a portion of the original engine driving range. Ex. 1652, 8:59–63. Where only the electric motor is operated to drive the vehicle in the enlarged motor driving range, the "original motor driving range is enlarged so as [to] include a portion that causes an operation of the electric motor under a relatively high load." *Id.* at 9:6–8.

We agree with Petitioner, that the hybrid vehicle of Ibaraki '882 in the MOTOR DRIVE mode provides all propulsion to the vehicle without the use of torque from the engine. It would have been obvious that during such a mode, the motor be capable of providing acceleration of the vehicle just like an all-electric vehicle.

III. CONCLUSION

We are persuaded that Petitioner has demonstrated by a preponderance of the evidence that claims 4, 13, 15, 25, 28, 29, 32, 67, and 79 of the '634 patent are unpatentable.

IV. ORDER

Accordingly, it is hereby:

ORDERED that the *inter partes* review is *dismissed* with respect to claim 14;

FURTHER ORDERED that, based on the grounds under review, claims 4, 13, 15, 25, 28, 29, 32, 67, and 79 of U.S. Patent No. 7,237,634 B2 have been shown by a preponderance of the evidence to be unpatentable; and

FURTHER ORDERED that this is a Final Written Decision of the Board under 35 U.S.C. § 318(a), and parties to the proceeding seeking judicial review of this decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

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