

UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE PATENT TRIAL AND APPEAL BOARD

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FORD MOTOR COMPANY,  
Petitioner,

v.

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

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Case IPR2015-00794  
Patent 7,104,347 B2

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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 23–30, 32, and 39–41 of U.S. Patent No. 7,104,347 B2 (Ex. 1401, “the ’347 patent”). Paper 1 (“Pet.”). Paice LLC and The Abell Foundation, Inc. (collectively, “Patent Owner”) filed a Preliminary Response in unredacted and redacted forms. Papers 9, 10 (“Prelim. Resp.”). Patent Owner also filed a Motion to Seal. Paper 11 (“Motion to Seal”).

Pursuant to 35 U.S.C. § 314, we instituted *inter partes* review of the ’347 patent, on November 2, 2015, under 35 U.S.C. § 103(a), as to claims 23, 28, 30, and 32 as obvious over Ibaraki ’882;<sup>1</sup> claim 29 as obvious over Ibaraki ’882 and Admitted Prior Art (“APA”);<sup>2</sup> claim 39 as obvious over Ibaraki ’882 and Vittone;<sup>3</sup> claim 40 as obvious over Ibaraki ’882 and Yamaguchi;<sup>4</sup> claim 41 as obvious over Ibaraki ’882 and Ibaraki ’626;<sup>5</sup> claim

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<sup>1</sup> U.S. Patent No. 5,789,882, issued Aug. 4, 1998 (Ex. 1403) (“Ibaraki ’882”).

<sup>2</sup> Petitioner relies on Figures 1 and 2 of the ’347 patent, reproduced from the ’970 patent, and the Masding/Bumby disclosures from the ’634 patent (Ex. 1433).

<sup>3</sup> Oreste Vittone, *Fiat Conceptual Approach to Hybrid Cars Design*, 12TH INTERNATIONAL ELECTRIC VEHICLE SYMPOSIUM (1994) (Ex. 1420) (“Vittone”).

<sup>4</sup> U.S. Patent No. 5,865,263, issued Feb. 2, 1999 (Ex. 1421) (“Yamaguchi”).

<sup>5</sup> U.S. Patent No. 6,003,626, issued Dec. 21, 1999 (Ex. 1422) (“Ibaraki ’626”).

27 as obvious over Ibaraki '882 and Lateur;<sup>6</sup> and claims 25 and 26 as obvious over Ibaraki '882 and Frank.<sup>7</sup> Paper 12 (“Dec.”). We did not institute *inter partes* review of claim 24 as obvious over Ibaraki '882. Dec. 20–21.

Patent Owner filed a Response (Paper 16, “PO Resp.”), and Petitioner filed a Reply (Paper 22, “Pet. Reply”).<sup>8</sup> Oral hearing was held on June 28, 2016, and the hearing transcript has been entered in the record. Paper 30 (“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 23. For the reasons discussed below, we are persuaded that Petitioner has shown by a preponderance of the evidence that claims 25–30, 32, and 39–41 of the '347 patent are unpatentable.

#### *B. Related Proceedings*

Petitioner indicates that the '347 patent is the subject of *Paice, LLC and The Abell Foundation, Inc. v. Ford Motor Company*, Case No. 1-14-cv-00492 and *Paice LLC and The Abell Foundation, Inc. v. Hyundai Motor America et. al.*, Case No. 1:2012-cv-00499. Pet. 1; Paper 5, 2. Petitioner

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<sup>6</sup> U.S. Patent No. 5,823,280, issued Oct. 20, 1998 (Ex. 1407) (“Lateur”).

<sup>7</sup> U.S. Patent No. 6,116,363, issued Sept. 12, 2000 (Ex. 1418) (“Frank”).

<sup>8</sup> In addition, Patent Owner filed a Motion for Observation on Cross-Examination (Paper 23) and Petitioner filed a Response to Motion for Observation on Cross-Examination (Paper 26), both of which have been considered.

also indicates that the '347 patent was the subject of IPR2014-00571, IPR2014-00579, and IPR2014-00884, in which final decisions have been issued. *Id.*; Paper 5, 3. Petitioner further indicates that patents related to the '347 patent are the subject matter of IPR2014-00570, IPR2014-01415, IPR2014-00568, IPR2014-00852, IPR2014-00875, IPR2014-00904, IPR2014-01416, IPR2015-00606, IPR2015-00767, IPR2015-00722, IPR2015-00758, IPR2015-00784, IPR2015-00785, IPR2015-00791, IPR2015-00787, IPR2015-00790, IPR2015-00795, and IPR2015-00792. *Id.* at 1–2; Paper 5, 3.

*C. The '347 Patent*

The '347 patent describes a hybrid vehicle with an internal combustion engine, two electric motors (a starter motor and a traction motor), and a battery bank, all controlled by a microprocessor that directs the transfer of torque from the engine and traction motor to the drive wheels of the vehicle. Ex. 1401, 17:5–45, Fig. 4. The microprocessor features a control strategy that runs the engine only under conditions of high efficiency, typically when the vehicle's instantaneous torque requirements (i.e., the amount of torque required to propel the vehicle, or "road load") are at least equal to 30% of the engine's maximum torque output ("MTO") capability. *Id.* at 20:52–60, 35:5–14; *see also id.* at 13:47–61 ("the engine is never operated at less than 30% of MTO, and is thus never operated inefficiently").

Running the engine only when it is efficient to do so leads to improved fuel economy and reduced emissions. *Id.* at 13:47–52. To achieve such efficiency, the hybrid vehicle includes various operating modes that depend on the vehicle's torque requirements, the battery's state of charge,

and other operating parameters. *Id.* at 19:53–55. For example, the hybrid vehicle may operate in: (1) an all-electric mode, where only the traction motor provides the torque to propel the vehicle and operation of the engine would be inefficient (i.e., stop-and-go city driving); (2) an engine-only mode, where only the engine provides the torque to propel the vehicle and the engine would run at an efficient level (i.e., highway cruising); (3) a dual-operation mode, where the traction motor provides additional torque to propel the vehicle beyond that already provided by the engine and the torque required to propel the vehicle exceeds the maximum torque output of the engine (i.e., while accelerating, passing, and climbing hills); and (4) a battery recharge mode where the engine operates a generator to recharge the battery while the traction motor drives the vehicle. *Id.* at 35:66–36:58, 37:26–38:55.

*D. Illustrative Claim*

Petitioner challenges claims 23, 25–30, 32, and 39–41 of the '347 patent. Pet. 4–60. Claim 23 is illustrative of the claims at issue and is reproduced below:

23. A method of control of a hybrid vehicle, said vehicle comprising an internal combustion engine capable of efficiently producing torque at loads between a lower level SP and a maximum torque output MTO, a battery, and one or more electric motors being capable of providing output torque responsive to supplied current, and of generating electrical current responsive to applied torque, said engine being controllably connected to wheels of said vehicle for applying propulsive torque thereto and to said at least one motor for applying torque thereto, said method comprising the steps of:  
determining the instantaneous torque RL required to propel said vehicle responsive to an operator command;  
monitoring the state of charge of said battery;

employing said at least one electric motor to propel said vehicle when the torque RL required to do so is less than said lower level SP;

employing said engine to propel said vehicle when the torque RL required to do so is between said lower level SP and MTO;

employing both said at least one electric motor and said engine to propel said vehicle when the torque RL required to do so is more than MTO; and

employing said engine to propel said vehicle when the torque RL required to do so is less than said lower level SP and using the torque between RL and SP to drive said at least one electric motor to charge said battery when the state of charge of said battery indicates the desirability of doing so; and

wherein the torque produced by said engine when operated at said setpoint (SP) is substantially less than the maximum torque output (MTO) of said engine.

Ex. 1001, 60:22–54.

## II. ANALYSIS

### A. *Petitioner Estoppel*

On September 28, 2015, we rendered a final written decision of claims 1, 7, 8, 18, 21, 23, and 37 of the '347 patent in IPR2014-00571, and claims 1, 6, 7, 9, 15, 21, 23, and 36 of the '347 patent in IPR2014-00579. *Ford Motor Co. v. Paice LLC & The Abell Foundation, Inc.*, Case IPR2014-00571 (PTAB September 28, 2015) (Paper 44); *Ford Motor Co. v. Paice LLC & The Abell Foundation, Inc.*, Case IPR2014-00579 (PTAB September 28, 2015) (Paper 45). Patent Owner argues that, pursuant to 35 U.S.C. § 315(e)(1), Petitioner may not maintain its challenge of claim 23. PO Resp. 14–15. Petitioner responds that it is not estopped because it was necessary for it to file multiple petitions to address the '347 patent's many

dependent claims, such as dependent claims 25–30, 32, and 39–41, which depend from independent claim 23. Pet. Reply 2–3.

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 September 28, 2015, final written decisions were entered in IPR2014-00571 and IPR2014-00579, in which we determined that claim 23 of the ’347 patent is unpatentable.<sup>9</sup> Petitioner in this proceeding is the same Petitioner in IPR2014-00571 and IPR2014-00579. The grounds raised by Petitioner in IPR2014-00571 and IPR2014-00579 against claim 23 is not the same as the ground raised against claim 23 in this proceeding. Nonetheless, Ibaraki ’882 was cited during prosecution that led to the ’347 patent and is listed on the face of the ’347 patent. Ex. 1401. Petitioner does not argue that it reasonably could not have raised its challenge to claim 23 based on Ibaraki ’882 in IPR2014-00571 and IPR2014-00579. Pet. Reply 2–3. We

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<sup>9</sup> The challenge against claim 23 was dismissed in IPR2014-00884. *Ford Motor Co. v. Paice LLC & The Abell Foundation, Inc.*, Case IPR2014-00884 (PTAB December 10, 2015) (Paper 38).

determine that Petitioner reasonably could have raised this challenge in IPR2014-00571 and IPR2014-00579. Accordingly, Petitioner is estopped under 35 U.S.C. § 315(e)(1) from maintaining the ground based on Ibaraki '882 against claim 23. We dismiss the *inter partes* review with respect to claim 23.

Although we determine it is necessary to address the parties' contentions with respect to independent claim 23 because claims 25–30, 32, and 39–41 depend from claim 23, we do not otherwise provide a final written decision on the merits with respect to claim 23, or again hold that claim 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. “Road Load” or “RL”*

The term “road load” or “RL” is recited in independent claim 23. The Specification of the '347 patent defines “road load” as “the vehicle’s instantaneous torque demands, i.e., that amount of torque required to propel the vehicle at a desired speed,” and further notes that it “can be positive or negative, i.e., when decelerating or descending a hill, in which case the

negative road load . . . is usually employed to charge the battery.” Ex. 1401, 12:38–58. Accordingly, we construe “road load” and “RL” as “the amount of instantaneous torque required to propel the vehicle, be it positive or negative.”<sup>10</sup>

## 2. “Set Point” or “SP”

The term “setpoint” or “SP” is recited in independent claim 23 and dependent claims 25–30, 32, and 39–41. Petitioner proposes that “setpoint” or “SP” be construed, in the context of these claims, as “predetermined torque value.” Pet. 5–6. 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. 5–6.<sup>11</sup>

We agree with Petitioner that the claims compare the setpoint either to an engine torque value or a torque based “road load” value. Pet. 5–6. Claim 23 recites a condition “when the torque RL required to do so is less than said lower level SP.” Ex. 1401, 60:39–41. Claim 23 further recites a range established by the lower level SP at one end, and the maximum torque output MTO of the engine at the other end, by the language “producing torque at loads between a lower level SP and a maximum torque output MTO” and “when the torque RL required to do so is between said lower level SP and MTO.” *Id.* at 60:24–25, 60:40–42.

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<sup>10</sup> This construction is the same as that proposed by Petitioner. Pet. 4–5. Patent Owner does not propose a different construction.

<sup>11</sup> 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. 5–9.

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 ’347 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. 6. This argument is misplaced. Although such use of a setpoint is described by other language in the ’347 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 ’347 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. 1401, 19:58–64 (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. 5–6 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. 8–9. 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. 1401, 40:22–31 (emphasis added). This argument also is misplaced. As we noted above, independent claim 23 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 23, 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.”

### *3. The “operating” limitations*

Patent Owner asserts that the challenged claims require a comparison of road load (RL) to setpoint (SP) and also to maximum torque output (MTO). PO Resp. 9–14. The assertion is based on the requirements in claim 23 of (1) operating at least one electric motor to propel the hybrid vehicle “when the torque RL required to do so is less than said lower level SP,” (2) operating an internal combustion engine of the hybrid vehicle to propel the hybrid vehicle “when the torque RL required to do so is between said lower level SP and MTO,” and (3) operating both the at least one electric motor and the engine to propel the hybrid vehicle “when the torque RL required to do so is more than MTO.”

In the above discussion of the construction of setpoint, we already noted that claim 23 requires a comparison of road load to a setpoint because of the claim recitations “when the torque RL required to do so is less than said lower level SP” and “when the torque RL required to do so is between said lower level SP and MTO.” 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 road load (RL) to a lower level

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

*C. Claims 23, 28, 30, and 32 – Obviousness over Ibaraki '882*

Petitioner contends that claims 23, 28, 30, and 32 are unpatentable under 35 U.S.C. § 103(a) as obvious over Ibaraki '882. Pet. 6–36.

*1. Ibaraki '882 (Ex. 1403)*

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. 1403, 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

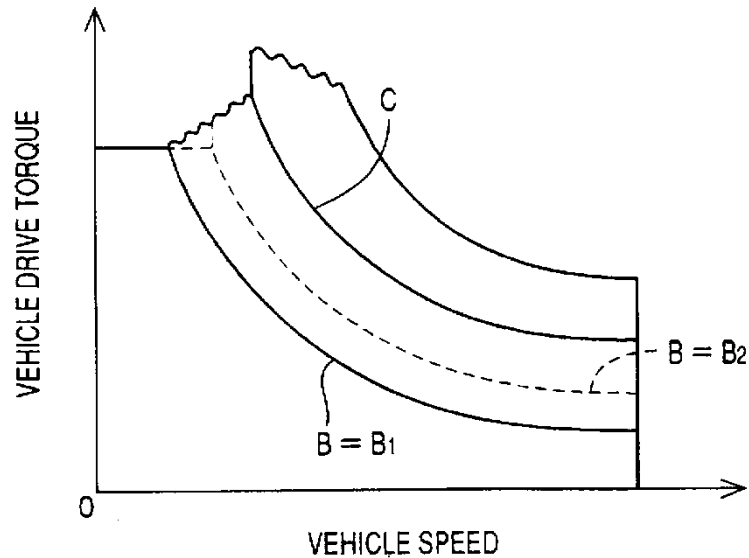


Figure 11 shows a graph which represents a predetermined relationship between the vehicle drive torque and running speed.

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. Analysis

Petitioner contends that claims 23, 28, 30, and 32 are unpatentable under 35 U.S.C. § 103(a) as obvious over Ibaraki '882. Pet. 6–36.

Petitioner provides a detailed analysis, supported by evidence, demonstrating, by a preponderance of the evidence, that claims 23, 28, 30, and 32 are obvious over Ibaraki '882. *Id.*

As discussed above, we dismiss the *inter partes* review with respect to claim 23. Claims 25–30, 32, and 39–41, however, depend from claim 23 and necessarily include all of the limitations of claim 23. Accordingly, we first address the contentions made by Petitioner as to how Ibaraki '882 renders obvious claim 23.

Claim 23 recites a “method of control of a hybrid vehicle,” where the “vehicle comprising an internal combustion engine capable of efficiently producing torque at loads between a lower level [setpoint] SP and a maximum torque output MTO.” Claim 23 further recites “the torque produced by said engine when operated at said setpoint (SP) is substantially less than the maximum torque output (MTO) of said engine.” Claim 23 additionally recites “a battery” and “monitoring the state of charge of said battery.” Petitioner argues that Ibaraki '882 discloses a drive control apparatus for a hybrid vehicle, where the vehicle includes an electric motor and an internal combustion engine. Pet. 6–7 (citing Ex. 1403, 1:9–14, 19:11–54; Ex. 1408 ¶¶ 169–170). Petitioner further argues that Ibaraki '882 discloses an energy efficiency map that includes a threshold and multiple setpoints based on the engine speed. Pet. 8–9 (citing Ex. 1403, 25:46–26:8,

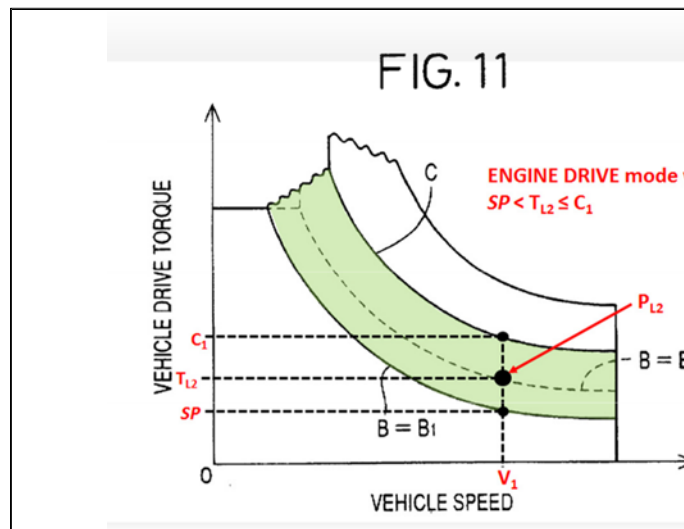
Fig. 5; Ex. 1408 ¶¶ 185–187). Petitioner asserts that the setpoints represent the point where the hybrid vehicle transitions from motor drive mode to engine drive mode and the engine efficiently produces torque above the setpoint. *Id.* Petitioner argues that Ibaraki '882 similarly discloses a drive source selecting data map that includes a boundary line, along which are setpoints. *Id.* at 9–10 (citing Ex. 1403, 20:49–21:20, 24:6–26, Fig. 11; Ex. 1408 ¶¶ 185, 188–190, 193). 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 25–26 (citing Ex. 1403, 25:46–56, Fig. 5). Petitioner further argues that Ibaraki '882 discloses an energy storage device, which can be “in the form of a battery or condenser” and the controller receives a state of charge SOC of the electric energy storage device or battery. *Id.* at 11, 16 (citing Ex. 1403, 19:55–57, 20:10–23; Ex 1408 ¶¶ 198–199) (emphasis omitted).

Claim 23 further recites “one or more electric motors being capable of providing output torque responsive to supplied current, and of generating electrical current responsive to applied torque.” Claim 23 also recites “said engine being controllably connected to wheels of said vehicle for applying propulsive torque thereto and to said at least one motor for applying torque thereto.” Petitioner contends that Ibaraki '882 discloses a “dynamo-electric motor” that receives electric energy, i.e. current, from the energy storage device or battery when in a “DRIVE” state and transfers the power to the

wheels ultimately. *Id.* at 11–12 (citing Ex. 1403, 19:24–28, 19:55–63; Ex. 1408 ¶¶ 200–204). Petitioner further contends that Ibaraki ’882 discloses a “CHARGING” state, where the motor functions as an electric generator or dynamo, with regenerative braking. *Id.* at 12 (citing Ex. 1403, 19:61–67). Petitioner argues that Ibaraki ’882 discloses that the engine is controlled by a “clutch.” *Id.* at 12–13 (citing Ex. 1403, 19:50–54, Fig. 8; Ex. 1408 ¶¶ 208–210).

Claim 23 also recites “determining the instantaneous torque RL required to propel said vehicle responsive to an operator command.” Petitioner argues that Ibaraki ’882 discloses a required drive power for a vehicle that is determined by the vehicle torque and vehicle speed. *Id.* at 13–14 (citing Ex. 1403, 20:39–43, 20:58–21:1, 23:66–24:21; Ex. 1408 ¶¶ 221–224). Petitioner further asserts that Ibaraki ’882 discloses that the “instantaneous drive power required for running the vehicle, which power includes components for overcoming the air resistance experienced by the vehicle and the rolling resistance of each vehicle wheel.” *Id.* at 14–15 (quoting Ex. 1403, 12:50–54)(emphasis omitted). Petitioner asserts that a person with ordinary skill in the art would have known that power and torque are related by speed. Pet. 14 n.1 (citing Ex. 1408 ¶ 190). Petitioner contends, with supporting evidence, that a person having ordinary skill in the art would have understood that the “vehicle drive torque” values described in Ibaraki ’882 represent instantaneous road load (torque) required to propel the vehicle responsive to operator command (accelerator pedal operating amount and rate of change of accelerator pedal operating amount). Pet. 15; Ex. 1408 ¶ 230.

Claim 23 further recites four different modes used to propel the vehicle: (1) “employing said at least one electric motor to propel said vehicle when the torque RL required to do so is less than said lower level SP,” (2) “employing said engine to propel said vehicle when the torque RL required to do so is between said lower level SP and MTO,” (3) “employing both said at least one electric motor and said engine to propel said vehicle when the torque RL required to do so is more than MTO,” and (4) “employing said engine to propel said vehicle when the torque RL required to do so is less than said lower level SP and using the torque between RL and SP to drive said at least one electric motor to charge said battery when the state of charge of said battery indicates the desirability of doing so.” Petitioner contends that Ibaraki ’882 discloses (1) a “MOTOR DRIVE mode,” (2) an “ENGINE DRIVE mode,” (3) an “ENGINE-MOTOR DRIVE mode,” and (4) an “ELECTRICITY GENERATING DRIVE mode.” *Id.* at 16–25 (citing Ex. 1403, 15:37–50, 19:18–27, 19:55–20:9, 20:18–63, 20:43–53, 20:55–21:1, 23:6–19, 23:66–24:30, 26:18–21, 26:28–33, Figs. 5, 7, 10, 11; Ex. 1408 ¶¶ 242–250, 253–262, 266–281, 287–294). In support of its contentions, Petitioner relies on the following annotated Ibaraki ’882 Figure 11, reproduced below. Pet. 15.



and modes are selected as a function of required torque at a given vehicle speed. *See* Pet. 16–25 (citing Ex. 1408 ¶¶ 242–290).

Notwithstanding Patent Owner’s arguments, which we address below, we agree with Petitioner’s analysis and conclusion with regard to claim 23, and adopt them as our own.

Each of claims 28, 30, and 32 depends from independent claim 23. Notwithstanding Patent Owner’s arguments, which we address below, we have considered Petitioner’s showing for these claims and are persuaded by such showing. Accordingly, Petitioner has shown by a preponderance of the evidence that claims 28, 30, and 32 would have been obvious based on Ibaraki ’882 and the relevant knowledge of a person having ordinary skill in the art.

Patent Owner argues that (1) Ibaraki ’882 does not compare road load to setpoint; (2) Ibaraki ’882 does not compare road load to MTO; and (3) Ibaraki ’882 does not disclose a setpoint that is substantially less than MTO. PO Resp. 15–46. We address each argument in the order presented by Patent Owner. Patent Owner presents these same arguments for each of the grounds challenged in the Petition, and, although we only address these arguments with respect to claims 23, 28, 30 and 32, this analysis applies to each of the grounds challenged. *See* PO Resp. 46–60.

a. Comparison of Road Load to Setpoint

Patent Owner argues Ibaraki ’882 describes comparing power to power thresholds to determine the operational mode of the vehicle instead of comparing road load to a setpoint, both of which are torque values. *Id.* at 15–32. 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. 1408 ¶ 225; Ex. 2406 ¶ 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. 1403, 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. 1403, 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. 1408 ¶¶ 224–230. 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.* ¶¶ 244–250. 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 '347 patent specification describes that the instantaneous torque necessary to propel the vehicle is independent of vehicle speed. PO Resp. 18–19; Ex. 1401, 12:51–57. But that passage is in the “DISCUSSION OF THE PRIOR ART” section of the '347 patent. Patent Owner has not shown that that description applies to every embodiment described in the '347 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 '347 also contemplates including not just the torque value in the comparison, but also speed. *See, e.g.*, Ex. 1401, Fig. 4, 58:53–54.

#### b. Comparison of Road Load to MTO

Patent Owner argues that Ibaraki '882 does not compare road load to MTO to determine if both the electric motor and engine are required to propel the vehicle. PO Resp. 32–42. Patent Owner argues that Ibaraki '882 does not mention MTO, or use MTO in mode selection control strategy. *Id.* at 32. But Petitioner does not assert that Ibaraki '882 mentions or discusses MTO. Rather, as explained above, Petitioner asserts that Ibaraki '882 would operate the vehicle in the ENGINE-MOTOR DRIVE mode when a point ( $P_{L3}$ ) denotes that the “current vehicle drive torque” ( $T_{L3}$ ) at a given vehicle

speed ( $V_1$ ) is above the torque point ( $C_1$ ), which would be above the IC engine's MTO. Pet. 20–22; Ex. 1403, 20:55–62, 26:28–33; Ex. 1755 ¶¶ 275–282. Thus, Petitioner asserts that a person having ordinary skill in the art at the time of the invention would have understood the MTO to correspond to, for example, point  $C_1$  in the annotated Figure 11.

Moreover, Dr. Davis testifies that a person of ordinary skill in the art would have understood that it would have been obvious “to use the electric motor to provide additional output torque above the engine's maximum torque output (MTO) during such high vehicle load situations [as described in Ibaraki '882].” Ex. 1408 ¶ 278. In support of that assertion, he explains, with supporting evidence, that it was well known to use both the motor and engine above the engine's MTO. *Id.* Accordingly, even to the extent that Ibaraki '882 alone does not describe explicitly operating the engine and motor “when the torque RL required to do so is more than the MTO,” based on the record before us, doing so would have been an obvious modification to make to the Ibaraki '882 control system. “[I]f 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 Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 417 (2007).

Patent Owner does not rebut sufficiently Dr. Davis's testimony that a person of ordinary skill in the art would have understood that it would have been obvious to use the electric motor to provide additional output torque above the engine's maximum torque output (MTO) during the high vehicle load situations described in Ibaraki '882. For this reason alone, we are not persuaded by Patent Owner's arguments that Petitioner fails to show by a

preponderance of the evidence that Ibaraki '882, based on the knowledge of a person of skill in the art, taught or suggested operating both the motor and engine above the engine's MTO.

In any event, we also address Patent Owner's arguments that the curve C of Figure 11 of Ibaraki '882, or any given point along that curve, such as  $C_1$ , does not correspond to MTO. In particular, Patent Owner argues that a typical MTO for an engine would be shaped like a bell curve, as opposed to the inverse shaped parabola of boundary line C of Ibaraki '882 Figure 11. PO Resp. 33–37. But as Petitioner points out, this argument and Patent Owner's supporting evidence are based on a Patent Owner presented Figure 11 that is not the same as the actual figure of Ibaraki '882. *See, e.g.,* Pet. Reply 12–17. Patent Owner's proposed Figure 11, which Mr. Hannemann bases his testimony upon, is labeled "engine speed" along the X axis. The X axis of Figure 11 of Ibaraki '882 is labeled "vehicle speed." Moreover, the flat portion on the far left of Figure 11 of Ibaraki '882 is shown as a slope in Patent Owner's rendition of the figure. *See, e.g., id.* at 12–13. Based on this alone, we do not determine the evidence to which we are directed by Patent Owner to be particularly helpful or reliable. As such, the Patent Owner's arguments are not persuasive for this additional reason. On the other hand, and as explained above, we give substantial weight to Dr. Davis's testimony that a person having ordinary skill in the art would have understood that the torque point  $C_1$  would be equal to or possibly less than the maximum torque output (MTO) at that given vehicle speed ( $V_1$ ). Ex. 1408 ¶ 275.

c. 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. 43–46. Patent Owner's arguments are similar to those addressed above with respect to the contention, for example, that point C<sub>1</sub> from Figure 11 does not correspond to MTO. See, e.g., *id.* at 45 n. 10. The arguments have been addressed, and for reasons already provided, we are not persuaded by Patent Owner's arguments that that point C<sub>1</sub> from Figure 11 does not correspond to MTO. Moreover, Petitioner, directing attention to paragraphs 302 and 303 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. 25–26; Ex. 1408 ¶¶ 302–303. Patent Owner argues that such an assertion is based on an unreasonably broad construction which essentially reads the “substantially less than the maximum torque output” limitation out of the claim. PO Resp. 45–46. But, as explained previously above, substantially less includes anything less than 70% of MTO. Thus, we are not persuaded by Patent Owner's argument.

*D. Claim 29 – Obviousness over Ibaraki '882 and APA*

Petitioner contends that claim 29 is unpatentable under 35 U.S.C. § 103(a) as obvious over Ibaraki '882 and APA. Pet. 36–38. 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. 1408.

Dependent claim 29, which depends from independent claim 23, recites “said setpoint SP is at least approximately 30% of MTO.” Petitioner

argues that a person with ordinary skill in the art would have understood that Ibaraki '882 included typical engines, such as the ones described by the APA (Masding/Bumby), where Ibaraki '882's 70% fuel efficiency correlates to approximately 33% of MTO. Pet. 37 (citing Ex. 1408 ¶¶ 393–416). Petitioner further contends that such an adjustment is nothing more than an obvious design choice. *Id.*; See Ex. 1408 ¶ 392.

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. 47–48. 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. 37; Ex. 1408 ¶¶ 392–416. 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. 1408 ¶ 399. 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 '347 and '970 Patents)." *Id.* ¶ 416; see Pet. 37. 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. 37–38 (citing Ex. 1408 ¶¶ 393–416). Dr. Davis concludes that “it would have been an obvious design choice to use a set point that is at least approximately 30% of MTO.” Ex. 1408 ¶ 417 (emphasis omitted). Accordingly, we do not agree with Patent Owner that Petitioner's explanations of how the limitations of claim 29 are met and using a setpoint that at least approximately 30% of MTO is an obvious design choice are conclusory.

Patent Owner further argues that “Ford completely ignores a motivation to combine Ibaraki '882 with ‘the disclosed prior art engine of Bumby/Masding 1988.’” PO Resp. 48. We disagree with Patent Owner. Petitioner establishes that APA of the Masding/Bumby engines are disclosed in the '634 patent. Pet. 37; Ex. 1433. The '634 patent is a divisional of the '347 patent. Ex. 1433 (60). Petitioner sets forth that “a POSA would have known that Ibaraki '882's 70% relative fuel efficiency (*i.e.*,  $0.7\eta_{ICE_{max}}$ ) correlates to a *setpoint* that is approximately 33% of MTO.” Pet. 37 (citing Ex. 1408 ¶¶ 393–416). That is, Petitioner is relying on 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. 1408 ¶¶ 393–416. 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 30% of MTO based on the teachings of Ibaraki '882 and APA.

*E. Claim 39 – Obviousness over Ibaraki '882 and Vittone*

Petitioner contends that claim 39 is unpatentable under 35 U.S.C. § 103(a) as obvious over Ibaraki '882 and Vittone. Pet. 38–43. 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 39. *Id.*; Ex. 1408.

Dependent claim 39, which depends from independent claim 23, recites “the rate of change of torque output by said engine is limited, such that combustion of fuel within said engine can be controlled to occur substantially at the stoichiometric ratio” and “if said engine is incapable of supplying the instantaneous torque required, the additional torque required is supplied by either or both of said motor(s).” Petitioner argues that Vittone discloses these limitations. *Id.* Petitioner argues that Vittone discloses controlling “transients [] to achieve the stoichiometric control over the whole working range.” *Id.* at 38 (quoting Ex. 1420, 26; citing Ex. 1408 ¶¶ 425–428). 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 39. “Vittone operates the electric motor to provide any shortfall in the drivability torque requirements as a result of limiting the engine’s output.” *Id.* (citing Ex.

1420, 27; Ex. 1408 ¶ 439). As such, Petitioner argues that Vittone’s “steady state management” discloses limiting a rate of change. *Id.* at 39–41.

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 42–43. 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 42. 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. 49–51. 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 51 (citing Ex. 2406 ¶ 107). 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. 2406 ¶¶ 107–108).

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. 40–41; Pet. Reply 20–21. 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. 1408 ¶¶ 439–440 (citing Ex. 1420, 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. 1408 ¶ 442 (explaining Ex. 1420, 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. 52–54. 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. 42–43; Ex. 1408 ¶¶ 421–431. 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 the two disclosures 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. 52–54; Ex. 2406 ¶¶ 110–113. Patent Owner's arguments and supporting evidence are narrowly based on incorporating physically all technicalities of Vittone 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). 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. 2406 ¶ 113. 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.

*F. Claim 40 – Obviousness over Ibaraki '882 and Yamaguchi*

Petitioner contends that claim 40 is unpatentable under 35 U.S.C. § 103(a) as obvious over Ibaraki '882 and Yamaguchi. Pet. 43–45. 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 40. *Id.*; Ex. 1408.

Dependent claim 40, which depends from independent claim 23, recites “said engine is rotated before starting such that its cylinders are heated by compression of air therein.” Petitioner argues that Yamaguchi discloses this limitation. *Id.* 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 44–45 (citing Ex. 1408 ¶¶ 456–457; Ex. 1421, 8:62–65, Fig. 8) (emphasis omitted). Petitioner further argues that Yamaguchi discloses that “the motor is rotated to 600 rpm in the positive direction [] to allow for rotating the engine before the engine is ignited.” *Id.* (citing Ex. 1408 ¶¶ 456–457; Ex. 1421, 8:41–44) (emphasis omitted).

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 Yamaguchi. *Id.* at 43. Petitioner argues that one of ordinary skill in the art would have known and understood that “[i]t was well-known to preheat the engine and/or the 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. 1419, 46, 56; Ex. 1408 ¶¶ 452–454; Ex. 1403, 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.* at 43–44 (citing Ex. 1403, 2:52–56; Ex. 1408 ¶ 461).

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 rationale to combine Ibaraki ’882 and Yamaguchi. PO Resp. 54–55. 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. 43–45; Ex. 1421, 1:34–35; Ex. 1419, 46, 56; Ex. 1408 ¶¶ 421–422.

*G. Claim 41 – Obviousness over Ibaraki ’882 and Ibaraki ’626*

Petitioner contends that claim 41 is unpatentable under 35 U.S.C. § 103(a) as obvious over Ibaraki ’882 and Ibaraki ’626. Pet. 46–51. 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 41. *Id.*; Ex. 1408.

Dependent claim 41, which depends from independent claim 23, recites “said engine can be operated at torque output levels less than SP under abnormal and transient conditions” and “said conditions comprising starting and stopping of the engine and provision of torque to satisfy drivability or safety consideration.” Petitioner argues that Ibaraki ’626 discloses these limitations. *Id.* 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 49 (citing Ex. 1422, 5:25–42, 7:50–52, Fig. 2, Fig. 4; Ex. 1408 ¶¶ 492–498). 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 49–50 (citing Ex. 1422, 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 46–49. Petitioner argues that a person of ordinary skill in the art would have recognized that both Ibaraki ’882 and Ibaraki ’626 disclose “substantially the same general control strategy for operating a parallel hybrid vehicle.” *Id.* at 47 (citing Ex. 1408 ¶ 475). 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 47–49 (citing Ex. 1408 ¶¶ 476–484). 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. 1408 ¶¶ 476–484).

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. 55–56. 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. 46–49. As discussed above, Petitioner establishes that a person with ordinary skill in the art would have recognized that Ibaraki '882 and Ibaraki '626 disclose “substantially the same general control strategy 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.* at 46–51. 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. Claim 27 – Obviousness over Ibaraki '882 and Lateur*

Petitioner contends that claim 27 is unpatentable under 35 U.S.C. § 103(a) as obvious over Ibaraki '882 and Lateur. 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 27. *Id.*; Ex. 1408.

Dependent claim 27, which depends from independent claim 23, recites “the further step of operating said controller to accept operator input of a desired cruising speed” and “said controller thereafter controlling the instantaneous engine torque output and operation of said motor(s) to supply additional torque as needed in accordance with variation in RL to maintain the speed of said vehicle substantially constant.” Petitioner argues that Lateur discloses these limitations. *Id.* at 52–54. Petitioner argues that Lateur discloses that “it was known to design a cruise control device which provided a controller to operator input specifying a desired speed.” *Id.* at 52 (citing Ex. 1408 ¶ 521; Ex. 1407 9:47–57, Fig. 11).

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 Lateur. *Id.* at 51–52. Petitioner argues that the benefit of Lateur’s “cruise control” is that it allows “the vehicle operator to relax from constant foot throttle manipulation” and potentially improves the “vehicle’s fuel efficiency value by limiting throttle excursions to small steps.” *Id.* (citing Ex. 1406, 14). Accordingly, Petitioner argues that a person with ordinary skill in the art would have combined Lateur’s “cruise control” functionality with Ibaraki '882’s hybrid vehicle in order to allow “the vehicle operator to relax from constant foot throttle manipulation” and potentially improve the “vehicle’s fuel efficiency value by limiting throttle excursions to small steps.” *Id.* (citing Ex. 1406, 14).

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

Patent Owner argues that Lateur’s “cruise control” feature does not render claim 27 obvious, because, none of the prior art “discloses using road

load as a control variable to determine when to operation the engine.” PO Resp. 56–57. We disagree with Patent Owner. As discussed above, Ibaraki ’882 discloses the use of road load as a control variable. See Sections II.C.2.a, II.C.2.b.

Patent Owner further argues that Petitioner’s “argument regarding an alleged rationale to combine Lateur with Ibaraki ’882 is conclusory and ignores the actual requirements of the claims.” PO Resp. 57–58. We disagree with Patent Owner. As discussed above, Petitioner argues that a person with ordinary skill in the art would have recognized the benefit of “cruise control” functionality is that it permits “the vehicle operator to relax from constant foot throttle manipulation” and potentially improve the “vehicle’s fuel efficiency value by limiting throttle excursions to small steps.” Pet. 51–52 (citing Ex. 1406, 14). Petitioner further argues that a person with ordinary skill in the art would have combined this functionality with Ibaraki ’882 in order to provide this same benefit to the Ibaraki ’882 hybrid vehicle. *Id.* As such, we disagree with Patent Owner that Petitioner rationale to combine Lateur with Ibaraki ’882 is conclusory.

*I. Claims 25 and 26 – Obviousness over Ibaraki ’882 and Frank*

Petitioner contends that claims 25 and 26 are unpatentable under 35 U.S.C. § 103(a) as obvious over Ibaraki ’882 and Frank. Pet. 54–60. 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 25 and 26. *Id.*; Ex. 1408.

Claims 25 and 26 recite “the further step of employing said controller to monitor RL over time, and to control transition between propulsion of said vehicle by said motor(s) to propulsion by said engine such that said

transition occurs only when  $RL > SP$  for at least a predetermined time, or when  $R > SP2$ , wherein  $SP2$  is a larger percentage of MTO than  $SP$ ” and “the further step of employing said controller to monitor  $RL$  over time, and to control transition between propulsion of said vehicle by said engine to propulsion by said motor(s) such that said transition occurs only when  $RL < SP$  for at least a predetermined time” respectively. Petitioner argues that Frank discloses these limitations. *Id.* at 56–60. Specifically, Petitioner argues that Frank discloses a time based delay between operating modes and a person with ordinary skill in the art would have understood that Frank “recognized the problems associated with ‘frequent cycling’ that occurs between operating modes of any hybrid vehicle.” *Id.* at 57–58 (citing Ex. 1418, 8:32–37, Ex. 1408 ¶¶ 571–580).

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 Frank. *Id.* at 54–56. Petitioner argues that a person with ordinary skill in the art would have recognized the deficiency in Ibaraki ’882 that erratic, high frequency cycling between operating modes would result in damage to several parts of the vehicle, such as the engine, motor, clutch, or transmission, and increase exhaust emissions and reduce fuel efficiency. *Id.* (citing Ex. 1408 ¶¶ 545–546). Petitioner explains that a time delay would reduce frequency cycling between operating modes by ensuring the vehicle has fully transitioned between modes, and Frank recognized the problems between frequency cycling and introduced a time delay to solve this problem. *Id.* (citing Ex. 1418, 8:32–37; Ex. 1408 ¶¶ 551–554). Petitioner argues that a person with ordinary skill in the art would have recognized that adding a time delay, as disclosed by Frank, to the

Ibaraki '882 hybrid vehicle would have required nothing more than a simple modification, and that such a person would have been motivated to introduce a time delay in order to solve the problem with frequent cycling. *Id.* (citing Ex. 1408 ¶¶ 539–554, 577–578).

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

Patent Owner argues that Frank discloses “speed-responsive hysteresis,” whereas the claims require “road load-based hysteresis,” and, therefore, the combination of Ibaraki '882 and Frank fails to teach or suggest claims 25 and 26. PO Resp. 58–59. We disagree with Patent Owner's argument. As discussed above, Ibaraki '882 discloses transitioning between operating modes based on road load. *See* Section II.C.2. Petitioner only relies on Frank to disclose a time delay before transitioning between modes. Pet. 56–60 (citing Ex. 1418, 8:32–37, Ex. 1408 ¶¶ 571–580). As such, Patent Owner's argument is tantamount to an attack on the references separately when the Petitioner's argument is based on what the combination of references teaches or suggests. Nonobviousness cannot be established by attacking the references individually when the rejection is predicated upon a combination of prior art disclosures. *See In re Merck & Co. Inc.*, 800 F.2d 1091, 1097 (Fed. Cir. 1986).

Patent Owner further argues that Petitioner “fails to present any rational basis for combining Ibaraki '882 with Frank to arrive at the claimed invention.” PO Resp. 59–60. We disagree with Patent Owner. As discussed above, Petitioner explains that a person with ordinary skill in the art would have recognized a problem with Ibaraki '882 is that frequent cycling between operating modes would result in damage to several parts of

the vehicle, such as the engine, motor, clutch, or transmission, and increase exhaust emissions and reduce fuel efficiency. Pet. 54–56 (citing Ex. 1408 ¶¶ 545–546). Petitioner explains that a time delay would reduce frequency cycling between operating modes by ensuring the vehicle has fully transitioned between modes, and Frank recognized the problems between frequency cycling and introduced a time delay to solve this problem. *Id.* (citing Ex. 1418, 8:32–37; Ex. 1408 ¶¶ 551–554). We are persuaded by Petitioner that a person with ordinary skill in the art would have recognized the benefit of a time delay before switching operating modes, and would have been motivated to modify Ibaraki '882 with such a simple modification in order to resolve the problem with frequent cycling.

### III. CONCLUSION

We are persuaded that Petitioner has demonstrated by a preponderance of the evidence that claims 25–30, 32, and 39–41 of the '347 patent are unpatentable.

### IV. ORDER

Accordingly, it is hereby:

ORDERED that the *inter partes* review is *dismissed* with respect to claim 23;

FURTHER ORDERED that, based on the grounds under review, claims 25–30, 32, and 39–41 of U.S. Patent No. 7,104,347 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

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judicial review of this decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

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