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Paper 36
Entered: October 21, 2016

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

FORD MOTOR COMPANY,
Petitioner,

v.

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

Case IPR2015-00791
Patent 7,237,634 B2

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

MEDLEY, *Administrative Patent Judge*.

FINAL WRITTEN DECISION
Inter Partes Review
35 U.S.C. § 318(a) and 37 C.F.R. § 42.73

I. INTRODUCTION

We have jurisdiction to hear this *inter partes* review 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. For the reasons that follow, we dismiss the *inter partes* review with respect to claims 80, 93, 99, 114, 127, 132, 139, and 215, and determine that Petitioner has shown by a preponderance of the evidence

that claims 94, 96, 106–108, 113, 128, 140, 141, 146, 229, and 231 of U.S. Patent No. 7,237,634 B2 are unpatentable.

A. Procedural History

Petitioner, Ford Motor Company, filed a Petition requesting an *inter partes* review of claims 33, 37, 39–41, 80, 93, 94, 96, 99, 106–108, 113, 114, 127, 128, 132, 139–141, 146, 215, 229, and 231 of U.S. Patent No. 7,237,634 B2 (Ex. 1450, "the '634 patent"). Paper 1 ("Pet."). Patent Owner, Paice LLC & The Abell Foundation, Inc., filed a Preliminary Response in both unredacted and redacted forms. Papers 9, 10 ("Prelim. Resp."). Upon consideration of the Petition and Preliminary Response, on October 27, 2015, we instituted an *inter partes* review of claims 80, 93, 94, 96, 99, 106–108, 113, 114, 127, 128, 132, 139–141, 146, 215, 229, and 231, pursuant to 35 U.S.C. § 314. Paper 12 ("Dec.").

Subsequent to institution, Patent Owner filed a Patent Owner Response (Paper 17 ("PO Resp.")) and Petitioner filed a Reply (Paper 25 ("Pet. Reply")).[1] An oral hearing was held on June 28, 2016, and a transcript of the hearing is included in the record (Paper 34 ("Tr.")).

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

[1] In addition, Patent Owner filed a Motion for Observation on Cross-Examination (Paper 27) and Petitioner filed a Response to Motion for Observation on Cross-Examination (Paper 30), both of which have been considered.

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, IPR2015-00790, IPR2015-00799, IPR2015-00800, and IPR2015-00801.

C. The '634 Patent (Ex. 1450)

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. 1450, 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 Claims

Petitioner challenges independent claim 80 and dependent claims 93, 94, 96, 99, 106–108, and 113 which depend either directly or indirectly from claim 80. Petitioner also challenges independent claim 114 and dependent claims 127, 128, 132, 139–141, and 146, which depend either directly or indirectly from claim 114. Petitioner also challenges independent claim 215 and dependent claims 229 and 231, which depend directly from claim 215. Independent claims 80, 114, and 215 are reproduced below:

> 80. A method for controlling a hybrid vehicle, comprising:
>
> determining instantaneous road load (RL) required to propel the hybrid vehicle responsive to an operator command;
>
> monitoring the RL over time;
>
> operating at least one electric motor to propel the hybrid vehicle when the RL required to do so is less than a setpoint (SP);
>
> operating an internal combustion engine of the hybrid vehicle to propel the hybrid vehicle when the RL required to do so is between the SP and a maximum torque output (MTO) of the engine, wherein the engine is operable to efficiently produce torque above the SP, and wherein the SP is substantially less than the MTO; and
>
> wherein said operating the internal combustion engine to propel the hybrid vehicle is performed when: the RL>the SP for at least a predetermined time; or the RL>a second setpoint (SP2), wherein the SP2 is a larger percentage of the MTO than the SP; and
>
> 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 the MTO.

Id. at 65:11–33.

114. A method for controlling a hybrid vehicle, comprising:

determining instantaneous road load (RL) required to propel the hybrid vehicle responsive to an operator command;

monitoring the RL over time;

operating at least one electric motor to propel the hybrid vehicle when the RL required to do so is less than a setpoint (SP);

wherein said operating the at least one electric motor to propel the hybrid vehicle is performed when the RL<the SP for at least a predetermined amount of time;

operating an internal combustion engine of the hybrid vehicle to propel the hybrid vehicle when the RL required to do so is between the SP and a maximum torque output (MTO) of the engine, wherein the engine is operable to efficiently produce torque above the SP, and wherein the SP is substantially less than the MTO; and

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 the MTO.

Id. at 68:34–55.

215. A method for controlling a hybrid vehicle, comprising:

determining instantaneous road load (RL) required to propel the hybrid vehicle responsive to an operator command;

operating at least one electric motor to propel the hybrid vehicle when the RL required to do so is less than a setpoint (SP);

operating an internal combustion engine of the hybrid vehicle to propel the hybrid vehicle when the RL required to do so is between the SP and a maximum torque output (MTO) of the engine, wherein the engine is operable to efficiently produce torque above the SP, and wherein the SP is substantially less than the MTO; and

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 the MTO; and

regeneratively charging a battery of the hybrid vehicle when instantaneous torque output of the engine>the RL, when

> the RL is negative, and/or when braking is initiated by an operator of the hybrid vehicle.

Id. at 79:10–31.

E. Grounds of Unpatentability

We instituted an *inter partes* review of claims 80, 93, 94, 96, 99, 106–108, 113, 114, 127, 128, 132, 139–141, 146, 215, 229, and 231 on the following grounds:

Reference[s]	**Basis**	**Challenged Claim(s)**
Ibaraki '882[2] and the general knowledge of a POSA	§ 103	215 and 229
Ibaraki '882, Frank,[3] and the general knowledge of a POSA	§ 103	80, 93, 94, 96, 99, 106–108, 114, 127, 128, 132, and 139–141
Ibaraki '882, Frank, Suga,[4] and the general knowledge of a POSA	§ 103	113 and 146
Ibaraki '882, Jurgen,[5] Lateur,[6] and the general knowledge of a POSA	§ 103	231

II. ANALYSIS

A. Petitioner Estoppel

On March 10, 2016, we rendered a final written decision of claims 80, 93, 99, 114, 127, 132, 139, and 215 of the '634 patent in IPR2014-01416.

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[2] U.S. Patent No. 5,789,882, issued Aug. 4, 1998 (Ex. 1452) ("Ibaraki '882").
[3] U.S. Patent No. 6,116,363, issued Sept. 12, 2000 (Ex. 1489) ("Frank").
[4] U.S. Patent No. 5,623,104, issued Apr. 22, 1997 (Ex. 1454) ("Suga").
[5] Ronald Jurgen, *Automotive Electronics Handbook*, 1995 (Ex. 1491) ("Jurgen").
[6] U.S. Patent No. 5,823,280, issued Oct. 20, 1998 (Ex. 1490) ("Lateur").

Ford Motor Co. v. Paice LLC & The Abell Foundation, Inc., Case IPR2014-01416 (PTAB March 10, 2016) (Paper 26). Patent Owner argues that, pursuant to 35 U.S.C. § 315(e)(1), Petitioner may not maintain its challenge of claims 80, 93, 99, 114, 127, 132, 139, and 215. PO Resp. 17. Petitioner responds that it is not estopped with respect to claims 80, 114, and 215 because it was necessary for it to file multiple petitions to address multiple dependent claims. Pet. Reply 4.

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 March 10, 2016, a final written decision was entered in IPR2014-01416, in which we determined that claims 80, 93, 99, 114, 127, 132, 139, and 215 of the '634 patent are unpatentable. Petitioner in this proceeding is the same Petitioner in IPR2014-01416. The grounds raised by Petitioner in IPR2014-01416 against claims 80, 93, 99, 114, 127, 132, 139, and 215 were not the same as the grounds raised against those claims in this proceeding. Nonetheless, Ibaraki '882 and Frank were cited during prosecution that led to the '634 patent and are listed on the face of the '634 patent. Ex. 1450.

Petitioner does not argue that it reasonably could not have raised its challenge to claims 80, 93, 99, 114, 127, 132, 139, and 215 based on Ibaraki '882 and Frank in IPR2014-01416. Pet. Reply 4. We determine that Petitioner reasonably could have raised this challenge in IPR2014-01416. Accordingly, Petitioner is estopped under 35 U.S.C. § 315(e)(1) from maintaining the grounds based on Ibaraki '882 against claims 80, 93, 99, 114, 127, 132, 139, and 215. We dismiss the *inter partes* review with respect to claims 80, 93, 99, 114, 127, 132, 139, and 215.

Although we determine it necessary to address the parties' contentions with respect to independent claims 80, 114, and 215 because claims 94, 96, 106–108, 113, 128, 140, 141, 146, 229, and 231 depend from one of claims 80, 114, and 215, we do not otherwise provide a final written decision on the merits with respect to claims 80, 93, 99, 114, 127, 132, 139, and 215, or again hold those claims to be unpatentable.

B. Claim Construction

In an *inter partes* review, claim terms in an unexpired patent are given their broadest reasonable construction in light of the specification of the patent in which they appear. 37 C.F.R. § 42.100(b). Under the broadest reasonable construction standard, claim terms are generally 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). Any special definition for a claim term must be set forth with reasonable clarity, deliberateness, and precision. *In re Paulsen*, 30 F.3d 1475, 1480 (Fed. Cir. 1994).

Petitioner proposes constructions for the following claim terms: "road load," "low-load operation mode I," "high-way cruising operation mode

IV," and "acceleration operation mode V." Pet. 9, 11. In our Decision to Institute, we interpreted those terms. Dec. 9–10, 12–14. The claim terms "low-load operation mode I," "high-way cruising operation mode IV," and "acceleration operation mode V," however, are found only in dependent claims 99 and 132. For reasons stated above, we dismiss the *inter partes* review with respect to claims 99 and 132. Thus, we determine it unnecessary to interpret those terms for purposes of this decision. Moreover, neither party has indicated that our interpretation with respect to road load (RL) was improper, and we do not perceive any reason or evidence that now compels any deviation from our initial interpretation. Accordingly, we construe "road load" as the amount of instantaneous torque required to propel the vehicle, be it positive or negative.

For purposes of this decision, we find it necessary to construe "setpoint" and the "operating limitations" found in claims 80, 114, and 215.

Setpoint (SP)

The term "setpoint" or "SP" is recited in independent claims 80, 114, and 215, and, thus, necessarily is included in dependent claims 94, 96, 106–108, 113, 128, 140, 141, 146, 229, and 231. Petitioner proposes that "setpoint" or "SP" be construed, in the context of these claims, as "predetermined torque value." Pet. 10–11. Patent Owner argues that "setpoint" or "SP" be construed as "a definite, but potentially variable value

at which a transition between operating modes may occur." PO Resp. 7.[7]

We agree with Petitioner that the claims compare the setpoint either to an engine torque value or a torque based "road load" value. Pet. 10–11. Each of claims 80, 114, and 215 recites a condition "when the RL required to do so is less than a setpoint (SP)." Ex. 1450, 65:17–18, 68:41–42; 79:16–17. Each of claims 80, 114, and 215 further recites a range established by the setpoint at one end, and the maximum torque output of the engine at the other end, by the language "when the RL required to do so is between the SP and a maximum torque output (MTO) of the engine." *Id*. at 65:20–22, 68:47–49; 79:19–21.

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

[7] 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. 12. Petitioner agrees with that interpretation, while Patent Owner does not. Pet. Reply 2; PO Resp. 7–11.

in the 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 Specification of the '634 patent, 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. 1450, 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. 10–11. 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. 1450, 40:18–26 (emphasis added). This argument also is misplaced. As we noted above, independent claim 1 requires a comparison of the setpoint to an engine torque 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."

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. 11–17. The assertion is based on the requirements in

each of claims 80, 114, and 215 of (1) operating at least one first electric motor to propel the hybrid vehicle "when the RL required to do so is less than the SP," (2) operating an internal combustion engine of the hybrid vehicle to propel the hybrid vehicle "when the RL required to do so is between the SP and a maximum torque output (MTO) of the engine," and (3) operating both the at least one first electric motor and the engine to propel the hybrid vehicle "when the torque RL required to do so is more than the MTO."

In the above discussion of the construction of setpoint, we already noted that claims 80, 114, and 215 each require a comparison of road load to a setpoint because of the claim recitations "when the RL required to do so is less than the SP" and "when the RL required to do so is between the SP and a maximum torques output (MTO) of the engine." For similar reasons, claims 80, 114, and 215 each require a comparison of road load to a maximum torque output (MTO) because of the recitation "when the torque RL required to do so is more than the 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 setpoint (SP) and also to a maximum torque output (MTO). That, however, does not mean the claims exclude the comparison of other parameters.

C. Principles of Law

A patent claim is unpatentable under 35 U.S.C. § 103(a) if the differences between the claimed subject matter and the prior art are such that the subject matter, as a whole, would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said

subject matter pertains. *KSR Int'l Co. v. Teleflex Inc*., 550 U.S. 398, 406 (2007). The question of obviousness is resolved on the basis of underlying factual determinations including: (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of ordinary skill in the art; and (4) objective evidence of nonobviousness. *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).

In that regard, an obviousness analysis "need not seek out precise teachings directed to the specific subject matter of the challenged claim, for a court can take account of the inferences and creative steps that a person of ordinary skill in the art would employ." *KSR*, 550 U.S. at 418; *see Translogic*, 504 F.3d at 1259.

The level of ordinary skill in the art is reflected by the prior art of record. *See Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001); *In re GPAC Inc*., 57 F.3d 1573, 1579 (Fed. Cir. 1995); *In re Oelrich*, 579 F.2d 86, 91 (CCPA 1978).

D. Claims 215 and 229

As discussed above, we dismiss the *inter partes* review with respect to claim 215 pursuant to 35 U.S.C. § 315(e)(1). Claim 229, however, depends from claim 215 and necessarily includes all of the limitations of claim 215. Accordingly, we first address the contentions made by Petitioner as to how Ibaraki '882 renders obvious claim 215.

Petitioner contends that claims 215 and 229 are unpatentable under 35 U.S.C. § 103(a) as obvious over Ibaraki '882 and the general knowledge of a person of ordinary skill in the art. Pet. 38–39. To support its contention, Petitioner provides detailed explanations as to how the prior art meets each claim limitation of claims 215 and 229. *Id*. Petitioner also relies

upon a Declaration of Dr. Gregory W. Davis, who has been retained as an expert witness by Petitioner for the instant proceeding. Ex. 1455. For the reasons that follow, and notwithstanding Patent Owner's arguments, which we address below, we are persuaded by Petitioner's showing, which we adopt as our own, that claim 229, which depends from claim 215, is unpatentable under 35 U.S.C. § 103(a) as obvious over Ibaraki '882 and the general knowledge of a person of ordinary skill in the art.

Ibaraki '882

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. 1452, 1:9–14. Ibaraki '882 describes that when the electric motor (14, Fig. 1 or 114, Fig. 8) functions also as an electric generator, a separate electric generator may be provided in addition to the electric motor. *Id.* at 26:34–38. Ibaraki '882 further describes an electric energy storage device or battery 22. *Id.* at Fig. 1. 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

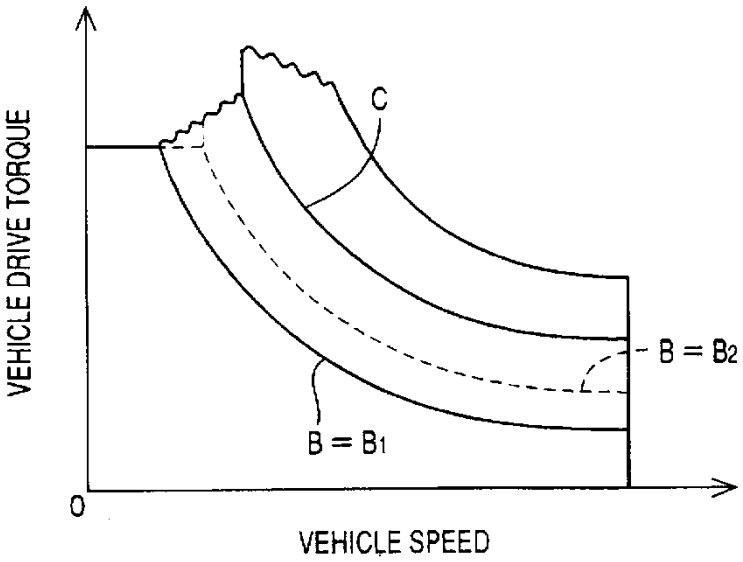


Figure 11 shows a graph which represents a predetermined relationship between the vehicle drive torque and running speed.

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.

Claim 215

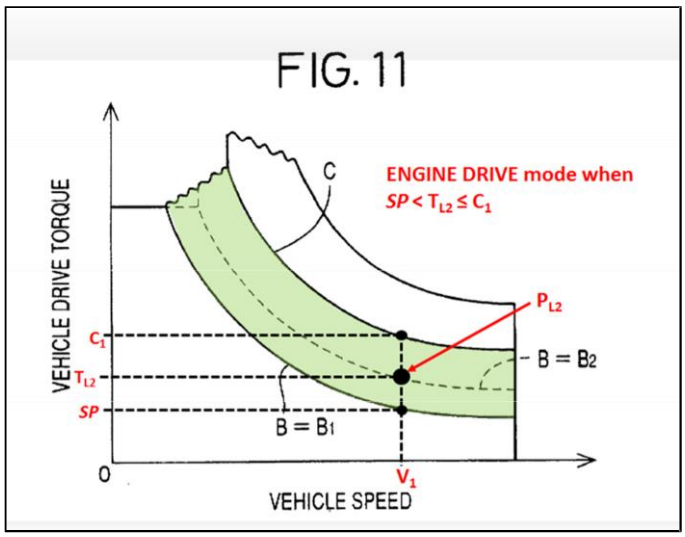
Claim 215 recites a method for controlling a hybrid vehicle. Petitioner contends that Ibaraki '882 describes a drive control apparatus for controlling a hybrid vehicle that may be propelled by an internal engine and electric motor. Pet. 13, 38; Ex. 1452, 1:9–14; Ex. 1455 ¶¶ 152–154. We are persuaded by Petitioner's showing, and adopt it as our own, that Ibaraki '882 describes a method for controlling a hybrid vehicle.

Claim 215 recites "determining instantaneous road load (RL) required to propel the hybrid vehicle responsive to an operator command." 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. 17, 38; Ex. 1455 ¶¶ 165–180. We are persuaded by Petitioner's showing, and adopt it as our own, that Ibaraki '882 describes this limitation.

Claim 215 recites "operating at least one electric motor to propel the hybrid vehicle when the RL required to do so is less than a setpoint (SP)." Petitioner relies on annotated graphs, along with Dr. Davis' testimony, explaining that Ibaraki '882 describes different operating modes, where the vehicle is operated by motor alone (MOTOR DRIVE mode), when the road load (RL) is less than the setpoint (SP) along boundary B. Pet. 18–20, 38;

Ex. 1452, 19:55–20:9, 20:43–62; Ex. 1455 ¶¶ 181–192. We are persuaded by Petitioner's showing, and adopt it as our own, that Ibaraki '882 describes operating at least one electric motor to propel the hybrid vehicle when the road load required to do so is less than a set point (SP).

Claim 215 recites "operating an internal combustion engine of the hybrid vehicle to propel the hybrid vehicle when the RL required to do so is between the SP and a maximum torque output (MTO) of the engine." Petitioner contends that Ibaraki '882 describes an internal combustion engine (engine 112 in Fig. 8) that may be operated to propel the hybrid vehicle during an ENGINE DRIVE mode in which engine 112 is selected as the drive power source. Pet. 20; Ex. 1452, 20:43–53; 19:18–27; Ex. 1455 ¶¶ 196–199. Petitioner contends, with respect to Ibaraki '882 Figure 11, that the engine drive mode lies between the two boundary lines B and C. Ibaraki '882 describes that the controller uses the data map of Figure 11 to select ENGINE DRIVE mode when the vehicle running condition as represented by the current vehicle drive torque and speed V is held within the range between boundary lines B and C. Ex. 1452, 20:49–58. In support of its contentions, Petitioner relies on the following annotated Ibaraki '882 Figure 11.



Ibaraki '882 Figure 11 as annotated in the Petition.

Petitioner explains, with supporting evidence, that at a given vehicle speed (annotated as V_1), a given setpoint (annotated as SP) along boundary B is known, and that the setpoint marks the transition between the MOTOR DRIVE mode and the ENGINE DRIVE mode. As long as the current vehicle drive torque are below torque point C_1, Petitioner contends, the vehicle will operate in the ENGINE DRIVE mode. Pet. 22–23; Ex. 1452, 20:55–62; 23:66–24:30; Ex. 1455 ¶¶ 205–207.

With respect to the maximum torque output limitation, Petitioner contends, with supporting evidence, that a person having ordinary skill in the art would have recognized that an IC engine, like that described in Ibaraki '882, necessarily has a maximum torque output (MTO), above which the IC engine cannot produce additional torque. Pet. 22–23; Ex. 1455 ¶ 206. Petitioner further contends that because the range of torque setpoints along boundary B represents the lower-bound of the ENGINE DRIVE mode, a person having ordinary skill in the art would have understood that the maximum torque output must be greater than any setpoint along boundary

line B, and that the MTO would be equal to or greater than torque point C_1. *Id.* We are persuaded by Petitioner's showing, and adopt it as our own, that Ibaraki '882 describes operating an internal combustion engine of the hybrid vehicle to propel the hybrid vehicle when the RL required to do so is between the SP and a maximum torque output (MTO) of the engine.

Claim 215 further recites "wherein the engine is operable to efficiently produce torque above the SP." Petitioner contends, with supporting evidence, that at the time of the invention, it was known that for hybrid vehicles, a key point is to operate the IC engine at more efficient operating points. Pet. 23; Ex. 1463, 12; Ex. 1455 ¶¶ 128–130. Petitioner also points out that Ibaraki '882 itself describes that an object of its invention is to provide a drive control apparatus for a hybrid vehicle which permits effective reduction in the fuel consumption amount or exhaust gas amount of the engine, and in the context of the ENGINE DRIVE mode. Pet. 24; Ex. 1452, 2:52–56, 25:1–10. Petitioner contends that a person having ordinary skill in the art would have known that reduced fuel consumption is characteristic of improved IC engine efficiency. Pet. 24; Ex. 1455 ¶¶ 128–130, 208; Ex. 1464, 2. We are persuaded by Petitioner's showing, and adopt it as our own, that Ibaraki '882, based on the relevant knowledge at the time of the invention, meets the recitation that the engine is operable to efficiently produce torque above the SP.

Claim 215 recites "wherein the SP is substantially less than the MTO." Petitioner asserts that, based on a description in the '634 patent (claim 15), "substantially less than the MTO" includes a SP which is less than approximately 70% of the MTO. Pet. 24. Petitioner further contends, with supporting evidence, that since an IC engine cannot operate or provide

torque above its MTO, the setpoints used to delineate the start of the ENGINE DRIVE mode are substantially less than the MTO of the engine. Pet. 24–26; Ex. 1455 ¶ 226. Dr. Davis explains that the points along curve B of Figure 11, for example, would have been understood by a person of ordinary skill in the art to be setpoints below the MTO. Ex. 1455 ¶ 226. Dr. Davis further explains that a person having ordinary skill in the art would have understood that the MTO at vehicle speed must at least be equal to point C_1 (from annotated Figure 11 above), and if it were not, then the IC engine could not alone drive the vehicle within the entire ENGINE DRIVE mode range. *Id.* ¶¶ 225–226. Dr. Davis further explains why a person having ordinary skill in the art would have understood that the setpoint (from the annotated figure above shown as B_1 or SP) is substantially less than point C_1, since SP is no more than half of the vehicle drive torque of C_1. *Id.* We are persuaded by Petitioner's showing, and adopt it as our own, that Ibaraki '882, based on the relevant knowledge at the time of the invention, meets the recitation that the SP is substantially less than the MTO.

Claim 215 recites "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 the MTO." For this limitation, Petitioner relies on the ENGINE-MOTOR DRIVE mode of Ibaraki '882, and explains that the "current vehicle drive torque" (shown as T_{L3} per annotated Figure 11) is the "instantaneous torque required to propel the vehicle" (or road load) at this "vehicle running condition." Pet. 28. Petitioner further explains, with supporting evidence, 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. 28–29; Ex. 1452, 20:55–62, 26:28–33; Ex. 1455 ¶¶ 241–245.

In particular, Dr. Davis testifies:

> 241. It is also my opinion that a person having ordinary skill in the art would have understood the torque point C_1 along the predetermined "boundary line C" would be equal to or possibly less than the maximum torque output (MTO) at that given vehicle speed (V_1). First, an IC engine **cannot** operate above the engine's MTO. Because the IC engine alone operates in the "ENGINE DRIVE mode" when the vehicle drive torque is between "boundary line B" and "boundary line C" the MTO cannot be less than the torque point C_1 at that given vehicle speed. It follows that the maximum torque output (MTO) of the engine is at minimum equal to the torque point C_1 when operated at a vehicle speed V_1, because the engine is still operating alone until the torque exceeds the point C_1.
>
> 242. Ibaraki '882 states that the "ENGINE-MOTOR DRIVE mode" is selected "when the vehicle load is comparatively high." (Ex. 1452 [Ibaraki '882] at 26:28–33.)
>
> 243. It is my opinion that a person of ordinary skill in the art would have understood that high "vehicle loads" would include vehicle drive torques above the engine's maximum torque output (MTO). It is also my opinion that a person having ordinary skill would have understood that a hybrid vehicle control strategy would at some point allow the IC engine to provide output torque up to and including its MTO. Otherwise, the system would be artificially limiting the performance of the vehicle. In other words, the hybrid vehicle would not be providing the full output capabilities of the IC engine and the motor under high loads. Thus, within the ENGINE-MOTOR DRIVE mode the system would eventually allow the IC engine to provide torque at its MTO and also allow the additional supplemental torque to be provided from the electric motor.

> 244. A person of ordinary skill in the art would have understood that it would be 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 discussed above in the State of the Art in ¶¶ 128–134 the control techniques for using the motor above the engine's MTO were well known.

Ex. 1455 ¶¶ 241–244.

Ibaraki '882 describes that the ENGINE-MOTOR drive mode is selected when the "vehicle load is comparatively high." Ex. 1452, 26:28–33. We give substantial weight to Dr. Davis's testimony that the torque point C_1 along the predetermined "boundary line C" would be equal to or possibly less than the maximum torque output (MTO) at vehicle speed (V_1). Ex. 1455 ¶ 241. We further give substantial weight to Dr. Davis's testimony that at such high vehicle load situations it would have been obvious to use the electric motor to provide additional output torque above the engine's maximum torque output. *Id.* at ¶ 244. Dr. Davis's testimony is consistent with the teachings of Ibaraki '882 and the state of the art at the time of the invention. *See, e.g.*, Ex. 1463, 3. We are persuaded by Petitioner's showing, and adopt it as our own, that Ibaraki '882, based on the relevant knowledge a person of ordinary skill in the art would have had at the time of the invention, meets the recitation of operating both the at least one first electric motor and the engine to propel the hybrid vehicle when the torque RL required to do so is more than the MTO.

Claim 215 recites "regeneratively charging a battery of the hybrid vehicle when the instantaneous torque output of the engine>the RL, when the RL is negative, and/or when braking is initiated by an operator of the hybrid vehicle." Petitioner accounts for the regeneratively charging a

battery language, by citing to a description in Ibaraki '882 of 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. Pet. 39; Ex. 1452, 23:1–30; Ex. 1455 ¶¶ 298–300. We are persuaded by Petitioner's showing, and adopt it as our own, that Ibaraki '882, based on the relevant knowledge a person of ordinary skill in the art would have had at the time of the invention, meets the above quoted language.

Patent Owner's Contentions

Patent Owner makes three arguments with respect to claim 215: (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. 18–46. We address each argument in the order presented by Patent Owner.

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 18–34. 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. 1455 ¶ 170; Ex. 2407 ¶ 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. 1452, 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." *Id.* at 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. 1455 ¶¶ 170–173. 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.* ¶¶ 305–307. 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. 21; Ex. 1450, 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 also contemplates including not just the torque value in the comparison, but also speed. *See, e.g.*, Ex. 1450, Fig. 4, 59:3–5.

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. 35–45. Patent Owner argues that Ibaraki '882 does not mention MTO, or use MTO in mode selection control strategy. *Id.* at 35. 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. 28–29; Ex. 1452, 20:55–62, 26:28–33; Ex. 1455 ¶¶ 241–245. 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. 1455 ¶ 244. 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. 36–39. 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 6–10. Patent Owner's proposed Figure 11, which Mr. Hannemann[8] 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 7. 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. 1455 ¶ 241.

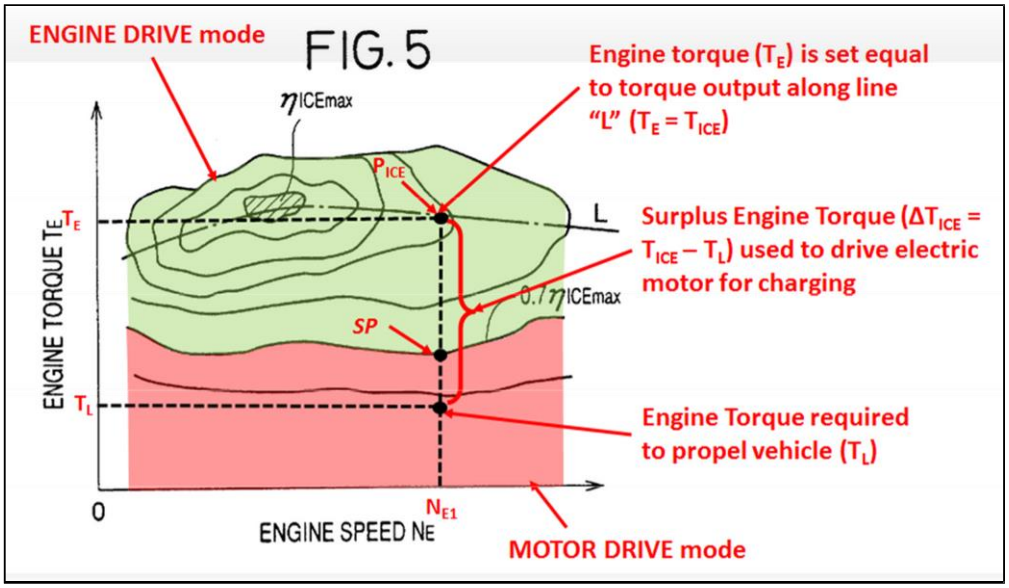
Patent Owner argues that Ibaraki '882 does not disclose a setpoint that is substantially less than MTO. PO Resp. 46–49. Patent Owner's arguments are similar to those addressed above with respect to the contention, for example, that point C_1 from Figure 11 does not correspond to MTO. *See, e.g.*, *id.* at 48 n. 9. The arguments have been addressed, and for reasons already provided, we are not persuaded by Patent Owner's arguments that that point C_1 from Figure 11 does not correspond to MTO.

[8] Declaration of Neil Hannemann (Ex. 2407).

Claim 229

Claim 229 depends from claim 215 and recites "operating the engine to charge the battery when the state of the charge of the battery indicates the need to do so." Petitioner contends that Ibaraki '882 describes monitoring and determining whether the battery has fallen below a predetermined charge threshold. Pet. 34, 39; Ex. 1452, 23:6–14, Fig. 10. Petitioner further contends that when the battery is below the threshold "A", the controller executes an ELECTRICITY GENERATING DRIVE mode. Pet. 35; Ex. 1452, 23:15–19. During this mode, Petitioner contends, the engine speed is held constant and the engine torque increases to a value greater than the torque required to propel the vehicle, such that the surplus torque is used by the engine to drive the motor for charging the battery. Pet. 35; Ex. 1452, 15:37–50; Ex. 1455 ¶¶ 275–279. We are persuaded by Petitioner's showing, and adopt it as our own, that Ibaraki '882, based on the relevant knowledge at the time of the invention, meets the recitation of operating the engine to charge the battery when the state of the charge of the battery indicates the need to do so.

Claim 229 also recites "wherein the engine is operable to provide torque at least equal to the SP to propel the hybrid vehicle and to drive the at least one electric motor to charge the battery." Petitioner directs attention to annotated Ibaraki '882 Figure 5 below and explains that while operating in the ELECTRICITY GENERATING DRIVE mode, the engine output P_{ICE} may be selected within a predetermined range along line L. Pet. 36; Ex. 1452, 26:18–21.



Ibaraki '882 Figure 5 annotated in the Petition.

Petitioner further contends that the point of engine output P_{ICE} is directly related to an engine torque T_{ICE} at a given engine speed N_E. Pet. 36; Ex. 1455 ¶¶ 282–283. Petitioner explains, with supporting evidence, that line L is above the setpoint that is used to delineate whether the vehicle operates in a MOTOR DRIVE mode or ENGINE DRIVE mode, such that when the torque is set equal to a value along line L, the surplus torque above the torque required to propel the vehicle is used to drive the electric motor for charging the battery. Pet. 37; Ex. 1455 ¶¶ 284–286. We are persuaded by Petitioner's showing, and adopt it as our own, that Ibaraki '882, based on the relevant knowledge at the time of the invention, meets the recitation that the engine is operable to provide torque at least equal to the SP to propel the hybrid vehicle and to drive the at least one electric motor to charge the battery.

Claim 229 further recites "wherein a first portion of the torque equal to RL is used to propel the hybrid vehicle, wherein a second portion of the

torque in excess of RL is used to drive the at least one electric motor to charge the battery." Petitioner contends, as explained above with respect to annotated Figure 5, that the surplus engine torque ($\Delta T_{ICE} = T_{ICE} - T_L$) greater than the RL torque (T_L) is produced by the engine for charging the battery. Petitioner further explains that the first portion of engine torque up to the RL (T_L) is used to operate the engine to drive the vehicle and the surplus torque ($T_{ICE} - T_L$) generated by the engine is used to drive the electric motor to charge the battery. Pet. 37–38; Ex. 1455 ¶¶ 287–290. We are persuaded by Petitioner's showing, and adopt it as our own, that Ibaraki '882, based on the relevant knowledge at the time of the invention, meets the recitation that a first portion of the torque equal to RL is used to propel the hybrid vehicle, and a second portion of the torque in excess of RL is used to drive the at least one electric motor to charge the battery.

Claim 229 recites "wherein said operating the engine to charge the battery comprises if the engine is not already running, starting the engine." Petitioner contends that in order for the engine to provide torque to drive the motor for charging, it would have been obvious that the engine is started prior to or during operation in the ELECRICITY GENERATING DRIVE mode. Pet. 38; Ex. 1455 ¶¶ 291–296. We are persuaded by Petitioner's showing, and adopt it as our own, that Ibaraki '882, based on the relevant knowledge at the time of the invention, meets the recitation of starting the engine as claimed.

In summary, we are persuaded by Petitioner's showing, and adopt it as our own, that Ibaraki '882, based on the relevant knowledge at the time of the invention, renders obvious each of claim 229. Patent Owner does not argue for the separate patentability of claim 229.

E. Claims 80, 94, 96, 106–108, 128, 140, and 141

Petitioner contends that claims 80, 94, 96, 106–108, 114, 128, 140, and 141 are unpatentable under 35 U.S.C. § 103(a) as obvious over Ibaraki '882, Frank, and the general knowledge of a POSA. Pet. 40–54. To support its contentions, Petitioner provides detailed explanations as to how the prior art meets each claim limitation of claims 80, 94, 96, 106–108, 114, 128, 140, and 141. *Id*. Petitioner also relies upon the Declaration of Dr. Davis for support. Ex. 1455.

As discussed above, we dismiss the *inter partes* review with respect to claims 80 and 114. However, claims 94, 96, and 106–108 depend either directly or indirectly from claim 80, and claims 128, 140, and 141 depend either directly or indirectly from claim 114. Accordingly, we address the contentions made by Petitioner as to how Ibaraki '882 in combination with Frank renders obvious claims 80 and 114. For the reasons that follow, and notwithstanding Patent Owner's arguments, which we address below, we are persuaded by Petitioner's showing, which we adopt as our own, that claims 94, 96, and 106–108, which depend from claim 80, and claims 128, 140, and 141, which depend from 114, are unpatentable under 35 U.S.C. § 103(a) as obvious over Ibaraki '882 based on the general knowledge of a person of ordinary skill in the art in combination with Frank.

Independent claim 80 is similar to claim 215 discussed above except it does not include the regeneratively charging step. In addition, claim 80 differs from claim 215 in that it adds that the engine is operated (1) when RL>SP for a predetermined time, or (2) when RL>a second setpoint (SP2), where SP2 is a larger percentage of MTO than the first setpoint (SP). Claim 114 is similar to independent claim 215, except it does not include the

regeneratively charging step, but adds that the at least one motor is operated when RL<SP for at least a predetermined amount of time. Claims 80 and 114 also each add the step of "monitoring the RL over time."

Petitioner's showing with respect to claims 80 and 114 is similar to the showing with respect to claim 215 insofar as the same or similar limitations are concerned. *Compare, e.g.,* Pet. 38 with 45. Similar to our determinations above, with respect to claim 215, we determine that Petitioner has sufficiently accounted for the similar limitations of claims 80 and 114. We now address the limitations of claims 80 and 114 that are different from those of claim 215.

Claim 80 recites that the engine is operated (1) when RL>SP for a predetermined time, or (2) when RL>a second setpoint (SP2), where SP2 is a larger percentage of MTO than the first setpoint (SP). Claim 80 also recites "monitoring the RL over time."

Petitioner contends that Ibaraki '882 Figure 10 is illustrative of how the Ibaraki '882 controller continually loops through the flow diagram of Figure 10 to determine the current operating mode ("monitoring RL over time"). Pet. 42; Ex. 1452, 10:66–67; Ex. 1455 ¶¶ 321–324. Petitioner explains that when road load is hovering at or around setpoint, Ibaraki '882 would be toggling between the MOTOR DRIVE and ENGINE DRIVE modes, and that toggling rapidly between the two modes would cause the system to start/stop the engine motor at an unacceptably high frequency and engage/disengage the clutch mechanism at an unacceptably high frequency. Pet. 42–43; Ex. 1455 ¶¶ 331–339. Petitioner argues that a person having ordinary skill in the art would have realized that a time delay would have been needed to ensure the full transition between modes had occurred.

Pet. 43; Ex. 1455 ¶ 339. Petitioner cites to Frank for its disclosure of the use of a time delay in the on-off control of an internal combustion engine in a hybrid vehicle to reduce excessive cycling of the engine's being turned on and off repetitively. Pet. 43; Ex. 1489, 8:32–37. Petitioner articulates reasoning with rational underpinnings on why a person of ordinary skill in the art at the time of the invention would have combined Frank with Ibaraki '882 and the knowledge of a person having ordinary skill in the art. Pet. 40–42; Ex. 1455 ¶¶ 315–319. We have considered all of Petitioner's contentions and supporting evidence with respect to the challenge to claim 80.

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 Frank reasonably would have suggested the limitations of claim 80, and that the combination would have been obvious for the reasons provided by Petitioner. Indeed, in *KSR Int'l Co. v. Teleflex Inc.*, the Supreme Court explained that if a feature has been used to improve one device, and a person of ordinary skill in the art would have recognized that it would improve a similar device in that field or another, implementing that feature on the similar device is likely obvious. *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 417 (2007). Here, a person of ordinary skill in the art would have recognized that Frank would have improved the control routine of Ibaraki '882 to achieve the predictable result of preventing the undesirable frequent cycling between operating modes.

Claim 114 recites the at least one motor is operated "when the RL<the SP for at least a predetermined amount of time." Claim 114 also recites "monitoring the RL over time."

Petitioner contends that Ibaraki '882 Figure 10 is illustrative of how the Ibaraki '882 controller continually loops through the flow diagram of Figure 10 to determine the current operating mode ("monitoring RL over time"). Pet. 42; Ex. 1452, 10:66–67; Ex. 1455 ¶¶ 321–324. Petitioner explains that when road load is hovering at or around setpoint, Ibaraki '882 would be toggling between the MOTOR DRIVE and ENGINE DRIVE modes, and that toggling rapidly between the two modes would cause the system to start/stop the engine motor and engine at an unacceptably high frequency and engage/disengage the clutch mechanism at an unacceptably high frequency. Pet. 44; Ex. 1455 ¶¶ 347–351. Petitioner argues that a person having ordinary skill in the art would have realized that a time delay would have been needed to ensure the full transition between modes had occurred. Pet. 44; Ex. 1455 ¶¶ 352–355. Petitioner cites to Frank for its disclosure of the use of a time delay in the on-off control of an internal combustion engine in a hybrid vehicle to reduce excessive cycling of the engine's being turned on and off repetitively between operating modes of the hybrid vehicle. Pet. 44; Ex. 1489, 8:32–37. Petitioner articulates reasoning with rational underpinnings on why a person of ordinary skill in the art at the time of the invention would have combined Frank with Ibaraki '882 and the knowledge of a person having ordinary skill in the art. Pet. 44–45; Ex. 1455 ¶¶ 357–359. We have considered all of Petitioner's contentions and supporting evidence with respect to the challenge to claim 114.

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 Frank reasonably would have suggested the limitations of claim 114, and that the combination would have been obvious for the reasons provided by Petitioner. Here, a person of ordinary skill in the art would have recognized that Frank would have improved the control routine of Ibaraki '882 to achieve the predictable result of preventing the undesirable frequent cycling between operating modes.

Patent Owner's Contentions

Patent Owner makes the same arguments with respect to claims 80 and 114 that it did with respect to claim 215, 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. 18–47. We have addressed already those arguments, which we determine are not persuasive for the reasons provided above.

Patent Owner additionally argues, with respect to claims 80 and 114, that Frank's hysteresis is speed based as opposed to road load based because Frank uses vehicle speed to determine when to turn the engine on and off. PO Resp. 49–51. As such, Patent Owner argues, Frank does not cure the alleged deficiencies with respect to Ibaraki '882, "which takes the 'instantaneous drive power' as the control variable, not road load." *Id.* at 51. Patent Owner's arguments are misplaced since Petitioner does not rely on Frank to teach a road load "control variable" for controlling the modes of operation of a hybrid vehicle, but instead relies on Ibaraki '882 in light of

the relevant knowledge of a person having ordinary skill in the art at the time of the invention for the feature.

Patent Owner also argues that Petitioner fails to present any rationale for combining Ibaraki '882's power-based system with Frank's speed-based hysteresis teaching. PO Resp. 51–52. We disagree. As Dr. Davis opines, a person having ordinary skill in the art would have understood that the engines of both the Frank and Ibaraki '882 systems would be at risk of frequent cycling. Ex. 1455 ¶ 317. A person having ordinary skill in the art would have recognized that employing a time delay would have been beneficial to a control strategy for switching operational mode of a hybrid vehicle, regardless of whether the control strategy is based on road load or speed. *Id.* ¶¶ 315–319. A person having ordinary skill in the art would have found it obvious to add Frank's time delay to the Ibaraki '882 system, because doing so would have prevented unwanted cycling that may occur when hybrid vehicles switch between operating modes. *See, e.g.*, Pet. 40–42; Ex. 1455 ¶¶ 315–319.

Claims 94, 96, 106–108, 128, 140, and 141

Claims 94, 96, and 106–108 depend either directly or indirectly from claim 80, and claims 128, 140, and 141 depend either directly or indirectly from claim 114. We have reviewed the Petition, along with the supporting evidence, and determine that Petitioner has shown by a preponderance of the evidence that claims 94, 96, 106–108, 128, 140, and 141 are unpatentable under 35 U.S.C. § 103(a) as obvious over Ibaraki '882, Frank, and the general knowledge of a person of ordinary skill in the art.

For example, claim 107, which depends from claim 80, recites "a variable-ratio transmission disposed between the engine and the wheels of

the hybrid vehicle." Claim 108, which depends from claim 107, further recites "wherein said variable-ratio transmission comprises a planetary gear mechanism." For claims 107 and 108, Petitioner contends that Ibaraki '882 describes, in Figures 1 and 8, a transmission 16 and a transmission 116 that are disposed between the engine and the wheels of the hybrid vehicle. Pet. 50; Ex. 1452, 11:6–21, 19:23–28. Petitioner further contends, with supporting evidence, that the transmission is a "variable-ratio" transmission that comprises a planetary gear mechanism. Pet. 50–51; Ex. 1452, 18:34–56, 19:28–32; Ex. 1455 ¶¶ 415–424. We determine that Petitioner has shown by a preponderance of the evidence that claims 107 and 108 would have been obvious based on Ibaraki '882, Frank, and the relevant knowledge of a person having ordinary skill in the art. We also reviewed the Petitioner's showings with respect to claims 94, 96, 106, 128, 140, and 141 and determine that the showing is persuasive.

In summary, and for each one of claims 94, 96, 106–108, 128, 140, and 141, we are persuaded by Petitioner's showing, which we adopt as our own, that Ibaraki '882 in combination with Frank reasonably would have suggested the limitations of claims 94, 96, 106–108, 128, 140, and 141, and that the combination would have been obvious for the reasons provided by Petitioner. Patent Owner does not argue for the separate patentability of these claims.

F. Claims 113 and 146

Claim 113 depends from independent claim 80 and claim 146 depends from independent claim 114. Petitioner contends that claims 113 and 146 are unpatentable under 35 U.S.C. § 103(a) as obvious over Ibaraki '882, Frank, Suga, and the general knowledge of a POSA. Pet. 54–56. To support

its contention, Petitioner provides detailed explanations as to how the prior art meets each claim limitation of claims 113 and 146. *Id*. Petitioner also relies upon the Declaration of Dr. Davis for support. Ex. 1455.

Claim 146 recites "wherein the at least one 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." Claim 113 is similar.

Petitioner explains that a person having ordinary skill in the art at the time of the invention would have understood that the claimed "Federal urban cycle" refers to the "Federal Urban Driving Schedule (FUDS)," which was more commonly known as the "LA4 driving schedule" to test the exhaust gas emissions of an IC engine. Pet. 54 (citing Ex. 1455 ¶¶ 433–440). Petitioner further explains, with supporting evidence, that by 1998 a person having ordinary skill in the art still recognized FUDS as being the LA4 drive cycle for testing electric motors. Pet. 54; Ex. 1454, 1:6–10; Ex. 1455 ¶¶ 433–440).

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. 55; Ex. 1455 ¶¶ 452–454. 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. 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. Pet. 55. Petitioner reasons that a person having ordinary skill in the art would have been motivated to use the teachings of Suga to select an electric motor that could efficiently provide the power requirements necessary to provide the vehicle drive torque during Ibaraki '882's MOTOR DRIVE mode. Pet. 54; Ex. 1455 ¶¶ 441–451.

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 Frank and Suga reasonably would have suggested the limitations of claims 113 and 146, and that the combination would have been obvious for the reasons provided by Petitioner.

Patent Owner's Contentions

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 113 and 146 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. 2407 ¶ 100. 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 modify Ibaraki '882 to operate like an electric vehicle where the motor is sized to provide all of the power requirements. Ex. 2407 ¶ 100. 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. 1452, 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.

G. Claim 231

Claim 231 depends from independent claim 215. Petitioner contends that claim 231 is unpatentable under 35 U.S.C. § 103(a) as obvious over Ibaraki '882, Jurgen, Lateur, and the general knowledge of a POSA.

Pet. 56–59. To support its contention, Petitioner provides detailed explanations as to how the prior art meets each claim limitation of claim 231. *Id*. Petitioner also relies upon the Declaration of Dr. Davis for support. Ex. 1455.

Claim 231 recites receiving operator input specifying a desired cruising speed and controlling the engine torque output and operation of the motor in accordance with variation in the RL to maintain the desired speed. Petitioner contends that Ibaraki '882 discloses a hybrid vehicle that includes a controller that receives operator input signals that include accelerator pedal operation, brake pedal operation and shift lever operation. Pet. 57; Ex. 1452, 20:10–33. Petitioner explains that although Ibaraki 882 does not describe receiving an operator input of a desired cruising speed from a cruise control device, both Lateur and Jurgen describe known cruise control devices which provided a controller with operator input specifying a desired speed. Pet. 57; Ex. 1490, 9:47–50; Ex. 1491, 47. For example, Lateur describes that microprocessor 26 determines whether the speed control switch is producing a cruise control on signal or a cruise control off signal. Ex. 1490, 9:47–50. Petitioner contends, with supporting evidence, that Ibaraki '882 modified to include cruise control would have applied the same control strategy of Ibaraki '882 Figure 11 to maintain substantially constant vehicle speed. Pet. 57–59; Ex. 1455 ¶¶ 471–473, 481–486.

Petitioner articulates reasoning with rational underpinnings on why a person of ordinary skill in the art at the time of the invention would have combined Lateur and Jurgen with Ibaraki '882. Pet. 56–59; Ex. 1455 ¶¶ 471–477. 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 Lateur and Jurgen reasonably would have suggested the limitations of claim 231, and that the combination would have been obvious for the reasons provided by Petitioner. Here, a person of ordinary skill in the art would have recognized that Lateur and Jurgen would have improved the control routine of Ibaraki '882 to achieve the predictable result of providing cruise control to maintain substantially constant vehicle speed.

Patent Owner's Contentions

Patent Owner argues that Jurgen's and Lateur's teachings are insufficient to render claim 231 obvious, because such disclosures are unrelated to controlling the engine output torque in accordance with variation in road load as required by claim 231. PO Resp. 57. Patent Owner's arguments are misplaced since Petitioner does not rely on Jurgen or Lateur to teach controlling the engine output torque in accordance with variation in road load, but instead relies on Ibaraki '882 in light of the relevant knowledge of a person having ordinary skill in the art at the time of the invention for the feature. Pet. 57. In particular, Petitioner explains that Ibaraki '882 executes drive modes for the vehicle based on torque as explained throughout the Petition.

Patent Owner argues that Petitioner's argument regarding the rationale to combine Lateur and Jurgen with Ibaraki '882 is conclusory and ignores the requirements of claim 231. PO Resp. 57–58. We disagree. Petitioner provides a rationale to combine which is not conclusory, nor does it ignore the requirements of the claim. Adding cruise control, a known feature at the time of the invention, to Ibaraki '882's system would have been obvious at the time of the invention for the reasons provided by Petitioner. *See, e.g.,*

Pet. 56 (citing Ex. 1491, 47, cruise control may "improve the vehicle's fuel efficiency value by limiting throttle excursions to small steps.")

III. CONCLUSION[9]

For all of the above reasons, we dismiss the *inter partes* review with respect to claims 80, 93, 99, 114, 127, 132, 139, and 215, and determine that Petitioner has shown by a preponderance of the evidence that claims 94, 96, 106–108, 113, 128, 140, 141, 146, 229, and 231 are unpatentable.

IV. ORDER

It is

ORDERED that the *inter partes* review is *dismissed* with respect to claims 80, 93, 99, 114, 127, 132, 139, and 215;

FURTHER ORDERED that claims 94, 96, 106–108, 113, 128, 140, 141, 146, 229, and 231 of the '634 patent are unpatentable; and

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

[9] In making the obviousness conclusions, we recognize that it is the subject matter of each claim, as a whole, that is evaluated, rather than just each individual limitation, separately. 35 U.S.C. § 103.

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