

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

AM GENERAL LLC,
Petitioner,

v.

UUSI, LLC,
Patent Owner.

Case IPR2016-01049
Patent 5,570,666

Before PHILLIP J. KAUFFMAN, MEREDITH C. PETRAVICK, and
JAMES J. MAYBERRY, *Administrative Patent Judges*.

MAYBERRY, *Administrative Patent Judge*.

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

I. INTRODUCTION

AM General LLC (“AM General” or “Petitioner”) filed a Petition requesting *inter partes* review of claims 10, 11, and 13 of U.S. Patent No. 5,570,666 (Ex. 1001, the “’666 patent”). Paper 1 (“Pet.”). Uusi, LLC (“Uusi” or “Patent Owner”) filed a Preliminary Response. Paper 9 (“Prelim. Resp.”). We permitted AM General to file a Reply to Uusi’s Preliminary Response and Uusi to file a Sur-Reply. See Papers 11, 13.¹ We instituted trial for claims 10, 11, and 13. Paper 14, 27 (“Dec. on Inst.”).

After we instituted trial, Uusi filed a Patent Owner Response. Paper 27 (“PO Resp.”). AM General filed a Reply to Uusi’s Patent Owner Response. Paper 32. AM General filed a Motion to Exclude Evidence (Paper 33), to which Uusi did not file an opposition.

AM General relies on the Declaration testimony of Dr. C. Arthur MacCarley (“Dr. MacCarley”) in support of its Petition and Reply. See Exs. 1003, 1009. Uusi relies on the Declaration testimony of Dr. Bruno Lequesne (“Dr. Lequesne”) in support of its Patent Owner Preliminary Response and Patent Owner Response. See Exs. 2001, 2008.

Oral hearing was conducted on August 2, 2017. The record contains a transcript of the hearing. Paper 41 (“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.

¹ The Reply and Sur-Reply addressed the issue of whether a lawsuit brought under 28 U.S.C. § 1498 against the United States government, to which Petitioner was a noticed third party, triggers the one-year bar under 35 U.S.C. § 315(b). See Paper 11, 1; Paper 13, 1.

AM General has shown, by a preponderance of the evidence, that claims 10, 11, and 13 of the '666 patent are unpatentable.

A. Related Matters

We are informed that the '666 patent is involved in litigation before the U.S. Court of Federal Claims ("CoFC") in *Uusi, LLC. v. United States*, Case No. 1:12-cv-00216 (C.F.C.). Pet. 6–7; see Prelim. Resp. 1–18. We also are informed that Petitioner has requested *inter partes* review of U.S. Patent Nos. 5,729,456; 6,009,369; and 6,148,258, which are related to the '666 patent. Pet. 7; see Prelim. Resp. 18 (identifying IPR2016-01048, IPR2016-1050, and IPR2016-1051).²

B. The '666 Patent

The '666 patent issued November 5, 1996 from an application filed April 1, 1993, which is a continuation-in-part of an application filed October 31, 1991. Ex. 1001, (45), (22), (63). The '666 patent is titled "Glow Plug Controller." *Id.* at (54). The '666 patent describes a glow plug controller system that assists in low temperature engine starting by energizing the glow plugs for pre-set times before and after engine cranking takes place (the pre-glow and after glow periods). *Id.* at 5:62–6:5, 7:6–61, Fig. 4. Once enabled, "[t]he controller . . . reads the engine temperature from an internal controller temperature sensor." *Id.* at 7:6–12. The controller then looks up the corresponding pre-glow and after-glow periods from a table in memory. *Id.* at 7:13–24. If the engine temperature is equal to or less than 11° Celsius, the pre-glow period is 35 seconds and the after-glow period is 60 seconds. *Id.* at 7:25–27. If the engine temperature is

² Trial was not instituted in IPR2016-01048.

above 11° Celsius, the pre-glow and after-glow periods each are zero seconds. *Id.* at 7:27–28.

Figure 4 of the '666 patent is reproduced below.

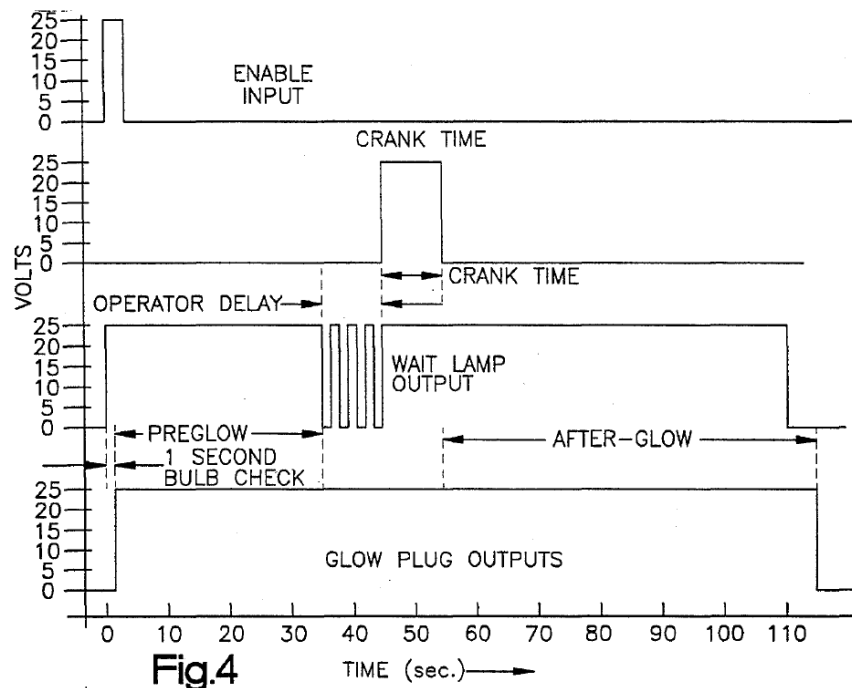


Figure 4 is a timing diagram for 35 seconds of pre-glow, 10 seconds of operator delay, 10 seconds of crank time, and 60 seconds of after glow. *Id.* at 5:29–31. As indicated by the cyclic “wait lamp output” in Figure 4, a wait/pilot lamp flashes at the end of the pre-glow period, prompting the operator to crank the engine. *Id.* at 7:41–44. The operator delay shown in Figure 4 is the time between the end of the pre-glow period and the low-to-high transition of the crank input (indicating that the operator has begun cranking the engine).³ *Id.* at 7:44–49. When the crank input undergoes a high-to-low voltage transition (indicating that the operator has stopped cranking the engine), the after-glow period begins. *Id.* at 7:49–51.

³ “The cranking period is the time that the cranking input is high.” *Id.* at 7:47–49.

C. Challenged Claims

Claims 10, 11, and 13 of the '666 patent are reproduced below.

10. Apparatus for governing application of electrical power to a one or more glow plugs in a diesel engine, the diesel engine having associated therewith a starter for starting the engine, said apparatus comprising:

a) a user actuated switch for applying power to the glow plugs prior to starting the engine;

b) user actuated apparatus and circuitry for actuating said starter and for producing a cranking signal only when said starter is operating;

c) a temperature sensor mounted to the diesel engine for monitoring an ambient temperature prior to starting of the diesel engine; and

d) glow plug control circuitry comprising:

i) a programmable controller electrically connected to said temperature sensor and to said user actuated switch having a stored program that responds to actuation of said switch by calculating a [pre-glow] period if a sensed temperature as indicated by a signal from the temperature sensor is below a first set point temperature; and

ii) output circuitry coupled to the programmable controller responsive to the cessation of said cranking signal to apply electrical power to said glow plug during an afterglow period initiated in response to cessation of said cranking signal.

Ex. 1001, 16:20–44.

11. The apparatus of claim 10, further comprising:
circuitry for applying electrical power to said glow plug during engine cranking as indicated by the cranking signal.

Ex. 1001, 16:45–48.

13. The apparatus of claim 10, further comprising:
apparatus and circuitry for providing an indication of the termination of the [pre-glow] period.

Ex. 1001, 16:49–51.

D. The Asserted Prior Art

We instituted *inter partes* review of the '666 patent on two asserted grounds of unpatentability, which rely on the following three references:

Yasuhara	US 4,491,100	Jan. 1, 1985	Ex. 1004
Demizu	US 4,566,410	Jan. 28, 1986	Ex. 1005
Masaka	US 4,939,347	July 3, 1990	Ex. 1006

E. Asserted Grounds of Unpatentability

We instituted *inter partes* review of claims 10, 11, and 13 of the '666 patent on the following two grounds of unpatentability: (i) claims 10, 11, and 13 under 35 U.S.C. § 103(a) as obvious over Yasuhara and Masaka and (ii) claims 10, 11, and 13 under 35 U.S.C. § 103(a) as obvious over Demizu and Masaka. *See* Dec. on Inst. 27.

II. ANALYSIS

A. Statutory Bar under 35 U.S.C. § 315(b)

Section 315(b) of the patent statute (Title 35) provides:

PATENT OWNER'S ACTION.—An *inter partes* review may not be instituted if the petition requesting the proceeding is filed more than 1 year after the date on which the petitioner, real party in interest, or privy of the petitioner is *served with a complaint alleging infringement of the patent*. (Emphasis added.)

Uusi sued the U.S. government in the Court of Federal Claims to recover reasonable and entire compensation from the government for its alleged use or manufacture of an invention covered by the '666 patent without a license under 28 U.S.C. § 1498(a). *See, e.g.*, Pet. 6–8 (identifying the Court of Federal Claims litigation and stating that “[o]n March 17, 2014, the U.S. government was served with an amended complaint in the CoFC seeking compensation pursuant to 28 U.S.C. § 1498 for the unauthorized use or manufacture of inventions allegedly covered by the '666 [p]atent”). AM

General provides that it is “a government contractor that sold to the government products allegedly covered by the ’666 [p]atent” and is “a noticed party in [the Court of Federal Claims] action pursuant to CoFC Rule 14(b).” Pet. 8.

In our Decision on Institution, we determined that, at that stage of the proceeding, the record evidence did not support a conclusion that the Petition was time barred based on the government being served with a complaint in the Court of Federal Claims action more than one year prior to the filing date of the Petition. See Dec. on Inst. 2–9. Uusi contends that our conclusion was incorrect as a matter of law. PO Resp. 4. Specifically, Uusi contends that the Decision on Institution improperly construes Section 315(b) because the U.S. government is a privy to AM General or, alternatively, a real party in interest to this proceeding, and was served with a complaint alleging infringement of the ’666 patent more than one year prior to the filing date of the Petition. We look at this issue anew, on the complete record before us, taking each of these contentions in turn.

1. The U.S. Government Allegedly as AM General’s Privy

Uusi contends that “the breadth of § 315(b) indicates that it is intended to substantially narrow a patent owner’s exposure to fending off invalidity attacks on multiple fronts” and we “must [interpret and apply 315(b)] in a way that realizes this legislative intent as expressed in the plain language of the statute.” PO Resp. 6. To this end, Uusi argues that the concept of “privity” and the term “privity” in the statute “was understood to mean essentially any ground on which a party can be bound by the actions of another based upon the substantive legal relationship between the parties.” *Id.* (citing *Taylor v. Sturgell*, 553 U.S. 880, 894 n.8 (2008)). Uusi identifies

two specific substantive legal relationships between AM General and the U.S. government that it contends creates privity between these two parties: (1) the party to a proceeding and a nonparty have a pre-existing substantive relationship imposed by law, or (2) a special statutory scheme is put in place by Congress to foreclose successive litigation in a given area.” *Id.* at 6–7 (citing *Taylor*, 553 U.S. at 893–95).

Uusi argues that the U.S. government assumed liability for AM General’s infringement of the ’666 patent under 28 U.S.C. § 1498 and that this statutory regime establishes a special relationship between the U.S. government and AM General such that the government is AM General’s *designated representative*. PO Resp. 7. Uusi argues that “[a] person is represented by a party who is . . . an official or agency invested by law with authority to represent the person’s interest. *Id.* at 7–8; *cf. Taylor*, 553 U.S. at 894 (“[N]onparty preclusion may be justified based on a variety of pre-existing ‘substantive legal relationship[s]’ between the person to be bound and a party to the judgment,” such as relationships imposed under property law.).

Uusi further contends that AM General is actively participating in the Court of Federal Claims proceeding as a third party defendant. PO Resp. 8. Uusi argues that, in exchange for this ability to participate at the Court of Federal Claims, Section 315(b) prevents AM General from bringing an *inter partes* review more than one year after the government was served with a complaint in the Court of Federal Claims—that is, that Section 315(b) represents a special statutory scheme put in place by Congress to foreclose successive litigation in a given area. PO Resp. 9; *see also Taylor*, 553 U.S. at 895 (“[I]n certain circumstances a special statutory scheme may

‘expressly foreclos[e] successive litigation by non-litigants . . . if the scheme is otherwise consistent with due process.’”). Uusi argues that, to conclude otherwise, frustrates the purpose of 315(b) of preventing the proliferation of *inter partes* review proceedings against a patent owner. *Id.* Uusi also argues that the U.S. government is AM General’s privy as AM General not only has the opportunity to control this *inter partes* review, it is actually controlling the proceeding. *Id.* at 10.

Upon our review of the complete trial record, we conclude that the U.S. government is not in privity with AM General with respect to the Court of Federal Claims proceeding. The Office Patent Trial Practice Guide provides guidance as to the type of relationship that would create privity between the parties—“privity is essentially a shorthand statement that collateral estoppel is to be applied in a given case.” 77 Fed. Reg. 48,756, 48,759 (Aug. 14, 2012). That is, our privity “analysis seeks to determine whether the relationship between the purported ‘privy’ and the relevant other party is sufficiently close such that both should be bound by the trial outcome and related estoppels.” *Id.* Our Trial Practice Guide notes that multiple factors are relevant to the inquiry of whether an entity is another entity’s privy. *Id.* (citing *Taylor*, 553 U.S. at 893–95).

We determine that the U.S. government is not AM General’s statutorily-appointed representative in the Court of Federal Claims proceeding. Proceedings under 28 U.S.C. § 1498 do not establish the government as an infringing contractor’s *legal or designated representative*. Instead, the proceeding provides a mechanism for a patent owner to seek reasonable and entire compensation from the government for the government’s taking of a license to the patent owner’s patent. *See, e.g.,*

Motorola, Inc. v. U.S., 729 F.2d 765, 768 (Fed. Cir. 1984) (“The theoretical basis for . . . recovery [under 28 U.S.C. § 1498] is the doctrine of eminent domain. In this context, the United States is not in the position of an ordinary infringer, but rather a compulsory, nonexclusive licensee.”) (internal citations omitted). That is, the government is not representing the contractor’s interests, the government is representing its own interests as a nonexclusive licensee. Although it is true that 28 U.S.C. § 1498 shields a contractor from an infringement suit, nothing in the statute *designates* the government as *representing* the contractor’s interests. Significantly, the government can end a Court of Federal Claims proceeding without the contractor’s permission. *See, e.g.*, Tr. 49:14–18 (“JUDGE MAYBERRY: . . . if the government wants to end the proceedings -- settle them with the complainants, can the third-party defendant continue the case, if the government steps away? MR. KESAN: I don’t believe so, Your Honor.”).

We also determine that Section 315(b) is not the type of special statutory scheme that “may ‘expressly foreclos[e] successive litigation by non-litigants . . . if the scheme is otherwise consistent with due process’” as identified in *Taylor*. *Taylor*, 553 U.S. at 895. The Supreme Court’s examples for this circumstance—such as bankruptcy, probate, and *quo warranto* actions—illustrate that the intended “special statutory scheme” is directed to those types of actions that may be brought on behalf of the public at large. *See id.*

A common consideration in determining whether a non-party (or, in this case, a nominal third party) is in privity with a litigant and, as such, should be collaterally estopped from re-litigating an issue, is “whether the nonparty “‘assume[d] control’ over the litigation in which” that issue was

decided. *Taylor*, 553 U.S. at 895. We do not discern any evidence in the record, nor does Uusi point us to any persuasive evidence, that suggests that AM General *exercises control* over the Court of Federal Claims proceeding—Uusi’s evidence merely demonstrates that AM General actively participates in the matter. *See, e.g., Penda Corp. v. U.S.*, 44 F.3d 967, 970 (Fed. Cir. 1994) (“A third-party defendant noticed under Rule 14(a)(1) ‘may assist the [Government] in the defense of the case, or it may offer additional evidence on its own behalf and advance such legal contentions as it deems appropriate in the protection of its interest.’ The grant of third-party defendant status under Rule 14, however, does not affect the jurisdiction of the Court of Federal Claims,” *which is limited to actions against the government.*).

Penda is instructive to our analysis. In determining that a third-party defendant (Cadillac) lacked standing to appeal a judgment from a Court of Federal Claims proceeding against the government, the Federal Circuit stated that “Penda could not assert issue preclusion in a subsequent infringement action against Cadillac because Cadillac was only a nominal defendant before the Court of Federal Claims.” *Penda*, 44 F.3d at 972. As we stated above, the touchstone of privity is collateral estoppel and in *Penda*, the Federal Circuit states that Cadillac would not be collaterally estopped from defending an infringement action by Penda even though Penda had prevailed against the government in a matter covering the same issues.

Uusi attempts to limit *Penda* to the issue of whether a third-party defendant had Article III standing to appeal. *See* PO Resp. 10. We determine, however, that the Federal Circuit’s analysis is instructive in this

case. Further, the fact that AM General could not appeal a decision from the Court of Federal Claims proceeding demonstrates that such a proceeding does not offer AM General a full and fair opportunity to litigate the issues in the § 1498 proceeding. *See Taylor*, 553 U.S. at 892 (indicating that a “full and fair opportunity to litigate” provides a party with its “own day in court” and not providing this opportunity cuts against applying *res judicata*).

With respect to the issue of controlling this *inter partes* review, Uusi’s contention that AM General is exercising actual control over the matter is misplaced. AM General is the entity that filed the Petition. As such, the question regarding control of this proceeding is whether the other entity (the government) is exercising certain control over the *inter partes* review, such that those actions elevate the other entity to at least a privy of the party that filed the petition (AM General).

In conclusion, we determine that AM General and the U.S. government are not privies within the meaning of Section 315(b), based on their relationship in the Court of Federal Claims proceeding. Significant to our determination is that AM General may not be collaterally estopped from re-litigating issues of invalidity decided in the Court of Federal Claims proceeding, as that proceeding does not give AM General a full and fair opportunity to litigate all issues. Accordingly, the Petition is not barred under 35 U.S.C. § 315(b).

2. The U.S. Government Allegedly as a Real Party in Interest to this Proceeding

Alternatively, Uusi argues that Section 315(b) bars the Petition because the U.S. government is a real party in interest to this proceeding. PO Resp. 11. As an initial matter, Uusi contends that “something less must

be required to establish a real party in interest” as compared to a privy. *Id.* As we make clear in our Trial Practice Guide, the concept of a real party in interest is less expansive than that for a privy. *See* 77 Fed. Reg. 48,756, 48,759 (“The notion of ‘privy’ is more expansive, encompassing parties that do not necessarily need to be identified in the petition as a ‘real party-in-interest.’”). That is, those parties that would be considered real parties in interest represent a smaller set than those parties that would be considered privies.

Uusi contends that “[a] real party in interest is simply a person . . . who generally, but not necessarily, benefits from the action’s final outcome.”⁴ PO Resp. 11. Uusi argues that “[t]he U.S. will potentially benefit from the outcome of these proceedings.” *Id.* at 12. Uusi also argues that the fact that the government does not control this *inter partes* review is not relevant to the real party in interest inquiry, but only to the privy inquiry. *Id.* at 13.

“Whether a party who is not a named participant in a given proceeding nonetheless constitutes a ‘real party-in-interest’ . . . to that proceeding is a highly fact-dependent question” with no “bright line test,”

⁴ Uusi seems to argue that because substantive law designates the government to prosecute the infringement action in the Court of Federal Claims to the benefit of AM General, that circumstance makes the government a real party in interest. *See* PO Resp. 12. Such an assertion focuses on the wrong proceeding. In a real-party-in-interest inquiry, the focus is on the *inter partes* review proceeding. *See Petroleum Geo-Servs. Inc. v. WesternGeco LLC*, IPR2014–01475, slip op. at 52 (PTAB July 11, 2016) (Paper 71) (“The determination of whether a party is an RPI is a ‘highly fact-dependent question,’ in which the focus is on the party’s relationship to the *inter partes* review pending before the Board.”) (non-precedential).

and is assessed “on a case-by-case basis.” 77 Fed. Reg. at 48,759. The Office Patent Trial Practice Guide provides guidance regarding factors to consider in determining whether a party is a real party-in-interest. *See* 77 Fed. Reg. at 48,759–60. Considerations may include whether a non-party “funds and directs and controls” an *inter partes* review petition or proceeding. *Id.* at 48,760. Additional relevant factors include: the non-party’s (that is, the government’s) relationship with the petitioner; the non-party’s relationship to the petition itself, including the nature and/or degree of involvement in the filing; and the nature of the entity filing the petition. *Id.*

We discern no evidence to suggest that the U.S. government funds or controls this *inter partes* review. Similarly, we discern no evidence to suggest that the U.S. government desires *inter partes* review of the ’666 patent and is using AM General as a surrogate petitioner to achieve that review. The sole evidence in support of Uusi’s contention is the involvement of AM General in the Court of Federal Claim’s proceeding and AM General’s indemnification of the government for its infringement. Although the government may benefit from a favorable result in this *inter partes* review, this fact alone is insufficient to elevate the government to a real party in interest. *See, e.g., U.S. Dep’t of Homeland Sec. v. Golden*, IPR2014-00714, slip op. at 11 (PTAB Oct. 1, 2015) (paper 35) (“A party also is not considered a real party in interest in an *inter partes* review solely because it is a joint defendant with a petitioner.”) (non-precedential). Indeed—as for AM General indemnifying the government—this fact cuts against the government as a real party in interest, as its liability for any infringement of the ’666 patent is borne by AM General. This fact also

limits the government's interest in a favorable result in this *inter partes* review.

Further, as we specifically addressed in our Trial Practice Guide, “[t]he typical common-law expression of the ‘real party-in-interest’ (the party ‘who, according to the governing substantive law, is entitled to enforce the right’) does not fit directly into the AIA trial context,” which also cuts against Uusi's argument that the government is a real-party-in-interest in this proceeding. *See* PO Resp. 11. Uusi asserts that “the real party in interest is the person for whose benefit the action is prosecuted.” *Id.* As an indemnitor, this proceeding is prosecuted for AM General's benefit, not the government's. Further, the fact that the government is entitled to have petitioned for an *inter partes* review of the '666 patent does not convert the government into a real party in interest. Any person, other than the patent owner, may petition for an *inter partes* review of a patent. *See* 35 U.S.C. § 311(a).

Accordingly, we do not agree with Uusi that the U.S. government is a real party in interest in this proceeding. As such, the Petition is not barred under 35 U.S.C. § 315(b).

B. Level of Ordinary Skill in the Art

AM General contends that a person having ordinary skill in the art to which the '666 patent pertains:

would have either (1) a Ph.D. in electrical engineering, with a focus on designing power control circuits and some familiarity with vehicle electrical systems; (2) a Master's degree in electrical engineering, and two years of experience designing power control circuits and some familiarity with automotive vehicle electrical systems; (3) a Bachelor's degree in electrical engineering and four years of experience designing power

control circuits and some familiarity with automotive vehicle electrical systems; or (4) some undergraduate engineering coursework including at least one introductory course to electrical engineering, ten years of relevant work experience including 6 years of experience designing power control circuits, and some familiarity with automotive vehicle electrical systems.

Pet. 15 (citing Ex. 1003 (Decl. of C. Arthur MacCarley Ph.D.) ¶ 10). Uusi's declarant, Dr. Bruno Lequesne, states that the appropriate level of ordinary skill in the art is:

at least a bachelor's degree in electrical engineering or its equivalent, and approximately two to three years [of] experience in automotive technology and/or the design and development of open loop and closed loop automotive electronic systems. More education could substitute for experience, and that experience, especially when combined with training, could substitute for formal college education.

Ex. 2001 ¶ 14.

The level of ordinary skill in the art is a factual issue underlying a determination of whether a claim is obvious and how a claim term is construed. *See, e.g., Graham v. John Deere Co.*, 383 U.S. 1, 17 (1966) (identifying “the level of ordinary skill in the pertinent art” as one of “several basic factual inquiries” in an obviousness analysis). Factual indicators of the level of ordinary skill in the art include “the various prior art approaches employed, the types of problems encountered in the art, the rapidity with which innovations are made, the sophistication of the technology involved, and the educational background of those actively working in the field.” *Jacobson Bros. v. United States*, 512 F.2d 1065, 1071 (Ct. Cl. 1975); *see also Orthopedic Equip. Co. v. United States*, 702 F.2d 1005, 1011 (Fed. Cir. 1983) (quoting with approval *Jacobson Bros.*).

We find that the prior art of record is primarily directed to control systems for glow plugs used in a diesel-powered internal combustion engine. *See, e.g.*, Ex. 1004, Abstract (describing a device for activating and deactivating glow plugs that employs a microcomputer); Ex. 1005, Abstract (describing a diesel engine glow plug controlling device); Ex. 1006, Abstract (describing a controller for energizing glow plugs for a diesel engine).

The types of problems encountered in the prior art include providing stable power to the control system and glow plugs during glow plug operation, where the length of time of operating the glow plugs is a function of engine temperature. *See* Ex. 1004, 1:10–27; Ex. 1005, 3:7–20; Ex. 1006, 3:17–20.

We additionally find that innovation is not rapid in this area. For example, the record includes evidence that it was common in the prior art to have glow plug controller circuits. *See* Ex. 1001, 1:44–45; Ex. 1002, 47 (providing prior art Figure “A”); Ex. 2001 ¶ 21 (recognizing that glow plugs with solid state controllers were well known); Ex. 1003 ¶ 18 (“[G]low plug control requirements based on temperatures, time and battery voltage have been well known for as long as diesel engines have been used in automobiles.”). Also, the technology encompasses basic electrical control structures operated by a microcomputer. *See, e.g.*, Ex. 1003, Figs. 1 and 2 (depicting control system, including computer processing unit), Ex. 1004, Fig. 3 (same); Ex. 1003 ¶ 18 (“[W]ith the introduction of cheaper and improved electronic circuitry in the late 1970s and early 1980s, glow plug controllers began to be implemented using electronic components.”). Finally, record evidence demonstrates that individuals in this field typically have electrical engineering degrees. *See, e.g.*, Ex. 1003 ¶ 10 (indicating that

a person having ordinary skill in the art would have an electrical engineering degree); Ex. 2001 ¶ 14 (same).

Finally, the level of ordinary skill identified by each party is comparable. Basically, both parties contend that a person having ordinary skill in the art would have a Bachelor degree in Electrical Engineering and either 2 to 3 or 4 years of experience, with less experience required for a person with an advanced degree or more experience required for a person with no degree. *Cf.* Ex. 1003 ¶ 10 *with* Ex. 2001 ¶ 14.

Based on our evidentiary findings, we find that the level of ordinary skill in the art is a Bachelor's degree in electrical engineering and three to four years of experience designing control circuits or automotive electronic systems, with additional education substituting for the prescribed work experience or additional experience substituting for a formal college degree.

C. Claim Construction

In an *inter partes* review, in construing claim terms in an expired patent we apply a district court-type claim construction, that is, in accordance with *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005) (en banc). *See* 37 C.F.R. § 42.100(b); *see also In re CSB–Sys. Int'l, Inc.*, 832 F.3d 1335, 1341 (Fed. Cir. 2016) (“[W]hen an expired patent is subject to reexamination, the traditional *Phillips* construction standard attaches.”) (citing *In re Rambus*, 694 F.3d 42, 46 (Fed. Cir. 2012)); *Black & Decker, Inc. v. Positec USA, Inc.*, 646 F. App'x 1019, 1024 (Fed. Cir. 2016) (unpublished) (holding that in an *inter partes* review, “[c]laims of an expired patent are given their ordinary and customary meaning in accordance with our opinion in [*Phillips*]”). Both parties agree that the '666 patent has expired. *See* Pet. 14; PO Resp. 20. Therefore, “[i]n determining the

meaning of the disputed claim limitation, we look principally to the intrinsic evidence of record, examining the claim language itself, the written description, and the prosecution history, if in evidence.” *DePuy Spine, Inc. v. Medtronic Sofamor Danek, Inc.*, 469 F.3d 1005, 1014 (Fed. Cir. 2006) (citing *Phillips*, 415 F.3d at 1312–17).

1. “*cranking signal*”

Claim 10 recites, in relevant part, a “user actuated apparatus and circuitry for actuating said starter and for producing *a cranking signal* only when said starter is operating.” Ex. 1001, 16:26–28 (emphasis added). In our Decision on Institution, we construed the term “cranking signal,” under the *Phillips* regime, to mean “a signal that is indicative of the starter motor being actually cranked.” Dec. on Inst. 14. Both parties ostensibly agree with this construction, yet they disagree as to the proper scope of the construction. See PO Resp. 21 (“Patent Owner does not dispute the Board’s construction.”); Tr. 9:11–13 (“Petitioner is . . . okay with this construction to the extent it means a signal that is indicative of the starter motor being actually cranked by the operator.”).

Specifically, Uusi contends that our construction limits the signal to a time when the starter motor is engaged with the crankshaft of the engine and is turning the crankshaft. See, e.g., PO Resp. 39 (“Finally, the starter motor is fully engaged with the ring gear and turns. Only then does the starter motor actually start cranking the engine.”) (internal citations omitted); Tr. 60:22–61:2 (“[T]here are numerous steps that take place from the time you first turn the key until the time that that actual cranking takes place, which is at the point in time when the signal -- when the cranking signal is sent.”); Tr. 61:21–62:1 (“[T]he signal ceases when the starter motor stops cranking the

engine. And that happens before the key switch goes from ST back to ON. So the -- that's the process that's known as disengagement.”). AM General contends that the proper construction for cranking signal is “a signal indicative of power being supplied to the starter.” Reply 5. That is, the signal that is indicative of the starter motor being actually cranked is a signal that indicates that an operator has turned a key (or other actuated a switch) and supplied power to the starter. See Tr. 11:18–22 (“JUDGE MAYBERRY: . . . your position is that you're okay with . . . the cranking the engine part [of the construction] as long as cranking the engine means that power has been sent to the starter? MS. JANTZI: Correct.”). Accordingly, we must clarify our construction. Specifically, the issue before us is whether the starter is operating, as recited in claim 10, when the solenoid is energized, or only when the starter motor is turning the engine crankshaft.

“[T]he words of a claim ‘are generally given their ordinary and customary meaning,’” that is, “the meaning that the term would have to a person of ordinary skill in the art in question at the time of the invention.” *Phillips*, 415 F.3d at 1312–1313. “[T]he context in which a term is used in the [claim at issue] can be highly instructive” and “[o]ther claims of the patent in question . . . can also be valuable sources of enlightenment as to the meaning of a claim term.” *Id.* at 1314. Claim 10 requires a “user actuated apparatus and circuitry for . . . producing a cranking signal” and that signal is produced “only when [the] starter is operating.” Ex. 1001, 16:26–28. Claim 10 also requires “glow plug control circuitry comprising: . . . output circuitry coupled to the programmable controller responsive to the cessation of said cranking signal to apply electrical power to said glow plug during an

afterglow period initiated in response to cessation of said cranking signal.” *Id.* at 16:32–44. Independent claim 14, which is not subject to this proceeding, includes similar language with respect to the cranking signal. *See id.* at 16:56–18:10. Claim 11, which depends from claim 10, further recites “circuitry for applying electrical power to said glow plug during engine cranking as indicated by the cranking signal.” *Id.* at 16:45–48.

From the context of the claims, we understand that the cranking signal is produced when the *starter* is operating. We also understand that electric power is supplied to the glow plugs during engine cranking, which is indicated by the cranking signal and that power is also supplied to the glow plugs during an afterglow period when the cranking signal ceases. That is, the express claim language does not specify that it is the starter *motor* that is operating nor does it state anything about the crankshaft of the engine turning. With respect to the claim language, Uusi argues that the language distinguishes actuating (that is, powering) the starter and producing a cranking signal. *See* PO Resp. 23.

Phillips instructs us that the Specification is usually “the single best guide to the meaning of a disputed term.” *Phillips*, 415 F.3d at 1315. The ’666 patent’s Specification provides:

An ENGINE CRANK signal from the starter solenoid. A low (less than 1 volt DC) to high (greater than 10 volts DC) signal transition marks the end of operator delay. (The operator is cranking the engine.) The controller then waits for the high to low transition, at which time the pre-glow period terminates, if the pre-glow period is in effect, and the after glow period shall begin. This input shall sink less than 100 mA.

Ex. 1001, 6:38–45. The Specification further states:

According to another feature of the invention, a system is provided for governing application of electrical power to a glow

plug in a diesel engine, the engine including means for cranking the engine for starting, the system having a user control switch, and user controlled apparatus and circuitry for actuating the cranking means, along with circuitry for providing a cranking signal only when the cranking means is providing engine cranking. The glow plug controller includes circuitry actuatable by the user controlled switch for applying electrical power to the glow plug in a [pre-glow] period, and circuitry responsive to cessation of the cranking signal to apply electrical power to the glow plug in an afterglow period, the afterglow period being defined as initiating in response to cessation of the cranking signal. This aspect to the invention provides a “customized” initiation for the afterglow period which is substantially coincident with engine starting. Thus, the [pre-glow] period is terminated upon engine starting, and the afterglow period is begun when the engine starts. This has the advantage of adapting the application of electric power in the afterglow mode following starting of the engine, after which application of the power in a mode different from the [pre-glow] mode is advantageous.

Id. at 4:45–68.

AM General contends that the language from column 6 of the Specification, reproduced above, describes the ENGINE CRANK signal—which the parties agree is the recited cranking signal—as a signal from the starter solenoid and indicates that an *operator* is cranking the engine. Reply 6; *see also* Tr. 9:11–16 (indicating that our preliminary construction of cranking signal “is okay” provided that the signal is “indicative that the operator is cranking the engine, which is verbatim from the only section in the patent that actually discusses the cranking signal.”).

Uusi directs us to the language in column 4 of the ’666 patent, indicating that it “explains that [the ’666 patent’s] system includes ‘circuitry for providing a cranking signal only when the cranking means is providing engine cranking.’” PO Resp. 24. Uusi argues that cranking the engine is

different from powering the starter. *See* Tr. 53:18–20. That is, Uusi argues that “column 4, lines 45 through 68 [of the Specification] has a lot of explanation of what the cranking signal actually is. And it consistently states that the [cranking signal] means . . . [it is] providing engine cranking.” *Id.* at 53:20–54:1.⁵

We find that certain figures from the ’666 patent Specification are instructive and we reproduce a representative one of these figures (Figure 6), below.

⁵ AM General argued that Uusi did not rely on the disclosure in column 4 of the ’666 patent in its Patent Owner Response and, as such, any argument referencing this section of the Specification at oral argument is improper. *See* Tr. 55. We find that Uusi sufficiently referenced the disclosure in column 4 of the ’666 patent in its claim construction argument. *See, e.g.*, PO Resp. 24 (citing Ex. 1001, 4:45–53).

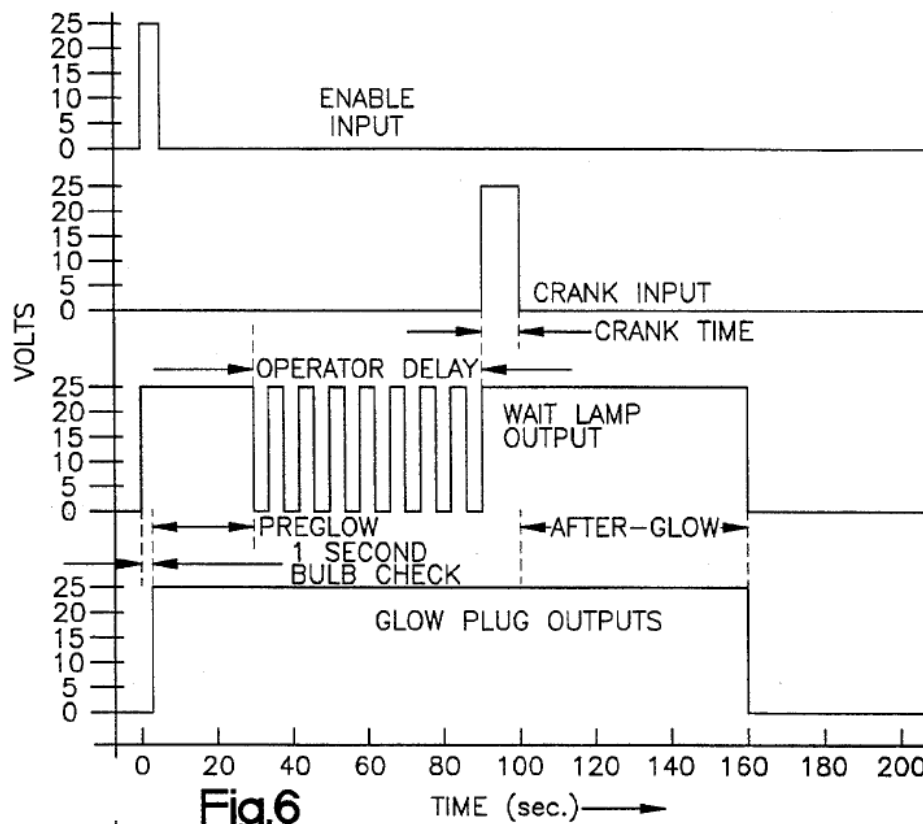


Fig.6

Figure 6 depicts “a timing diagram for 35 seconds of pre-glow, 55 seconds of operator delay, 10 seconds of crank time, and 60 seconds of after-glow.” Ex. 1001, 5:35–37; *see also id.*, Figs. 4, 10 (depicting similar timing diagrams).⁶ Significant to our inquiry here, the crank signal (“CRANK INPUT”) voltage rises from 0 volts to 25 volts *at the same time* that operator delay ends (time equal to 90 seconds). Operator delay is the time from the end of the pre-glow time period to when the operator begins to crank the engine. *See id.* at 6:38–41. The operator is prompted to crank the engine by a wait/pilot lamp, which begins to flash at the end of the pre-glow period. *Id.* at 7:41–57. That is, Figure 6 indicates that the cranking signal is initiated

⁶ Figure 4 of the '666 patent is reproduced *supra*.

when the operator turns the run/start switch to “start” to begin the engine starting sequence. *See* Reply 8–9.

Uusi contends that the Figures of the ’666 patent do not reflect the time from when an operator turns the run/start switch to the “start” position and when the starter motor actually begins to crank the engine. *See* Tr. 61:5–6 (addressing Figure 6). Uusi does argue that circuitry on the starter solenoid determines when the starter motor is actually turning the crankshaft of the engine. *See* Tr. 64:1–15; *cf.* Ex. 1009 ¶ 16 (“Tellingly, [the] ’666 [patent] lacks any discussion of a sensor for measuring movement of the starter motor.”).

As we indicated above, claim 10 requires that, at the cessation of the cranking signal, the after-glow period begins. Uusi contends that the cranking signal ceases when the starter motor is no longer cranking the engine—a time before the run/start switch is returned to “run” position. PO Resp. 50. Uusi contends that the starter motor disengages from the crankshaft when the crankshaft reaches a rotation rate of about 200 revolutions per minute. *Id.* Uusi argues that when this disengagement happens, “the starter motor is still powered or actuated and the key switch is still in the ‘ST’ position, but the starter motor is detached from and no longer cranking the engine and is thus no longer producing the claimed ‘cranking signal.’” *Id.*

Phillips further instructs us that we “should also consider the patent’s prosecution history” to the extent that it is in evidence. *Phillips*, 415 F.3d at 1317. During prosecution, the patentee amended the claim that would issue as claim 10 to replace the term “engine cranking means” with the term “starter.” *See* Ex. 1002, 227–28 (showing the amendment for claim 14,

which would issue as claim 10). As AM General points out, the patentee chose to use the term “starter,” not “starter motor.” See Reply 11.

We may also consider extrinsic evidence, although such evidence “is ‘less significant than the intrinsic record in determining “the legally operative meaning of claim language.”” *Phillips*, 415 F.3d at 1317. In support of Uusi’s construction, its declarant, Dr. Lequesne, provides a tutorial on how a typical starter works. See Ex. 2001 ¶¶ 36–43. As Dr. Lequesne declares, when an operator moves the run/start switch to start, the starter solenoid is energized. See *id.* ¶ 37. At a time after the solenoid is energized, the starter motor turns and a pinion engages with the engine crankshaft. See *id.* ¶¶ 42, 44 (“This delay consists of the time for the solenoid armature to move, the pinion to engage the crankshaft, and the closing of the main power relay to the starter motor.”). It is this step (the starter motor turning and a pinion engaging with the engine crankshaft) when the starter motor is actually cranking the engine. *Id.* ¶ 44. This process is depicted in Ex. 2004; see also Ex. 2008 ¶ 43 (“Positioning the crank signal at the starter solenoid as taught in the ’666 Patent provides an indication that not only the operator wishes to crank, but that the starter motor actually receives power.”).

Dr. MacCarley, AM General’s declarant, states that a person having ordinary skill in the art would have monitored power being sent to the starter solenoid and that such a signal “would be supplied only when the starter is operating, i.e., powered to function, because when the ignition/starting switch [] is opened the second switch (e.g., solenoid switch) immediately opens.” Ex. 1009 ¶ 23. Dr. MacCarley relies on Exhibit 1010 to support his

testimony. *See id.* Exhibits 1010 and 2004 provide similar information on the basic operations of a starter.

In consideration of this intrinsic and extrinsic evidence, we construe the term “cranking signal” to mean “a signal indicative of the starter operating.” That is, we modify our preliminary construction to clarify our interpretation of the claim. We include the term “starter,” rather than “starter motor,” to be consistent with the language of claim 10 and the prosecution history. We also change “being actually cranked” to “operating” to further comport with the actual language of the claim. Although the term includes the word “cranking,” the language of claim 10 expressly specifies that the cranking signal is produced when the starter is operating, without limiting that operation to turning the crankshaft of the engine.

To be clear, we determine that the starter is operating when the starter is first powered and ceases operating when the starter is no longer powered. This determination is consistent with the Specification, which equates when an operator moves the run/start switch to “start” position with “cranking the engine.” *See* Ex. 1001, 6:38–45. Also, Figures 4, 6, and 10 of the ’666 patent show that the cranking signal goes from 0 volts to 25 volts at the same time that operator delay ends, which is when the operator moves the run/start switch to “start” position. *See id.*, Figs. 5, 6, 10, 7:37–49. Further, we find no disclosure in the Specification that describes circuitry that determines when the starter motor component of the starter is actually engaged with the engine crankshaft and turns the crankshaft. More significantly, we find no disclosure of circuitry that determines when the starter motor disengages

from crankshaft, causing a cessation of the cranking signal, even though the starter motor would still be operating.

We do not agree with Uusi's argument that, by reciting both "user actuated apparatus and circuitry *for actuating said starter and for producing a cranking signal* only when said starter is operating," that claim 10 distinguished a signal indicative of the starter being powered from producing a cranking signal. Apparatus and circuitry for actuating a starter represents structure that initiates and sends power to the starter. Apparatus and circuitry for producing a cranking signal is structure that produces a signal to be sent to the controller that indicates that the starter is powered and operating.

We also do not agree with Uusi's argument that the language in column 4 of the '666 patent supports a different construction than we determine here. Uusi seems to rely on the language "when the cranking means is providing engine cranking" to support its construction that requires the engine crankshaft to actually be turned by the starter motor. We recognize that this language states "engine cranking," which suggests that the cranking signal is related to the turning of the engine crankshaft. However, we note that claim 10 was amended to no longer recite a "cranking means." Further, the Specification equates cranking the engine with the operator action of moving the run/start switch to "start," which supports a determination that engine cranking means operating the starter. *See Ex. 1001, 6:38–45.*

The section of the Specification relied on Uusi in support of its proffered construction also states that the after-glow period, which claim 10 ties to the cessation of the cranking signal, advantageously begins when the

engine starts. *See* Ex. 1001, 4:59–67. However, Uusi fails to direct us to any persuasive evidence, including additional disclosure, that the phrase “when the engine starts” means when the starter motor disengages from the crankshaft rather than when the run/start switch is returned to the run position, ceasing operation of the starter.

We disagree with Uusi that extrinsic evidence of record supports a different construction. Dr. Lequesne’s tutorial on how a starter works may be correct, but his application of this extrinsic evidence to the construction of the term “cranking signal” conflicts with the Specification. Specifically, as discussed above, Figures 4, 6, and 10 of the ’666 patent do not show a gap in time from the time that operator delay ends and the rise in voltage of the cranking signal. This lack of a time gap contradicts Dr. Lequesne’s opinion that the cranking signal is indicative of the starter motor component of a starter actually engaged with and turning the engine crankshaft. Given this conflict, we give little or no weight to this extrinsic evidence.

Further, our construction of the term “cranking signal” to mean “a signal indicative of the starter operating” is consistent with our analysis in the Decision on Institution. *See, e.g.*, Dec. on Inst. 19 (“For example, Patent Owner’s argument that Masaka fails to teach the ‘cranking signal’ limitation . . . does not address Masaka’s disclosure that the after-glow timer starts counting when the ST position detection signal (asserted cranking signal) goes low” nor does it “explain sufficiently why the ST position detection signal is not a signal that is indicative of the starter motor being actually cranked”).

2. “*ambient temperature*”

Claim 10 recites, in relevant part, “a temperature sensor mounted to the diesel engine for monitoring *an ambient temperature* prior to starting of the diesel engine.” Ex. 1001, 16:29–31 (emphasis added). In our Decision on institution, we construed “ambient temperature” to mean “existing engine temperature.” Dec. on Inst. 15. The parties do not dispute this construction. See PO. Resp. 25; Reply 12. Based on the complete trial record, we see no reason to modify our construction.

D. Overview of the Prior Art References

We instituted trial on grounds of unpatentability that rely on grounds based on Yasuhara, Demizu, and Masaka. See Dec. on Inst. 27. We summarize these three references below:

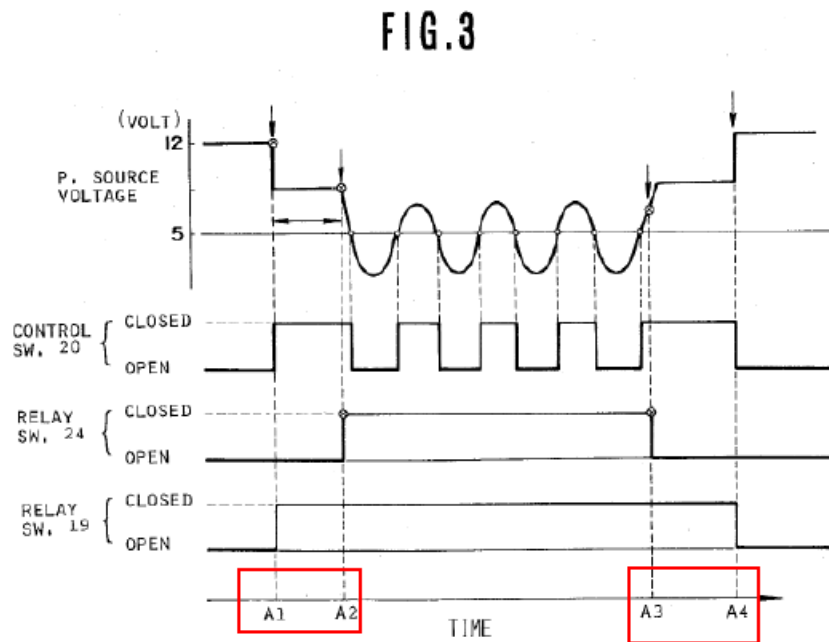
1. *Yasuhara*

AM General asserts that Yasuhara, titled “Control System for a Glow Plug of an Internal Combustion Engine,” and issued January 1, 1985, is prior art to the challenged claims under 35 U.S.C. § 102(b). Pet. 15. Uusi does not dispute this fact. See, e.g., PO Resp. 28–31 (addressing Yasuhara but not challenging its status as prior art).

Yasuhara discloses a temperature sensor that senses the temperature of the engine, and a control unit that calculates a glow plug preheating period on the basis of the sensed engine temperature and the time elapsed since the engine was last turned off. Ex. 1004, 3:57–59, 5:13–18. If the engine temperature is higher than a reference value representing that preheating is unnecessary, the preheating period is set equal to zero. *Id.* at 7:18–21. Upon completion of preheating, an indicator urges the engine operator to start the engine. *Id.* at 5:36–43. The glow plugs, if activated for

preheating, remain activated during and after activation of the starting motor. *Id.* at 6:29–34. Not until the rotational speed of the crankshaft exceeds a reference value are the glow plugs deactivated. *Id.* at 6:36–40, Fig. 3.

Petitioner’s annotated version of Yasuhara’s Figure 3 is reproduced below.



Pet. 3. Figure 3 of Yasuhara is a control system time chart. Ex. 1004, Fig. 3. With respect to the period A3–A4 shown in the figure above, Petitioner explains: “After cranking ceases at A3, control switch 20 remains closed—and glow plug section 21 remains active—for a period of time (i.e., after-glow) until A4.” Pet. 4 (citing Ex. 1004, 6:36–51, Fig. 3).

2. Demizu

AM General asserts that Demizu, titled “Diesel Engine Glow Plug Controlling Device,” and issued January 28, 1986, is prior art to the challenged claims under 35 U.S.C. § 102(b). Pet. 44. Uusi does not dispute

this fact. *See, e.g.*, PO Resp. 31–33 (addressing Demizu but not challenging its status as prior art).

Demizu discloses a glow plug controlling device having a computer that “decides whether or not the engine needs to be preheated, on the basis of the output signal of the water temperature sensor and when necessary, the computer calculates a current supply time which is necessary to heat the glow plugs to a predetermined temperature.” Ex. 1005, 3:46–51. The computer calculates the time necessary to heat the glow plugs to a predetermined temperature if the temperature sensed by a water temperature sensor is less than a predetermined temperature. *Id.* at 4:51–5:19.

3. Masaka

AM General asserts that Masaka, titled “Energization Control Apparatus for Glow Plug,” and issued July 3, 1990, is prior art to the challenged claims under § 102(b). Pet. 17. Uusi does not dispute this fact. *See, e.g.*, PO Resp. 34–36 (addressing Masaka but not challenging its status as prior art).

Masaka discloses an energization control apparatus for a glow plug that includes preheating timer 107 and after glow timer 108. Ex. 1006, 9:30–10:29, Fig. 8. “The after glow timer 108 is started in response to an ST position detection signal output from the ST position detector 110.” *Id.* at 9:68–10:2. “Counting of the after glow timer 108 is started when the ST position detection signal goes low.” *Id.* at 10:3–4. “The ST position detection signal output through the ST position detector 110 goes high when a movable contact 102d of the key switch 102 is connected to a starter terminal 102b.” *Id.* at 10:8–11. “When the movable contact 102d is

released from the starter terminal 102b, the ST position detection signal goes low.” *Id.* at 10:11–13.

E. Analyzed Grounds of Unpatentability

As Petitioner, AM General bears the burden of persuasion to prove unpatentability of the challenged claims, and that burden never shifts to Patent Owner, Uusi. *Dynamic Drinkware, LLC v. Nat’l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015); *see also* 35 U.S.C. § 316(e) (“[T]he petitioner shall have the burden of proving a proposition of unpatentability by a preponderance of the evidence.”). To prevail, AM General must establish the facts supporting its challenge by a preponderance of the evidence. 35 U.S.C. § 316(e); 37 C.F.R. § 42.1(d). Below, we explain how AM General has met its burden with respect to the Challenged Claims and address each of the two grounds in turn.

As we indicated above, both of the grounds for which we instituted trial are obviousness grounds.

Section 103(a) forbids issuance of a patent when “the differences between the subject matter sought to be patented 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) when available, secondary considerations, such as

commercial success, long felt but unsolved needs, and failure of others.⁷ *Graham*, 383 U.S. at 17–18. We analyze these factual determinations, below.

1. Alleged unpatentability of claims 10, 11, and 13 over Yasuhara and Masaka

AM General alleges that independent claim 10 and claims 11 and 13, which depend directly from claim 10, are obvious over Yasuhara and Masaka.

a. Independent claim 10

Disclosure of the subject matter of claim 10

Claim 10 recites “a user actuated switch for applying power to the glow plugs prior to starting the engine.” Ex. 1001, 16:24–25 (element “10(a)”). AM General contends that Yasuhara discloses the subject matter of element 10(a). Pet. 22–24. Specifically, AM General contends that Yasuhara discloses key switch 10, which includes movable contact 11 and fixed contacts 12 and 13. *Id.* at 22–23. Yasuhara discloses that, when key switch 10 contacts fixed contact 12, glow plug section 21 is powered when relay switch 19 is closed. *See id.*; *see also* Ex. 1004, 3:13–18 (“[When] movable contact 11 of the key switch 10 is in contact with the fixed contact 12, when the relay switch 19 is closed, DC electrical power is conducted from the power source 14 to the glow plug section 21 so that the glow plug section 21 is activated.”). Yasuhara further discloses that when “movable contact 11 of the key switch 10 is in contact with only the first fixed contact 12 thereof, the diode 40 prevents current flow from the power source 14 to

⁷ We discuss the level of ordinary skill in the art in Section II.B, *supra*. Uusi does not argue any secondary considerations.

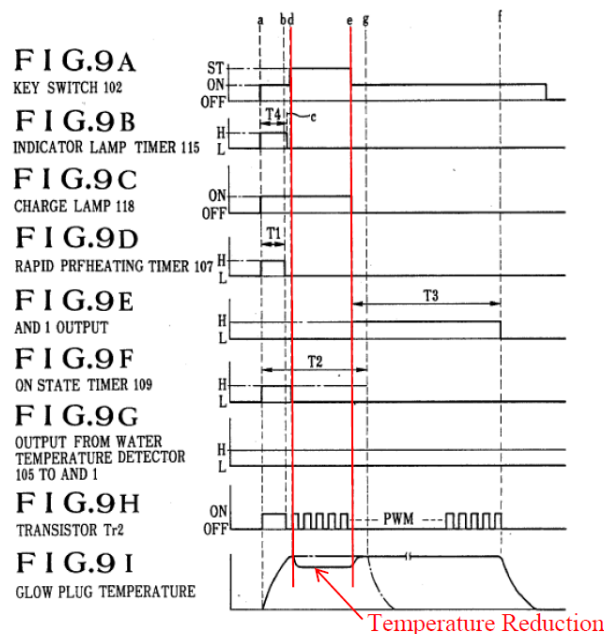
the starting motor 16.” Pet. 22; Ex. 1004, 3:51–56. Further, “[w]hen the movable contact 11 of the key switch 10 comes into contact with the fixed contact 13, DC electrical power is conducted from the power source 14 to the starting motor 16 so that the starting motor 16 can be activated.” Ex. 1004, 2:40–44. In this way, Yasuhara discloses a user actuated switch for applying power to the glow plugs prior to starting the engine as recited in element 10(a). *See also* Ex. 1003 ¶ 54 (“Yasuhara teaches that when the key switch 10 is actuated from a rest position, moveable contact 11 first contacts fixed contact 12, which activates the glow plug section 21 while diode 40 prevents current flow to the starting motor 16.”).

Uusi does not dispute AM General’s contentions with respect to claim element 10(a). We agree with AM General’s characterizations of Yasuhara as presented in the Petition with respect to claim element 10(a), which are supported by the evidence of record, and we adopt them as our findings of fact. Based on this record evidence, we find that Yasuhara discloses the element 10(a) of claim 10.

Claim 10 further recites “user actuated apparatus and circuitry for actuating said starter and for producing a cranking signal only when said starter is operating.” Ex 1001, 16:26–28 (element “10(b)”). AM General contends that Yasuhara discloses the user actuated apparatus and circuitry for actuating said starter. Pet 24–26. Specifically, AM General alleges that switch 10, battery 14, and connections to starter motor 16 correspond to the recited user actuated apparatus and circuitry. *See id.*; *see also id.* at 26 (presenting an annotated version of Yasuhara’s Figure 1, indicating the user actuated apparatus and circuitry). AM General further contends that Masaka discloses producing a cranking signal, specifically, an ST position detection

signal from ST position detector 110. Pet. 26–29; *see also* Ex. 1006, 10:8–13 (“The ST position detection signal output through the ST position detector 110 goes high when a movable contact 102d of the key switch 102 is connected to starter terminal 102b. When the movable contact 102d is released from the starter terminal 102b, the ST position detection signal goes low.”); Ex. 1006, Fig. 8 (depicting key switch 102 with an “OFF,” “ON,” and “ST” (start) position and ST POSITION DETECTOR 110 connected to key switch 102). That is, Masaka discloses that ST position detector 110 generates an ST position detection signal that rises when an operator moves the key switch to the “ST” position and goes low when the operator returns the switch to the “ON” position, such that the signal is generated only when the key switch is in the “ST” position. Masaka, like Yasuhara, discloses that, when the key switch is in the “ST” position, the starter is supplied with power to start the engine. *See* Pet. 27–28 (explaining that the ST position detection signal (the alleged cranking signal) is high only when the starter is operating—when contact 102d separates from starter terminal 102b, the starter is no longer powered and the ST position detection signal goes low).

We reproduce Dr. MacCarley’s annotated version of Masaka’s Figures 9A–9I, below:



The annotated version of Masaka's Figure 9 provides timing charts showing the operation of Masaka's glow plug control system, highlighting the alleged "cranking signal." See Ex. 1006, 3:62–63; Ex. 1009 ¶¶ 58–60. As Dr. MacCarley explains:

When the key switch is moved to the ST position at time ["d"] (red line, left), the glow plug temperature dips (Fig. 9I) and remains reduced for a period until time ["e"] when the key returns to the ON position (red line, right). A [person having ordinary skill in the art] would have understood this reduction in temperature is the result of the starter drawing a large amount of current from the electrical system (i.e., actually cranking)—thereby limiting the current available for heating the glow plugs. Notably, Fig. 9H shows that the pulse width modulated signal is maintained constant during the period between time ["d"] and time ["e,"] which demonstrates that the dip in temperature is not the result of the powering of Tr2.

Ex. 1009 ¶ 59. Dr. MacCarley further declares that:

Once the starter is no longer drawing current, the temperature returns to a higher value. As shown in Figure 9, these two actions (i.e., moving the key to/from ST and the glow plug temperature changing) are correlated in time. Since the ST

position and the starter operation occur together without any purported “significant delay,” Masaka renders obvious producing a “cranking signal” indicative of the starter motor actually cranking and only when the starter is operating. Indeed, when Masaka’s switch is moved to ST the starter motor operates and when it is no longer in the ST position, the starter motor operation ceases. Thus, Masaka teaches that its ST position is an accurate indicator of when the starter motor is actually cranking.

Id. ¶ 60. That is, Masaka’s Figure 9 illustrates that, at the same time that the key switch is moved to the “ST” position, the starter begins to operate and this operation continues until the key switch is returned to the “ON” position.

Uusi contends that Masaka fails to disclose the subject matter of element 10(b). PO Resp. 37. Uusi argues that Masaka’s ST position detection signal is not the recited cranking signal as that term should be construed. *Id.* at 38. Uusi characterizes Masaka’s ST position detection signal as “indicative of a connection having been made in the circuitry that permits power to be supplied.” *Id.* Uusi argues that “[w]hen the key switch is moved beyond the ON position to a ‘start’ position, i.e., position ‘ST’ in *Masaka*, the starting process begins, but many steps must take place before the starter is actually being cranked.” *Id.* at 39.

We disagree with Uusi’s argument because it is contrary to our claim construction. As we indicated above in connection with our claim construction analysis, we construe the term “cranking signal” to mean “a signal indicative of the starter operating.” Uusi’s traversal of AM General’s position is based on its proffered construction, which we did not adopt.

Further, we do not agree with Uusi’s characterization that Masaka’s ST position detection signal is “indicative of a connection having been made in the circuitry that permits power to be supplied.” See PO Resp. 38.

Instead we find, consistent with AM General’s characterization in the Petition, that Masaka’s ST position detection signal indicates that power is supplied to the starter such that it begins its operation. See Pet. 26–29; Reply 20–22; Ex. 1006, 10:8–13; see also Ex. 1009 ¶¶ 59–60 (explaining Masaka’s Figures 9A–9I). We find that Dr. MacCarley’s explanation of the glow plug temperature decrease depicted in Figure 9I and corresponding in time with the rise in the ST position detection signal as disclosing that, when Masaka’s key switch is moved to the “ST” position, the starter begins to operate and this operation continues until the key is returned to the “ON” position.

Uusi further argues against AM General’s “fallback position” that “even if the claimed cranking signal is not disclosed in the cited prior art, a person of skill would have understood that the cranking signal of *Yasuhara*, *Masaka*, and *Demizu* is produced only when the starter is operating.” PO Resp. 43–45. As we find that Masaka discloses that its ST position detection signal is produced only when the starter is operating, we need not address the “fallback position.”⁸

We agree with AM General’s characterizations of *Yasuhara* and *Masaka* as presented in the Petition with respect to claim element 10(b), which are supported by the evidence of record, and we adopt them as our findings of fact, including Dr. MacCarley’s characterization of Masaka’s Figures 9A-9I. Based on this record evidence, we find that *Yasuhara*, as modified by *Masaka*, discloses the element 10(b) of claim 10.

⁸ We address Uusi’s argument that it would not have been obvious to modify *Yasuhara* with Masaka’s ST position detection signal below.

Claim 10 further recites “a temperature sensor mounted to the diesel engine for monitoring an ambient temperature prior to starting of the diesel engine.” Ex. 1001, 16:29–31 (element “10(c)”). AM General contends that Yasuhara discloses temperature sensor 25, which senses the temperature of the engine, that is, the ambient temperature. Pet. 29–30; *see* Ex. 1004, 3:37–63, 7:5–14.

AM General further contends that a person having ordinary skill in the art “would have understood that ‘temperature sensor 25’ is necessarily (and thus inherently) mounted to the diesel engine.” Pet. 29 fn.11 (referencing Ex. 1003 ¶ 65). AM General still further contends that, to the extent that Yasuhara fails to disclose temperature sensor 25 mounted to the engine, that such a positioning would have been obvious “in order for the temperature sensor to provide the most accurate information for determining the temperature of the engine . . . (e.g., such that it could measure the coolant temperature).” *Id.* at 29–30 fn.11. AM General continues that an artisan of ordinary skill “would have understood that engine components are commonly mounted to the engine, and such a configuration is a mere design choice that would have been straightforward and obvious.” *Id.* at 30 fn.11.

Uusi contends that a person having ordinary skill in the art would not have had reason to mount a temperature sensor to the diesel engine. PO Resp. 47. Uusi argues that the engine is crowded with components, making it valuable “real estate,” and that there are more benign and lower cost locations for such a sensor. *Id.* Uusi contends that, “[t]ypically, engine coolant systems have a thermostat (temperature sensitive valve) mounted somewhere in the coolant ducts between the engine and the radiator.” *Id.* Uusi also argues that coolant temperature is different from engine

temperature. *Id.* at 48. Uusi points out that engine and coolant temperature can “frequently be different,” including during a “hot soak.” *Id.*

As an initial matter, we find that AM General has failed to persuasively demonstrate that Yasuhara inherently discloses that its temperature sensor is mounted to the diesel engine as required by element 10(c). Whether a reference inherently discloses a claim limitation is a question of fact. *See In re Napier*, 55 F.3d 610, 613 (Fed. Cir. 1995). “To establish inherency, . . . evidence ‘must make clear that the missing descriptive matter is necessarily present in the thing described in the reference, and that it would be so recognized by persons of ordinary skill.’” *In re Robertson*, 169 F.3d 743, 745 (Fed. Cir. 1999). We find that the Petition fails to make clear that Yasuhara’s temperature sensor 25 is necessarily mounted to the diesel engine. Although, as AM General indicates, Yasuhara discloses that temperature sensor 25 measures engine temperature, Yasuhara does state that *preferably*, such a measurement is of the engine coolant. *See* Reply 15–17; Ex. 1004, 3:57–63. One possible, and perhaps probable, location of the sensor is mounted to the engine, but the sensor may be positioned, alternatively, outside the engine to measure coolant as it enters the radiator. *See* Ex. 2008 ¶ 114. AM General fails to provide persuasive evidence or argument that precludes an alternative placement of the sensor. *See Robertson*, 169 F.3d at 745 (“Inherency, however, may not be established by probabilities or possibilities. The mere fact that a certain thing *may result* from a given set of circumstances is not sufficient.”).

We agree with AM General, however, that mounting a temperature sensor to the diesel engine would have been obvious to a person having

ordinary skill in the art. As AM General and its declarant, Dr. MacCarley indicate, Yasuhara expressly discloses that temperature sensor 25 measures engine temperature and preferably engine coolant temperature. We agree with AM General that, given this express teaching, the most accurate position for the sensor is mounted to the engine such that it may access engine coolant before it leaves the engine environment. *See* Pet. 29–30; Ex. 1003 ¶ 65 (“Indeed, a POSITA would have understood that in order for the temperature sensor to provide the most accurate information for determining the temperature of the engine, it would need to be mounted to the engine (*e.g., such that it could measure the coolant temperature.*)”) (Emphasis added); Ex. 1009 ¶ 69.⁹

We disagree with Uusi’s arguments that a person having ordinary skill in the art would not have mounted temperature sensor 25 to the diesel engine. Although the engine may represent valuable real estate for mounting sensors, we find that Yasuhara’s express teaching of wanting to measure *engine* temperature would indicate to a person having ordinary skill in the art that the engine is an obvious location for mounting temperature sensor 25 to get the most accurate measure. We credit Dr. MacCarley’s

⁹ Although we agree with AM General’s reasoning with respect to mounting the temperature sensor to the engine provides the most accurate measure of engine temperature, we do not agree with its additional reasoning that such a position is a matter of design choice. Such an assertion seems to cut against AM General’s other reasoning that mounting the sensor to the engine provides a more accurate temperature reading—that is, the sensor mounted to the engine solves the problem of providing the best measure of temperature for calculating the pre-glow period. *Cf. In re Kuhle*, 526 F.2d 553, 555 (CCPA 1975) (concluding that the use of claimed feature solves no stated problem and presents no unexpected result and “would be an obvious matter of design choice within the skill of the art”).

testimony in support of this finding. *See* Ex. 1009 ¶ 42 (“[A] temperature sensor mounted to the block and measuring the coolant within the water jacket was well-known, and provided a reliable and predictable method of measuring existing engine temperature” and, further, “the coolant temperature is the primary and best indicator of the engine temperature, because it surrounds the combustion areas and provides an average temperature that can be readily used by the electronic control unit.”). We find that the record evidence provides support to Dr. MacCarley’s testimony. *See id.* ¶¶ 41–45. We give little weight to Dr. Lequesne’s testimony with respect to mounting a temperature sensor to the engine block. We find that he fails to adequately and persuasively support his opinion testimony with underlying factual evidence. *See* Ex. 2008 ¶¶ 112–116; *see also* 37 C.F.R. § 42.65(a) (“Expert testimony that does not disclose the underlying facts or data on which the opinion is based is entitled to little or no weight.”).

We also find that Yasuhara’s teaching that the temperature determined from temperature sensor 25 is used to establish the pre-glow period would have instructed a person having ordinary skill in the art of the importance of an accurate measurement. *See* Ex. 1004, 5:13–22 (disclosing the use of temperature to calculate pre-glow time).

Accordingly, we agree with AM General’s characterizations of Yasuhara as presented in the Petition with respect to claim element 10(c), which are supported by the evidence of record, and we adopt them as our findings of fact, including Dr. MacCarley’s characterization of Yasuhara’s teachings with respect to temperature sensor 25. Based on this record evidence, we conclude that it would have been obvious to modify

temperature sensor 25 to be mounted to Yasuhara's diesel engine, satisfying element 10(c) of claim 10.

Claim 10 further recites:

glow plug control circuitry comprising:

i) a programmable controller electrically connected to said temperature sensor and to said user actuated switch having a stored program that responds to actuation of said switch by calculating a [pre-glow] period if a sensed temperature as indicated by a signal from the temperature sensor is below a first set point temperature.

Ex. 1001, 16:32–39 (element “10(d)(i)”). AM General contends that Yasuhara discloses the subject matter of element 10(d)(i). Specifically, AM General contends that Yasuhara discloses a programmable controller (control unit 15 having CPU 31 with ROM 33 and RAM 32) connected to temperature sensor 25. Pet. 31–32; *see also* Ex. 1004 Fig. 2 (depicting control unit 15 and temperature sensor 25). Further, AM General contends that Yasuhara discloses that temperature sensor 25 outputs analog signal T_w to control unit 15, which is actuated by key switch 10, and that the pre-glow period is calculated based on T_w . *See id.*; *see also* Ex. 1004, 5:7–12 (providing that control unit 15 starts to operate when movable contact 11 of key switch 10 contacts first fixed contact 12), 5:13–19 (“First, the control unit 15 closes the control switch 20 as shown at a time point A1 of FIG. 3, and calculates the length of time necessary to complete preheating by the glow plug section 21 on the basis of the engine temperature and the time elapsed since the engine was last turned off, indicated by the signals T_w and t respectively.”). Also, AM General contends that Yasuhara discloses that control unit 15 calculates a pre-glow period if the sensed temperature is below a first set point temperature. *See* Pet. 33; *see also* Ex. 1003 ¶ 67

(describing calculating the pre-glow period); Ex. 1004, 7:18–22 (“Specifically, if the engine temperature is higher than a reference value representing that preheating is unnecessary, the preheating time is set equal to zero to prevent the glow plug section 21 from being activated for an unnecessarily long time.”).

Uusi does not dispute these contentions.¹⁰ We agree with AM General’s characterizations of Yasuhara as presented in the Petition with respect to claim element 10(d)(i), which are supported by the evidence of record, and we adopt them as our findings of fact. Based on this record evidence, we find that Yasuhara discloses the element 10(d)(i) of claim 10.

Claim 10 further recites:

glow plug control circuitry comprising:

...

ii) output circuitry coupled to the programmable controller responsive to the cessation of said cranking signal to apply electrical power to said glow plug during an afterglow period initiated in response to cessation of said cranking signal.

Ex. 1001, 16:32–44 (element “10(d)(ii)”). AM General contends that Yasuhara, as modified by Masaka’s cranking signal, discloses the subject matter of element 10(d)(ii). See Pet. 35–39 (including footnote 14, which discusses the combination of Yasuhara and Masaka). As AM General provides, Yasuhara discloses an after-glow period for the glow plugs from time A3 to A4, where time A3 corresponds to the time that key switch 10 is moved to the primary operating position from the secondary (start) position

¹⁰ Uusi indicates that “[t]he Board has already determined that *Yasuhara* does not disclose” claim element 10(d). PO Resp. 55. Our Decision on Institution, however, merely found that Yasuhara fails to disclose element 10(d)(ii), not 10(d)(i).

and starter motor 16 is de-energized. *See id.* at 35–37; *see also* Ex. 1004, 6:22–34. As we stated in our Decision on Institution, we found this disclosure, alone, as insufficient to teach the subject matter of element 10(d)(ii), because Yasuhara teaches that the glow plugs *remain* active from a time before A3 until time A4. Dec. on Inst. 23. Element 10(d)(ii) requires electrical power to be supplied to the glow plug during an afterglow period initiated *in response to* cessation of a cranking signal.

AM General further contends, however, that Masaka teaches electric power supplied to glow plugs during an after-glow period in response to ceasing a cranking signal. Pet. 38–39. As Masaka discloses,

The after glow timer 108 is started in response to an ST position detection signal output from the ST position detector 110. Counting of the after glow timer 108 is started when the ST position detection signal goes low. The after glow timer 108 continuously outputs a timer signal of “H” level to an AND gate AND1 until its predetermined timer time T3 (T3=10 minutes in this embodiment) has elapsed. The ST position detection signal output through the ST position detector 110 goes high when a movable contact 102d of the key switch 102 is connected to a starter terminal 102b. When the movable contact 102d is released from the starter terminal 102b, the ST position detection signal goes low.

Ex. 1006, 9:68–10:13; *see also* Pet. 38–39 (relying, in part, on this disclosure in Masaka); Ex. 1003 ¶ 72 (“Masaka teaches that after glow operation is started in response to an ST position detection signal from ST position detector 110, where an after glow timer 108 is started when the ST position detection signal goes low.”). That is, in response to the ST position signal going low, after glow timer 108 is started. Further, the ST position signal goes low when the operator releases the key switch from the “ST” position—stops cranking the engine. *See also* Figs. 9A–9I (illustrating that when key switch

102 moves from ST to ON at time “e,” the position signal goes low and the AND 1 output goes H (hi) for an after-glow period of time T3).

Uusi contends that Masaka fails to disclose the subject matter of element 10(d)(ii). PO Resp. 49–52. Uusi argues that Masaka’s ST position detection signal is not the recited “cranking signal,” because it fails to indicate that the starter motor is actually cranking the engine, as it does not take into consideration the starter disengaging from the crankshaft at a certain revolutions per minute rate of the crankshaft. *Id.* at 49–51. As we discussed above in connection with our claim construction analysis and analysis of element 10(b), we disagree with this argument because it is not commensurate with our construction of the term “cranking signal.” We construed “cranking signal” to mean “a signal indicative of the starter operating.” We further found in that analysis that Masaka’s ST position detection signal is indicative of whether the starter is operating. *See, e.g.*, Ex. 1006, 10:11–13 (“When the movable contact 102d is released from the starter terminal 102b, the ST position detection signal goes low.”); 12:17–50 (describing operation of Masaka’s system when key switch 102 is moved to and released from the “ST” position 102b).

Accordingly, we agree with AM General’s characterizations of Yasuhara and Masaka as presented in the Petition with respect to claim element 10(d)(ii), which are supported by the evidence of record, and we adopt them as our findings of fact. That is, we find that Yasuhara, as modified by Masaka’s ST position detection signal and programming for initiating the after-glow period in response to the ST position detection signal going from high to low voltage, discloses the subject matter of claim element 10(d)(ii).

Reasons to combine the teachings of Yasuhara and Masaka

AM General contends that it would have been obvious to a person having ordinary skill in the art at the time of the invention of claim 10 to incorporate Masaka's ST position detection signal into Yasuhara's system. Pet. 26. AM General explains that incorporating "Masaka's ST position detection signal into Yasuhara's control unit 15 would have enabled improved sensing of when the starting motor 16 was activated and permitted better control of the switching of control switch 20 in response." *Id.* at 27. AM General continues that "[s]uch a combination would have ensured consistent timing of the afterglow start upon cessation of the cranking." *Id.* AM General further explains that a person having ordinary skill in the art would have recognized that such a combination "would have worked as expected—understanding, e.g., that Yasuhara's program stored in memory 33 could be modified to accommodate an ST position detection signal—and would have further allowed for improved efficiency and effectiveness of the glow plug start process." Pet. 27 (referencing Ex. 1003 ¶ 62). AM General further reasons that "Yasuhara and Masaka are in the same field, and endeavor to solve the same problem: to provide a glow plug controller capable of quick and stable starting of a diesel engine in cold weather conditions." Pet. 20; *see also id.* (explaining the similarities in Yasuhara's and Masaka's system).

With respect to modifying Yasuhara's programmable controller to be responsive to the cessation of a cranking signal to apply electrical power to a glow plug during an after-glow period initiated in response to cessation of the cranking signal (element 10(d)(ii)), AM General reasons that:

It would have been obvious to a [person having ordinary skill in the art] at the time the invention was made to [] implement Yasuhara's control system using Masaka's advantageous initiation of after glow operation in response to cessation of the cranking signal, with the apparatus of Yasuhara because both teachings are directed towards glow plug control circuitry, and further because the benefits of afterglow cycling of glow plugs were well known in the art.

Pet. 38 (referencing Ex. 1003 ¶ 73). AM General further reasons that:

a [person having ordinary skill in the art] would have recognized that linking the initiation of the afterglow period to the cessation of the cranking signal would improve the effectiveness of the glow plug-assisted engine start process, and would have ensured consistent timing of the afterglow start upon cessation of the cranking. Moreover, Yasuhara expressly discloses a speed sensor 27 configured to measure the rotational speed of the crankshaft, which could be used to determine whether the engine was being cranked or running. A [person having ordinary skill in the art] would understand how to implement the system of Yasuhara to achieve the function and results disclosed in Masaka.

Id. (citing Ex. 1003 ¶ 73; Ex. 1004, 4:1–5) (internal citations omitted); *see also* Ex. 1004, Fig. 3 (disclosing that after glow period begins at time A3, when the operator stops cranking the engine).

Uusi argues that a person having ordinary skill in the art would not have had reason to combine the teachings of Yasuhara and Masaka. PO Resp. 55–58. First, Uusi appears to argue that certain elements of claim 10 are not disclosed in either Yasuhara or Masaka. *Id.* at 55–57. In the discussion above, we address how Yasuhara and Masaka disclose the subject matter of claim 10.

Uusi further argues that Yasuhara teaches away from AM General's proposed modification. PO Resp. 57. Uusi argues that:

Yasuhara teaches away from using an afterglow, since the glowplug control ends either when “the engine speed signal S reaches a reference value . . . chosen so as to represent . . . self sustaining operation of the engine” (Ex. 1004 6:36-43), or the system times out (*Id.* 6:47-50). In other words, the *Yasuhara* systems ends glowplug control either as soon as the engine is starting, or the system times out due to a failure of the engine to start.

PO Resp. 30. We disagree with this argument. “A reference may be said to teach away when a person of ordinary skill, upon reading the reference . . . would be led in a direction divergent from the path that was taken by the applicant.” *In re Haruna*, 249 F.3d 1327, 1335 (Fed. Cir. 2001) (quoting *Tec Air, Inc. v. Denso Mfg. Mich. Inc.*, 192 F.3d 1353, 1360 (Fed. Cir. 1999)); *see, e.g., In re Fulton*, 391 F.3d 1195, 1201 (Fed. Cir. 2004) (holding that, to teach away, the prior art must “criticize, discredit, or otherwise discourage the solution claimed”). Based on this record, we find no credible evidence that *Yasuhara* criticizes, discredits, or otherwise discourages initiating after glow in response to the cessation of a cranking signal. Further, we find, contrary to Uusi’s assertion, that *Yasuhara* teaches operating the glow plugs during an after glow period, that is, after engine cranking. *See, e.g., Ex. 1004*, Fig. 3 (showing afterglow beginning at time A3, after engine cranking), 6:22–35 (disclosing that when the key switch is returned to the primary operative position from the start position, starter motor 16 deactivates, but glow plug section 21 remains active); Reply 13–15 (explaining that *Yasuhara* discloses operating the glow plugs after the engine starts).

Uusi further argues that a person having ordinary skill in the art would not have mounted a temperature sensor on the diesel engine. PO Resp. 47.

Specifically, Uusi argues that off the engine is a more benign environment, mounting off the engine would be a lower cost, and the engine is crowded, making it valuable real estate. *Id.* We addressed this argument above, in connection with our analysis of claim element 10(c), where we gave more weight to Dr. MacCarley’s testimony than Uusi’s supporting evidence.

Accordingly, we determine that AM General has provided adequate reasoning, with a rational underpinning, for modifying Yasuhara with Masaka’s ST position detection signal, as we agree that incorporating “Masaka’s ST position detection signal into Yasuhara’s control unit 15 would have enabled improved sensing of when the starting motor 16 was activated and permitted better control of the switching of control switch 20 in response.” *See* Pet. 27; *KSR Int’l Co.*, 550 U.S. at 418 (citing *In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006)) (“[O]bviousness grounds cannot be sustained by mere conclusory statements; instead, there must be some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness.”). Also, based on the record evidence, we conclude that it would have been obvious to use the cessation of Masaka’s cranking signal (that is, the ST position detection signal moving from high to low voltage) to trigger the after-glow period. First, as discussed above, we determined that it would have been obvious to modify Yasuhara to include Masaka’s ST position detection signal. Given this modification, it would have been further obvious to, in response to the cessation of that signal, to trigger the after-glow period. We find that AM General has provided an adequate reasoning for this modification, with a rational underpinning—linking the initiation of the afterglow period to the cessation of the cranking signal would improve the effectiveness of the glow plug-assisted engine start

process, and would have ensured consistent timing of the afterglow start upon cessation of the cranking. *See* Pet. 38; *KSR Int’l Co.*, 550 U.S. at 418.

We further determine that AM General has provided adequate reasoning, with a rational underpinning, for modifying Yasuhara to mount its temperature sensor on the diesel engine—that mounting the sensor to the engine would provide the accurate engine temperature measurement. *See* Pet. 29–30; *KSR Int’l Co.*, 550 U.S. at 418. As we discussed above in connection with our analysis of element 10(c), we credit Dr. MacCarley’s testimony in support of this reasoning and adopt this reasoning as our own.

Conclusion as to claim 10

Based on the complete trial record, we determine that AM general has demonstrated, by a preponderance of the evidence, that independent claim 10 is unpatentable under 35 U.S.C. § 103(a) over Yasuhara and Masaka.

b. Dependent claims 11 and 13

Dependent claim 11, which depends directly from claim 10, further recites “circuitry for applying electrical power to said glow plug during engine cranking as indicated by the cranking signal.” Ex. 1001, 16:45–48. AM General contends that Masaka discloses that electrical power is supplied to the glow plugs during engine cranking. Pet. 42. AM General references its discussion with respect to claim 10 as to why it would have been obvious to a person having ordinary skill in the art to modify Yasuhara with Masaka’s ST position detection signal, the alleged cranking signal. *Id.*

Uusi argues that “because none of the references disclose any cranking signal . . . the references also do not disclose the limitation of claim 11.” PO Resp. 58. As we discussed above in connection with our analysis of claim 10, we find that Masaka discloses the recited cranking signal.

Accordingly, Uusi's argument is not persuasive of a deficiency in AM General's position.

We agree with AM General's characterizations of Yasuhara and Masaka as presented in the Petition with respect to claim 11, which are supported by the evidence of record, and we adopt them as our findings of fact. Based on this record evidence, we find that Yasuhara, as modified by Masaka's ST position detection signal, discloses the subject matter of claim 11. Further, as discussed above in connection with our analysis of claim 10, we determine that AM General has provided an adequate reason, with rational underpinning, for its proposed modification of Yasuhara with Masaka's ST position detection signal.

Accordingly, based on the complete trial record, we determine that AM General has demonstrated, by a preponderance of the evidence, that dependent claim 11 is unpatentable under 35 U.S.C. § 103(a) over Yasuhara and Masaka.

Claim 13 depends directly from claim 10 and further recites "apparatus and circuitry for providing an indication of the termination of the [pre-glow] period." AM General contends that Yasuhara discloses indicator 28, with its associated circuitry, that indicates the termination of the pre-glow period. Pet. 42–43; *see also* Ex. 1004, 5:23–44 (disclosing that control unit 15 activates indicator 28 upon the start of pre-glow and deactivates indicator 28 at the end of pre-glow), 7:48–50 ("In the step 60, the control unit 15 deactivates the indicator 28 to report that preheating has been completed."). In other words, Yasuhara discloses that deactivation of indicator 28 signals that pre-glow has terminated.

Uusi argues that “*Yasuhara* merely discloses that a ‘report urges the engine operator to perform the next step toward starting the engine.’” PO Resp. 59. We find that this characterization does not accurately reflect *Yasuhara*’s disclosure. We agree with AM General’s characterizations of *Yasuhara* and *Masaka* as presented in the Petition with respect to claim 13, which are supported by the evidence of record, and we adopt them as our findings of fact. Based on this record evidence, we find that *Yasuhara* expressly discloses the subject matter of claim 13.

Accordingly, based on the complete trial record, we determine that AM general has demonstrated, by a preponderance of the evidence, that dependent claim 13 is unpatentable under 35 U.S.C. § 103(a) over *Yasuhara* and *Masaka*.

2. Alleged unpatentability of claims 10, 11, and 13 over Demizu and Masaka

a. Independent claim 10

Disclosure of the subject matter of claim 10

Claim 10 recites “a user actuated switch for applying power to the glow plugs prior to starting the engine.” Ex. 1001, 16:24–25 (element “10(a)”). AM General contends that *Demizu* discloses key switch 1, which includes a preheating starting position “G,” an engine starting position “ST,” and an “ON” position. Pet. 48–49. Key switch 1 is moved to the “G” position during the pre-glow period, to the “ST” position to operate the starter, and to the “ON” position to run the engine. *See id.*

Uusi does not dispute AM General’s contentions with respect to claim element 10(a). We agree with AM General’s characterizations of *Demizu* as presented in the Petition with respect to claim element 10(a), which are

supported by the evidence of record, and we adopt them as our findings of fact. Based on this record evidence, we find that Demizu discloses the element 10(a) of claim 10.

Claim 10 further recites “user actuated apparatus and circuitry for actuating said starter and for producing a cranking signal only when said starter is operating.” Ex 1001, 16:26–28 (element “10(b)”). AM General contends that Demizu discloses the subject matter of element 10(b). Specifically, AM General contends that Demizu’s key switch 1 and battery 5 correspond to the user actuated apparatus and circuitry for actuating the starter and that, when key switch 1 is moved to the “ST” position, the starter begins operation and computer 2a receives a signal indicative of the switch position. Pet. 49–50. AM General explains that “through the ST signal input at input interface 2b, the one-chip computer 2a is informed that the key switch 1 is in the ST position and that the starter motor is activated, thereby cranking the engine.” *Id.* at 50; *see also* Ex. 1005, 6:10–14 (“Then, the key switch 1 is thrown to ST position to supply a current to the starter motor in order to start the engine. After the engine has been started, the key switch 1 returns to ON position to complete the control operation.”), Figs. 2(a), 4(a) (depicting a signal related to “(A) KEY SWITCH POSITION,” including for the ST position), Fig. 3 (depicting circuitry between the ST position of key switch 1 and input interface 2b).

Uusi contends that Demizu fails to disclose the subject matter of claim element 10(b). PO Resp. 42–43. Uusi argues that Demizu merely discloses that turning key switch to the ST position powers the starter and, for the same reasons as Uusi provided in traversing Masaka and element 2(b),

Demizu fails to disclose the recited cranking signal.¹¹ *Id.* at 43.

Dr. Lequesne states that “there is no mention in *Demizu* of a cranking signal whatsoever.” Ex. 2001 ¶ 83; *see also* Ex. 2008 ¶ 105 (failing to address Dr. MacCarley’s characterization of *Demizu*).

We disagree with Uusi’s argument. We find that *Demizu* discloses the recited cranking signal, as we construe that term. As discussed above, Figures 2(a), 3, and 4(a) disclose that, when key switch 1 is moved to the ST position, power from battery 5 is sent to the starter, operating the starter, and a signal is sent to input interface 2b. When key switch 1 is moved off the ST position, the starter is no longer powered (and, as such, no longer operates) and the signal to input interface 2b ends. *See* Ex. 1003 ¶¶ 97–99 (providing testimony on how *Demizu* satisfies the subject matter of element 2(b)). Further, we do not credit Dr. Lequesne’s testimony, as it does not effectively address the disclosure in Figures 2(a), 3, and 4(a) with respect to a signal sent to input interface 2b when key switch 1 is in the ST position.

We agree with AM General’s characterizations of *Demizu* as presented in the Petition and by Dr. MacCarley with respect to claim element 10(b), which are supported by the evidence of record, and we adopt them as our findings of fact. We credit Dr. MacCarley’s testimony as it is consistent with *Demizu*’s disclosure. Based on this record evidence, we find that *Demizu* discloses the element 10(b) of claim 10.

Claim 10 further recites “a temperature sensor mounted to the diesel engine for monitoring an ambient temperature prior to starting of the diesel

¹¹ We analyzed Uusi’s traversal of *Masaka* with respect to element 10(b) above, in connection with our analysis of whether the combination of *Yasuhara* and *Masaka* renders claim 10 obvious, *supra*.

engine.” Ex. 1001, 16:29–31 (element “10(c)”). AM General contends that Demizu discloses water temperature sensor 6 provided in the water pipe of the engine to detect the engine coolant temperature. Pet. 53–54. AM General further contends that Demizu’s computer 2a detects the signal from water temperature sensor 6 to determine if preheating the glow plugs is necessary. *Id.* AM General also asserts that a person having ordinary skill in the art “would have understood that the water temperature sensor 6 would necessarily (and thus inherently) be mounted to the diesel engine.” Pet. 53 (referencing Ex. 1003 ¶ 105).

As an alternative argument, AM General contends that “it would have been at minimum obvious to mount the water temperature sensor 6 to the diesel engine to ensure that an accurate temperature reading was obtained and because components of diesel engines are generally mounted to the engine.” Pet. 53 (referencing Ex. 1003 ¶ 105). In yet another alternative argument, AM General contends that an artisan of ordinary skill “would have understood that engine components are commonly mounted to the engine, and such a configuration is a mere design choice that would have been straightforward and obvious.” *Id.* at 53–54 (referencing Ex. 1003 ¶ 105).

Uusi does not directly address AM General’s contention that Demizu expressly discloses a temperature sensor mounted to the diesel engine for monitoring an ambient temperature prior to starting of the diesel engine by disclosing that water temperature sensor 6 is in a water pipe *of the engine*. Uusi does contend that Dr. MacCarley testified that Demizu fails to expressly disclose mounting a temperature sensor on the engine. PO Resp. 46 (citing Ex. 2006, 112:3–8). We find, however, that such a contention is

contrary to the record evidence. Dr. MacCarley testified that Demizu discloses that temperature sensor 6 is in a water pipe *of the engine*. See Ex. 2006, 110:4–5, 111:5–7; *see also id.* at 112:6–13 (“[B]eing that [the temperature sensor] is monitoring coolant temperature in the engine, it has to be a cooling passage. Added to that knowledge, every water-cooled engine in my experience, the coolant temperature is the primary and best indicator of the engine temperature that matters, that is surrounding the combustion areas of the engine”); Reply 24–25 n.14 (identify where Dr. MacCarley testified that Demizu expressly discloses a temperature sensor mounted to the diesel engine); Ex. 1009 ¶ 70 (“A POSITA would have understood the water pipe is an integral component of the engine.”).

Uusi contends that a person having ordinary skill in the art would not have had reason to mount a temperature sensor to the diesel engine. PO Resp. 47. Uusi argues that the engine is crowded with components, making it valuable “real estate,” and that there are more benign and lower cost locations for such a sensor. *Id.* Uusi contends that, “[t]ypically, engine coolant systems have a thermostat (temperature sensitive valve) mounted somewhere in the coolant ducts between the engine and the radiator.” *Id.* Uusi also argues that coolant temperature is different from engine temperature. *Id.* at 48. Uusi points out that engine and coolant temperature can “frequently be different,” including during a “hot soak.” *Id.*

We agree with AM General’s characterizations of Demizu as presented in the Petition and by Dr. MacCarley with respect to claim element 10(c), which are supported by the evidence of record, and we adopt them as our findings of fact. We credit Dr. MacCarley’s testimony as it is consistent with Demizu’s disclosure. Based on this record evidence, we find

that Demizu discloses the element 10(c) of claim 10. That is, we find that Demizu’s disclosure that water temperature sensor 6 is located in the cooling pipe of the engine means that the sensor is mounted to the diesel engine, as the water pipe is part of the engine. *See* Ex. 1009 ¶ 70 (“A POSITA would have understood the water pipe is an integral component of the engine.”).¹²

Alternatively, we agree with AM General that mounting a temperature sensor to the diesel engine would have been obvious to a person having ordinary skill in the art. As AM General and its declarant, Dr. MacCarley, indicate, Demizu expressly discloses that water temperature sensor 6 measures engine cooling water temperature and is mounted in the water pipe of the engine. *See* Ex. 1005, 1:24–28. We agree with AM General that, given this express teaching, the most accurate position for the sensor is mounted to the engine such that it may access engine coolant before it leaves the engine environment. *See* Pet. 53–54; Ex. 1003 ¶ 105 (“[M]ount[ing] the water temperature sensor 6 to the diesel engine [] ensure[s] that an accurate temperature reading [is] obtained.”); Ex. 1009 ¶ 72.¹³

¹² As we find that Demizu expressly discloses the subject matter of element 10(c), we need not address AM General’s inherency argument.

¹³ Although we agree with AM General’s reasoning with respect to mounting the temperature sensor to the engine provides the most accurate measure of engine temperature, we do not agree with its additional reasoning that such a position is a matter of design choice. Such an assertion seems to cut against AM General’s other reasoning that mounting the sensor to the engine provides a more accurate temperature reading—that is, the sensor mounted to the engine solves the problem of providing the best measure of temperature for calculating the pre-glow period. *Cf. Kuhle*, 526 F.2d at 555 (concluding that the use of claimed feature solves no stated problem and presents no unexpected result and “would be an obvious matter of design choice within the skill of the art”).

We disagree with Uusi's arguments that a person having ordinary skill in the art would not have mounted temperature sensor 6 to the diesel engine. Although the engine may represent valuable real estate for mounting sensors, we find that Demizu's express teaching of wanting to measure engine temperature in the cooling pipe of the engine would indicate to a person having ordinary skill in the art that the engine is an obvious location for mounting water temperature sensor 6 to get the most accurate measure. We credit Dr. MacCarley's testimony in support of this finding. *See* Ex. 1009 ¶ 72 ("As explained above, measuring coolant within the engine block (*e.g.*, in the water jacket) was a well-known and predictable method of measuring the existing engine temperature."). We find that the record evidence provides support to Dr. MacCarley's testimony. *See id.* ¶¶ 69–73. We give little weight to Dr. Lequesne's testimony with respect to mounting a temperature sensor to the engine block. We find that he fails to adequately support his opinion testimony with underlying factual evidence. *See* Ex. 2008 ¶¶ 112–116; *see also* 37 C.F.R. § 42.65(a).

Further, we do not agree with Dr. Lequesne's testimony that measuring engine coolant temperature does not correspond to engine ambient temperature under "hot soak" conditions. *See* Ex. 2008 ¶ 116. We credit Dr. MacCarley's testimony that under this limited condition, different parts of the engine will be at different temperatures, such that any engine-mounted temperature sensor, including a sensor measuring coolant temperature, would not reflect this variation, but would still provide a sufficiently accurate indication of ambient engine temperature. *See* Ex. 1009 ¶ 73. As such, the "hot soak" condition does not reflect a deficiency in measuring engine coolant temperature. *See id.*

Claim 10 further recites:

glow plug control circuitry comprising:

i) a programmable controller electrically connected to said temperature sensor and to said user actuated switch having a stored program that responds to actuation of said switch by calculating a [pre-glow] period if a sensed temperature as indicated by a signal from the temperature sensor is below a first set point temperature.

Ex. 1001, 16:32–39 (element “10(d)(i)”). AM General contends that Demizu discloses that computer 2a is connected to water temperature sensor 6 and, when key switch 1 is moved to the “G” position, a control procedure calculates a pre-glow period based on the measurement from water temperature sensor 6, including whether the temperature is below $T_1^\circ \text{C}$. Pet. 55–56; *see also* Ex. 1005, 4:51–59 (“First, in a cold engine starting mode, . . . key switch 1 is thrown to a preheating starting position (G). Then, the one-chip computer 2a . . . starts control operation according to the control procedure stored in the ROM 41.”), 4:60–63 (“[C]omputer 2a detects on the basis of the output signal of the water temperature sensor 6 encoded by the AD converter into a digital signal that the water temperature is lower than $T_1^\circ \text{C}$.”), 5:14–19 (“[C]omputer 2a calculates a current supply time T_p required to supply a current to the glow relay 3 to heat the glow plugs 4 to a predetermined temperature, on the basis of the stored plug-temperature equivalent digital value and stores the calculated result in the RAM 42.”); Ex. 1003 ¶ 108 (describing Demizu calculating a pre-glow period).

Uusi contends that Demizu fails to calculate a “[pre-glow] period . . . based on ‘sensed temperature’ (i.e., sensing ‘existing engine temperature’) as recited in the claim.” PO Resp. 52. Uusi argues that “[i]n *Demizu*, the [pre-glow] period is calculated based upon current supplied to the

glowplugs.” *Id.* Uusi continues that this distinction is the same as made during prosecution of the application that matured into the ’666 patent, where “the patentee overcame the objection by amending the claims and arguing that the patent bases [pre-glow] upon sensed temperature, not voltage as in the prior art.” *Id.* at 53. At oral hearing, Uusi’s counsel stated that:

In Demizu, the pre-glow period is calculated based on currents being supplied to the glow plugs. So, basically, Demizu uses a fixed control procedure that is based on a predetermined temperature the glow plugs should reach before current is supplied to them.

...

Demizu goes on to say in column 5, lines 14 through 20 that -- it says, Then a voltage drop corresponding to a resistance which is equivalent to the temperature of the glow plugs occurs. And it is this voltage drop that is used to calculate the current supply time.

Tr. 72:16–73:5.

We disagree with Uusi’s argument, as this argument is not commensurate with the scope of claim element 10(d)(i). Our position is best understood by first looking at element 10(d) in parts, then together. First, element 10(d)(i) requires a programmable controller electrically connected to the temperature sensor of element 10(c) and to the user actuated switch of element 10(b). As the Petition indicates, control unit 2 includes a programmable controller (computer 2a) that is electrically connected to water temperature sensor 6 and key switch 1. *See* Pet. 55–57; *see also* Ex. 1003 ¶¶ 106–108 (describing Demizu with respect to element 10(d)(i)); Ex. 1005, Fig. 3 (depicting computer 2a electronically connected to sensor 6 and switch 1). Demizu’s computer 2a has a stored program that responds to actuating key switch 1 by calculating a pre-glow period if a sensed

temperature as indicated by a signal from the temperature sensor is below a first set point temperature. Demizu discloses that, in response to receiving a signal that key switch 1 has moved to position “G,” computer 2a determines if the sensed temperature of the engine is below a first set point temperature. *See* Ex. 1005, 4:51–63. Demizu expressly discloses that computer 2a detects the output signal of water temperature sensor 6—a sensed temperature—and determines if that temperature is below $T_1^{\circ}\text{C}$. If so, “computer 2a closes the constant current circuit 21 through the output buffer 44 and the output interface 2c to supply a predetermined current to the glow plugs 4.” *Id.* at 4:66–5:1. As a result, a voltage drop occurs that is equivalent to the temperature of the glow plugs and AD converter converts the value of the voltage drop into a digital signal (the plug-temperature equivalent digital signal) and sends this signal to computer 2a. *Id.* at 5:2–13. Then, T_p —the pre-glow period time—is calculated based on the plug-temperature equivalent digital signal. *Id.* at 5:14–19.

In summary, Demizu discloses (1) a programmable controller electrically connected to the temperature sensor; (2) a programmable controller electrically connected to the user actuated switch; (3) the programmable controller having a stored program that responds to actuation of the switch; and (4) the programmable controller responds by calculating a pre-glow period if a sensed temperature as indicated by a signal from the temperature sensor is below a first set point temperature. Importantly, the calculated pre-glow period need not be based on the sensed temperature—the claim merely requires that the programmable controller respond, *if a sensed temperature as indicated by a signal from the temperature sensor is below a first set point temperature*, by calculating a pre-glow period. In

Demizu, computer 2a determines if a sensed temperature as indicated by a signal from the temperature sensor is below a first set point temperature based on a sensed value from temperature sensor 6 and, if so, calculates a pre-glow period based on the plug-temperature equivalent digital signal. *See* Ex. 1009 ¶¶ 82–83.

Accordingly, Uusi's argument that the pre-glow period is calculated based upon current supplied to the glowplugs is inapposite, as the claims do not preclude calculating the pre-glow period based on a value other than the sensed temperature. That is, element 10(d)(i) does *not* require the programmable controller to calculate a pre-glow period if a sensed temperature as indicated by a signal from the temperature sensor is below a first set point temperature, *based on that sensed temperature*.

Further, Uusi's reliance on the prosecution history fails to adequately support its position. Our review of the prosecution history does not demonstrate us that element 10(d)(i) must be read to require the pre-glow period to be based on the sensed temperature. The patentee does argue that "Masaka . . . does not concern calculation of the time for [energizing the glow plugs] based upon ambient temperature." Ex. 1002, 245. However, the patentee further argues that there would have been no motivation to combine Masaka and Boisvert because Masaka's temperature sensor did not operate in the manner the Examiner determined would have been obvious and that the Examiner did not find that Masaka's use was flawed. *Id.* We discern nothing the prosecution history that would require us to read element 10(d)(i) as requiring the pre-glow period to be calculated based on the sensed temperature and Uusi does not point us to anything in the record to

support its position. *See, e.g., id.* at 286–287 (providing *Quayle* action indicating allowable subject matter but providing no reasons for allowance).

We agree with AM General’s characterizations of Demizu as presented in the Petition with respect to claim element 10(d)(i), which are supported by the evidence of record, and we adopt them as our findings of fact. Based on this record evidence, we find that Demizu discloses the element 10(d)(i) of claim 10.

Claim 10 further recites:

glow plug control circuitry comprising:

...

ii) output circuitry coupled to the programmable controller responsive to the cessation of said cranking signal to apply electrical power to said glow plug during an afterglow period initiated in response to cessation of said cranking signal.

Ex. 1001, 16:32–44 (element “10(d)(ii)”). AM General contends that Demizu discloses key switch 1 operates the starter when in the “ST” position and then returns to the “ON” position when the engine starts. Pet. 57–58. As we discussed in connection with our analysis of claim element 10(b), computer 2a receives a signal based on the position of key switch 1. *See also* Ex. 1005, 6:10–14 (“Then, the key switch 1 is thrown to ST position to supply a current to the starter motor in order to start the engine. After the engine has been started, the key switch 1 returns to ON position to complete the control operation.”), Figs. 2(a), 4(a) (depicting a signal related to “(A) KEY SWITCH POSITION,” including for the ST position), Fig. 3 (depicting circuitry between the ST position of key switch 1 and input interface 2b).

AM General also contends that Demizu discloses output circuit 27 for controlling glow plugs 4. Pet. 57–58. AM General further contends that

Masaka discloses a glow plug controller that, responsive to the cessation of a cranking signal, applies electrical power to the glow plug during an afterglow period. *Id.* at 59–60. AM General contends that it would have been obvious to combine the teachings of Masaka with Demizu to arrive at the subject matter of element 10(d)(ii). *Id.* at 59 n.24.

Uusi contends that Masaka fails to disclose a glow plug controller that, responsive to the cessation of a cranking signal, applies electrical power to the glow plug during an afterglow period, because Masaka’s ST position detection signal is not a cranking signal. As we discussed above, in connection with our analysis of claim 10 over Yasuhara and Masaka, this argument is not commensurate with our construction of “cranking signal.”

Reasons to combine the teachings of Demizu and Masaka

AM General contends that it would have been obvious to a person having ordinary skill in the art at the time of the invention of claim 10 to combine the teachings of Demizu and Masaka “and in particular to employ Masaka’s teachings of an advantageous afterglow initiation sequence in response to cessation of a cranking signal.” Pet. 45. AM General argues that both references are in the same field of endeavor and directed to solving the same problem and that both Demizu and Masaka use glow plug controllers to execute pre-glow periods. *Id.* AM General further reasons that Masaka discloses using a glow plug controller to initiate an afterglow period linked to cessation of a cranking signal and that “both teach receiving and monitor a signal indicating the key is in the ST position.” *Id.* at 45–46.

AM General reasons that “the benefits of afterglow activation of glow plugs, as taught by Masaka, were well-known in the art. Linking the initiation of the afterglow period to the cessation of the cranking signal

would improve efficiency and effectiveness of the glow plug start process.” Pet. 46 (referencing Ex. 1003 ¶ 92). AM General concludes that a person having ordinary skill in the art:

would have found it obvious and straightforward to implement Demizu’s controlling device, which already monitors the ST signal, to measure cranking of a starter motor and initiate afterglow in response to cessation of the cranking signal. Moreover, a [person having ordinary skill in the art] would have understood that such an implementation would have worked as expected. Accordingly, a [person having ordinary skill in the art] would have understood how to use the control system of Demizu to achieve the function and results disclosed in Masaka and would have understood that such an implementation would have worked as expected.

Id. AM General also reasons that “afterglow cycling enabled more efficient startup as the engine reached optimal running temperatures.” Pet. 59.

Uusi argues that a person having ordinary skill in the art would not have had reason to combine the teachings of Demizu and Masaka. PO Resp. 55–58. First, Uusi appears to argue that certain elements of claim 10 are not disclosed in either Demizu or Masaka. *Id.* at 55–57. We address above how Demizu and Masaka disclose the subject matter of claim 10.

Uusi further argues that Demizu teaches away from AM General’s proposed modification. PO Resp. 57. Uusi argues that “*Demizu* teaches away from use of an afterglow period because it expressly states that the operation of its glowplug controller is complete as soon as the engine has started.” *Id.* at 32.

We disagree with Uusi’s argument. As we stated above in our analysis of claim 10 over Yasuhara and Masaka, “[a] reference may be said to teach away when a person of ordinary skill, upon reading the reference

. . . would be led in a direction divergent from the path that was taken by the applicant.” *In re Haruna*, 249 F.3d at 1335; *see, e.g., In re Fulton*, 391 F.3d at 1201 (holding that, to teach away, the prior art must “criticize, discredit, or otherwise discourage the solution claimed”). Uusi fails to provide credible argument or evidence as to how Demizu criticizes, discredits, or otherwise discourages initiating after glow in response to the cessation of a cranking signal. The mere fact that Demizu discloses that its control sequence is complete after the engine starts is not sufficient to discourage an artisan of ordinary skill from pursuing AM General’s proposed modification of Demizu with Masaka’s teaching of an after glow period initiated at the cessation of its cranking signal.

Accordingly, we determine that AM General has provided adequate reasoning, with a rational underpinning, for modifying Demizu with Masaka’s teachings of an advantageous afterglow initiation sequence in response to cessation of a cranking signal. We credit Dr. MacCarley’s testimony that “[l]inking the initiation of the afterglow period to the cessation of the cranking signal would improve efficiency and effectiveness of the glow plug start process,” that “afterglow cycling enabled more efficient startup as the engine reached optimal running temperatures,” and that the combination would work as expected. *See* Ex. 1003 ¶¶ 92, 111. We credit this testimony, in part, given the similarities in the systems disclosed in Demizu and Masaka.

Conclusion as to claim 10

Based on the complete trial record, we determine that AM general has demonstrated, by a preponderance of the evidence, that independent claim 10 is unpatentable under 35 U.S.C. § 103(a) over Demizu and Masaka.

b. Dependent claims 11 and 13

Dependent claim 11, which depends directly from claim 10, further recites “circuitry for applying electrical power to said glow plug during engine cranking as indicated by the cranking signal.” Ex. 1001, 16:45–48. AM General contends that Demizu discloses that constant current circuit 21 supplies electrical power from battery 5 when the starter motor is on. Pet. 60–61. AM General explains that a person having ordinary skill in the art “would have understood that the opening and closing of glow relay 3 and constant current circuit 21 would supply power to the glow plugs” when key switch 1 is in the “ST” position, as shown in Ex. 1006, Fig. 4(a). *Id.* at 61; see Ex. 1005, Fig. 4(a). As discussed above in connection with our analysis of element 10(b), AM General contends (and we find), that Demizu discloses the recited cranking signal.

Uusi argues that “because none of the references disclose any cranking signal . . . the references also do not disclose the limitation of claim 11.” PO Resp. 58. As we discussed above in connection with our analysis of claim 10, we find that Demizu (and Masaka) disclose the recited cranking signal. Accordingly, Uusi’s argument is not persuasive of a deficiency in AM General’s position.

We agree with AM General’s characterizations of Demizu as presented in the Petition with respect to claim 11, which are supported by the evidence of record, and we adopt them as our findings of fact.

Accordingly, based on the complete trial record, we determine that AM general has demonstrated, by a preponderance of the evidence, that dependent claim 11 is unpatentable under 35 U.S.C. § 103(a) over Demizu and Masaka.

Claim 13 depends directly from claim 10 and further recites “apparatus and circuitry for providing an indication of the termination of the [pre-glow] period.” Ex. 1001, 16:53–54. AM General contends that Masaka discloses the subject matter of claim 13, including indicator lamp 119. Pet. 62–63; *see also* Ex. 1006, 12:17–19 (“When the timer time T4 of the indicator lamp timer 111 has elapsed (time c in FIG. 9B), the transistor Tr1 is turned off and the indicator lamp 119 is also turned off,”); *id.*, Figs. 9A–9I (showing pre-glow time T1 ending and indicator lamp 118 going off at “c”).

AM General reasons that:

it would have been obvious to a [person having ordinary skill in the art] to implement Demizu’s controlling device using Masaka’s advantageous teachings of an indicator lamp configured to indicate to the user the end of the [pre-glow] period, because . . . [this artisan of ordinary skill] would recognize that user action is required to proceed with the starting sequence following [pre-glow], and indications to users are known to decrease error and/or equipment malfunction.”

Pet. 62–63.

Uusi argues “*Masaka* goes straight from rapid preheating time to any purported next step without involving a signal to or action from an operator.” PO Resp. 58. We disagree with this argument, as we find that Masaka expressly discloses turning off indicator lamp 119 at the end of rapid heating.

We agree with AM General's characterizations of Masaka as presented in the Petition with respect to claim 13, which are supported by the evidence of record, and we adopt them as our findings of fact. We also find that AM General has provided sufficient reasoning, with rational underpinning, for modifying Demizu with Masaka's teaching of an indicator lamp that goes off at the end of the pre-glow period and we adopt this reasoning as our own.

Accordingly, based on the complete trial record, we determine that AM general has demonstrated, by a preponderance of the evidence, that dependent claim 13 is unpatentable under 35 U.S.C. § 103(a) over Demizu and Masaka.

3. AM General's Motion to Exclude Evidence

AM General moves to exclude Ex. 2003 and Patent Owner's citation to the Nartron Website. Paper 33. As we do not rely on Ex. 2003 or the Nartron Website in our Final Written Decision, we determine that the motion is moot, and we hereby dismiss this motion.

Further, as Petitioner points out, 37 C.F.R. § 42.63(a) requires that "[a]ll evidence must be filed in the form of an exhibit." Paper 33, 9. Patent Owner did not file the Narton Website into the record as an exhibit. We will not consider evidence not in the record and, thus, the motion, with respect to the Nartron Website, is also moot for this reason.

III. CONCLUSION

For the foregoing reasons, we determine that the information presented in the Petition establishes, by a preponderance of the evidence, that claims 10, 11, and 13 of the '666 patent are unpatentable.

IV. ORDERS

After due consideration of the record before us, it is:

ORDERED that claims 10, 11, and 13 are unpatentable under 35 U.S.C. § 103(a) over Yasuhara and Masaka;

FURTHER ORDERED that claims 10, 11, and 13 are unpatentable under 35 U.S.C. § 103(a) over Demizu and Masaka;

FURTHER ORDERED that AM General's Motion to Exclude Evidence is dismissed; 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.

IPR2016-01049
Patent 5,570,666

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