Trials@uspto.gov
571-272-7822

Paper No. 28
Entered: December 22, 2016

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

ROBERT BOSCH LLC and DAIMLER AG,
Petitioner,

v.

ORBITAL AUSTRALIA PTY LTD,
Patent Owner.

Case IPR2015-01258
Patent 5,655,365

Before KEN B. BARRETT, JEREMY M. PLENZLER, and AMANDA F. WIEKER, *Administrative Patent Judges*.

BARRETT, *Administrative Patent Judge.*

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

I. INTRODUCTION

Robert Bosch LLC and Daimler AG (collectively, "Petitioner") filed a request for an *inter partes* review of claims 1, 2, 5, 9, 10, 12–14, and 18 of U.S. Patent No. 5,655,365 ("the '365 patent," Ex. 1001). Paper 3 ("Pet."). Orbital Australia Pty Ltd ("Patent Owner") filed a Patent Owner Preliminary Response. Paper 10 ("Prelim. Resp."). The Board instituted a trial for claims 1, 2, 5, 9, 10, 12–14, and 18. Paper 11 ("Dec. on Inst."). Although Petitioner proposed nine grounds of unpatentability, we instituted trial on only one asserted ground of unpatentability for anticipation and four asserted grounds of unpatentability for obviousness. Dec. on Inst. 18.

After institution of trial, Patent Owner filed a Request for Rehearing, arguing, *inter alia*, that our preliminary claim construction was in error. Paper 13, 6. We denied the Request, noting that "Patent Owner's arguments regarding the constructions of the claim terms can be submitted in its patent owner response, but are not appropriate subject matter for a request on rehearing." Paper 16, 5; *see id.* at 7. We also notified Patent Owner that a certain aspect of Patent Owner's proposed claim construction remained unclear to us. *Id.* at 4.

In due course, Patent Owner filed a Patent Owner Response ("PO Resp.") to the Petition. Paper 19. Petitioner filed a Reply ("Reply") to Patent Owner's Response. Paper 23.

Oral hearing was conducted on August 29, 2016. The record contains a transcript of the hearing. Paper 27 ("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).

For the reasons discussed herein, we determine Petitioner has shown by a preponderance of the evidence that claims 1, 2, 5, 9, 10, 12–14, and 18 are unpatentable.

A. Related Proceedings

Both parties identify, as matters involving the '365 patent, a district court case, *Orbital Australia Pty Ltd. and Orbital Fluid Technologies, Inc., v. Daimler AG, Mercedes-Benz USA LLC, Mercedes-Benz US International Inc., Robert Bosch GmbH, and Robert Bosch LLC*, Case No. 3:14-cv-808-REP (E.D. Va.), and Patent Trial and Appeal Board case IPR2015-01259. Pet. 58–59; Paper 5. Additionally, we note that Petitioner filed a Petition in IPR2016-00083 (institution denied) challenging claims of the '365 patent. *See, e.g.*, Paper 20.

B. The'365 Patent

The '365 patent pertains to "a method of operating an internal combustion engine in order to produce high exhaust gas temperatures" in the context of catalytic treatment of exhaust gases to reduce contaminants. Ex. 1001, col. 1, ll. 4–9. The patent explains that the catalyst, to effectively reduce contamination levels, must attain a minimum operating temperature, the "light-off" temperature. *Id.* at col. 1, ll. 10–17. The patent is directed to a method to reduce the time required to raise the catalyst to a light-off temperature condition, for example, upon engine start-up after a period of non-operation, and to maintain that condition. *Id.* at col. 1, ll. 19–25, 49–55.

The '365 patent describes a method where the ignition of the air/fuel mixture within at least one engine cylinder is retarded to a point when the

crankangle is After Top Dead Centre[1] (ATDC) and, while the ignition is so retarded, increasing the fueling rate to that cylinder to a level higher than required when operating normally. *Id.* at col. 1, ll. 56–64. The combination of the retarded ignition and the high fuelling rate results in a high amount of thermal energy available to heat the catalyst. *Id.* at col. 3, ll. 48–54. The specification, explaining why there is a need to increase the fueling rate during the disclosed method of operation, states:

> [A]t startup the engine typically will operate at a relatively low load and speed, such as is termed "engine idle", and therefore the amount of fuel being delivered to the engine is comparatively small and hence, only a relatively small amount of heat is available for raising the temperature of the exhaust gases and hence the temperature of the catalytic material to its "light-off" temperature.

Id. at col. 1, ll. 26–32. The specification provides the following example regarding the increased fueling rate:

> In a two-stroke three cylinder 1.2 liter direct injected engine, the anticipated fuel per cycle at normal engine idle is 3 mg/cylinder/cycle whereas when retarded ignition and a high fuelling rate is enabled in accordance with the method of the present invention, the increased fuelling rate may be as high as 18 to 25 mg/cylinder/cycle, i.e[.,] 85% to 115% of the fuelling rate at maximum engine load.

Id. at col. 5, ll. 50–57. In the claimed method, the timing of the introduction of fuel is maintained at before top dead centre (BTDC). *Id.* at col. 6, ll. 16–18 (claim 1).

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[1] The '365 patent uses Australian spelling for certain words such as "centre" and "fuelling." We use in this decision both the Australian and American spellings interchangeably.

Figures 1 and 2 of the ’365 patent are reproduced below.

Fig. 1

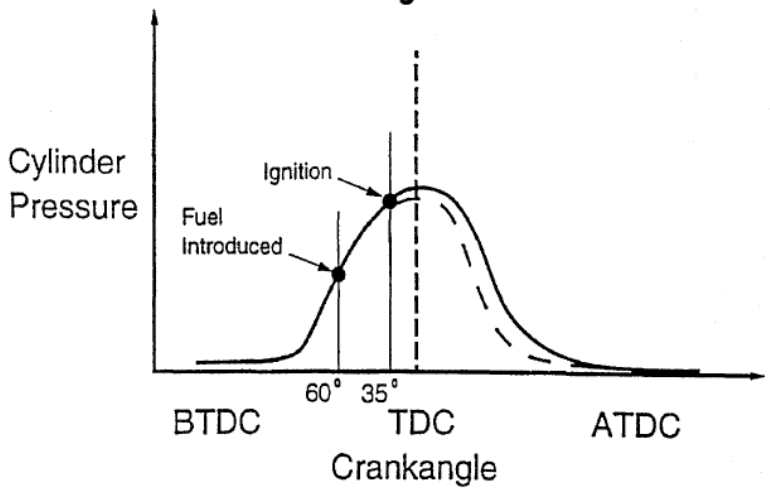
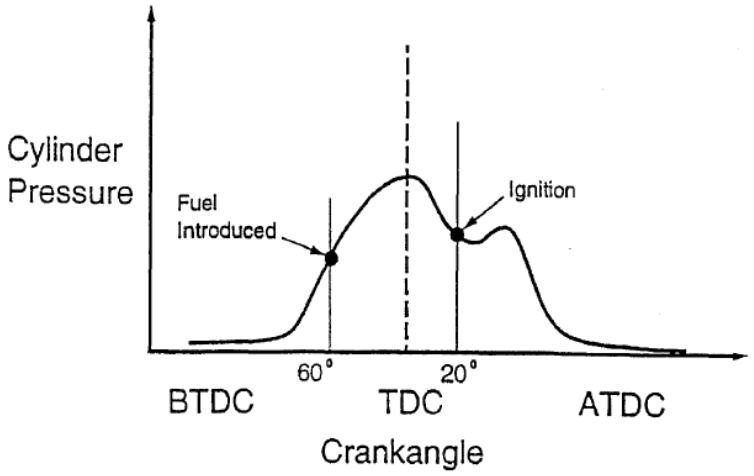


Fig. 2



Figures 1 and 2 depict graphs showing the cylinder pressure-crankangle characteristics for a typical direct injected two-stroke internal combustion engine and for such an engine operated according to the method of the ’365 patent, respectively. *Id.* at col. 2, ll. 46–52.

C. Illustrative Claim

Claim 1 is an independent claim. Claims 2, 5, 9, 10, 12–14, and 18 depend directly or indirectly from independent claim 1. Claim 1, reproduced below with paragraphing added, is illustrative:

> 1. A method of operating an internal combustion engine comprising
>
> retarding the ignition of a gas/fuel mixture within at least one cylinder of the engine to after top dead centre (ATDC) in respect of the combustion cycle of said at least one cylinder of the engine and,
>
> while said ignition is so retarded, increasing the fuelling rate of said at least one cylinder to a level higher than that required when the engine is operating normally to thereby assist in increasing the exhaust gas temperature of the engine,
>
> the timing of the introduction of fuel into the at least one cylinder being maintained at before top dead centre (BTDC).

Ex. 1001, col. 6, ll. 7–18.

D. Applied References

W E. Bernhardt & E. Hoffman, *Methods for Fast Catalytic System Warm-Up During Vehicle Cold Starts*, Society of Automotive Engineers (1972) ("Bernhardt")			Ex. 1002
Eichler et al. ("Eichler '791")	GB 1 447 791	Sept. 2, 1976	Ex. 1003
Griese	US 3,799,134	Mar. 26, 1974	Ex. 1004
Onishi et al. ("Onishi")	US 3,572,298	Mar. 23, 1971	Ex. 1005

Petitioner relies also on the Declaration of Dr. Ron Matthews, dated June 15, 2015, (Ex. 1006) in support of Petitioner's arguments. Patent Owner does not proffer an expert declaration in support of its arguments.

E. Grounds of Unpatentability Instituted

We instituted *inter partes* review of claims 1, 2, 5, 9, 10, 12–14, and 18 on the following grounds of unpatentability under 35 U.S.C. §§ 102 and 103 (Dec. on Inst. 18):

Reference[s]	**Basis**	**Claim[s]**
Bernhardt[2]	§ 102(b)	1, 2, 5, 10, 12, 13, and 18
Bernhardt and Onishi	§ 103(a)	9
Bernhardt and Griese	§ 103(a)	14
Eichler '791 and Bernhardt	§ 103(a)	1, 2, 5, 10, 12–14, and 18
Eichler '791, Bernhardt, and Onishi	§ 103(a)	9

II. ANALYSIS

A. Level of Ordinary Skill in the Art

Petitioner maintains that a person of ordinary skill in the art "would have at least an undergraduate degree in mechanical engineering or a similar technical field and at least two (2) years of relevant work experience or equivalent advanced education in a field related to engine control technology." Pet. 3 n.1. Patent Owner adopts, for purposes of this proceeding, Petitioner's proposed definition of the ordinary artisan. PO

[2] In its Preliminary Response, Patent Owner argued that Petitioner failed to meet its burden of establishing Bernhardt as a prior art printed publication. Prelim. Resp. 29, 32. Patent Owner subsequently withdrew its argument and "agree[d] that it will not submit in the IPR2015-01258 proceeding any arguments challenging the admissibility of the Bernhardt Exhibit in a motion to exclude, at the Oral Hearing, or at any other time in the IPR2015-01258 proceeding, including in any appeal of a final written decision." Paper 22.

Resp. 12 n.2. Based on our review of the record, we too adopt Petitioner's assessment of the level of ordinary skill in the art.

B. Claim Construction

The '365 patent has expired. Prelim. Resp. 3; *see* Pet. 3–4; PO Resp. 11. "[T]he Board's review of the claims of an expired patent is similar to that of a district court's review." *In re Rambus, Inc.*, 694 F.3d 42, 46 (Fed. Cir. 2012). Accordingly, we apply the principle set forth in *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312–13 (Fed. Cir. 2005) (en banc) (quoting *Vitronics Corp. v. Conceptronic, Inc.*, 90 F.3d 1576, 1582 (Fed. Cir. 1996)), that the "words of a claim 'are generally given their ordinary and customary meaning'" as understood by a person of ordinary skill in the art in question at the time of the invention. "In 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). "[C]laims 'must be read in view of the specification, of which they are a part.'" *Phillips*, 415 F.3d at 1315 (quoting *Markman v. Westview Instruments, Inc.*, 52 F.3d 967, 979 (Fed. Cir. 1995)). "[T]he specification 'is always highly relevant to the claim construction analysis. Usually, it is dispositive; it is the single best guide to the meaning of a disputed term.'" *Id.* (quoting *Vitronics*, 90 F.3d at 1582). Extrinsic evidence is "less significant than the intrinsic record in determining the legally operative meaning of claim language." *Id.* at 1317 (citations and internal quotation marks omitted).

Method claim 1 calls for: 1) retarding the ignition to ATDC; 2) increasing the fueling rate, while the "ignition is so retarded," to a level higher than that during normal operation; and 3) maintaining fuel introduction timing at BTDC.

Patent Owner concedes that the challenged claims are unpatentable if the Board maintains its claim constructions as set forth in the Decision on Institution. Tr. 28:24–29:16.

1. the timing of the introduction of fuel

Claim 1 recites "the timing of the introduction of fuel into the at least one cylinder being maintained at before top dead centre (BTDC)." Ex. 1001, col. 6, ll. 16–18. The parties agree that this recitation requires at least that the initiation of fuel addition to the cylinder begin before top dead center. *See* Pet. 5; PO Resp. 13–14. Specifically, Patent Owner argues that the term "introduction" refers to the start of injection and, thus, the limitation requires merely that fuel injection begin BTDC but does not require that the addition of fuel end in the BTDC range. *See* PO Resp. 13–14. Petitioner, on the other hand, argues that the "maintained" language requires that all fuel be injected at BTDC. Pet. 5; Reply 3. As we did in the Decision on Institution, we, for purposes of this Final Decision, agree with the parties that claim 1 requires that the start of the injection[3] of fuel begins at BTDC. In construing this phrase, we need not and do not reach

[3] We, like the parties, assume for purposes of this decision that fuel introduction in the claimed invention involves fuel *injection*. *See, e.g.*, Pet. 2; PO Resp. 1; *but see* Reply 4 n.1 (Petitioner clarifying that it does not "concede that 'introduction of fuel' necessarily implies, or is limited to, a particular type of fuel injection system."). We do not reach the issue of whether the claimed "introduction of fuel" is limited to fuel injection.

Petitioner's argument that the claims require *all* fuel to be injected BTDC. *See Vivid Techs., Inc. v. Am. Sci. & Eng'g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999). Whether injection of some fuel must occur ATDC is discussed further below, with respect to the construction of "while said ignition is so retarded, increasing the fuelling rate."

2. fuelling rate

In the Decision on Institution, we preliminarily construed "fuelling rate" as the quantity of fuel injected in a cylinder during a single cycle. Dec. on Inst. 9–10; *see* Ex. 1001, col. 2, ll. 3–4 ("the fuelling rate (measured in mg/cylinder/cycle)"). The parties agree that this is the proper construction of that phrase. PO Resp. 13; Pet. 5 ("this phrase should be construed to mean 'the amount of fuel introduced into a cylinder during a combustion cycle'"); Tr. 31:12–18. Accordingly, we adopt that construction in this Final Decision.

3. while said ignition is so retarded, increasing the fuelling rate

The dispositive issue in this case is the proper construction of the limitation of claim 1 pertaining to when "increasing the fuelling rate" occurs. That limitation recites:

> [W]hile said ignition is so retarded, increasing the fuelling rate of said at least one cylinder to a level higher than that required when the engine is operating normally[.]

Ex. 1001, col. 6, ll. 11–15. In the Decision on Institution, we preliminarily construed this phrase as meaning "increasing the quantity of fuel delivered to a cylinder, while the cylinder is in an ignition-retarded condition, to a level higher than the quantity of fuel that would be delivered in a normal operating condition." Dec. on Inst. 9–10. Petitioner agrees with our preliminary construction (Reply 14), and Patent Owner contends that this

phrase instead should be construed to require "the quantity of fuel injected into the cylinder during a given cycle must *increase* ATDC . . . and further, that the quantity of fuel injected into the cylinder during a given cycle must be *greater than* the quantity of fuel injected into the cylinder during a cycle of normal operation" (PO Resp. 19). We now revisit our preliminary construction in light of the fully developed record and after considering all the arguments of the parties.

Claim Language

The phrase "so retarded" in this limitation refers back to the first step of the method, which recites "retarding the ignition . . . to after top dead centre (ATDC)." Accordingly, claim 1 requires increasing the fuelling rate—while the ignition is retarded to ATDC—to a level higher than that when operating normally. There is no dispute that "increasing the fuelling rate . . . to a level higher than that required when the engine is operating normally" means that the total quantity of fuel injected into a cylinder during a single cycle is greater than the total quantity added during normal operation. PO Resp. 19; *see* Reply 14; *see supra* Section II(B)(2) (construing "fuelling rate").

The parties' dispute relates to timing of the *end* of the fuel injection and specifically whether the claims require that at least some fuel be added to the pertinent cylinder while the crankshaft is in a position ATDC. As discussed above, the parties do not dispute that the *start* of fuel injection must occur BTDC. *See supra* Section II(B)(1) (construing "the timing of the introduction of fuel . . . maintained at . . . BTDC").

As mentioned above, Petitioner argues that the claims require all fuel to be introduced BTDC, thereby precluding any fuel from being added

ATDC. *See* Pet. 5–6; Reply 3. Patent Owner argues that the pertinent claim phrase means "that there is at least some fuel injection ATDC to increase the total quantity of fuel injected during the combustion cycle." PO Resp. 29; *see also id.* at 19 (arguing that the "phrase should be construed to require that the quantity of fuel injected into the cylinder during a given cycle must *increase* ATDC"). In other words, Patent Owner "maintains that the overall timing requirements of claim 1 provide that fuel injection begin BTDC and end ATDC." *Id.* at 20. As to when the step of "increasing the fuelling rate" occurs, Patent Owner argues that the claim phrase "retarding the ignition . . . to after top dead centre (ATDC)" defines "ATDC [as] the time period under which ignition is considered to be 'so retarded.'" PO Resp. 23. Thus, Patent Owner impliedly argues that a particular engine cylinder is in a "so retarded" ignition state only during the portion of a cycle when the crankangle is in the ATDC range. *See id.* at 23–24; *see also id.* at 27–28 (Patent Owner referring to "'retarded ignition' state" and "'non-retarded ignition' state").

Petitioner replies that "[n]othing in the claim language or specification justifies [Patent Owner] Orbital's attempt to require that the fuel injection end ATDC," and agrees with the Board's preliminary construction of the pertinent phrase. Reply 13, 14. Petitioner argues that "this phrase relates to the amount of fuel being introduced into the cylinder in combustion cycles in which ignition is retarded to ATDC, it does not specify the particular time during the combustion cycle in which fuel must be injected." *Id.* at 14.

We do not find Patent Owner's arguments persuasive. As Petitioner notes (Reply 16), in claim 1, the fuelling rate of at least one cylinder during the period "while said ignition is so retarded" is compared to the fuelling rate during the period "when the engine is operating normally," a phrase

appearing later in the same limitation. This suggests that the retarded ignition state, like the operating normally state, is a condition of the engine's pertinent cylinder, not a period within a single cycle, e.g., ATDC. *See* Ex. 1001, col. 3, ll. 22–33 (distinguishing "cylinder(s) operating under ignition retard/high fuelling rate conditions" with other cylinder(s) operating under "normal conditions"). In other words, a particular cylinder during a given cycle is operating either normally or is "so retarded," according to the claimed method. Patent Owner offers no persuasive argument or evidence that one of ordinary skill in the art would understand the state of being ignition-retarded applies to only the portion of a cycle occurring ATDC, or would understand the claim to require a cylinder, during the same cycle, to be in both a normal operating state (in the BTDC range) and in an ignition-retarded state (in the ATDC range). *Cf.* Tr. 32:1–23 (counsel for Patent Owner confirming that, before the start of a cycle, the status of being ignition-retarded or operating normally is known).

Patent Owner argues that the Board's preliminary construction renders redundant and superfluous the phrase "while said ignition is so retarded." PO Resp. 27–29. Patent Owner reasons that the phrase "when the engine is operating normally" already contrasts the fueling rate of the "'retarded ignition' state" with the normally operating ("non-retarded ignition") state thereby rendering redundant and superfluous the phrase "while said ignition is so retarded" if we do not adopt Patent Owner's proposed construction. *Id.* We do not find this argument persuasive. That phrase does not, as Patent Owner argues, limit the timing of the "increasing the fuelling rate" step to a period that is a subset of a given cycle, e.g., ATDC. Rather, the "while said ignition is so retarded" phrase requires the "increasing the fuelling rate" step

to be performed at the same time as, i.e., "while," the ignition is retarded pursuant to the "retarding the ignition" step, i.e., in an ignition-retarding condition or state. This is confirmed by the specification, which discusses performing the first two steps of the claim at the same time, explaining that, upon attainment of the desired exhaust temperature, "the engine management system may then cease to effect the ignition retard and high fuelling rate conditions and return the cylinder to normal ignition timing and fuelling rates." Ex. 1001, col. 5, ll. 24–29. Were the "while said ignition is so retarded" absent from the claim, consistent with Patent Owner's argument, the method would be practiced in a situation where the ignition was retarded then returned to normal, and thereafter the fueling rate increased relative to that of the normal operating conditions. By contrast, requiring the increasing of the fuelling rate to occur "while said ignition is so retarded" serves the claimed method's purpose of increasing downstream gas temperatures. *See* Ex. 1008, 84 (Applicant, during prosecution, attempting to distinguish Morikawa by arguing that the reference "contains no disclosure of increasing the fuelling rate while the ignition is retarded for the purpose of assisting in increasing the exhaust gas temperature, as in the present invention"); *id.* at 85 (similarly attempting to distinguish two other references because they allegedly "lack disclosure which would have made it obvious to increase the fuelling rate while the ignition is retarded for the purpose of assisting in increasing the exhaust gas temperature"). The phrase "while said ignition is so retarded" is not redundant or superfluous under our preliminary construction.

Patent Owner's argument that "[t]he claimed method thus requires an action in which the quantity of fuel injected into the cylinder during a given

cycle must increase after top dead center" (PO Resp. 29–30) is not commensurate with the language of the claim. The pertinent limitation calls for "increasing the fuelling rate." As the parties agree, "fuelling rate" refers to the total amount of fuel added to a cylinder in a single cycle. "Fuelling rate" does not refer to the cumulative amount of fuel in the cylinder at a particular point during a cycle, e.g., ATDC. *See supra* Section II(B)(2). Patent Owner, is, in effect, arguing that the claim language "while said ignition is so retarded, *increasing the fuelling rate* of said at least one cylinder" should be rewritten to read "while said ignition is so retarded, *increasing the fuel in* said at least one cylinder." We recognize that adding fuel to a cylinder at any point during a cycle (including while BTDC and ATDC) will contribute to the overall quantity of fuel introduced during that cycle, but it does not follow necessarily that the adding of fuel during a cycle results in a fuelling rate increase relative to that of normal operation. For example,[4] where the normal fuelling rate is 3 mg/cylinder/cycle, a total of 3 milligrams of fuel will be introduced over the course of one cycle, and adding some of the fuel in the ATDC range would not result in an increase of that fuelling rate. Similarly, where the increased fuelling rate is 18 mg/cylinder/cycle, injecting all 18 milligrams of the fuel in the BTDC range would still result in the engine operating with an increased fuelling rate, as compared to the normal fuelling rate of 3 mg. Patent Owner's acknowledgement (Tr. 37:16–38:11) that the fuelling rate is established prior to the start of a cycle further highlights the flaw in Patent Owner's argument

[4] The fuelling rate values in this example are those of an embodiment of the invention disclosed in the specification. *See* Ex. 1001, col. 5, ll. 47–57.

that the claim should be read to require an increase in that rate during the cycle.

The Specification

In the Patent Owner Response, Patent Owner points to a particular portion of the specification as purportedly supporting its proposed claim construction (PO Resp. 16, 31–32) and argues that "the '365 Patent unmistakably describes an embodiment in which fuel is injected ATDC" (*id.* at 16). Specifically, Patent Owner points to the specification's statement that "[i]t is however also envisaged that the fuel be *introduced* to the cylinder after top dead centre (ATDC) under certain conditions or situations." *Id.* (quoting Ex. 1001, col. 2, ll. 13–15) (emphasis added); *id.* at 32. However, as Petitioner notes (Reply 8, 19) and Patent Owner admits (Tr. 41:5–42:21; *see* PO Resp. 38–39), this is an unclaimed embodiment—or, in Patent Owner's terms (Tr. 42:10–12), "a disclaimed embodiment"—as it is excluded by the explicit language of claim 1, which requires that the timing of the *introduction* of fuel be maintained at BTDC.[5] Patent Owner does not direct our attention to the disclosure in the specification of any other embodiment where fuel is added ATDC. Because the only disclosure of fuel injection ATDC is admittedly not covered by the claims, the specification not only fails to support Patent Owner's proposed construction but also further suggests that Patent Owner's proposed construction is incorrect. Patent Owner does not offer any persuasive argument that the

[5] As discussed below, the fuel introduction timing limitation was added by amendment during prosecution to overcome the Morikawa reference. *See also* Tr. 42:8–21; PO Resp. 38–39.

Board's preliminary construction is inconsistent with the specification's description of the claimed invention.

The specification refers to "ignition retard" and "high fuelling rate" as "conditions" distinct from normal conditions or normal settings. For example, the specification states:

> When the appropriate sensor or sensors detect that the engine parameter, for example the exhaust system temperature, is again above the acceptable value, the engine management system may then cease to effect the *ignition retard and high fuelling rate conditions* and return the cylinder to normal ignition timing and fuelling rates.

Ex. 1001, col. 5, ll. 24–29 (emphasis added); *see also id.* at col. 3, ll. 26–27 ("the cylinder(s) operating under ignition retard/high fuelling rate conditions"); *id.* at col. 4, ll. 17–18 ("maintaining the retarded ignition and high fuelling rate conditions for a 'light-off' period only"); *id.* at col. 5, ll. 58–65 (distinguishing cylinders running under "normal settings" with those operating with retarded ignition and increased fuelling rate). These are conditions that may be enabled. *Id.* at col. 5, ll. 50–54 (distinguishing fuel-per-cycle at normal idle from that "when retarded ignition and a high fuelling rate is enabled in accordance with the method of the present invention").

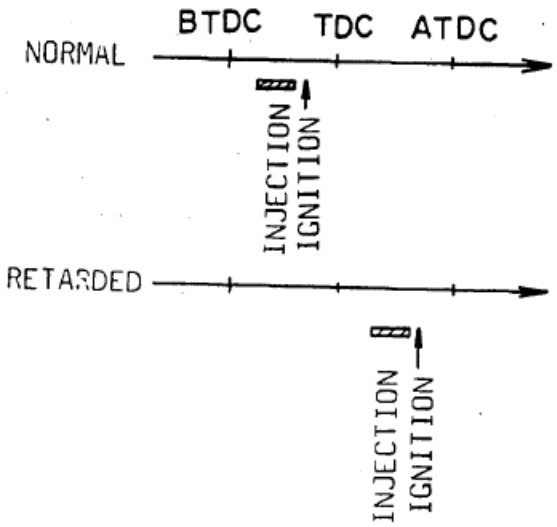
The phrase "while said ignition is so retarded" is not, as Patent Owner suggests, limited to the period of time when the crankangle position during a given cycle is ATDC. The engine is in a period "while said ignition is so retarded [to ATDC]" at all crankangle positions when the retarded-ignition condition is enabled, including those times during the cycle when the crankangle is BTDC. Thus, when the cylinder is operated in a condition where ignition occurs at a retarded angle that is ATDC and where all fuel is

injected before the crankangle reaches top dead center, it still would be true that the fuel was injected while the ignition was "so retarded."

The Prosecution History

We agree with Petitioner's argument (Reply 19) that the prosecution history does not support Patent Owner's argument that claim 1 requires fuel injection to end ATDC. At various stages of the prosecution, each of the three limitations of the issued claim 1 were in separate claims, which were eventually combined into one independent claim to gain allowance. Initially, the sole independent claim 1 recited merely the ignition retarding step, while dependent claim 2 called for increasing fuelling rate "while said ignition is so retarded." Ex. 1008, 15. The Examiner rejected the claims as, *inter alia*, anticipated by the Morikawa reference. *Id.* at 74. Applicant responded by amending independent claim 1 to also include the increasing fuelling rate limitation, and by adding new dependent claim 20 directed to the fuel introduction timing being maintained at BTDC. *Id.* at 83. Applicant attempted to distinguish amended claim 1 (having the first two limitations of the eventually issued claim 1) by arguing that the increased fueling rate of Morikawa's method was performed for a purpose different than Applicant's purpose of increasing the exhaust temperature. *Id.* at 84. The Examiner maintained the rejection of claim 1, finding that Morikawa's method inherently raised the exhaust temperature. *Id.* at 91. The Examiner, however, indicated that claim 20—pertaining to maintaining the fuel introduction timing at BTDC—would be allowable if rewritten to include the limitations of claim 1. *Id.* at 93. Applicant amended claim 1 to include the limitation of dependent claim 20 (*id.* at 106, 108), and a Notice of Allowability issued (*id.* at 110).

Figure 4 of Morikawa (Ex. 1011) is shown below.



Morikawa's Figure 4 is a time chart showing fuel injection timing (shaded bar) and ignition timing (arrow). Ex. 1011, col. 2, ll. 27–28. Morikawa's Figure 4 shows normal engine operation (top) and retarded engine operation (bottom), with both injection and ignition timings being BTDC in normal engine operation, and both injection and ignition timings being ATDC in retarded operation. *See id.* at col. 4, ll. 18–27. Accordingly, Applicant overcame Morikawa by limiting the claim to a third option—where ignition timing was retarded to ATDC and "the timing of the introduction of fuel . . . being maintained at before top dead centre (BTDC)." *See* Ex. 1008, 83, 107; Reply 20 (Petitioner arguing that Applicant overcame Morikawa by claiming a condition where "the timing of introduction of fuel is left unchanged—i.e., maintained at BTDC"). We find persuasive Petitioner's argument (*id.*) that "at no point during prosecution did [Patent Owner] Orbital distinguish *Morikawa* based on the requirement that the quantity of fuel injected into the cylinder during a given cycle must increase, and thus end, at ATDC."

Patent Owner impliedly argues that the Examiner's stated conclusion regarding art of record not relied upon in the Final Office Action, coupled with the Examiner's failure to reject the claims as obvious over a hypothetical combination of references (Morikawa, Hunt, and Griese), supports Patent Owner's proposed construction. PO Resp. 36–37 (citing Ex. 1008, 91, 93; Ex. 1011; Ex. 2016). Patent Owner, however, does not explain adequately and persuasively how that statement sheds light on the meaning of the disputed claim language. Further, to the extent the Examiner's unexpressed understanding of the claim meaning is relevant for our purposes, we are not willing to engage in speculation as to what that understanding might have been or why the Examiner did not enter an obviousness rejection over Patent Owner's currently proposed hypothetical prior art combination.

Patent Owner also discusses amendments to claim 1 made during prosecution and compares various engine states through a document listing several "[c]onditions" (the "conditions document"). PO Resp. 33–39 (citing, *inter alia*, the conditions document, Ex. 2008). Patent Owner's arguments are not persuasive as the analysis is circular in that it is premised on the correctness of Patent Owner's construction and relies heavily on the conditions document, which, apparently, was created by Patent Owner's counsel as a deposition exhibit. *See, e.g.*, PO Resp. 35 (premising the discussion of the conditions document with "[u]nder Patent Owner's construction"); *id.* at 38 (same); *see* Ex. 2006, 40 (Matthews Depo. Tr. 157:20–23) (Patent Owner's counsel stating "I just handed you what's been marked as Exhibit 18. It's a crank angle timing diagram for six exemplary conditions that I've labeled[.]").

Extrinsic Evidence

We have considered the parties' extrinsic evidence but do not find it particularly helpful in construing the disputed phrase. Patent Owner argues that—during the prosecution of another patent ("the Bosch Patent")—a representative of the parent corporation of Petitioner Robert Bosch LLC made a statement characterizing the disclosure in the specification of the '365 patent, and argues that statement is consistent with Patent Owner's claim construction position. PO Resp. 41–43 (citing Ex. 2002); Pet. 58. Patent Owner argues that this statement—that the '365 patent "refers to the injection quantity being increased in a retarded ignition angle"—is an indication of how a person of ordinary skill would understand the '365 patent. PO Resp. 42 (emphasis omitted).

Patent Owner's argument is unpersuasive for several reasons. First, even assuming the Bosch representative's argument is indicative of the understanding of a person of ordinary skill, the statement is referring to the disclosure of the '365 patent, not the claims. Ex. 2002, 160. Thus, at most, Patent Owner is using a statement in another prosecution history to construe the specification (rather than the claim language) of the patent at issue in this case. Second, Patent Owner's limited and selective quotation is ambiguous at best. When read in context, however, it becomes clear that the Bosch representative was using the phrase "in a retarded ignition angle" as shorthand for the retarded operating condition of a cylinder. *See id.* (the sentence, immediately preceding Patent Owner's quotation, referring to "operat[ing] one of three cylinders at a retarded ignition angle" and citing lines from paragraphs in columns 3 and 5 of the '365 patent, which discuss the "conditions"). Accordingly, to the extent the Bosch prosecution history

is relevant to the meaning of the disputed claim phrase, it weighs against Patent Owner's proposed construction.

In view of the foregoing, we maintain our earlier construction of the phrase "while said ignition is so retarded, increasing the fuelling rate of said at least one cylinder to a level higher than that required when the engine is operating normally." The phrase means increasing the quantity of fuel delivered to a cylinder, while the cylinder is in an ignition-retarded condition, to a level higher than the quantity of fuel that would be delivered in a normal operating condition.

C. Anticipation by Bernhardt

Petitioner asserts that claims 1, 2, 5, 10, 12, 13, and 18 are anticipated by Bernhardt (Ex. 1002). Pet. 12–24. In support of this assertion, Petitioner provides an analysis of Bernhardt's disclosure and includes claim charts explaining how each limitation of the challenged claims is disclosed in Bernhardt.

Bernhardt pertains to studies regarding the rapid warm-up of a catalytic converter during engine cold starts. Ex. 1002, 1. Bernhardt discloses:

> It has been found that under appropriate operating conditions the engine itself is able to act as a preheater for the catalytic system. Warm-up spark retard and an increased idling speed of the engine with full open throttle lead to higher exhaust temperatures and thereby to a greater enthalpy of the exhaust gases, so that the after burning system could be brought rapidly up to its operating temperature.

Id. at 8. Bernhardt explains that "[a]s expected the exhaust gas temperature increased very rapidly when the ignition timing was retarded to a region after T.D.C." *Id.* at 10. Bernhardt also discloses the introduction of

secondary air upstream of a catalyst bed during the initial period after a cold engine start-up. *Id.* at 2.

Patent Owner, in its Response to the Petition, does not dispute that Bernhardt describes most elements of the claims before us. *See* PO Resp. 51; *see* Tr. 28:24–29:16. We find Petitioner's evidence regarding the non-disputed limitations persuasive and adopt Petitioner's reasoning. Pet. 12–24.

Patent Owner contends, however, that Bernhardt does not anticipate if we adopt its proposed construction of "while said ignition is so retarded, increasing the fuelling rate" as requiring some fuel to be injected ATDC. PO Resp. 51. Specifically, Patent Owner argues that Bernhardt "necessarily injects all fuel BTDC" and therefore Bernhardt fails to disclose the "increasing the fuelling rate" limitation under Patent Owner's narrow construction. Patent Owner's argument is not persuasive because, for the reasons set forth above, the properly construed claims are not as narrow as Patent Owner proposes. *See* Section II.B.

Based on the argument and evidence presented in the Petition and having considered the argument and evidence presented by both parties during the trial, we are persuaded that Petitioner has established, by a preponderance of the evidence, that claims 1, 2, 5, 10, 12, 13, and 18 are anticipated by Bernhardt.

D. Obviousness over Bernhardt and Onishi and Obviousness over Bernhardt and Griese

Claim 9 depends from claim 1 and recites "the fuel is introduced at between 60° to 80° BTDC." Ex. 1001, col. 6, ll. 35–36. Petitioner acknowledges that Bernhardt "does not explicitly disclose introducing all

fuel . . . between 60° to 80° BTDC." Pet. 24 (emphasis omitted) (referring to claim 9 in the context of Petitioner's argument that the claims require that *all* fuel would have to be injected BTDC, which is an issue we do not reach). Petitioner turns to Onishi (Ex. 1005) for this feature and reasons that it would have been obvious to utilize the claimed fuel introduction range in Bernhardt's method. *Id.* at 24–28.

Onishi is directed to a stratified charge engine[6] with reduced noxious components in the engine emissions and where performance and durability in full load operation are improved. Ex. 1005, col. 1, ll. 15–21. Onishi explains that

> the higher the air-fuel ratio the slower the combustion rate and the higher the exhaust temperature [and] [t]his tends to invite troubles in the exhaust valve system, increased unsmoothness of combustion process, engine roughness, and frequent occurrence of misfire, which in turn results in difficulty of starting and drop of acceleration.

Id. at col. 2, ll. 44–51. Onishi discloses that "fuel injection and ignition may be controlled independently of each other to a considerable extent." *Id.* at col. 10, ll. 1–2. Onishi states:

> [W]hile the initiation angle of fuel injection is varied from 140 deg. ahead of the top dead center to 80 deg. ahead of the same center, i.e., over a range of 60 deg. in terms of the crank angle, the ignition timing may be varied independently thereof and the ignition and operation are made possible without any undesirable outcome, over a range from about 40 deg. ahead of the top dead center to a point past the said center.

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[6] A stratified charge engine is one where a relatively rich fuel mixture is maintained around the spark plug while a lean overall mixture is maintained in the cylinder. *See* Ex. 1005, col. 2, ll. 12–24.

Id. at col. 9, ll. 65–73. Onishi explains that "[a]mple allowance for ignition timing brings about a stable and practically useful stratified charge, and permits operation at a lean overall air-fuel ratio." *Id.* at col. 7, ll. 67–69.

Claim 14 depends from claim 1 and recites "wherein the engine is operated according to said method [of claim 1] when the temperature of the catalytic material is sensed or determined to be below a required operating temperature." Ex. 1001, col. 6, ll. 49–52. Petitioner acknowledges that Bernhardt "does not explicitly disclose that the [catalytic material] temperature is measured by a sensor." Pet. 29. Petitioner relies on Griese (Ex. 1004) for the disclosure of a sensor for sensing the temperature of a catalytic material and contends claim 14 would have been obvious over Bernhardt and Griese. *Id.* at 28–31.

Griese pertains to the operation of an engine to bring an exhaust gas cleaning catalyzator quickly to its operating temperature during a cold start of the engine via the burning of an abnormally high quantity of fuel-air mixture to generate a high enthalpy exhaust gas. Ex. 1004, col. 4, ll. 34–49. Griese teaches the use of a thermostat to control the system such that the heating method is used until the exhaust cleaning arrangement reaches the required temperature. *Id.* at col. 5, ll. 30–34, 62–66.

Patent Owner relies on its arguments concerning the Bernhardt anticipation ground and does not challenge otherwise Petitioner's contentions regarding these two obviousness grounds. PO Resp. 51; *see* Tr. 28:24–29:16.

We are persuaded by Petitioner's contentions with respect to these two obviousness grounds based on Bernhardt (Pet. 24–31), and we adopt them as our own. We determine that Petitioner has demonstrated by a

preponderance of the evidence that the combination of Bernhardt and Onishi renders obvious claim 9 and that the combination of Bernhardt and Griese renders obvious claim 14.

E. Obviousness over Eichler '791 and Bernhardt and Obviousness over Eichler '791, Bernhardt, and Onishi

Petitioner argues that claims 1, 2, 5, 10, 12–14, and 18 would have been obvious over Eichler '791 and Bernhardt. Pet. 31–41.

Bernhardt has been discussed above. Eichler '791 pertains to an internal combustion engine having an electrically controlled inlet manifold injection system. Ex. 1003, 1, ll. 86–89, 2, ll. 21–23. Eichler '791 discloses that "[w]hen the exhaust gases of the internal combustion engine are passed through a thermal and/or catalytic reactor, . . . it is often desired to heat such a reactor quickly during the warming-up phase of the internal combustion engine and thereby cause it to operate." *Id.* at 3, l. 130–4, l. 7. When the engine is cold, the spark may be retarded and an auxiliary air valve may be opened. *Id.* at 4, ll. 7–23. Eichler '791 discloses that a temperature sensor in the exhaust system "operates in parallel with the engine speed transducer and at low exhaust gas temperatures retards the spark timing device and opens the auxiliary air valve during slow idling." *Id.* at 5, ll. 69–76. "The ignition processes are then triggered at a crankshaft angle of 20° to 25° A.T.D.C." *Id.* at 4, ll. 110–112.

Petitioner relies on Bernhardt, *inter alia*, for claimed features of "increasing the fuelling rate" and maintaining fuel introduction at BTDC. *See* Pet. 31–41; *see also id.* at 34 & n.12 (Petitioner also relying on Bernhardt for the increase to occur "while said ignition is so retarded").

As to dependent claim 9, Petitioner acknowledges that Eichler '791 and Bernhardt "do not explicitly disclose introducing fuel between at 60° to 80° BTDC" as called for by that claim. Pet. 41. Petitioner turns to Onishi for this feature and reasons that it would have been obvious to utilize the claimed fuel introduction range with the ignition timing retard of Eichler '791 and the increased fueling rate of Bernhardt. *Id.* at 41–44.

Patent Owner argues that, should we adopt Patent Owner's proposed construction of "while said ignition is so retarded, increasing the fuelling rate," Petitioner cannot demonstrate that the articulated combinations render obvious the challenged claims. PO Resp. 52. We have not adopted Patent Owner's proposed construction. *Cf.* Tr. 28:24–29:16 (Patent Owner conceding that the prior art would read on the claims if the Board maintains its preliminary construction).

We are persuaded by Petitioner's contentions with respect to these two obviousness grounds based on Eichler '791 (Pet. 31–44), and we adopt them as our own. We determine that Petitioner has demonstrated by a preponderance of the evidence that the combination of Eichler '791 and Bernhardt renders obvious claims 1, 2, 5, 10, 12–14, and 18 and that the combination of Eichler '791, Bernhardt, and Onishi renders obvious claim 9.

III. CONCLUSION

For the reasons given above, Petitioner has shown by a preponderance of the evidence that claims 1, 2, 5, 10, 12, 13, and 18 are unpatentable as anticipated by Bernhardt; that claim 9 is unpatentable as being obvious over Bernhardt and Onishi; that claim 14 is unpatentable as being obvious over Bernhardt and Griese; that claims 1, 2, 5, 10, 12–14, and 18 are unpatentable

as being obvious over Eichler ’791 and Bernhardt; and that claim 9 is unpatentable as being obvious over Eichler ’791, Bernhardt, and Onishi.

IV. ORDER

Accordingly, it is

ORDERED that claims 1, 2, 5, 9, 10, 12–14, and 18 of the ’365 patent are held *unpatentable*; and

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

FOR PETITIONER:

Lionel Lavenue
Aaron Parker
Joshua Goldberg
David Reese
FINNEGAN, HENDERSON, FARABOW, GARRETT & DUNNER, LLP
lionel.lavenue@finnegan.com
aaron.parker@finnegan.com
joshua.goldberg@finnegan.com
david.reese@finnegan.com

Edward DeFranco
Brett Watkins
QUINN EMANUEL URQUHART & SULLIVAN, LLP
eddefranco@quinnemanuel.com
brettwatkins@quinnemanuel.com

FOR PATENT OWNER:

David Magee
Andrew Schultz
PEPPER HAMILTON LLP
mageed@pepperlaw.com
schultza@pepperlaw.com