

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

BMW OF NORTH AMERICA, LLC,
Petitioner,

v.

MICHIGAN MOTOR TECHNOLOGIES, LLC,
Patent Owner.

IPR2023-01032
Patent 6,581,565 B2

Before JAMES P. CALVE, NEIL T. POWELL, and SCOTT B. HOWARD,
Administrative Patent Judges.

HOWARD, *Administrative Patent Judge.*

DECISION
Granting Institution of *Inter Partes* Review
35 U.S.C. § 314

I. INTRODUCTION

A. Background and Summary

BMW of North America, LLC¹ (“Petitioner”) filed a Petition (Paper 1, “Pet.”) requesting *inter partes* review of claims 1–7 (“challenged claims”) of U.S. Patent No 6,581,565 B2 (Ex. 1001, “the ’565 patent”). Michigan Motor Technologies, LLC (“Patent Owner”) filed a Corrected Patent Owner Preliminary Response (Paper 12, “Prelim. Resp.”).

We have authority, acting on the designation of the Director, to determine whether to institute an *inter partes* review under 35 U.S.C. § 314 and 37 C.F.R. § 42.4(a). *Inter partes* review may not be instituted unless “the information presented in the petition filed under section 311 and any response filed under section 313 shows that there is a reasonable likelihood that the petitioner would prevail with respect to at least 1 of the claims challenged in the petition.” 35 U.S.C. § 314(a) (2018). “When instituting *inter partes* review, the Board will authorize the review to proceed on all of the challenged claims and on all grounds of unpatentability asserted for each claim.” 37 C.F.R. § 42.108(a) (2022).

For the reasons set forth below, upon considering the briefing and the evidence of record, we determine that the information presented in the Petition establishes a reasonable likelihood that Petitioner will prevail with respect to at least one of the challenged claims. Accordingly, we institute *inter partes* review on all of the challenged claims based on all of the grounds identified in the Petition.

¹ Although the Petition was originally filed by BMW of North America, LLC and Mercedes-Benz USA, LLC, this proceeding was terminated with respect to Mercedes-Benz. Paper 13 (Termination Order).

B. Real Parties in Interest

In the Petition,² Petitioner identifies Mercedes-Benz USA, LLC, BMW of North America LLC, Mercedes-Benz Intellectual Property GmbH & Co. KG, Mercedes-Benz AG, Mercedes-Benz Group AG, and Bayerische Motoren Werke AG as real parties in interest. Pet. 83

Patent Owner identifies Michigan Motor Technologies LLC as the real party in interest. Paper 4, 2 (Patent Owner's Mandatory Notices).

C. Related Matters

The parties identify the following district court proceedings in which the '482 patent is being asserted:

Michigan Motor Technologies LLC v. Mercedes-Benz USA, LLC, No. 1:22-cv-3957 (N.D. Ill.) and

Michigan Motor Technologies LLC v. Bayerische Motoren Werke AG, No. 1:22-cv-3804 (N.D. Ill.).

Pet. 83; Paper 4, 2.

We take Official Notice of prior *inter partes* reviews involving the '565 patent: *Volkswagen Group of America, Inc. v. Michigan Motor Technologies LLC*, IPR2020-00444 and *Volkswagen Group of America, Inc. v. Michigan Motor Technologies LLC*, IPR2020-00445 (the Volkswagen IPRs). We terminated the Volkswagen IPRs due to settlement after institution of trial. *See Volkswagen*, IPR2020-00444, Paper 22 (PTAB April 20, 2021); *Volkswagen*, IPR2020-00445, Paper 22 (PTAB April 20, 2021).

² Following the Termination with respect to Mercedes-Benz USA, LLC, Petitioner has not filed updated mandatory notices indicating that the real parties in interest have change. *See* 37 C.F.R. § 42.8(a)(3) (requiring a party to file an updated mandatory notice with 21 days of a change in the real party in interest).

D. The '565 Patent

The '565 patent relates to torque control for Direct Injection Spark Ignition (“DISI”) internal combustion engines. Ex. 1001, code (57), 1:19–21. The '565 patent describes an exemplary engine in connection with Figure 1, which is reproduced below.

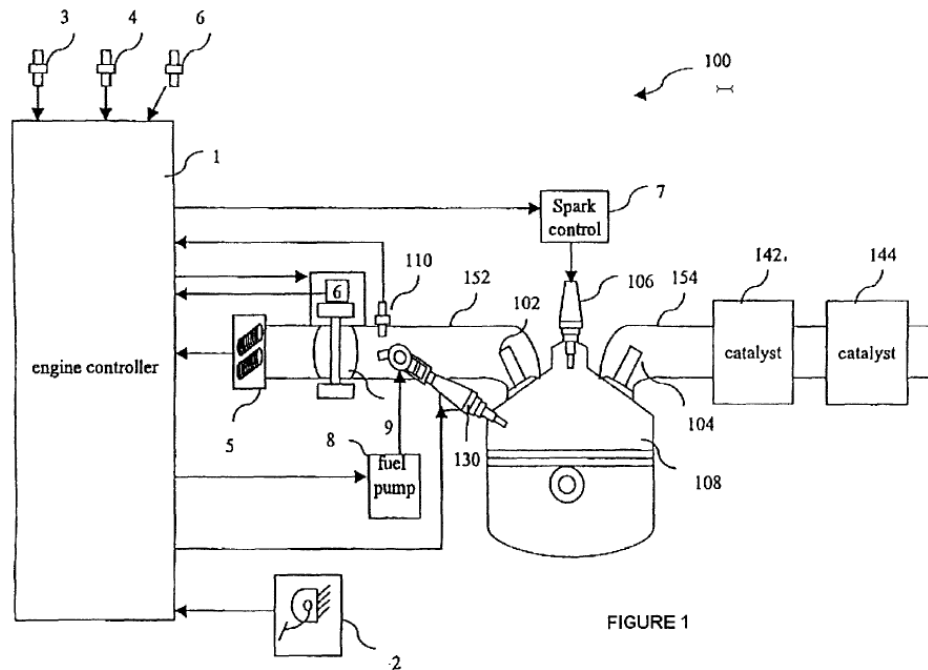


Figure 1 shows direct injection spark ignition engine 100, which includes air intake valve 102, exhaust valve 104, spark plug 106, combustion chamber 108, manifold absolute pressure sensor 110, fuel injector 130, three way catalytic converter 142, Nox trap/catalyst 144, air-intake manifold 152, and exhaust manifold 154. *Id.* at 2:40–56. Direct injection spark ignition engine 100 also includes engine controller 1. *Id.* at 2:40–42. Accelerator pedal and sensor assembly 2, engine speed sensor 3, engine temperature sensor 4, air charge temperature sensor 5, manifold absolute pressure sensor 110, and throttle position indicator 6 all provide signals to engine controller 1. *Id.* at 2:42–46.

Air and fuel mix in combustion chamber 108. Ex. 1001, 2:47–49. Throttle 9 controls an air charge, which travels via intake manifold 152 through intake air valve 102. *Id.* at 2:48–50. Fuel injector 130 injects the fuel into combustion chamber 108 directly. *Id.* at 2:47–48. Spark control unit 7 operates spark plug 106 to produce a spark for igniting the air/fuel mixture. *Id.* at 2:51–53. The resulting combustion produces exhaust gases, which exit through exhaust valve 104 to exhaust manifold 154. *Id.* at 2:53–55.

The '565 patent discusses calculating a desired output torque in connection with Figure 2, which is reproduced below.

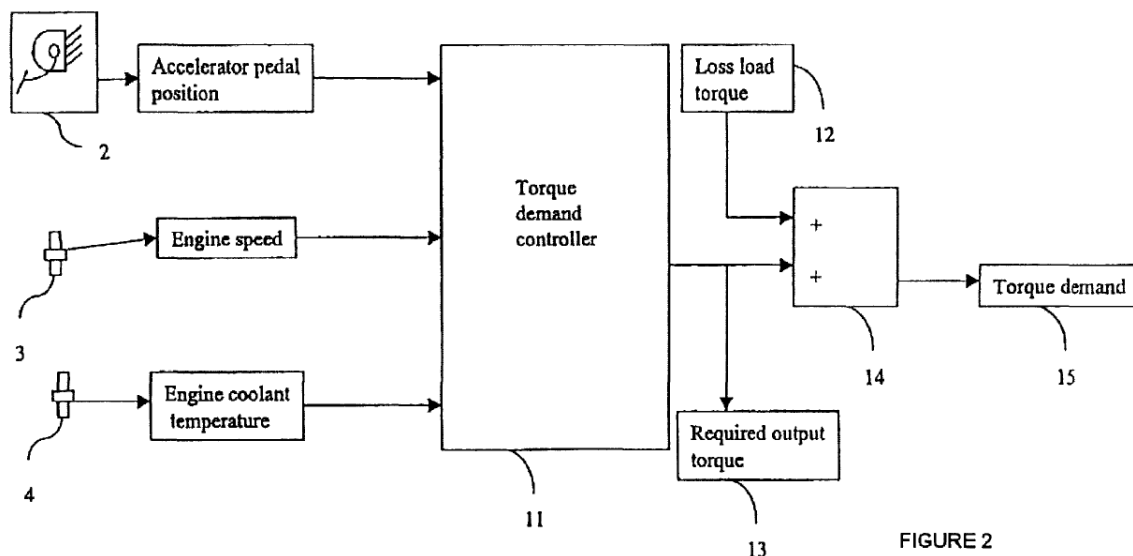


Figure 2 is a block diagram showing torque demand controller 11, which forms part of engine controller 1. Ex. 1001, 2:34–35, 2:57–58. Torque demand controller 11 receives various signals and outputs torque demand signal 15. *Id.* at 2:58–67. Torque demand controller 11 receives an accelerator pedal position signal from accelerator pedal and sensor assembly 2, an engine speed signal from engine speed sensor 3, and an engine temperature signal from engine temperature sensor 4. *Id.* at 2:59–63. Based on these inputs, torque demand controller 11 determines required output

torque signal 13, to which loss torque load signal 12 is added, which produces torque demand signal 15. *Id.* at 2:57–67.

The '565 patent discusses how the torque demand signal is used in connection with Figure 3, which is reproduced below.

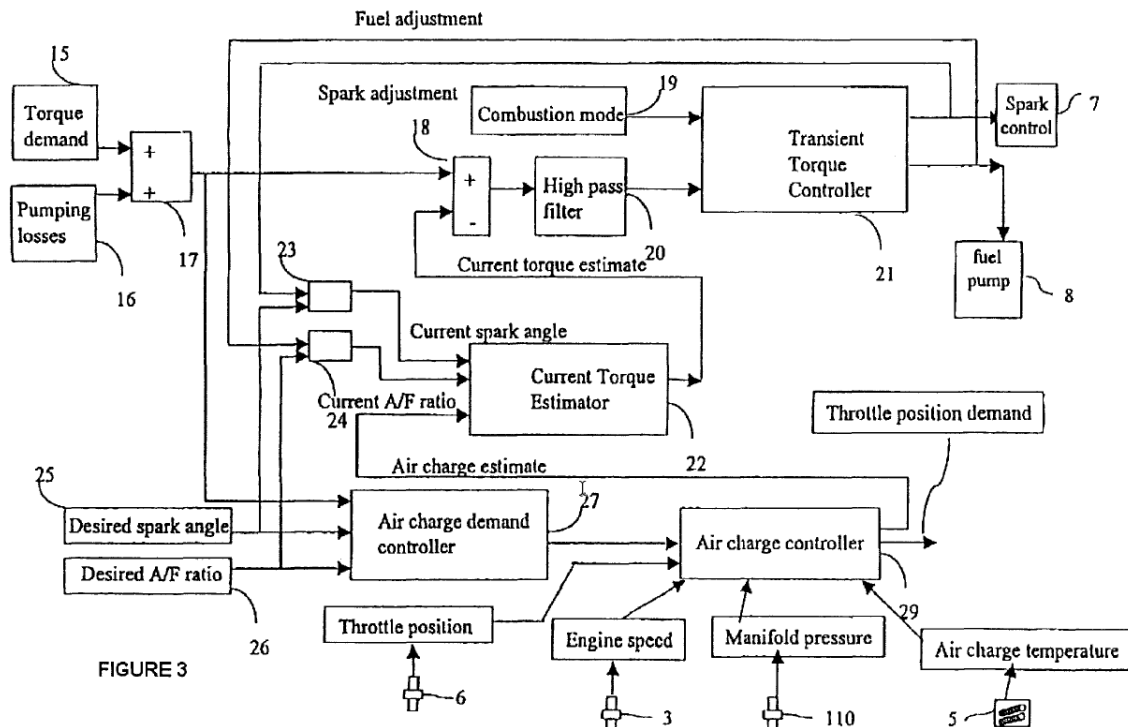


Figure 3 “is a block diagram of a torque producer.” Ex. 1001, 2:36.

The torque producer of Figure 3 includes adder 17. Ex. 1001, 3:1–6. Adder 17 receives torque demand signal 15, as well as pumping losses signal 16, “which represents losses due to the inherent losses in the engine cycle.” Ex. 1001, 3:1–4. Adder 17 generates a desired torque signal.

Air charge demand controller 27 receives the desired torque signal generated by adder 17, as well as desired spark angle signal 25 and desired air fuel ratio signal 26. Ex. 1001, 3:7–9. Air charge demand controller 27 produces an air charge demand signal, which it provides to air charge controller 29. *Id.* at 3:13–15.

Based on the air charge demand signal and various other inputs, air charge controller 29 provides multiple outputs. Ex. 1001, 3:13–22. Air charge controller 29 sends a desired throttle position signal to throttle 9. *Id.* at 3:19–21. Air charge controller 29 also produces “a signal representing an estimate of the air charge.” *Id.* at 3:19–22.

Current torque estimator 22 receives the air charge estimate signal, along with a signal representing the current air/fuel ratio and a signal representing the current spark angle. Ex. 1001, 3:27–33. Based on these signals, current torque estimator 22 produces “a signal representing an estimate of the current torque.” *Id.* at 3:29–33.

Comparator 18 compares the estimate of the current torque to the desired torque signal, producing an error signal. Ex. 1001, 3:34–36. High pass filter 20 filters the error signal. *Id.*

Transient torque controller 21 uses the filtered error signal “to generate signals for temporarily adjusting the torque produced by the engine 100.” Ex. 1001, 3:36–39. Depending on whether combustion mode signal 19 indicates engine 100 is operating in stratified mode³ or homogeneous mode,⁴ either a fuel adjustment signal is generated to adjust fueling, or a spark adjustment signal is generated to adjust spark timing. *Id.* at 3:40–50.

³ In stratified mode, “the combustion chambers contain stratified layers having different air/fuel mixtures.” Ex. 1001, 1:22–24. In stratified mode, “spark angle has little influence on the torque produced. The torque producer modifies the air/fuel in order to control the torque produced.” *Id.* at 1:36–39.

⁴ In homogeneous mode, “a homogeneous mixture of air and fuel is introduced into the combustion chamber.” Ex. 1001, 1:31–22. In homogeneous mode, “the air/fuel ratio is controlled tightly in order to maintain correct operation of the catalytic converter to reduce noxious

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E. Illustrative Claim

The '565 patent includes seven claims, all of which are challenged. Claims 1 and 7 are independent. Claims 2–6 depend, directly or indirectly, from claim 1. Claim 1 is illustrative and reproduced below.

1. A device for controlling a torque output of an engine, the device comprising:
 - a torque demand controller for generating a torque demand signal; and
 - a torque producer which receives the torque demand signal, the torque producer includes:
 - an estimator which receives as inputs a current spark angle signal, a current air/fuel ratio signal and an estimated air charge signal and outputs an estimated torque signal;
 - a comparator which receives as inputs the estimated torque signal and a desired torque signal and outputs a difference signal;
 - a high pass filter which receives as an input the difference signal and outputs a filtered difference signal in which low frequency components are absent; and
 - a transient torque controller which receives as an input the filtered difference signal and outputs a fuel adjustment signal and a spark adjustment signal.

Id. at 4:2–22.

F. Prior Art and Asserted Grounds

Petitioner asserts that claims 1–7 would have been unpatentable on the following grounds:

emission. The torque producer modifies the timing of the spark ignition in order to control the torque produced.” *Id.* at 1:40–45.

Claim(s) Challenged	35 U.S.C. § ⁵	Reference(s)/Basis
1, 4, 7,	103(a)	Suzuki, ⁶ Cullen, ⁷ Scherer ⁸
2, 3, 5, 6,	103(a)	Suzuki, Cullen, Scherer, Takahashi ⁹

Petitioner relies on the testimony of Arthur MacCarley, Ph.D., P.E.
(Ex. 1003).

II. ANALYSIS

A. Legal Standards

In *Graham v. John Deere Co. of Kan. City*, 383 U.S. 1 (1966), the Supreme Court set out a framework for assessing obviousness under 35 U.S.C. § 103 that requires consideration of four factors: (1) the “level of ordinary skill in the pertinent art,” (2) the “scope and content of the prior art,” (3) the “differences between the prior art and the claims at issue,” and (4) if in evidence, “secondary considerations” of non-obviousness such as “commercial success, long-felt but unsolved needs, failure of others, etc.” *Id.* at 17–18. “While the sequence of these questions might be reordered in any particular case,” *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 407 (2007), the U.S. Court of Appeals for the Federal Circuit has repeatedly emphasized that “it is error to reach a conclusion of obviousness until all

⁵ The Leahy-Smith America Invents Act (“AIA”) included revisions to 35 U.S.C. § 103 that became effective on March 16, 2013. Because the ’565 patent claims the benefit of the filing date from an application filed before March 16, 2013, we apply the pre-AIA version of the statutory basis for unpatentability. *See* Ex. 1001, code (22).

⁶ US 6,006,717, issued December 28, 1999 (Ex. 1005).

⁷ US 5,241,855, issued September 7, 1993 (Ex. 1006).

⁸ US 6,047,681, issued April 11, 2000 (Ex. 1007).

⁹ US 5,282,449, issued February 1, 1994 (Ex. 1008).

those factors are considered,” *WBIP, LLC v. Kohler*, 829 F.3d 1317, 1328 (Fed. Cir. 2016). Because Patent Owner does not address objective evidence of non-obviousness, we focus solely on the first three *Graham* factors.

B. Level of Ordinary Skill in the Art

In determining whether an invention would have been obvious at the time it was made, we consider the level of ordinary skill in the pertinent art at the time of the invention. *Graham*, 383 U.S. at 17. “The importance of resolving the level of ordinary skill in the art lies in the necessity of maintaining objectivity in the obviousness inquiry.” *Ryko Mfg. Co. v. Nu-Star, Inc.*, 950 F.2d 714, 718 (Fed. Cir. 1991). The “person having ordinary skill in the art” is a hypothetical construct, from whose vantage point obviousness is assessed. *In re Rouffet*, 149 F.3d 1350, 1357 (Fed. Cir. 1998).

Factors pertinent to a determination of the level of ordinary skill in the art include “(1) the educational level of the inventor; (2) type of problems encountered in the art; (3) prior art solutions to those problems; (4) rapidity with which innovations are made; (5) sophistication of the technology; and (6) educational level of active workers in the field.” *Envtl. Designs, Ltd. v. Union Oil Co. of Cal.*, 713 F.2d 693, 696–697 (Fed. Cir. 1983) (citing *Orthopedic Equip. Co. v. All Orthopedic Appliances, Inc.*, 707 F.2d 1376, 1381–82 (Fed. Cir. 1983)). “Not all such factors may be present in every case, and one or more of these or other factors may predominate in a particular case.” *Id.*

Petitioner argues that a person having ordinary skill in the art “would have had a B.S. degree in Electrical Engineering, Mechanical Engineering, Automotive Engineering (or equivalent), as well as at least 2–4 years of industry or research experience in the relevant field of engine control

systems or, alternatively, at least an M.S. degree in Electrical Engineering or Mechanical Engineering.” Pet. 10 (citing Ex. 1003 ¶¶ 36–37).

Patent Owner argues that a person having ordinary skill in the art would have had “(1) a B.S. in mechanical engineering or a closely related field with three or more years of experience in either programmable engine systems or engine control systems or (2) at least a M.S. in mechanical engineering.” Prelim. Resp. 12.

On one hand, Patent Owner presents only attorney argument, unsupported by any evidence. *See* Prelim. Resp. 12. Accordingly, we give it no weight. *Elbit Systems of America, LLC v. Thales Visionix, Inc.*, 881 F.3d 1354, 1359 (Fed. Cir. 2018) (“[a]ttorney argument is not evidence’ and cannot rebut other admitted evidence” (quoting *Icon Health & Fitness, Inc. v. Strava, Inc.*, 849 F.3d 1034, 1043 (Fed. Cir. 2017))); *Gemtron Corp. v. Saint-Gobain Corp.*, 572 F.3d 1371, 1380 (Fed. Cir. 2009) (unsworn attorney argument is not evidence).

On the other hand, Petitioner’s formulation is supported by conclusory testimony which does not provide supporting evidence or reasoning. *See* Ex. 1003 ¶¶ 36–37). We give such testimony little weight. *See* 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.”).

Although we give Dr. MacCarley testimony little weight, it is consistent with the invention disclosed in the ’565 patent, which claims a device for controlling torque output in an engine. Accordingly, we adopt Petitioner’s formulation of the person having ordinary skill in the art.¹⁰

¹⁰ If Patent Owner disagrees with Petitioner’s formulation of the level of skill in the art, it must do so in its Response. If a different level of skill
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C. Claim Construction

We apply the same claim construction standard used in the federal courts, in other words, the claim construction standard that would be used to construe the claim in a civil action under 35 U.S.C. § 282(b), which is articulated in *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005) (en banc). See 37 C.F.R. § 42.100(b). Under the *Phillips* standard, the “words of a claim ‘are generally given their ordinary and customary meaning,’ which 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, i.e., as of the effective filing date of the patent application.” *Phillips*, 415 F.3d at 1312–13.

Petitioner argues that no terms need construction in this proceeding. Pet. 10.

Patent Owner argues that all claim terms “should receive their plain and ordinary meaning.” Prelim. Resp. 13.

For the purposes of this Decision, we need not expressly construe any claim terms. See *Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017) (noting that “we need only construe terms ‘that are in controversy, and only to the extent necessary to resolve the controversy’” (quoting *Vivid Techs., Inc. v. Am. Sci. & Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999))).

would affect the outcome in this case, the parties must brief that issue as well. The parties are also encouraged to submit evidence, other than conclusory expert testimony, that supports its position.

D. Discretionary Denial – 325(d)

1. Legal Standard

Patent Owner urges us to exercise our discretion to deny institution of trial under 35 U.S.C. § 325(d). Prelim. Resp. 18–20. Under § 325(d), we have discretion to deny a petition that presents the same or substantially the same prior art or arguments as previously presented to the Office. In evaluating whether the factual predicate under § 325(d) is met, we consider a number of non-exclusive factors, as set forth in *Becton, Dickinson & Co. v. B. Braun Melsungen AG*, IPR2017-01586, Paper 8 at 17–18 (PTAB Dec. 15, 2017) (Institution Decision) (precedential as to Section III.C.5, first paragraph) (“*Becton Dickinson* factors”):

(a) the similarities and material differences between the asserted art and the prior art involved during examination;

(b) the cumulative nature of the asserted art and the prior art evaluated during examination;

(c) the extent to which the asserted art was evaluated during examination, including whether the prior art was the basis for rejection;

(d) the extent of the overlap between the arguments made during examination and the manner in which Petitioner relies on the prior art or Patent Owner distinguishes the prior art;

(e) whether Petitioner has pointed out sufficiently how the Examiner erred in its evaluation of the asserted prior art; and

(f) the extent to which additional evidence and facts presented in the Petition warrant reconsideration of the prior art or arguments.

Becton, Dickinson, IPR2017-01586, Paper 8 at 17–18.

In performing an analysis under § 325(d), “the Board uses the following two-part framework:

(1) whether the same or substantially the same art previously was presented to the Office or whether the same or substantially the same arguments previously were presented to the Office; and (2) if either condition of first part of the framework is satisfied, whether the petitioner has demonstrated that the Office erred in a manner material to the patentability of challenged claims. . . . If, after review of [*Becton Dickinson*] factors (a), (b), and (d), it is determined that the same or substantially the same art or arguments previously were presented to the Office, then factors (c), (e), and (f) relate to whether the petitioner has demonstrated a material error by the Office.

Advanced Bionics, LLC v. MED-EL Elektromedizinische Geräte GmbH, IPR2019-01469, Paper 6 at 8, 10 (PTAB Feb. 13, 2020) (Institution Decision) (precedential) (footnote omitted). Consequently, we first turn to an analysis of *Becton Dickinson* factors (a), (b), and (d) to determine whether the same or substantially the same art previously was presented to the Office or whether the same or substantially the same arguments previously were presented to the Office.

2. Part One of the Advanced Bionics Analysis

Becton Dickinson factors (a), (b), and (d) require us to determine, respectively: (a) “the similarities and material differences between the asserted art and the prior art involved during examination;” (b) “the cumulative nature of the asserted art and the prior art evaluated during examination,” and (d) “the extent of the overlap between the arguments made during examination and the manner in which Petitioner relies on the prior art or Patent Owner distinguishes the prior art.” *Becton, Dickinson*, IPR2017-01586, Paper 8 at 17.

Patent Owner argues that IPR2020-00445 involved substantially similar prior art:

Here, Petitioners assert the same reference, Suzuki, as in [IPR2020-00445], as well as the same combining references Scherer and Takahashi. Petitioners in the instant IPR swap out Robichaux – the primary reference in [IPR2020-00445] – with Suzuki, a secondary reference in [IPR2020-00445] with even less relevance to the ‘565 patent than Robichaux. In addition, Scherer was considered by the U.S.P.T.O. during the prosecution of the ‘565 patent – this is the *third* time Scherer is put forth as an alleged prior art reference for the ‘565 patent.

The newly introduced asserted reference, Cullen, is substantially similar and cumulative of the references asserted in [IPR2020-00445].

Prelim. Resp. 19–20.^{11, 12}

Petitioner argues that only a single reference—Scherer—was considered by the Office during the prosecution of the ‘565 patent. Pet. 20–21. However, Petitioner argues, Scherer “was not used as the basis for any prior-art rejections and the Examiner provided no substantive analysis of Scherer.” *Id.* at 21. Additionally, Petitioner argues that the other three references—Suzuki, Cullen, and Takahashi—were not presented during the prosecution of the ‘565 patent. *Id.*

Petitioner further argues that the analysis in the Volkswagen IPRs “also favors institution. In those proceedings the PTAB only issued an institution decision—it did *not* issue a Final Written Decision on the merits and thus never decided whether any of the prior art references invalidated any claims of the ‘565 patent.” Pet. 22.

¹¹ Patent Owner italicizes the names of prior art references. Here and elsewhere, we have removed the italics.

¹² Patent Owner does not make an argument based on IPR2020-00444, which involves the same references as the instant proceeding. Regardless, we consider both prior petitions.

We agree with Petitioner. Because only one of the four references that are the basis of this Petition were considered by the Office during the prosecution of the '565 patent, we cannot say that the same or substantially the same art previously was presented to the Office during prosecution. Instead, the Petition's reliance on Suzuki, Cullen, and Takahashi—which were not considered by the Office during the prosecution of the '565 patent—shows that this proceeding involves substantially different prior art. *See Volkswagen*, IPR2020-00444, Paper 12 at 16–17 (PTAB Aug. 5, 2020) (rejecting identical argument).

Nor do either of the prior petitions in the Volkswagen IPRs show that the Office previously considered the prior art so as to satisfy § 325(d). Each of those proceedings was terminated after institution but before a final written decision was issued. In such situations, the concerns underlying § 325(d) are not implicated. We do not treat the prior art references that were the basis for those terminated proceedings as being presented to the Office pursuant to § 325(d). *See Google LLC v. Uniloc 2017 LLC*, IPR2019-01584, Paper 7 at 11–12 (PTAB Mar. 24, 2020) (“[I]t is unwarranted to apply our discretion under 35 U.S.C. § 325(d) to deny the instant Petition simply because it relies on the same or similar references that we considered in an institution decision in a prior petition.”).

3. Conclusion

Based on our consideration of *Becton Dickinson* factors (a), (b), and (d), we find that the same or substantially the same art or arguments were not previously presented to the Office. Thus, our analysis ends at this point, and we need not proceed to part two of the *Advanced Bionics* framework. *See Advanced Bionics*, IPR2019-01469, Paper 6 at 8. We therefore decline to exercise our discretion to deny institution based on 35 U.S.C. § 325(d).

E. Suzuki, Cullen, and Scherer

Petitioner argues that claims 1, 4, and 7 would have been obvious over Suzuki, Cullen, and Scherer. Pet. 29–69. Based on the current record, we are persuaded that Petitioner has established a reasonable likelihood of prevailing on this asserted obviousness ground with respect to at least claim 1.

1. Overview of Suzuki

Suzuki is titled “Direct-injection Spark-ignition Type Engine Control Apparatus” and “is directed to a control apparatus, or controller, for a direct-injection spark-ignition type engine.” Ex. 1005, code (54), 2:52–53. Suzuki shows an exemplary engine in Figure 2, which is reproduced below.

FIG.2

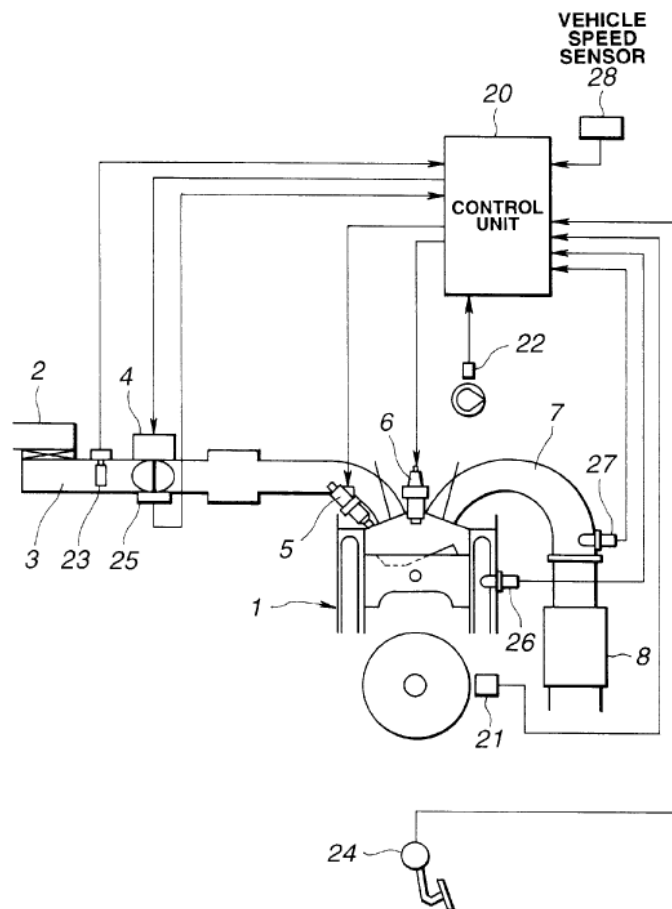


Figure 2 shows engine 1, which includes intake passage 3, throttle valve 4, fuel injector 5, spark plug 6, exhaust passage 7, controller 20, accelerator sensor 24, and various other components. *Id.* at 3:24–43, 3:61–4:5, 4:18–21.

Engine 1 is “a direct-injection spark-ignition engine.” *Id.* at 3:23–24. Controller 20 controls throttle valve 4, which controls air intake through intake passage 3 into the combustion chamber. Ex. 1005, 3:24–31. In response to a signal from controller 20, fuel injector 5 injects fuel directly into the combustion chamber. *Id.* at 3:33–34. The fuel mixes with air in the combustion chamber, and spark plug 6 generates a spark to combust the mixture of fuel and air. *Id.* at 3:38–45. Exhaust gases leave the combustion chamber through exhaust passage 7. *Id.* at 3:62–63.

Fuel injector 5 can introduce fuel into the combustion chamber during the intake stroke or the compression stroke. Ex. 1005, 3:39–44. If fuel injector 5 injects fuel during the intake stroke, the fuel forms a homogeneous mixture with the air in the combustion chamber. *Id.* at 3:39–42. If fuel injector 5 injects fuel during the compression stroke, the fuel forms a stratified mixture with the air around spark plug 6. *Id.* at 3:42–44. “The combustion modes include homogenous stoichiometric combustion . . . , homogeneous lean combustion . . . , and stratified lean combustion.” *Id.* at 3:46–50. Suzuki discusses provisions for switching between homogeneous and stratified combustion modes in connection with Figures 1(A) and 1(B), which are reproduced below.

FIG.1(A)

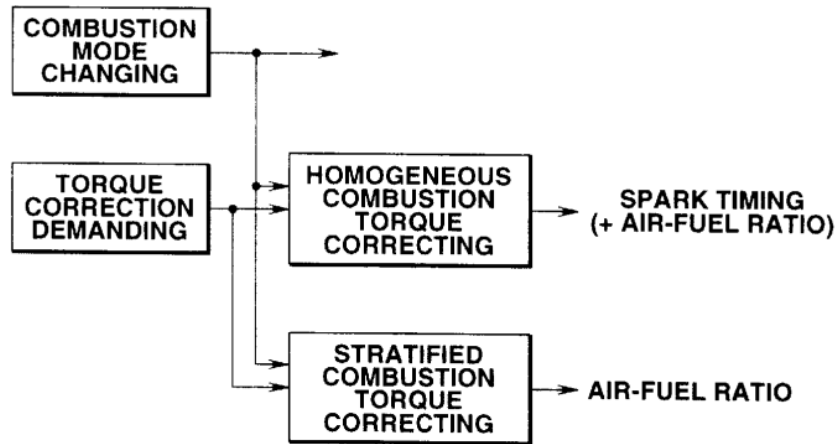
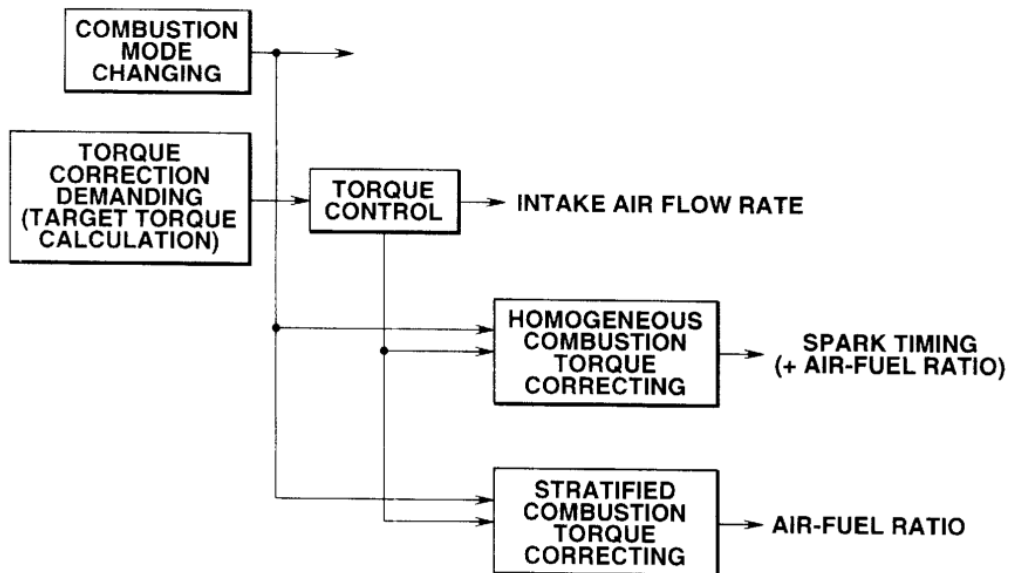


FIG.1(B)



Figures 1(A) and 1(B) are “block diagrams showing the overall arrangement of the invention.” *Id.* at 1:66–67.

In Figure 1(A), there is shown a combustion mode changing section, a torque correction demanding section, a homogeneous combustion torque correcting section, and a stratified combustion torque correcting section. Ex. 1005, 2:54–3:4. Combustion mode changing section serves to make “a combustion change between homogeneous combustion (wherein fuel is injected during an intake stroke to diffuse the fuel so as to form a homogeneous mixture in the combustion chamber) and stratified combustion (wherein fuel is injected during a compression stroke to form a stratified mixture around the spark plug).” *Id.* at 2:55–61. The torque correction demanding section generates a torque correction demand according to engine operating conditions. *Id.* at 2:61–63. During homogeneous combustion, the homogeneous torque correcting section responds to the torque correction demand by “correcting at least the spark timing in order to make a torque correction during homogeneous combustion.” *Id.* at 2:64–3:1. During stratified combustion, the stratified torque correcting section responds to the torque correction demand “and corrects at least the air-fuel ratio in order to make a torque correction.” *Id.* at 3:1–3.

Another overall arrangement appears in Figure 1(B). Ex. 1005, 3:5. In addition to the sections of the arrangement of Figure 1(A), the arrangement of Figure 1(B) includes a torque control section, which responds “to the torque correction demand and controls the amount of air permitted to enter the engine in order to control the torque.” *Id.* at 3:12–15. Suzuki explains that

[b]ecause air intake cannot be changed rapidly, a homogenous combustion torque correcting section corrects at least the spark timing in order to make a torque correction with a fast response (compared with the delay associated with intake air flow rate control) during homogenous combustion. A stratified

combustion torque correcting section corrects at least the air-fuel ratio to make torque correction during stratified combustion.

Id. at 3:15–22.

Suzuki discusses details of one method of correcting torque in connection with Figure 6, a flow diagram illustrating “a torque correcting routine” which is not reproduced. Ex. 1005, 2:10–11, 7:11–12.

In step S31, “a target torque tTRQ calculated by torque demand control is retrieved. The parameter tTRQ includes a torque correction demand (demand for increasing or decreasing the torque) resulting from gear shifting of the transmission, turning on the air conditioner, recovery from a fuel cut, or the like.” Ex. 1005, 7:14–19. Following this,

[i]n step S32, an air correction factor to obtain the target torque (the torque correction demand) is calculated to control the degree of opening of the electronic controlled throttle valve 4.

In step S33, the output torque during intake air correction is estimated.

In step S34, the estimated torque is subtracted from the target torque (which is based on the torque demand control target torque or the torque correction demand calculated at step S31) to calculate the torque shortage due to the delay involved with changing the amount of intake air.

Id. at 7:29–39.

At step S36, the combustion mode is read and it is ascertained whether it is the homogeneous or stratified combustion mode. Ex. 1005, 7:45–50.

Depending on which combustion mode is active, in step S38 or step S40, different control parameters are set. Ex. 1005, 7:51–64. Subsequently, control proceeds according to a spark timing calculation routine and a fuel delivery requirement calculation routine. *Id.* at 7:65–67.

For the embodiment discussed in connection with Figure 6, Suzuki shows response waveforms in Figure 13, which is reproduced below.

FIG.13

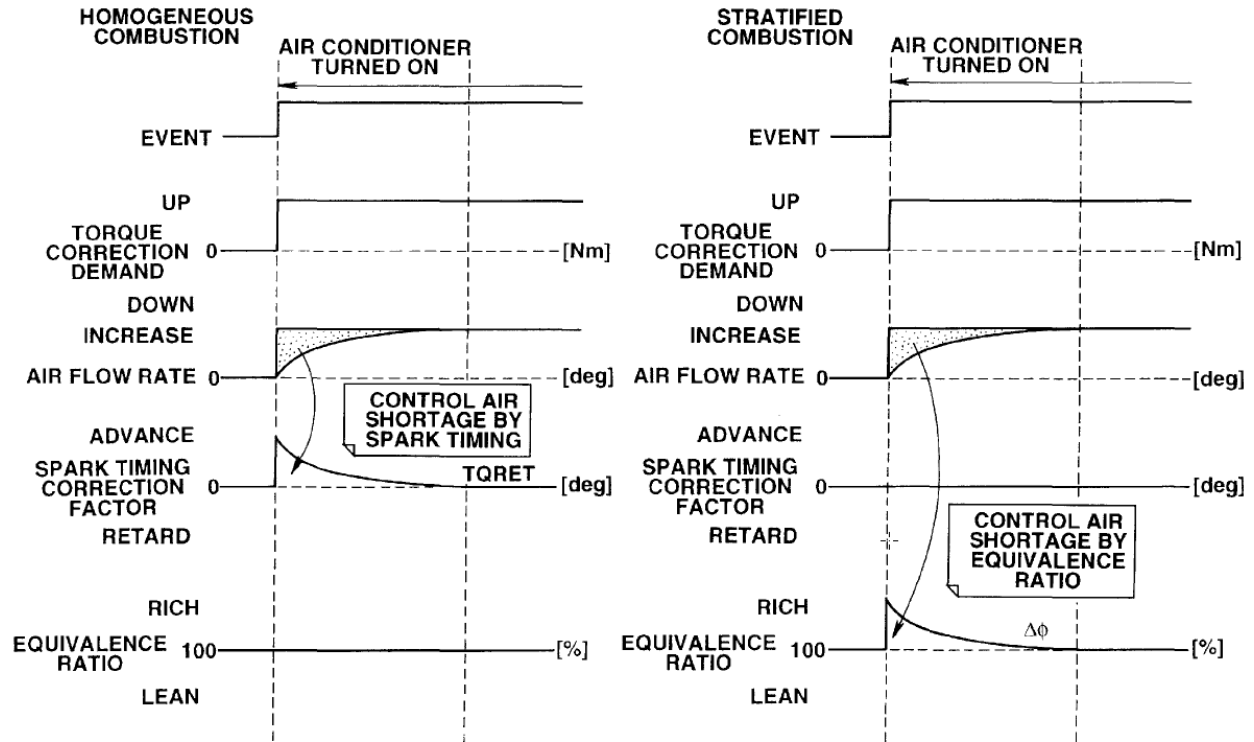


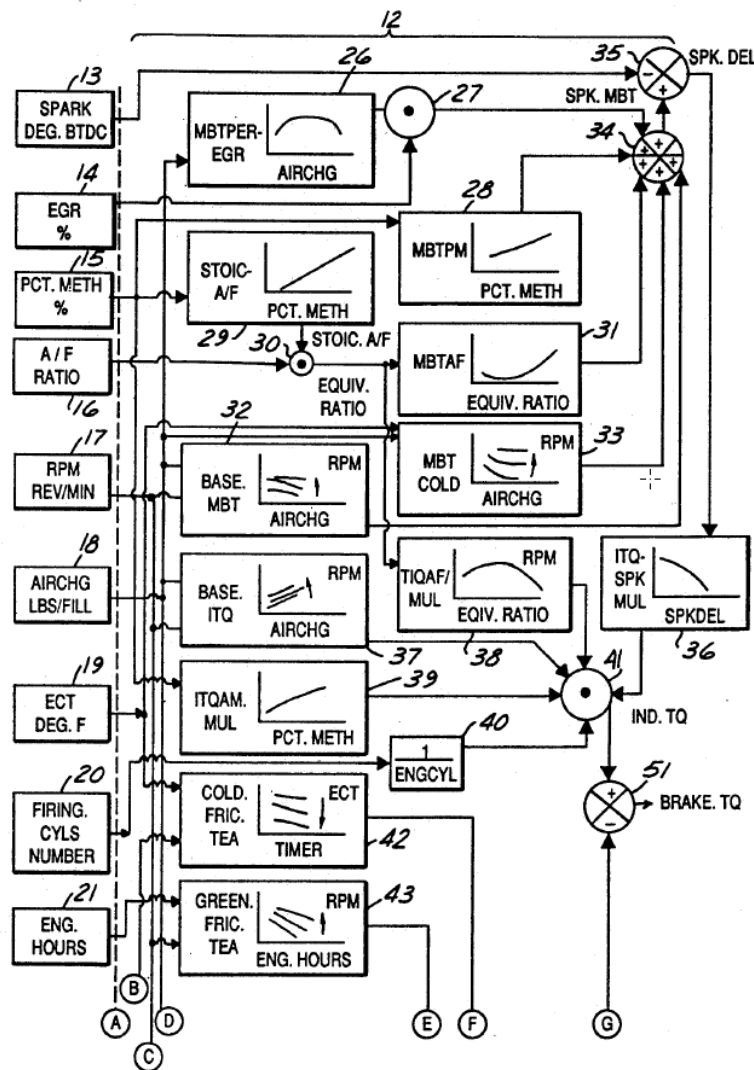
Figure 13 shows, for both homogeneous combustion and stratified combustion, variation in certain values, such as torque correction demand, air flow rate, spark timing correction factor, and equivalence ratio in response to activation of an air conditioner. *See Ex. 1005, Fig. 13.* Suzuki explains that

FIG. 13 shows response waveforms for the second embodiment. Assuming that a torque correction (torque up) demand is produced when the air conditioner is turned on, the amount of air to the engine increases; however, a torque shortage occurs because of the delay in increasing the actual amount of air to the engine. The spark timing is corrected to correct the torque shortage during homogeneous combustion and the equivalence ratio (air-fuel ratio) is corrected, without correcting the spark timing, to correct the torque shortage during stratified combustion.

Id. at 8:51–60.

2. Overview of Cullen

Cullen discusses “inferring the torque produced by an engine.”
Ex. 1006, 1:7–8. Cullen states that it was not practical to measure engine torque directly. *Id.* at 1:16–17. Cullen desires “an improved torque prediction algorithm.” *Id.* at 2:26–29. Cullen discusses an example of inferring engine torque in connection with Figures 3 and 3A, which are reproduced below.



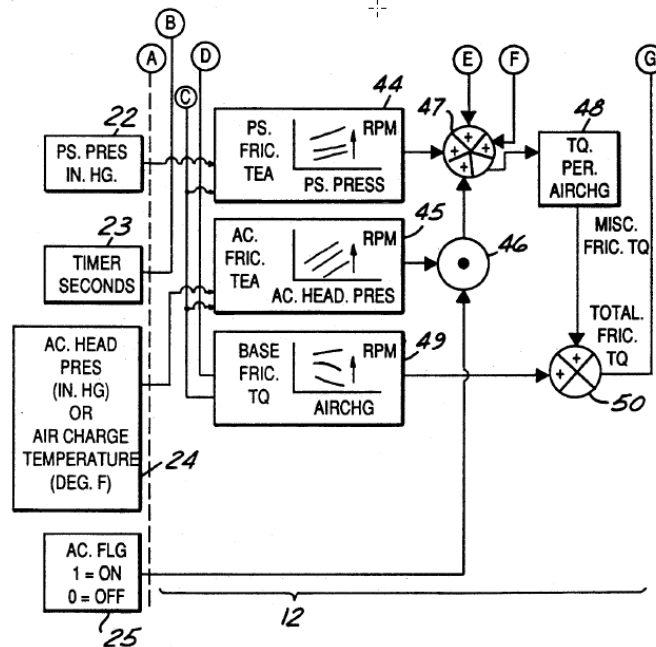


FIG. 3A

Figures 3 and 3A provide “a logic flow diagram of the operation of an electronic engine control module.” *Id.* at 2:52–54. Figures 3 and 3A show electronic engine control module 12. *Id.* at 6:3–4. Electronic control module 12 has algorithms for processing spark timing input 13, exhaust gas recirculation rate input 14, percent methanol fuel input 15, air/fuel ratio input 16, engine rpm input 17, engine air charge input 18, engine coolant temperature 19, firing cylinder indication input 20, engine operating hours 21, power steering pressure 22, timer input 23, input 24 indicating air conditioning head pressure or temperature, and flag input 25 indicating air conditioning on or off. *Id.* at 5:61–6:2. Based on inputs from various blocks, block 41 provides indicated torque. *Id.* at 6:67–7:1. Based on inputs from various blocks, summer 50 (Figure 3A) provides total friction torque. *Id.* at 7:28–29. Summer 51 (Figure 3) receives positive input from block 41 and negative input from summer 50 “to provide total friction torque.” *Id.* at 7:31–33.

3. Overview of Scherer

Scherer discloses an apparatus and method for controlling an internal combustion engine's torque. Ex. 1007, 1:7–11. Scherer discusses one embodiment in connection with Figure 1, which is reproduced below.

Fig. 1

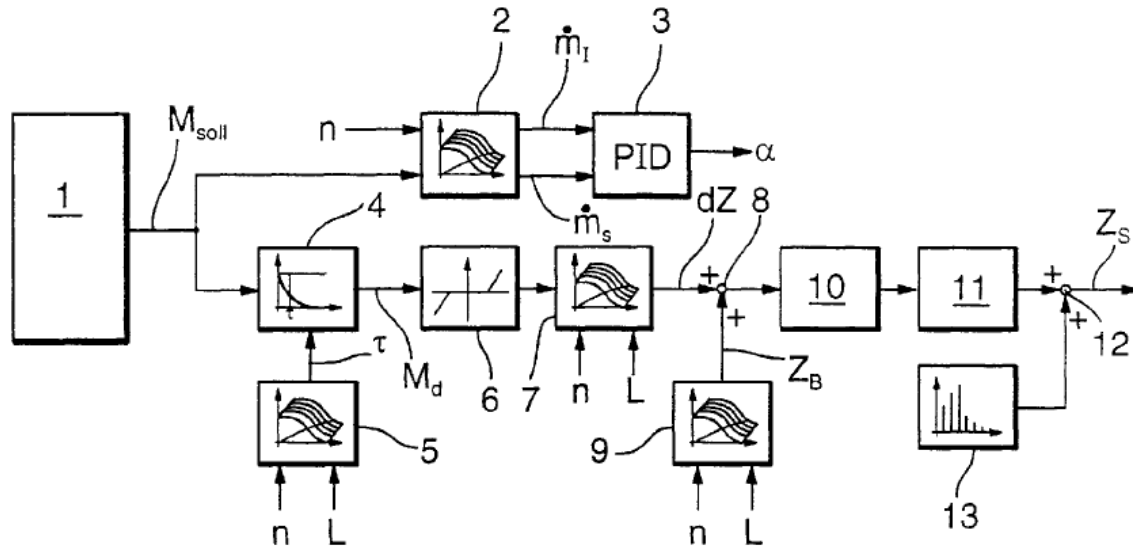


Figure 1 is a block diagram of a device for adjusting engine torque of an Otto engine. *Id.* at 3:30–31.

The device of Figure 1 includes engine torque coordination unit 1, an “airflow regulating branch,” and a parallel “ignition point adjusting branch.” Ex. 1007, 3:60–63, 4:20–23. Engine torque coordination unit 1 “provides a signal indicative, for example, of the desired engine torque (M_{des}) requested by the driver via the accelerator pedal.”¹³ *Id.* at 3:61–63. The airflow regulating branch includes input-side air flow rate calculating unit 2 and adjoining PID air flow rate regulator 3. *Id.* at 3:67–4:2. The ignition point adjusting branch includes high pass filter 4 with characteristic time constant

¹³ The signal referred to as M_{des} in the text appears to be labeled M_{soll} in Figure 1.

diagram unit 5. *Id.* at 4:20–35. The ignition point adjusting branch also includes input-side dead zone unit 6, unit 7, adder 8, ignition point calculating unit 9, unit 10, unit 11, adder 12, and conventional knock regulating stage 13. *Id.* at 4:53–5:5.

Air flow rate calculating unit 2 of the airflow regulating branch receives demanded desired engine torque M_{des} and the momentary rotational engine speed (n). Ex. 1007, 4:2–5. Based on these inputs and a stored characteristics diagram, air flow rate calculating unit 2 calculates a desired air flow rate value (m_s). *Id.* at 4:2–7. The actual air flow rate value (m_I) is also detected by air flow rate calculating unit 2 via an associated sensor system. *Id.* at 4:8–10.

PID air flow regulator 3 receives both the desired air flow rate value m_s and the actual air flow rate value m_I . Ex. 1007 4:8–12. Based on these values, PID air flow regulator 3 identifies “a suitable control signal (α) for an air-flow regulating throttle valve.” *Id.* at 4:8–13. Scherer explains that

As is well known, because of the finite throttle valve adjusting speed and mainly because of the suction pipe filling characteristics, engine torque cannot be adjusted in this manner to follow a highly dynamic desired engine torque change without a noticeable sluggishness. That is, it can adjust only a quasi-static desired engine torque part.

Id. at 4:13–19.

Given this, Scherer relies on the ignition point adjusting branch “to adjust the dynamic desired torque component which exceeds this quasi-static part.” Ex. 1007, 4:20–22. Scherer uses the ignition point adjusting branch

only to adjust specifically that dynamic desired torque component which cannot be regulated by the air-flow-regulating branch. The high pass filter stage, which precisely determines this dynamic desired torque component (M_d), consists of a high

pass filter 4 with an adjustable decay time constant (τ), and a characteristic time constant diagram unit 5.

Id. at 4:28–35.

High pass filter 4 transmits the dynamic desired torque component M_d to input-side dead zone unit 6, and the ignition point adjusting branch uses the dynamic desired torque component M_d and various other factors to generate an adjusting signal (Z_s) for the ignition point adjustment, which is output from adder 12. Ex. 1007, 4:53–5:6. Scherer explains that “[t]he ignition point adjusting branch is able to react very rapidly to sudden changes of the engine torque.” *Id.* at 4:23–25.

Scherer discusses other variations of its system in connection with Figures 2–4. For example, in connection with Figure 2, Scherer discusses a system similar to that of Figure 1 but adapted for a diesel engine. Ex. 1007, 5:16–18. In this embodiment, “instead of an air flow rate regulating device, a device for adjusting the fuel injection duration is provided.” *Id.* at 5:23–24. Additionally, “[i]nstead of the ignition point adjusting branch of the device of Fig. 1, the device of Fig. 2 contains an injection start adjusting branch.” *Id.* at 5:35–37.

4. *Analysis of Claim 1*

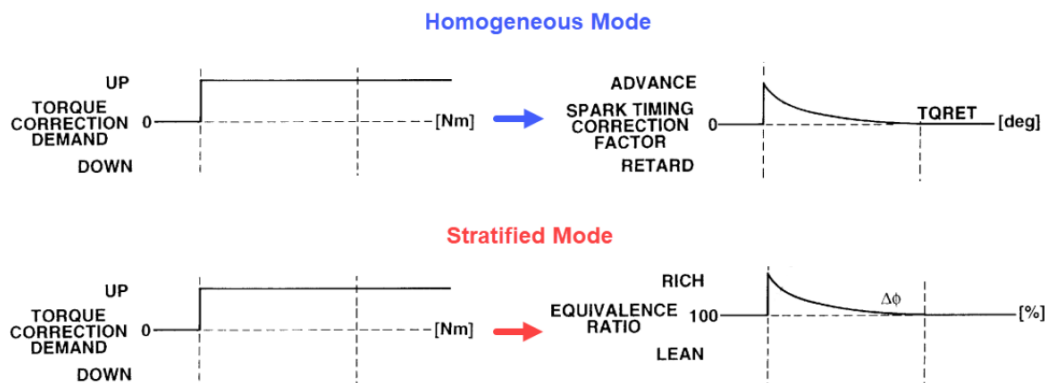
a) *High Pass Filter Limitation*

Claim 1 recites, *inter alia*, “a high pass filter which receives as an input the difference signal and outputs a filtered difference signal in which low frequency components are absent.” Ex. 1001, 4:16–18. Petitioner argues that the combination of Suzuki and Scherer teaches this limitation. Pet. 48–53; *see also* Ex. 1003 ¶¶ 93–102.

Based on the current record, we agree. Suzuki teaches a DISI engine controller for adjusting torque based on engine operating conditions.

Ex. 1005, 1:4-7, 1:44-48. As part of the process for adjusting torque, Suzuki calculates a torque shortage, which is the difference between the estimated torque being produced and the desired torque. *See* Ex. 1003 ¶¶88-92; Ex. 1005 Fig. 6, 7:35-39; *see also* Pet. 46-48.

Although not explicitly stated in Suzuki (*see* Ex. 1005), a person having ordinary skill in the art would have understood that various correction factor response curves in Suzuki suggest using a high pass filter. Ex. 1003 ¶¶ 95-98. For example, the curves in Suzuki Figure 13 show that Suzuki's processing of the torque correction demand signal into either a spark timing correction signal or an air/fuel ratio adjustment signal generates an exponential decay curve. Ex. 1005, Fig. 13; Ex. 1003 ¶¶ 96-97. This is shown in the annotated excerpt from Suzuki Fig. 13, reproduced below.



Ex. 1003 ¶ 96; *see also* Ex. 1003, Fig. 13. The portion of Suzuki Figure 13 reproduced above shows the Torque Correction Demand and the Spark Timing Correction for a Homogeneous Mode and the Torque Correction Demand and Equivalence Ratio for Stratified Mode. Ex. 1003 ¶ 96; *see also* Ex. 1003, Fig. 13. This exponential decay matches the response using a high pass filter to Suzuki's correction demand signal. Ex. 1003 ¶¶ 96-99.

Scherer also teaches using a high pass filter to filter a torque demand signal. *See* Ex. 1003 ¶ 99; Ex. 1007, 3:59-63, 4:20-45, Figs. 1, 2.

According to Scherer, a high pass filter allows the system to “react very rapidly to sudden changes of the engine torque” arising during transient engine operations. Ex. 1007, 4:20–4:31; *see also id.* at 4:31–5:15; Ex. 1003 ¶ 100. A person having ordinary skill in the art would have included Scherer’s high pass filter in Suzuki’s torque controller to produce the Spark Timing Correction for a Homogeneous Mode and the Equivalence Ratio for Stratified Mode because it would enable the system to adjust for dynamic changes in torque values more accurately. Ex. 1003 ¶ 100; *see also id.* ¶¶ 65–69.

Patent Owner argues that neither Suzuki nor Cullen teach using a high pass filter. Prelim. Resp. 21. We disagree. Although Suzuki does not explicitly state that it is using a high pass filter, Petitioner has sufficiently shown that Spark Timing Correction and the Equivalence Ratio for Stratified Mode in Suzuki Figure 13 are the result of using a high pass filter. Based on the current record, Suzuki suggests using a high pass filter to generate those signals. *See Merck & Co. v. Biocraft Laboratories, Inc.*, 874 F.2d 804, 807–08 (Fed. Cir. 1989) (“[T]he question under 35 USC § 103 is not merely what the references expressly teach but what they would have suggested to one of ordinary skill in the art at the time the invention was made.” (quoting *In re Lamberti*, 545 F.2d 747, 750 (CCPA 1976))).

Patent Owner further argues that even though Scherer uses a high pass filter, “it is not employed in the unique manner of the teachings of the ‘565.” Prelim. Resp. 21. According to Patent Owner, “Scherer uses the high pass filter with an adjustable decay time constant (t), which is a function of engine speed and load to generate the filtered output of dynamic desired torque.” *Id.*

We do not agree with Patent Owner's argument, which focuses exclusively on Scherer but ignores the combination of Suzuki and Scherer as set forth in the Petition. "The question in an obviousness inquiry is whether it would have been obvious to a person of ordinary skill in the art to combine the relevant disclosures of the two references, not whether each individual reference discloses all of the necessary elements." *Game & Tech Co. v. Wargaming Grp. Ltd.*, 942 F.3d 1343, 1352 (Fed. Cir. 2019) (citing *Cohesive Techs., Inc. v. Waters Corp.*, 543 F.3d 1351, 1364 (Fed. Cir. 2008)). The issue is not, as Patent Owner frames it, whether one reference teaches the entire limitation. Instead, is whether the claimed limitation would have been obvious in light of the prior art. As discussed above, Petitioner has sufficiently shown that the answer to that question is yes.

Patent Owner further argues that a person having ordinary skill in the art would not have combined Suzuki and Scherer. Prelim. Resp. 23. Specifically, Patent Owner argues that because the inventors of Suzuki and Scherer did not combine their references, that is strong evidence of non-obviousness:

As is generally recognized, almost all inventions comprise a combination of elements that each were independently known in the prior art. Petitioners argue that a [person having ordinary skill in the art] would have been well-aware of the prior art references being relied upon by Petitioner. ([Pet. 31]) *However, the mere fact that the inventors of these prior art references were inarguably at least [persons having ordinary skill in the art] but did not themselves think to combine the individually known elements to arrive at the particularly claimed combination is itself the best, most objective, and most contemporaneous evidence of non-obviousness of the claimed invention set forth and patentably defined in the challenged claims of the '565 patent.*

By combining particular elements of the prior art references in a particular manner such that a [person having ordinary skill in art] would arrive at a claimed combination that has distinct advantages over the prior art, the Petitioners are using impermissible hindsight reasoning to find any prior art references that fit the '565 patent. The “[d]etermination of obviousness cannot be based on the hindsight combination of components selectively culled from the prior art to fit the parameters of the patented invention.” *ATD Corp. v. Lydall, Inc.*, 159 F.3d 534, 546 (Fed. Cir. 1998). *That the inventors did not themselves think to combine the individually known elements in the prior art to arrive at the particularly claimed combination to achieve these admitted advantages is itself the best, most objective, and most contemporaneous evidence of non-obviousness of the claimed invention.* In short, the realization that the claimed combination of elements of the challenged claims would yield these distinct advantages over the prior art is what the three coinventors of the '565 patent recognized, but which the prior art inventors did not.

Prelim. Resp. 23–24 (emphases added).

We do not agree with Patent Owner’s argument which ignores the fundamental difference between anticipation and obviousness. Under Patent Owner’s argument, a failure to show anticipation would always be strong evidence of non-obviousness. But that is inconsistent with fundamental design of the United States patent code, which draws a distinction between the two. *See* 35 U.S.C. §§ 102, 103. Moreover, it is inconsistent with the Supreme Court’s *KSR* decision, which held that “if a technique has been used to improve one device, and a person of ordinary skill in the art would recognize that it would improve similar devices in the same way, using the technique is obvious unless its actual application is beyond his or her skill.” *KSR*, 550 U.S. at 417; *see also id.* at 416 (“The combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results.”), 47 (“If a person of ordinary skill in

the art can implement a predictable variation, § 103 likely bars its patentability.”). There is no need for anyone to actually make the combination for it to be obvious to a person having ordinary skill in the art.

This is not to say that evidence of a long-felt, but unfilled need is not objective evidence of non-obviousness. *See Apple Inc. v. Samsung Elecs. Co.*, 839 F.3d 1034, 1056 (Fed. Cir. 2018) (“Evidence of a long-felt but unresolved need can weigh in favor of the non-obviousness of an invention because it is reasonable to infer the need would not have persisted had the solution been obvious.”). To do so, however, Patent Owner must come forth with evidence demonstrating that the claimed “invention satisfied a long-felt and unmet need that existed on the patent’s filing date.” *Perfect Web Techs., Inc. v. InfoUSA, Inc.*, 587 F.3d 1324, 1332 (Fed. Cir. 2009) (citing *Procter & Gamble Co. v. Teva Pharms. USA, Inc.*, 566 F.3d 989, 998 (Fed. Cir. 2009)). Although Patent Owner argues that neither the inventors of Suzuki or Scherer combined the references, that is far short of evidence of a long-felt, but unmet need.

Patent Owner also argues that Petitioner did not identify a teaching, suggestion, or motivation to combine in the references themselves: “Petitioners’ analysis is misguided because a proper prior art analysis would explain where the references themselves provide the teaching, motivation or suggestion to combine their teachings.” Prelim. Resp. 24–25.

However, in *KSR* the Supreme Court held that “the analysis need not seek out precise teachings directed to the specific subject matter of the challenged claim, for a court can take account of the inferences and creative steps that a person of ordinary skill in the art would employ.” *KSR*, 550 U.S. at 418. In other words, “if a technique has been used to improve one device, and a person of ordinary skill in the art would recognize that it would

improve similar devices in the same way, using the technique is obvious unless its actual application is beyond his or her skill.” *Id.* at 417.

Patent Owner also argues that Scherer teaches away from the claimed invention:

The issue with *Scherer* is that there is no consideration of a stratified charge operation mode for a DISI engine as the ’565 teaches and thus Scherer teaches *[D]iesel engine control*, which the ’565 does not teach. In this light, Scherer “teaches away” from the ’565 patent with technology relating to [D]iesel engines and not teaching to Direct Injection Spark Ignition (DISI) engine’s unique operational characteristics, the focus of the ’565 patent.

Prelim. Resp. 25.

We do not agree with Patent Owner that Scherer teaches away from the claimed invention. First, Scherer is not limited to Diesel engines. Although the Figure 2 embodiment discusses a Diesel engine, the Figure 1 embodiment involves an Otto engine that uses spark plugs. *See* Ex. 1007 Figs. 1–2, 3:59–60, 5:16–18.

Second, a reference teaches away from the claimed invention if “a person of ordinary skill, upon reading the reference, would be discouraged from following the path set out in the reference, or would be led in a direction divergent from the path that was taken by the applicant.” *In re Gurley*, 27 F.3d 551, 553 (Fed Cir. 1994). The discussion of using a high pass filter with a Diesel engine, “does not teach away” from using a high pass filter with a DISI engine as “it merely expresses a general preference for an alternative invention but does not ‘criticize, discredit, or otherwise discourage’ investigation into the invention claimed.” *DePuy Spine, Inc. v. Medtronic Sofamor Danek, Inc.*, 567 F.3d 1314, 1327 (Fed. Cir. 2009) (quoting *In re Fulton*, 391 F.3d 1195, 1201 (Fed. Cir. 2004)).

b) Undisputed Limitations

The preamble¹⁴ of claim 1 recites “[a] device for controlling a torque output of an engine, the device comprising.” Ex. 1001, 4:2–3. Petitioner argues Suzuki teaches the preamble. Pet. 37–38; *see also* Ex. 1003 ¶¶ 70–71. Specifically, Petitioner argues “Suzuki teaches that its system is used ‘for correcting engine torque,’ i.e., controlling a torque output of an engine.” Pet. 37 (quoting Ex. 1005, 1:5–7).

Claim 1 further recites “a torque demand controller for generating a torque demand signal.” Ex. 1001, 4:5–6. Petitioner argues Suzuki teaches that limitation. Pet. 39–40; *see also* Ex. 1003 ¶¶ 72–74. Specifically, Petitioner argues that “Suzuki discloses a ‘torque correction demanding section’ (i.e., the claimed ‘torque demand controller’) of control unit 20 ‘[that] produces a torque correction demand based on engine operating conditions.’” Pet. 39 (quoting Ex. 1003, 3:10–12) (emphasis omitted).

Claim 1 further recites “a torque producer which receives the torque demand signal, the torque producer includes.” Ex. 1001, 4:7–8. Petitioner argues that Suzuki teaches that limitation. Pet. 40–41; *see also* Ex. 1003 ¶¶ 76–79. Specifically, Petitioner argues that Suzuki teaches “that the control unit 20 includes ‘a torque correction section . . . which receives a torque correction demand and produces a torque correction output in response to the torque correction demand.’” Pet. 40–41 (citing Ex. 1005, 15:47–16:2 (claim 1)). Petitioner also argues that “Suzuki’s ‘torque control section is responsive to the torque correction demand’ and includes ‘a

¹⁴ Because, as discussed below, Petitioner has sufficiently shown that Luff teaches the preamble, we need not determine whether the preamble is limiting. *See Nidec*, 868 F.3d at 1017.

homogeneous combustion torque correcting section [that] corrects at least the spark timing’ and ‘[a] stratified combustion torque correcting section [that] corrects at least the air-fuel ratio’” and that the “homogeneous combustion torque correction section, and stratified combustion torque correction section collectively disclose the torque producer recited in claim 1.” *Id.* at 41 (quoting Ex. 1005, 3:10–22) (citing Ex. 1005, Fig. 1B; Ex. 1003 ¶¶ 76–79) (alteration in original).

Claim 1 further recites “an estimator which receives as inputs a current spark angle signal, a current air/fuel ratio signal and an estimated air charge signal and outputs an estimated torque signal.” Ex. 1001, 4:9–12. Petitioner argues that the combination of Suzuki and Cullen teach this limitation.¹⁵ Pet. 42–46; *see also* Ex. 1003 ¶¶ 80–87. Specifically, Petitioner argues “Suzuki’s control unit 20 functions as an estimator that estimates and outputs the estimated output torque.” Pet. 42 (citing Ex. 1005, Figs. 4–6, 7:33–34; Ex. 1003 ¶¶ 80–87). Petitioner further argues that “Cullen discloses particular implementation details for estimating torque, including an estimator which receives as inputs a current spark angle signal, a current air/fuel ratio signal, and an estimated air charge signal, that would have been readily applicable to Suzuki’s torque controller.” *Id.* at 43 (citing Ex. 1003 ¶¶ 80–87); *see also id.* (citing Ex. 1006, 5:59–62, 6:67–7:2). According to Petitioner, Cullen teaches using “estimated air charge (‘AIRCHG’), current air/fuel ratio (‘A/F’), and current spark angle (‘SPKDEL’/‘SPK’), among others, as inputs to calculate estimated torque

¹⁵ Patent Owner does not dispute that the combination Suzuki and Cullen teaches this limitation. However, as discussed below, Patent Owner argues that a person having ordinary skill in the art would not have combined the references. *See* Section II.E.4.(c), *infra*.

(‘IND_TQ’).” *Id.* at 44 (citing Ex. 1006, 4:5–15, 5:33–6:2, 6:67–7:2); *see also id.* at 45 (quoting Ex. 1006, 5:33–53).

Claim 1 further recites “a comparator which receives as inputs the estimated torque signal and a desired torque signal and outputs a difference signal.” Ex. 1001, 4:13–15. Petitioner argues Suzuki teaches that limitation. Pet. 46–48; *see also* Ex. 1003 ¶¶ 88–92. Specifically, Petitioner argues “Suzuki discloses a torque correction section that subtracts estimated torque from target torque to output a torque shortage signal (S34).” Pet. 46 (citing Ex. 1005, Fig. 5, 7:35–39). Petitioner identifies that calculation of torque shortage as the “comparator which receives as inputs the estimated torque signal and a desired torque signal and outputs a difference signal.” *Id.* at 47 (citing Ex. 1005 Fig. 6; Ex. 1003 ¶¶ 88–92).

Claim 1 further recites “a transient torque controller which receives as an input the filtered difference signal and outputs a fuel adjustment signal and a spark adjustment signal.” Ex. 1001, 4:19–21. Petitioner argues the combination of Suzuki and Scherer teach this limitation.¹⁶ Pet. 53–57; *see also* Ex. 1003 ¶¶ 103–109. Specifically, Petitioner argues Suzuki teaches a transient torque controller which receives a torque difference signal as an input and then and outputs a fuel adjustment signal and a spark adjustment signal. Pet. 54–57; *see also* Ex. 1003 ¶¶ 103–109. Petitioner further argues that, based on Scherer, a person having ordinary skill in the art would have

¹⁶ Patent Owner does not dispute that the combination Suzuki and Scherer teaches this limitation. However, as discussed above, Patent Owner argues that a person having ordinary skill in the art would not have combined the references. *See* Section II.E.4.(a), *supra*. We incorporate by reference our findings and conclusions regarding the reason to combine Suzuki and Scherer.

first filtered the torque difference signal with a high pass filter. Pet. 57 (citing Ex. 1003 ¶¶ 103–109).

After reviewing Petitioner’s arguments and information regarding the limitations identified above, including the MacCarley Declaration, which are not addressed by Patent Owner at this stage (*see* Prelim. Resp.), we are persuaded that Petitioner sufficiently demonstrates, for purposes of this Decision, that the combination of Suzuki, Cullen, and Scherer teaches each of the limitations recited in this section.

c) Reason to Combine Suzuki and Cullen

As discussed above, Petitioner relies on Suzuki for the majority of the limitations reciting in claim 1. *See* Pet. 37–58. Petitioner further relies on Cullen for an estimator that receives as inputs a current spark angle signal, a current air/fuel ratio signal and an estimated air charge signal and outputs an estimated torque signal. *See* Pet. 42–46. Petitioner argues that a person having ordinary skill in the art would have combined the relevant teachings of those references. Pet. 31–33, 42–46.

Based on the current record, we are sufficiently persuaded by Petitioner’s arguments that a person having ordinary skill in the art would have combined Suzuki’s teaching with the relevant teachings from Cullen. Specifically, because Suzuki teaches adjusting spark timing (Ex. 1005 at FIG. 6 (S38)–(S39)) or air/fuel ratio (*id.* at FIG. 6 (S34)) to adjust the engine’s output torque, a person having ordinary skill in the art would modify Suzuki’s system to use an estimator with spark and fuel inputs as taught by Cullen. Ex. 1003 ¶ 62. A person having ordinary skill in the art would have used Cullen’s inputs in order to make “predicted torque calculation . . . more accurate.” Ex. 1006, 2:32–40; *see also* Ex. 1003 ¶ 63.

Moreover, a person having ordinary skill in the art would have a reasonable expectation of success. Ex. 1003 ¶ 64.

With the exception of the teaching away argument, Patent Owner relies on the same arguments discussed above for Scherer and the high pass filter limitation. *Compare* Prelim. Resp. 22–25, with Section II.E.4.(a), *supra*. For the same reasons as discussed above, we do not agree with Patent Owner’s arguments.

d) Conclusion Regarding Claim 1

Based on the current record, there is a reasonable likelihood that Petitioner will prevail in demonstrating that claim 1 is unpatentable as obvious in view of Suzuki, Cullen, and Scherer.

5. Analysis of Claims 4 and 7

Because Petitioner demonstrates a reasonable likelihood of success in proving that at least one claim of the ’565 patent is unpatentable, we institute on all grounds and all claims raised in the Petition. *See* 37 C.F.R.

§ 42.108(a). Therefore, at this stage of the proceeding, it is not necessary for us to provide an assessment of every challenge raised by Petitioner, especially, as in this case, when Patent Owner does not separately argue those claims. Those challenges, in our view, are best left for trial after full development of the record.

F. Takahashi Ground

Petitioner also challenges the patentability of claims 2, 3, 5, and 6 based on Suzuki, Cullen, Scherer, and Takahashi. *See* Pet. 70–82. Besides relying on the arguments addressed above and further arguing that the Takahashi does not cure the alleged deficiencies, Patent Owner does not separately address the merits of Petitioner’s other prior art challenges. *See* Prelim. Resp. 25–26. Because, as discussed above, Petitioner meets the

threshold for institution by demonstrating a reasonable likelihood that at least claim 1 is unpatentable as obvious, we need not decide whether Petitioner's other challenges demonstrate the same. Those challenges, in our view, are best left for trial after full development of the record.

III. CONCLUSION

Following § 314, we have determined that the totality of the information presented at this stage shows there is a reasonable likelihood that Petitioner would prevail with respect to at least one of the claims challenged in the Petition, and we institute on all grounds raised and all claims challenged in the Petition. Additionally, we decline to exercise our discretion under § 325(d) to deny institution.

Our factual findings, conclusions of law, and determinations at this stage of the proceeding are preliminary, and based on the evidentiary record developed thus far. This is not a final decision as to the patentability of claims for which *inter partes* review is instituted. Our final decision will be based on the record as fully developed during trial.

IV. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that, pursuant to 35 U.S.C. § 314(a), an *inter partes* review is instituted for claims 1–7 of the '565 patent on the unpatentability grounds asserted in the Petition; and

FURTHER ORDERED that pursuant to 35 U.S.C. § 314(c) and 37 C.F.R. § 42.4, notice is hereby given of the institution of a trial, which commences on the entry date of this decision.

IPR2023-01032
US 6,581,565 B2

FOR PETITIONER:

James M. Glass
QUINN EMANUEL URQUHART & SULLIVAN, LLP
jimglass@quinnemanuel.com

FOR PATENT OWNER:

Timothy Devlin
Jason Wejnert
DEVLIN LAW FIRM LLC
tdevlin@devlinlawfirm.com
jason.wejnert@dinsmore.com