

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.

IPR2023-01224
Patent 6,557,540 B1

Before JAMES A. TARTAL, BARBARA A. PARVIS, and
SCOTT B. HOWARD, *Administrative Patent Judges*.

Opinion for the Board filed by *Administrative Patent Judge* TARTAL.

Opinion Concurring filed by *Administrative Patent Judge* HOWARD.

TARTAL, *Administrative Patent Judge*.

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

I. INTRODUCTION

BMW of North America LLC (“Petitioner”)¹ filed a Petition pursuant to 35 U.S.C. §§ 311–319 requesting an *inter partes* review of claims 1, 2, 7, 10, 11, and 14 (“the Challenged Claims”) of U.S. Patent No. 6,557,540 B1 (Ex. 1001, “the ’540 patent”). Paper 1 (“Pet.”). Michigan Motor Technologies LLC (“Patent Owner”)² filed a Preliminary Response. Paper 11.

We have authority to determine whether to institute an *inter partes* review. 35 U.S.C. § 314(b) (2018); 37 C.F.R. § 42.4(a) (2023). An *inter partes* review may not be instituted “unless . . . the information presented in the petition . . . 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). Upon consideration of the Petition, the Preliminary Response, and the evidence of record, we conclude that the information presented shows a reasonable likelihood that Petitioner would prevail in showing the unpatentability of at least one of the Challenged Claims. Accordingly, we authorize an *inter partes* review to be instituted as to the Challenged Claims of the ’540 patent on the grounds raised in the Petition. Our factual findings and conclusions at this stage of the proceeding

¹ The Petition was filed by Mercedes-Benz USA, LLC and BMW of North America, LLC. The Petition identified as real parties in interest “Petitioners Mercedes-Benz USA, LLC and BMW of North America LLC; Mercedes-Benz Intellectual Property GmbH & Co. KG; Mercedes-Benz AG and Mercedes-Benz Group AG; and Bayerische Motoren Werke AG.” Pet. 90. After the Petition was filed, a motion to terminate as to Mercedes-Benz USA LLC based on settlement was granted. Paper 9. The case caption was updated to reflect that BMW of North America, LLC, remains as Petitioner. *Id.* at App’x.

² Patent Owner identifies no additional real parties in interest. Paper 4, 2.

are based on the evidentiary record developed thus far (prior to Patent Owner's Response). This is not a final decision as to patentability of claims for which *inter partes* review is instituted. Any final decision will be based on the record, as fully developed during trial.

II. BACKGROUND

A. The '540 Patent

The '540 patent issued May 6, 2003, from an application filed on December 11, 2001, and is directed to calculating a valve timing command for an engine with variable timing valve actuators. Ex. 1001, 1:6–9, codes (21), (22), (45). Figure 1 of the '540 patent is reproduced below.

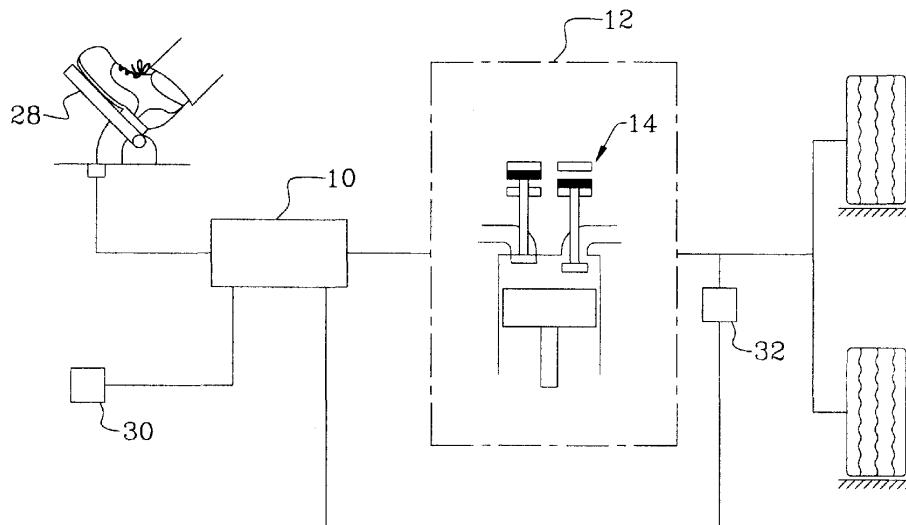


FIGURE 1

Figure 1 illustrates a “schematic of a vehicle having an engine controlled with the method of the preferred embodiment,” and Figure 2 illustrates “a flowchart of the method of the preferred embodiment.” *Id.* at 1:40–43. Figure 1 shows control unit 10, engine 12 with electromagnetic valve actuators 14, conventional pedal 28, environmental sensor 30, and engine sensor 32. *Id.* at 1:54–57, 2:6–8, 2:23–38.

Figure 2 of the '540 patent is reproduced below.

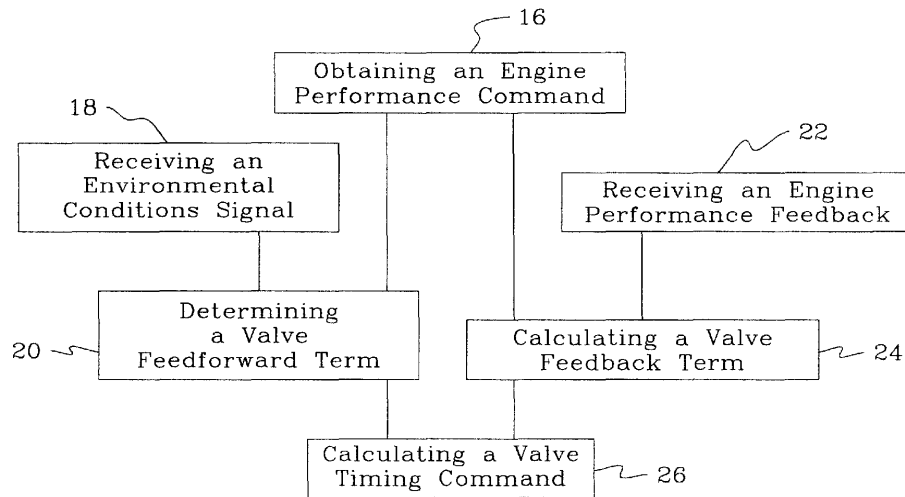


FIGURE 2

Figure 2 shows “six principle actions,” each of which corresponds to a limitation in claim 1 of the '540 patent, as follows: “obtaining an engine performance command 16; receiving an environmental conditions signal 18; determining a valve feedforward term 20; receiving an engine performance feedback 22; calculating a valve feedback term 24; and calculating a valve timing command 26 based on the valve feedforward term and the valve feedback term.” *Id.* at 1:61–2:1. Control unit 10 performs the method to calculate valve timing commands for engine 12. *Id.* at 1:54–57. Each of the principle actions identified in the '540 patent is described in further detail in the Specification, as summarized below.

“[O]btaining an engine performance command 16 preferably includes receiving a vehicle performance command from a driver,” including “from the foot of a driver with the use of a conventional pedal 28” or by “deriving the engine performance command from the vehicle performance command.” *Id.* at 2:4–13. Alternatively, “the engine performance command” may be

“based on additional suitable factors, such as a traction control signal or a cruise control signal.” *Id.* at 2:13–17. The “engine performance command” may be a “desired engine torque” (i.e. “an engine torque command”) or “another suitable variable, such as a desired engine acceleration.” *Id.* at 2:17–23.

“[R]eceiving an environmental conditions signal 18” preferably includes control unit 10 receiving a signal from environmental sensor 30, such as “ambient temperature outside the vehicle,” “ambient pressure,” or “other suitable information.” *Id.* at 2:23–33. Control unit 10 uses the environmental conditions signal 18 to determine valve feedforward term 20. *Id.*

“[R]eceiving an engine performance feedback 22” preferably includes control unit 10 receiving data, preferably engine speed, from engine sensor 32 in the vehicle, “which uses the data to determine the valve feedforward term and the valve feedback term.” *Id.* at 2:36–42. “Other engine measurables, such as engine torque data, may be useful in the determination of the terms,” and “engine sensor 32 may alternatively sense other suitable information.” *Id.* at 2:42–47.

“[D]etermining a valve feedforward term 20 preferably includes determining the valve feedforward term based on the engine torque command, the ambient temperature data, and the engine speed data,” but “may be based on other suitable factors, such as engine torque data, air-fuel ratio data, engine combustion stability data, or ambient pressure data.” *Id.* at 2:48–54. “[C]ontrol unit 10 preferably includes a look-up table, which has been optimized for fuel efficiency, power output, and engine emissions based on various engine torque commands, various ambient temperature data, and various engine speed data (or engine torque data).” *Id.* at 2:54–59.

Alternatively, control unit 10 may be “programmed to perform a real-time optimization of the fuel efficiency, power output, and engine emission (or any other suitable measurement) based on the engine torque command, the ambient temperature data, and the engine speed data (or any other suitable commands and measurables).” *Id.* at 2:59–65.

“[C]alculating the valve feedback term 24 preferably includes comparing the engine performance command and the engine performance feedback.” Ex. 1001, 2:66–3:1 The ’540 patent further explains as follows:

By the definition of the term, the valve feedback term functions to compare the input with the output and to calculate a correction term based on the difference, if any. The comparison and the calculation are preferably accomplished by the control unit 10, but may alternatively be accomplished by a suitable separate device.

Id. at 3:1–7.

“[C]alculating a valve timing command 26 preferably includes calculating an EVO [exhaust valve opening] command, an EVC/IVO [exhaust valve closing / inlet valve opening] command, and an IVC [inlet valve closing] command.” *Id.* at 3:10–26. “The adjustment of the timing of the EVO, the EVC/IVO, and the IVC when used partially, separately, or together may provide the desired fuel efficiency, power output, and emissions from the engine 12 of the vehicle.” *Id.* at 3:18–21.

B. Illustrative Claim

Petitioner challenges claims 1, 2, 7, 10, 11, and 14 of the ’540 patent. Pet. 4. Claim 1 is the sole independent claim. Claims 2, 7, 10, 11, and 14 depend from claim 1. Claim 1 is illustrative of the claimed subject matter and is reproduced below:

1. A method for calculating a valve timing command for an engine of a vehicle, comprising:

obtaining an engine performance command;
receiving an environmental conditions signal;
determining a valve feedforward term based on the engine performance command and the environmental conditions signal;
receiving an engine performance feedback;
calculating a valve feedback term based on the engine performance command and the engine performance feedback; and
calculating a valve timing command based on the valve feedforward term and the valve feedback term.

Ex. 1001, 3:52–4:6.

C. Asserted Grounds of Unpatentability

Petitioner asserts that the Challenged Claims are unpatentable based on the following grounds:

Claims Challenged	35 U.S.C. § ³	References/Basis
1, 2, 7, 10, 11, 14	103(a)	Ogawa, ⁴ Yoshioka ⁵
1, 2, 7, 10, 11, 14	103(a)	Yoshioka, Ogawa, Jankovic ⁶

Pet. 4. Petitioner further relies on the supporting Declaration of Gerald J. Micklow, Ph.D., P.E., dated July 18, 2023. Ex. 1003.

³ The Leahy-Smith America Invents Act (“AIA”) included revisions to 35 U.S.C. § 103 that became effective on March 16, 2013. We apply the pre-AIA version of § 103 here, because the ’540 patent issued from an application filed before the effective date of the AIA. *See* Ex. 1001, code (22).

⁴ U.S. Patent App. Pub. No. US 2002/0029757 A1, published Mar. 14, 2002 (Ex. 1005, “Ogawa”).

⁵ U.S. Patent No. 5,713, 317 (issued February 3, 1998) (Ex. 1006, “Yoshioka”).

⁶ Jankovic, et al., “Torque Management of Engines with Variable Cam Timing,” *Control Systems, IEEE*, Vol. 18, No. 5 (Oct. 1998), pp. 34–42) (Ex. 1007, “Jankovic”).

D. Related Proceedings

The Parties identify the '540 patent as a subject of *Michigan Motor Technologies, LLC v. Mercedes-Benz USA, LLC*, Case 1:22-cv-03957 (N.D. Ill.), and *Michigan Motor Technologies, LLC v. Bayerische Motoren Werke AG et al*, Case 1:22-cv-03804 (N.D. Ill.). Pet. 91; Paper 4, 2.

III. ANALYSIS

*A. Discretionary Denial*⁷

The Director has discretion to institute an *inter partes* review under 35 U.S.C. § 314(a). *Gen. Plastic Indus. Co. v. Canon Kabushiki Kaisha*, IPR2016-01357, Paper 19 at 15 (PTAB Sept. 6, 2017) (precedential) (citing 35 U.S.C. § 314(a)). Patent Owner argues that we should exercise our discretion to deny institution because the '540 patent “expired almost two years ago,” and states that it is “in discussions” with Petitioner over the district court proceedings, and has offered Petitioner a “Covenant Not to Sue on the [']540 patent in return for dismissing this IPR Petition.” Prelim. Resp. 1. Neither of these arguments supports denial of institution because *inter partes* review is not limited to unexpired patents (*see* 35 U.S.C. § 311) and we don't consider efforts to reach a settlement relevant to whether discretionary denial is warranted. *See, e.g.*, USPTO Memorandum, Interim Procedure for Discretionary Denials in AIA Post-Grant Proceedings with

⁷ Petitioner argues that discretionary denial under 35 U.S.C. § 325(d) is “not implicated here,” because the Petition “addresses new arguments based on prior art not addressed during prosecution or any post-issuance proceeding.” Pet. 21. Patent Owner does not argue that the Petition should be denied based on Section 325(d). *See* Prelim. Resp.

Parallel District Court Litigation (June 21, 2022) (“Interim *Fintiv* Guidance”).⁸

Patent Owner also argues that we should exercise our discretion to deny institution because the ’540 patent “was invalidated as ineligible under 35 U.S.C. § 101 in two concurrent district court litigations.” Prelim. Resp. 1. This argument, alone, is not dispositive of whether discretionary denial is warranted. We consider the advanced state of a district court proceeding as a “factor that weighs in favor of denying the Petition under § 314(a).” *NHK Spring Co. v. Intri-Plex Techs., Inc.*, IPR2018-00752, Paper 8 (PTAB Sept. 12, 2018) (precedential). As part of this balanced assessment, we consider the following factors: (1) whether the district court granted a stay or evidence exists that one may be granted if this proceeding is instituted; (2) proximity of the district court’s trial date to the Board’s projected statutory deadline for a final written decision; (3) investment in the parallel proceeding by the court and the parties; (4) overlap between issues raised in the petition and in the parallel proceeding; (5) whether the petitioner and the defendant in the parallel proceeding are the same party; and (6) other circumstances that impact the Board’s exercise of discretion, including the merits. *Apple Inc. v. Fintiv, Inc.*, IPR2020-00019, Paper 11 (PTAB Mar. 20, 2020) (precedential). USPTO Director Vidal has further stated that “a *Fintiv* analysis should be conducted . . . where a district court has rendered a non-final invalidity determination that some or all of the claims challenged in an IPR petition are invalid, even on grounds that cannot

⁸ Available at http://www.uspto.gov/sites/default/files/documents/interim_proc_discretionary_denials_aia_parallel_district_court_litigation_memo_20220621_.pdf.

be raised in that IPR.” *Volvo Penta of the Americas, LLC, v. Brunswick Corporation*, IPR2022-01366, Paper 15 at 8 (May 2, 2023) (citing *AviaGames, Inc. v. Skillz Platform, Inc.*, IPR2022-00530, Paper 14 at 3 (March 2, 2023)).

In this case Patent Owner does not suggest that the claims of the ’540 patent found by the district court to be ineligible under 35 U.S.C. § 101 are precluded from further judicial review. Accordingly, there has been no showing that the patentability of the Challenged Claims has been finally adjudicated. We, therefore, first consider *Fintiv* factors 1–5 in our balanced assessment of whether discretionary denial is warranted. *See Volvo Penta*, Paper 15 at 8 (stating that “the Board should evaluate *Fintiv* factors 1–5,” and that “[i]f the Board determines that *Fintiv* factors 1–5 favor exercise of discretion to deny institution, the Board shall consider whether the merits are compelling”). Because we determine, for the reasons provided below, that our collective consideration of factors 1–5 does not favor discretionary denial, we need not reach whether the merits of Petitioner’s contentions are “compelling.”

According to Patent Owner, the factors to be considered by the Board favor denial. Prelim. Resp. 2 (citing *Fintiv*). Patent Owner, however, does not direct its arguments to each of the factors for consideration, but instead asserts, for example, that “[a] settlement and dismissal of the related district court action is expected long before a Final Written Decision is expected, in early 2025.” *Id.* at 4–5.

Petitioner argues in the Petition that the factors do not weigh in favor of discretionary denial. Pet. 25. Petitioner asserts “[a] schedule has not yet been issued in the corresponding district court litigation” and “the trial date for the district court case (which has not been set) will likely not be

until 2025.” *Id.* at 26. Petitioner also contends the “merits of the petition weigh strongly in favor of institution.” *Id.* Petitioner further stipulates it “will not seek resolution in the District Court of any ground of invalidity for the ’540 Patent that utilizes the same combination of prior art reference[s] relied upon in the grounds of the instant petition.” *Id.* at 26–27.

Factor 1 does not weigh for or against exercising discretion to deny *inter partes* review in this case because, although there is no evidence that a stay exists or may be granted in district court, the value of any potential stay in reducing the likelihood of duplication of effort is minimal where, as here, there is no trial date and the district court already determined the Challenged Claims do not recite patent-eligible subject matter. Thus, there is no suggestion that the district court will have reason to consider the issues of obviousness presented here after a trial date is set. Factor 2 favors institution as it is undisputed that no trial date was set in district court.

Factors 3 and 4 favor institution because, although the district court invested resources in considering whether the Challenged Claims recite patent-eligible subject matter, there is no evidence that the district court or the Parties directed substantial resources towards the issues of obviousness raised here. Additionally, Petitioner “stipulate[s] that, if the Board institutes *inter partes* review, Petitioner will not seek resolution in the [d]istrict [c]ourt of any ground of invalidity for the ’540 [p]atent that utilizes the same combination of prior art reference[s] relied upon in the grounds of the instant petition.” Pet. 26–27. Although Petitioner has not stipulated to forgo relying on all the patents and prior art publications that could have reasonably been raised in the *inter partes* review (*see Sotera Wireless, Inc. v. Masimo Corp.*, IPR2020-01019, Paper 12 at 18–19 (precedential as to § II.A.)), Petitioner’s stipulation may contribute to streamlining the issues

presented in the district court proceeding as to the '540 patent. *See Sand Revolution II*, IPR2019-01393, Paper 24 at 11–12 (similar stipulation “mitigates to some degree the concerns of duplicative efforts between the district court and the Board, as well as concerns of potentially conflicting decisions”).

Factor 5 weighs marginally in favor of denial because Petitioner and Patent Owner are also parties in the district court proceedings; however, neither Petitioner nor Patent Owner provides evidence in this case to show whether the district court trial is likely to proceed before the date a final written decision would be due in this case. *See Huawei Tech. Co. v. WSOU Inv., LLC*, IPR2021-00225, Paper 11 at 14 (PTAB June 14, 2021) (suggesting that factor 5 “favors denial if trial precedes the Board’s Final Written Decision and favors institution if the opposite is true”) (internal quotation marks omitted).

In consideration of a “balanced assessment” of *Fintiv* factors 1–5 we find factor 1 is neutral, factors 2–4 favor institution, and that the identity of the Parties under factor 5 does not outweigh considerations based on factors 1–4. Accordingly, we decline to exercise our discretion to deny institution under 35 U.S.C. § 314(a) for the foregoing reasons.⁹

⁹ Were we obligated to consider the merits under the *Fintiv* analysis, we also find that, in the absence of any substantive argument from Patent Owner disputing Petitioner’s contentions on the merits, Petitioner’s contentions demonstrate compelling merit, as further detailed in our discussion below of Petitioner’s challenge of claim 1 of the '540 patent. *See, infra*, Section III.F.1; *see also* Interim *Fintiv* Guidance 4 (“Compelling, meritorious challenges are those in which the evidence, if unrebutted in trial, would plainly lead to a conclusion that one or more claims are unpatentable by a preponderance of the evidence.”).

B. Legal Standards for Obviousness

A patent claim is unpatentable for obviousness if the differences between the claimed subject matter and the prior art are such that the subject matter, as a whole, would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). In *Graham v. John Deere Co. of Kan. City*, 383 U.S. 1 (1966), the Supreme Court set out a framework for assessing obviousness 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) “secondary considerations” of nonobviousness such as “commercial success, long felt but unsolved needs, failure of others, etc.” *Id.* at 17–18; *see also KSR*, 550 U.S. at 407.

“Whether an ordinarily skilled artisan would have been motivated to modify the teachings of a reference is a question of fact.” *WBIP, LLC v. Kohler Co.*, 829 F.3d 1317, 1327 (Fed. Cir. 2016) (citations omitted). “[W]here a party argues a skilled artisan would have been motivated to combine references, it must show the artisan ‘would have had a reasonable expectation of success from doing so.’” *Arctic Cat Inc. v. Bombardier Recreational Prods. Inc.*, 876 F.3d 1350, 1360–61 (Fed. Cir. 2017) (quoting *In re Cyclobenzaprine Hydrochloride Extended-Release Capsule Patent Litig.*, 676 F.3d 1063, 1068–69 (Fed. Cir. 2012)).

C. Level of Ordinary Skill in the Art

In determining the level of ordinary skill in the art, various factors may be considered, including the “type of problems encountered in the art; prior art solutions to those problems; rapidity with which innovations are made; sophistication of the technology; and educational level of active

workers in the field.” *In re GPAC Inc.*, 57 F.3d 1573, 1579 (Fed. Cir. 1995) (citation omitted).

Petitioner contends a person of ordinary skill in the art “would have had a B.S. degree in Electrical Engineering or Mechanical Engineering (or equivalent), as well as at least 1-2 years of academic or industry experience in the design and analysis of internal combustion engines or, alternatively, at least an M.S. degree in Electrical Engineering or Mechanical Engineering.” Pet. 12 (citing Ex. 1003 ¶ 47). Patent Owner does not dispute the level of ordinary skill identified by Petitioner. *See* Prelim. Resp.

We find, on the current record, that the ’540 patent and the cited prior art references reflect the appropriate level of skill at the time of the claimed invention and that the level of appropriate skill reflected in these references and in the ’540 patent is consistent with the definition of a person of ordinary skill in the art proposed by Petitioner. Accordingly, we adopt Petitioner’s proposed level of ordinary skill in the art for purposes of this Decision.

D. Claim Construction

We apply the same claim construction standard that would be used to construe the claim in a civil action under 35 U.S.C. § 282(b). 37 C.F.R. § 42.100(b). Under that standard, claim terms “are generally given their ordinary and customary meaning” as would have been understood by a person of ordinary skill in the art at the time of the invention. *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312–13 (Fed. Cir. 2005) (en banc)).

“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). Extrinsic evidence is “less significant than the intrinsic record in determining ‘the legally operative meaning of claim language.’” *Phillips*, 415 F.3d at 1317.

Petitioner proposes construction of the claim term “engine performance command,” to mean a “command that defines a desired engine torque, or other desired measure of engine performance, such as engine speed or engine acceleration.” Pet. 13 (citing Ex. 1003 ¶¶ 62–63; IPR2022-00160, Paper 9 at 12). Patent Owner does not dispute or address claim construction. *See* Prelim. Resp. We find that an express construction of any claim term is not necessary for purposes of this Decision. *See Wellman, Inc. v. Eastman Chem. Co.*, 642 F.3d 1355, 1361 (Fed. Cir. 2011) (“[C]laim terms need only be construed ‘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))).

E. Summary of Prior Art References

1. Summary of Ogawa

Ogawa, titled “Valve Timing Controller, Valve Timing Control Method and Engine Control Unit For Internal Combustion Engine,” relates to “enabling a valve timing to be appropriately set in accordance with a load on the engine even in a stratified combustion mode.” Ex. 1005, code (54), Abstract. More specifically, Ogawa states as follows:

The present invention relates generally to a valve timing controller, a valve timing control method and an engine control unit for an internal combustion engine which is equipped with a valve timing changing mechanism for changing a valve timing for at least one of an intake valve and an exhaust valve such that the engine is operated in a combustion mode switched between a uniform combustion mode in which a fuel injection is performed

during an intake stroke and a stratified combustion mode in which a fuel injection is performed in a compression stroke.

Id. ¶ 2. Figure 1 of Ogawa, reproduced below, illustrates the configuration of a valve timing controller for an internal combustion engine.

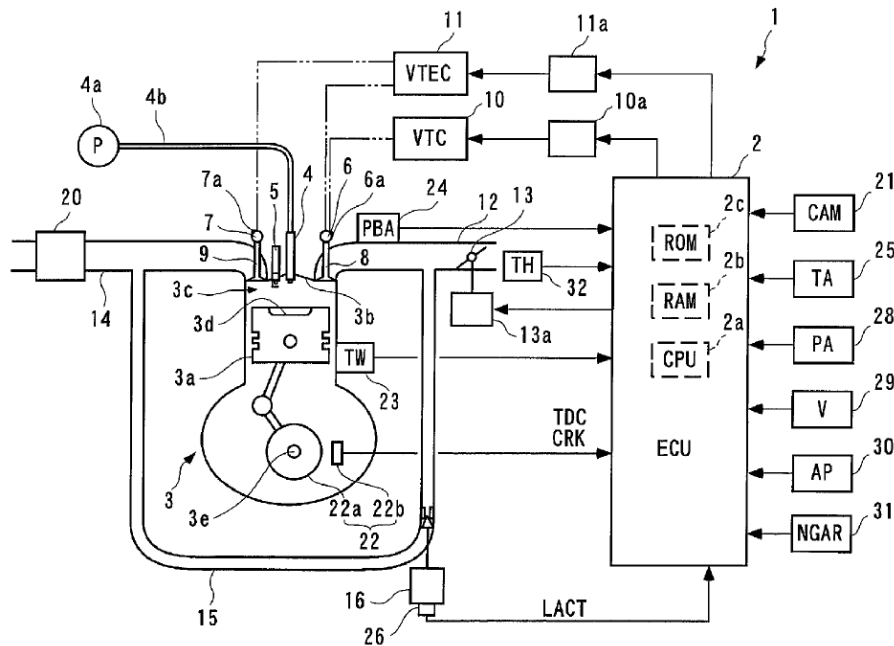


Figure 1 shows one cylinder 3 of a gasoline combustion engine, including piston 3a with recess 3d, combustion chamber 3c, fuel injection valve 4, ignition plug 5, intake cam shaft 6, exhaust cam shaft 7, intake valve 8, and exhaust valve 9. *Id.* ¶¶ 55–59. Intake cam shaft 6 includes “a cam phase changing mechanism (hereinafter abbreviated as ‘VTC’) 10 and a VTC electromagnetic control valve 10a for controlling the cam phase VTCACT.” *Id.* ¶ 60. “The VCT 10 continuously advances or retards the cam phase VTCACT to advance or retard an open/close timing for the intake valve 8.” *Id.* “This causes valve overlapping between the intake valve 8 and the exhaust valve 9 to increase or decrease, resulting in an increase or a decrease in the internal EGR and a change in the filling efficiency.” *Id.*

Figure 1 also illustrates electric control unit (“ECU”) 2. *Id.* ¶ 57. The ECU receives signals, such as from the “throttle valve opening sensor 32

which sends to the ECU 2 a signal indicative of the detected throttle opening TH.” *Id.* ¶ 67. Using this signal, the “ECU 2 controls the throttle valve opening TH through the electric motor 13a in accordance with an operating state of the engine 3 to control the amount of intake air to the engine 3.” *Id.* The ECU also receives “a signal indicative of a detected accelerator pedal opening AP, which is an operation amount of an accelerator pedal (not shown) from an accelerator pedal opening sensor 30.” *Id.* ¶ 70. The ECU receives additional signals, such as from atmospheric pressure sensor 28, vehicle speed sensor 29, and gear stage sensor 31. *Id.*

Ogawa describes that “a required torque outputted by the internal combustion engine is determined based on the detected engine rotational speed and accelerator pedal opening, and a valve timing for the intake valve and/or the exhaust valve is determined in accordance with the determined required torque and engine rotational speed.” *Id.* ¶ 11. The “valve timing is determined in accordance with the required torque and engine rotational speed, while the required torque is determined as a torque which should be outputted by the internal combustion engine, based on the engine rotational speed and the accelerator pedal opening which represents a load on the engine.” *Id.*

2. *Summary of Yoshioka*

Yoshioka is generally directed to controlling “a continuously variable valve timing mechanism of an internal combustion engine to continuously and variably control the timing of an intake valve according to atmospheric pressure.” Ex. 1006, Abstract. Yoshioka provides as follows:

The method or apparatus reads an engine revolution speed NE, an engine load GN, and an atmospheric pressure PA, refers to a map according to the atmospheric pressure PA, to find an atmospheric pressure correction coefficient Kpa, . . . , calculates

a corrected engine load GNpa as $GN_{paf} - GN/K_{pa}$, and refers to a map according to the corrected engine load GNpa and engine revolution speed NE, to find a target displacement to be imposed on the open/close timing of the intake valve.

Id. Yoshioka explains that it “uses the two-dimensional map of engine load and engine revolution speed, to continuously control the open/close timing of the intake valve both at low and high highlands, thereby smoothing the torque characteristics with respect to the engine load and the throttle opening.” *Id.* at 9:22–27.

Figure 1 of Yoshioka illustrates “an electronically controlled internal combustion engine having an apparatus for continuously and variably controlling the open/close timing of a valve,” and is reproduced below.

Fig. 1

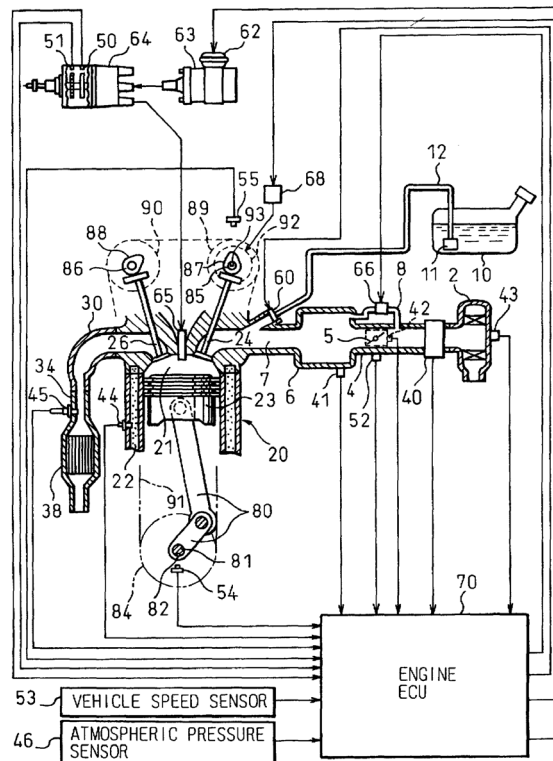
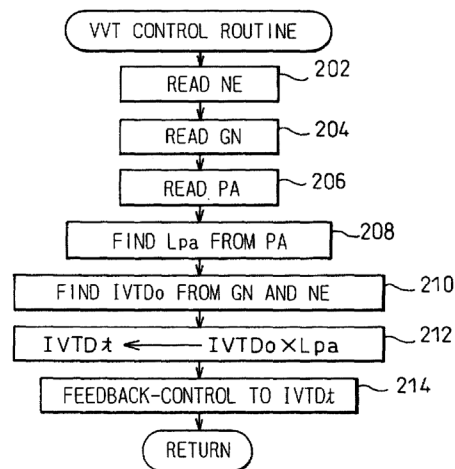


Figure 1 shows an engine with numerous features, including throttle valve 5 in throttle body 4, surge tank (intake manifold) 6, airflow meter 40,

temperature sensor 43, vacuum sensor 41, atmospheric pressure sensor 46, throttle sensor 42 (which detects the opening of throttle valve 5), fuel injector 60, igniter 62, ignition coil 63, spark plug 65, ignition distributor 64 (with reference position sensor 50 and crank angle sensor 51), vehicle speed sensor 53, exhaust valve 26, catalytic converter 38, crankshaft 81 (with buried magnet 82), first magnetic sensor 54, cam shaft 85 (with buried magnet 93), second magnetic sensor 55, cam 87, and “continuously variable mechanism 92 (to determine the open/close timing” of intake valve 24. *Id.* at 4:6–5:13. The engine also includes electronic engine control unit (ECU) 70, which is “a microcomputer to control fuel injection, ignition timing, idling speed, and . . . the open/close timing of a valve.” *Id.* at 5:21–24. “[T]he hydraulic pressure control valve 68 according to signals from first and second magnetic sensors 54 and 55 so that the cam shaft 85 of intake valve 24 maintains a required rotational phase with respect to crankshaft 81.” *Id.* at 6:8–13.

Figure 9 of Yoshioka is a “flowchart showing a routine of variably controlling the open/close timing of a valve,” and is reproduced below.

Fig. 9



Id. at 3:44–46. Figure 9 illustrates a “flowchart showing a variable valve timing control routine,” according to Yoshioka. *Id.* at 7:53–55. Yoshioka includes a valve timing control, which “sets the target open/close timing of the intake valve 24 according to operating conditions and controls the continuously variable mechanism 92.” *Id.* at 6:6–8.

3. *Summary of Jankovic*

Jankovic is an article directed to addressing emissions improvements without performance degradation in internal combustion engines using a “variable cam timing (VCT) system,” which “addresses both drivability and emissions performance by utilizing an electro-hydraulic mechanism to rotate the camshaft relative to the crankshaft in order to retard the cam timing with respect to the intake and exhaust strokes of the engine.” Ex. 1007, 34. By controlling exhaust valve closing, “the amount of residual gas trapped in the cylinder at the end of the exhaust stroke is controlled by cam timing, suppressing NO_x formation and reducing the pumping losses.” *Id.* This “permits the engine designer to optimize cam timing over a wide range of engine operating conditions. Providing both good idle quality (minimal overlap between the intake and exhaust events) and improved wide-open throttle performance (maximum inducted charge).” *Id.* Jankovic describes “a continuous-time nonlinear, low-frequency phenomenological model” to optimize “the performance of the compensator, the sensitivity to measurement noise, and the sensitivity to parameter variation.” *Id.* at 36.

F. *Alleged Obviousness Over Ogawa and Yoshioka*

Petitioner contends the subject matter of claims 1, 2, 7, 10, 11 and 14 would have been obvious over Ogawa and Yoshioka. Pet. 27–57. Petitioner’s contentions are supported by Dr. Micklow. Ex. 1003 ¶¶ 73–137. At this stage of the proceeding, Patent Owner does not dispute Petitioner’s

contentions with regard to alleged obviousness over Ogawa and Yoshioka. *See* Prelim. Resp. We focus our discussion below on Petitioner’s contentions with respect to claim 1 and determine that Petitioner has shown a reasonable likelihood of prevailing.¹⁰

1. Claim 1

Petitioner contends the combination of Ogawa and Yoshioka teaches the subject matter recited in claim 1. Pet. 30–46.

A method for calculating a valve timing command for an engine of a vehicle, comprising:

Petitioner contends Ogawa teaches “a valve timing control method” for a vehicle’s “engine.” Pet. 30–31 (citing Ex. 1005 ¶¶ 2, 37). Petitioner further alleges that “Ogawa teaches methods for ‘determining the valve timing’ by ‘control[ling] the duty ratio DbVTC of a driving signal outputted to the VTC electronic magnetic control valve’ that controls the valve cam shaft phase (*i.e.*, a valve timing command).” *Id.* at 31 (citing Ex. 1005 ¶¶ 17, 60, 82).

¹⁰ For the same reasons, we further find that it is highly likely Petitioner would prevail with respect to claim 1 and note that Patent Owner does not identify any limitation plausibly missing from the cited prior art and that Patent Owner presents no testimony to undermine Dr. Micklow’s opinions supporting Petitioner’s contentions. Petitioner presents compelling evidence of unpatentability because the evidence in the current record, if unrebutted during trial, would “plainly lead to a conclusion” that claim 1 is unpatentable by “a preponderance of the evidence.” *See* Interim *Fintiv* Guidance 4; *see also OpenSky Indus., LLC v. VLSI Tech. LLC*, IPR2021-01064, Paper 102 at 49 (Oct. 4, 2022) (precedential) (“A challenge can only ‘plainly lead to a conclusion that one or more claims are unpatentable’ if it is highly likely that the petitioner would prevail with respect to at least one challenged claim.”) (quoting Interim *Fintiv* Guidance 4).

obtaining an engine performance command;

Petitioner contends the '540 patent “expressly discloses that desired torque is one example of an “engine performance command” (Ex. 1001, 2:17–18) and that “Ogawa teaches ‘the CPU 2a . . . determines a required torque PMCMD outputted by the engine 3,’ *i.e.*, an engine performance command, based on ‘the accelerator pedal opening AP,’ ‘which is an operation amount of an accelerator pedal.’” Pet. 31 (citing Ex. 1005 ¶¶ 70, 72).

receiving an environmental conditions signal;

Petitioner contends Ogawa teaches “its ECU ‘is further supplied with a signal indicative of a detected atmospheric pressure PA from an atmospheric pressure sensor 28,’” corresponding to “receiving an environmental conditions signal,” as required by claim 1. Pet. 33 (citing Ex. 1005 ¶ 70). Petitioner further contends that “[r]eceiving an atmospheric or ambient pressure signal as taught by Ogawa is the type of environmental conditions signal the '540 patent describes receiving in its preferred embodiment.” *Id.* at 34 (citing Ex. 1001, 2:23–35).

determining a valve feedforward term based on the engine performance command and the environmental conditions signal;

Petitioner relies on Ogawa in view of Yoshioka as teaching this limitation. Pet. 34–37 (citing, e.g., Ex. 1003 ¶¶ 91–96). Petitioner contends Ogawa establishes an output parameter, VTCCMDMAP, which is a “valve feedforward term,” calculated from the engine performance command and the engine speed. *Id.* at 35 (citing Ex. 1005 ¶¶ 82, 84, 116, Fig. 3). Ogawa discloses that “the ECU 2 searches a VTCCMDH map for HI.VT in accordance with the engine rotational speed NE and the requested torque

PMCMD to find a basic value VTCCMDMAP for a target cam phase.”
Ex. 1005 ¶ 84.

Petitioner further contends that Yoshioka also discloses a valve feedforward term, “target timing displacement IVTDt.” Pet. 36 (citing Ex. 1006, 7:41–45). Petitioner contends “Yoshioka determines its target timing displacement IVTDt by first calculating a correction coefficient Lpa based on an atmospheric pressure signal PA,” and “then determining the initial valve displacement IVTD0 based on engine load GN and engine speed NE.” *Id.* Finally, Petitioner contends “Yoshioka’s valve feedforward term IVTDt is calculated based on IVTD0 and Lpa.” *Id.* Petitioner proposes that “modifying Ogawa’s valve feedforward term to account for atmospheric pressure, as taught by Yoshioka, would ‘improve the output of an engine at high altitude under high load, as well as reducing fuel consumption and improving exhaust purifying performance at high altitudes under low/medium load.’” *Id.* at 36–37 (citing Ex. 1006, 1:44–49; Ex. 1003 ¶¶ 91–96); *see also* Pet. 29 (asserting that a person of ordinary skill in the art “would have had a *reasonable expectation of success* of applying Yoshioka’s teachings to Ogawa’s valve timing control methods,” because Ogawa’s engine control unit “already receives signals representing atmospheric pressure and engine speed, and . . . sets its engine performance command PMCMD according to a particular engine load”).

receiving an engine performance feedback;

Petitioner contends “Ogawa discloses ‘a crank angle sensor 22’ that operates as an ‘engine rotational speed detecting means’ and ‘outputs a CRK signal,’ i.e., an engine performance feedback, from which ‘ECU 2 calculates the engine rotational speed.’” Pet. 37 (internal emphases omitted) (citing Ex. 1005 ¶¶ 64–65). Petitioner contends Ogawa’s disclosure of “ECU 2

calculates the engine rotational speed NE . . . based on the CRK signal” (Ex. 1005 ¶ 65) is essentially the same variable used in the ’540 patent. Pet. 37–38 (citing Ex. 1001, 2:36–42).

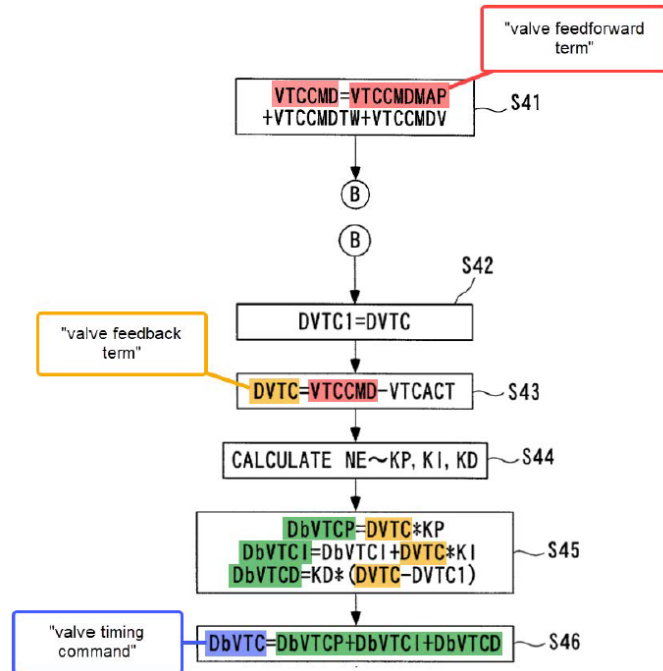
calculating a valve feedback term based on the engine performance command and the engine performance feedback; and

Petitioner contends Ogawa teaches the same method described in the ’540 patent for this calculation, because Ogawa “discloses that its ECU ‘calculates a deviation between the target cam phase VTCCMD,’ i.e., an input, ‘and a detected actual cam phase . . . VTCACT,’ i.e., an output, ‘as a current cam phase deviation DVTC,’ i.e., a difference.” Pet. 41–44 (citing Ex. 1001, 2:66–3:4; Ex. 1003 ¶¶ 101–107; Ex. 1005 ¶¶ 65, 84, Figs. 3, 4).

calculating a valve timing command based on the valve feedforward term and the valve feedback term.

Petitioner contends Ogawa teaches using “VTCCMDMAP,” the alleged “valve feedforward term,” to calculate “DVTC,” the alleged “valve feedback term,” which Ogawa uses to calculate “DbVTC,” the alleged “valve timing command.” Pet. 44–45 (citing Ex. 1005 Figs. 3, 4).

Petitioner provides an annotated version of Ogawa's Figures 3 and 4 to illustrate the correspondence of elements, and this figure is reproduced below.



Id. at 45 (annotating Ex. 1005 Figs. 3, 4). Figures 3 and 4, annotated by Petitioner, show the “valve timing command,” DbVTC, calculated from the “valve feedforward term,” “VTCCMDMAP,” and “valve feedback term,” “DVTC.”

Based on our review of the evidence and arguments cited by Petitioner, we find Petitioner sufficiently shows for purposes of institution that the asserted combination of Ogawa and Yoshioka teaches every limitation of claim 1 and that one of ordinary skill in the art would have had sufficient reason to combine Ogawa and Yoshioka and would have had a reasonable expectation of success in doing so.

2. Claims 2, 7, 10, 11, and 14

Petitioner provides a detailed analysis in support of its contentions that the subject matter of claims 2, 7, 10, 11, and 14 would have been

obvious over the combination of Ogawa and Yoshioka, with the support of Dr. Micklow. Pet. 46–57; Ex. 1003 ¶¶ 113–137. Patent Owner does not dispute Petitioner’s contentions. *See* Prelim. Resp.

For the reasons explained above in our analysis of claim 1 and based on our review and consideration of Petitioner’s arguments and evidence directed to claims 2, 7, 10, 11, and 14, on the preliminary record before us, we find that Petitioner has shown sufficiently that the asserted combination of Ogawa and Yoshioka teaches every limitation of claims 2, 7, 10, 11, and 14, and that one of ordinary skill in the art would have had sufficient reason to combine Ogawa and Yoshioka and would have had a reasonable expectation of success in doing so

3. *Determination of a Reasonable Likelihood of Prevailing*

“Once all relevant facts are found, the ultimate legal determination [of obviousness] involves the weighing of the fact findings to conclude whether the claimed combination would have been obvious to an ordinary artisan.” *Arctic Cat*, 876 F.3d at 1361. Considering the record presently before us, Petitioner has established a reasonable likelihood that it would prevail in showing that the combination of Ogawa and Yoshioka would have rendered the subject matter of claims 1, 2, 7, 10, 11, and 14 of the ’540 patent obvious to one of ordinary skill in the art at the time of the invention.

G. *Alleged Obviousness Over Yoshioka, Ogawa, and Jankovic*

Petitioner additionally contends that the subject matter of claims 1, 2, 7, 10, 11, and 14 would have been obvious over Yoshioka, Ogawa, and Jankovic. Pet. 52–55. Patent Owner does not dispute Petitioner’s contentions regarding alleged obviousness over Yoshioka, Ogawa, and Jankovic at this preliminary stage of the proceeding. *See* Prelim. Resp.

Because we have determined above that, at this stage of the proceeding and on the present record, the information presented in the Petition and Preliminary Response shows that there is a reasonable likelihood that Petitioner will prevail with respect to at least one claim based on alleged obviousness over Ogawa and Yoshioka, we need not address, in this Decision, Petitioner's additional challenges. *See* 35 U.S.C. § 314(a).

IV. CONCLUSION

Based on the evidence before us, we determine that Petitioner demonstrates a reasonable likelihood that it would prevail in establishing that at least one challenged claim of the '540 patent is unpatentable. Accordingly, we institute an *inter partes* review of the Challenged Claims of the '540 patent on all of the grounds raised in the Petition. *See SAS Inst.*, 138 S. Ct. at 1359–60 (holding that a decision to institute under 35 U.S.C. § 314 may not institute on fewer than all claims challenged in the petition); *PGS Geophysical AS v. Iancu*, 891 F.3d 1354, 1360 (Fed. Cir. 2018) (stating that the decision whether to institute *inter partes* review requires “a simple yes-or-no institution choice respecting a petition, embracing all challenges included in the petition”).

Our determination in this Decision is not a final determination on either the patentability of any challenged claims or the construction of any claim term. The factual findings set forth in this Decision are preliminary and provided for the sole purpose of deciding whether to institute a review. Any final findings will be based on the full trial record, including any information presented by Patent Owner in a timely filed response to the Petition. *See Trivascular, Inc. v. Samuels*, 812 F.3d 1056, 1068 (Fed. Cir. 2016) (noting that “there is a significant difference between a petitioner's burden to establish a ‘reasonable likelihood of success’

at institution, and actually proving invalidity by a preponderance of the evidence at trial”) (quoting 35 U.S.C. § 314(a) and comparing *id.* with § 316(e)).

IV. ORDER

Upon consideration of the record before us, it is:

ORDERED that, pursuant to 35 U.S.C. § 314(a), an *inter partes* review of claims 1, 2, 7, 10, 11, and 14 of U.S. Patent No. 6,557,540 B1 is instituted with respect to all grounds set forth in the Petition; and

FURTHER ORDERED that, pursuant to 35 U.S.C. § 314(c) and 37 C.F.R. § 42.4(b), *inter partes* review of U.S. Patent No. 6,557,540 B1 shall commence on the entry date of this Order, and notice is hereby given of the institution of a trial.

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.

IPR2023-01224
Patent 6,557,540 B1

HOWARD, *Administrative Patent Judge*, concurring.

For the reasons set forth in *BMW of N. Amer. v. Mich. Motor Techs., LLC*, IPR2023-01031, Paper 12 (PTAB Jan. 23, 2024), I find that the first five *Fintiv* factors weigh in favor of our exercising our discretion to deny institution. However, for the reasons given in footnote 9 and section III.F.1 of the majority decision, I agree with the majority that compelling merits exist. Accordingly, I agree with not exercising our discretion to deny institution based on a parallel district court proceeding.

I agree with and join all other aspects of the majority decision.

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FOR PETITIONER:

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

Matthew Middleton
DLA PIPER LLP (US)
matthew.middleton@us.dlapiper.com

FOR PATENT OWNER:

Timothy Devlin
Jason Wejnert
DEVLIN LAW FIRM LLC
td-ptab@devlinlawfirm.com
jason.wejnert@dinsmore.com