

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.

IPR2023-01233
Patent 6,581,574 B1

Before BARBARA A. PARVIS, MICHAEL L. WOODS, and
STEPHEN E. BELISLE, *Administrative Patent Judges*.

WOODS, *Administrative Patent Judge*.

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

I. INTRODUCTION

BMW of North America, LLC, (“Petitioner”) and Mercedes-Benz USA, LLC, (“Mercedes”) filed a Petition (Paper 3, “Pet.”) for *inter partes* review of claims 1–18 (the “Challenged Claims”) of U.S. Patent No. 6,581,574 B1 (Ex. 1001, “the ’574 patent”). Pet. 1. Michigan Motor Technologies, LLC, (“Patent Owner”) filed a Preliminary Response (Paper 9, “Prelim. Resp.”). Mercedes settled its dispute with Patent Owner and we dismissed Mercedes as a party to this proceeding. *See* Paper 10. Accordingly, BMW of North America, LLC, is the sole petitioner.

Under 35 U.S.C. § 314 and 37 C.F.R. § 42.4(a), we have authority to institute an *inter partes* review if “the information presented in the petition . . . and any response . . . 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). After considering the Petition, the Preliminary Response, and the evidence of record, we determine the information presented shows a reasonable likelihood that Petitioner would prevail in establishing the unpatentability of at least one of the Challenged Claims of the ’574 patent. Accordingly, we institute an *inter partes* review of claims 1–18 of the ’574 patent on the grounds asserted in the Petition.

II. BACKGROUND

A. Real Parties-in-Interest

Petitioner identifies BMW of North America, LLC, Bayerische Motoren Werke AG, Mercedes-Benz USA, LLC, and Mercedes-Benz Intellectual Property GmbH & Co as the real-parties-in-interest. Pet. 1.

Patent Owner identifies itself as the sole real-party-in-interest. *See* Paper 4, 2.

B. Related Matters

The parties identify the following court proceedings relating to the '574 patent: *Michigan Motor Technologies, LLC V. Bayerische Motoren Werke AG et al.*, C.A., No. 22-3804 (N.D. Ill.) (“Related Litigation”); *Michigan Motor Technologies, LLC v. Mercedes-Benz USA, LLC*, C.A., No. 22-03957 (N.D. Ill.). Pet. 1; Paper 4, 2.

C. Overview of the '574 Patent

The '574 patent is titled “Method for Controlling Fuel Rail Pressure.” Ex. 1001, code (54). The '574 patent describes a method for controlling fuel pressure within a fuel delivery system including a fuel rail of an internal combustion engine (“ICE”). *Id.* at code (57). We reproduce Figure 1 of the '574 patent, below:

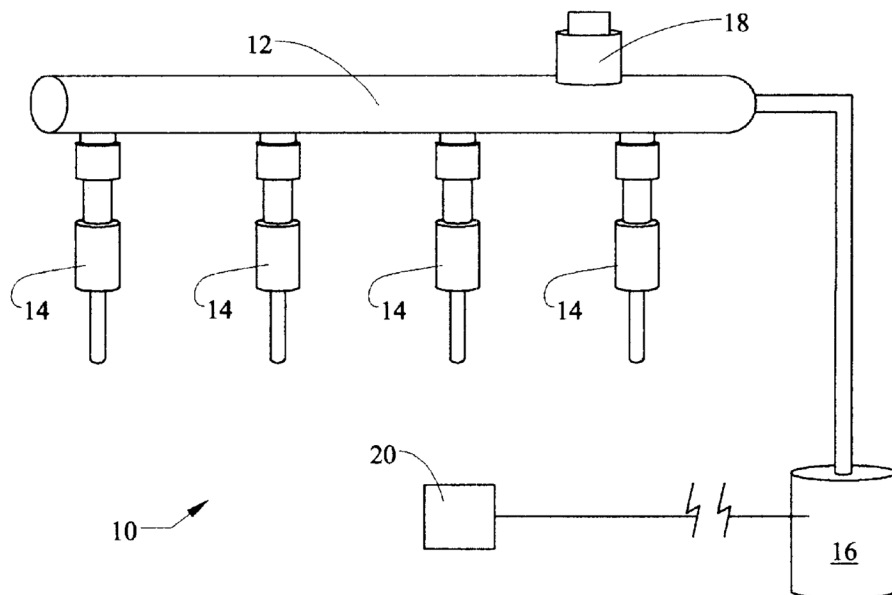


Fig. 1

Figure 1, reproduced above, “is a schematic view of a first preferred embodiment of a fuel rail delivery system.” *Id.* at 1:26–27. In particular, Figure 1 depicts fuel delivery system 10 including fuel rail 12, fuel injectors 14, fuel pump 16, fuel pressure sensor 18, and fuel pump motor controller 20. *Id.* at 1:49–54.

We further reproduce Figure 3, below:

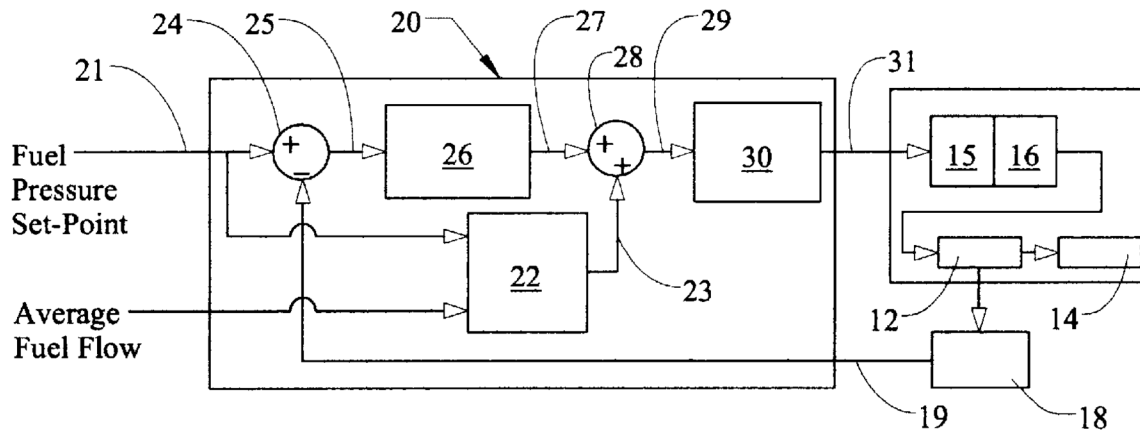


Fig. 3

Figure 3, reproduced above, depicts “a control diagram illustrating the method of controlling the fuel delivery system of the preferred embodiment.” *Id.* at 1:31–33. In referencing this figure, the ’574 patent describes that pump motor controller 20 is a processor adapted to control fuel pump 16 by controlling the speed of motor 15. *See id.* at 1:55–59. In particular, fuel pressure sensor 18 measures the pressure within fuel rail 12 and motor controller 20 receives the fuel pressure and calculates the difference between a set-point pressure and the fuel rail pressure. *Id.* at 1:58–62. The difference in pressure, error signal 25, is used to control the speed of motor 15/pump 16. *See id.* at 1:62–63. The set-point pressure is the pressure at which fuel delivery system 10 works most efficiently. *Id.* at 1:64–65. This optimum pressure, or set-point pressure, is predetermined

based on fuel injector features, specifications, and the particular application, and set-point pressure signal 21 is sent to fuel pump motor controller 20.

See id. at 2:2–5. Controller 20 calculates and outputs motor drive signal 31 to fuel pump motor 15 at a “speed that will provide the desired fuel pressure at the desired fuel flow rate.” *Id.* at 2:7–12. As further described in the ’574 patent,

The fuel rail pressure error signal 25 is calculated by subtracting the fuel pressure sensor signal 19 from the set-point pressure signal 21. This calculation is performed by a first summing junction 24. The fuel rail pressure error signal 25 is input to the feedback controller 26. In turn, the feedback controller 26 calculates a feedback control signal 27. The feedback controller 26 can be any suitable controller, such as a Proportional Integration and Differential or model based controller.

The feed forward control signal 23 and the feedback control signal 27 are summed in a second summing junction 28, thereby generating a motor controller signal 29. The fuel pump motor controller driver 30 receives the motor controller signal 29 and generates a motor drive signal 31 that controls the speed of the fuel pump motor 15.

Id. at 2:22–37 (emphasis omitted).¹

D. Challenged Claims

Petitioner challenges claims 1–18 of the ’574 patent. Pet. 1. Claims 1, 7, and 13 are independent. Ex. 1001, 3:62–6:39. We reproduce

¹ Bold emphasis to reference numerals in patent documents is omitted here and throughout the remainder of this Decision.

independent claim 1, below, with Petitioner's annotations to the claim elements in brackets:

1. [P] A method of controlling the fuel pressure within a fuel delivery system having a fuel pump which delivers fuel to a fuel rail of an internal combustion engine comprising:

[1(a)] providing a set-point fuel pressure;

[1(b)] providing the estimated average fuel flow through the system;

[1(c)] generating a feed forward control signal based upon the set-point fuel pressure and the average fuel flow;

[1(d)] measuring the fuel rail pressure with a fuel pressure sensor;

[1(e)] filtering the output of the fuel pressure sensor to filter out pulses due to the opening and closing of the fuel injectors;

[1(f)] comparing the fuel rail pressure to the set-point fuel pressure and generating an error signal based upon the difference between the fuel rail pressure and the set-point fuel pressure; and

[1(g)] modifying the feed forward control signal based upon the error signal thereby generating a motor controller signal and sending the motor control signal to the fuel pump motor.

Ex. 1001, 3:62–4:16; *see also* Pet. 21–34 (addressing claim 1 with annotations to claim elements).

E. Asserted Grounds of Unpatentability

Petitioner asserts that the Challenged Claims are unpatentable based on the following grounds (Pet. 5–6):

Ground	Claims Challenged	35 U.S.C. § ²	References/Basis
1	1–4, 7–10	103	Otterman ³ , Hosoya ⁴
2	13–16	103	Otterman, Greiner ⁵
3	5, 6, 11, 12, 17, 18	103	Otterman, Hosoya, Greiner
4	1–4, 7–10	103	Otterman, Hosoya, Buckland ⁶
5	13–16	103	Otterman, Greiner, Buckland
6	5, 6, 11, 12, 17, 18	103	Otterman, Hosoya, Greiner, Buckland

Petitioner also relies on the Declaration of Gerald J. Micklow, Ph.D. (Ex. 1003). *See, e.g.*, Pet. 4 (referencing Exhibit 1003).

III. DISCRETIONARY DENIAL

Under Section 314(a), the Director has discretion to deny institution. *See* 35 U.S.C. § 314(a) (stating, “[t]he Director may not authorize an *inter partes* review to be instituted unless the Director determines that the

² The ’574 patent was filed on March 27, 2002, and the pre-AIA version of 35 U.S.C. applies to this proceeding. *See* Ex. 1001, code (22).

³ U.S. Pat. No. 5,505,180, issued Apr. 9, 1996 (Ex. 1004, “Otterman”).

⁴ U.S. Pat. No. 5,806,497, issued Sept. 15, 1998 (Ex. 1005, “Hosoya”).

⁵ U.S. Pat. No. 4,426,981, issued Jan. 24, 1984 (Ex. 1006, “Greiner”).

⁶ U.S. Pat. No. 6,349,700 B1, issued Feb. 26, 2002 (Ex. 1007, “Buckland”).

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”) (emphasis added); *SAS Inst. Inc. v. Iancu*, 138 S. Ct. 1348, 1356 (2018) (“[Section] 314(a) invests the Director with discretion on the question whether to institute review” (emphasis omitted)); *Cuozzo Speed Techs., LLC v. Lee*, 136 S. Ct. 2131, 2140 (2016) (“[T]he agency’s decision to deny a petition is a matter committed to the Patent Office’s discretion.”); *Harmonic Inc. v. Avid Tech, Inc.*, 815 F.3d 1356, 1367 (Fed. Cir. 2016) (“[T]he PTO is permitted, but never compelled, to institute an IPR proceeding.”).

A. Based on Related Litigation

Patent Owner references the Related Litigation and argues that the Petition should be denied under *Fintiv*. Prelim. Resp. 24 (citing *Apple Inc. v. Fintiv, Inc.*, IPR2020-00019, Paper 11 (PTAB Mar. 20, 2020) (precedential) (“*Fintiv*”)).

In the Petition, Petitioner contends that the *Fintiv* factors weigh against discretionary denial. *See* Pet. 70 (“The *Fintiv* factors weigh against discretionary denial” (citing *Fintiv*)).

1. Fintiv Factors

In determining whether to exercise this discretion based on a related litigation, the Board assesses all relevant circumstances, including the merits, to balance considerations such as system efficiency, fairness, and patent quality. *See NHK Spring Co. v. Intrix-Plex Techs., Inc.*, IPR2018-00752, Paper 8 at 19–20 (PTAB Sept. 12, 2018) (precedential). We consider

the following six factors when determining whether to use our discretion to deny institution:

1. whether the court granted a stay or evidence exists that one may be granted if a proceeding is instituted;
2. proximity of the 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.

Fintiv, Paper 11 at 5–6. In evaluating these factors, we “take[] a holistic view of whether efficiency and integrity of the system are best served by denying or instituting review.” *Id.* at 6.

On June 21, 2022, the Director issued an Interim Procedure for Discretionary Denials in AIA Post-Grant Proceedings with Parallel District Court Litigation (“Interim *Fintiv* Guidance”). The Interim *Fintiv* Guidance provides “several clarifications” to “the PTAB’s current application of *Fintiv* to discretionary denial where there is parallel litigation” in response to comments received from stakeholders in response to a Request for Comments. Interim *Fintiv* Guidance 2.

2. *Analysis*

a. *Fintiv Factor 1: Stay in the Parallel Proceeding*

Under the first *Fintiv* factor, we consider “whether the court granted a stay or evidence exists that one may be granted if a proceeding is instituted.” *Fintiv*, Paper 11 at 6.

Petitioner represents that it “intend[s] to promptly seek a stay of the related district court actions if the Board institutes this proceeding.” Pet. 70. Petitioner submits that “[t]his factor weighs against discretionary denial, or at worst, is neutral.” *Id.*

Patent Owner does not respond to Petitioner’s representation that Petitioner will promptly seek a stay if we institute review. *See* Prelim. Resp. 24–25.

Because the court may determine whether or not to stay the Related Litigation based on a variety of circumstances and facts beyond our control, or even privy, we will not predict whether the Related Litigation will be stayed. *See Sand Revolution II, LLC v. Cont’l Intermodal Grp. - Trucking LLC*, IPR2019-01393, Paper 24 at 7 (PTAB June 16, 2020) (informative) (“*Sand Revolution*”). Accordingly, *Fintiv* factor 1 is neutral.

b. *Fintiv Factor 2: Trial Date in the Parallel Proceeding*

Under the second *Fintiv* factor, we consider the “proximity of the court’s trial date to the Board’s projected statutory deadline for a final written decision.” *Fintiv*, Paper 11 at 6.

Petitioner cites to the Federal Judiciary Report for the period ending March 31, 2023, and submits that “the Northern District of Illinois civil trials have taken a median of 53.5 months from filing to trial, which would

place the *trials in the corresponding litigations in January 2027.*” Pet. 70 (citing Ex. 1008, 47) (emphasis added) (footnote omitted).

Patent Owner does not dispute Petitioner’s determination of a January 2027 trial date. *See* Prelim. Resp. 24–25.

Because the deadline for our final written decision will be due approximately two years before the anticipated trial date in the parallel district court proceeding, *Fintiv* factor 2 weighs against exercising discretion to deny institution.

c. Fintiv Factor 3: Investment by the Court and the Parties in the Parallel Proceeding

Under the third *Fintiv* factor, we consider the “investment in the parallel proceeding by the court and the parties.” *Fintiv*, Paper 11 at 6.

Petitioner submits that “[i]n the corresponding district court litigations, a schedule has not yet been set, and thus the courts have not yet set a *Markman* hearing or trial date.” Pet. 70. Petitioner distinguishes the facts here from those in *Sand Revolution*, in which the parties had already exchanged infringement and invalidity contentions and the court issued a *Markman* order. *See id.* at 71. Petitioner explains that despite the considerably advanced state of the parallel litigation in *Sand Revolution*, the Board found that the third *Fintiv* factor “weighs only marginally, if at all, in favor of exercising discretion to deny institution.” *See id.*

Patent Owner does not address *Fintiv* factor 3. *See* Prelim. Resp. 24–25.

We agree with Petitioner and find the Related Litigation is at an early stage. Nothing in the record supports a finding that the court or parties have invested significant resources in the Related Litigation. Accordingly,

Fintiv factor 3 weighs against exercising discretion to deny institution

d. Fintiv Factor 4: Overlap Between Issues Raised in the Petition and Parallel Proceeding

Under the fourth *Fintiv* factor, we consider the “overlap between issues raised in the petition and in the parallel proceeding.” *Fintiv*, Paper 11 at 6. Petitioner stipulates that,

if the Board institutes *inter partes* review, Petitioner will not seek resolution in the District Court of any ground of invalidity for the ’574 Patent that utilizes the same combination of prior art reference relied upon in the grounds of the instant petition.

Pet. 71. Petitioner explains that its “proposal addresses the concern of narrowing the issues, as this stipulation ensures there is no overlap between the ’574 patent invalidity theories before the Board and at issue in the District Court.” *Id.*

Patent Owner does not address Petitioner’s stipulation. *See Prelim. Resp.* 24–25.

Petitioner’s stipulation mitigates concerns of duplicative efforts and potentially conflicting decisions. *See Sand Revolution*, Paper 24 at 12. Thus, *Fintiv* factor 4 weighs marginally against exercising discretion to deny institution.

e. Fintiv Factor 5: Whether Petitioner is Defendant in the Parallel Proceeding

Under the fifth *Fintiv* factor, we consider “whether the petitioner and the defendant in the parallel proceeding are the same party.” *Fintiv*, Paper 11 at 6.

Petitioner and Patent Owner acknowledge that they are parties in the Related Litigation. *See* Pet. 71 (“Petitioners and the PO are the parties before the District Court actions”); *cf.* Prelim. Resp. 24 (“Petitioner and Patent Owner are actively engaged in settlement discussions in the related district court action”).

There is no dispute that Petitioner is a party to the District Court Case. *See* Pet. 71; *see also* Prelim. Resp. 24. However, because a Final Written Decision is likely to issue before the district court trial, we weigh this factor against exercising discretion to deny *inter partes* review. *See Huawei Tech. Co. v. WSOU Inv., LLC*, IPR2021-00225, Paper 11 at 14 (PTAB June 14, 2021) (“[T]his factor favors denial if trial precedes the Board’s Final Written Decision and favors institution if the opposite is true” (internal quotation marks omitted)); *Google LLC v. Parus Holdings, Inc.*, IPR2020-00846, Paper 9 at 21 (PTAB Oct. 21, 2020) (“Here, . . . Petitioner is the defendant in the parallel proceeding. This fact could weigh either in favor of, or against, exercising discretion to deny institution, depending on which tribunal was likely to address the challenged patent first.”).

f. Fintiv Factor 6: Other Considerations

Under the sixth *Fintiv* factor, we consider “other circumstances that impact the Board’s exercise of discretion, including the merits.” *Fintiv*, Paper 11 at 6.

Patent Owner points to the fact that the parties “are actively engaged in settlement discussions in the related district court action” and that the parties agreed, with the Board’s authorization, to “a seven day extension of time to file a [patent owner preliminary response] for IPR2023-01031, IPR2023-01234, and IPR2023-01244, three other patents upon which

Petitioner filed IPR Petitions against [Patent Owner's] patents.” Prelim. Resp. 24. Patent Owner submits that “[d]iscretionary denial of the Petition would serve judicial economy in this matter and avoid the Board expending resources in continuing the process at this point” and that “this factor weights [sic] in favor of discretionary denial under *Fintiv*.” *Id.* at 25.

Even if the parties are engaged in settlement discussions, we do not find this fact as weighing for or against discretionary denial. Rather, we are aware of no other considerations that weigh for or against exercising our discretion to deny institution.

Furthermore, “in circumstances where the Board determines that the other *Fintiv* factors 1–5 do not favor discretionary denial, the Board shall decline to discretionarily deny under *Fintiv* without reaching the compelling merits analysis.” *See CommScope Techs. LLC v. Dali Wireless, Inc.*, IPR2022 01242, Paper 23 at 4–5 (PTAB Feb. 27, 2023) (decision on Director review) (precedential).

Accordingly, *Fintiv* factor 6 is neutral in our analysis.

3. Conclusion

In taking “a holistic view of whether efficiency and integrity of the system are best served by denying or instituting review” (*Fintiv*, Paper 11 at 6), the *Fintiv* factors, on balance, do not weigh in favor of exercising our discretion to deny institution.

B. Based on Prior Office Proceedings

Patent Owner contends that we should deny institution because Otterman was previously considered by the Board in a related *inter partes* review. *See* Prelim. Resp. 25. Patent Owner further points out that

Buckland was cited by the Examiner during prosecution of the '574 patent.
See id.

1. Same or Substantially Same Prior Art or Arguments

Under 35 U.S.C. § 325(d), “the Director may take into account whether, and reject the petition or request because, the same or substantially the same prior art or arguments previously were presented to the Office.” In evaluating arguments under § 325(d), we use

[a] 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.

Advanced Bionics, LLC v. MED-EL Elektromedizinische Geräte GmbH, IPR2019-01469, Paper 6 at 8 (PTAB Feb. 13, 2020) (precedential) (“*Advanced Bionics*”) (footnote omitted); *see also Becton, Dickinson & Co. v. B. Braun Melsungen AG*, IPR2017-01586, Paper 8 at 17–18 (PTAB Dec. 15, 2017) (precedential as to Section III.C.5, first paragraph) (listing factors to consider in evaluating the applicability of § 325(d)) (“*Becton Dickinson*”).

2. Analysis

Under *Advanced Bionics*, the *Becton Dickinson* factors (a), (b), and (d) are considered in the evaluation of whether the same or substantially the same art or arguments were previously presented to the Office. *Advanced Bionics*, Paper 6 at 10. *Becton Dickinson* identifies these factors as (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. *Becton Dickinson*, Paper 8 at 17–18.

As addressed extensively below, Otterman is the primary reference relied upon by Petitioner in this proceeding. Otterman, however, was not considered by the Office during prosecution of the application. *See, e.g.*, Ex. 1001, code (56); *see also* Pet. 72 (confirming the same). Although Otterman was considered by the Office in IPR2019-01286 (the “other IPR”), the petitioner—Volkswagen Group of America, Inc. (“VW”)—in that proceeding relied on Otterman for particular limitations recited in dependent claims 4, 10, and 16, *only*. *See* IPR2019-01286, Paper 3, 31–82; *see also id.* at 69–76 (addressing claims 4, 10, and 16); *see also* Pet. 72 (confirming the same). In the other IPR, VW relied primarily on JP Patent No. 2000-008926 (“Heiko”) and U.S. Patent No. 5,579,738 (“Frischmuth”) for addressing the majority of the recited limitations. *See* IPR2019-01286, Paper 3, 8–9. In the other IPR, the Board denied institution because VW failed to demonstrate a reasonable likelihood that the proposed combination of Heiko and Frischmuth fully addressed the independent claims. *See* IPR2019-01286, Paper 13 at 7 (“Petitioner has failed to demonstrate a reasonable likelihood of proving that Heiko and Frischmuth collectively teach using average fuel flow as a basis for generating a feed forward control signal as recited in all independent claims”); *see also* Pet. 72–73 (confirming the same).

In view of the above, the Office did not consider Otterman’s broader teachings in the other IPR. Rather, the Board’s consideration of Otterman was limited to addressing, for example, “monitoring the error signal” of fuel flow, which as recited in dependent claim 4. *See* IPR2019-01286, Paper 3,

69–76. In the present case, Petitioner’s reliance on Otterman differs significantly from VW’s reliance in the other IPR. Importantly, and as addressed extensively below, Petitioner relies extensively on Otterman in this proceeding to address the majority of the limitations recited in all of the Challenged Claims.

Finally, and although Patent Owner is correct that Buckland is deemed to have been considered by the Examiner during prosecution of the ’574 patent (*see* Prelim. Resp. 25), the Examiner did not consider Otterman, Hosoya, or Greiner, and did not consider the combination of any of these references with Buckland during prosecution of the ’574 patent (*see, e.g.,* Ex. 1001, code (56)). Accordingly, the challenges put forth in this *inter partes* review are materially different than the Examiner’s during prosecution.

Having considered (1) the similarities and material differences between the asserted art and the prior art considered by the Office, (2) the cumulative nature of the asserted art and the prior art evaluated by the Office, and (3) the extent of the overlap between the arguments made during examination and review of IPR2019-01286 and the manner in which Petitioner relies on the prior art, we do not find that the same or substantially the same art or arguments were previously presented to the Office.

Advanced Bionics, Paper 6 at 10; *Becton Dickinson*, Paper 8 at 17–18.

Because the first part of *Advanced Bionics* is not met, we do not proceed to the second part of the test, and we do not exercise discretion to deny institution based on § 325(d).

IV. ANALYSIS

A. Level of Ordinary Skill in the Art

Petitioner submits that a person of ordinary skill in the art at the time of the invention (“POSITA”)

would have had a bachelor[']s degree in electrical engineering or mechanical engineering (or equivalent) and at least 2-4 years of work experience in automotive electrical or electronics systems design. Additional work or research experience can substitute for less or different education, and vice-versa. Additional work or research experience can substitute for less or different education, and vice-versa.

Pet. 13 (citing Ex. 1003 ¶¶ 32–35).

Patent Owner, on the other hand, submits that a POSITA would have had either

(1) a B.S. in mechanical engineering or a closely related field with three or more years’ experience in either engine systems or engine control systems or (2) at least a M.S. in mechanical engineering.

Prelim. Resp. 15.

Although Petitioner’s and Patent Owner’s proposed definitions are similar, Petitioner’s definition is more flexible, as it provides that “[a]dditional work or research experience can substitute for less or different education, and vice-versa.” *Compare* Pet. 13, *with* Prelim. Resp. 15.

For purposes of this Decision, we adopt Petitioner’s assessment of the level of ordinary skill in the art. We are not persuaded that a skilled artisan would necessarily require at least a Master’s Degree in Mechanical Engineering or at least three or more years of experience in either engine systems or engine control systems, as Patent Owner proposes. *See* Prelim. Resp. 15. We find Petitioner’s definition, which applies a more flexible

approach, is consistent with the '574 patent and the asserted prior art. Pet. 13; *see Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001).

B. Claim Construction

In this *inter partes* review, we apply the same claim construction standard that would be used in a civil action under 35 U.S.C. § 282(b). 37 C.F.R. § 42.100(b). In applying this standard, we generally give claim terms their ordinary and customary meaning as would be understood by a person of ordinary skill in the art at the time of the invention and in the context of the entire patent disclosure. *See id.*; *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312–14 (Fed. Cir. 2005) (*en banc*).

Neither Petitioner nor Patent Owner expressly construe any term. *See* Pet. 13; *see also* Prelim. Resp. 16.

For purposes of this Decision, we need not and do not formally construe any claim term. *See Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017) (stating 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))). We remind the parties of their obligation, however, to submit any formal claim construction from a related proceeding, including the Related Litigation. *See* Consolidated Trial Practice Guide (“Consolidated Practice Guide” or “CTPG”)⁷ at 47–48 (“parties should submit a prior claim construction as soon as the decision is available.”). We further remind the parties that “[e]ach party bears the

⁷ Available at <https://www.uspto.gov/TrialPracticeGuideConsolidated>.

burden of providing sufficient support for any construction advanced by that party.” *Id.*

C. Principles of Law

Petitioner’s challenge is based on obviousness. *See* Pet. 12.

A patent claim is unpatentable as obvious if the differences between the claimed invention and the prior art are such that the claimed invention as a whole would have been obvious before the effective filing date of the claimed invention to a person having ordinary skill in the art to which the claimed invention pertains. *See KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). The question of obviousness is resolved on the basis of underlying factual determinations including: (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of ordinary skill in the art; and, when presented, (4) objective evidence of nonobviousness. *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).

We analyze the asserted grounds of unpatentability in accordance with these principles.

D. Ground 1: Alleged Obviousness over Otterman and Hosoya

Petitioner submits that claims 1–4 and 7–10 are unpatentable over Otterman and Hosoya. Pet. 12.

1. Otterman (Ex. 1004)

Otterman is a U.S. Patent titled, “Returnless Fuel Delivery Mechanism with Adaptive Learning.” Ex. 1004, code (54). Otterman discloses a mechanism for controlling the speed of a variable speed fuel

pump in a fuel delivery system that includes a demand sensor, feedforward pump values, with adaptive adjustments corresponding to the feedforward values, a pump controller for controlling the speed of the fuel pump, among other components. *See id.* at code (57). We reproduce Figure 1 of Otterman, below:

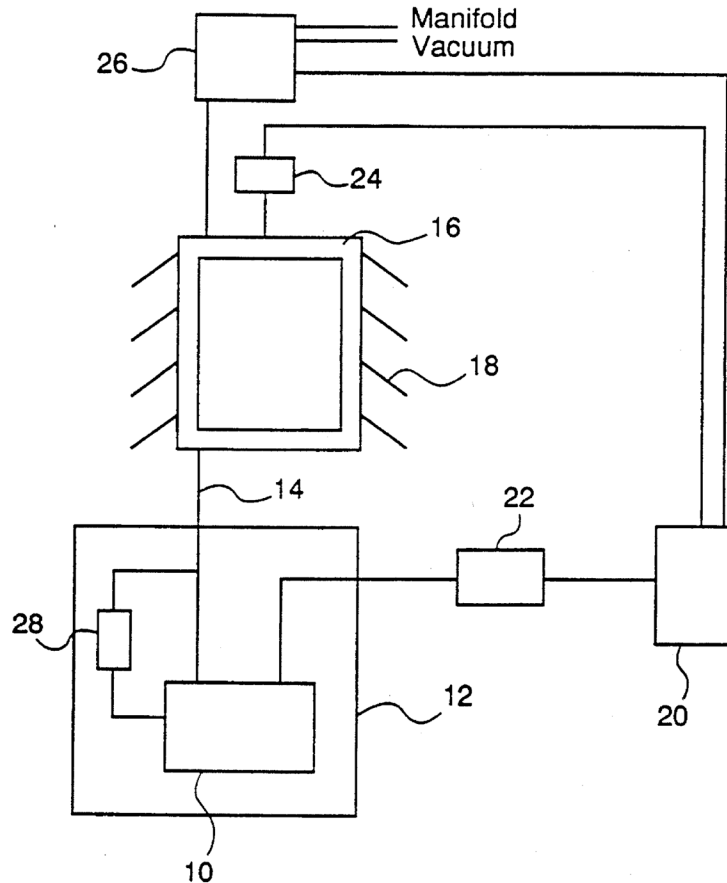


FIG. 1

Figure 1, reproduced above, is a schematic view of Otterman's first preferred embodiment of a fuel rail delivery system. Ex. 1001, 1:26–27. In particular, Figure 1 depicts fuel delivery system 10, including fuel pump 16 and fuel rail 12 adapted to deliver fuel to fuel injectors 14. *Id.* at 1:49–53. System 10 also includes fuel pressure sensor 18 and fuel pump motor controller 20. *Id.* at 1:52–54.

We also reproduce Figure 3 of Otterman, below:

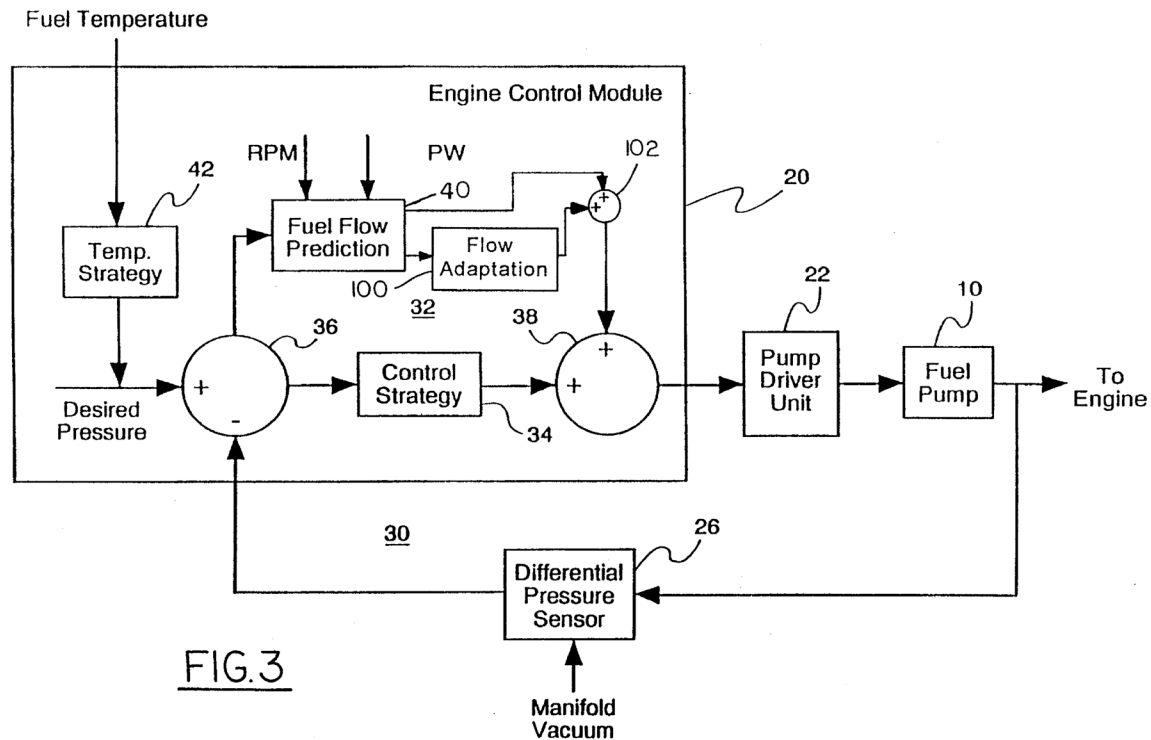


Figure 3, reproduced above, is a control diagram illustrating Otterman's method of controlling the fuel delivery system. *Id.* at 1:31–33. In particular, Figure 3 depicts flow adaptation block 100 including an adjusting mechanism that adapts to the output of fuel flow prediction block 40. *Id.* at 2:9–13. Otterman provides an example in which

after five years a particular fuel pump operating in a vehicle might provide less fuel for a given fuel pump duty cycle than it did for that duty cycle when it was new. Flow adaptation block 100 adapts the system to these changes by monitoring the average flow error supplied by control strategy block 34 over a time interval and generating cumulative adaptive adjustments to the duty cycle which was computed by fuel flow prediction block 40.

Id. at 4:15–22.

2. *Hosoya (Ex. 1005)*

Hosoya is a U.S. Patent document titled “Method of and Apparatus for Controlling Fuel Injection of Internal Combustion Engine.” Ex. 1005, code (54). Hosoya discloses a method and apparatus in which fuel pressures supplied to fuel injection valves are detected along with a pulse-width of the injected fuel. *See id.* at code (57). Hosoya discloses that

[c]onventionally, in order to prevent such fluctuation of the fuel injection quantity due to the drop of fuel pressure, the width of a fuel injection pulse is corrected in response to fuel pressures detected by a fuel pressure sensor. In correcting the pulse width, in order to avoid that the pulse width shall be corrected under an influence of a high-frequency fluctuation in the fuel pressures, a weighted averaging technique, for example, is employed to smooth the fuel pressures.

Id. at 1:27–36. Hosoya further discloses that “[w]hen the engine operating state is transitional, the smoothing is unable to follow a fluctuation in fuel pressures, and therefore, is unable to properly correct the pulse width in response to an actual fuel pressure.” *Id.* at 1:39–42. Hosoya explains that in certain circumstances, “the injection pulse width cannot be stably corrected in a steady state because of a high-frequency fluctuation in fuel pressures in the steady operating state.” *See id.* at 1:42–47.

Hosoya purports to address this problem by improving the accuracy of measurement of fuel injection quantity. *See id.* at 1:50–56. Hosoya explains that in one embodiment, “[i]nstead of the weighted averaging, it is possible to employ a construction for variably setting the cutoff frequency in a digital or analog low-pass filter.” *Id.* at 6:18–20.

3. *Independent Claim 1*

We address each of the limitations of claim 1 as partitioned by Petitioner. *See* Pet. 21–34.

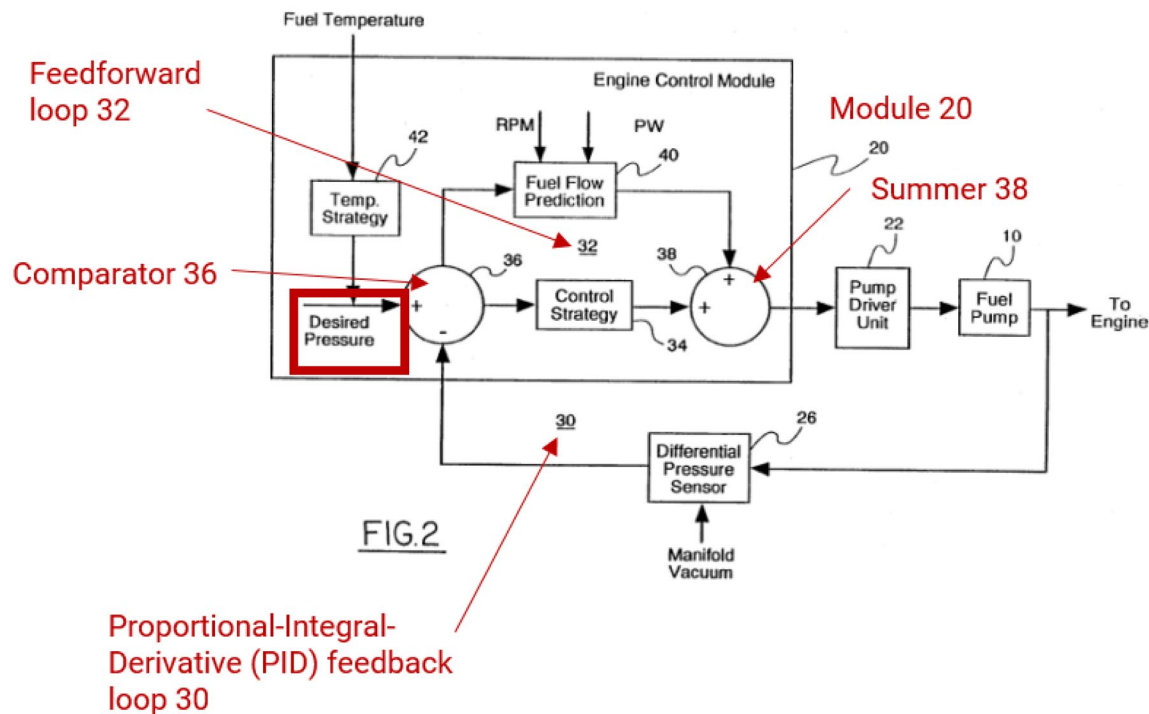
- a. Element 1(P) “A method of controlling the fuel pressure within a fuel delivery system having a fuel pump which delivers fuel to a fuel rail of an internal combustion engine”*

Petitioner submits that Otterman discloses element 1(P). Pet. 21 (citing Ex. 1003 ¶ 66).

Petitioner submits that Otterman discloses a system including “engine control module 20” for controlling a fuel delivery system, by “supplying control signals which are amplified and frequency multiplied by a power driver 22 and supplied to pump 10.” *Id.* at 22 (citing Ex. 1004, 2:55–58).

In support of this position, Petitioner submits an annotated version of Figure 1 of Otterman (*see id.* at 23), a copy of which we reproduce, below:

an annotated version of Otterman's Figure 2 (*id.* at 24), a copy of which we reproduce, below:



Annotated Figure 2, reproduced above, includes a red box around “Desired Pressure” and red text and arrows identifying “Module 20,” “Feedforward loop 32,” “Summer 38,” “Comparator 36,” and “Proportional-Integral-Derivative (PID) feedback loop 30.” *Id.* According to Petitioner, “Otterman discloses a ‘desired pressure’ that is received at comparator 36 of the system.” *Id.* at 23 (citing Ex. 1004, 3:18–22). Petitioner explains that this “‘desired pressure’ signal is a set-point or reference fuel pressure signal.” *Id.* (citing Ex. 1003 ¶ 67).

Petitioner also submits that “Otterman further explains the desired fuel pressure as a desired ‘differential’ pressure,” citing, as an example, Figure 4 which, according to Petitioner, “refers to setting a ‘target differential fuel pressure’” *Id.* (citing Ex. 1004, 4:57–60; Ex. 1003 ¶ 67).

Patent Owner disputes Petitioner’s position. *See* Prelim. Resp. 26. Patent Owner argues that Otterman does not disclose Element 1(a), because “neither the claim limitation nor the specification of the [’]574 Patent recites or specifies a ‘differential pressure.’” *Id.* at 26–27.

At this stage of the proceeding, we disagree with Patent Owner.

Patent Owner’s argument is premised on a relatively narrow interpretation of “set-point fuel pressure,” which is not currently supported by the record. Element 1(a) broadly recites, “providing a set-point fuel pressure.” Ex. 1001, 3:65. Patent Owner does not propose a construction of this term (*see* Prelim. Resp. 16) and, at this stage of the proceeding, we see nothing in the claim that precludes the “set-point fuel pressure” from being satisfied by Otterman’s disclosure of setting a target differential pressure. To illustrate, we reproduce Figure 4 of Otterman, below:

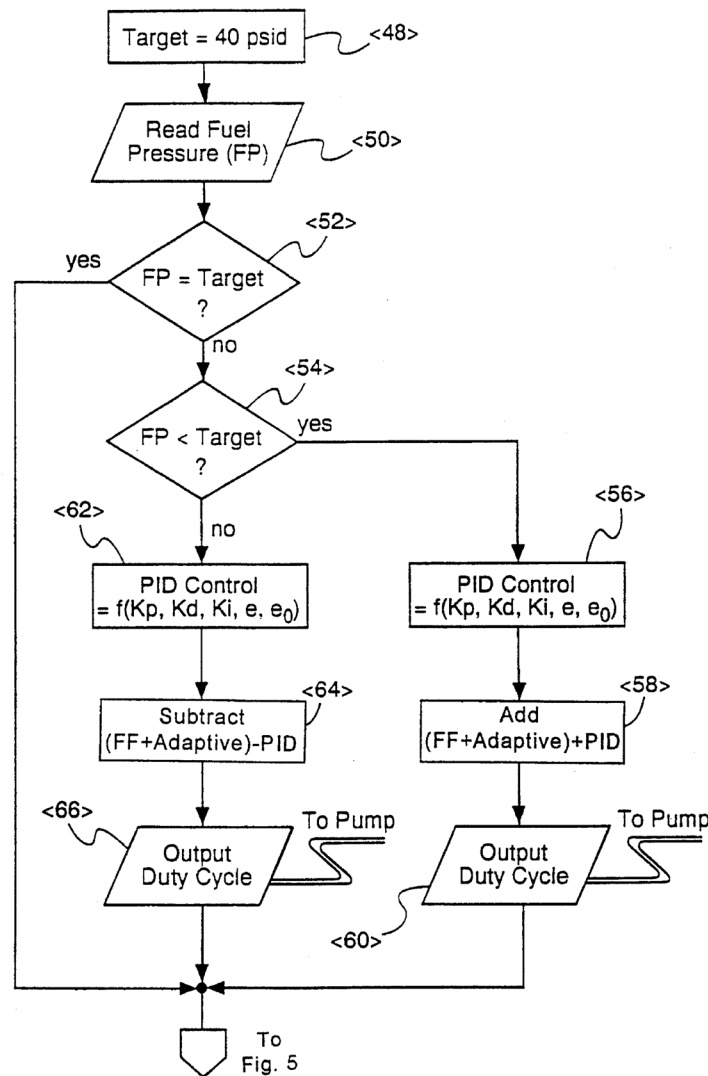


FIG. 4

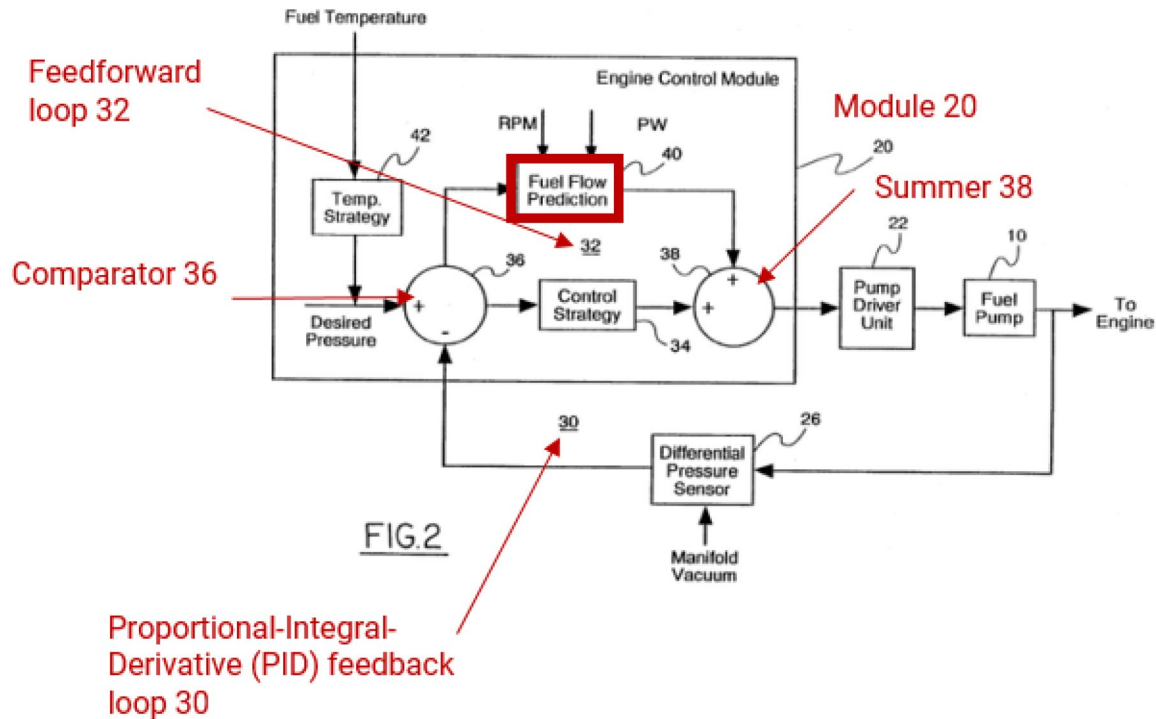
Figure 4 “is a flow chart showing how the improvement of [Otterman’s] invention fits into a fuel control method.” Ex. 1004, 2:36–37. Notably, Figure 4 of Otterman discloses a “target differential fuel pressure of” 40 psid. *See id.* at 4:57–60; *see also* Pet. 23 (citing the same).

Petitioner’s expert, Dr. Micklow, testifies that in his “opinion, a POSITA would appreciate that the ‘desired differential pressure’ disclosed in Otterman is ‘the desired pressure of the fuel rail relative to a reference manifold pressure.’” Ex. 1003 ¶ 68. Dr. Micklow further testifies that “[a]ccordingly, Otterman teaches the claimed ‘set-point fuel pressure.’” *Id.*

At this preliminary stage of the proceeding, based on the current briefing and evidence, including Dr. Micklow’s uncontroverted testimony, Petitioner has shown a reasonable likelihood that Otterman satisfies Element 1(a).

c. Element 1(b) “providing the estimated average fuel flow through the system”

Petitioner submits that Otterman discloses this element. Pet. 24 (citing Ex. 1003 ¶¶ 69–71). Petitioner explains that “Otterman discloses a ‘fuel flow prediction block 40 to predict mass fuel flow demanded’ in the system.” *Id.* (quoting Ex. 1004, 3:41–52) (citing Ex. 1004, Fig. 2; Ex. 1003 ¶ 69). Petitioner further explains, “given that Otterman teaches that a predicted or typical fuel flow is provided to the system, a POSITA would appreciate that Otterman teaches a predicted or ‘estimated average fuel flow.’” *Id.* at 24–25 (citing Ex. 1003 ¶ 69). In support of this position, Petitioner submits another annotated version of Otterman’s Figure 2 (*id.* at 25), a copy of which we reproduce, below:



Annotated Figure 2, reproduced above, is similar to the annotated version of Otterman’s Figure 2 addressed *supra* under Element 1(a), but further includes a red box around “Fuel Flow Prediction” 40. *Compare id.* at 23, *with id.* at 24. Petitioner submits that Otterman “discloses providing an estimated average fuel flow because Otterman discloses that the system monitors and provides the average fuel flow error.” Pet. 26 (citing Ex. 1004, 2:2–3, 4:18–22, 3:31–33).

Patent Owner disputes Petitioner’s position. *See* Prelim. Resp. 26–27. Patent Owner contends that Petitioner’s “conclusion does not necessarily follow” and that Petitioner “pulls ‘average fuel flow’ out of thin air without support in the claim language or the specification [and, t]herefore, *Otterman* does not disclose Element 1[b].” *Id.* at 27.

At this stage of the proceeding, we disagree with Patent Owner.

Otterman discloses,

Note that while a preferred embodiment utilizes differential pressure as reflected by the PID integral to determine flow error, other methods could be used, such as *monitoring the fuel stream*. What is required is to *measure the flow actually supplied by the returnless fuel system against the flow demanded* from the returnless fuel system, which is reflected by the feedforward and adaptive terms, and *compare the average difference over the time interval against some level of acceptable fluctuation*.

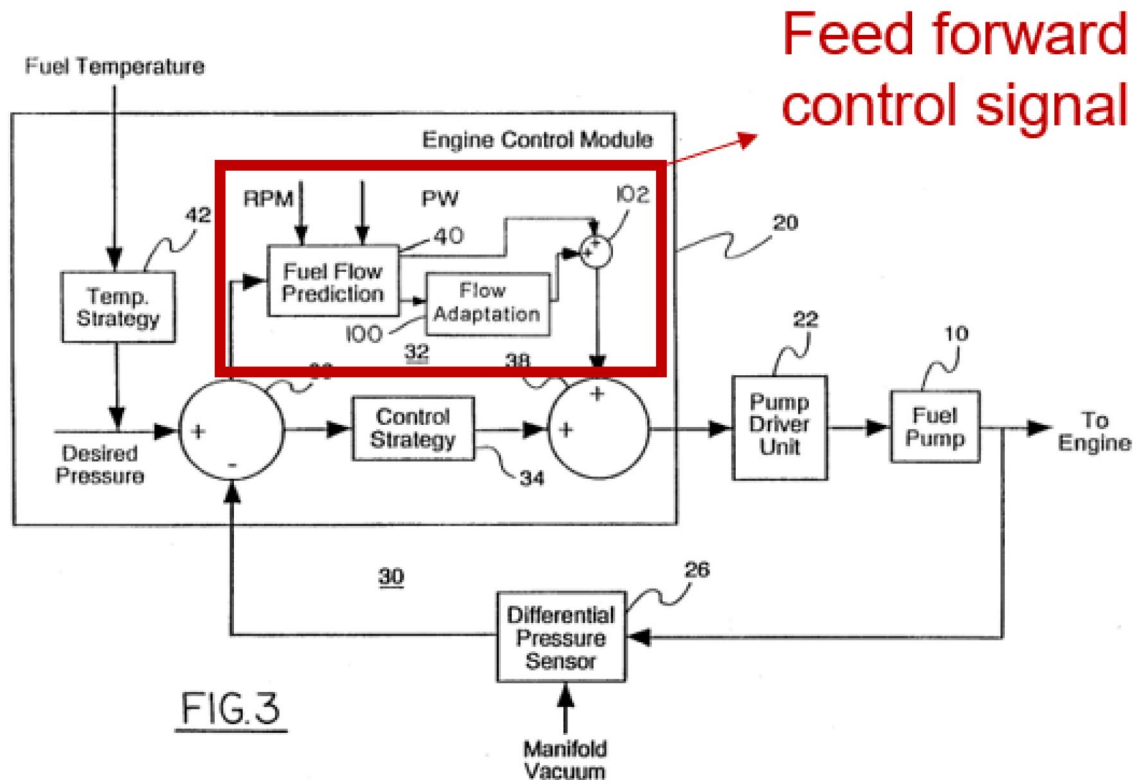
Ex. 1004, 6:25–33 (emphases added); *see also* Pet. 26 (citing the same).

Dr. Micklow testifies that, based on this disclosure, and in his “opinion, a POSITA would appreciate that ‘to determine the average flow error over time, the PID device would also determine the average fuel flow.’” Ex. 1003 ¶ 71. Dr. Micklow further testifies, “Otterman explains that while a preferred embodiment utilizes differential pressure to determine flow error, other methods could be used ‘such as monitoring the fuel stream.’” *Id.*

At this preliminary stage of the proceeding, based on the current briefing and evidence, including Dr. Micklow’s uncontroverted testimony, Petitioner has shown a reasonable likelihood that Otterman satisfies Element 1(b).

d. Element 1(c) “generating a feed forward control signal based upon the set-point fuel pressure and the average fuel flow”

Petitioner submits that Otterman discloses this element. Pet. 26 (citing Ex. 1003 ¶¶ 72–75). Petitioner submits an annotated version of Otterman’s Figure 3 (*id.* at 27), a copy of which we reproduce, below:



Ottoman's Figure 3, reproduced above, depicts "a control diagram showing the improvement of [Otterman's] invention in relation to the underlying control strategy." Ex. 1004, 2:33–35. Petitioner annotates Figure 3 to include a red box around Otterman's "Fuel Flow Prediction" 40, "Flow Adaptation" 100, "RPM" arrow, "PW," and summer 102. *See* Pet. 27. Petitioner explains, "In general, Otterman teaches that the 'feed forward' control is designated by reference numeral 32." *Id.* at 27 (citing Ex. 1004, 3:15–17). Petitioner further submits that the "feedforward term[]" is generated using a look-up table based upon the set point fuel pressure (i.e., desired pressure input) and average fuel flow (i.e., output of fuel flow prediction)." *Id.* (citing Ex. 1003 ¶ 73).

Dr. Micklow testifies that "Otterman discloses that the inputs to the fuel flow prediction block 40 'define a particular operating point which is pinpointed in a table to provide a corresponding optimum duty cycle for the

PWM signal to pump 10.” Ex. 1003 ¶ 73 (quoting Ex. 1004, 3:38–50). While referencing annotated Figure 3, Dr. Micklow explains, “the signal generated by the fuel flow prediction block is partly based upon desired pressure (average pressure) . . . [and that the] output of the fuel flow prediction block 40 is an optimum duty cycle for the PWM signal to pump 10 (feedforward fuel pump duty cycle).” *Id.* (citing Ex. 1004, 3:41–48). Dr. Micklow further testifies that the “output of the fuel flow prediction block 40 is input into summer 102, which adds an adaptive adjustment to the base feedforward fuel pump duty cycle to provide an ‘adjusted feedforward value,’ which is then continued into summer 38.” *Id.* (citing Ex. 1004, 4:34–39).

Based in part on this explanation, Dr. Micklow testifies that Otterman satisfies “‘generating a feed forward control signal based upon the set-point fuel pressure and the average fuel flow’ based on the fuel flow prediction (or typical/average fuel flow value).” *Id.*

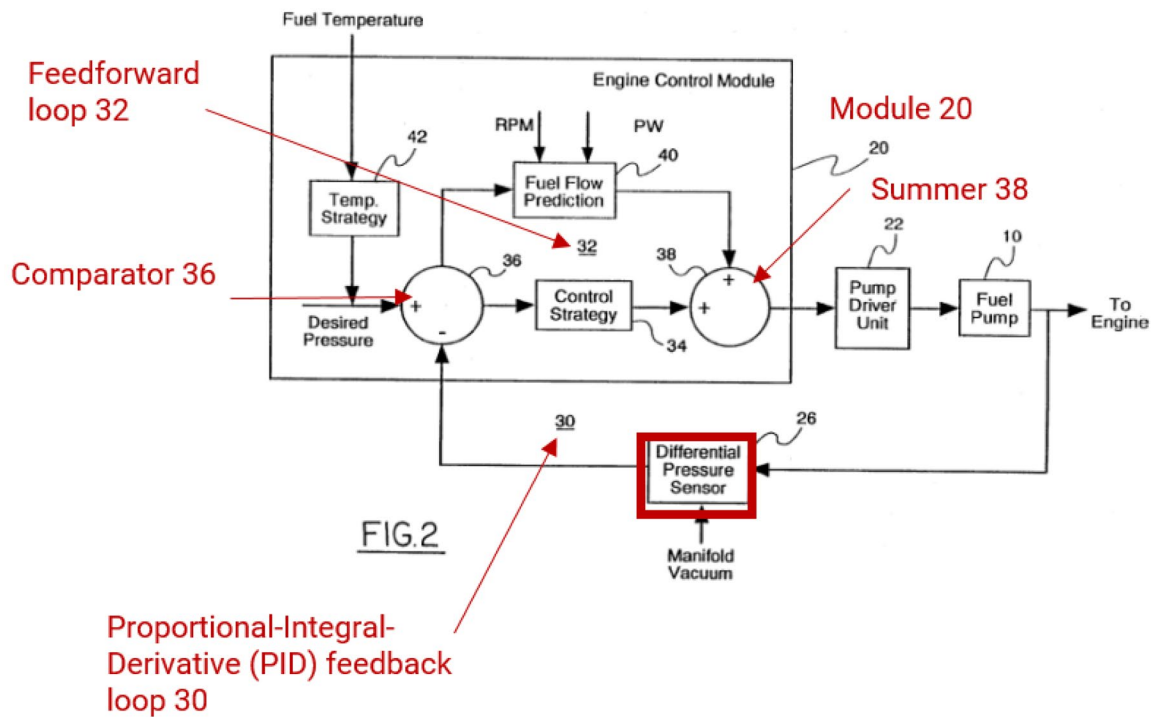
Patent Owner does not contest Petitioner’s showing for this particular limitation. *See* Prelim. Resp. 26–29.

At this preliminary stage of the proceeding, based on the current briefing and evidence, including Dr. Micklow’s uncontroverted testimony, Petitioner has shown a reasonable likelihood that Otterman satisfies Element 1(c).

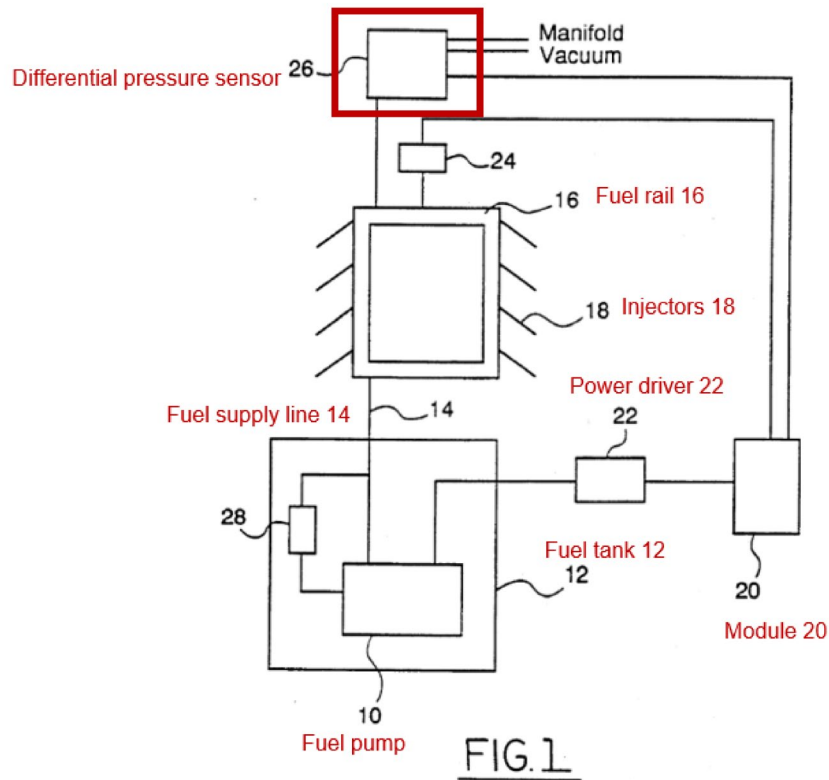
e. Element 1(d) “measuring the fuel rail pressure with a fuel pressure sensor”

Petitioner submits that Otterman discloses this element. Pet. 29 (citing Ex. 1003 ¶¶ 76–77). In support of this position, Petitioner submits an annotated version of Otterman’s Figure 2 (*id.*), a copy of which we

reproduce, below:



Annotated Figure 2, reproduced above, is similar to the annotated Figure 2 addressed *supra* under Element 1(a), and further includes a red box around “Differential Pressure Sensor” 26. Pet. 29. Petitioner also submits an annotated version of Otterman’s Figure 1 (*id.* at 30), a copy of which we reproduce, below:



Annotated Figure 1, reproduced above, includes Petitioner’s red annotations to Otterman’s “Differential pressure sensor” 26, “Fuel rail 16,” “Injectors 18,” “Power driver 22,” “Fuel supply line 14,” “Fuel tank 12,” “Module 20,” and “Fuel pump” 10. Pet. 30. Petitioner also includes a red box around “Differential pressure sensor” 26. *Id.*

Patent Owner contests Petitioner’s position. *See* Prelim. Resp. 27–28. In particular, Patent Owner argues that “neither the language of Element 1[d] or the specification of the [’]574 Patent recites ‘differential pressure.’ Therefore, *Otterman* does not disclose Element 1[d].” *Id.* at 28.

We disagree with Patent Owner’s argument. Otterman teaches measuring the pressure of the fuel rail relative to a reference manifold pressure. *See, e.g.,* Ex. 1004, Fig. 2 (element 26). Further, Element 1(d) is not so limited to exclude the measurement of this differential pressure.

In referencing Otterman’s annotated Figures 1 and 2, Dr. Micklow testifies that in his “opinion, a POSITA would appreciate that the ‘differential pressure signal’ provided by the differential pressure sensor 26, as disclosed in Otterman, is ‘the pressure of the fuel rail relative to a reference manifold pressure.’” Ex. 1003 ¶ 77. Based on this analysis, Dr. Micklow testifies that Otterman teaches the claimed “measuring the fuel rail pressure with the fuel pressure sensor.” *Id.*

At this preliminary stage of the proceeding, based on the current briefing and evidence, including Dr. Micklow’s uncontroverted testimony, Petitioner has shown a reasonable likelihood that Otterman satisfies Element 1(d).

f. Element 1(e) “filtering the output of the fuel pressure sensor to filter out pulses due to the opening and closing of the fuel injectors”

Petitioner submits that the combination of Otterman and Hosoya satisfy this element. *See* Pet. 31.

In addressing this limitation, Petitioner cites to Otterman’s disclosure that

In a preferred embodiment, loop 30 includes a PID device for measuring the flow error of the returnless fuel system. The PID device contains an integral function whose output represents the average error over time between the desired fuel flow and the system’s actual fuel flow.

Ex. 1004, 3:28–33 (emphasis added); *see also* Pet. 31 (citing the same). Based on this disclosure, Dr. Micklow testifies that “Otterman describes smoothing or averaging the difference between the desired fuel flow and the measured fuel flow.” Ex. 1003 ¶ 78. Dr. Micklow further testifies that a

“POSITA would recognize this integration step as a filtering step that would remove the effects of pressure variation as a result of the injector pulses.”

Id.

Petitioner also cites to Hosoya’s teaching of using “weighted averaging” and a “low pass filter to remove the pulses due to the opening and closing of the fuel injectors.” *See* Pet. 31 (citing Ex. 1005, 1:50–55, 2:6–18, 6:18–20). Petitioner submits that “Hosoya provides using a low pass filter to remove the pulses due to the opening and closing of the fuel injectors.” *Id.* (citing Ex. 1005, 1:50–55, 2:6–18, 6:18–20, Fig. 6).

Based on the teachings of Otterman and Hosoya, Petitioner reasons that a “POSITA would have been motivated to combine Hosoya’s low-pass filter with Otterman to avoid using the weighted average approach known in the art and to avoid the suboptimal ‘smoothing’ disclosed in Hosoya.” Pet. 31 (citing Ex. 1003 ¶ 80).

Patent Owner disputes Petitioner’s position. *See* Prelim. Resp. 28–29. First, Patent Owner contends that, as to Otterman, “it does not follow logically that a PID integral function in Otterman is a ‘filtering’ as alleged by Petitioner.” *Id.* at 28. Second, and as to Hosoya, Patent Owner argues that “Hosoya does not disclose ‘filtering the output of the fuel pressure sensor to filter out pulses due to the opening and closing of the fuel injectors’ because *Hosoya* discloses applying a low-pass filter with a cut-off frequency based on engine rotational speed, rather than ‘opening and closing of the fuel injectors’ as recited in Element 1[d].” *Id.* at 28–29 (citing Ex. 1005, 6:19–26).

We disagree with Patent Owner’s arguments. Rather than address the proposed combination of teachings, Patent Owner’s arguments attack the references individually and do not properly consider what the combination

of references would have signified to a person of ordinary skill in the art. *In re Merck & Co.*, 800 F.2d 1091, 1097 (Fed. Cir. 1986) (citing *In re Keller*, 642 F.2d 413, 425 (CCPA 1981)).

Petitioner relies on Otterman for its teaching of an “integral function whose output represents the average error over time between the desired fuel flow and the system’s actual fuel flow.” Pet. 31. Indeed, Otterman discloses that its “PID device contains an integral function whose output represents the average error over time between the desired fuel flow and the system’s actual fuel flow.” Ex. 1004, 3:31–33. Dr. Micklow submits uncontroverted testimony that “Otterman describes smoothing or averaging the difference between the desired fuel flow and the measured fuel flow” and that a “POSITA would recognize this integration step as a filtering step that would remove the effects of pressure variation as a result of the injector pulses.” Ex. 1003 ¶ 78.

As to Hosoya, Petitioner relies on Hosoya’s teaching of using “weighted averaging” and a “low pass filter to remove the pulses due to the opening and closing of the fuel injectors.” See Pet. 31 (citing Ex. 1005, 1:50–55, 2:6–18, 6:18–20). Indeed, Hosoya discloses

an apparatus for controlling fuel injection which corrects the injection pulse width based on a detection result of fuel pressure, *properly smooth detected fuel pressure values* according to an engine operating state, and *improve the accuracy of measurement of fuel injection quantity*.

Ex. 1005, 1:51–55 (emphases added).

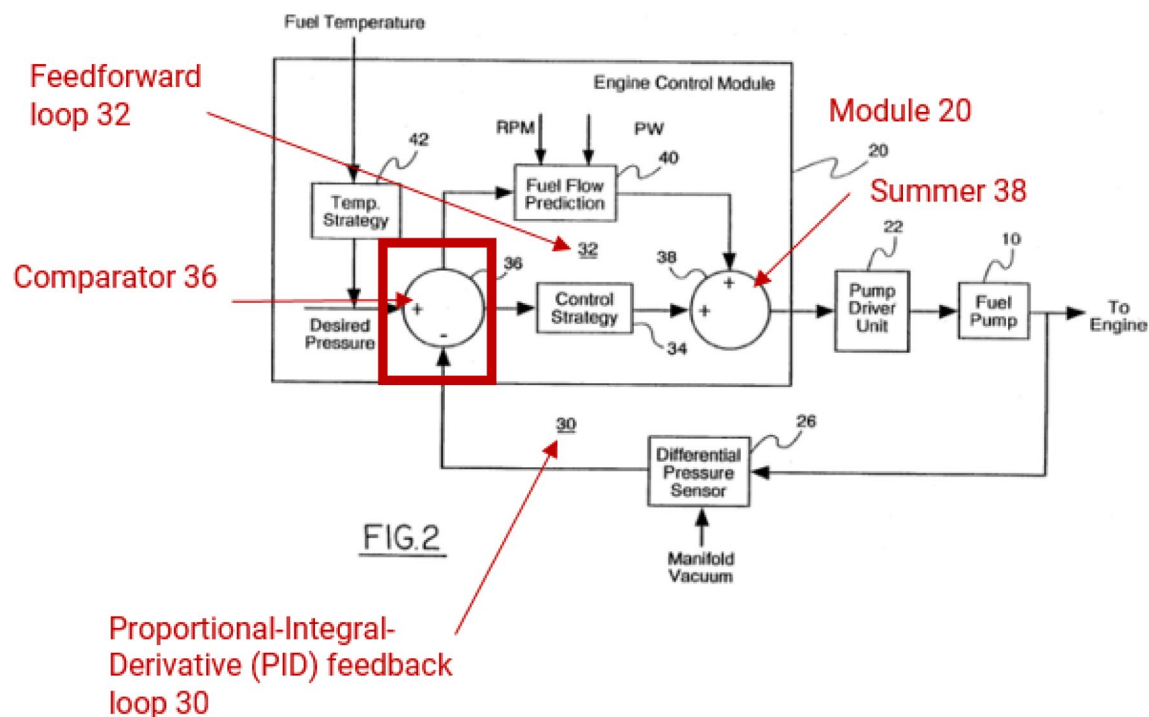
Based on these teachings, and the uncontroverted testimony of Dr. Micklow, at this stage of the proceeding, we find reasonable Dr. Micklow’s testimony that a “POSITA would have been motivated to combine Hosoya’s

low-pass filter with Otterman to avoid using the weighted average approach known in the art and to avoid the suboptimal ‘smoothing.’” Ex. 1003 ¶ 80.

At this preliminary stage of the proceeding, based on the current briefing and evidence, including Dr. Micklow’s uncontroverted testimony, Petitioner has shown a reasonable likelihood that the proposed combination of Otterman and Hosoya satisfies Element 1(e).

g. Element 1(f) “comparing the fuel rail pressure to the set-point fuel pressure and generating an error signal based upon the difference between the fuel rail pressure and the set-point fuel pressure”

Petitioner submits that Otterman discloses this element. Pet. 32. In support of its position, Petitioner submits an annotated version of Otterman’s Figure 2 (*id.*), a copy of which we reproduce, below:



With Otterman’s annotated Figure 2, reproduced above, Petitioner submits that “Otterman discloses comparing the desired differential pressure input and the actual differential pressure as input from a differential pressure

sensor 26.” Pet. 32. (citing Ex. 1004, 3:17–21; Ex. 1003 ¶ 82). Petitioner explains that the “desired differential pressure input is the set point fuel pressure, and the actual differential pressure is the fuel rail pressure itself.” *Id.*

Patent Owner disputes Petitioner’s position. *See* Prelim. Resp. 29. Patent Owner references its arguments addressed above in connection with Elements 1(a) and 1(d) and contends that “neither the claim language nor the specification of the [’]574 Patent recite ‘differential pressure’ for ‘fuel rail pressure’ or ‘set-point fuel pressure.’” *Id.*

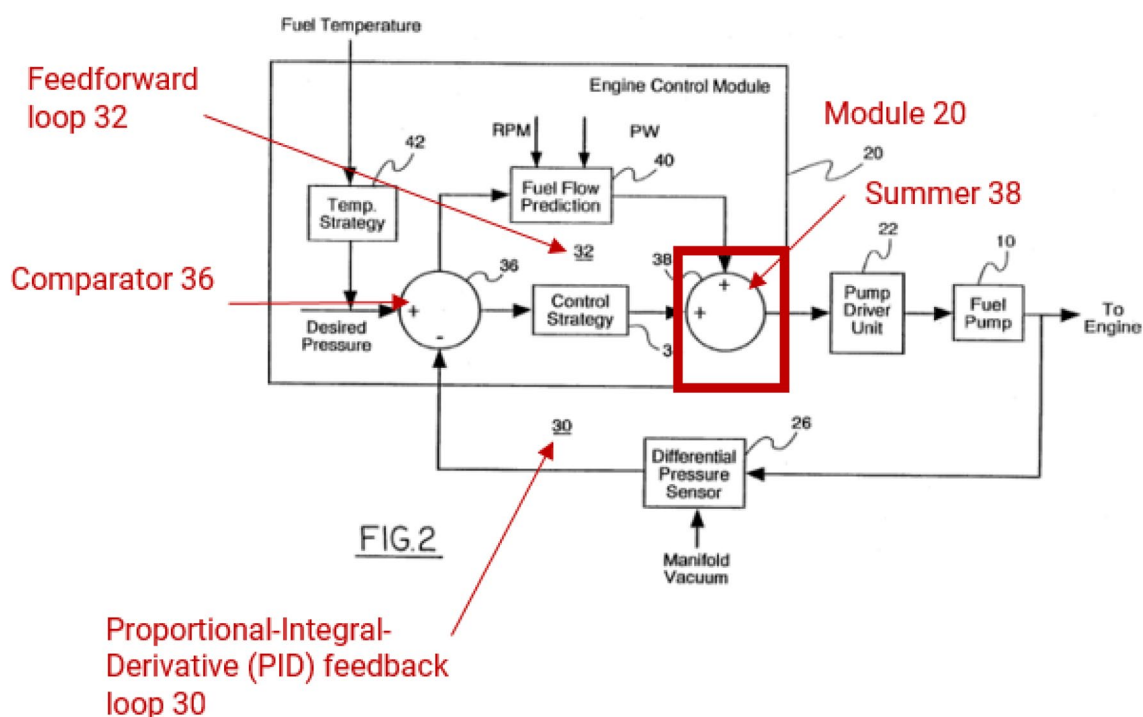
For the same reasons discussed above, we disagree with Patent Owner’s arguments. Patent Owner’s arguments are premised on a construction of “fuel rail pressure” and “set-point pressure” that would somehow exclude Otterman’s differential pressure, yet the record does not support Patent Owner’s position. Patent Owner does not propose a construction for these terms (*see* Prelim. Resp. 16) or otherwise meaningfully explain why Petitioner and Dr. Micklow’s testimony is wrong (*see id.* at 26–28, 29).

Dr. Micklow testifies that “a POSITA would appreciate that the ‘differential pressure’ provided by the differential pressure sensor 26, as disclosed in Otterman, is ‘the pressure of the fuel rail relative to a reference manifold pressure.’” Ex. 1003 ¶ 82. Dr. Micklow further testifies that “a POSITA would also appreciate that the ‘desired differential pressure’ disclosed in Otterman as being provided to the comparator is ‘the desired pressure of the fuel rail relative to a reference manifold pressure’—or the set point fuel pressure.” Based on this analysis, Dr. Micklow testifies that Otterman teaches Element 1(f). *See id.*

At this preliminary stage of the proceeding, based on the current briefing and evidence, including Dr. Micklow's uncontroverted testimony, Petitioner has shown a reasonable likelihood that Otterman satisfies Element 1(f).

h. Element 1(g) "modifying the feed forward control signal based upon the error signal thereby generating a motor controller signal and sending the motor control signal to the fuel pump motor"

Petitioner submits that Otterman discloses Element 1(g). Pet. 33 (citing Ex. 1003 ¶ 83). In support of this position, Petitioner submits an annotated version of Otterman's Figure 2 (*id.* at 34), a copy of which we reproduce, below:



Annotated Figure 2, reproduced above, is similar to annotated Figure 2 shown above under Element 1(a), but further includes a red box around "Summer 38." *See id.* Petitioner submits that "summing junction 38, which is a second summing junction, . . . receives an error signal generated by

feedback loop 30, and more specifically generated by . . . comparator 36 and processed by . . . control strategy block 34 in . . . feedback loop 30.” *Id.* at 33 (citing Ex. 1004, 3:12–28). Petitioner explains that “summing junction 38 also receives a feed forward control signal from . . . feed forward loop 32, and more specifically from . . . fuel flow prediction block 40.” *Id.*

Petitioner further explains that “summing junction 38 modifies the feed forward control signal (the fuel flow prediction signal) by adding the error term.” *Id.* (citing Ex. 1004, 3:21–25). Petitioner submits that the “signal is then provided to . . . pump driver block 22 to generate a signal that drives . . . fuel pump 10.” *Id.* (citing Ex. 1004, 2:55–58); Ex. 1003 ¶ 83. Dr. Micklow testifies that a “POSITA would know that the fuel pump 10 disclosed in Otterman necessarily has a fuel pump motor.” Ex. 1003 ¶ 83.

Patent Owner does not contest Petitioner’s showing for this particular limitation. *See* Prelim. Resp. 26–29.

At this preliminary stage of the proceeding, based on the current briefing and evidence, including Dr. Micklow’s uncontroverted testimony, Petitioner has shown a reasonable likelihood that Otterman satisfies Element 1(g).

i. Summary of Independent Claim 1

At this preliminary stage, Petitioner has shown a reasonable likelihood that the combination of Otterman and Hosoya satisfies claim 1.

4. Dependent Claims 3 and 4

Dependent claim 3 and its dependent claim 4 further include the steps of

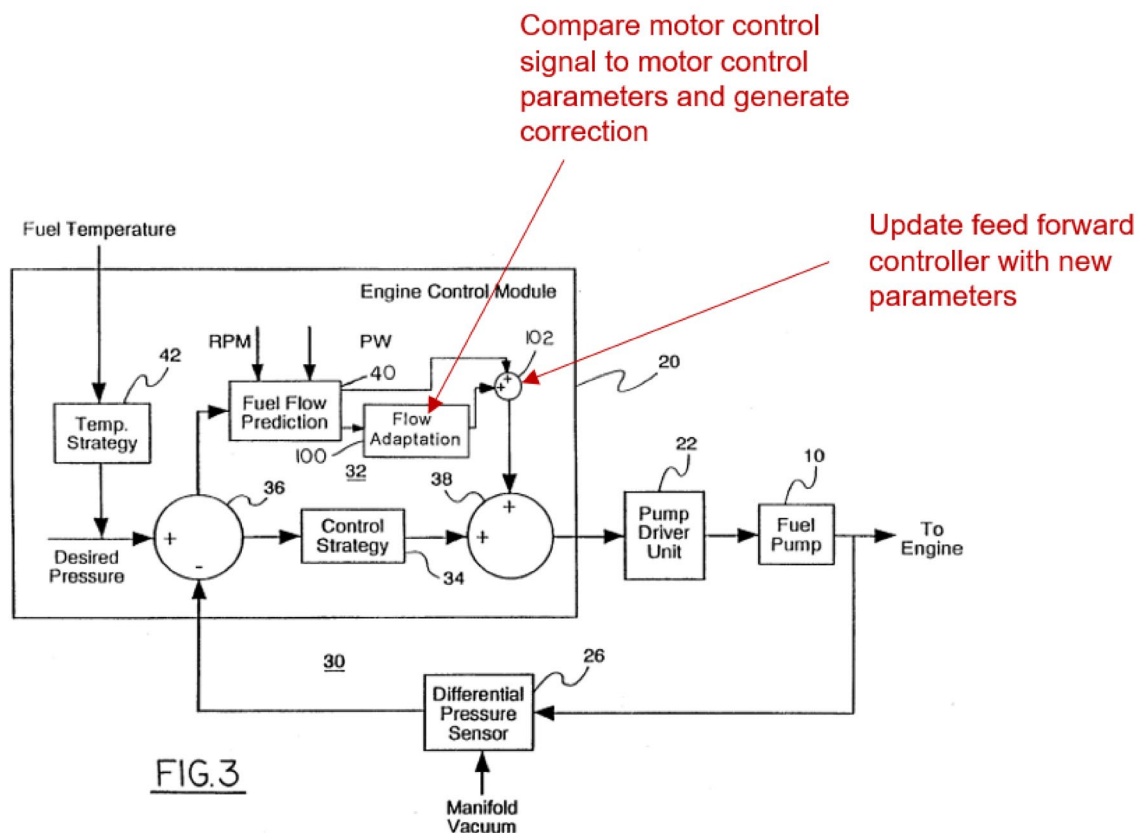
comparing the motor control signal to the fuel pump motor control parameters within the feed forward controller which correspond to the set-point pressure and the average fuel flow; . . .

updating the feed forward controller with new fuel pump motor control parameters[; and]

monitoring the error signal, and updating the feed forward controller after the error signal has stabilized and is below a pre-determined level.

Ex. 1001, 4:24–35.

In challenging claims 3 and 4, Petitioner submits that Otterman discloses the additional limitations. *See* Pet. 37–41. In support of this position, Petitioner provides annotated versions of Otterman's Figures 3, 4, and 6. *See id.* We first reproduce Petitioner's annotated version of Otterman's Figure 3, below:



Annotated Figure 3, reproduced above, includes Petitioner's annotations in red. *See id.* at 38. In particular, Petitioner includes a red arrow pointing to "Flow Adaptation" block 100, with a descriptor that states, "Compare motor control signal to motor control parameters and generate correction." *Id.* Petitioner also includes a red arrow pointed to summing junction 102, with a descriptor that states, "Update feed forward controller with new parameters." *Id.* In referencing this Figure, Petitioner submits that "Otterman teaches that the '[f]low adaptation block 100 includes an adjusting mechanism which adapts the output of fuel flow prediction block 40 for changes in the fuel system over time which manifest themselves as constant systematic or offset error.'" *Id.* at 37 (citing Ex. 1004, 4:10–15). Petitioner explains that "flow adaptation block 100 further adapts the system to these changes 'by monitoring the average flow error supplied by control strategy block 34 over a time interval and generating cumulative adaptive adjustments to the duty cycle which was computed by fuel flow prediction block 40.'" *Id.* at 38 (citing Ex. 1004, 4:10–15). Petitioner further explains that in order to "correct any detected errors in the system, . . . flow adaptation block 100 compares the fuel pump control signal ([i.e., the] motor control signal) required to obtain the correct average fuel flow, to the parameters provided by . . . fuel prediction block 40." *Id.* (citing Ex. 1004, 4:10–33). Petitioner further submits that the "difference between these values represents the amount that must be added to the fuel pump control parameters in summer 102 to correct for this difference." *Id.*

Petitioner also submits an annotated version of Otterman's Figure 4, a copy of which we reproduce, below:

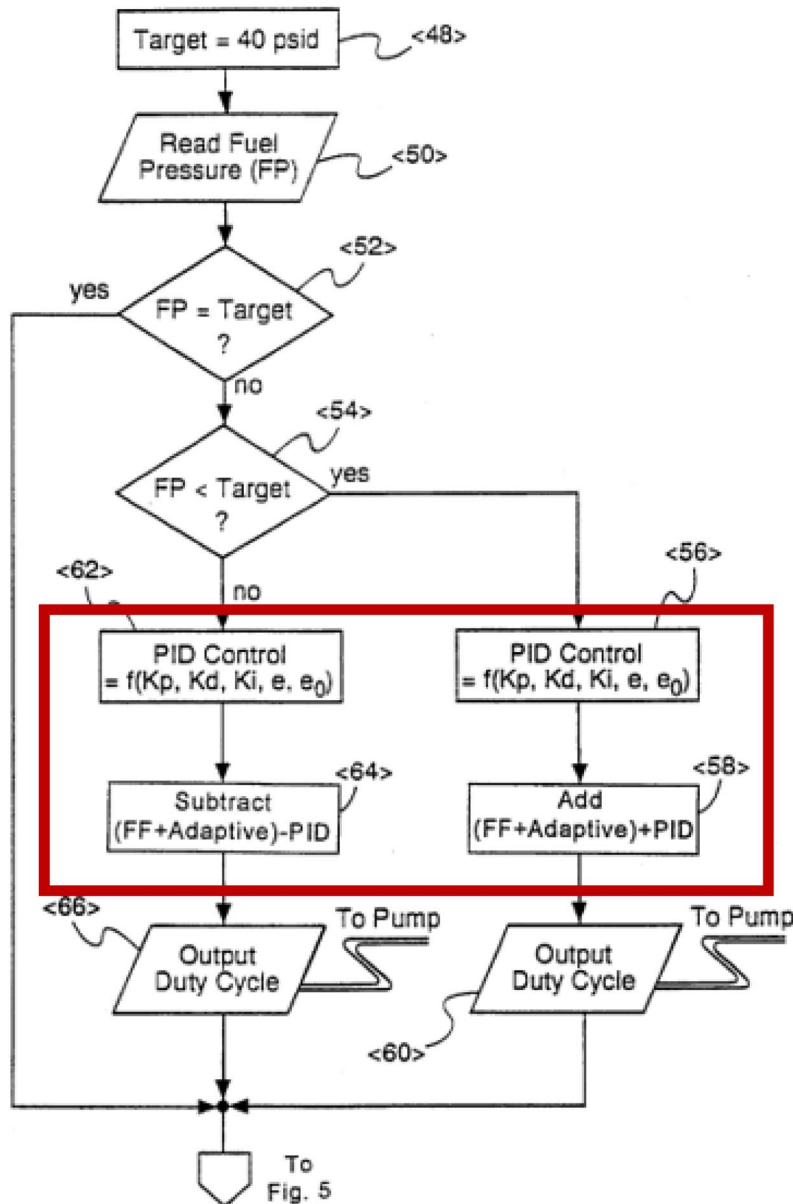


FIG.4

Figure 4, reproduced above, “is a flow chart showing how the improvement of [Otterman’s] invention fits into a fuel control method for a returnless fuel system.” Ex. 1004, 2:36–38. Petitioner provides a red box annotation around “PID control strategy output” 56, “adaptive adjustment terms” 58, “PID control strategy output” 62, and “adaptive adjustment terms” 64. See Pet. 38; *see also* Ex. 1004, 4:65–5:9. Otterman discloses:

If differential pressure is less than <54> target pressure, then the PID control strategy output <56> is added to the sum of the feedforward fuel pump duty cycle and adaptive adjustment terms <58>. This increases the duty cycle of the fuel pump PWM signal, increasing the pressure in the fuel rail when it is output <60> to the fuel pump.

If differential pressure is greater than <54> target pressure, then the PID control strategy output <62> is subtracted from the sum of the feedforward fuel pump duty cycle and adaptive adjustment terms <64>. This decreases the duty cycle of the fuel pump PWM signal, decreasing the pressure in the fuel rail when it is output <66> to the fuel pump.

Ex. 1004, 4:65–5:9.

In addressing the particular limitations of claim 4, which includes the steps of “monitoring the error signal, and updating the feed forward controller after the error signal has stabilized and is below a pre-determined level” (Ex. 1001, 4:32–35), Petitioner submits an annotated version of Otterman’s Figure 6 (Pet. 41), a copy of which we reproduce, below:

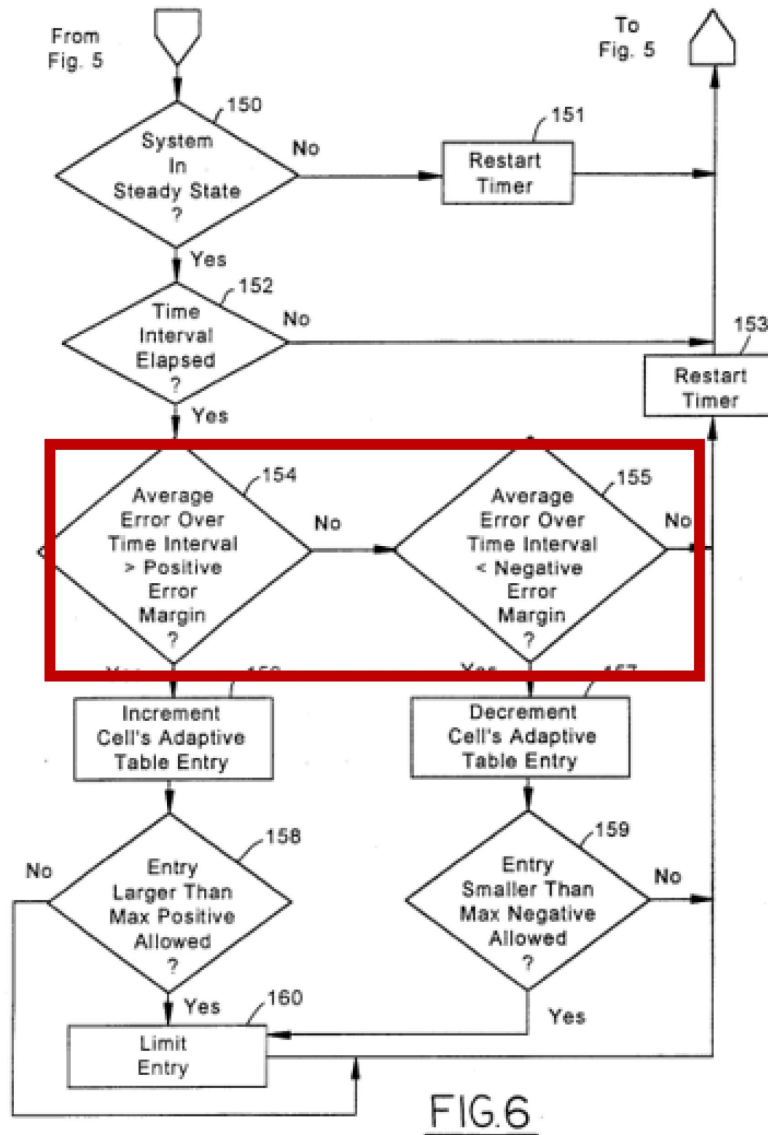


Figure 6, reproduced above, “is a flow chart showing a fuel control adaptation method of a preferred embodiment of [Otterman’s] invention.” Ex. 1004, 2:44–45. Petitioner annotates this figure to include a red box around query 154 (“Average Error Over Time Interval > Positive Error Margin?”) and query 155 (“Average Error Over Time Interval < Negative Error Margin?”). Pet. 41. In referencing this figure, Petitioner submits that Otterman “discloses monitoring the error over time, and making comparisons to a pre-determined threshold.” *Id.* (citing Ex. 1004, 6:34–40).

Petitioner cites to Otterman's disclosure that "the general criteria for making adaptive adjustments is to make them when (PID Integral>Positive Error Limit) or when (PID Integral<Negative Error Limit), with the positive and negative error limits defining a predetermined range of expected error." *Id.* (quoting Ex. 1004, 6:14–24).

Patent Owner disputes Petitioner's position on claim 4. *See* Prelim. Resp. 30. Patent Owner argues that "*Otterman* teaches away from 'monitoring the error signal' and 'updating the feed forward controller after the error signal has stabilized' as recited in claims 4 and 16 of the [']574 patent[,]" (referencing generally Ex. 1001). *Id.* Patent Owner explains that the "system in *Otterman* 'adapts the output of fuel flow prediction block 40 for changes in the systems over time which manifest themselves as constant systematic or offset error.'" *Id.* (citing Ex. 1004, 4:12–15). Patent Owner also explains that "*Otterman* further teaches that adjustments in fuel flow should be made at time intervals based on systematic errors and fuel flow demand." *Id.* (citing Ex. 1004, 5:55–6:24).

Patent Owner's teaching away argument is not persuasive. Teaching away requires a reference to actually criticize, discredit, or otherwise discourage the claimed solution. *See In re Fulton*, 391 F.3d 1195, 1201 (Fed. Cir. 2004). In support of Patent Owner's argument, Patent Owner cites to the following disclosures within Otterman:

Flow adaptation block 100 includes an adjusting mechanism which adapts the output of fuel flow prediction block 40 for changes in the fuel system over time which manifest themselves as constant systematic or offset error.

. . . .

. . . In a preferred embodiment, [Otterman’s fuel adaptation method] can be determined by checking to see whether different areas of the feedforward table have been used during the interval.

Ex. 1004, 4:11–15, 6:1–3; *see* Prelim. Resp. 30 (citing the same).

Nothing Patent Owner cited rises to the level of teaching away from the proposed combination. *See In re Fulton*, 391 F.3d at 1201. Even if Otterman teaches “that adjustments in fuel flow should be made at time intervals based on systematic errors and fuel flow demand” (Prelim. Resp. 30), this does not criticize, discredit, or otherwise discourage the step of “monitoring the error signal, and updating the feed forward controller after the error signal has stabilized and is below a pre-determined level,” as recited in claim 4.

At this stage of the proceeding, we find persuasive Dr. Micklow’s uncontroverted testimony that Otterman’s Figure 6 and its accompanying description “discloses monitoring the error over time, and making comparisons to a pre-determined threshold.” Ex. 1003 ¶ 90 (citing Ex. 1004, 6:34–40).

For purposes of institution, and at this stage of the proceeding, Petitioner has shown a reasonable likelihood that Otterman satisfies the limitations recited in claims 3 and 4.

5. Independent Claim 7

Independent claim 7 is similar to claim 1, with the primary exception being that claim 1 recites a method, whereas claim 7 recites a “fuel delivery system” comprising components adapted to deliver fuel. *Compare* Ex. 1001, 3:62–4:15, *with id.* at 2:47–5:9.

In challenging claim 7, Petitioner cites to its analysis in its challenge of claim 1. *See* Pet. 42–47.

In contesting Petitioner’s challenge of claim 7, Patent Owner argues, “for the same arguments made before for Elements 1[a]-1[e] . . . Petitioner fails to show that Otterman in combination with Hosoya discloses all the limitations of Independent Claim 7.” Prelim. Resp. 30–31.

For the same reasons discussed above, we disagree with Patent Owner’s arguments. As with its challenge of independent claim 1, and at this stage of the proceeding, Petitioner has shown a reasonable likelihood that Otterman in combination with Hosoya satisfies the limitations recited in independent claim 7.

6. Dependent Claim 10

Claim 10 depends from claim 7 and further includes “an adaptive learning controller having an algorithm which is adapted to monitor the conditions of the fuel delivery system and to update said feed forward controller.” Ex. 1001, 5:16–19.

In addressing claim 10, Petitioner submits that Otterman discloses these limitations. *See* Pet. 49 (citing Ex. 1003 ¶¶ 101, 102). Petitioner refers to Figure 3 of Otterman and cites to Otterman’s disclosure that “[f]low adaptation block 100 includes an adjusting mechanism which adapts the output of fuel flow prediction block 40 for changes in the fuel system over time which manifest themselves as constant systematic or offset error.” *Id.* (quoting Ex. 1004, 4:11–15). Petitioner explains that block 100 “monitor[s] the average flow error supplied by control strategy block 34 over a time interval and generat[es] cumulative adaptive adjustments to the duty cycle which was computed by fuel flow prediction block 40.” *Id.* (quoting Ex.

1004, 4:16–22). Petitioner explains that the “adaptive adjustments are added to the base feedforward fuel pump duty cycle at summer 102, and then continues to summer 38 for combination with the feedback control signal to generate the pump control signal.” *Id.* (citing Ex. 1004, 4:34–48, 4:65–5:3). Petitioner explains that Otterman’s Figure 6 discloses the algorithm. *Id.* at 50 (citing Ex. 1004, 6:34–40).

Patent Owner disputes Petitioner’s position, arguing that the *adaptive learning controller* recited in dependent claim 10 “operates continuously and not as a function of calculated time intervals.” Prelim. Resp. 31.

We disagree with Patent Owner’s position. Patent Owner’s argument is premised on a construction of “adaptive learning controller” that is not supported by the record. Patent Owner does not propose a construction of this term (*see* Prelim. Resp. 16) and nothing in the claim explicitly requires it to operate “continuously.” *See* Ex. 1001, 5:16–19.

At this stage of the proceeding, we find persuasive Dr. Micklow’s uncontroverted testimony. In particular, Dr. Micklow’s testimony that Otterman’s Figure 6 and its accompanying description “discloses monitoring the error over time, and making comparisons to a pre-determined threshold” is reasonable. *See* Ex. 1003 ¶ 90 (citing Ex. 1004, 6:34–40).

For purposes of institution, and at this stage of the proceeding, Petitioner has shown a reasonable likelihood that Otterman satisfies the limitations recited in claim 10.

7. Dependent Claims 2, 8, and 9

Petitioner contends, with citations to the evidence and testimony, that Otterman in view of Hosoya teach or suggest every limitation of claims 2, 8, and 9. *See* Pet. 34–37, 47–48. Patent Owner does not address Petitioner’s

arguments with respect to these additional claims, apart from the arguments addressed above. *See* Prelim. Resp. 26–31.

Upon review of the parties’ arguments and supporting evidence, and based on the current state of briefing, Petitioner demonstrates a reasonable likelihood that the subject matter of claims 2, 8, and 9 would have been obvious over the combined teachings of Otterman and Hosoya.

8. Summary of Ground 1

Petitioner demonstrates a reasonable likelihood that the subject matter of claims 1–4 and 7–10 would have been obvious over the combined disclosures of Otterman and Hosoya.

G. Ground 2: Alleged Obviousness over Otterman and Greiner

Petitioner submits that claims 13–16 would have been obvious over Otterman in view of Greiner. Pet. 53.

1. Greiner (Ex. 1006)

Greiner is a U.S. Patent titled, “Apparatus for Detecting the Fuel Quantity Delivered to the Combustion Chambers of a Diesel Engine.” Ex. 1006, code (54). We reproduce Figure 3 of Greiner, below:

FIG. 3

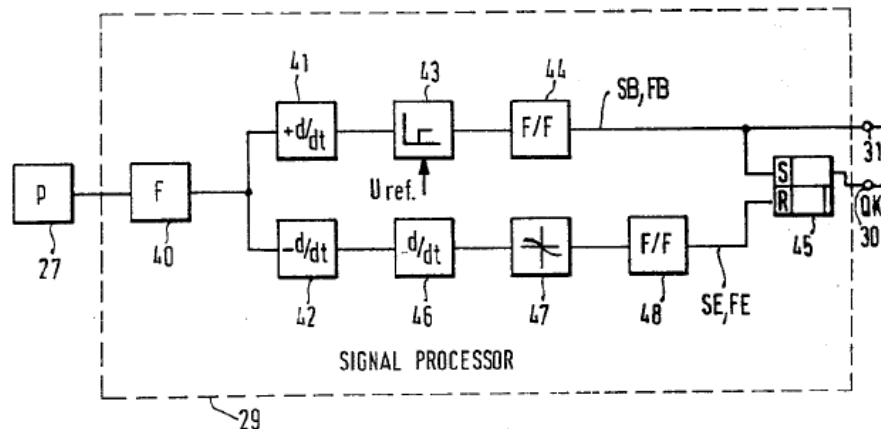


Figure 3, reproduced above, is a detailed diagram of a preferred circuit embodiment of Greiner's invention. Ex. 1006, 1:57–58. Figure 3 depicts, *inter alia*, pressure sensor 27 for detecting the fuel pressure and emits an output signal to signal processing circuit 29. *Id.* at 2:21–23. Circuit 29 has outputs 30, 31 for ejected fuel quantity and fuel injection onset. *Id.* at 2:25–26.

2. Independent Claim 13

Independent claim 13 is similar to independent claim 1 and Petitioner cross-references several limitations (that relied on Otterman) from claim 1 in challenging claim 13. *See* Pet. 54–57. As distinguished from Ground 1, however, Petitioner relies on a combination of Otterman and Greiner for addressing the following limitations:

- detecting pulses in the signal from the fuel pressure sensor to establish when the fuel injectors open and close;

- measuring the time between when an injector opens and closes to determine how long the injector is open;

- using the injector flow rate and the injector open time to calculate the average fuel flow.

See id. at 55–57.

Patent Owner argues that “[f]or the same reasons as discussed in relation to Claim 1 *infra*, the combination of *Otterman* with *Greiner* does not render independent claim 13 obvious.” Prelim. Resp. 32.

For the same reasons we disagreed with Patent Owner’s arguments above in connection with claim 1, we also disagree with those arguments as applied to claim 13.

To address the step of “detecting pulses in the signal from the fuel pressure sensor to establish when the fuel injectors open and close,” Petitioner cites to Greiner’s disclosure that “a branch of . . . signal processing circuit 29 detects the ‘injection onset.’” Pet. 55 (quoting Ex. 1006, 3:31–34) (citing *also* Ex. 1006, Fig. 3). Dr. Micklow testifies that “Greiner explains that the ‘differentiation element 41 is followed by a threshold value switch 43 and finally by a monostable multivibrator 44.’” Ex. 1003 ¶ 116 (citing Ex. 1006, 3:25–27). Dr. Micklow further testifies that “injection onset is detected when a certain threshold has been attained, triggering the monostable multivibrator 44, which ‘emits a corresponding signal at the output 31 as the identifying mark of the injection onset.’” *Id.* (citing Ex. 1006, 3:25–38). Dr. Micklow explains, “Greiner similarly discloses detecting the end of the injection pulse, by explaining that the ‘end of the injection process is ascertained via the second differentiation element 42 for the negative pressure gradient, which is followed by a further differentiation circuit 46.’” *Id.* (citing Ex. 1006, 3:39–48). Based on these and other teachings, Dr. Micklow testifies, “[a]ccordingly, Greiner describes a detection circuit that uses fuel pressure measurements and other known characteristics of the injectors to determine when the fuel injectors open and

close (*i.e.*, the onset and end of the injection process), thereby determining the duration and quantity of fuel delivered.” *Id.*

To address the step of “measuring the time between when an injector opens and closes to determine how long the injector is open,” Petitioner cites to Greiner’s disclosure that at “the non-inverting output of the flip-flop 45, a signal for the duration of the injection is obtained.” Pet. 56 (quoting Ex. 1006, 3:50–55). Based on this disclosure, Dr. Micklow testifies that Greiner discloses this element. Ex. 1003 ¶ 118.

To address the step of “using the injector flow rate and the injector open time to calculate the average fuel flow,” Petitioner cites to Greiner’s disclosure that it is “efficacious to form the integral via the course of pressure between the onset and end of the injection time, which likewise produces a good measurement signal depending upon the location of the pressure sensor.” Pet. 56 (quoting Ex. 1006, 3:55–60). Dr. Micklow testifies that a skilled artisan would have appreciated that “such integration of a signal is equivalent to averaging the signal.” Ex. 1003 ¶ 120. Dr. Micklow explains, “[a]ccordingly, Greiner also teaches using the injector flow rate and the injector open time to calculate an integral or average fuel flow.” *Id.*

In combining Greiner’s teachings with Otterman, Petitioner reasons that

a POSITA seeking to create a system as described by Otterman would be motivated to use Greiner’s teachings to detect and account for the “systematic errors” in the fuel supply system of Otterman *to ensure that the amount and timing of fuel delivered to the engine are accurate*. Indeed, a POSITA would have had a reason to combine the pulse detection approach described by Greiner in the system of Otterman because this would *improve the accuracy of the differential pressure measurement, and*

consequently would improve the accuracy of the pump control. Combining Greiner and Otterman in this manner would merely constitute each reference performing its intended function in the same way, and thus would yield a predictable and expected result.

Pet. 59–60 (citing *KSR*, 550 U.S. at 416–17; Ex. 1003 ¶ 128) (emphases added).

Upon review of the parties’ arguments and supporting evidence, and based on the current state of briefing, Petitioner demonstrates a reasonable likelihood that the subject matter of independent claim 13 would have been obvious over the combined disclosures of Otterman and Greiner.

3. *Dependent Claims 14–16*

Petitioner references its challenge under Ground 1 of claims 2, 3, and 4 in its challenge of claims 14, 15, and 16, respectively. *See* Pet. 57. Patent Owner does not address Petitioner’s arguments with respect to these additional claims, apart from the arguments addressed above. *See* Prelim. Resp. 32.

Upon review of the parties’ arguments and supporting evidence, and based on the current state of briefing, Petitioner demonstrates a reasonable likelihood that the subject matter of claims 14–16 would have been obvious over the combined disclosures of Otterman and Greiner.

4. *Summary of Ground 2*

Petitioner demonstrates a reasonable likelihood that the subject matter of claims 13–16 would have been obvious over the combined disclosures of Otterman and Greiner.

H. Grounds 3–6: Alleged Obviousness over Otterman, Hosoya, Greiner, and Buckland

Petitioner identifies where it contends Otterman in view of Hosoya, Greiner, and Buckland teach or suggest every limitation of claims 1–18. *See* Pet. 60–70. Patent Owner does not address Petitioner’s arguments with respect to these additional claims, apart from the arguments addressed above. *See* Prelim. Resp. 33–34.

Upon review of the parties’ arguments and supporting evidence, and based on the current state of briefing, Petitioner demonstrates a reasonable likelihood that the subject matter of claims 1–18 would have been obvious over the combined disclosures of Otterman, Hosoya, Greiner, and Buckland.

V. CONCLUSION

After considering the evidence and arguments presented in the Petition and Preliminary Response, we determine that the information presented shows a reasonable likelihood that Petitioner would prevail in establishing that claims 1–18 are unpatentable.

VI. ORDER

Accordingly, it is

ORDERED that, pursuant to 35 U.S.C. § 314(a), an *inter partes* review is instituted for claims 1–18 of the ’574 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.

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