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Paper 7
Entered: May 26, 2020

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

VOLKSWAGEN GROUP OF AMERICA, INC.,
Petitioner,

v.

MICHIGAN MOTOR TECHNOLOGIES, LLC,
Patent Owner.

IPR2020-00159
Patent 6,609,497 B2

Before JAMES A. TARTAL, BARBARA A. PARVIS, and SEAN P. O'HANLON, *Administrative Patent Judges.*

PARVIS, *Administrative Patent Judge*.

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

I. INTRODUCTION

Volkswagen Group of America Inc. ("Petitioner") filed a Petition pursuant to 35 U.S.C. §§ 311–319 requesting an *inter partes* review of claims 1–15 ("challenged claims") of U.S. Patent No. 6,609,497 B2 (Ex. 1001, "the '497 Patent"). Paper 2 ("Pet."). Michigan Motor

Technologies LLC ("Patent Owner") filed a Preliminary Response. Paper 6 ("Prelim. Resp.").

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 parties' briefing and the evidence of record, we conclude the information presented does not show there is a reasonable likelihood that Petitioner would prevail in establishing the unpatentability of at least one of claims 1–15 of the '497 Patent. Accordingly, we do not institute an *inter partes* review.

II. BACKGROUND

A. Related Matters

As required by 37 C.F.R. § 42.8(b)(2), each party identifies a judicial matter that would affect, or be affected by, a decision in this proceeding. In particular, the parties inform us that the '497 Patent is asserted in *Michigan Motor Technologies LLC v. Volkswagen AG*, No. 2:19-cv-10485 (E.D. Mich. 2019). Pet. 2; Paper 4.

B. The '497 Patent

The '497 Patent is directed to technology for determining the maximum braking torque ("MBT") spark timing of the combustion process of an internal combustion engine. Ex. 1001, 1:9–12. Figure 1 of the '497 Patent, reproduced below, illustrates a system for determining the MBT timing in an internal combustion engine.

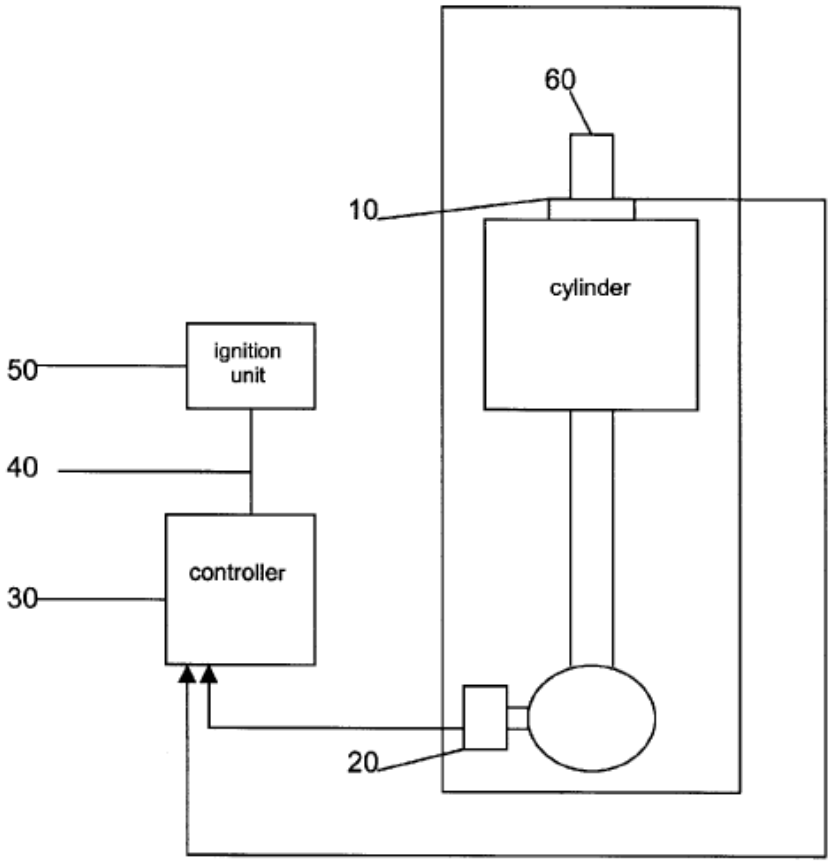

FIG. 1

Figure 1 illustrates an engine having, among other things, cylinder pressure sensor 10 and crank angle sensor 20, which are coupled to controller 30. *Id.* at 2:56–57.

Cylinder pressure sensor 10 measures the internal pressure of the cylinder during the combustion process. *Id.* at 2:31–33. Crank angle sensor 20 detects a crank angle corresponding to the rotational position of the engine. *Id.* at 2:44–45. Controller 30 receives the cylinder pressure measurements from cylinder pressure sensor 10, along with the corresponding crank angle output from the crank angle sensor 20. *Id.* at 2:61–66. Controller 30 performs predetermined operations using these

signals and controls the operation of the engine, including the ignition timing, by outputting the necessary control signals in response to the performed operations. *Id.* at 3:1–4. Controller 30 is coupled to ignition power unit 50, which receives as input ignition timing signal 40 output from controller 30. *Id.* at 3:4–7.

Figure 2 of the '497 Patent, reproduced below, illustrates a method of controlling the engine.

FIG. 2

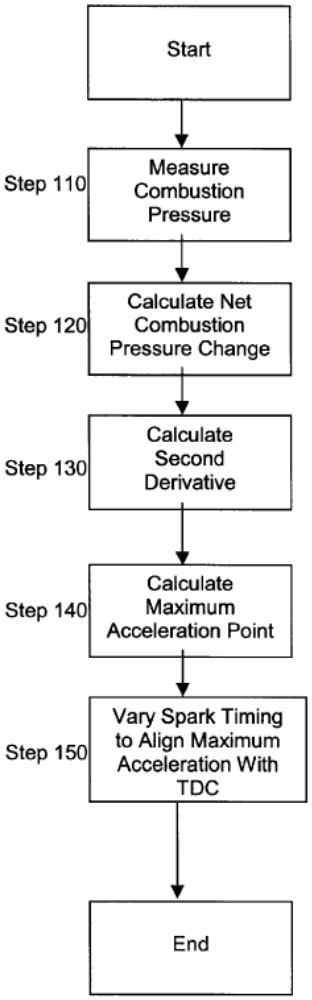

Figure 2, reproduced above, illustrates a flow chart of a method of controlling an internal combustion engine. *Id.* at 3:15–17. In Step 110 of the

method shown in Figure 2, the combustion pressure is measured in a cylinder of an internal combustion engine during a combustion cycle. *Id.* at 3:17–19. In the next Step 120 of Figure 2, the net combustion pressure change is calculated. *Id.* at 3:28–39. In Step 130 of Figure 2, the second derivative of the net combustion pressure change is calculated. *Id.* at 4:13–14.

The '497 Patent describes the next steps as follows:

> In the next Step 140 of FIG. 2, the maximum acceleration point during combustion is calculated from the second derivative of the net combustion pressure change. This calculation is preferably performed by a controller.
>
> In operation, the controller monitors the acceleration values calculated in Step 130 over the specified range of crank angles. After all of the acceleration values are monitored, the controller detects the crank angle at which the maximum acceleration value is achieved. The controller performs this calculation by detecting the largest positive acceleration value it receives. The controller then records the crank angle that corresponds to that acceleration value. This crank angle represents the maximum acceleration point of the combustion process.
>
> In Step 150 of FIG. 2, the spark timing of the engine is advanced by a controller to the point where the maximum acceleration point is aligned with the top dead center. It is at this point that the maximum braking torque timing is achieved.

Id. at 4:36–54.

C. Illustrative Claims

Petitioner challenges claims 1–15 of the '497 Patent. Pet. 1. Claims 1, 9, and 11 are the independent claims. Claims 2–8, 10, and 12–15 depend directly from one of claims 1, 9, and 11. Independent claim 1, reproduced below, is illustrative of the claimed subject matter.

> 1. A method of controlling an internal combustion engine, said engine having at least one cylinder, said method comprising the steps of:
>
> measuring the combustion pressure in said at least one cylinder at at least two discrete times during a combustion cycle;
>
> calculating a net combustion pressure change in said at least one cylinder based on said measured combustion pressures;
>
> calculating the second derivative of said net combustion pressure change;
>
> calculating the maximum acceleration point of said net combustion pressure change from said second derivative of said net combustion pressure change; and
>
> varying the spark timing of said engine until said maximum acceleration point is aligned with top dead center to achieve maximum braking torque spark timing.

Ex. 1001, 6:19–36.

D. Evidence

Petitioner relies on the following references:

U.S. Patent No. 4,976,241, filed October 12, 1989, issued December 11, 1990 (Ex. 1005, "Ishida");

U.S. Patent No. 4,774,922, filed October 16, 1987, issued October 4, 1988 (Ex. 1006, "Morita"); and

Patent Application Publication No. GB 2 001 130 A, filed July 11, 1978, published January 24, 1979 (Ex. 1007, "Scherenberg").

Additionally, Petitioner relies on the supporting Declaration of Glenn R. Bower, Ph.D. Ex. 1003. Patent Owner relies on the supporting Declaration of Russell A. Leonard, Jr., Ph.D. Ex. 2001.

E. Prior Art and Asserted Grounds

Petitioner asserts that claims 1–15 are unpatentable based on the following grounds in Table 1 below:

Claim(s) Challenged	35 U.S.C. §	Reference(s)/Basis
1–15	103(a)	Ishida
1–15	103(a)	Morita, Scherenberg

Table 1 Summarizes the Grounds Asserted by Petitioner.

Because the challenged claims of the '497 Patent have an effective filing date before March 16, 2013, the 35 U.S.C. §§ 102 and 103 provisions of the Leahy-Smith America Invents Act ("AIA"), Pub. L. No. 112-29, §§ 3(b)–3(c), 3(n)(1), 125 Stat. 284, 285–87, 293 (2011) do not apply.

Petitioner asserts that Ishida and Morita are prior art under 35 U.S.C. § 102(b). Pet. 4. Petitioner also asserts that Scherenberg is prior art under 35 U.S.C. § 102(a). *Id.* Patent Owner does not dispute Petitioner's showing that Ishida, Morita, and Scherenberg are prior art.

III. ANALYSIS

A. Legal Standards

A patent claim is unpatentable under 35 U.S.C. § 103 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). The question of obviousness is resolved on the basis of underlying factual determinations including: (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art;

(3) the level of ordinary skill in the art; and (4) objective evidence of non-obviousness. *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).

B. Level of Ordinary Skill in the Art

Petitioner asserts that a person of ordinary skill in the art at the time of the invention would have had a Bachelor of Science degree in Mechanical Engineering or Electrical Engineering (or the equivalent), as well as at least two to four years of academic or industry experience in the relevant field of engine control systems. Pet. 17 (citing Ex. 1003 ¶ 44). Patent Owner disagrees, arguing instead that a person of ordinary skill in the art would have had either a Bachelor of Science degree in Mechanical Engineering or a closely related field with three or more years of experience in either engine systems or engine control systems or at least a Master of Science degree in Mechanical Engineering. Prelim. Resp. 11 (citing Ex. 2001 ¶ 14).

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). The level of ordinary skill in the art is also reflected by the prior art of record. *See Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001).

The parties' proposals are similar with Petitioner specifying Electrical Engineering as an alternative degree and including persons with two years of academic or industry experience in the field of engine control systems (Pet. 17), whereas Patent Owner's proposal specifies as an alternative a degree in "a closely related field" and requires at least three years of experience or a

Master of Science degree Mechanical Engineering (Prelim. Resp. 11). Considering the subject matter of the '497 Patent, the background technical field, and the asserted prior art, we agree with Petitioner's proposed qualifications for an acceptable educational background. Our view is that degrees in mechanical engineering or electrical engineering, or some equivalent level of education, would provide sufficient educational background in light of the technology at issue in the'497 Patent and asserted prior art. Further, we agree two to four years of academic or industry experience in the relevant field of engine control systems is commensurate with the scope of the '497 Patent at issue and the asserted prior art.

Accordingly, we adopt Petitioner's proposal of the level of ordinary skill in the art.[1]

C. Claim Construction

In an *inter partes* review, we apply the same claim construction standard that would be used in a civil action, following the standard articulated in *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005) (en banc). 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. *Phillips*, 415 F.3d at 1312–13. Neither party provides proposed express constructions for any claim term. Pet. 17–18; Prelim. Resp. 11–12.

In view of the issues we address below, we determine that it is not necessary to provide an express interpretation of any claim terms. *See Nidec*

[1] Our conclusions herein do not turn on which definition is selected.

Motor Corp. v. Zhongshan Broad Ocean Motor Co., 868 F.3d 1013, 1017 (Fed. Cir. 2017); *Vivid Techs., Inc. v. Am. Sci. & Eng'g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999) ("[O]nly those terms need be construed that are in controversy, and only to the extent necessary to resolve the controversy.").

D. Obviousness over Ishida—Claims 1–15

Petitioner asserts claims 1–15 of the '497 Patent would have been obvious over Ishida. Pet. 5. Patent Owner opposes Petitioner's showing. *See generally* Prelim. Resp. In our discussion below, we first provide a brief overview of Ishida, and then we address the parties' contentions in turn.

1. Ishida

Ishida is directed to determining and controlling the combustion condition in a spark ignition internal combustion engine. Ex. 1005, 1:8–15. Ishida describes that its method is capable of preventing knocking while obtaining a maximal torque from an engine. *Id.* at 2:9–15.

Ishida describes determining combustion conditions to alter the spark timing. *Id.* at 9:57–66. More specifically, Ishida describes approximating a rate of change in heat evolution rate by obtaining the second derivative of cylinder internal pressure. *Id.* at 9:66–10:17. Obtaining the second derivative of cylinder internal pressure is described in more detail with respect to Figure 12 of Ishida, which is reproduced below.

FIG. 12

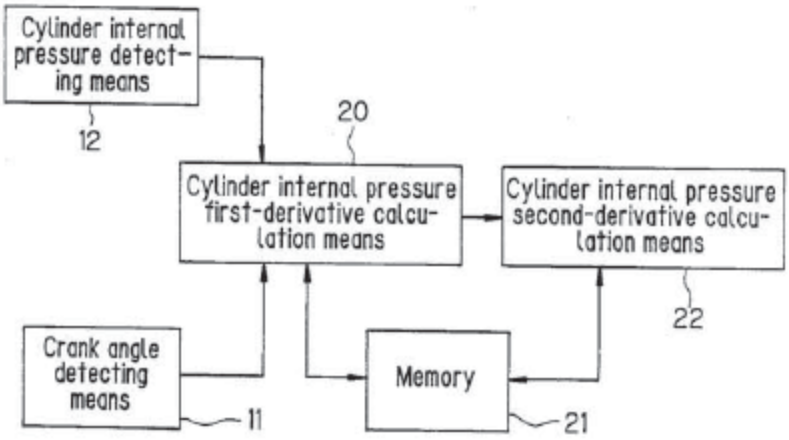

Figure 12 of Ishida illustrates a block diagram for obtaining the second derivative of cylinder internal pressure. *Id.* at 5:5–6. Cylinder internal pressure detecting means 12 samples the cylinder internal pressure and crank angle detecting means 11 detects crank angle position 9. *Id.* at 10:27–31. Cylinder internal pressure changing rate calculation means 20 reads from memory 21 prior sample data, calculates the rate of change per unit angle, and stores cylinder internal pressure and its rate of change in memory 21. *Id.* at 10:31–39. Cylinder internal pressure second-derivative calculation means 22 then calculates the cylinder internal pressure second-derivative by reading data from memory 21. *Id.* at 10:39–44.

Ishida describes using that determination to control the combustion condition of the engine to obtain a large torque from the engine while preventing knocking. *Id.* at 11:29–35. In particular, Ishida describes that ignition plug 25 is connected to electronic control unit (ECU) 31 and is driven and controlled by ECU 31. *Id.* at 11:48–57. Ignition timing is advanced or retarded to prevent knocking. *Id.* at 13:43–53.

Ishida also describes

> [w]hen, as in the embodiments described above, a combustion condition control device is configured using the combustion condition determination method according to the present invention, it is also effective to incorporate a logic to prevent the ignition timing from being advanced beyond an ignition timing for the maximal torque (MBT: Minimum spark advance for Best Torque)[.]

Id. at 28:51–58.

2. Claim 1

The parties' dispute centers on the following recitations in claim 1.

> calculating the maximum acceleration point of said net combustion pressure change from said second derivative of said net combustion pressure change; and
>
> varying the spark timing of said engine until said maximum acceleration point is aligned with top dead center to achieve maximum braking torque spark timing.

Ex. 1001, 6:19–36.

Petitioner asserts that the portions of Ishida discussed in the overview (*see supra* § III.D.1) teach the disputed recitations. Pet. 35–40 (citing, *e.g.*, Ex. 1005, 9:57–58, 9:63–10:2, 10:25–27, 11:29–35, 11:48–57, 13:43–53, 28:51–60). Petitioner also argues as follows:

> A POSA would have understood that MBT timing necessarily occurs when the maximum acceleration point is aligned with TDC [top dead center] in the engine due to the transition between the early flame development and the rapid flame development. EX1003, ¶125. Thus, as the control system in Ishida advances and retards ignition timing based on the calculated maximum acceleration, Ishida discloses varying the spark timing of the engine until the maximum acceleration point is aligned with TDC. *Id.*

Pet. 38. Dr. Bower's testimony is the same as Petitioner's contentions above. Ex. 1003 ¶ 125.

Patent Owner asserts that "*Ishida* teaches an engine which relies on the second derivative of pressure in the combustion chamber (Ex. 1005, 10:22–27) for aiding in controlling ignition timing of the engine." Prelim. Resp. 12 (citing Ex. 1005, 8:31–41, 7:62–67, Fig. 12). Patent Owner further asserts "[i]n comparison, the '497 patent teaches deriving a maximum acceleration from the second derivative of combustion pressure change." *Id.* at 14. Patent Owner also points to the prosecution history of the '497 Patent and asserts that Petitioner has not shown that Ishida teaches the "claim limitation that the Examiner found to be missing from *Ishida*." *Id.* at 20–21.[2]

We agree with Patent Owner.[3] Petitioner's contentions and Dr. Bower's testimony that a person having ordinary skill in the art would have understood that MBT timing necessarily occurs when the maximum acceleration point is aligned with top dead center (Pet. 38; Ex. 1003 ¶ 125) do not show persuasively that Ishida teaches using the calculation of the maximum acceleration point to vary the spark timing until that point is aligned with top dead center to achieve maximum braking torque spark timing control of the engine. Petitioner's contentions and Dr. Bower's

[2] Patent Owner asserts it "does not maintain that the calculation of the maximum acceleration point itself was novel," but, instead, Patent Owner asserts that the "step of varying the spark timing specifically to align the calculated maximum acceleration point with TDC" distinguishes claim 1 over the prior art. Prelim. Resp. 27–28.

[3] Patent Owner submits the Declaration of Dr. Russell Leonard (Ex. 2001) to support some of its arguments. *See generally* Prelim. Resp. However, we do not find it necessary to rely on Dr. Leonard's testimony in determining whether Petitioner has demonstrated a reasonable likelihood that it would prevail in showing the challenged claims are unpatentable.

testimony do not take into account that claim 1 recites "calculating the maximum acceleration point of said net combustion pressure change" and "varying the spark timing of said engine until *said maximum acceleration point* is aligned with top dead center." Ex. 1001, 6:19–36 (emphasis added).

Petitioner's contentions and Dr. Bower's testimony that Ishida teaches the disputed limitation are not consistent with Ishida's disclosures. Instead, consistent with Patent Owner's contentions (Prelim. Resp. 12–14), Ishida teaches that cylinder internal pressure second-derivative calculation means 22 calculates the cylinder internal pressure second-derivative by reading data from memory 21. Ex. 1005, 10:39–44. Ishida teaches using that determination to control the combustion condition of the engine to obtain a large torque from the engine while preventing knocking. *Id.* at 11:29–35.

Additionally, a finding made by the Examiner during prosecution is consistent with Patent Owner's position. In particular, the Examiner stated in the reasons for allowance that Ishida "differs from applicant's invention in that it does not teach deriving a maximum acceleration from the second derivative of combustion pressure change to adjust the ignition timing until the maximum acceleration occurs at top dead center." Ex. 1002, 100–101.

Petitioner makes assertions regarding the prosecution history with respect to whether we should exercise discretion under 35 U.S.C. § 325(d), which we consider to the extent they apply to Patent Owner's arguments. In particular, Petitioner asserts that Ishida "includes a considerable volume of subject matter: 65 sheets of Figures and 44 columns of text" and the Examiner did not cite or reference any particular portion of the Ishida specification or figures. Pet. 56. Petitioner asserts, therefore, Ishida was not evaluated during examination of the application that resulted in the '497 Patent. *Id.* Although the Examiner did not cite Ishida in a rejection, we agree

with Patent Owner that the Examiner's statement in the reasons for allowance regarding Ishida's deficiency (Ex. 1002, 100–101) supports Patent Owner's contentions.

Relying on the testimony of Dr. Bower, Petitioner also argues

> It would also have been obvious to a POSA to position the end of the "Flame Development" and the start of the "Rapid Burning" portions of the combustion process at or near TDC. Because work is only extracted from the combustion gases after TDC, a POSA would have known to initiate the "Rapid Burning" portion of the combustion process at or near TDC. EX1003, ¶127. A POSA would have further understood that it would also be a necessary result that this would coincide with the maximum acceleration of combustion as the combustion rate of "Rapid Burning" is several, possibly 8 times faster than that of the "Flame Development" portion. *Id.*

Pet. 39. Petitioner also asserts that a person having ordinary skill in the art would have been motivated to combine the respective embodiments in Ishida. *Id.* at 39–40. Dr. Bower's testimony is the same as Petitioner's contentions above, except Dr. Bower testifies regarding Exhibit 1008. Ex. 1003 ¶¶ 127–128. Exhibit 1008 is not in the English language and a translation has not been provided. 37 C.F.R. § 42.63(b).

We agree with Patent Owner (Prelim. Resp. 25) that Petitioner's assertions are not supported by any teaching in Ishida. Ishida teaches that the "ignition timing is advanced or retarded in accordance with the knocking allowance determined by the forecasting type combustion determination means 35 to prevent knocking, thereby controlling the ignition timing to an optimal value that enables the highest output of the engine." Ex. 1005, 13:48–53.

Petitioner also does not explain with sufficient specificity why a person having ordinary skill in the art would have modified Ishida such that

its system performs the steps of "calculating the maximum acceleration point of said net combustion pressure change" and "varying the spark timing of said engine until *said maximum acceleration point* is aligned with top dead center." Ex. 1001, 6:19–36 (emphasis added). We also are not persuaded by Petitioner's arguments regarding combining embodiments of Ishida because Petitioner does not point to an embodiment of Ishida that teaches the disputed recitation.

We determine that Petitioner has not shown that Ishida teaches "varying the spark timing of said engine until said maximum acceleration point is aligned with top dead center to achieve maximum braking torque spark timing" recited in claim 1. For at least that reason, we determine that the information presented does not demonstrate a reasonable likelihood that Petitioner would prevail in showing that independent claim 1 is unpatentable as obvious over Ishida.

3. Independent Claims 9 and 11

Each of independent claims 9 and 11 also recites "[deriving a/calculating the] maximum acceleration point" of the net combustion pressure change and "varying the spark timing of said engine" until the maximum acceleration point "is aligned with top dead center." Ex. 1001, 7:5–10, 8:1–7. Petitioner does not present arguments or evidence that remedy the deficiencies identified above. *See* Pet. 40–45.

Accordingly, for the same reasons discussed with respect to claim 1 (*see supra* § III.D.2), the information presented does not demonstrate a reasonable likelihood that Petitioner would prevail in showing that claims 9 and 11 are unpatentable as obvious over Ishida.

4. Dependent Claims 2–8, 10, and 12–15

Each of claims 2–8, 10, and 12–15 depends directly from one of independent claims 1, 9, and 11. Dependent claims 2–8, 10, and 12–15 by virtue of their dependency, also require "[deriving a/calculating the] maximum acceleration point" of the net combustion pressure change and "varying the spark timing of said engine" until the maximum acceleration point "is aligned with top dead center" recited in claims 1, 9, and 11. Petitioner does not present arguments or evidence that remedy the deficiencies identified above. *See* Pet. 45–55. Accordingly, for the same reasons discussed above (*see supra* § III.D.2), the information presented does not demonstrate a reasonable likelihood that Petitioner would prevail in showing that claims 2–8, 10, and 12–15 are unpatentable as obvious over Ishida.

E. Obviousness over Morita and Scherenberg—Claims 1–15

Petitioner asserts claims 1–15 of the '497 Patent would have been obvious over Morita and Scherenberg. Pet. 5. Patent Owner opposes Petitioner's showing. *See generally* Prelim. Resp. In our discussion below, we first provide a brief overview of the asserted prior art, and then we address the parties' contentions in turn.

1. Morita

Morita describes a spark ignition timing control system for an automotive internal combustion engine, which performs ignition timing control operation in both of an anti-knock mode and a gradual or stepwise mode advancing a spark advance toward a minimum advance for best torque (MBT) point. Ex. 1006, 1:11–19. Figure 2 of Morita is reproduced below.

FIG.2

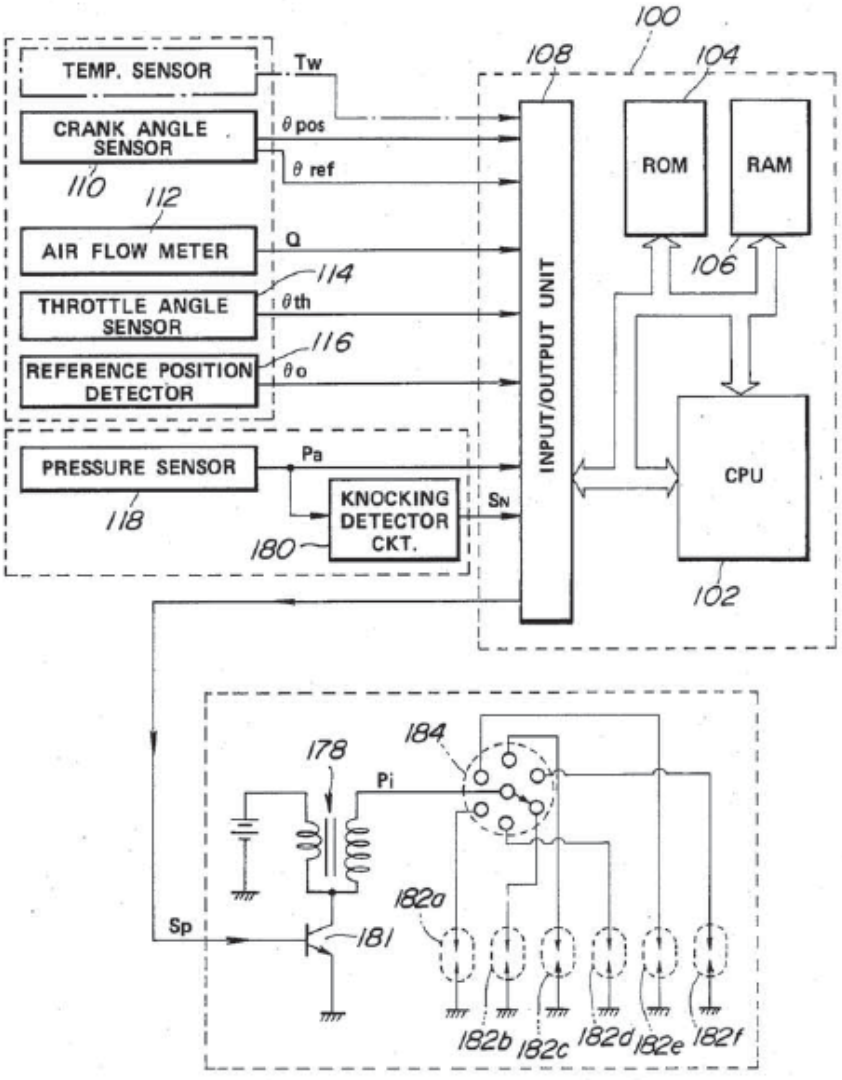

Figure 2, reproduced above, illustrates the circuitry of a spark ignition timing control system including, among other things, microprocessor-based control unit 100 for monitoring the engine driving condition including the engine knocking condition and deriving the spark advance based on the detected engine operating condition. *Id.* at 8:22–30. Control unit 100 comprises central processing unit (CPU) 102, read-only memory (ROM) 104, random-access memory (RAM) 106 and input/output unit 108. *Id.* at 8:30–32. Input/output unit 108 interfaces various peripheral components of

the spark ignition timing control system including crank angle sensor 110, air flow meter 112, throttle angle sensor 114, crank shaft reference position detector 116, and pressure sensor 118. *Id.* at 8:32–38.

2. Scherenberg

Scherenberg describes

> [d]ifferentiation dp/dt yields a curve as shown in figure 3 and a second differentiation gives the acceleration curve of figure 4. If a predetermined threshold value, represented by the line *a-a*, is taken as the basis, signals passing this threshold value upwards can be used, as a counter control by shifting the ignition on point to retardation which, as is well known, reduces the tendency to "pink."

Ex. 1007, 2:1–8. Scherenberg also describes "[t]he signal processing may be carried out for example by differentiating twice, the exceeding of a predetermined threshold value (see figure 4) being utilized by a circuit 5 for the detection of pinking." *Id.* at 2:23–27.

3. Claim 1

For "calculating the maximum acceleration point of said net combustion pressure change from said second derivative of said net combustion pressure change" recited in claim 1, Petitioner asserts

> Morita does not explicitly disclose calculating the maximum acceleration point of said net combustion pressure change from said second derivative of said net combustion pressure change. However, that feature is disclosed in Scherenberg. EX1003, ¶277.
>
> Specifically, Scherenberg calculates the maximum acceleration point from the second differentiation of the net combustion pressure and displays it on Figure 4. EX1007, 1:111–112; 2:1–8; 2:23–27. In order to be shown graphically on FIG. 4, a POSA would have understood that the maximum acceleration

> point of the second derivative of the combustion pressure change must be calculated. EX1003, ¶278.

Pet. 67.

For "varying the spark timing of said engine until said maximum acceleration point is aligned with top dead center to achieve maximum braking torque spark timing" recited in claim 1, Petitioner asserts

> Morita and Scherenberg render obvious element [1.E].
>
> Morita discloses varying the spark timing to achieve maximum braking torque spark timing. When combined with the calculation and signal processing method of Scherenberg, the combined teachings disclose varying the spark timing of the engine until the maximum acceleration point is aligned with top dead center to achieve MBT. EX1003, ¶281.

Pet. 68. Also, the overviews of Morita and Scherenberg (*see supra* §§ III.E.1, III.E.2) discuss certain teachings of Morita and Scherenberg relied upon by Petitioner.

Regarding reasoning to combine, Petitioner asserts

> S[c]herenberg discloses that the calculation and signal processing method can eliminate "the noise of interfering side effects such as valve crash, etc.," and the remaining signals provide for a more definite method of engine control. EX1007, 2:19–23. Thus, one of ordinary skill in the art would have been motivated to use the calculation and signal processing method from S[c]herenberg in the engine control system of Morita to eliminate noise and provide for a more definite method of control. EX1003, ¶251.

Pet. 59. Petitioner also characterizes its proposal as follows: "using the calculation and signal processing method from Scherenberg with the engine control system of Morita would have been nothing more than the simple substitution of one known element for another to obtain predictable results." *Id.* at 59, 70 (citing Ex. 1003 ¶¶ 241, 287).

Patent Owner asserts

> Petitioner attempts to modify the primary reference, *Morita*, by using a calculation technique disclosed in the secondary reference, *Scherenberg*. However, *Scherenberg* does not disclose using the calculated maximum acceleration point to vary the spark timing to align the maximum acceleration point with TDC. Neither, of course, does *Morita*.

Prelim. Resp. 27.

Upon consideration of Petitioner's arguments and evidence, including those discussed above in this subsection and in the overviews of Morita and Scherenberg (*see supra* §§ III.E.1, III.E.2), we agree with Patent Owner that neither reference teaches using the calculated maximum acceleration point to vary the spark timing to align the maximum acceleration point with top dead center. Consistent with Petitioner's acknowledgement (Pet. 67), Morita does not teach "calculating the maximum acceleration point of said net combustion pressure change from said second derivative of said net combustion pressure change" recited in claim 1. Contrary to Petitioner's arguments (Pet. 67–68), however, Scherenberg teaches obtaining an acceleration curve (Ex. 1007, 2), but not "calculating the maximum acceleration point . . . and varying the spark timing of said engine until said maximum acceleration point is aligned with top dead center" recited in claim 1. Also, in light of Morita's disclosures relating to retarding spark advance in response to a heavier engine knocking (Ex. 1006, 20:20–26), Petitioner has not explained sufficiently why a person having ordinary skill in the art would have had reason to use the calculation and signal processing method from Scherenberg in the engine control system of Morita to eliminate noise. Petitioner also has not explained sufficiently how such substitution provides for a more definite method of control.

In addition to the arguments above, Petitioner also argues "[i]t would be obvious to a POSA to position the end of the 'Flame Development' and the start of the 'Rapid Burning' portions of the combustion process at or near TDC." Pet. 69 (citing Ex. 1003 ¶ 286). Petitioner's assertions are not supported by any teaching in Morita or Scherenberg and Petitioner does not explain with sufficient specificity why a person having ordinary skill in the art would have made the proposed modification.

We determine that Petitioner has not shown that the combination of Morita and Scherenberg teaches "varying the spark timing of said engine until said maximum acceleration point is aligned with top dead center to achieve maximum braking torque spark timing" recited in claim 1. For at least that reason, we determine that the information presented does not demonstrate a reasonable likelihood that Petitioner would prevail in showing that independent claim 1 is unpatentable as obvious over the combination of Morita and Scherenberg.

4. Independent Claims 9 and 11

Each of independent claims 9 and 11 also recites "[deriving a/calculating the] maximum acceleration point" of the net combustion pressure change and "varying the spark timing of said engine" until the maximum acceleration point "is aligned with top dead center." Ex. 1001, 7:5–10, 8:1–7. Petitioner does not present arguments or evidence that remedy the deficiencies identified above. *See* Pet. 70–76.

Accordingly, for the same reasons discussed with respect to claim 1 (*see supra* § III.E.3), the information presented does not demonstrate a reasonable likelihood that Petitioner would prevail in showing that claims 9

and 11 are unpatentable as obvious over the combination of Morita and Scherenberg.

5. Dependent Claims 2–8, 10, and 12–15

Each of claims 2–8, 10, and 12–15 depends directly from one of independent claims 1, 9, and 11. Dependent claims 2–8, 10, and 12–15 by virtue of their dependency, also require "[deriving a/calculating the] maximum acceleration point" of the net combustion pressure change and "varying the spark timing of said engine" until the maximum acceleration point "is aligned with top dead center" recited in claims 1, 9, and 11. Petitioner does not present arguments or evidence that remedy the deficiencies identified above. *See* Pet. 76–82. Accordingly, for the same reasons discussed above (*see supra* § III.E.3), the information presented does not demonstrate a reasonable likelihood that Petitioner would prevail in showing that claims 2–8, 10, and 12–15 are unpatentable as obvious over the combination of Morita and Scherenberg.

IV. CONCLUSION

After considering the parties' evidence and arguments, we determine that the information presented does not show a reasonable likelihood that Petitioner would prevail in establishing that at least one of claims 1–15 of the '497 Patent is unpatentable on the grounds asserted in the Petition.

V. ORDER

Accordingly, it is

ORDERED that the Petition is *denied*, and no *inter partes* review is instituted.

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