NOTE: This disposition is nonprecedential.

United States Court of Appeals for the Federal Circuit

PAICE LLC, THE ABELL FOUNDATION, INC.,
Appellants

v.

FORD MOTOR COMPANY,
Appellee

2016-1647

Appeal from the United States Patent and Trademark Office, Patent Trial and Appeal Board in No. IPR2014-00875.

Decided: March 7, 2017

RUFFIN B. CORDELL, Fish & Richardson, PC, Washington, DC, argued for appellants. Also represented by TIMOTHY W. RIFFE, LINDA KORDZIEL, DANIEL TISHMAN, BRIAN JAMES LIVEDALEN.

MATTHEW J. MOORE, Latham & Watkins LLP, Washington, DC, argued for appellee. Also represented by GABRIEL BELL; ANDREW B. TURNER, JOHN P. RONDINI, FRANK A. ANGILERI, SANGEETA G. SHAH, Brooks Kushman PC, Southfield, MI.

Before PROST, *Chief Judge*, SCHALL and STOLL, *Circuit Judges*.

STOLL, *Circuit Judge*.

This is an appeal from the Patent Trial and Appeal Board's final written decision in an IPR proceeding that invalidated as obvious claims 1–4, 6, 12, and 19 of Paice's patent relating to hybrid vehicle control strategies. Paice contends that the Board's findings are not supported by substantial evidence. We disagree, except with respect to dependent claim 3, which was incorrectly analyzed as rising or falling with the independent claims. Accordingly, we affirm-in-part, vacate-in-part, and remand for further proceedings consistent with this opinion.

BACKGROUND

In early 2014, Paice LLC and the Abell Foundation (collectively, "Paice") sued Ford Motor Company for infringement of several patents covering hybrid vehicle technology, including U.S. Patent No. 7,559,388. Hybrid cars, in general, contain both a gas-powered engine and one or more battery-powered electric motors that can be used in isolation or in tandem to propel the car. The '388 patent teaches a vehicle control strategy to reduce emissions that operates the engine only when it is efficient to do so and utilizes the motor to propel the vehicle in scenarios where the engine cannot operate efficiently. The efficient range for engine operation is determined, in part, based on the vehicle's instantaneous torque demands, or "road load." '388 patent col. 19 ll. 31–33, col. 12 ll. 24–28. Typically, this efficient range occurs when the vehicle's road load is a substantial percentage of the engine's maximum torque output ("MTO"), i.e., when the torque demand is greater than 30% of MTO. *Id.* at col. 20 ll. 27–35, col. 13 ll. 44–46.

The '388 patent teaches that the vehicle can operate in multiple different modes depending on its instantaneous torque requirements, the battery's state of charge, and other operating parameters. *Id. at* col. 19 ll. 31–33. Three possible operating modes include: 1) an electric mode used during low-speed driving in which the required torque is provided to the wheels only by the motor, *id.* at col. 35 ll. 6–13; 2) an engine mode used during highway cruising where the engine alone provides the required torque, *id.* at col. 35 ll. 29–45; and 3) a hybrid mode that is used when the torque required is above the engine's MTO and the motor provides the additional torque above that provided by the engine, *id.* at col. 35 ll. 46–52.

The '388 patent also discloses limiting the rate of change of the engine's output torque to a threshold value. *Id.* at col. 38 ll. 55–59. The patent describes prior art cars that respond to the driver's depression of the accelerator pedal by opening the throttle and injecting additional fuel into the engine, often causing the engine to operate at non-stoichiometric fuel-to-air ratios that increased emissions. *Id.* at col. 38 ll. 59–66. Under the '388 patent's control strategy, if the car's instantaneous torque requirement exceeds the threshold value—for example, the driver requests rapid acceleration requiring a large increase in the rate of change in the engine's output torque above the threshold value—the electric motor is used to supply the difference between the car's instantaneous torque requirement and the threshold value. *Id.* at col. 38 l. 66 – col. 39 l. 19, col. 37 ll. 44–54. Independent claim 1 recites this improvement:

> 1. A hybrid vehicle, comprising:
>
> at least two wheels, operable to receive power to propel said hybrid vehicle;
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> a first alternating current (AC) electric motor, operable to provide power to said at least two wheels to propel said hybrid vehicle;

> a second AC electric motor;
>
> an engine coupled to said second electric motor, operable to provide power to said at least two wheels to propel the hybrid vehicle, and/or to said second electric motor to drive the second electric motor to generate electric power;
>
> a first alternating current-direct current (AC-DC) converter having an AC side coupled to said first electric motor, operable to accept AC or DC current and convert the current to DC or AC current respectively;
>
> a second AC-DC converter coupled to said second electric motor, at least operable to accept AC current and convert the current to DC;
>
> an electrical storage device operable to store energy converted to DC by said AC-DC converters and to provide energy to be converted to AC by at least said first AC-DC converter to power at least said first electric motor; and
>
> a controller;
>
> wherein a rate of change of torque output of said engine is limited to a threshold value, wherein when a rate of change of road load exceeds said threshold value of the rate of change of torque output of the engine, said controller is operable to operate said first motor and/or said second motor to supply additional power to at least said two wheels to supply remaining required torque.

Id. at col. 56 l. 42 – col. 57 l. 5.

The crux of the parties' dispute is the claim's final "wherein" clause, which limits the amount by which the rate of change of engine torque output can increase in response to a change in road load and activates an electric motor to supply the remaining required torque. Dependent claims 2–4, 6, and 12 each add new limitations to claim 1 and are also at issue in this appeal. Claim 19 is the method claim analog to claim 1.

Following Paice's assertion of its patents against Ford in district court, Ford filed a series of inter partes review petitions, one of which was instituted for the '388 patent. The Board subsequently invalidated claims 1, 3, and 19 as obvious over a combination of the Vittone and Ehsani references. It found that Vittone disclosed the disputed road load and torque threshold concepts from the '388 patent's "wherein" clause, and that Ehsani taught each of the remaining claim limitations. *Ford Motor Co. v. Paice LLC*, IPR2014-875, 2015 WL 7695188, at *3 (PTAB Nov. 23, 2015) (*Board Decision*). For similar reasons, the Board found that the combination of Vittone with the Kawakatsu reference rendered obvious claims 1, 3, 4, and 19—again, the Board reasoned that Vittone taught the disputed elements and Kawakatsu disclosed the remaining claim limitations. *Id.* at *13. Each of the dependent claims 2, 6, and 12 were obvious, according to the Board, based on a combination of Ehsani and Vittone with a third reference, which is indicated parenthetically for each of these claims: claim 2 (Caraceni), claim 6 (Fjällström), and claim 12 (Yamaguchi). *Id.* at *8–13. The Board did not separately address claim 3.

Paice appeals from the Board's final written decision invalidating each of these claims as obvious. We have jurisdiction pursuant to 35 U.S.C. § 141(a) and 28 U.S.C. § 1295(a)(4)(A).

DISCUSSION

Paice advances three sets of arguments on appeal. First, Paice contests the Board's conclusions that Vittone discloses: 1) the use of road load as a control parameter and 2) limiting the rate of change of engine output torque to a threshold value and operating the motor to supply the remaining required torque when a rate of change of road load exceeds the threshold value. Paice also faults the Board for not finding a sufficient motivation to combine Vittone with Ehsani. Second, Paice attacks the Board's invalidation of the dependent claims on a variety of grounds, including motivation to combine the references. Finally, Paice claims that the Board did not establish a motivation to combine Vittone with Kawakatsu.

A claim is unpatentable as obvious "if the differences between the subject matter sought to be patented 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." 35 U.S.C. § 103.[1] We review the Board's ultimate obviousness determination de novo and underlying factual findings for substantial evidence. *Harmonic Inc. v. Avid Tech., Inc.*, 815 F.3d 1356, 1363 (Fed. Cir. 2016). Substantial evidence "means such relevant evidence as a reasonable mind might accept as adequate to support a conclusion." *Consol. Edison Co. v. NLRB*, 305 U.S. 197, 229 (1938). Factual findings underlying the obviousness inquiry include the scope and content of the prior art, the differences between the prior art and the claimed invention, whether there is a motivation to combine prior art

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[1] Given the effective filing date of the '388 patent's claims, the version of 35 U.S.C. § 103 that applies here is the one in force preceding the changes made by the America Invents Act. *See* Leahy–Smith America Invents Act, Pub. L. No. 112-29, § 3(n), 125 Stat. 284, 293 (2011).

references, the level of ordinary skill in the art, and relevant secondary considerations. *Merck & Cie v. Gnosis S.P.A.*, 808 F.3d 829, 833 (Fed. Cir. 2015), *cert. denied*, 137 S. Ct. 297 (2016).

I.

A.

First, Paice contends that Vittone's disclosures of a "driveability torque requirement" and the "total traction torque" differ from the teachings of road load in the '388 patent because Vittone relies solely on the accelerator pedal position—how far the driver depresses the gas pedal—whereas road load takes into account both the pedal position and other external conditions on the car, such as wind conditions and rolling friction. Relatedly, Paice contends that the Board erroneously broadened its original construction of road load such that it was met by accelerator pedal position alone.

The Board rejected Paice's argument that Vittone does not disclose road load, and its conclusion is supported by substantial evidence. The Board found that the '388 patent defines road load as "the vehicle's instantaneous torque demands, i.e., that *amount of torque* required to propel the vehicle at a desired speed." *Board Decision*, 2015 WL 7695188, at *2 (quoting '388 patent col. 12 ll. 26–28). According to the Board, Vittone's disclosure of a "driveability torque requirement" and the "total traction torque," as determined by the accelerator pedal position, represents the torque required to propel the vehicle, i.e., road load. *Id.* at *4. The Board credited the testimony of Ford's expert, Dr. Stein, who explained that a person of ordinary skill in the art would have understood that the driveability torque requirement and the total traction torque represent the instantaneous torque required to propel the vehicle. *Id.* (citing J.A. 230–31, ¶ 173). We also detect no impermissible broadening of road load's construction.

In our opinion in the companion appeal, we construed the term road load to mean "the amount of instantaneous torque required to propel the vehicle, be it positive or negative." *Paice LLC v. Ford Motor Co.*, Nos. 2016-1412, -1415, -1745, slip op. at 8 (Fed. Cir. Mar. 7, 2017). In reaching this construction, we observed that the '388 patent does not disclose how to determine road load other than by reference to the accelerator pedal position. For example, the specification states: "the operator's depressing the accelerator pedal signifies an increase in desired speed, i.e., an increase in road load, while reducing the pressure on the accelerator or depressing the brake pedal signifies a desired reduction in vehicle speed." '388 patent col. 12 ll. 31–35. We cannot say, based on the record before us, that the Board's conclusion that Vittone discloses road load lacks substantial evidence support.

B.

Paice also alleges that the Board's conclusion that Vittone discloses limiting the rate of change of the engine's output torque to a threshold value and operating the motor to supply the remaining required torque when a rate of change of road load exceeds the threshold value lacks the support of substantial evidence. In reaching its conclusion, the Board relied on Vittone Figure 8, shown below, and its accompanying statement that "[a] further contribution to the emission reduction is achieved through the 'steady state' management of the thermal engine in transient phases, while the torque demand is assured by the electric motor support (Fig. 8)." J.A. 451, 455; *Board Decision*, 2015 WL 7695188, at *5–6.

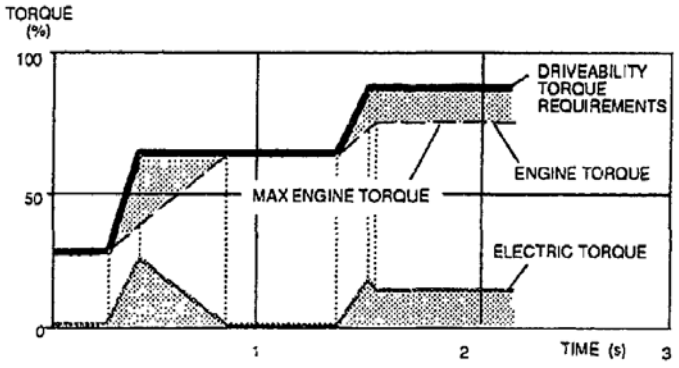

FIGURE 8
DRIVING TORQUE MANAGEMENT

J.A. 455. The Board further credited Dr. Stein's explanation that, during the transient phases in Figure 8 where the driveability torque requirements (solid black line) increased at different rates between 0–1 second and 1–2 seconds, the engine torque output (dashed line) responded by increasing at a relatively constant rate. *Board Decision*, 2015 WL 7695188, at *5–6 (citing J.A. 233–35, ¶¶ 177–78, 181). According to Dr. Stein, the common rate of change in engine output torque in the two transient phases is due to Vittone's "steady state" management, and the common rate of change in the engine output torque represents a threshold value. *Id.* (citing J.A. 233–35, ¶¶ 177–78, 181).

Paice complains that Dr. Stein's analysis of Figure 8 in Vittone is unreliable because, among other reasons, Figure 8 is merely demonstrative and not drawn to scale, and because Vittone does not describe what is meant by "steady state" management. Regardless of whether or not the figure is drawn to scale, we credit Dr. Stein's steady-state theory that Vittone describes this recited feature based on an analysis of the qualitative features of Fig-

ure 8. In particular, substantial evidence remains to support the Board's fact findings that Vittone broadly discloses limiting the rate of change of torque output of the engine and using an electric motor to assure that the additional torque demand is met. Vittone teaches that, in his hybrid mode control system, "[a] further contribution to the emission reduction is achieved through the '*steady state' management* of the thermal engine in *transient phases*, while the torque demand is assured by the electric motor support (Fig. 8)." J.A. 451 (emphases added). The Board found that this sentence in Vittone discloses the disputed claim limitation, *Board Decision*, 2015 WL 7695188, at *5, and Dr. Stein noted that "[a] conventional internal combustion engine typically runs rich during transient conditions in which the engine output torque increases rapidly," J.A. 232, ¶ 175. Dr. Stein further explained that the reference to "steady state management" in Vittone refers to "limiting the rate of engine output torque during [these] transient conditions" in which the output torque increases rapidly. J.A. 232–33, ¶ 175. This constitutes substantial evidence to support the Board's finding.

C.

In addition, Paice alleges that a POSA would not have been motivated to combine Ehsani and Vittone. Paice contends that the control systems of Ehsani and Vittone are incompatible because Ehsani controls its system to operate at constant power,[2] meaning that torque must be able to vary as the speed changes, whereas Vittone controls its system by limiting the engine's output torque. The Board, however, was not persuaded by this argument. Because both Ehsani and Vittone are directed to

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[2] As explained by Dr. Stein during his deposition, "power is equal to torque times speed of the engine." J.A. 2619.

the problem of reducing hybrid vehicle emissions, the Board found that a POSA would have been motivated to improve on Ehsani's vehicle and further reduce emissions by implementing Vittone's steady state management strategy. To support this factual finding, the Board credited the testimony of Dr. Stein, who explained that implementing a control strategy is a simple substitution of the existing control strategy and likely does not require changes to the underlying system architecture. *Board Decision*, 2015 WL 7695188, at *7 (citing J.A. 266–67, ¶¶ 253–54). The same portion of Dr. Stein's expert testimony also states that adding Vittone's control strategy to Ehsani would lead to a further reduction in emissions. J.A. 266–67, ¶ 254. Dr. Stein's testimony provides substantial evidence to support the Board's conclusion that a POSA would have been motivated to combine Vittone with Ehsani.

II.

Paice next alleges error in the Board's invalidation of dependent claims 2, 3, 6, and 12. With the exception of claim 3, we disagree.

Dependent claim 2 recites: "The hybrid vehicle of claim 1, wherein said threshold value is no more than about 2% per revolution." '388 patent col. 57 ll. 6–7. Paice alleges that the Board erred in relying on the Caraceni reference to disclose this limitation because Caraceni only discloses an absolute rate of change of engine torque output, not a percent change per revolution. Paice also faults the analysis of Ford's expert, Dr. Stein, for using the MTO to derive the percent of change per revolution, purportedly because limiting the rate of change of engine torque output at MTO would be unsafe. But the Board correctly considered and rejected both of these arguments. *Board Decision*, 2015 WL 7695188, at *8–9. Dr. Stein's expert report converted the "torque gradient" values from Caraceni into a "% per revolution" value using engine

speed and torque values. After conversion, as the Board notes, Dr. Stein determined that forty of the forty-two torque gradient values found in Caraceni Figure 14 satisfied claim 2's "no more than about 2% per revolution" requirement. *Id.* at *9. The Board expressly credited these calculations by Dr. Stein. *Id.* (citing J.A. 267–77, ¶¶ 255–73). Given this record, we conclude that substantial evidence supports the Board's conclusion.

Dependent claim 3 recites: "The hybrid vehicle of claim 1, wherein said controller is operable to vary said threshold value with respect to a state of charge of said electrical storage device." '388 patent col. 57 ll. 8–10. Even though Paice separately argued claim 3 in its Patent Owner's Response, J.A. 2297–98, the Board did not separately analyze claim 3's limitation. Instead, the Board invalidated it in conjunction with claims 1 and 19 without addressing claim 3's limitation. In order to "allow effective judicial review, . . . the agency is obligated to 'provide an administrative record showing the evidence on which the findings are based, accompanied by the agency's reasoning in reaching its conclusions.'" *Synopsys, Inc. v. Mentor Graphics Corp.*, 814 F.3d 1309, 1322 (Fed. Cir. 2016) (quoting *In re Lee*, 277 F.3d 1338, 1342 (Fed. Cir. 2002)). The Board did not do that here. Therefore, the Board's invalidation of this claim is not supported by substantial evidence, and we vacate and remand this case to the Board for consideration of Paice's arguments for this claim in the first instance.

Dependent claim 6 recites a three-motor hybrid vehicle that provides all-wheel drive. While Paice does not dispute that Fjällström discloses the three-motor all-wheel drive limitation in claim 6, Paice argues that a POSA would not have been motivated to modify Ehsani in view of Fjällström to provide a third AC electric motor to provide power to a second pair of wheels as required by claim 6 because: Ehsani already discloses an all-wheel drive hybrid electric vehicle; Ehsani uses AC electric

motors whereas Fjällström uses DC electric motors; and the two references teach different transmission architectures. The Board rejected each of these arguments in its opinion, in some instances explicitly crediting Dr. Stein's testimony to the contrary. *Board Decision*, 2015 WL 7695188, at *10–11. As the Board explained, Ehsani discloses multiple different vehicle architectures—including one with two motors, where each motor is coupled to a different set of wheels—and explains that various substitutions and alterations can be made to this architecture. Continuing, the Board reasoned that Fjällström suggests one such substitution—having three electric motors—that a POSA would have looked to when considering alternative architectures for an all-wheel drive hybrid vehicle. *Id.* at *10. Paice disagrees with the Board's conclusions but fails to show that the Board's reasoning is unsupported by substantial evidence, including the references themselves and expert testimony. Based on our standard of review, we cannot say the Board lacked substantial evidence for its conclusion.

Dependent claim 12 requires: "The hybrid vehicle of claim 1, wherein said engine is preheated prior to starting." '388 patent col. 57 ll. 51–52. Paice contends that a POSA would not have been motivated to combine Yamaguchi with Vittone because Yamaguchi discloses rotating the engine at high speeds to heat the engine, whereas Vittone teaches using a heated catalyst to warm up the main catalyst while the engine works at a minimum RPM. The Board again relied on Dr. Stein's testimony to reject this argument. He explained that Vittone's reference to the use of catalysts does not relate to preheating prior to starting the engine—instead, Vittone's engine is already on and working at a minimum RPM. *Board Decision*, 2015 WL 7695188, at *13 (citing J.A. 2784–85, ¶¶ 103–06). The Board found that none of the evidence proffered by Paice sufficiently proved that Vittone discourages or discredits Yamaguchi's method for preheating

at a high RPM. Given this record, we find substantial evidence supports the Board's conclusion that a POSA would have been motivated to combine Vittone with Yamaguchi.

III.

Finally, Paice contends that the Board erred in rejecting claims 1, 3, 4, and 19 as obvious over the combination of Kawakatsu and Vittone.[3] Because both the Ehsani/Vittone and Kawakatsu/Vittone obviousness combinations rely on Vittone to disclose the disputed claim limitations, the only difference between these combinations is the motivation to combine the references. Therefore, the only separate argument Paice raises for this combination is whether the Board incorrectly found that a POSA would have been motivated to modify Kawakatsu's control strategy with Vittone's.

The Board determined that a POSA would have combined the two control strategies because both references are directed to hybrid vehicles and to reducing emissions. The Board further credited Dr. Stein's testimony that adding Vittone's control strategy to Kawakatsu would be a "simple substitution" and that a POSA would have been motivated to improve on Kawakatsu's emissions reduction control strategy by implementing Vittone's steady state

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[3] As with the combination of Ehsani and Vittone, the Board failed to address dependent claim 3. With respect to claim 4, Paice argued in the Patent Owner Response that it was not obvious over the combination of Kawakatsu and Vittone for the same reasons Paice articulated for independent claim 1. J.A. 2313. Paice did not separately argue the validity of claim 4 on appeal either. Because we do not find Paice's arguments for independent claim 1 persuasive, we also do not find them persuasive for dependent claim 4.

control strategy. *Board Decision*, 2015 WL 7695188, at *14 (citing J.A. 347–48, ¶¶ 434–35). Those same paragraphs of Dr. Stein's declaration indicate that Vittone's "steady state" management during transient phases would be consistent with Kawakatsu's stated desire for improved efficiency and would not require a modification of Kawakatsu's system architecture. J.A. 347–48, ¶¶ 434–35. In light of this evidence, we conclude that substantial evidence supports the Board's conclusion that a POSA would have been motivated to combine Vittone's control strategy with Kawakatsu.

CONCLUSION

We have considered Paice's remaining arguments and find them unpersuasive. For the reasons stated above, substantial evidence supports the Board's conclusion that the asserted prior art references rendered claims 1, 2, 4, 6, 12, and 19 obvious. Accordingly, we affirm that portion of the Board's decision. The Board lacked substantial evidence to support its invalidation of claim 3, however, and we vacate and remand to the Board to consider Paice's arguments with respect to claim 3 in the first instance.

AFFIRMED-IN-PART, VACATED-IN-PART, AND REMANDED

COSTS

Each party shall bear its own costs.