NOTE: This disposition is nonprecedential.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

2016-1411

Appeal from the United States Patent and Trademark Office, Patent Trial and Appeal Board in No. IPR2014-00570.

PAICE LLC, THE ABELL FOUNDATION, INC.,
Appellants

v.

FORD MOTOR COMPANY,
Appellee

2016-2033

Appeal from the United States Patent and Trademark Office, Patent Trial and Appeal Board in No. IPR2014-01415.

Decided: April 21, 2017

RUFFIN B. CORDELL, Fish & Richardson, PC, Washington, DC, argued for appellants. Also represented by TIMOTHY W. RIFFE, 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 DYK, MAYER, and TARANTO, *Circuit Judges.*

TARANTO, *Circuit Judge*.

Paice and The Abell Foundation (collectively, Paice) own U.S. Patent No. 8,214,097 issued to Severinsky, which describes and claims a control strategy for hybrid vehicles. Ford Motor Company sought the two inter partes reviews of the '097 patent now before us. In one, the Patent Trial and Appeal Board determined that claims 1–6, 8–16, 18–26, 28–30, and 34 are unpatentable for obviousness. *Ford Motor Co. v. Paice LLC*, No. IPR2014-01415, 2016 WL 932941 (P.T.A.B. Mar. 10, 2016) (*1415 Decision*). In the other, the Board determined that claims 30–33, 35, 36, and 39 are unpatentable for obviousness. *Ford Motor Co. v. Paice LLC*, No. IPR2014-00570, 2015 WL 5782083 (P.T.A.B. Sept. 28, 2015) (*570 Decision*). Paice appeals, arguing that the Board misconstrued several claim terms and made insufficiently supported factual findings in arriving at the ultimate obviousness determinations. We have jurisdiction under 28 U.S.C. § 1295(a)(4)(A). We reject Paice's arguments and affirm.

I

For present purposes, a hybrid vehicle is a vehicle containing an electric motor (and associated battery) and an internal combustion engine (and associated gasoline or comparable fuel source). The '097 patent discloses certain processes for controlling the vehicle, focused on increasing fuel efficiency and decreasing emissions. Two features of the processes are key here: the vehicle's use of the motor, the engine, or both for propulsion is determined based on the vehicle's instantaneous torque requirements; and the rate of increase of the engine's torque output is controlled. '097 patent, col. 15, lines 38–41; *id.*, col. 19, lines 41–45; *id.*, col. 38, line 62, through col. 39, line 14. Except as otherwise noted below, claim 1 is illustrative of the challenged claims. It states:

> 1. A method for controlling a hybrid vehicle, said vehicle comprising a battery, a controller, wheels, an internal combustion engine and at least one electric motor, wherein both the internal combustion engine and motor are capable of providing torque to the wheels of said vehicle, and wherein said engine has an inherent maximum rate of increase of output torque, said method comprising the steps of:
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> > [a] operating the internal combustion engine of the hybrid vehicle to provide torque to operate the vehicle;
> >
> > [b] operating said at least one electric motor to provide additional torque when the amount of torque provided by said engine

> is less than the amount of torque required to operate the vehicle; and
>
> [c] employing said controller to control the engine such that a rate of increase of output torque of the engine is limited to less than said inherent maximum rate of increase of output torque, and wherein said step of controlling the engine such that the rate of increase of output torque of the engine is limited is performed such that combustion of fuel within the engine occurs at a substantially stoichiometric ratio; and comprising the further steps of:
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> [d] operating said internal combustion engine to provide torque to the hybrid vehicle when the torque required to operate the hybrid vehicle is between a setpoint SP and a maximum torque output (MTO) of the engine, wherein the engine is operable to efficiently produce torque above SP, and wherein SP is substantially less than MTO;
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> [e] operating both the at least one electric motor and the engine to provide torque to the hybrid vehicle when the torque required to operate the hybrid vehicle is more than MTO; and
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> [f] operating the at least one electric motor to provide torque to the hybrid vehicle when the torque required to operate the hybrid vehicle is less than SP.

’097 patent, col. 56, line 47, through col. 57, line 15 (bracketed letters added).

II

In construing the claims at issue, the Board permissibly applied the broadest-reasonable-interpretation standard, and because there are no underlying factual issues here, we review the Board's constructions de novo, considering the usual intrinsic sources of claim meaning, *e.g.*, the claims, the specification, and the prosecution history. *See D'Agostino v. MasterCard Int'l Inc.*, 844 F.3d 945, 948 (Fed. Cir. 2016).

Paice argues that the Board erred in construing "setpoint" (in elements [d]–[f]) to mean a "predetermined torque value that may or may not be reset." *1415 Decision* at *4. We recently affirmed the same construction of "setpoint" by the Board in a related IPR proceeding involving another Paice patent in the same family as the '097 patent. *Paice LLC v. Ford Motor Co.*, Nos. 16-1412, -1415, -1745, 2017 WL 900062, at *3 (Fed. Cir. Mar. 7, 2017). Given the relationship of the patents, we affirm the Board's construction here as well.

Paice also argues that the Board incorrectly read the first group of claim elements, particularly [b] and [c], as "unrelated requirements" rather than requiring "a coordinated control strategy whereby the controller limits the rate of increase of the gas engine's output torque allowing the gas engine to burn fuel at a substantially stoichiometric ratio, while at the same time, the controller controls the electric motor to provide the shortfall in torque required for propelling the vehicle." Appellant's Br. 32. According to Paice, the Board implicitly rejected its construction when it found that a key prior-art reference—an earlier patent issued to Severinsky, U.S. Patent No. 5,343,970—discloses the [b] element, concerning the motor's providing additional torque, in its disclosure of activating the electric motor "when torque in excess of the capabilities of engine 40 is required." *1415 Decision* at *7 (quoting Severinsky, col. 14, lines 17–18).

But neither the language of claim 1 nor the language of the other claims at issue requires the simultaneous control urged by Paice so as to make the Board's reading incorrect under the broadest-reasonable-interpretation standard. Claim 1 requires the step of "operating said at least one electric motor to provide additional torque when the amount of torque provided by said engine is less than the amount of torque required to operate the vehicle" and the separate step of "employing said controller to control the engine such that a rate of increase of output torque of the engine is limited." '097 patent, col. 56, lines 56–61. That claim language does not require the Board to conclude that the two steps, one involving the electric motor and one involving the gas engine, must occur at the same time. The other independent claims at issue, claims 11, 21, and 30, do not add anything to change that conclusion. Nor do the specification or prosecution-history passages cited by Paice.[1]

III

"We review the Board's ultimate determination of obviousness de novo and its underlying factual determinations for substantial evidence." *Personal Web Techs., LLC v. Apple, Inc.*, 848 F.3d 987, 991 (Fed. Cir. 2017). The factual determinations "include findings as to the scope and content of the prior art, the differences between the prior art and the claimed invention, the level of ordinary skill in the art, the presence or absence of a motivation to combine or modify with a reasonable expectation of success, and objective indicia of non-obviousness." *Ariosa Diagnostics v. Verinata Health, Inc.*, 805 F.3d 1359, 1364 (Fed. Cir. 2015). Paice's challenges on appeal ultimately focus on various factual findings.

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[1] Given our conclusion, we need not address Ford's argument that Paice failed to preserve its present simultaneity argument.

A

The Board determined that claims 1, 2, 5, 6, 8–12, 15, 16, 18–22, 25, 26, 28, and 29 would have been obvious over a combination of the Severinsky and Anderson references.[2] We reject Paice's challenges.

In challenging that determination, Paice first focuses on claim elements exemplified by claim 1's requirement of "operating said internal combustion engine to provide torque to the hybrid vehicle when the torque required to operate the hybrid vehicle is between a setpoint SP and a maximum torque output (MTO) of the engine." '097 patent, col. 57, lines 1–4. Paice argues that substantial evidence does not support the Board's finding that Severinsky discloses that element in disclosing the comparison of the torque required to operate the hybrid vehicle to a setpoint in order to determine when to operate the engine versus the electric motor.

This court's March 2017 opinion affirmed a Board determination that Severinsky discloses a claim element, in another Paice patent, that is not materially different from the setpoint claim element at issue here. *Paice*, 2017 WL 900062, at *6–7. Paice argues for a different result here on the ground that the March opinion relied upon evidence, from the Paice patent there at issue, not considered by the Board in the current case. *See* Letter from Appellants to Clarify Issues in Pending Appeals, ECF No. 56. In the March opinion, this court concluded that the Board had incorrectly "reinterpret[ed] . . . 'road load' as including output torque" rather than input torque (*i.e.*, the torque required to propel the vehicle), but the court

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[2] "Anderson" is shorthand for Catherine Anderson & Erin Pettit, The Effects of APU Characteristics on the Design of Hybrid Control Strategies for Hybrid Electric Vehicles, SAE Technical Paper 950493 (1995).

nonetheless affirmed the Board's finding. *Paice*, 2017 WL 900062, at *7. Passages in the Paice patent there at issue, the court concluded, themselves indicated that the prior-art Severinsky taught making the operating-mode decision based on the torque required to propel the vehicle (input torque). *Id.* The same result is required in this case, because the Board's decision here is supported by substantial evidence independent of any passages from the patent at issue in the March opinion.

As the Board noted, Severinsky discloses operating the engine "*only under the most efficient conditions of output power and speed*. When the engine can be used efficiently to drive the vehicle forward, e.g. in highway cruising, it is so employed." Severinsky, col. 7, lines 8–13 (emphasis added). Severinsky adds that, in determining whether the engine is operating under its most efficient conditions, the controller considers the vehicle's propulsion requirements: "at all times the microprocessor 48 may determine the load (if any) to be provided to the engine by the motor, *responsive to the load imposed by the vehicle's propulsion requirements, so that the engine 40 can be operated in its most fuel efficient operating range*." *Id.*, col. 17, lines 11–15 (emphasis added). Severinsky further states that the microprocessor runs the engine "only in the near vicinity of its most efficient operational point, that is, such that it produces 60–90% of its maximum torque whenever operated." *Id.*, col. 20, lines 63–67. The Board found the lower limit of this range—60% of the maximum torque output—to be a setpoint that is a parameter for determining the operating mode. On this record, the Board had substantial evidence to find that Severinsky discloses comparing the amount of torque required to propel the vehicle to a predetermined torque value in deciding whether to operate the engine.

Paice also challenges the Board's reliance on a combination of Severinsky and Anderson to meet the claim requirement that the engine's rate of increase of output torque is limited to maintain substantially stoichiometric combustion.[3] Paice argues that a person of ordinary skill in the art would not have had a motivation to combine the references and that the combination would not have worked. The Board did and properly could find otherwise.

Regarding a motivation to combine, the Board found that "a skilled artisan would have been led to combine the basic hybrid control strategy of Severinsky with the known technique of slowing the engine transient [to maintain substantially stoichiometric combustion[4]], as taught by Anderson, because both references share the same fundamental goals of reducing carbon emissions by maintaining a stoichiometric air-to-fuel ratio." *1415 Decision* at *13. Severinsky refers clearly to the aim of reducing carbon emissions, Severinsky, col. 12, lines 13–33, specifically by limiting the supply of air to the engine to only "slightly in excess of the amount required for stoichiometric combustion," *id.*, col. 12, lines 16–17. Experts from both parties testified that, as a result of regulatory standards related to emissions, a person of skill in the art would have been focused on a stoichiometric strategy. The Board thus had substantial evidence

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[3] Evidence that the Board could credit states that stoichiometric combustion occurs "when there is just enough oxygen [in the engine] for conversion of all of the fuel," with no excess fuel or air. J.A. 188 ¶ 69. (Except where otherwise noted, citations to the Joint Appendix refer to the appendix filed in Appeal No. 2016-2033.)

[4] Evidence that the Board could credit indicates that "a transient response refers to the response of a system to a change in its equilibrium as a result of specific, transient input," J.A. 194 ¶ 81, and that, in this context, "transient" refers to a change in the torque, power, or speed output of an engine following changes in driver demand, *id.* ¶ 82.

for its finding that a person of skill in the art seeking to reduce emissions would have been motivated to combine the teachings of Severinsky with those of Anderson. *See KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 420 (2007) ("[A]ny need or problem known in the field of endeavor at the time of invention and addressed by the patent can provide a reason for combining the elements in the manner claimed.").

The Board also had sufficient evidence to reject Paice's contention that the Severinsky-Anderson combination would not have worked. *See 1415 Decision* at *13–15. According to Paice, Anderson teaches that slow transients are possible only with series hybrids, not with parallel hybrids, which is the type of hybrid disclosed in the '097 patent. The Board could find otherwise.

According to the evidence, in a series hybrid, the engine-motor-wheels arrangement means that only the motor, not the engine, is mechanically coupled to the wheels and so only the motor, not the engine, directly propels the vehicle; the engine supplies power for the electric motor. In a parallel hybrid, both the engine and motor are mechanically coupled to the wheels, so each by itself can directly propel the vehicle. The key passage of Anderson relied on by Paice is one describing a control strategy, "the mode a parallel hybrid vehicle always uses," in which the engine must "follow the actual wheel power whenever possible (similar to a conventional automobile)" and, accordingly, must "perform fast power transients." Anderson at 67.

The Board was not required to give that passage the reading Paice gives it. Anderson describes that control strategy as an example of an "extreme" strategy on the "spectrum of control strategies," and as not "the optimum strategy." *Id.* Earlier, Anderson says that its teachings related to the optimum strategy are not limited to series hybrids: after explaining the differences between series and parallel hybrids, Anderson states that "[t]he thought processes presented in this paper are sufficiently general that they can be applied to any type of vehicle." *Id.* at 66. And later, after explaining that fast transients cause increased emissions, Anderson states that "[s]ome of this effect can be reduced using a hybrid strategy that only allows slow transients." *Id.* at 69. That passage, which is not in terms limited to series hybrids (when the very next sentence, beginning a new paragraph, is so limited), can be read as being of general application to hybrids. On this evidence, we cannot say that substantial evidence is lacking for the Board's reading of Anderson as disclosing the avoidance of fast transients in parallel hybrids.

Paice further argues that even if the teachings of Severinsky and Anderson were properly combined, the references do not disclose limiting the rate of increase of the engine's output torque to less than the inherent maximum rate of increase of output torque to maintain substantially stoichiometric combustion. But the Board found that Severinsky teaches limiting the rate of increase of the engine's output torque by controlling the rate of fuel supply to the engine and, together with Anderson's slow-transients teaching, would have suggested limiting the output torque increase to less than the engine's maximum rate of increase. *1415 Decision* at *7–9. The evidence cited by the Board supports that finding.

B

In the 2014-1415 IPR, Ford separately challenged claims 3, 13, and 33 as unpatentable for obviousness over Severinsky, Anderson, and U.S. Patent No. 5,865,263 to

Yamaguchi. The Board agreed with Ford. We affirm that determination.[5]

These dependent claims contain the additional requirement that "the engine is heated prior to supply of fuel for starting the engine." *E.g.*, '097 patent, col. 57, lines 22–23. The Board found that Yamaguchi "discloses rotating an engine to 600 rpm before starting it, and then starting the engine once it reaches a predetermined temperature." *1415 Decision* at *15. Paice does not dispute that finding. Rather, Paice argues that a person of ordinary skill in the art would not have been motivated to combine Severinsky, Anderson, and Yamaguchi because Severinsky expressly teaches operating the engine at lower temperatures to decrease nitrogen oxide emissions.

Severinsky states that "the engine 40 will be operated in lean burn mode" and that "the engine will be operated at a lower temperature" to reduce nitrogen oxide emissions that result from operating in that mode. Severinsky, col. 12, lines 14–20. But the Board found that this disclosure referred to maintaining a low *operating* temperature, not a low *starting* temperature. *1415 Decision* at *15. Substantial evidence supports that finding. The language in Severinsky speaks of the temperature at which "the engine will be operated." And operating at a "lower temperature" does not necessarily discourage preheating the engine: Ford's expert testified that a lower temperature is not needed to reduce nitrogen oxide emissions when starting the engine because even when the engine is warmed before being started, it is likely significantly cooler than it is during normal engine operation. J.A. 4031–32 ¶ 82. Therefore, the Board's finding of

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[5] We also affirm the Board's materially indistinguishable determination of obviousness of claims 32 and 33 in the 2014-570 IPR.

a motivation to combine was supported by substantial evidence.

C

Dependent claims 4, 14, and 24, which depend on claims 3, 13, and 23, respectively, add the requirement of "a fuel:air ratio of no more than 1.2 of the stoichiometric ratio for starting the engine." *E.g.*, '097 patent, col. 57, lines 25–26. The Board determined that the Takaoka prior-art reference[6] discloses this additional limitation and on that basis found unpatentability. *1415 Decision* at *16–17. We affirm that determination.

Substantial evidence supports the Board's finding about Takaoka and the claim element at issue. Takaoka proposes an engine that "would operate with $\lambda = 1$ over its entire range." Takaoka at 54. Ford's expert provided undisputed testimony that "[a] person of ordinary skill in the art knows that a lambda value of 1 ($\lambda = 1$) corresponds [to] a[n] air:fuel ratio of 1.0 of the stoichiometric ratio." J.A. 434 ¶ 603. As Ford's expert explained, "[a] stoichiometric ratio refers to the ideal quantity . . . of one reactant to completely react with the other reactant in a chemical reaction such that there are no leftover reactants after the reaction takes place." J.A. 187 ¶ 67. And "[t]he fuel[:]air . . . ratio is the inverse of the [air:fuel] ratio." J.A. 188 ¶ 69. Accordingly, Takaoka's air:fuel ratio of 1.0 is a fuel:air ratio of 1.0 of the stoichiometric ratio, and given that the Board could credit the expert declaration that "the entire range" covered the starting of the engine, *see* J.A. 4033 ¶ 84, the Board properly found the claim limitation met.

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[6] "Takaoka" is shorthand for Toshifumi Takaoka et al., A High-Expansion-Ratio Gasoline Engine for the TOYOTA Hybrid System, 47 Technical Rev. 53 (1998).

D

The Board determined that claims 30 and 34 are unpatentable for obviousness over Severinsky and Takaoka. *1415 Decision* at *17–18. Paice challenges the determination by disputing the motivation to combine Severinsky and Takaoka and also the Board's reading of Takaoka as disclosing limiting the rate of change of torque produced by the engine so that fuel combustion occurs at a substantially stoichiometric ratio. We reject the challenge.[7]

Paice contends that the Board's rationale for combining Severinsky and Takaoka was insufficiently supported. The Board found that a person of ordinary skill in the art would have been motivated to combine these references because they are both "concerned with improving fuel economy and reducing emissions in hybrid vehicles." *1415 Decision* at *18. In reaching this finding, the Board adopted as its own Ford's reasoning regarding a motivation to combine, *id.*, which included argument and evidence that "'[m]aximum fuel efficiency' requires complete combustion of the fuel, which can only be achieved if the engine is operating at a substantially stoichiometric ratio." J.A. 152 (citing J.A. 470 (expert testimony)). As discussed in the previous section, Takaoka was concerned with a potential solution for achieving substantially stoichiometric combustion. And Ford's expert testified that implementing Takaoka's control strategy would require nothing more than altering an algorithm. In sum: both references involved the problems of reducing emissions in hybrid vehicles and maximizing fuel efficiency, Takaoka disclosed a potential solution, and there is

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[7] Paice also argues that the combined references do not teach the controller limitations under its proposed construction related to certain steps being performed simultaneously. Because Paice's proposed construction is incorrect, we need not consider that argument.

evidence suggesting that Takaoka's solution was relatively simple to implement. That is enough.

Paice also contends that Takaoka fails to disclose a controller that limits the rate of change of torque produced so that fuel combustion occurs at a substantially stoichiometric ratio, arguing that Takaoka discloses an engine design, not a hybrid-control strategy. The Board disagreed, finding that "Takaoka discloses expressly a control scheme for lowering the emission levels of the engine." *1415 Decision* at *17. That finding is supported by substantial evidence. Although Takaoka does disclose a "newly developed gasoline engine," Takaoka at 53, that disclosure hardly precludes a finding that Takaoka also discloses achieving the stated goals through use of a control strategy. And Takaoka in fact repeatedly discusses controlling the engine. *See, e.g.*, *id.* at 57 ("[T]he engine is controlled so that the intake valve closing is advanced when the load requirements are high."); *id.* at 58 ("By allocating a portion of the load to the electric motor, the system is able to reduce engine load fluctuation under conditions such as rapid acceleration."); *id.* at 60 ("Emissions levels much lower than the current standard values were attained by optimum control of the motor and engine."). It was reasonable for the Board to find that Takaoka discloses a control strategy for limiting engine torque, particularly where it credited Ford's expert testimony that "a mechanical component alone (e.g., an engine) is not capable of such control." *1415 Decision* at *17 (quoting J.A. 4042).

E

In the 2014-570 IPR, the Board determined that dependent claim 33 would have been obvious. Claim 33 requires that the "fuel and air are supplied to said engine at a fuel:air ratio of no more than 1.2 of the stoichiometric ratio for starting the engine." '097 patent, col. 60, lines 36–38. Paice challenges the obviousness ruling on the ground that U.S. Patent No. 4,707,984 to Katsuno, which the Board relied on to disclose this additional limitation, teaches an air:fuel *correction amount*, not an actual air:fuel ratio for starting the engine. We reject the challenge.

According to Paice's expert, "Katsuno describes an air[:]fuel ratio correction routine that adjusts the air[:]fuel ratio via an air[:]fuel ratio correction amount . . . based on information received from . . . air ratio sensors." Appeal No. 2016-1411, J.A. 3771 ¶ 125. An air:fuel correction amount is allegedly different from an actual air:fuel ratio—the air:fuel ratio correction amount is a "correction factor by which the air[:]fuel ratio is adjusted towards a stoichiometric ratio." *Id.* The Board did not dispute that Katsuno discloses an air:fuel correction ratio. Instead, in finding that Katsuno discloses an air-fuel ratio of no more than 1.2 of the stoichiometric ratio, the Board relied on expert testimony that the 1.2 air:fuel correction ratio disclosed in Katsuno "correlates to a 1.2 fuel:air ratio." *570 Decision* at *10 (quoting J.A. 3852–53).

The Board-cited testimony is supported by Katsuno itself. Katsuno refers to the air:fuel correction ratio as FAF1, *see* Katsuno, col. 5, lines 36–37, and states that "FAF1 is guarded by a minimum value 0.8 . . . and by a maximum value 1.2 . . . , thereby also preventing the controlled air[:]fuel ratio from becoming overrich or overlean," *id.*, col. 7, lines 1–5. This suggests that a FAF1 value of 1.0 would not be "overrich" or "overlean." And the reference teaches that whether or not the air:fuel ratio is too rich or too lean is in relation to the stoichiometric air:fuel ratio, *see id.*, col. 6, lines 9–12, so it is reasonable to infer that a FAF1 value of 1.0 would correlate with a mixture of air and fuel that results in stoichiometric combustion—an air:fuel ratio of 1.0 of the stoichiometric ratio. As previously discussed with respect to claims 4, 14, and 24, that air:fuel ratio comes within claim language calling for a fuel:air ratio of no more than 1.2 of the stoichiometric ratio.

Paice argues that, nevertheless, Katsuno does not disclose a fuel:air ratio of no more than 1.2 of the stoichiometric ratio when *starting* the engine. According to Paice, FAF1 is set at 1.0 during engine starting. *See* Katsuno, col. 5, lines 40–44, 61–63. But Paice provides no basis for overturning the Board's finding that a FAF1 value of 1.0 correlates with a fuel:air ratio of 1.0 of the stoichiometric ratio. We conclude that Paice has failed to show that the Board lacked substantial evidence for its obviousness determination as to claim 33.

IV

For the foregoing reasons, we affirm the Board's final written decisions.

AFFIRMED