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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

FORD MOTOR COMPANY,
Petitioner,

v.

PAICE LLC & THE ABELL FOUNDATION, INC.,
Patent Owner.

Case IPR2014-01416
Patent 7,237,634 B2

Before SALLY C. MEDLEY, KALYAN K. DESHPANDE, and CARL M. DEFRANCO, *Administrative Patent Judges.*

DEFRANCO, *Administrative Patent Judge.*

FINAL WRITTEN DECISION
35 U.S.C. § 318(a) and 37 C.F.R. § 42.73

I. INTRODUCTION

Paice LLC and The Abell Foundation, Inc. (collectively, "Paice") are the owners of U.S. Patent No. 7,237,634 B2 ("the '634 patent"). Ford Motor Company ("Ford") filed a Petition ("Pet.") for *inter partes* review of the '634 patent, challenging the patentability of claims 80, 93, 98, 99, 102, 109, 114, 127, 131, 132, 135, 139, 142, 161, 215, 228, 232, 233, and 235–237 under 35 U.S.C. § 103. In a preliminary proceeding, we instituted trial because Ford demonstrated a reasonable likelihood that it would prevail in proving unpatentability of the challenged claims. Once trial was instituted, Paice filed a Patent Owner Response ("PO Resp."), and Ford followed with a Reply ("Reply"). The parties waived oral argument, choosing instead to rely on arguments presented during a prior, consolidated hearing conducted in several related proceedings, namely, IPR2014-000570, -00571, -00579, -00875, -00884, and -00904.[1] Pursuant to our jurisdiction under 35 U.S.C. § 6(c), we conclude that Ford has proven, by a preponderance of the evidence, that the challenged claims are unpatentable.

II. BACKGROUND

A. Related Cases

The '634 patent was previously the subject of a final written decision in IPR2014-00904. That prior proceeding, however, involved different claims and grounds than the instant proceeding. Specifically, the -00904 proceeding resulted in a final determination that claims 1, 14, 16, 18, and 24 of the '634 patent are unpatentable under 35 U.S.C. § 103. 2015 WL 8536745 (PTAB Dec. 10, 2015). We granted institution of trial in the

[1] Transcripts have been entered into the record in those earlier proceedings.

instant proceeding in March 2015, well before our final written decision in the -00904 proceeding.

The ’634 patent is also the subject of co-pending district court actions, including *Paice, LLC v. Ford Motor Co.*, No. 1:14-cv-00492 (D. Md.), filed Feb. 19, 2014, and *Paice LLC v. Hyundai Motor Co.*, No. 1:12-cv-00499 (D. Md.), filed Feb. 16, 2012. Pet. 1–2; PO Resp. 3 (referencing the district courts’ claim constructions).

B. The ’634 Patent

The ’634 patent describes a hybrid vehicle with an internal combustion engine, an electric motor, and a battery bank, all controlled by a microprocessor that controls the direction of torque transfer between the engine, motor, and drive wheels of the vehicle. Ex. 1101, 17:17–56, Fig. 4. The microprocessor monitors the vehicle’s instantaneous torque requirements, also known as “road load (RL),” to determine whether the engine, the electric motor, or both, will be used as a source to propel to propel the vehicle. *Id*. at 11:63–65. Aptly, the ’634 patent describes the vehicle’s various modes of operation in terms of an engine-only mode, an all-electric mode, or a hybrid mode. *Id*. at 35:63–36:55, 37:24–38:8.

As summarized in the ’634 patent, the microprocessor selects the appropriate mode of operation “in response to evaluation of the road load, that is, the vehicle’s instantaneous torque demands and input commands provided by the operator of the vehicle.”[2] *Id*. at 17:40–45. “[T]he microprocessor can effectively determine the road load by monitoring the

[2] The ’634 patent contrasts the claimed invention to prior control strategies “based solely on speed,” which are “incapable of responding to the operator’s commands, and will ultimately be unsatisfactory.” Ex. 1101, 13:39–42.

response of the vehicle to the operator's command for more power." *Id*. at 37:42–49. "[T]he torque required to propel the vehicle [i.e., road load] varies as indicated by the operator's commands." *Id*. at 38:9–11. For example, the microprocessor "monitors the rate at which the operator depresses pedals [for acceleration and braking] as well as the degree to which [the pedals] are depressed." *Id*. at 27:26–38. These operator input commands are provided to the microprocessor "as an indication that an amount of torque" from the engine "will shortly be required." *Id*. at 27:41–57.

The microprocessor then compares the vehicle's torque requirements against a predefined "setpoint (SP)" and uses the results of the comparison to determine the vehicle's mode of operation. *Id*. at 40:16–49. The microprocessor utilizes a hybrid control strategy that runs the engine only in a range of high fuel efficiency, such as when the torque required to drive the vehicle, or road load (RL), reaches a setpoint (SP) of approximately 30% of the engine's maximum torque output (MTO). *Id*. at 20:61–67, 37:24–44; *see also id*. at 13:64–65 ("the engine is never operated at less than 30% of MTO, and is thus never operated inefficiently"). Other operating parameters may also play a role in the microprocessor's choice of the vehicle's mode of operation, such as the battery's state of charge and the operator's driving history over time. *Id*. at 19:63–20:3; *see also id*. at 37:20–23 ("according to one aspect of the invention, the microprocessor 48 controls the vehicle's mode of operation at any given time in dependence on 'recent history,' as well as on the instantaneous road load and battery charge state"). According to the '634 patent, a microprocessor control strategy that operates the engine in a range above the setpoint (SP), but substantially less than the maximum

torque output (MTO), maximizes fuel efficiency and reduces pollutant emissions of the hybrid vehicle. *Id*. at 15:55–58.

B. The Challenged Claims

Of the challenged claims, claims 80, 114, 161, and 215 are independent. Claim 161 is illustrative:

> 161. A method for controlling a hybrid vehicle, comprising:
>
> determining instantaneous road load (RL) required to propel the hybrid vehicle responsive to an operator command;
>
> wherein the hybrid vehicle is operated in *a plurality of operating modes corresponding to values for the RL and a setpoint (SP)*;
>
> *operating at least one first electric motor* to propel the hybrid vehicle when the RL required to do so is less than the SP;
>
> wherein said operating the at least one first electric motor to drive the hybrid vehicle composes *a low-load operation mode I*;
>
> *operating an internal combustion engine of the hybrid vehicle to propel the hybrid vehicle when the RL required to do so is between the SP and a maximum torque output (MTO) of the engine, wherein the engine is operable to efficiently produce torque above the SP, and wherein the SP is substantially less than the MTO*;
>
> wherein said operating the internal combustion engine of the hybrid vehicle to propel the hybrid vehicle composes *a high-way cruising operation mode IV*;
>
> *operating both the at least one first electric motor and the engine* to propel the hybrid vehicle when the torque RL required to do so is more than the MTO;
>
> wherein said operating both the at least one first electric motor and the engine to propel the hybrid vehicle composes *an acceleration operation mode V*;

> receiving operator input specifying a change in required torque to be applied to wheels of the hybrid vehicle; and
>
> if the received operator input specifies a rapid increase in the required torque, changing operation from operating mode I directly to operating mode V.

Ex. 1101, 73:41–74:9 (emphases added).

C. The Instituted Grounds

In the preliminary proceeding, we instituted trial because Ford made a threshold showing of a "reasonable likelihood" that:

> (1) claims 161, 215, 228, 232, 233, 237 are either anticipated by, or would have been obvious over, Severinsky[3];
>
> (2) claims 80, 93, 98, 99, 102, 109, 114, 127, 131, 132, 135, 139, 142 would have been obvious over Severinsky and Frank[4]; and
>
> (3) claims 215, 228, 233, 235, 236 would have been obvious over Tabata.[5]

Dec. to Inst. 10–11. We now decide whether Ford has proven the unpatentability of these same claims by a "preponderance of the evidence." 35 U.S.C. § 316(e).

III. ANALYSIS

A. Claim Construction

In an *inter partes* review, claim terms in an unexpired patent are given their broadest reasonable construction in light of the specification of the patent in which they appear. 37 C.F.R. § 42.100(b). Here, Ford proposes a construction for several claim terms, including "road load," "setpoint," "low-load mode I," "highway cruising mode IV," and "acceleration mode

[3] U.S. Patent No. 5,343,970, iss. Sept. 6, 1994 (Ex. 1103, "Severinsky").
[4] U.S. Patent No. 5,824,534, iss. Dec. 1, 1998 (Ex. 1104, "Frank").
[5] U.S. Patent No. 5,841,201, iss. Nov. 24, 1998 (Ex. 1105, "Tabata").

V." Pet. 11–15. Our review centers on the construction of two claim terms—"road load (RL)" and "setpoint (SP)."[6]

1. "Road load" or "RL"

The term "road load" or "RL" appears in each of the independent claims at issue here. Ford proposes that "road load" means the instantaneous torque required for propulsion of the vehicle. Pet. 11–12. Paice agrees with that construction. PO Resp. 10; Ex. 1148, 39:14–17. And, the parties' proposed construction appears to comport with the specification, which 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." Ex. 1101, 12:44–46. In further defining "road load," the specification notes that:

> 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, *indicating that the torque being supplied is to be reduced or should be negative*.

Id. at 12:50–61 (emphases added). As such, the specification states that road load "can be positive or negative." *Id*. at 12:55–58. Thus, consistent with the specification, we construe "road load" or "RL" as "the amount of instantaneous torque required to propel the vehicle, be it positive or negative."

[6] Ford also proposes a construction for the terms "low-load mode I," "highway cruising mode IV," and "acceleration mode V." Pet. 14. Paice is silent on any construction for these terms. We determine that, for purposes of our review, no further construction is necessary aside from the way those terms are defined in claims 99, 133, 161, and 233.

2. "Setpoint" or "SP"

The term "setpoint" or "SP" is found in each of the independent claims at issue. Ford proposes that "setpoint" be construed, in the context of the claims, as a "predetermined torque value." Pet. 13–14. In that regard, Ford correctly notes that the claims compare the setpoint against "a torque-based *road load* value." *Id*. at 13. For example, each of the challenged independent claims speak of the "setpoint" or "SP" as being the lower limit at which the engine can produce torque efficiently, i.e., operating the engine to propel the hybrid vehicle "*when the RL required to do so is between the SP and a maximum torque output (MTO) of the engine,* wherein the engine is operable to efficiently produce torque above the SP."[7] This express language suggests that "setpoint" is not just any value, but a value that—per the surrounding claim language—equates to "torque." *See Phillips v. AWH Corp.*, 415 F.3d 1303, 1314 (Fed. Cir. 2005) (en banc) ("[T]he claims themselves provide substantial guidance as to the meaning of particular claim terms . . . [T]he context in which a term is used in the asserted claim can be highly instructive").

Paice, on the other hand, argues that "setpoint" is synonymous with a "transition" point, not a torque value. PO Resp. 3–6. Citing the specification, Paice urges that "setpoint" must be construed to indicate a point "at which a transition between operating modes may occur." *Id*. at 3, 6. Paice's argument is misplaced. While Paice is correct that *sometimes* the specification describes the setpoint in terms of a "transition point" (s*ee id.* at

[7] Paice's declarant, Mr. Neil Hannemann, similarly testified that under the "most straightforward" approach for the claimed "comparison," the "setpoint is a torque value." Ex. 1149, 79:16–80:25.

4–5), the claim language itself makes clear that setpoint relates simply to a torque value, without requiring that it be a transition point. Indeed, the specification acknowledges that the mode of operation does not always transition, or switch, at the setpoint, but instead depends on a number of parameters. For instance,

> the values of the sensed parameters in response to which the operating mode is selected may vary . . . , so that the operating mode is *not repetitively switched simply because one of the sensed parameters fluctuates around a defined setpoint*.

Ex. 1101, 19:67–20:6 (emphasis added). That disclosure suggests that a transition does not spring simply from the recitation of "setpoint." Thus, we will not import into the meaning of "setpoint" an extraneous limitation that is supported by neither the claim language nor the specification. As such, we reject Paice's attempt to further limit the meaning of setpoint to a transition between operating modes.

We also regard as meaningful that nothing in the specification precludes a setpoint from being reset, after it has been set. The specification states that the value of a setpoint may be "reset . . . in response to a repetitive driving pattern." Ex. 1101, 40:50– 64. But, just because a setpoint may be reset under certain circumstances does not foreclose it from being "set," or "fixed," at some point in time.[8] A setpoint for however short a period of time still is a setpoint. Thus, we construe "setpoint" as a "predetermined torque value that may or may not be reset."

[8] The definition of "set" is "determined . . . premeditated . . . fixed . . . prescribed, specified . . . built-in . . . settled." *Merriam-Webster's Collegiate Dictionary* (10th ed. 2000).

Finally, Paice argues that any construction limiting the meaning of setpoint to a "torque value" would be "directly at odds with the construction adopted by two district courts" in related litigation.[9] PO Resp. 3. Although, generally, we construe claim terms under a different standard than a district court, and thus, are not bound by a district court's prior construction, Paice's emphasis on the district court's construction compels us to address it. *See Power Integrations, Inc. v. Lee*, 797 F.3d 1318, 1327 (Fed. Cir. 2015) ("Given that [patent owner's] principal argument to the board . . . was expressly tied to the district court's claim construction, we think that the board had an obligation, in these circumstances, to evaluate that construction").

In that regard, the district court held:

> there is nothing in the claims or specification that indicate a given setpoint value is actually represented in terms of torque. In fact, the specification clearly indicates that the state of charge of the battery bank, 'expressed as a percentage of its full charge' is compared against setpoints, the result of the comparison being used to control the mode of the vehicle.

Ex. 1113, 13, 21. But, as discussed above, although claims are read in light of the specification, it is the use of the term "setpoint" within the context of the claims themselves that provides a firm basis for our construction. *See Phillips, supra*. Here, the claims instruct us that "setpoint," when read in the context of the surrounding language, is limited to a torque value. As for the district court's statement that the battery's state of the charge is compared to

[9] *Paice LLC v. Toyota Motor Corp.*, No. 2:07-cv-00180, 2008 WL 6822398 (E.D. Tex. Dec. 5, 2008); *Paice LLC v. Hyundai Motor Co.*, No. 1:12-cv-00499, 2014 WL 3725652 (D. Md. July 24, 2014).

a setpoint, we note that *the claims* actually speak of comparing the "state of charge of the battery" to "a predetermined level," not a "setpoint" or "SP" as found elsewhere in the claims. *See, e.g.*, Ex. 1101, 67:36–38 (dependent claim 101), 70:54–56 (dependent claim 134). Thus, in the context of the claims, we decline to read "setpoint" as also encompassing a state of charge of the battery, as the district court did. Instead, we construe "setpoint" as representing a torque-based value.

B. Ground 1—Anticipation by, and Obviousness Over, Severinsky

1. Independent Claims 161 and 215

Ford challenges independent claims 161 and 215 on the ground that the claimed invention is anticipated by Severinsky.[10] Pet. 16–27, 36–39; Reply 10–15. To the extent that Severinsky does not anticipate the challenged claims, Ford argues that the claimed invention would have been obvious in view of the teachings of Severinsky and the knowledge of skilled artisans in the relevant time frame. *Id*. at 16.

Claims 161 and 215 are directed to a "method for controlling a hybrid vehicle." The claims recite various "operating modes" for the vehicle, in which either an "electric motor," or an "internal combustion engine," or "both," are selected to propel the vehicle. Ex. 1101, 73:41–67, 79:10–27. Claim 161 describes these three modes as a "low-load" mode, a "high-way cruising" mode, and an "acceleration" mode, respectively. Id. at 73:49–74:3. Claim 215 adds a battery "charging" mode to the mix. *Id*. at 79:28–31.

At the outset, we find that, like claims 161 and 215, Severinsky discloses the basic components of a hybrid vehicle, including (1) an internal

[10] Paice does not dispute that Severinsky is prior art against the '634 patent.

combustion engine that provides propulsive torque to the wheels of the vehicle, (2) an electric motor that also is capable of providing propulsive torque to the wheels, and (3) a "battery" that provides electrical current to the motor. *Compare* Ex. 1003, Fig. 3 (Severinsky) *with* Ex. 1101, Fig. 4 (the '634 patent). More significantly, Severinsky discloses "*controlling* the relative contributions of the internal combustion engine and electric motor" so that the hybrid vehicle "may be operated in a *variety of operating modes* selected dependent on desired vehicle performance." Ex. 1103, 22:19–39 (emphasis added). Those modes, according to Severinsky, include:

> "a low speed/reversing mode, wherein all energy is supplied by said battery and all torque by said electric motor";
>
> "a high speed/cruising mode, wherein all energy is supplied by combustible fuel and all torque by said engine"; and
>
> "an acceleration/hill climbing mode, wherein energy is supplied by both combustible fuel and said battery, and torque by both said engine and said motor."

Ex. 1103, 22:39–50; *see also id*. at 10:24–11:6 (describing each mode in greater detail). We find that those disclosures in Severinsky meet the general configuration of the operating modes required by claims 161 and 215.

Claims 161 and 215 also require operating the engine when the torque required to propel the vehicle reaches a "setpoint" or "SP" so that the engine produces torque "efficiently." Ex. 1101, 73:55–60 (claim 161), 79:18–24 (claim 215). Severinsky discloses that the engine is operated only when it is "efficient" to do so, and if not, the motor is used:

> the internal combustion engine is operated *only under the most efficient conditions of output power[11] and speed*. When the engine *can be used efficiently* to drive the vehicle forward, e.g. in highway cruising, it is so employed. Under other circumstances, e.g. in traffic, the electric motor alone drives the vehicle forward and the internal combustion engine is used only to charge the batteries as needed.

Ex. 1103, 7:8–16 (emphasis added); *see also id*. at 9:40–52 ("the internal combustion engine operates only in its most efficient operating range"). Paice does not appear to dispute that Severinsky teaches operating the engine when it is efficient to do so. PO Resp. 8 ("Severinsky and the '634 patent may have the same goal (efficient engine operation)"). Thus, we find that Severinsky, like the claims, discloses operating the engine when it can produce torque efficiently.

With respect to the claimed "setpoint" for achieving such efficiency, Severinsky teaches 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*. at 20:63–66 (emphasis added). Ford's declarant, Dr. Gregory Davis, testifies that a skilled artisan would have understood the lower limit of Severinsky's range, i.e., 60% of maximum torque, to be a "setpoint" for efficient operation of the engine. Ex. 1107 ¶ 208. Dr. Davis further testifies that Severinsky's lower limit of 60% is "substantially less than the MTO" of the engine, thereby

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[11] Paice's declarant, Mr. Hannemann, testified that a skilled artisan would have understood that "power is a product of *torque* and speed." Ex. 1149, 31:6–13 (emphasis added); *see also* Ex. 2104 ¶ 36 ("For every engine speed, *there is an associated torque value*. Another way of defining an engine's operating range would be by its output power, which is the engine's speed multiplied by the output *torque*") (emphases added).

meeting the language of claims 161 and 215. *Id*. ¶¶ 231–232. Crediting the testimony of Dr. Davis, we are persuaded that Severinsky discloses, or at the very least suggests, the "setpoint" limitations of claims 161 and 215. *See id.* ¶¶ 183–212, 223–232, 323–326.

Faced with the explicit teachings of Severinsky, Paice raises a number of arguments, none of which we find persuasive. *See* PO Resp. 7–16, 49–50. First, Paice argues repeatedly that Severinsky fails to teach the claimed setpoint because Severinsky determines when to turn the engine on "based on the speed of the vehicle," and "not road load" as required by the claims. *Id*. at 7, 17, 25–38, 45. Although Paice acknowledges that "Severinsky clearly teaches 'mode switching'," it nonetheless maintains that Severinsky "only discloses speed and *not load* as the control metric." *Id*. at 19 (emphasis added).

Paice would have us believe that "speed" is the *sole* factor used by Severinsky in determining when to employ the engine. That is not the case. Severinsky makes clear that the controller uses the "load" requirements of the vehicle in determining when to run the engine. Importantly, Severinsky discloses that

> *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.

Ex. 1103, 17:11–15 (emphases added). We are not persuaded by Paice's focus on Severinsky's disclosure of "speed," when Severinsky plainly teaches using "load" for determining the engine's "most fuel efficient

operating range." It is the totality of Severinsky that must be assessed, not its individual parts.

Although it may not use the term "road load" *per se*, Severinsky describes operation of the engine in terms similar to our construction of "road load," and uses language much like the claims. For example, just as claims 161 and 215 describe the engine as being operated in response to "instantaneous road load (RL) required to propel the hybrid vehicle," so too does Severinsky describe operating the engine in response to "the load imposed by the vehicle's propulsion requirements." *Id*. The similarity of those descriptions provides ample support for finding that Severinsky teaches an engine control strategy that depends on the load, or torque, required to propel the vehicle, as called for by the claims.

Moreover, Severinsky teaches elsewhere that efficient operation of the engine is based on torque, not speed. In particular, Severinsky specifies that the microprocessor runs the engine at an "operational point" at which "it produces *60–90% of its maximum torque*." *Id*. at 20:63–67 (emphasis added). That disclosure by Severinsky is no different than the way in which the '634 patent claims the "setpoint." For instance, claim 232, which depends from claim 215, recites that the setpoint is "approximately 30% of the MTO" of the engine. Ex. 1101, 80:62–63. Just as the claimed setpoint is expressed in terms of a *percentage of maximum torque*, so too is Severinsky's "operational point," which is described as "60–90% of its maximum torque." That Severinsky describes the engine's operational point in terms similar to, if not the same as, the claimed setpoint, i.e., a percentage of *maximum torque*, runs counter to Paice's argument that Severinsky employs the engine based on speed alone.

Paice cites a number of passages in Severinsky that purportedly evince a control strategy that is based on speed, as opposed to torque or load. PO Resp. 7, 21, 45. We do not find the cited passages supportive of Paice's argument. For example, Paice accuses Ford of "glossing over" Severinsky's disclosure of turning the engine off during "low speed" or "traffic" situations, and turning it on during "moderate speed" or "highway cruising" situations. *Id*. at 7–8. Those disclosures, however, do not foreclose Severinsky from teaching that "load" or "torque" requirements are a determinative factor of when to employ the engine. In other words, torque and speed are not mutually exclusive concepts.[12] Indeed, the '634 patent itself speaks of "speed" when describing the vehicle's various operating modes, stating that "the traction motor provides torque to propel the vehicle in *low-speed situations*" and "[d]uring substantially steady-state operation, e.g., during *highway cruising*, the control system operates the engine." Ex. 1101, 17:47–48, 19:45–46, respectively (emphasis added). Thus, just as "speed" plays a role in the control strategy of the '634 patent, so too does it in Severinsky.

Paice also points to Severinsky's disclosure of "speed-responsive hysteresis" and argues repeatedly that it depicts a control strategy "based on speed, not road load." PO Resp. 7, 17–19, 22, 25. According to Paice, "[i]t simply makes no sense for Severinsky to use 'speed responsive-hysteresis' if Severinsky uses road load to control engine starts and stops." *Id*. at 25. But Severinsky only discusses the hysteresis feature as "speed-responsive" because it is used to avoid cycling the engine on and off in "low-speed" situations where engine speed dips to "20-25 mph" while in a highway

[12] *See supra* n.11.

mode. Ex. 1103, 18:23–42. That discussion of low-speed hysteresis is essentially the same as the description of hysteresis in the '634 patent, which discloses that "excessive mode switching otherwise likely to be encountered in suburban traffic can be largely avoided [by] implementing this '*low-speed* hysteresis'." Ex. 1101, 43:67–44:3. In any event, that Severinsky may teach an additional hysteresis feature as a way of controlling unintended engine starts during temporary dips in speed does not preclude Severinsky from also teaching the use of a torque value, or road load, as a way to determine when to employ the engine in the first instance. We find persuasive the testimony of Ford's declarant, Dr. Davis, confirming that "[e]ven if Severinsky '970 was considering speed in this particular situation [of nuisance engine starts], it is generally, if not always, using torque/road load in its mode decisions." Ex. 1147 ¶ 20.

Generally speaking, Paice is attempting to hold Severinsky to a different standard than it holds the claimed invention. That Severinsky may discuss "speed" as one of the parameters used by the microprocessor does not negate its overall, and express, teaching of employing the engine "responsive to the load imposed by the vehicle's propulsion requirements," or road load, "so that the engine [] can be operated in its most fuel efficient operating range." Ex. 1103, 17:11–15. Thus, we reject Paice's arguments that criticize Severinsky's references to "speed," when the '634 patent itself recognizes that "speed" plays a role in a road load-responsive hybrid control strategy.[13]

[13] Even claims 12 and 300 of the '634 patent acknowledge that "the controller is operable to vary the SP as a *function of speed* of the engine." Ex. 1101, 59:3–5, 89:51–52 (emphasis added).

Paice also faults Severinsky for disclosing that "the microprocessor receives inputs from the driver." PO Resp. 26 n.8. But, once again, Paice fails to recognize that the claims at issue expressly call for receiving inputs from the driver as part of the engine control strategy. For instance, claim 161 recites: "receiving operator input specifying a change in required torque to be applied to the wheels of the hybrid vehicle." Ex. 1101, 74:4–5. The '634 patent explains that the "operator input" includes the position of the accelerator and brake pedals, which is then used "to properly control operation of the vehicle." *Id*. at 27:26–46. Severinsky discloses the same type of input: "a controller adapted to receive input commands from a driver . . . to control operation of said controllable torque transfer unit." Ex. 1103, 24:60–63. Given that claim 161 requires operator input (such as pedal position) as part of the claimed method, we are not persuaded by Paice's attack on Severinsky for teaching a control strategy that relies on the same input.

In the end, we are not persuaded by Paice's arguments that Severinsky does not anticipate, or render obvious, the claimed "setpoint." PO Resp. 7–38, 44–50. Rather, we credit the testimony of Ford's declarant, Dr. Davis, that a skilled artisan would have understood the lower limit of Severinsky's range—60% of MTO—to be a predetermined setpoint that is based on torque. *See* Ex. 1107 ¶¶ 203–212. Thus, we find that Severinsky fulfills the claimed criteria of comparing the torque required to propel the vehicle, or road load, to a "setpoint," including operating the engine "to efficiently produce torque *above the SP*, and wherein the SP is *substantially less than the MTO*."

2. The Dependent Claims

Paice does not argue dependent claims 228, 232, 233, and 237 separately from independent claim 215. After considering Ford's analysis, which we adopt as our own, we are persuaded that Severinsky discloses or suggests each of the limitations of these dependent claims. *See* Pet. 27–36. For example, with respect to claim 228, Severinsky discloses that either the engine or the motor can be operated in a "battery charge mode . . . responsive to monitoring the state of charge of battery." Ex. 1103, 15:1–10, 16:67–17:15. As to claim 232, Severinsky's lower limit of 60% appears to fall within the claimed range that the setpoint be greater than "at least approximately 30% of the MTO of the engine." Ex. 1107 ¶¶ 272–274. And, with respect to claim 237, Severinsky discloses a "two-way clutch" that "controllabl[y]" couples the engine to the drive wheels of the vehicle. Ex. 1103, 9:58–61, Figs. 3, 11.

3. Conclusion

After considering the evidence and arguments presented at trial, we find that Severinsky discloses, and at the very least suggests, each and every limitation of independent claims 161 and 215, as well as dependent claims 228, 232, 233, and 237. As such, we conclude that a preponderance of the evidence establishes that these claims are anticipated by, and would have been obvious over, Severinsky.

C. Ground 2—Claims 80, 93, 98, 99, 102, 109, 114, 127, 131, 132, 135, 139, and 142—Obviousness Over Severinsky and Frank

Ford argues that independent claims 80 and 114, as well as dependent claims 93, 98, 99, 102, 109 127, 131, 132, 135, 139, and 142, would have been obvious over Severinsky and Frank. Pet. 39–48; Reply 15–18. Claims

80 and 114 require operating the engine when the torque required to propel the vehicle is "above the SP" and "substantially less than the MTO," which we previously found is present in Severinsky. *See* Section B. above. Claim 80 includes the additional limitation that the torque required to propel the vehicle, or road load (RL), be above the setpoint "for at least a predetermined time" before operating the engine. Ex. 1101, 65:26–28. Claim 114 includes a similar requirement. *Id*. at 68:43–45. The '634 patent describes this time-delay step as "hysteresis in the mode-switching determination" for preventing undesirable and repetitive engine starts during certain types of driving. *Id*. at 41:30–47.

Severinsky expressly contemplates "hysteresis in mode switching." Ex. 1103, 18:34–42. More specifically, Severinsky states:

> At moderate speeds, as experienced in suburban driving, the speed of the vehicle on average is between 30–45 mph. The vehicle will operate in a highway mode with the engine running constantly after the vehicle reaches a speed of 30–35 mph. The engine will continue to run unless the engine speed is reduced to 20–25 mph *for a period of time, typically 2–3 minutes. This speed responsive hysteresis in mode switching will eliminate nuisance engine starts*.

Ex. 1103, 18:34–42 (emphasis added). Hysteresis, in that context, evidently means a time delay that depends on the engine running at a steady state for 2–3 minutes already before switching modes.

And, likewise, Ford points to Frank as confirming it was well known to utilize a "time delay" with an on-off "threshold," or setpoint, of an engine in a hybrid vehicle to reduce excessive cycling of the engine being turned on and off repetitively. Pet. 42–43 (citing Ex. 1104, 8:4–11). Ford also cites to Frank for teaching the use of a second on-off setpoint, slightly offset from a

first setpoint, as the actual trigger for controlling undesirable excessive cycling of the engine. *Id*. When viewed through the eyes of the skilled artisan, Severinsky and Frank evidently teach a time-delay in conjunction with a setpoint for operating the engine in order to reduce undesirable excessive cycling in switching between different operational modes. Each of claims 80 and 114 requires such a time delay for the triggering condition when "the RL>the SP."

That Severinsky also may disclose this "hysteresis" time-delay as being "speed-responsive" does not negate or detract from its overall teaching of applying a time delay to an on-off setpoint to prevent frequent cycling between the engine and motor in a hybrid vehicle. Ex. 1107 ¶ 363, Ex. 1147 ¶ 20. Indeed, Ford's declarant, Dr. Davis, explains that "[t]ime-delays or additional thresholds were frequently employed in traditional transmissions in order to prevent excessive cycling between gears." Ex. 1107 ¶ 374. Dr. Davis also confirms that "[a] person of ordinary skill in the art would have been familiar with these techniques" for preventing unwanted cycling effects "when the vehicle operation hovers around a particular *setpoint*." *Id*.

With that background in mind, we credit the testimony of Dr. Davis that a skilled artisan would have been led to incorporate Frank's time-delay feature with Severinsky's engine control strategy because both hybrid strategies utilize a threshold, or "setpoint," for switching the engine on and off. Ex. 1107 ¶¶ 373–377. Also, we are not persuaded by Paice's contention that the proposed combination would result in a "speed-responsive hysteresis." PO Resp. 7, 18, 22, 24. As discussed above, Severinsky's setpoint already accounts for a torque value and is already available for use with a time-delay feature, such as that taught by Frank. Ex.

1107 ¶¶ 366–370. Thus, we find that Severinsky's disclosure of a *torque*-based setpoint for starting and stopping the engine, when combined with Frank's teaching of a time-delay with an on-off threshold for an engine, would have suggested to a skilled artisan the features of claims 80 and 114. *See* Pet. 39–42, 45–47.

Paice does not argue dependent claims 93, 98, 99, 102, 109, 127, 131, 132, 135, 139, and 142 separately from their respective independent claims. After considering Ford's analysis, which we adopt as our own, we are persuaded that Severinsky discloses the features recited in the claims depending from claims 80 and 114, for example, a battery charge mode (claim 93, 127, 139), a setpoint of at least 30% of MTO (claims 98, 131), and a clutch (claims 109, 142). *See* Pet. 43–48. In sum, we conclude that Ford has demonstrated, by a preponderance of the evidence, that claims 80, 93, 98, 99, 102, 109, 114, 127, 131, 132, 135, 139, and 142 would have been unpatentable for obviousness over Severinsky and Frank.

D. Ground 3—Claims 215, 228, 233, 235, and 236—Obviousness Over Tabata

In this ground, Ford again challenges claims 215, 228, and 233, only now it asserts that they would have been obvious over Tabata. Pet. 48–58; Reply 19–25. Ford also includes claims 235 and 236 as part of this challenge. *Id*. As discussed above, claim 215 is independent and recites operating modes for the vehicle that include either the electric motor, or the engine, or both. And more significantly, claim 215 requires that the engine be "operable to efficiently produce torque above the SP, and wherein the SP is substantially less than the MTO." Ex. 1101, 79:10–31.

Tabata discloses a hybrid vehicle that operates in a plurality of modes, including:

> "Motor Drive" mode 1;
> "Engine Drive" mode 2;
> "Engine Drive & Charging" mode 3; and
> "Engine-Motor Drive" mode 4.

Ex. 1105, 11:15–24, Fig. 15. Central to Tabata is a controller that executes a hybrid control strategy so that the engine achieves "a maximum value of the fuel consumption efficiency." *Id*. at 13:65–67. As described, the engine is operated when "the currently required output Pd is larger than the first threshold P1 and smaller than the second threshold P2." *Id*. at 33:30–32.

Ford's declarant, Dr. Davis, explains that, as used in Tabata, the term "Pd" means road load or RL, and the terms "P1" and "P2" constitute lower and upper limits for efficient operation of the engine. Ex. 1107 ¶¶ 480–486. Indeed, much like the claimed "setpoint," Tabata discloses that both P1 and P2 are determined "so as to minimize the exhaust gas emissions and the fuel consumption, depending upon the energy efficiency during running of the vehicle." Ex. 1105, 30:59–62; 32:7–9. In other words, Tabata discloses that the engine runs most efficiently when the road load is between a lower limit (P1) and an upper limit (P2). And, as Dr. Davis further explains, Figure 7 of Tabata illustrates that the engine operates in a "sweet spot" between lower and upper limits P1 and P2, and that a skilled artisan would have recognized the lower limit as a setpoint for operating the engine well below its MTO. Ex. 1107 ¶¶ 487–496. We credit the testimony of Dr. Davis that Tabata's engine operates "efficiently" in a range "above the SP" and "substantially less than the MTO," as required by claim 215.

Paice's sole argument against Tabata is that it "uses demand power . . . and compares that to power thresholds to determine the operational mode of the vehicle." Id. According to Paice, Tabata's use of a "power" demand as a threshold is "fundamentally different" from the "torque" or "load" demand on which the claimed "setpoint" is based. Id. at 54, 57–58. We disagree.

Although power and speed are different, Paice's declarant, Mr. Hannemann, testified that a skilled artisan would have understood that "power is a product of *torque* and speed." Ex. 1149, 31:6–13 (emphasis added). Mr. Hannemann further explained that "[f]or every engine speed, *there is an associated torque value*. Another way of defining an engine's operating range would be by its output power, which is the engine's speed multiplied by the output *torque*." Ex. 2104 ¶ 36 (emphases added). Indeed, Tabata itself recognizes this well-known relationship between power and torque, stating that that the "required output Pd" may be calculated "on the basis of the engine speed N_E and engine torque T_E." Ex. 1105, 13:10–12; *see also id*. at 13:53–64, 21:12–33, Fig. 7.

When questioned about Tabata's disclosure of a power-based control strategy vis-a-vis the claimed torque-based strategy, Mr. Hannemann acknowledged there was no apparent advantage to using torque as opposed to power as a setpoint for operating the engine. Ex. 1154, 39:23–40:6. The only difference, he stated, might be the size of the engine and motor, but size is not part of the claims, and thus, is irrelevant. Based on the close mathematical relationship between power and torque, which was confirmed by both parties' declarants, we conclude that a skilled artisan would have viewed Tabata as suggesting the setpoint feature of claim 215. As such,

Ford has demonstrated by preponderant evidence that claim 215 is unpatentable as obvious in view of Tabata.

Paice does not argue the challenged claims depending from claim 215. After considering Ford's analysis, which we adopt as our own, we are persuaded that Tabata discloses the limitations of dependent claims 228, 233, 235, and 236. For instance, with respect to claim 228, Tabata illustrates expressly that "SOC" (i.e., state of charge) of the battery is determined before any modes of operation are executed. Ex. 1105, Fig. 15 (as depicted in steps S12, S16, S18). Tabata further states that an integral part of the hybrid control sub-routine is "to determine whether the amount of electric energy SOC stored in the electric storage device [i.e., battery] is equal to or larger than a predetermined upper limit." *Id*. at 28:40–45. That disclosure persuades us that Tabata meets the battery-charge monitoring step of claim 228. As for claims 235 and 236, Tabata expressly discloses a "continuously variable transmission" equipped with "planetary gear sets." *Id*. at 9:63–10:27.

In sum, we conclude that Ford has demonstrated, by a preponderance of the evidence, that claims 215, 228, 233, 235, and 236 are unpatentable for obviousness over Tabata.

IV. CONCLUSION

After considering the parties' arguments and evidence, we conclude that Ford has demonstrated, by a preponderance of the evidence, that:

> (1) claims 161, 215, 228, 232, 233, and 237 are anticipated by Severinsky, or alternatively, would have been rendered obvious by Severinsky;

(2) claims 80, 93, 98, 99, 102, 109, 114, 127, 131, 132, 135, 139, and 142 would have been rendered obvious by Severinsky and Frank; and

(3) claims 215, 228, 233, 235, and 236 would have been rendered obvious in view of Tabata.

V. ORDER

Accordingly, it is hereby:

ORDERED that claims 80, 93, 98, 99, 102, 109, 114, 127, 131, 132, 135, 139, 142, 161, 215, 228, 232, 233, and 235–237 of the '634 patent are held unpatentable; and

FURTHER ORDERED that any party seeking judicial review of this Final Written Decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

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