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Paper 86  
Entered: May 9, 2016

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

ZHONGSHAN BROAD OCEAN MOTOR CO., LTD.,  
BROAD OCEAN MOTOR LLC, and  
BROAD OCEAN TECHNOLOGIES, LLC,  
Petitioner,

v.

NIDEC MOTOR CORPORATION,  
Patent Owner.

Case IPR2014-01121<sup>1</sup>  
Patent 7,626,349 B2

Before SALLY C. MEDLEY, JUSTIN T. ARBES,  
BENJAMIN D. M. WOOD, JAMES A. TARTAL, and  
PATRICK M. BOUCHER, *Administrative Patent Judges*.

BOUCHER, *Administrative Patent Judge*.

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

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<sup>1</sup> Case IPR2015-00762 has been joined with this proceeding.

## I. INTRODUCTION

### A. *Background*

The trial in this proceeding resulted from the filing of two petitions by Zhongshan Broad Ocean Motor Co., Ltd., Broad Ocean Motor LLC, and Broad Ocean Technologies, LLC (collectively, “Petitioner”). First, in response to a corrected petition (Paper 7<sup>2</sup>, “Pet. 1121”) filed in IPR2014-01121, the Board instituted trial with respect to the following ground of unpatentability: claims 1–3, 8, 9, 12, 16, and 19 as unpatentable under 35 U.S.C. § 103(a) over U.S. Patent No. 5,410,230 (Ex. 1006, “Bessler”) and Peter Franz Kocybik, *Electronic Control of Torque Ripple in Brushless Motors* (University of Plymouth, July 2000) (Ex. 1007, “Kocybik”). Paper 20, 17. Second, in response to the concurrent filing in IPR2015-00762 of a petition (IPR2015-00762, Paper 3, “Pet. 762”) and a Motion for Joinder (IPR2015-00762, Paper 4), the Board instituted trial with respect to the following ground of unpatentability, and joined IPR2015-00762 with IPR2014-01121: claims 1–3, 8, 9, 12, 16, and 19 as anticipated under

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<sup>2</sup> Unless otherwise indicated, citations are to IPR2014-01121. In some instances, the parties filed papers under seal with concurrently filed public redacted versions; unless otherwise indicated, citations are to public versions of the papers.

35 U.S.C. § 102(b) by JP 2003-348885 (Ex. 1003<sup>3</sup>, “Hideji”). Paper 67, 9–10. Patent Owner timely filed Patent Owner Responses. Papers 30, 72. Petitioner timely filed Replies to the Patent Owner Responses. Papers 36, 78. An oral hearing was held on February 23, 2016. Paper 85 (“Tr.”).

We have jurisdiction under 35 U.S.C. § 6(c). This Decision is a Final Written Decision under 35 U.S.C. § 318(a) as to the patentability of the claims on which we instituted trial. Based on the record before us, Petitioner has shown, by a preponderance of the evidence, that claims 1–3, 8, 9, 12, 16, and 19 are unpatentable.<sup>4</sup>

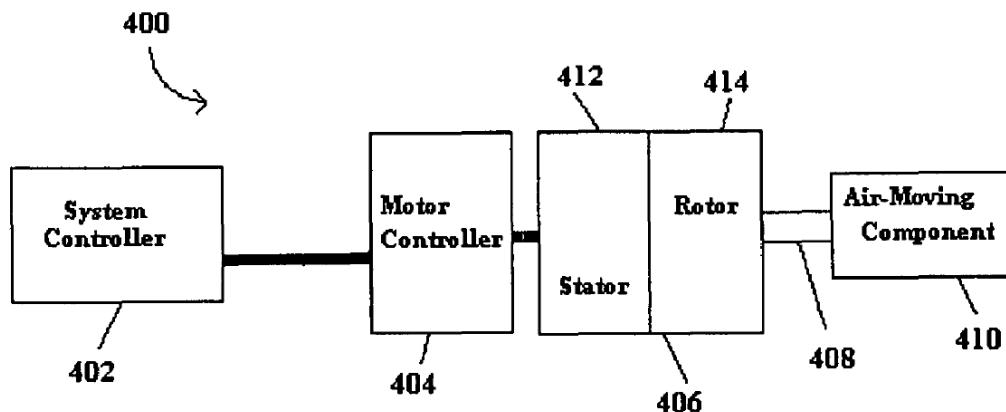
#### *B. The ’349 Patent (Ex. 1001)*

The ’349 patent relates to heating, ventilating, and/or air conditioning (“HVAC”) systems that use air-moving components, such as a blower. Ex. 1001, col. 1, ll. 8–11. Figure 4 of the ’349 patent is reproduced below.

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<sup>3</sup>An unattested English translation of Hideji was filed as Ex. 1005 in IPR2014-01121. An attested English translation of Hideji was filed as Ex. 1005 in IPR2015-00762. Except for the attestation, the translations are identical. Accordingly, to simplify citation to the record, we subsequently cite to Ex. 1005 of IPR2014-01121 for citations to Hideji.

<sup>4</sup>Judges Wood and Boucher disagree with Judges Medley, Arbes, and Tartial that 35 U.S.C. § 315(c) permits issues presented in IPR2015-00762 to have been joined to IPR2014-01121. Paper 67 (Boucher, APJ, dissenting).

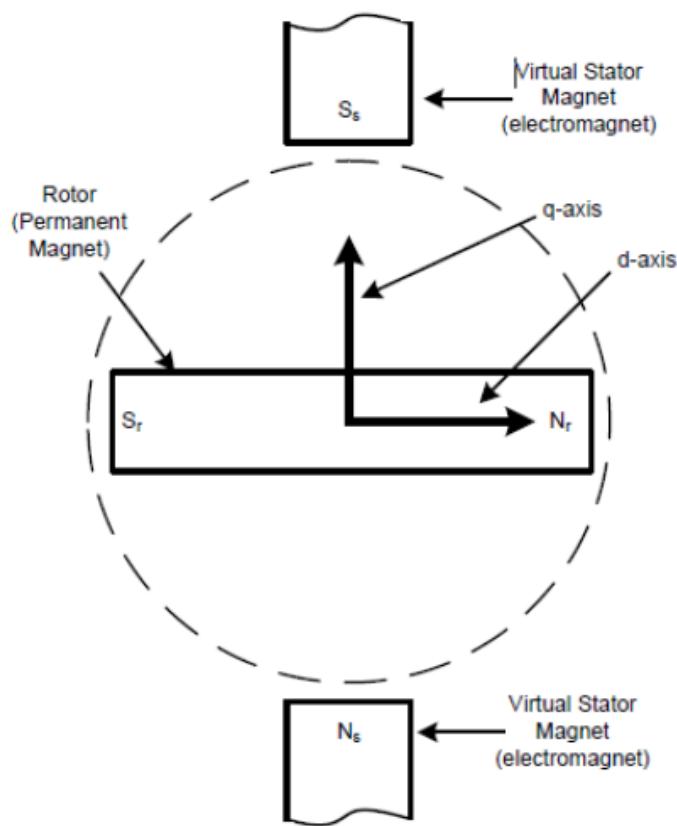


**Figure 4**

Figure 4 is a block diagram of HVAC system 400, which includes system controller 402, motor controller 404, permanent magnet motor 406, and air-moving component 410. *Id.* at col. 3, ll. 50–52. Permanent magnet motor 406 includes shaft 408, stationary assembly 412, and rotatable assembly 414. *Id.* at col. 3, ll. 52–54. The rotatable and stationary assemblies are magnetically coupled, and the rotatable assembly is coupled to the air-moving component via the shaft to drive rotation of the air-moving component. *Id.* at col. 3, ll. 54–58. The motor controller is configured to perform sinewave commutation in response to one or more control signals received from the system controller to produce continuous-phase currents in the permanent magnet motor for driving the air-moving component. *Id.* at col. 3, ll. 59–63.

Petitioner's expert, Dr. Mark Ehsani, provides an explanation of "vector control" of permanent-magnet synchronous motors, which we accept

as an accurate description of the understanding of one of ordinary skill in the art. Dr. Ehsani explains that “[t]he concept of vector control, which typically uses d and [Q] current components, arises from [a] principle [in which] torque arrives from the interaction of two magnetic fields, one originating from the stator and one originating from the rotor.” Ex. 1009 ¶ 13. The drawing from page 6 of Dr. Ehsani’s Declaration is reproduced below.



The drawing from Dr. Ehsani’s Declaration illustrates a rotor, which has a permanent magnet having north and south poles  $N_r$  and  $S_r$ , respectively, and illustrates a stator, which includes electromagnets that result in a virtual

stator magnet having north and south poles  $N_s$  and  $S_s$ , respectively. *Id.* ¶ 15. The d axis is aligned with the rotor and the Q axis<sup>5</sup> is offset 90° from the d axis. The motor commutates the winding currents to maintain orthogonality of the d and Q axes as the rotor turns. *Id.* ¶ 16.

The Specification of the '349 patent provides sparse details of how vector control is achieved in the context of the claimed invention. Figure 8 of the '349 patent is reproduced below, with reference numbers in red added by the Board.

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<sup>5</sup> Dr. Ehsani uses a lower-case letter q in referring to this axis. We use an upper-case letter Q for consistency with the claims that are before us.

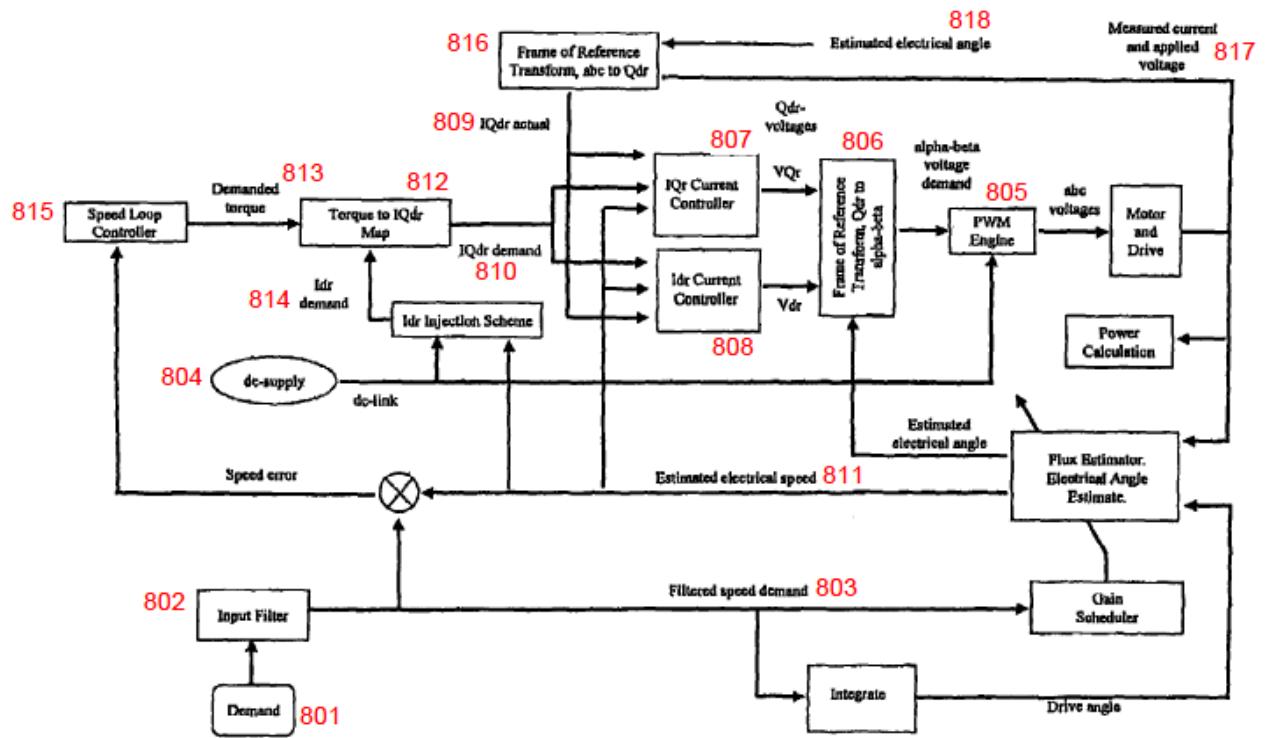


Figure 8

Figure 8 is a block diagram of a sensorless vector control scheme. Ex. 1001, col. 3, ll. 16–17. Although the Specification of the '349 patent does not explain the drawing, very similar drawings are provided as Figures 2 and 3 in U.S. Patent No. 7,342,379 B2 (Ex. 3001, "the '379 patent"), the disclosure of which is incorporated by reference into the '349 patent. *Id.* at col. 4, ll. 23–29. In addition, Patent Owner's expert, Dr. Gary Blank, was questioned extensively by Petitioner's counsel at his deposition regarding Figure 8. *See* Ex. 1043, 24:3–51:4. With respect to the following observations, we find Dr. Blank's testimony consistent with the explanation

of Figures 2 and 3 of the '379 patent provided by the Specification of the '379 patent, and accept Dr. Blank's testimony as an accurate description of what one of ordinary skill in the art would understand from Figure 8.

Demand 801 provides a speed demand as a source of power for the motor drive, which is filtered by input filter 802 to provide filtered speed demand 803. Ex. 1043, 24:23–25:25. The power to drive the motor originates from dc-supply 804 and is supplied to pulse width modulation engine 805, which converts a direct-current signal into alternating current voltages, and controls the magnitude of those voltages by varying the width of the pulse. *Id.* at 26:24–27:18. Such control is effected by using an  $\alpha$ - $\beta$  voltage demand generated by frame of reference transform 806 using V<sub>Qr</sub> and V<sub>dr</sub> signals, as well as an estimated electrical angle. *Id.* at 27:19–29:8. The V<sub>Qr</sub> and V<sub>dr</sub> signals are supplied respectively by I<sub>Qr</sub> current controller 807 and I<sub>dr</sub> current controller 808, which receive “I<sub>Qdr</sub> actual” signal 809, “I<sub>Qdr</sub> demand” signal 810, and estimated electrical speed 811 derived from filtered speed demand 803. *Id.* at 30:20–31:3, 32:10–18. The “I<sub>Qdr</sub> actual” signal is a combination of signals along the Q and d axes, and the “I<sub>Qdr</sub> demand” signal results from a conversion performed by torque to I<sub>Qdr</sub> map 812 using demanded torque 813 (provided by speed loop controller 815, which is part of the motor controller) and I<sub>dr</sub> demand 814. *Id.* at 31:4–24, 26:18–23. The “I<sub>Qdr</sub> actual” signal 809 is determined by frame of reference transform 816 from measured current and applied voltage 817, as well as estimated electrical angle 818. *Id.* at 65:6–66:11.

*C. Illustrative Claim*

Claim 1 of the '349 patent is illustrative of the claims at issue:

1. A heating, venting and/or air conditioning (HVAC) system comprising a system controller, a motor controller, an air-moving component, and a permanent magnet motor having a stationary assembly, a rotatable assembly in magnetic coupling relation to the stationary assembly, and a shaft coupled to the air-moving component, wherein the motor controller is configured for performing sinewave commutation, using independent values of Q and d axis currents, in response to one or more signals received from the system controller to produce continuous phase currents in the permanent magnet motor for driving the air-moving component.

II. ANALYSIS

*A. Claim Construction*

The Board interprets claims of an unexpired patent using the broadest reasonable construction in light of the specification of the patent in which they appear. *See* 37 C.F.R. § 42.100(b); *In re Cuozzo Speed Techs., LLC*, 793 F.3d 1268, 1278 (Fed. Cir. 2015) (“We conclude that Congress implicitly approved the broadest reasonable interpretation standard in enacting the AIA”), *cert. granted sub nom. Cuozzo Speed Techs., LLC v. Lee*, 136 S. Ct. 890 (mem.) (2016).

### 1. *Preambles*

Patent Owner contends that “[t]he preambles of the challenged claims, requiring an ‘HVAC system,’ are limiting.” Paper 30, 8. We disagree that the “HVAC system” portions of the preambles are limiting.<sup>6</sup>

“Generally, . . . the preamble does not limit the claims.” *DeGeorge v. Bernier*, 768 F.2d 1318, 1322 n.3 (Fed. Cir. 1985). In particular, “[t]he preamble of a claim does not limit the scope of the claim when it merely states a purpose or intended use of the invention.” *In re Paulsen*, 30 F.3d 1475, 1479 (Fed. Cir. 1994) (citing *DeGeorge*, 768 F.2d at 1322 n.3). In this instance, the “HVAC system” portions of the preambles of the challenged claims provide no antecedents for ensuing claim terms, with the bodies of the claims neither repeating nor referencing HVAC systems. Because the language in the bodies of the claims, standing alone, is sufficient to set forth the invention, the “HVAC system” portions merely provide a stated purpose for the invention. Accordingly, we find no

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<sup>6</sup> Independent claim 1 recites a “heating, ventilating and/or air conditioning (HVAC) system.” Independent claim 16 recites a “blower assembly for a heating, ventilating and/or air conditioning (HVAC) system.” Independent claim 19 recites a “method for driving an air-moving component of a heating, ventilating and/or air conditioning (HVAC) system in response to a control signal, the HVAC system including a permanent magnet motor having a stationary assembly and a rotatable assembly in magnetic coupling relation to the stationary assembly, said rotatable assembly coupled in driving relation to the air-moving component.”

compelling reason to afford weight to the “HVAC system” language in the preambles.

2. “*using independent values of Q and d axis currents*”

In the Institution Decisions, the Board construed “using independent values of Q and d axis currents,” which is recited in independent claims 1, 16, and 19, as requiring the use of Q and d axis current values that are developed independently of each other, without relying on one to derive the other. Paper 20, 7–8; IPR2015-00762, Paper 12, 6–7. Patent Owner does not explicitly contest this construction, and advocated for this construction in its Preliminary Responses. Paper 14, 9–10; IPR2015-00762, Paper 10, 19. But Patent Owner presents arguments that implicitly construe the phrase as requiring the use of independent *demand* Q and d axis currents, rather than the use of independent *actual* Q and d axis currents. *See* Paper 72, 6, 8.

The phrase was added to the claims during prosecution, and Petitioner contends that it refers to the *actual* Q and d axis currents, noting the patentee’s representation that support for the limitation “can be found, among other places, in Fig. 8 of the instant application as filed.” Paper 78, 8–9 (quoting Ex. 1002, 16). Petitioner observes that, in Figure 8 of the ’349 patent (reproduced above), “[t]he ‘estimated electrical angle’ and ‘measured current and applied voltage’ signals [818 and 817] are input to the ‘Frame of Reference transform, abc to Qdr’ [816], which outputs the ‘IQdr actual’ signal [809].” *Id.* at 10. The ’379 patent, incorporated by reference into the

'349 patent, addresses decoupling of the IQdr components in producing torque:

The decoupling of IQdr components in the production of torque can be applied within either a sensorless control system or a sensor-controlled system. If a given motor does not show any discernible hybrid behavior, the control technique can default to that classically used with a [permanent-magnet] motor (i.e., Idr torque contribution assumed to be zero) where the torque contribution comes from IQr.

Ex. 3001, col. 6, ll. 1–7. Petitioner’s position that these IQdr components refer to the *actual* Q and d axis currents, rather than the *demand* Q and d axis currents, is supported by the above disclosure as well as by Dr. Ehsani’s testimony that, in an ideal permanent-magnet, it is the *actual* d axis current value that is assumed to be zero. *See* Ex. 1009 ¶¶ 18–19.

We clarify our construction of “using independent values of Q and d axis currents” as requiring the use of actual Q and d axis current values that are developed independently of each other, without relying on one to derive the other.

### 3. “*back-emf . . . motor*”

In the Institution Decisions, the Board construed “back-emf . . . motor,” which is recited in claim 9, as coterminous with “permanent magnet motor.” Paper 20, 7–8; IPR2015-00762, Paper 12, 6–7. Neither party contests that construction and we adopt it for this Final Written Decision.

*B. Petitioner’s Motion to Exclude*

Petitioner filed a Motion to Exclude portions of Exhibit 2003 and the entirety of Exhibits 2010, 2011, and 2018–2025. Paper 50. But as Patent Owner contends, Petitioner’s Motion does not address Patent Owner’s timely supplementation of the challenged evidence pursuant to 37 C.F.R. § 42.64(b)(2). Paper 54, 1. Patent Owner contends that the supplemental evidence is curative and that “[b]ecause Petitioners do not argue in their motion that [Patent Owner’s] supplemental evidence failed to cure the deficiencies they identify (or is deficient in any other way), Petitioners have waived any argument regarding the sufficiency of the supplemental evidence.” *Id.* (citing 37 C.F.R. § 42.23(b)). Petitioner counters that Patent Owner failed to seek authorization to file its supplemental evidence or its Opposition: “The Board should therefore ignore both Patent Owner’s supplemental evidence and its Opposition because it failed to seek authorization from the Board beforehand.” Paper 68, 1–2 (citing *Gnosis S.P.A. v. South Alabama Med. Sci. Found.*, Case IPR2013-00116, Paper 29, 3 (October 9, 2013)).

Petitioner’s argument does not accurately reflect the requirements of the Board’s rules governing *inter partes* review proceedings. Once a trial has been instituted, any objection to evidence must be filed within five business days of service of the evidence and must identify the grounds for the objection “with sufficient particularity to allow correction in the form of supplemental evidence.” 37 C.F.R. § 42.64(b)(1). The party relying on the

evidence to which an objection is timely served is then provided an opportunity to correct, by serving supplemental evidence within ten business days of service of the objection. *See* 37 C.F.R. §§ 42.64(b)(1), 42.64(b)(2). If, upon receiving the supplemental evidence, the opposing party is still of the opinion that the evidence is inadmissible, the opposing party may file a motion to exclude such evidence. Service of such supplemental evidence does not require Board authorization, nor does filing of an opposition to a motion to exclude. 37 C.F.R. §§ 42.23, 42.64(b)(2), 42.64(c). Nothing in the *Gnosis* order cited by Petitioner stands for any contrary proposition. Indeed, the Scheduling Orders for this proceeding explicitly set forth deadlines for filing oppositions to motions to exclude. Paper 21, 4; Paper 70, 4.

We have considered the parties' arguments, but need not reach the merits of Petitioner's Motion to Exclude because, as explained below, even if the disputed evidence is considered, Patent Owner has not shown proof of secondary considerations that would support a conclusion of nonobviousness of the challenged claims. Accordingly, Petitioner's Motion to Exclude is dismissed as moot.

### *C. Patent Owner's Motion to Exclude*

Patent Owner filed a Motion to Exclude portions of Exhibit 1020 and the entirety of Exhibits 1034 and 1035. Paper 53. As Petitioner points out, Patent Owner failed to follow the correct procedure to preserve its objections

to Petitioner’s evidence. *See* Paper 58, 1–2. On May 19, 2015, the Office amended 37 C.F.R. § 42.64(b)(1) in a final rule-making notice to require that objections be “filed” rather than “served” within five business days of service of evidence to which the objections are directed. 80 Fed. Reg. 28,561, 28,563 (May 19, 2015). Patent Owner acknowledges that it *served* its objections on Petitioner on August 28, 2015, but did not *file* them until September 21, 2015 “in accordance with established practice under the former version of 37 C.F.R. § 42.[64](b)(1).” Paper 65, 1.

Patent Owner requests that, in view of the rule change, we exercise our discretion under 37 C.F.R. § 42.5(b) to waive or suspend the requirement of the version of 37 C.F.R. § 42.64(b)(1) in effect at the relevant time. *Id.* at 2. We do not question the sincerity of Patent Owner’s representations that it “was admittedly unaware” of the rule change and that its errors “were honest mistakes on its part.” Paper 65, 1–2. Those representations are relevant. Nevertheless, in considering Patent Owner’s request, we are mindful of the history of this proceeding and guided by considerations of fairness. Patent Owner has benefited from our previous strict enforcement of 37 C.F.R. § 42.63(b) over strenuous efforts by Petitioner—including a request that we exercise our discretion under 37 C.F.R. § 42.5—to correct Petitioner’s failure to include an affidavit attesting to the accuracy of the English translation of Hideji with its original filing in IPR2014-01121. *See* Paper 25. In this context, we decline to use our discretionary authority to excuse Patent Owner’s error.

Accordingly, we dismiss Patent Owner’s Motion to Exclude.<sup>7</sup>

*D. Obviousness Over Bessler and Kocybik*

Petitioner contends that claims 1–3, 8, 9, 12, 16, and 19 are unpatentable over Bessler and Kocybik under 35 U.S.C. § 103(a). Pet. 1121, 4. Bessler discloses an HVAC system that uses an electronically commutated motor (“ECM”). Ex. 1006, col. 4, ll. 11–13. In challenging independent claim 1, Petitioner contends that Bessler discloses all limitations but one, acknowledging that “Bessler does not explicitly disclose the use of sine wave commutation and independent [Q]- and d- axis currents.” Pet. 1121, 36. For the limitation that recites such features, Petitioner relies on Kocybik, noting that, like Bessler, Kocybik discloses an ECM. *Id.* at 41–46.

Figure 1 of Bessler is reproduced below.

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<sup>7</sup> Alternatively, the Motion would be dismissed because we do not rely on the evidence sought to be excluded in this Decision.

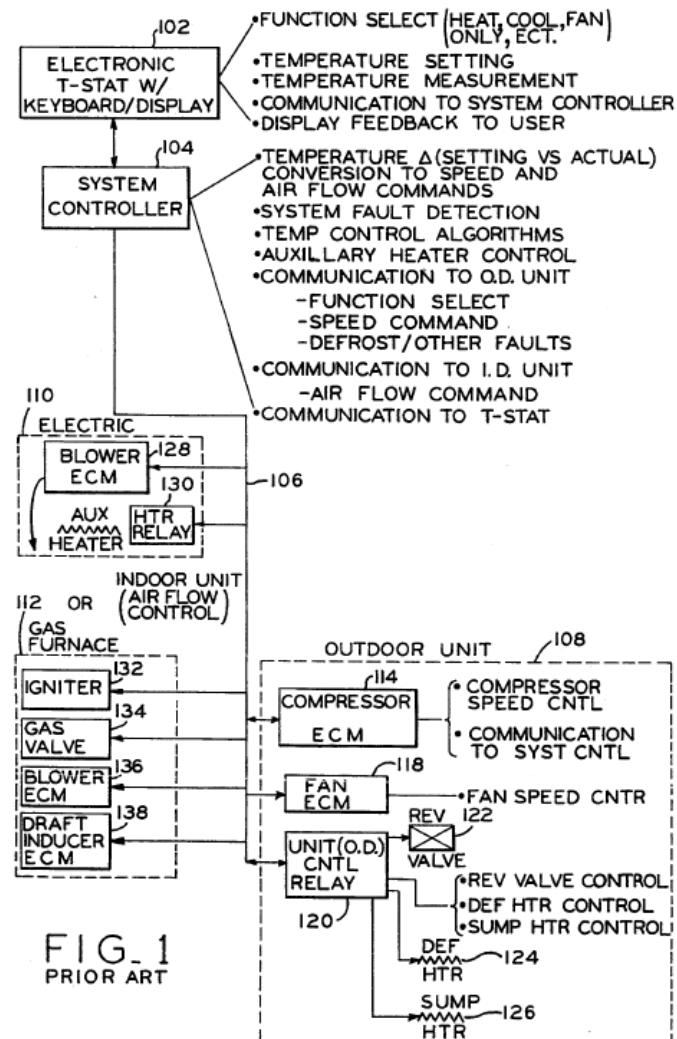


Figure 1 illustrates a central heating and air-conditioning variable speed control system. Ex. 1006, col. 3, ll. 8–11. Petitioner draws a correspondence between (1) structural elements shown in Figure 1 and a related embodiment shown in Figure 2; and (2) the “system controller,” “motor controller,” “blower” or “air-moving component,” and “permanent magnet motor” recited in different combinations in independent claims 1, 16, and 19. Pet. 1121, 37–41, 53–56.

Petitioner relies on Kocybik, which is a doctoral thesis that includes a survey of electric motor control schemes for permanent magnet motors,<sup>8</sup> for disclosure of sinewave commutation using vector control with independent Q and d axes to produce continuous phase currents. *Id.* at 43–46 (citing Ex. 1007, 11–12, 17, 37, 40, 80, 86, 140, 144, Fig. 6.3, Fig. 6.10, Figs. 7.13–7.14, Fig. 9.1). We agree with Petitioner’s analysis as to how Bessler and Kocybik teach the limitations of claims 1, 16, and 19, which is supported by the testimony of Dr. Ehsani. *See* Ex. 1009 ¶¶ 47–55. Indeed, Patent Owner does not dispute that Kocybik teaches sinewave commutation using vector control with independent Q and d axes to produce continuous phase currents. Furthermore, Petitioner has provided adequate reasoning why a person of ordinary skill in the art would have effected the combination proposed (i.e., configuring the system of Bessler to perform sinewave commutation in the manner described in Kocybik), namely that the use of sinewave commutation and independent Q and d axis currents would have provided predictable results to address known problems associated with other types of motors. Pet. 1121, 36–37 (citing *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 415–421 (2007)). In particular, Petitioner reasons persuasively that “using

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<sup>8</sup> Patent Owner does not dispute Petitioner’s assertion that Kocybik qualifies as a prior art printed publication under 35 U.S.C. § 102(b). *See* Pet. 1121, 4; Paper 30, 3 (“Kocybik describes high end applications at the time of its publication”), 25 (“Kocybik references higher end applications at the time of its publication”); Paper 21, 3 (“The patent owner is cautioned that any arguments for patentability not raised in the response will be deemed waived.”); Paper 70, 3 (same).

rectangular currents creates unwanted torque, and the use of sinusoidal currents can reduce unwanted torque and create smoother and quieter motor operation.” *Id.* at 37 (citing Ex. 1007, 25; Ex. 1009 ¶ 52).

We are not persuaded by Patent Owner’s counterarguments. First, Patent Owner contends that Bessler teaches away from the claimed combinations because “one of the principal objects of Bessler is to eliminate the need for a system controller in an HVAC system,” and that a benefit of such elimination is a reduction in the number of microprocessors used. Paper 30, 15–16 (citing Ex. 1006, col. 1, ll. 22–34, col. 2, ll. 3–5). Patent Owner observes that Bessler “provides an integral microprocessor in its motor controller that can interpret, for example, the cycling of the on/off signal of the thermostat and *directly* create motor control signals without the need of a system controller developing interim system demand signals.” *Id.* at 19–20 (citing Ex. 1006, col. 5, l. 66–col. 6, l. 22). Like Bessler, the Specification of the ’349 patent describes that the “system controller” may be a thermostat *or* a separate controller : “the system controller **402** *may be a thermostat*, an additional control module in communication with a thermostat, or a standalone controller for the HVAC system **400**.” Ex. 1001, col. 4, ll. 35–38 (emphasis added). Thus, the claims do not require a separate standalone system controller. For these reasons, Patent Owner’s teaching away arguments are not commensurate in scope with the claim language.

Second, Patent Owner contends that Kocybik is applied too expansively by Petitioner because Kocybik limits its disclosure to “higher end applications” like hybrid car engines, the aerospace industry, and high-accuracy machine tooling applications: “To be sure, Kocybik discusses motor control schemes including that sine wave commutation may be used with a [brushless permanent magnet] motor, but Kocybik does not discuss HVAC systems or the motors used in them.” Paper 30, 25–27. Patent Owner argues that only through hindsight reconstruction would one apply the teachings of Kocybik to Bessler because common sense in the industry cautioned against using more complex technology in HVAC systems.<sup>9</sup> *Id.* at 27. But Patent Owner’s argument does not effectively rebut the testimony of Dr. Ehsani that a person of ordinary skill in the art “would have recognized that a permanent magnet motor using sinusoidal commutation, such as is disclosed in Kocybik, could result in a motor that exhibits less unwanted ripple torque and, in turn, smoother output torque.” Ex. 1009 ¶ 52 (citing Ex. 1007, 25).

Third, Patent Owner argues that the claims are nonobvious in light of certain objective indicia of nonobviousness. Paper 30, 27–35. When considering evidence of secondary considerations, we are mindful that the objective evidence of nonobviousness in any given case may be entitled to

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<sup>9</sup> Patent Owner also argued that economic infeasibility suggested against the proposed combination, but withdrew that argument at the oral hearing. Tr. 57:20–23.

more or less weight, depending on its nature and its relationship with the merits of the claimed invention. *See Stratoflex Inc. v. Aeroquip*, 713 F.2d 1530, 1538 (Fed. Cir. 1983). To be given substantial weight, evidence of secondary considerations must be relevant to the subject matter as claimed, and there must be a nexus between the merits of the claimed invention and the evidence of secondary considerations. *Ashland Oil, Inc. v. Delta Resins & Refractories, Inc.*, 776 F.2d 281, 305 n.42 (Fed. Cir. 1985).

Patent Owner provides a narrative describing its attempts “to break into the market for variable speed electronically commutated motors for HVAC applications” by designing and selling a square-wave commutated brushless permanent magnet motor and controller called “Magellan.” Paper 30, 29. Dissatisfied with its market share, Patent Owner “decided it needed a different approach,” developing “a more highly functional motor even if the resulting product would cost more.” *Id.* at 30. Patent Owner contends that the quiet operation, a beneficial consequence of sinewave commutation, “was a key feature that led to sales and gained market share,” and supports that contention with testimony by Mark E. Carrier, one of the inventors of the ’349 patent and the Vice President of New Product Development for Patent Owner. *Id.* at 30–31 (citing Ex. 2003 ¶¶ 12(b), 29–32, 34, 44–48). Patent Owner also contends that the selection of independent Q and d axis current control “benefited” the resulting product “because it directly contributed to making torque control easier and more accurate.” *Id.* at 31. Tellingly, Patent Owner cites to no testimony or documentation that

establishes such a connection between the independence of Q and d axis current control and the increase in sales for its new product. For this reason alone, Patent Owner fails to establish the necessary nexus between the merits of the claimed invention and its evidence of secondary considerations. *See In re Pearson*, 494 F.2d 1399, 1405 (CCPA 1974) (unsupported attorney argument in a brief cannot take the place of evidence). We also note our agreement with Petitioner that the evidence of record suggests a number of other features of Patent Owner’s products that may have contributed to commercial success so that we cannot conclude that there is an established nexus between that commercial success and the features recited in the claims. *See* Paper 36, 22–23 (citing Exs. 2005, 2006, 2014) (other advantages include “segmented stator benefits,” “processor boards are separated,” “use of a power module and DSP chip for enhanced performance and reliability,” “Includes Innovative Twist Lock”).

Having considered all of the evidence of record, including Patent Owner’s evidence of alleged secondary considerations of nonobviousness, we conclude that Petitioner has demonstrated, by a preponderance of the

evidence, that independent claims 1, 16, and 19 of the '349 patent are unpatentable.<sup>10</sup>

With respect to dependent claims 2, 3, 8, 9, and 12, we also conclude that Petitioner has demonstrated that they are unpatentable. Claims 2, 3, 8, and 9 recite specific features that Petitioner identifies as disclosed in Kocybik, and we agree with those identifications. Pet. 11–21, 46–52. Claim 12 recites that “at least one control signal from the system controller represents a desired torque or speed of the permanent magnet motor,” which Petitioner identifies as disclosed by Bessler. *Id.* at 52–53 (citing Ex. 1006, col. 2, ll. 47–50, col. 6, ll. 7–20). We agree with that identification. The rationale expressed by Petitioner for combining Bessler and Kocybik for the limitations of the dependent claims remains unchanged, and we determine that that rationale sufficiently supports a conclusion that the subject matter

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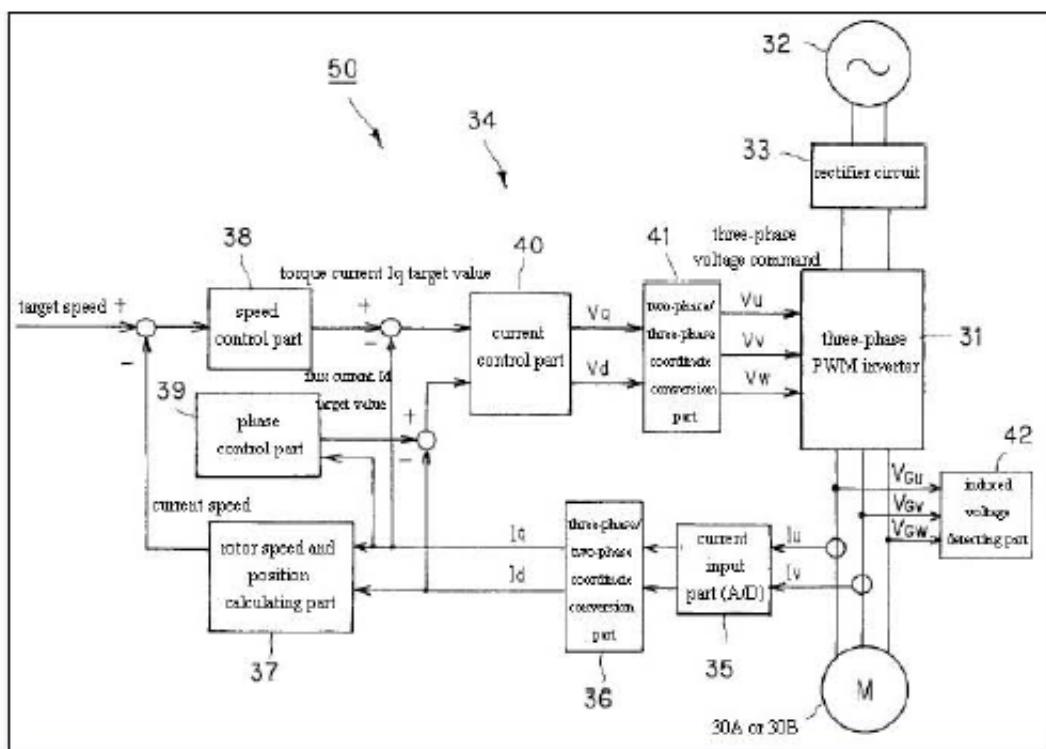
<sup>10</sup> Our conclusion would be unaffected by a determination that the preambles of the claims reciting an HVAC system are limiting. Although Kocybik is not directed explicitly to HVAC systems, Petitioner relies on Bessler for such a teaching. We are persuaded that a person of ordinary skill in the art would have combined the teachings of the references in the manner articulated by Petitioner, particularly given Petitioner’s identification of the disclosure of an ECM by Kocybik and Bessler’s discussion of ECMs. See Pet. 1121, 36–37, 41–42. In particular, the suggestion that one of ordinary skill in the art would substitute a sinusoidally commutated ECM, as disclosed by Kocybik, for the square-wave commutated ECM disclosed by Bessler is supported by sufficient rational underpinnings. See *KSR*, 550 U.S. at 418.

of the dependent claims would have been obvious to one of ordinary skill in the art at the time of the invention. *See Pet. 1121, 36–37.*

#### E. Anticipation by Hideji

Hideji discloses a refrigerant circuit of an air conditioning device with a compressor driven by a permanent magnet synchronous motor.<sup>11</sup> Ex. 1005 ¶ 22. Figure 2 of Hideji is reproduced below.

【Fig. 2】



<sup>11</sup> Hideji uses the terms “permanent magnet synchronous motor” and “brushless DC motor” synonymously. Ex. 1005 ¶ 22.

Figure 2 is a block diagram of a driving device for a permanent magnet synchronous motor. *Id.* ¶ 28. Driving device 50 includes three-phase pulse-width modulation (“PWM”) inverter 31, alternating-current power supply 32, rectifier circuit 33, and control device 34. *Id.* ¶ 30. The control device includes power input part 35, three-phase/two-phase coordinate conversion part 36, rotor speed and position calculating part 37, speed control part 38, phase control part 39, current control part 40, two-phase/three-phase coordinate conversion part 41, and induced voltage detecting part 42. *Id.* ¶ 32. Two-phase/three-phase coordinate conversion part 41 outputs pulse-modulated sinusoidal voltage commands  $V_u$ ,  $V_v$ , and  $V_w$  to a switching element of the three-phase PWM inverter, thereby providing quasi-sinusoidal three-phase alternating current to the motor. *Id.* ¶ 33. Three-phase/two-phase coordinate conversion part 36 converts coordinates of two-phase alternating current  $I_u$  and  $I_v$  introduced by current input part 35 to a revolving coordinate system on the rotor of the motor, and calculates flux current  $I_d$  (d axis current) and torque current  $I_q$  (Q axis current). *Id.* ¶ 35.

Petitioner adequately identifies the “system controller,” “motor controller,” “blower” or “air-moving component,” and “permanent magnet motor,” recited in different combinations in independent claims 1, 16, and 19, with reference to the above structures disclosed by Hideji. Pet. 762, 12–19, 32–44. Petitioner also identifies sufficient structure of Hideji’s brushless DC motor that includes stator and rotor components, i.e., stationary and rotatable assemblies with a shaft coupled to the air-moving component or

blower, as recited in the independent claims. *Id.* at 17–19. Petitioner’s analysis is supported with testimony by Dr. Ehsani. Ex. 1009.

With respect to the limitations requiring “performing sinewave commutation, using independent values of Q and d axis currents, in response to one or more control signals received from the system controller to produce continuous phase currents in the permanent magnet motor for driving the air-moving component,” recited in each of independent claims 1, 16, and 19, Petitioner observes that Figure 2 of Hideji illustrates that three-phase/two-phase coordinate conversion part 36 outputs separate values for  $I_q$  and  $I_d$ , i.e., the Q and d axis currents.<sup>12</sup> Pet. 762, 23–24. Hideji discloses that

[t]he three-phase/two-phase coordinate conversion part 36 converts the coordinates of the alternating current  $I_u$  and  $I_v$  introduced by the current input part 35 to a revolving coordination system (d-q coordination system) on the rotor of the brushless DC motor 30A, and calculates flux current  $I_d$  (d-axis current) and torque current  $I_q$  (q-axis current).

Ex. 1005 ¶ 35. Petitioner reasons that such transformation results in separate, independent values of Q and d axis currents determined from control signals received from the system controller. Pet. 762, 23. Petitioner supports this reasoning with testimony by Dr. Ehsani. Ex. 1009 ¶ 38.

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<sup>12</sup> We note that the labels “ $I_q$ ” and “ $I_d$ ” output from part 36 of Hideji are identified directly as such in the original Japanese reference. Ex. 1003, 8.

Patent Owner responds that “[t]aken in context, the independent Q and d axis current must necessarily be the Q and d axis currents the motor controller calculates are required to satisfy the system controller demand and that are used to set or produce the continuous phase sine wave commutated currents for the motor.” Paper 72, 6. In light of our construction of “using independent values of Q and d axis currents,” we disagree with this position. In particular, Patent Owner’s argument that the structure identified by Petitioner “at best, represents the instantaneous measured current values of  $I_q$  and  $I_d$ ” and “is not the demanded value of  $I_q$  and  $I_d$  developed by the motor controller,” *id.*, is unpersuasive. For the reasons expressed above, we construe the claim limitation as requiring the use of *actual* Q and d axis currents that are developed independently of each other.

Patent Owner further argues that, if Hideji were to anticipate, “it must show that independently derived  $I_q$  and  $I_d$  values are fed into the current control part 40.” *Id.* at 10. Patent Owner observes that, in this context, Hideji explicitly describes a dependence on “the Q axis current and d axis current”:

The phase control part 39 identifies the state of a load by introducing the torque current  $I_q$  in direct proportion to the change of the load acting on the brushless DC motor 30A, to generate a flux current  $I_d$  target value corresponding to the state of the load. Specifically, by introducing the torque current  $I_q$  in direct proportion to the increase of the load acting on the brushless DC motor 30A, the flux current  $I_d$  target value is reduced on the basis of the following formula. In addition, in the following formula, k is a positive constant.

The flux current  $I_d$  target value is equal to  $k \times I_q^2$ . By reducing the flux current  $I_d$  target value, the flux voltage  $V_d$  output by the after-mentioned current control part 40 is reduced, the phases of the voltage commands  $V_u$ ,  $V_v$  and  $V_w$  output by the two-phase/three-phase coordinate conversion part 41 are advanced, and the phases of the voltage commands  $V_u$ ,  $V_v$  and  $V_w$  delayed due to the increase of the load are restored.

Ex. 1005 ¶¶ 38–39. This argument obscures the fact that the expression in paragraph 39 of Hideji relates the  $I_d$  target value (equivalent to the *demand* d axis current value) to the *actual* Q axis current value  $I_q$ , a fact confirmed by both parties at the oral hearing. Tr. 15:14–16:4, 33:7–16. Hideji’s disclosure of a proportionality of the *demand* d axis current and the square of the *actual* Q axis current is irrelevant in light of our construction of “using independent values of Q and d axis currents.”

We conclude that Petitioner has demonstrated, by a preponderance of the evidence, that independent claims 1, 16, and 19 are anticipated by Hideji.

With respect to dependent claims 2, 3, 8, 9, and 12, we also conclude that Petitioner has demonstrated that they are anticipated by Hideji. Petitioner identifies disclosures in Hideji that correspond to the limitations in each of these claims, identifications that are not contested by Patent Owner, and we agree with those identifications. *See* Pet. 762, 27–32.

#### *F. Motion to Amend*

Contingent upon respective Board determinations that original independent claims 1, 16, and 19 are unpatentable, Patent Owner moves to

amend those claims by substituting proposed claims 21–23. Paper 73, 6. The proposed amendments are similar for each of the independent claims, reciting the use of “vector control” having independent values of Q and d axis currents, “wherein the control signals received from the system controller are at least one member selected from the group consisting of demanded torque, demanded speed, and demanded airflow and wherein vector control of the motor controller enables substantially no interaction between the motor controller and an airflow control loop of the system.” *Id.* at 1–3. Patent Owner asserts that its conditional amendments “add[] limitations to those claims that further define and narrow the scope of the claimed invention.” *Id.* at 7. Patent Owner provides charts on pages 7–9 of the Motion to Amend identifying support for existing claims limitations and for its conditional amendments. The identified support for existing claim limitations includes, *inter alia*, Figure 8 of the ’349 patent and Exhibit 3001, i.e. the ’379 patent, which is incorporated by reference into the ’349 patent. *Id.* at 7–9; Ex. 1001, col. 4, ll. 23–29.

In our Order memorializing the conference call with the parties regarding the Motion to Amend, we directed the parties to *Idle Free Sys., Inc. v. Bergstrom, Inc.*, Case IPR2012-00027 (PTAB June 11, 2013) (Paper 26) (informative), and *MasterImage 3D, Inc. v. RealD Inc.*, Case IPR2015-00040 (PTAB July 15, 2015) (Paper 42), for “[g]uidance regarding the mechanics and substance of motions to amend.” Paper 71, 2. As the moving party, Patent Owner bears the burden of establishing that it is

entitled to the relief—namely, addition of the proposed claims to the patent. 37 C.F.R. § 42.20(c). To satisfy that burden, Patent Owner must meet the requirements of 37 C.F.R. § 42.121 and demonstrate the patentability of the proposed substitute claims. *Idle Free*, Paper 26, at 6–10; *see also Microsoft Corp. v. Proxyconn, Inc.*, 789 F.3d 1292, 1308 (Fed. Cir. 2015) (“Assuming an amendment is appropriately responsive to the grounds of unpatentability involved in the trial, the patentee must still go on to show that it is entitled to its substitute claim.”).

A component of Patent Owner’s burden includes the need “to show patentable distinction over the prior art of record and also prior art known” to Patent Owner. *Idle Free*, Paper 26, at 7. The Board has held that “prior art of record” refers to material art in the prosecution history of the patent, material art of record in the current proceeding before the Board, and material art of record in any other proceeding before the Office involving the patent. *See MasterImage 3D*, Paper 42, at 2. To that end, Patent Owner discusses Bessler, Kocybik, and Hideji, and combinations of the three, in its motion. Paper 73, 15–21. But Patent Owner does not discuss the ’379 patent, nor does it discuss U.S. Patent Nos. 6,326,750, 6,756,757, or 7,208,895, each of which is also incorporated by reference into the ’349 patent. *See* Ex. 1001, col. 4, ll. 23–29. Each of these references also appears on the face of the ’349 patent as having been cited during prosecution of the ’349 patent. *Id.* at [56].

Patent Owner does not challenge Petitioner’s contention that each of these references is prior art to the ’349 patent. *See* Paper 77, 14–16. The omission of these references from Patent Owner’s analysis is significant. As we note above, the Specification of the ’349 patent provides sparse details of how vector control is achieved in the context of the claimed invention—whether as originally claimed or as proposed by the conditional amendments. The drawing on which the patentee relied for adding limitations related to vector control during prosecution is very similar to Figures 2 and 3 of the ’379 patent; indeed, it is substantially identical to those drawings in those respects that relate to vector control. As such, we find at least the ’379 patent to be material prior art of record. Patent Owner addresses the disclosure of the ’379 patent in its Reply to Petitioner’s Opposition to Patent Owner’s Motion to Amend. Paper 80, 8–10.

When questioned at the oral hearing regarding its failure to address the ’379 patent and other patents incorporated by reference into the ’349 patent in its Motion to Amend, Patent Owner responded that “we have to make judgments about what we think is the closest prior art given the page limitations that are imposed upon us.” Tr. 63:13–25. Yet Patent Owner used less than 21 of the 25 pages permitted for motions to amend, leaving an unused portion that exceeds the space it devotes to addressing the ’379 patent in its Reply to Petitioner’s Opposition to Patent Owner’s Motion to Amend. *See* 37 C.F.R. § 42.24(a)(1)(vi).

With respect to the proposed additional limitations, Patent Owner’s expert, Dr. Blank, testified that the ’379 patent discloses “vector control.” Ex. 1043, 14:14–15:14. The “speed loop controller” that appears in Figure 8 of the ’349 patent (identified by the Board as element 815 *supra*) also appears in Figure 3 of the ’379 patent, interfacing with elements of the vector control scheme in the same way. Dr. Blank testified that the “airflow control loop” proposed to be added to the claims would be recognized as included in the “speed loop controller.” *Id.* at 80:8–82:4 (“So it’s not explicit, but it’s in there.”). According to Dr. Blank, there would be substantially no motor controller interaction with such an airflow loop controller. *Id.* at 82:5–83:3. Furthermore, Dr. Blank testified that column 6, lines 1–7 of the ’379 patent would teach a person of ordinary skill how to generate independent Q and d axis currents. *Id.* at 46:13–49:1.

Thus, we are not persuaded that Patent Owner’s proposed amendments adequately distinguish from the disclosure of the ’379 patent. Accordingly, we deny Patent Owner’s Motion to Amend.

#### *F. Motions for Observation*

Patent Owner filed three (sealed) motions for observation on the cross-examination of three witnesses of Petitioner (Papers 46–49). Petitioner responded with three separately filed Responses (Papers 59–61). The Scheduling Order provides for a single motion for observation on cross-examination from either party, and a single response from the

opposing party, each of which is limited to 15 pages. *See* Paper 21, 5; 37 C.F.R. §§ 42.24(a)(1)(v), 42.24(b)(3). As such, we have considered only the first 15 pages filed by each party in rendering our Decision. *See* Papers 46, 59, 60; Paper 61, 1.

### III. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that, based on a preponderance of the evidence, claims 1–3, 8, 9, 12, 16, and 19 of U.S. Patent No. 7,626,349 B2 are held to be unpatentable;

FURTHER ORDERED that Petitioner’s Motion to Exclude portions of Exhibit 2003 and the entirety of Exhibits 2010, 2011, and 2018–2025 is *dismissed*;

FURTHER ORDERED that Patent Owner’s Motion to Exclude portions of Exhibit 1020 and the entirety of Exhibits 1034 and 1035 is *dismissed*;

FURTHER ORDERED that Patent Owner’s Motion to Amend is *denied*; and

FURTHER ORDERED that, because this is a final written decision, parties to this proceeding seeking judicial review of our decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

IPR2014-01121  
Patent 7,626,349 B2

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