2016-2321

United States Court of Appeals for the Federal Circuit

NIDEC MOTOR CORPORATION,

Appellant,

v.

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

Appellees.

Appeal from the United States Patent and Trademark Office
Patent Trial and Appeal Board, IPR2014-01121,
Sally C. Medley, Justin T. Arbes, Benjamin D. M. Wood, James A. Tartal,
and Patrick M. Boucher,
Administrative Patent Judges

BRIEF OF APPELLANT

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Counsel For Patent Owner/Appellant

November 7, 2016

CERTIFICATE OF INTEREST

Counsel for Patent Owner/Appellant certifies the following information in compliance with Federal Rule of Appellate Procedure 26.1 and Federal Circuit Rules 26.1 and 47.4:

1. The full name of every party represented by us is:

   Nidec Motor Corporation

2. The names of the real parties in interest (if the party named in the caption is not the real party in interest) represented by us is:

   N/A

3. All parent corporations and any publicly held companies that own 10 percent or more of the stock of Nidec Motor Corporation are:

   Nidec Americas Holding Corporation
   Nidec Corporation

4. The names of all law firms and the partners or associates that appeared for Nidec Motor Corporation before the Patent Trial and Appeal Board or are expected to appear in this Court are:

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November 7, 2016

/s/ Scott R. Brown
Scott R. Brown
Counsel for Appellant

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STATEMENT OF RELATED CASES

Prior to the Appellees (collectively, "Broad Ocean") filing their Petition for *Inter Partes* Review (IPR) of claims 1-3, 8, 9, 12, 16, and 19 of U.S. Patent No. 7,626,349 ("the '349 Patent"), Appellant Nidec Motor Corporation sued Broad Ocean for infringement of the '349 Patent in *Nidec Motor Corp. v. Broad Ocean Motor LLC et al.*, Civil Action No. 4:13-cv-018-95-JCH, in the United States District Court for the Eastern District of Missouri.

On May 12, 2016, the district court ordered that case administratively closed pending a final, non-appealable decision with respect to each of the IPR proceedings involving the '349 Patent.

STATEMENT OF JURISDICTION

The Patent Trial and Appeal Board had jurisdiction over Broad Ocean's IPR Petition under 35 U.S.C. § 6. This appeal is from a final decision; namely, the Board's Final Written Decision issued on May 9, 2016. Nidec timely filed its Notice of Appeal on July 11, 2016. This Court thus has jurisdiction under 28 U.S.C. § 1295(a)(4)(A) and 35 U.S.C. § 319.

ISSUES PRESENTED FOR REVIEW

1. Whether the Board erred in determining claims 1-3, 8, 9, 16, and 19 unpatentable as obvious in view of Bessler and Kocybik, when Bessler's invention teaches away from the claimed combination.

2. Whether the Board erred in determining claims 1-3, 8, 9, 16, and 19 unpatentable as anticipated by Hideji, when: (1) the Board exceeded its statutory authority by instituting IPR more than a year after Broad Ocean was served with a complaint asserting the '349 patent by permitting Broad Ocean to join itself to circumvent the one-year statutory bar; and (2) Hideji does not disclose a motor controller "configured for performing sinewave commutation, *using independent values of Q and d axis currents*."

STATEMENT OF THE CASE

This appeal arises from Broad Ocean's IPR challenging the patentability of eight claims of the Nidec-owned '349 patent. Nidec is a leading manufacturer of motors and controls. Its large motors are used in industrial and commercial applications, while its smaller motors can be found in residential applications such as home HVAC systems.

The '349 patent's invention relates to improvements in an HVAC system motor controller. Namely, each challenged claim requires a motor controller that performs sinewave commutation using independent values of quadrature and direct (Q and d) axis currents. The claimed control scheme results in reduction in torque ripple, which in turn reduces vibrations in the HVAC system that can otherwise be amplified through a duct system. The prior art, which uses square-wave commutation, did not achieve the many benefits of sinewave commutation and independent Q and d axis control. For example, the prior art attempted to address unwanted vibrations and noise endemic to square-wave systems by employing mechanical dampers to the rotating parts of the system. Such dampening is avoided and the vibrations prevented in the first instance as a result of the invention.

In its Final Written Decision, the Board determined that the '349 patent's invention was unpatentable. First, the Board held that a skilled artisan would have

found it obvious to combine a motor capable of performing sinewave commutation as described in Peter Franz Kocybik, *Electronic Control of Torque Ripple in Brushless Motors* (University of Plymouth, July 2000), with an HVAC system described in U.S. Patent No. 5,410,230 to Bessler, to arrive at the claimed invention. In so holding, the Board ignored that the claimed advance of Bessler was to eliminate one of the limitations of the instant claimed invention, and instead engaged in impermissible hindsight by concluding it would have been obvious to implement the relatively complex sinewave commutation techniques described in Kocybik into the HVAC system of Bessler.

Second, the Board allowed Broad Ocean to present otherwise time-barred anticipation arguments by joining itself to its already pending IPR, and subsequently found the claims anticipated by JP2003-348885 to Hideji. Although a three-judge panel originally held that such arguments were time-barred, the USPTO expanded the panel and the subsequent five-judge panel reversed. And although Hideji fails to disclose "independent values of Q and d axis currents," the principal limitation at issue in this appeal, the Board relied on Broad Ocean expert's conclusory statement that Hideji shows such a feature notwithstanding that the expert's statement was offered in the context of a different (and ultimately rejected) construction of the term "independent."

Because the Board engaged in impermissible hindsight by combining Bessler and Kocybik, exceeded its statutory authority by instituting IPR proceedings in view of Hideji in the first place, and misconstrued what Hideji does (and does not) disclose once those proceedings were instituted, the Board erred in concluding that claims 1-3, 8, 9, 16, and 19 are unpatentable as obvious or anticipated. This Court should thus reverse and remand.

STATEMENT OF FACTS

I. THE '349 PATENT

A. Background of the Invention

The '349 patent was filed on February 1, 2007, and relates to improvements in controlling a permanent magnet (PM) motor used in an HVAC system. Appx0046, Appx0051, Col. 1:38-44.

PM motors generally include a stationary component (stator) and a rotating component (rotor). Appx0800, Col. 3:14-16. The rotor includes a permanent magnet and the stator includes multiple phase windings that, when electrically charged, form electromagnets. Appx0481, ¶ 15, Appx0800, Col. 3:17-22. The motor controller commutates—i.e., energizes in a particular sequence—currents among the phase windings to create a rotating magnetic field, which, in turn, causes the PM rotor to rotate. Appx0051, Col. 1:37-47.

Prior-art HVAC systems employed square-wave, or "6-step," commutation to energize the phase windings. Appx0051, Col. 1:30-33. In 6-step commutation, a motor controller applies a positive voltage to one of three phase windings, a negative voltage to a second, and leaves the third unenergized. Appx0051, Col. 1:37-43. The motor controller then sequentially (and abruptly) rotates the positive and negative voltages among the phase windings to create the rotating magnetic field that in turn

causes the PM rotor to rotate and drive an air-moving component. Appx0051, Col. 1:43-47. This abrupt switching results in discontinuous phase currents, high cogging torque and torque ripple, and vibrations that are amplified through the duct system. Appx0051, Col. 1:51-61. These prior-art HVAC systems thus required mechanical dampers to address the unwanted vibrations and noise. Appx0051, Col. 1:64-67.

The ’349 patent’s invention, in contrast, uses sophisticated sinewave-commutation techniques such that the motor operates with reduced torque cogging and torque ripple, resulting in quieter operation and eliminating the need for mechanical dampers. The basic structure of the ’349 patent’s HVAC system is shown in Figure 4, reproduced below.

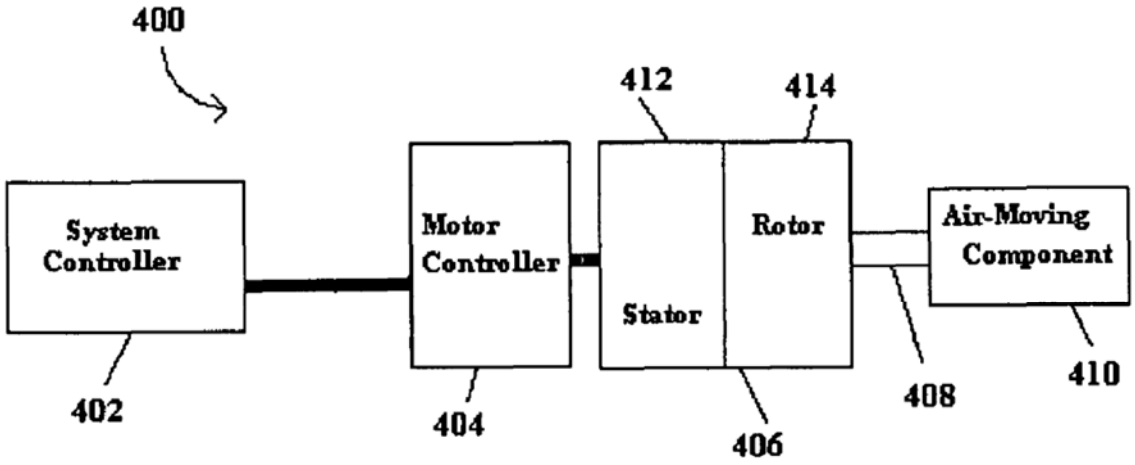
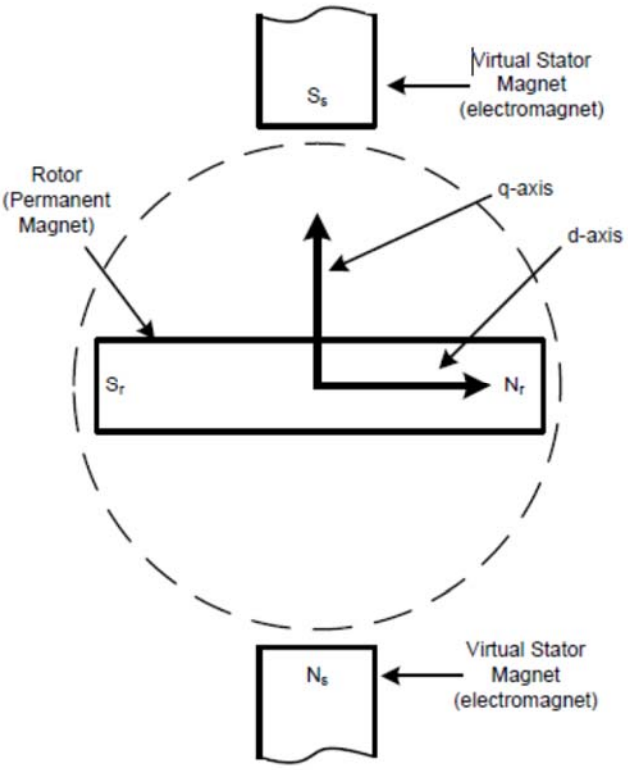


Figure 4

Appx0049.

The HVAC system 400 includes a PM motor 406 with a shaft 408, a stator 412, and a rotor 414. Appx0052, Col. 3:50-54. The rotor 414 is magnetically coupled to the stator 412 and coupled to an air-moving component 410 via the shaft 408. Appx0052, Col. 3:54-58.

The motor controller 404 employs vector-control techniques to produce continuous phase currents in the windings of the stator 412 and thus reduce unwanted torque ripple and torque cogging. Broad Ocean's expert, Dr. Mark Ehsani, explained vector control using the following illustration.



Appx0480.

This drawing shows a rotor with a permanent magnet having north and south poles Nr and Sr, respectively, a stator with electromagnets that result in a virtual magnet having north and south poles Ns and Ss, respectively, and a rotating frame of reference with a direct axis (d-axis) and a quadrature axis (q-axis). Appx0481, ¶¶ 15-16. Dr. Ehsani explained that use of the rotating frame of reference "simplifies the mathematical representation of the motor control and allows for precise control of the motor." Appx0479, ¶ 12. Namely, the d-axis is aligned with the rotor and the q-axis is offset 90 degrees from the d-axis. Appx0481, ¶ 16. In order to produce the maximum possible torque, the magnetic field created by the stator must remain 90 degrees from the rotor (i.e., aligned with the q-axis) as the rotor turns. Appx0481, ¶ 16. But the stator windings are stationary, and thus the energizing currents are ultimately supplied to the phase windings in the stationary frame of reference. Appx0481, ¶ 16. Vector control thus requires complex hardware such as a digital signal processor (DSP) capable of performing transformations between the stationary and rotating frame of references such that the motor controller can commutate the winding currents to maintain orthogonality of the d- and q-axes as the rotor turns. Appx0481, ¶ 16, Appx0744, Col. 1:51-56.

In the '349 patent, the motor controller 404 uses these vector-control techniques to ensure continuous phase currents are produced in the PM motor 406.

Appx0052, Col. 4:3-7. More particularly, in response to receiving control signals demanding a speed, torque, or airflow from a system controller 402, the motor controller performs sinewave commutation—i.e., "us[es] vector control to ensure the continuous phase currents produced in the permanent magnet motor are substantially sinusoidal"—to drive the air-moving component 410 to meet system demands. Appx0052, Cols. 3:59-4:7. Unlike 6-step commutation, during sinewave commutation the motor controller 404 continuously energizes each phase winding in the stator 412, eliminating the stepwise progression and reducing torque cogging and ripple, which in turn reduces vibrations in the HVAC system. Appx0052-0053, Cols. 4:66-5:19. As such, dampening can now be avoided and the vibrations prevented in the first instance. Appx0053, Col. 5:8-11.

B. The Claims-at-Issue and the Board's Construction

Claims 1-3, 8, 9, 16, and 19 of the '349 patent are at issue in this appeal. Independent claim 1 generally recites an HVAC system including a motor controller "configured for performing sinewave commutation, using independent values of Q and d axis currents, in response to one or more control signals received from [a] system controller to produce continuous phase currents in [a] permanent magnet motor for driving [an] air-moving component." Appx0053, Col. 5:34-45. Independent claims 16 and 19 recite a blower assembly and a method for driving an

air-moving component, respectively, comprising substantially similar features as claim 1. Appx0053, Col. 6:23-33, 43-55. And the remaining challenged claims each depend from claim 1 and recite additional features of the PM motor including a plurality of phase windings (claim 2), substantially sinusoidal phase currents (claim 3), a brushless permanent magnet (BPM) motor (claim 8), and a back-emf BPM motor (claim 9). Appx0053, Cols. 5:46-51, 62-63, 6:1-2.

In reviewing the claims-at-issue, the Board discussed two claim-construction issues relevant to this appeal. First, notwithstanding the common thread that the term "HVAC system" provides throughout the '349 patent's specification, the Board refused to give that term patentable weight because it was recited in the preamble and not the body of the claims. *See* Appx0021-0022. The Board also (for the *first time* in its Final Written Decision) construed the term "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." Appx0022-0023 (emphasis added). Previously, the Board had not considered this term to be referring to "actual" currents. Appx0179.

II. *INTER PARTES* REVIEW

A. The Prior Art

Broad Ocean filed a petition for IPR of the ’349 patent on July 3, 2014, and a revised petition on July 28, 2014. In the petitions, Broad Ocean challenged claims 1-3, 8, 9, 16, and 19 of the ’349 patent as being obvious in view of a combination of Bessler and Kocybik, and as anticipated by Hideji. Appx0058-0107, Appx0114-0170. Each relied-on prior-art reference is briefly discussed below.

1. U.S. Patent No. 5,410,230 to Bessler

Bessler, which was considered during prosecution of the ’349 patent, describes a HVAC system including a motor controller that is directly responsive to a two-state (on/off) temperature signal provided by a thermostat. Appx0222, Cols. 1:18-21, 31-37, 2:3-5. The motor controller includes a microprocessor 302 having memory storing various system parameters. Appx0224-0025, Cols. 5:40-42, 6:13-22, 7:58-64. During use, the microprocessor 302 outputs a motor control signal solely as a function of the received two-state temperature signal and at least one of the stored parameters. Appx0225, Cols. 7:61-Col. 8:8. Bessler explains that because only a relatively primitive microprocessor 302 is needed to output a motor-control signal as a function of the on/off temperature signal and stored parameters, *its invention eliminates a system controller otherwise needed to generate a “signal*

defining the speed and airflow rate of the system." Appx0223, Col. 3:55-66 (emphasis added).

2. Peter Franz Kocybik, Electronic Control of Torque Ripple in Brushless Motors *(University of Plymouth, July 2000)*

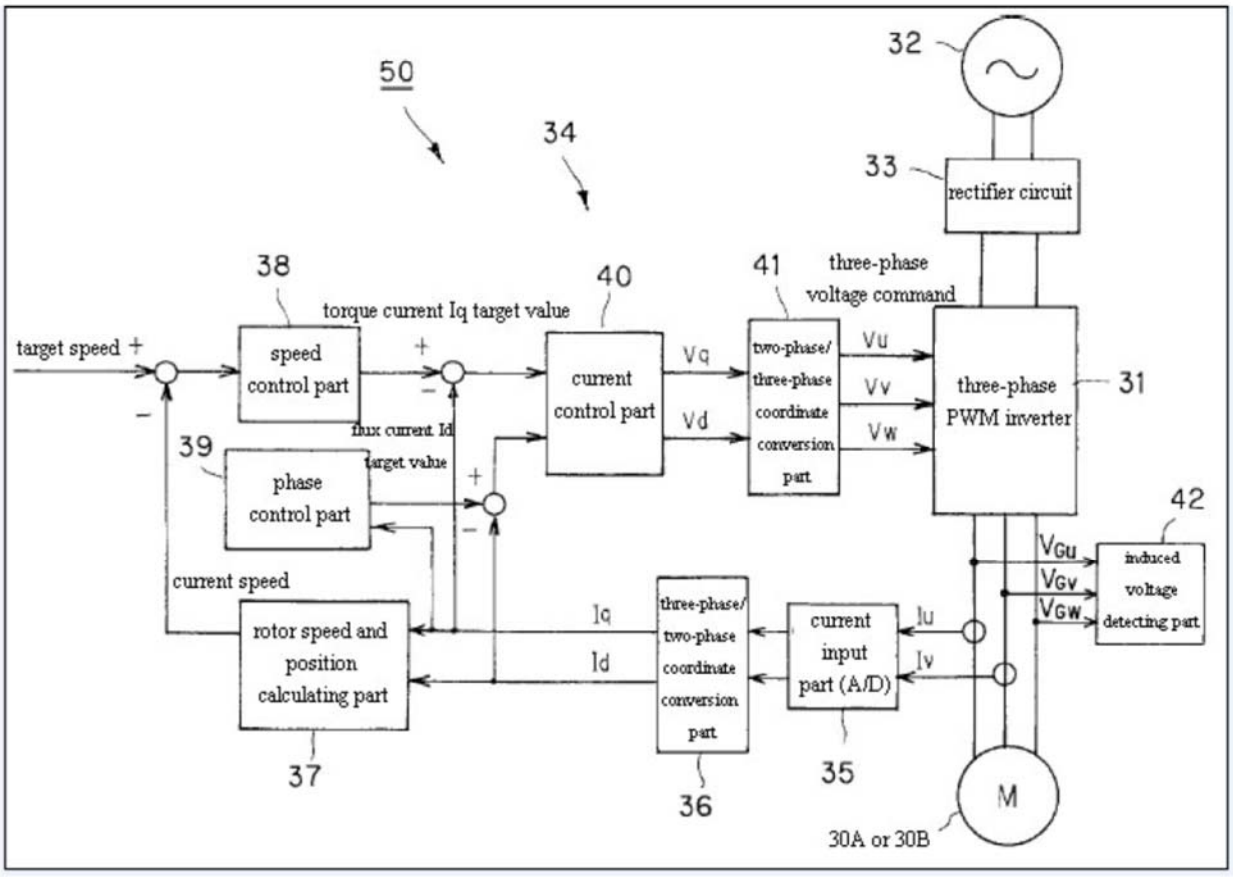
Kocybik is a doctoral thesis canvassing control schemes used for brushless motors. Appx0234-0235. In one application, Kocybik compares the use of rectangular current pulses (i.e., 6-step commutation) in "brushless dc motors," with sinewave commutation in "brushless ac motors." Appx0262-0263. Kocybik explains that "[f]or an ideal brushless ac motor[,] the drive has to produce ideal sinewave currents," requiring "high bandwidth current control." Appx0263. Kocybik concludes that *the "brushless ac motor is therefore more suitable for high precision control tasks than the brushless dc motor*." Appx0263 (emphasis added). Kocybik provides some examples of the relatively exotic applications that would require such "demanding direct drive applications," including high accuracy machine tools, robotic arms, aerospace applications, and hybrid cars. Appx0249, Appx0265-0266. Notably, Kocybik does not discuss HVAC systems or the motors used therein.

3. JP2003-348885 to Hideji

Hideji is directed to "a method and device for controlling a [PM] synchronous motor and an air conditioning device," and, more particularly, to "controlling a [PM]

synchronous motor in a sine wave driving mode." Appx0195-0196, ¶¶ 0001, 0006. Figure 2 shows a block diagram of Hideji's driving device 50 for a PM motor, reproduced below.

【Fig. 2】



Appx0212.

This driving device 50 uses *dependent* Q and d axis currents to produce a demanded torque in a PM motor. Specifically, in response to receiving a target speed (i.e., a system demand), a speed control part 38 performs proportional integral (PI)

control based on the deviation between actual and target speed to generate a "torque current Iq target value" (i.e., a demand q-axis current). Appx0201, ¶¶ 0036-37. A phase control part 39 then calculates "a flux current Id target value" (i.e., a demand d-axis current) *according to the formula* $Id = k \times Iq^2$. Appx0201-0202, ¶¶ 0038-39. Thus, *the d-axis current is derived from, and thus dependent from, the q-axis current*. Appx0201-0202, ¶¶ 0038-39.

A current control part 40 next "executes PI control based on the deviation between the torque current Iq target value . . . and the actual current Iq to calculate a torque voltage Vq (Vq-axis voltage), and executes PI control based on the deviation between the flux current Id target value . . . and the actual flux current Id target value to calculate a flux voltage Vd (Vd-axis voltage)." Appx0201-0202, ¶ 0040. The current control part 40's output, Vq and Vd, is then used to create the continuous-phase sinewave-commutated currents for the motor. Appx0202, ¶ 0041. Namely, voltages Vq and Vd are converted from the rotating frame of reference to the stationary frame of reference by two-phase/three-phase coordinate conversion part 41, resulting in pulse-modulated sinusoidal voltage commands Vu, Vv, and Vw. Appx0202, ¶ 0041. These voltages are supplied to the three-phase pulse width modulation (PWM) inverter 31, which outputs a three-phase, alternating current to a brushless DC motor 30A. Appx0202, ¶ 0041.

As part of a feedback path of the driving device 50, current input part 35 reads and performs analog-to-digital conversion of instantaneous, alternating currents Iu and Iv. Appx0201, ¶ 0034. These instantaneous, alternating currents Iu and Iv thus originate from the Id and Iq target values, which, as discussed, are dependent upon one another. Appx0201-0202, ¶¶ 0038-39.

A three-phase/two-phase coordinate conversion part 36 receives the digital measurements of Iu and Iv and transforms them back to the rotating frame of reference, resulting in an actual torque current Iq (i.e., actual q-axis current) and actual flux current Id (i.e., actual d-axis current). Appx0201, ¶ 0035. These currents, in turn, are used to determine the actual rotor speed and position, and, ultimately to participate in the generation of the dependent target q- and d-axis currents, as discussed. Appx0201, ¶ 0035. *The actual q- and d-axis currents, which are created by the target q- and d-axis currents, are therefore themselves dependent upon one another*.

B. The Institution Decisions

On January 21, 2015, the Board instituted IPR with respect to the Bessler/Kocybik obviousness ground. Appx0184-0188. But the Board denied the Petition with respect to the Hideji anticipation ground because Broad Ocean failed to comply with 37 C.F.R. § 42.63(b) by not providing an affidavit attesting to the

accuracy of Hideji, which was translated into English from its native Japanese. Appx0184.

On February 20, 2015, Broad Ocean filed a second, time-barred petition for IPR of the '349 patent again challenging the claims-at-issue as being anticipated by Hideji. Appx0803-0858. Although Broad Ocean acknowledged its petition was untimely under 35 U.S.C. § 315(b), Broad Ocean asserted that the one-year time limit did not bar its petition because it was instead seeking to join itself under 35 U.S.C. § 315(c) to the previously instituted IPR. Appx0813.

On July 20, 2015, a three-judge panel of the Board denied the second petition as time-barred. Appx0869-0873. The panel explained that "the phrase 'join as a party' [of § 315(c)] indicates that only a person who is not already a party to an instituted [IPR] can be joined to the proceeding." Appx0870-0871. Thus Broad Ocean, as the petitioner in the original IPR, could not now join itself in an effort to fix the defects of its first petition. Appx0871-0873.

On August 18, 2015, Broad Ocean requested rehearing of the Board's decision not to institute IPR. Appx0879-0931. In response, the USPTO expanded the panel considering the issue to five judges, and, on October 5, 2015—one week before oral argument was scheduled for the instituted obviousness ground—the expanded panel granted Broad Ocean's motion for rehearing, instituted IPR with respect to Hideji,

and joined the proceeding with the previously-instituted IPR. Appx0940-0941. The majority's decision drew sharp criticism in a dissent from two judges of the original three-judge panel, who opined that the Board was "us[ing] an expanded panel on rehearing to arrogate power beyond that granted by Congress." Appx0942 (Boucher, A.P.J., dissenting).

C. The Board's Final Decision

In its Final Written Decision, the Board determined claims 1-3, 8, 9, 16, and 19 to be unpatentable as obvious in view of a combination of Bessler and Kocybik, and as anticipated by Hideji. Appx0027-0039, Appx0044. This appeal follows.

SUMMARY OF ARGUMENT

The Board invalidated claims 1-3, 8, 9, 12, 16, and 19 of the '349 patent as obvious in view of Bessler and Kocybik, and as anticipated by Hideji. The Board erred in both respects.

First, the Board's obviousness conclusion is flawed because Bessler teaches away from the proposed combination. Bessler's aim was to simplify an HVAC system's control scheme by eliminating one of the claimed elements: a system controller used to interpret system demands and, in response, develop motor control signals. One skilled in the art would thus not have found it obvious to ignore this core teaching and instead outfit Bessler's HVAC system with an additional (and higher-functioning) controller necessary to perform even more complex sinewave-commutation computations. For its part, Kocybik does nothing to ameliorate Bessler's teaching, confirming that its described sinewave-commutation techniques necessitate complex hardware and thus are best suited for exotic applications requiring high-precision control.

Second, the Board erred in invalidating the challenged claims as anticipated. The Board should not have even instituted IPR on this ground because it was time-barred (as Broad Ocean itself conceded) and § 315(c)'s joinder provision should not

be interpreted as providing an end-run around to § 315(b)'s one year statute of limitations.

In any event, Hideji fails to disclose the principal limitation on appeal: performing sinewave commutation, using independent values of Q and d axis currents. Indeed, Hideji expressly states that the q- and d-axis currents described therein are derived from one another and thus are dependent. Dr. Ehsani's opinion to the contrary is conclusory and was premised on a construction of "independent" rejected by the Board.

Thus, this Court should reverse the Board's decision that claims 1-3, 8, 9, 12, 16, and 19 are unpatentable as obvious in view of Bessler and Kocybik, and as anticipated by Hideji.

ARGUMENT

I. APPLICABLE LEGAL STANDARDS

A. Standards During IPR

During IPR of an unexpired patent, the Board gives claim terms their broadest reasonable interpretation, *In re Cuozzo Speed Techs., LLC*, 793 F.3d 1268, 1280 (Fed. Cir. 2015), *aff'd sub nom. Cuozzo Speed Techs., LLC v. Lee*, 136 S. Ct. 2131 (2016), and the petitioner must prove that the challenged claims, as so construed, are unpatentable by a preponderance of the evidence, 35 U.S.C. § 316(e); 37 C.F.R. § 42.1(d).

For obviousness, this means the petitioner must show that the "objective reach of the claim . . . extends to what is obvious." *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 419 (2007). This is determined by analyzing (1) the scope and content of the prior art, (2) the differences between the prior art and the claims, (3) the level of ordinary skill in the pertinent art, and (4) secondary considerations of nonobviousness. *Graham v. John Deere Co. of Kan. City*, 383 U.S. 1, 17-18 (1966). This determination must be based on the knowledge possessed by one of ordinary skill in the art at the time of the invention; it is impermissible to use hindsight to piece together the prior art. *InTouch Techs., Inc. v. VGO Commc'ns, Inc.*, 751 F.3d 1327, 1351-52 (Fed. Cir. 2014). Obviousness is unlikely if the prior art teaches away

from the claimed invention such that "a person of ordinary skill, upon reading the reference, would be discouraged from following the path set out in the reference, or would be led in a direction divergent from the path that was taken by the application." *In re Gurley*, 27 F.3d 551, 553 (Fed. Cir. 1994).

To show anticipation, the petitioner must demonstrate that the claimed invention is not new, meaning "[a] single reference . . . describe[s] the claimed invention with sufficient precision and detail to establish that the subject matter existed in the prior art." *Verve, LLC v. Crane Cams, Inc.*, 311 F.3d 1116, 1120 (Fed. Cir. 2002). In that regard, references that are ambiguous as to the presence or description of an element cannot, as a matter of law, anticipate. *Cheese Sys., Inc. v. Tetra Pak Cheese & Powder Sys., Inc.*, 725 F.3d 1341, 1351 (Fed. Cir. 2013).

B. This Court's Review of the Board's Decisions

This Court reviews the Board's decisions under the standards of the Administrative Procedure Act (APA). *Pride Mobility Prods. Corp. v. Permobil, Inc.*, 818 F.3d 1307, 1313 (Fed. Cir. 2016). Namely, this Court should "hold unlawful and set aside agency action, findings, and conclusions found to be . . . arbitrary, capricious, an abuse of discretion, or otherwise not in accordance with law; . . . contrary to a constitutional right . . . ; [or] in excess of statutory jurisdiction, authority, or limitations." 5 U.S.C. § 706(2)(A)-(C); *see also Cuozzo Speed Techs.,*

LLC v. Lee, 136 S. Ct. 2131, 2142 (2016) (explaining Board "shenanigans" are reviewable under the APA).

Moreover, this Court reviews (1) the Board's ultimate claim construction de novo and any underlying factual determinations involving extrinsic evidence for substantial evidence, *In re Cuozzo Speed Techs.*, 793 F.3d at 1280; (2) the Board's ultimate conclusion of obviousness de novo and any factual findings made in connection with that determination for substantial evidence, *id.*; and (3) the Board's finding of anticipation for substantial evidence, *In re Hyatt*, 211 F.3d 1367, 1371–72 (Fed. Cir. 2000). Substantial evidence is "such evidence as a reasonable mind might accept as adequate to support a conclusion." *In re Applied Materials, Inc.*, 692 F.3d 1289, 1294 (Fed. Cir. 2012).

II. THE CLAIMS AT ISSUE ARE NOT OBVIOUS IN VIEW OF BESSLER AND KOCYBIK BECAUSE BESSLER TEACHES AWAY FROM IMPLEMENTING SINEWAVE COMMUTATION TECHNIQUES IN AN HVAC SYSTEM.

The Board concluded that claims 1-3, 8, 9, 16, and 19 are obvious in view of Bessler and Kocybik. Claim 1, which is representative of the independent claims at issue, is reproduced below.

> 1. A heating, ventilating 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 control signals received from the system controller to produce continuous phase currents in the permanent magnet motor for driving the air-moving component.

Appx0053, Col. 5:34-45.

The Board first determined that "HVAC system" in the preamble did not limit the claims, and then explained that Bessler discloses all the remaining features but one: "performing sinewave commutation, using independent Q and d axis currents." Appx0021-0022, Appx0027. The Board instead relied on Kocybik as showing this feature, concluding that a person of ordinary skill in the art would have "configur[ed] the system of Bessler to perform sinewave commutation in the manner described in Kocybik" because such combination "would have provided predictable results to address known problems associated with other types of motors." Appx0029.

But the Board's ultimate obviousness conclusion is flawed because it fails to appreciate that a skilled artisan would not have found it obvious to include a complex processor necessary to perform high-level, sinewave-commutation computations in Bessler's HVAC system. Indeed, Bessler teaches away from such a combination,

and Kocybik fails to ameliorate the teachings of Bessler. Instead, by concluding a skilled artisan would have effected the combination, the Board engaged in impermissible hindsight reconstruction.

A. The Board's Flawed Claim Construction

At the outset, the Board erred by declining to give "HVAC system" patentable weight. The Board's sole rationale for doing so was that HVAC system appears only in the preamble, noting that generally the preamble does not limit the claims. Appx0020-0021. But the Board too rigidly relied on HVAC system's location in the preamble rather than crediting that term's significance throughout the specification as a whole. *See Catalina Mktg. Int'l, Inc. v. Coolsavings.com, Inc.*, 289 F.3d 801, 808 (Fed. Cir. 2002) (noting that "[n]o litmus test defines when a preamble limits claim scope"); *Applied Materials, Inc. v. Advanced Semiconductor Materials Am., Inc.*, 98 F.3d 1563, 1573-74 (Fed. Cir. 1996) (explaining that whether the preamble forms a limitation of a claim "is determined on the facts of each case in light of the overall form of the claim, and the invention as described in the specification").

Notably, (1) the '349 patent is titled "Low Noise Heating, Ventilating and/or Air Conditioning (HVAC) Systems," (2) the "background of the invention" section is devoted entirely to the issues presented by incorporating square-wave commutation control of a motor into an HVAC system, (3) the problem to be solved

is set in the context of eliminating unwanted vibrations and motor inefficiencies in HVAC systems, (4) every embodiment of the sinewave-commuted motor is in an HVAC system, and (5) "HVAC system" breathes life and meaning into the claims, which recite structures specifically found in an HVAC system. *See generally* Appx0051-0053. Clearly, HVAC system limits the claims. *See Deere & Co. v. Bush Hog, LLC*, 703 F.3d 1349, 1358 (Fed. Cir. 2012) (concluding the preamble's "rotary cutter deck" limited the claims because (1) the specification "repeatedly refer[red] to the 'present invention' as 'an improved deck for a rotary cutter,' or a 'rotary cutter deck'"; (2) the "title of the patent, the summary of the invention, and every drawing" referred to "the invention as a deck for a rotary cutter"; (3) the specification "explain[ed] that the invention addresses a concern specific to rotary cutters"; and (4) the recitation in the preamble was "necessary to understand the subject matter encompassed by the claim" and "describe[d] a fundamental characteristic of the claimed invention that inform[ed] one of skill in the art as to the structure required by the claim").

B. Bessler Teaches Away from the Asserted Combination.

Even setting aside the Board's flawed construction, however, its ultimate obviousness conclusion was in error because Bessler teaches away from the proposed combination. As instructed by the Supreme Court in *KSR Int'l Co. v.*

Teleflex Inc., 550 U.S. 398 (2007), the obviousness inquiry here asks "whether [an HVAC system] designer of ordinary skill, facing the wide range of needs created by developments in the field of endeavor, would have seen a benefit to" combining the sinewave commutation methods described in Kocybik with the HVAC system described in Bessler. *See* 550 U.S. at 419. Following *KSR*'s "common sense" approach, the answer must be no, because (1) Bessler expressly states its principal objective is to *eliminate a system controller*, the component used to interpret system demand signals into a control signal used by the motor controller to perform sinewave commutation; and (2) the developments in the HVAC industry were leading designers to simpler systems with any attendant noise and vibrations remedied using mechanical dampers. *Cf. KSR*, 550 U.S. at 420-24 (explaining that the combination of a computerized sensor with a throttle pedal was obvious because, in contrast to here, "[t]echnological developments made it clear that engines using computer-controlled throttles would become standard").

1. One of Bessler's Principal Aims Was to Eliminate the Claimed System Controller.

Every challenged independent claim of the '349 patent requires a system controller. Dr. Gary Blank explained that the ordinary meaning of a system controller for an HVAC system is "a controller that develops control signals that

interpret the demands from, for example, a thermostat, into system demand signals that the motor controller can interpret, such as desired torque, speed, or airflow, to drive the motor to meet the system demands." Appx0768-0769, ¶ 35. Dr. Blank's understanding is consistent with the '349 patent's specification, which provides that the motor controller "is configured for performing sinewave commutation in response to one or more (analog or digital) control signals received from the system controller" that represent "a desired torque or speed of the motor" or "a desired airflow to be produced by the air-moving component." Appx0052, Cols. 3:59-4:2. Broad Ocean's expert, Dr. Ehsani, agreed that this is what one of skill would understand a system controller is or does, Appx0641-0642, and Bessler confirms this interpretation, explaining that in a traditional HVAC system, a system controller measures a "difference between the actual temperature of the air and the preset temperature which is desired," and then "convert[s that difference] into a signal defining the speed and airflow rate of the system," Appx0224, Col. 3:55-60.

And one of Bessler's principal objects is "to provide a central heating, air conditioning and ventilating system which does not require a system controller." Appx0222, Col. 2:3-5 (emphasis added); *see also* Appx0223, Col. 3:12-16 (describing Fig. 2 as "a block diagram of a central heating and air conditioning (CHAC) variable speed control system embodying *a preferred form of the present*

invention that does not require a system controller interposed between a thermostat and the remainder of the system" (emphasis added)); Appx0223, Col. 4:31-35 (explaining that in "one preferred embodiment" the invention "*eliminates the need for system controller*" (emphasis added)).

One skilled in the art at the time of the '349 patent's invention thus simply would not have found it obvious to combine the sinewave-commutation techniques of Kocybik with the HVAC system of Bessler, because doing so would require the skilled artisan to disregard the core teaching of Bessler—that the HVAC system should *eliminate a system controller*—and instead outfit Bessler's HVAC system with a controller required to generate the necessary motor control signals used in sinewave commutation. Appx0768-0769, ¶ 35. For its part, Kocybik does not even mention HVAC systems or the system controllers used therein, and thus does nothing to ameliorate these teachings of Bessler. The '349 patent's invention is thus not obvious in view of Bessler and Kocybik for this reason alone.

2. Bessler Teaches Away from Including Complex, High-Functioning Hardware in an HVAC System.

Even more fundamentally, however, Bessler's stated purpose of reducing the complexity of HVAC systems by, e.g., eliminating the system controller, would have taught a skilled artisan away from outfitting an HVAC system with the complex

hardware necessary to perform sinewave commutation. At the outset, one of ordinary skill at the time of the invention would have appreciated that sinewave commutation based upon q- and d-axis vector control required more hardware and more highly functioning hardware than used in 6-step commutation. For example, in another IPR, IPR2014-01122, Broad Ocean asserted U.S. Patent No. 6,498,449 ("the '449 patent") against a Nidec-owned patent. The '449 patent expresses the common wisdom teaching away from using vector control and sinewave commutation because of the hardware requirements. Namely, the '449 patent notes that d-q transformation calculations require "a high speed processor such as a [DSP]," but that if such d-q transformation calculations are eliminated, a "low cost microprocessor may be used . . . instead of the DSPs of the prior art." *See, e.g.*, Appx0744, Cols. 1:51-56, 2:2-8.

And Bessler teaches away from implementing such highly functioning hardware and vector-control techniques in what was seen as a relatively simple application: HVAC systems. Indeed, Bessler's principal object of eliminating a system controller is done in an effort to reduce the overall complexity of the HVAC system. *See generally* Appx0222, Cols. 1:15-2:5. Bessler does so by including a microprocessor directly in the HVAC's motor controller that receives a simple cyclic on/off signal from a thermostat and in turn generates a motor control signal to control

the torque or speed of the motor. Appx0223-0224, Cols. 4:33-35, 6:1-22. This relatively primitive motor controller itself generates a motor control signal by looking up stored parameters and outputting the signal as a function of the received temperature signal and at least one of those parameters. Appx0226, Col. 10:1-6.

Thus, one skilled in the art at the time of the '349 patent would not have found it obvious to combine the sinewave-commutation techniques of Kocybik with the HVAC system of Bessler. Doing so would require a skilled artisan to disregard the core teaching of Bessler—that the HVAC system should be *simplified by eliminating a system controller necessary to generate control signals*—in order to outfit an HVAC system with an even more complex controller having the computing capacity necessary to implement sinewave commutation. Indeed, Broad Ocean's own expert, Dr. Ehsani, suggested the inventors of the '349 patent had elected to "kill a fly with a sledge hammer" when employing independent Q and d axis control with HVAC systems, suggesting to this day their invention is against the common understanding of one of ordinary, or even extraordinary, skill in the art. Appx0633-0634.

Kocybik, for its part, does nothing to ameliorate Bessler's teaching away from employing such complex techniques in HVAC systems. Indeed, Kocybik reaffirms the common understanding that sinewave-commutation techniques were ill-suited for relatively simple applications such as HVAC systems. Specifically, Kocybik,

which notably does not discuss HVAC systems or the motors used in them, acknowledged the complex hardware necessary to perform sinewave-commutation computations and explains that "brushless ac motors" (i.e., sinewave-commutated motors) are "more suitable for high precision control tasks than the brushless dc motor" (i.e., 6-step-commutated motors). Appx0262-0263. For example, Kocybik discusses relatively exotic applications at the time of its publication that may require sinewave commutation, including hybrid car engines, aerospace applications, robotic arms, and high-accuracy machine tooling applications. Appx0265-0266. One skilled in the art would thus not find it obvious to include the sinewave-commutation techniques of Kocybik in HVAC systems. Such systems, as evidenced by Bessler, were not considered to require the performance of a sinewave-commutated PM motor.

C. By Suggesting a Skilled Artisan Would Have Nonetheless Effected the Proposed Combination, the Board Engaged in Impermissible Hindsight Reconstruction.

The Board disagreed that Bessler taught away from such a combination, explaining 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." Appx0030 (citation and internal

quotation marks omitted). The Board thus concluded that this motor controller and its integral microprocessor reads on the claimed "system controller," noting that "the claims do not require a separate standalone system controller." Appx0030. The Board also asserted that Nidec'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 [PM] 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.'" Appx0031 (quoting Appx0492, ¶ 52).

But the Board's (and Dr. Ehsani's) reasoning misses the point. First, Nidec has never maintained that the claims require a "separate standalone system controller" as the Board suggests. *See* Appx0030. While it need not be standalone, to meet the claim language there must be a system controller developing the type of control signal exemplified by the speed, torque, or airflow demand signals by the disclosed system controller in the '349 patent. Moreover, in order to perform the claimed vector-control techniques, an HVAC system would *necessarily require a complex controller* (standalone or not) such as a DSP capable of performing *high-level processes necessary to effect sinewave commutation*. *See, e.g.*, Appx0744, Cols. 1:51-56, 2:2-8. But the very point of Bessler is to *eliminate* the need for structure that interprets thermostat signals into system demand signals for later use

by the motor controller. *See* Appx0225, Col. 7:61 to Col. 8:8. Thus, Bessler's elimination of a system controller and touted benefit derived from that elimination teaches away from equipping its HVAC system with even more hardware (and higher functioning hardware at that) necessary to perform the complex sinewave-commutation techniques discussed in Kocybik. Appx0223, Appx0226, Cols. 3:59-60, 10:1-6.

Second, Nidec does not dispute Dr. Ehsani's opinion that a person of ordinary skill in the art would recognize that a PM motor using sinusoidal commutation reduces torque ripple and results in a quieter operation. Instead, Nidec disputes that one of ordinary skill would have found it obvious to *incorporate* such a complex solution *into an HVAC system*, particularly when the base reference relied upon, Bessler, expressly teaches reducing HVAC system complexity, and when Kocybik notes that sinewave-commutation techniques were best suited for rather exotic, high-precision tasks.

As this Court has aptly stated, the Board "cannot use hindsight reconstruction to pick and choose among isolated disclosures in the prior art to deprecate the claimed invention." *In re Fine*, 837 F.2d 1071, 1075 (Fed. Cir. 1988). By suggesting that it would have somehow been obvious to combine Kocybik with Bessler at the time of '349 patent's invention, the Board did not consider the claims through the

lens of one of ordinary skill in the art at the time of the invention, guided only by the prior art references and the then-accepted wisdom in the field. *See, e.g.*, *W. L. Gore & Assocs., Inc. v. Garlock, Inc.*, 721 F.2d 1540, 1553 (Fed. Cir. 1983). Instead, the Board engaged in the very sort of impermissible hindsight reconstruction this Court repeatedly denounces. *See, e.g.*, *Cheese Sys.*, 725 F.3d at 1353.

Because there is no rational basis for concluding that a skilled artisan at the time of invention would have found it obvious to combine the sinewave-commutation techniques of Kocybik with Bessler's HVAC system, the Court should reverse the Board's conclusion that the challenged claims are unpatentable under § 103. *See KSR*, 550 U.S. at 418 (explaining that to sustain an obviousness rejection "there must be some articulated reasoning with some rational underpinning" (quoting *In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006))).

III. THE BOARD SHOULD NOT HAVE INSTITUTED IPR WITH RESPECT TO HIDEJI, NOR DOES THAT REFERENCE ANTICIPATE THE CLAIMS AT ISSUE.

Hideji should not have been considered by the Board. A three-judge panel correctly denied Broad Ocean's second (and time-barred) petition asserting anticipation by Hideji because it was filed outside of § 315(b)'s one-year time bar, dismissing Broad Ocean's argument that it could get around the one-year limit by joining itself under § 315(c) "as a party" to its already pending IPR. Appx0803-

0858, Appx0869-0873. But in response to a petition for rehearing, Appx0879-0931, the Director expanded the panel to five judges—essentially stacking the deck with two additional pro-joinder judges—and that expanded panel reversed the prior decision and instituted IPR with respect to Hideji, Appx0940-0941. The three-judge majority, which included the original dissenter joined by the two new judges, explained that the § 315(c) joinder provision allowed Broad Ocean to join the pending IPR notwithstanding that it was already "a party" to that proceeding. Appx0940-0941.

These procedural gymnastics and *ultra vires* actions are the very type of "shenanigans" the Supreme Court cautioned would ultimately be subject to appellate review. *See Cuozzo*, 136 S. Ct. at 2142. This Court should thus review, and ultimately reverse, the Board's institution decision with respect to Hideji. But even if the Court allows the Board's institution decision to stand, the Court should reverse the Board's ultimate conclusion that Hideji anticipates the claims at issue because that reference fails to disclose a primary limitation of each claim: independent values of Q and d axis currents.

A. 35 U.S.C. § 314(d) Does Not Preclude Judicial Review of the Board's Interpretation of 35 U.S.C. § 315(b) and (c).

At the outset, the Board's decision is reviewable on appeal. Of course, 35 U.S.C. § 314(d) provides that "[t]he determination by the Director whether to institute an [IPR] under this section shall be final and nonappealable." But in considering the reach of that section, the Supreme Court in *Cuozzo* concluded that § 314(d) bars only *some* challenges to Board decisions to institute—including the "mine-run" claim in that case—but left open the possibility of judicial review for institution decisions when the Board has exceeded its statutory authority or for those that raise constitutional concerns. 136 S. Ct. at 2136, 2140-42. "Such, 'shenanigans,'" the Court explained, "may be properly reviewable in the context of § 319 and under the [APA]." *Id.* at 2142. This Court recently expounded that, after *Cuozzo*, it cannot review decisions "closely tied to the application and interpretation of statutes related to the [USPTO]'s decision to initiate [IPR]," but that it has "unfettered" review of institution decisions if the challenge (1) implicates constitutional questions; (2) depends on statutes "less closely related" to, or presents questions of interpretation that reach "well beyond," § 314; or (3) is "directed to the Board's ultimate invalidation authority with respect to a specific patent." *Husky Injection Molding Sys. Ltd. v. Athena Automation Ltd.*, --- F.3d ----, 2016 WL

5335500, at *5 (Fed. Cir. 2016) (quoting *Cuozzo*, 136 S. Ct. at 2141). The present appeal falls squarely within the realm of claims identified in *Cuozzo* and *Husky Injection Molding Systems* as subject to judicial review, § 314(d) notwithstanding.

1. The "Shenanigans" By the USPTO.

The USPTO is engaging in a practice of panel-stacking to ensure its preferred interpretation is consistently implemented in the Board's decisions. Specifically, when a majority of a panel renders a decision seemingly in conflict with the Director's policy stance, the Director simply reconfigures the panel by adding a couple of judges who will interpret the statutes in line with the Director's policy positions, such that on rehearing a majority of the newly expanded panel renders a decision conforming to the Director's position.

This procedure—what one judge of this Court has deemed "case-specific readjudication," Appx1013—was candidly explained by the USPTO's solicitor during recent arguments in *Yissum Research Development Co. of the Hebrew University of Jerusalem v. Sony Corp.*, Nos. 2015-1342, 2015-1343. There, the solicitor noted that the Director made a policy decision that § 315(c) (i.e., the joinder provision) should be interpreted as allowing petitioners to introduce new claims that would otherwise be time-barred by § 315(b). Appx1004-1005. And the solicitor explained that the "[D]irector [has to] be able to make sure that her policy judgments

are enforced by the Board" by engaging in what the solicitor referred to as "interpretation *through* the [B]oard *by* the agency." Appx1005-1006 (emphasis added).

In response, the Court seemingly expressed skepticism about the propriety of this practice, asking the solicitor point-blank whether it was in fact the case that "anytime there ha[s] been a seeming other outlier, you've engaged the power to reconfigure the panel so as to get the result you want." Appx1011-1012. The solicitor responded with an unequivocal "yes." Appx1012. Pressed on the issue, the solicitor further explained that if an individual panel went against the Director's "policy position," the USPTO would simply "exercise its authority to try to bring that panel's decision in line with the agency's view." Appx1012, Appx1017.

Consistent with the statements made by the USPTO solicitor in *Yissum*, on at least two occasions well-reasoned panel decisions that held § 315(c) does not authorize the Board to join time-barred claims to an existing IPR where the petitioner is already a party have been vacated and flipped when the USPTO expanded the original panel and added judges who arrived at the opposite conclusion. It happened in *Target Corp. v. Destination Maternity Corp.*, where an already expanded five judge panel's decision was vacated and reversed by a newly reconfigured seven-

judge panel. No. IPR2014-00508 (P.T.A.B. Feb. 12, 2015) (Paper 28). And it happened again in the present case.

In a vigorous dissent to the decision by the expanded panel in the present case, the original two-judge majority complained that the new majority acted *ultra vires*, explaining that "[a]s in [*Target Corp.*], the Board use[d] an expanded panel on rehearing to arrogate power beyond that granted by Congress" and, in so doing, "endorse[d] an end-run around a statutory bar." Appx0942 (Boucher, A.P.J., dissenting). This practice of expanding the panel solely in an effort to provide a petitioner an end-run around for advancing time-barred arguments is the very type "shenanigans" the Supreme Court noted would be "properly reviewable in the context of § 319 and the [APA]." *Cuozzo*, 136 S. Ct. at 2142.

2. Nidec's Challenge to the Board's Institution Decision Raises Due Process Concerns.

The USPTO's procedure below of expanding the panel to ensure an interpretation of § 315(c) consistent with the Director's apparent policy stance for which no notice-and-comment rulemaking has occurred and no precedential opinion has been designated by the Board—but contrary to its judges' independent legal statutory analysis—raises due process concerns, subject to judicial review. *See id.* at 2141.

As noted by this Court, "The right to an impartial decision maker is unquestionably an aspect of procedural due process. This applies to administrative proceedings as well as judicial trials." *NEC Corp. v. United States*, 151 F.3d 1361, 1371 (Fed. Cir. 1998) (citations omitted). And the Court has recognized due process concerns "arising out of the combination of adjudicative and administrative functions within a single administrative agency, such as partiality of adjudicative officers and unfairness to parties." *In re Alappat*, 33 F.3d 1526, 1546 (Fed. Cir. 1994), *abrogated on other grounds by In re Bilski*, 545 F.3d 943 (Fed. Cir. 2008). Panel-stacking of the type described above deprives patent owners of an important procedural protection and raises due process concerns that surely distinguish this appeal from the mine-run issue in *Cuozzo*.

Namely, when faced with statutory language susceptible to more than one interpretation, agencies typically engage in notice-and-comment rulemaking, which requires the agency to provide a rationale for its interpretation along with an opportunity for public comment. *See generally Farrell v. Dep't of Interior*, 314 F.3d 584, 590 (Fed. Cir. 2002) ("If an agency policy statement is intended to impose obligations or to limit the rights of members of the public, it is subject to the [APA], and, with certain exceptions, must be published in the Federal Register as a regulation." (citing 5 U.S.C. § 553(b)-(c) (the notice-and-comment rulemaking

provisions of the APA))). These proceedings create a record that is subject to judicial review. *See id.*; *see also Cuozzo*, 136 S. Ct. at 2144 (reviewing whether the USPTO's regulation requiring the agency to give patent claims their "broadest reasonable construction" during IPR constituted a "reasonable exercise of [the agency's] rulemaking authority").

Notably, in spite of the USPTO's keen interest in the issue, and adamant statements by judges on the Board that the agency's interpretation exceeds the unambiguous language of the statute (as will be discussed more fully below), the USPTO has chosen not to engage in notice-and-comment rulemaking with respect to this question. Nor has the USPTO designated any opinions addressing the joinder issue as precedential—presumably because it cannot muster sufficient internal support among its judges to sustain such a designation.

The USPTO's alternative panel-stacking procedure implicates due process concerns, because the ultimate joinder decision under § 315(c) is not being performed by impartial decision makers, but rather by the Director who selectively staffs panels to achieve her preferred interpretation. *See NEC*, 151 F.3d at 1371. Moreover, decisions by the Board do not accurately reflect independent adjudicative interpretation of the statute by judges, but rather reflect the Director's policy stance without the procedural protections of notice-and-comment rulemaking. *See In re*

Alappat, 33 F.3d at 1546. Judge Taranto suggested as much when he noted that it seemed "a little odd" that the agency should be allowed to interpret the statute "without [notice-and-comment rulemaking] or any formal process." Appx1010.

To be clear, Nidec is not alleging that the agency is directing individual judges to decide cases in a certain way, nor that the decisions of individual judges are not the product of their own independent analysis and judgment, as evidenced by the spirited dissent in the expanded panel decision below. However, the USPTO's practice of "reset[ting panels] by adding a few members who will come out the other way" substantially undercuts the independence of the Board as a whole. Appx1013. It is this coordination of Board decisions through readjudication that implicates due process concerns and renders judicial review particularly appropriate here. *See Shaw Indus. Grp., Inc. v. Automated Creel Sys., Inc.*, 817 F.3d 1293, 1303 (Fed. Cir. 2016) (Reyna, J., concurring) (opining that the USPTO's "claim to unchecked discretionary authority," which it bases "on the statute that makes institution or denial of [IPR] 'final and nonappealable,'" is "unprecedented").

3. Neither Achates *nor* Wi-Fi *Precludes Review of This Case.*

Although this Court has previously declined to review institution decisions that dealt with § 315(b)'s time bar, those decisions do not preclude review here. Specifically, in *Achates Reference Publishing, Inc. v. Apple Inc.*, 803 F.3d 652 (Fed.

Cir. 2015), this Court found that § 314(d) barred judicial review of whether the codefendants in a lawsuit filed more than one year before the petition were real parties-in-interest or privies of the petitioner, in which case the petition would be barred under § 315(b). 800 F.3d at 654, 657-59. And in *Wi-Fi One, LLC v. Broadcom Corp.*, --- F.3d ----, 2016 WL 4933298 (Fed. Cir. 2016), the Federal Circuit explained that *Achates* remained good law notwithstanding *Cuozzo*, and thus again declined to review a substantially similar question. 2016 WL 4933298 at *3-4.

But *Achates* and *Wi-Fi* present a far different situation than the one facing the Court. At the most basic level, *Achates* and *Wi-Fi* did not involve the "shenanigans" present here: expanding the panel to ensure a decision in line with the Director's policy.

But beyond that, as stated by the *Achates*' Board, "Whether a non-party is a 'real party-in-interest' or 'privy' for purposes of an [IPR] is a 'highly fact-dependent question,'" and "[d]epending on the circumstances, a number of factors may be relevant to the analysis." *Apple Inc. v. Achates Reference Publ'g, Inc.*, No. IPR2013-00081, 2013 WL 8595560, at *7 (P.T.A.B. June 3, 2013) (quoting Office Patent Trial Practice Guide, 77 Fed. Reg. 48,756, 48,759 (Aug. 14, 2012)). In contrast, the present case involves no fact-intensive inquiry; indeed, Broad Ocean admits its petition was time-barred under § 315(b). Appx0813.

Finally, whether or not a party has a sufficiently close relationship such that its claims should too be time-barred is a question that falls squarely within the realm of the USPTO's authority and discretion, and, in any event, is one that was specifically addressed via notice-and-comment rulemaking. *See* Office Patent Trial Practice Guide, 77 Fed. Reg. at 48,756. In contrast, and as discussed, the USPTO has not addressed this issue—whether a party can join itself—via notice-and-comment rulemaking, but rather consistently expands panels in an effort to act outside the prescribed rulemaking procedure and instead engage in "interpretation through the [B]oard by the agency." Appx1005-1006.

Instead, and as will addressed in the next section, the instant appeal involves a straightforward matter of statutory interpretation: what constitutes "a party" for purposes of § 315(c). This is the type of question that is squarely within the purview of the judiciary, and should be reviewed by this Court.

B. Section 315(c) Does Not Provide an End-Run Around for a Time-Barred Party under § 315(b) to Join Itself to a Pending IPR.

A proper reading of § 315(c)'s "join as a party" reveals that the Board below improperly relied on that provision to join Broad Ocean to its already pending IPR. In staking out the parameters that define the IPR process, Congress strove to balance two often conflicting objectives: to establish a relatively quick and efficient means

for challenging issued patents while at the same time shielding patent owners from undue harassment. Section 315(c) furthers the first objective by granting the USPTO discretion to "join as a party to [an instituted IPR] any person who properly files a petition [for IPR]," while § 315(b) furthers the second by barring institution "if the petition requesting the proceeding is filed more than 1 year after the date on which the petitioner . . . is served with a complaint alleging infringement of the patent." In the present case, a sharply divided expanded panel has incorrectly interpreted § 315(c) as allowing a petitioner to circumvent the § 315(b) statute of limitations and introduce new claims and issues to an instituted IPR by simply filing a new, otherwise time-barred, petition, and then using the "party" joinder process of § 315(c) to join the new claims to the instituted IPR.

The majority is apparently seeking to implement the USPTO's policy-based determination that § 315(b) should be interpreted in a manner granting maximum discretion on the Board. But in doing so, as noted by a number of judges on the Board, the panel has acted in an "*ultra vires*" manner that ignores the unambiguous language of the statute and "arrogate[s] power beyond that granted by Congress." Appx0942 (Boucher, A.P.J., dissenting); *see also Skyhawke Techs. v. L&H Concepts, LLC*, No. IPR2014-01485, 2015 WL 1306523, at *2 (P.T.A.B. Mar. 20, 2015) (Paper 13); *Target*, IPR2014-00508, Paper 28, at *26-27 (Fitzpatrick, A.P.J.,

dissenting); *Medtronic, Inc. v. Endotach LLC*, No. IPR2014-00695, 2014 WL 4854767, at *7 (P.T.A.B. Sept. 25, 2014) (Fitzpatrick, A.P.J., concurring).

This Court should correct this mistaken application of § 315(c), a misinterpretation that effectively eviscerates an important statutory limitation on USPTO discretion intended to serve as a meaningful procedural protection for patent owners.

1. The Plain Language of § 315(c) Only Authorizes Joinder of a New Party to an Instituted IPR.

On its face, § 315(c) only authorizes the Director to "join [any person] *as a party*" to an instituted IPR. § 315(c) (emphasis added). As a matter of simple logic, a person cannot be "join[ed] *as a party*" if that person is *already a party* to the instituted review. In *Target*, the three dissenting judges found § 315(c) unambiguous on this point, concluding that the statute only authorizes joinder of non-parties, and as such cannot be used as a vehicle for an existing party to introduce new and time-barred issues into an already instituted IPR. No. IPR2014-00508, Paper 28, at 26-27 (Fitzpatrick, A.P.J., dissenting) ("In our view, § 315(c) is not ambiguous as to whether it permits joinder of grounds or issues. It unambiguously does not. It states that a person 'may join as a party' and, despite referring to 'a petition,' nowhere refers to the joining of that petition." (footnote omitted)).

The unanimous *Skyhawke* panel came to the same conclusion, noting that "[a] person cannot be joined *as a party* to a proceeding in which it is already a party. The statute does not refer to the joining of a petition or new patentability challenges presented therein, nor does the statute refer to the joining of a new issue (as opposed to a person)." 2015 WL 1306523, at *2; *see also Medtronic*, 2014 WL 4854767, at *7 (Fitzpatrick, A.P.J., concurring) ("[Section] 315(c) authorizes joinder of a person, not a petition, to an instituted [IPR]. It does not provide a mechanism for joining an additional petition to [an instituted IPR]."). This plain meaning should control here. *See White v. United States*, 543 F.3d 1330, 1337 (Fed. Cir. 2008) ("[I]t is a bedrock canon of statutory construction that our judicial inquiry ends where statutory language is plain and unambiguous.").

In its decision granting rehearing, the majority nonetheless concluded that "§ 315(c) permits the joinder of any person who properly files a petition under [35 U.S.C.] § 311, including a petitioner who is already a party to the earlier instituted [IPR]." Appx0936. The majority provided absolutely no independent analysis to support this conclusion, but instead simply stated that it arrived at its conclusion "for the reasons explained by several majority opinions in prior decisions of the Board," citing *Target* and *Medtronic*. Appx0936.

The *Target* majority found it significant that § 315(c) states "'any person who properly *files a petition* under section 311' may be joined at the Director's discretion," and that § 311(a), in turn, only excludes the owner of the patent at issue from filing a petition. No. IPR2014-00508, Paper 28, at 7. Thus, the majority concluded, "when 'any person' is read in light of § 311(a), the only person excluded by the language is the owner of the patent at issue" and, importantly, "the statute does not exclude a person who is already a petitioner in an instituted review proceeding that is the subject of the joinder analysis." *Id.* Finally, the majority opined, an "interpretation that requires us to read 'any party' [sic] as excluding the same petitioner, in essence, reads the word 'any' out of the statute." *Id.* at 8.

But other language in the statute clearly limits the otherwise expansive scope of "any person," and this in no way constitutes reading the word "any" out of the statute. Indeed, as the *Target* majority recognized, "any person" does not include the patent owner, because § 311(a) specifies that a petition may be filed by "a person who is not the owner of a patent." *Id.* at 7. Just as surely as § 311(a) excludes the patent owner from the otherwise expansive "any person" language, so too § 315(c) excludes a person that is already a party by means of the language "may join as a party."

The *Target* majority suggests that Congress could have used the language "any non-party" instead of "any person" if it intended § 315(c) to be limited to the joinder of persons not already a party to the instituted IPR. *Id.* at 8. But § 315(c) already explicitly recites joinder "as a party," which would strike many (such as the *Target* dissent) as unambiguous with respect to the scope and purpose of the provision. And this argument cuts both ways: if Congress had intended § 315(c) to function as a mechanism by which a party to an instituted IPR can introduce new issues to the IPR, it surely could have enacted statutory language to that effect as well. Moreover, if the USPTO thought that such joinder was authorized by § 315(c), it could and should have addressed this contingency in its extensive rulemaking implementing IPR. The fact that neither Congress nor the USPTO has addressed the matter more explicitly strongly suggests that § 315(c) was never intended to be interpreted so broadly.

As interpreted by the expanded panel below, § 315(c) would effectively eviscerate § 315(b) by permitting an end-run around the statutory bar specifically directed at preventing a defendant in an infringement action from raising new claims in IPR proceedings more than one year after filing of a complaint. This could not have been the intent of Congress. Indeed, Congress went to great lengths to ensure that such a loophole would not occur, explicitly extending the § 315(b) bar to

encompass not only a party who has been sued, but also privies of the party and anyone attempting to file a petition as a surrogate for a real party in interest. As noted in the Office Patent Trial Practice Guide, the "real party-in-interest" and "privies" requirements "seek[] to protect patent owners from harassment via successive petitions by the same or related parties, to prevent parties from having a 'second bite at the apple,' and to protect the integrity of both the USPTO and Federal Courts by assuring that all issues are promptly raised and vetted." 77 Fed. Reg. at 48,759. Why would Congress have gone to such lengths to preclude a party from circumventing the statutory bar through the use of a surrogate if the same result could be achieved by use of joinder under § 315(c)?

Judge Taranto recently opined during oral arguments in *Yissum* that it does indeed seem "odd" that Congress would have intended § 315(c) to provide a procedural end-run around allowing petitioners to join new claims that are otherwise time-barred under § 315(b), and noted that there appears to be "quite a lot of force" to the argument that § 315(c) does not authorize claim joinder given that this statute explicitly "says joining parties." Appx0993, Appx1010. Now that the issue is squarely before the Court, it should correct the Board's flawed interpretation of § 315(c).

2. Legislative History Provides Further Support for Limiting § 315(c) to the Joinder of Nonparties.

Even if the Court finds § 315(c) ambiguous, the legislative history further supports that § 315(c) cannot be used to join new (and time-barred) claims advanced by a current party to a pending IPR. *See Indian Harbor Ins. Co. v. United States*, 704 F.3d 949, 954 (Fed. Cir. 2013) (explaining that when a "statute is clear and unambiguous, then the plain meaning of the statute is generally conclusive," but if "the statutory language is ambiguous, legislative history can be useful in determining Congressional intent").

Specifically, the Committee Report pertaining to the America Invents Act (AIA) states that under § 315(c), "[t]he director may allow *other petitioners* to join an [IPR]." H.R. Rep. No. 112-98, pt. 1, at 76 (2011) (emphasis added), *as reprinted in* 2011 U.S.C.C.A.N. 67, 100. The *Target* majority acknowledged the existence of this legislative history, and never attempted to rebut its significance. No. IPR2014-00508, Paper 28, at 10. Instead, the *Target* majority cited to, and credited instead, statements made by Senator Kyl prior to enactment of the statute. *Id.* 10-14. But it is well-established that "the authoritative source for finding the Legislature's intent lies in the Committee Reports on the bill" and, accordingly, that the Supreme Court

has "eschewed reliance on the passing comments of one Member." *See Garcia v. United States*, 469 U.S. 70, 76 (1984).

In any event, as noted by the *Target* dissent, one of the statements cited by the majority was made by Senator Kyl in 2008, in connection with a quite different version of the statute that was never enacted. No. IPR2014-00508, Paper 28, at 30 (Fitzpatrick, A.P.J., dissenting). Another cited statement did not specifically identify § 315(c), and the dissent found this statement to be ambiguous with respect to whether the senator was even referring to § 315(c), or whether he might have instead been referring to 35 U.S.C. § 325. *Id.* at 29 (Fitzpatrick, A.P.J., dissenting).

Instead, the IPR provisions, as best understood in the light of the full Committee Report, indicates that Congress only intended for "other petitioners" to join an already instituted IPR. *See* H.R. Rep. No. 112-98, pt. 1, at 76. The legislative history simply does not suggest Congress intended to grant the USPTO discretion to allow a party who has already enjoyed a full year since the filing of a complaint, during which it was allowed to raise issues and introduce prior art, to later use the joinder provision as an end-run around to the statutory time bar.

The *Target* majority also emphasized that "a primary purpose of the AIA was to 'limit unnecessary and counterproductive litigation costs,' and concluded that this purpose supported a broad interpretation of the Board's discretion to take up new

issues as a means for relieving the district court from the necessity of addressing them. No. IPR2014-00508, Paper No. 28, at 12. But the Board has stated that the primary interest in conducting its procedures "pertains to the just, speedy, and inexpensive resolution of proceedings before the [Board], and not to the just, speedy, and inexpensive resolution of the parties' disputes generally." *See ZTE Corp. v. ContentGuard Holdings Inc.*, No. IPR2013-00454, 2013 WL 8595746, at *4 (P.T.A.B. Sept. 25, 2013). And in overemphasizing the importance of reducing the work load of the district courts, the *Target* majority fails to give adequate weight to another primary objective of Congress in enacting the AIA, which was to limit the potential for harassment of patent owners. Indeed, the Committee Report noted that "[t]he Committee recognizes the importance of quiet title to patent owners to ensure continued investment resources," and thus condemned "harassment . . . through repeated . . . administrative attacks on the validity of a patent." H.R. Rep. No. 112-98, pt. 1, at 48.

In short, even if § 315(c) is ambiguous, the legislative history confirms that it cannot be used as an end-run around to § 315(b). Accordingly, the Board erred when insisting IPR with respect to Hideji, and that institution decision should be reversed.

C. Even If Considered, Hideji Does Not Anticipate the Challenged Claims Because Hideji Does Not Disclose Independent Values of Q and d Axis Currents.

Notwithstanding the impropriety of the Board's institution decision, the Board's finding that Hideji anticipates claims 1-3, 8, 9, 16, and 19 is not supported by substantial evidence and should thus be reversed.

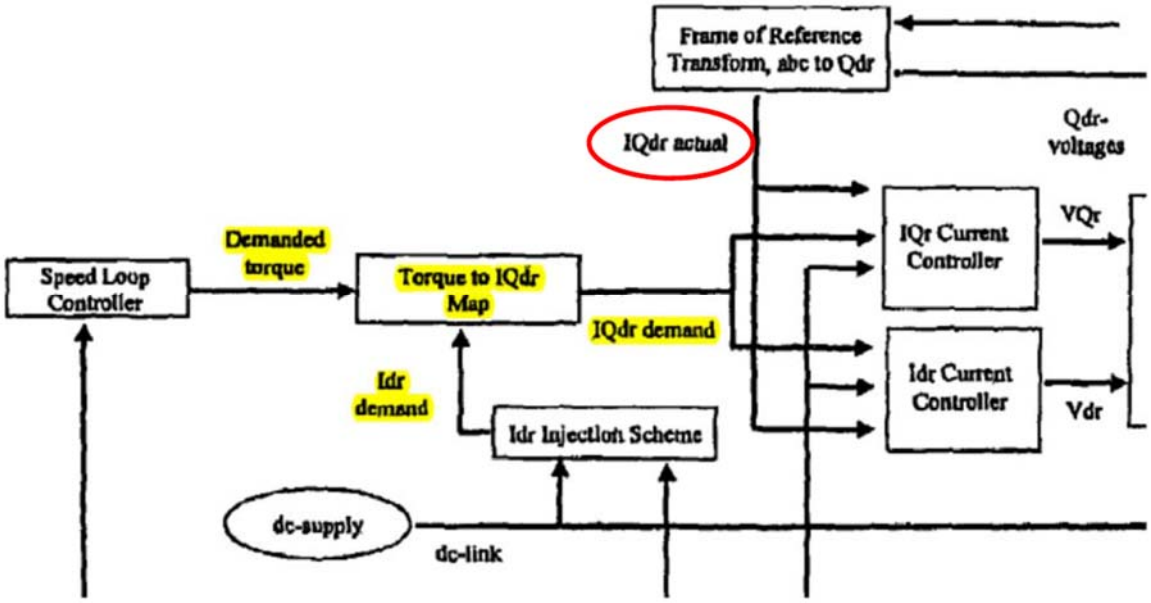
The Board first asserted that Hideji generally shows the various HVAC components recited in the independent claims, and then focused its attention on the limitation "performing sinewave commutation, using independent values of Q and d axis currents, in response to one or more control signals received from the system controller to produce continuous phase currents in the permanent magnet motor for driving the air-moving component." Appx0036-0037. Relying on Figure 2 of Hideji and the corresponding description provided at paragraph 35, the Board determined that Hideji disclosed this feature. Appx0037. The Board explained that the torque current Iq and the flux current Id leaving part 36 of Hideji shows a Q and d axis current, respectively. Appx0036-0037. The Board also observed that Iq and Id are depicted as "separate" currents and thus they are "independent." Appx0037. And the Board further relied on testimony provided by Broad Ocean's expert, Dr. Mark Ehsani, who opined that Iq and Id show independent values of Q and d axis currents. Appx0037, Appx0489, ¶ 38.

However, even assuming Hideji discloses "separate" currents, nowhere does Hideji disclose *independent* Q and d axis currents *as that term was ultimately construed by the Board*, much less "produc[ing] continuous phase currents in the permanent magnet motor" using such currents. And Dr. Ehsani's conclusory opinion should have had no bearing on the issue, because his opinion was premised on a construction of "independent" that was expressly rejected by the Board and is inconsistent with the meaning of the term as it was ultimately construed.

1. The Board Erred by Construing Independent Values of Q and d Axis Currents to Require the Use of Actual Q and d Axis Current Values.

At the outset, the Board erred when it concluded that the phrase "independent values of Q and d axis currents" refers to "actual" values of Q and d axis currents (i.e., a measure of currents actually being supplied to the motor) rather than demand currents (i.e., currents calculated to satisfy a given speed or torque demand). Appx0022-0023. In its initial institution decision, the Board construed the term "using independent values of Q and d axis currents" as simply "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." Appx0179. But then its Final Written Decision, the Board "clarif[ied]" its construction, explaining (for the first time) that the term should be construed 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." Appx0023. In arriving at this construction, the Board relied heavily on Figure 8 of the '349 patent, which is reproduced in-part and annotated below.



Appx0050.

Specifically, the Board explained that (1) during prosecution the patentee represented that Figure 8 supported the limitation; (2) that figure in turn shows an IQdr actual signal (circled above) that is decoupled into Q and d axis currents; (3) U.S. Patent No. 7,342,379 ("the '379 patent"), which is incorporated by reference in the '349 patent, describes decoupling an IQdr signal, with the resulting d axis current assumed to be zero and the resulting Q axis current used to produce the demanded torque; and (4) Dr. Ehsani testified that in an ideal PM motor, the actual

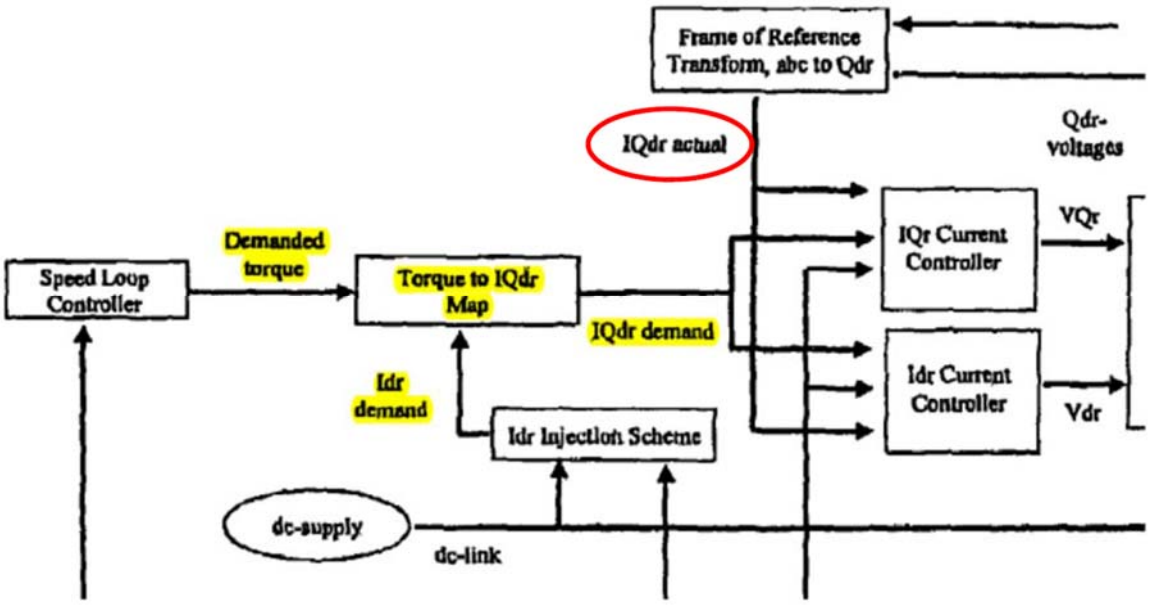
d axis current value is assumed to be zero. Appx0022-0023. Thus, the Board concluded, the claim limitation "independent values of Q and d axis currents" must be referring to actual, not demand, currents. Appx0022-0023.

But this construction misinterprets the teachings of the '379 patent and is inconsistent with a construction one skilled in the art would have afforded the term. Specifically, when given its proper context, it is clear that the portion of '379 patent that the Board relies on refers not to deriving *actual* Q and d axis currents, but instead refers to deriving *demanded* Q and d axis currents. Notably, the three paragraphs immediately preceding the relied-on portion of the '379 patent describe in detail how to derive the "required" or "demand[ed]" Q axis current to produce a desired torque. *See* Appx0801, Col. 5:40-67. The '379 patent then goes on to explain—via the portion cited in the Board's Final Written Decision—an embodiment in which IQdr components are decoupled, with the torque contribution determined solely from the Q axis current. *See* Appx0801, Col. 6:1-7. In light of the preceding three paragraphs describing using the "required" or "demand[ed]" Q axis current to produce a desired torque, it is clear that column 6, lines 1-7, also refers to demand, not actual, currents.

This conclusion is bolstered by a review of the '349 and '379 patents as a whole. Specifically, the portion relied-on by the Board describes "[t]he decoupling of IQdr components *in the production of torque*." Appx0801, Col. 6:1-2 (emphasis

added). And when the '379 patent describes the production of torque, it does so in connection with *demand* IQdr components, not actual IQdr components. *See, e.g.*, Appx0801, Col. 5:44-50 ("the controller reads the *intended dr-axis injection current*[1] in step 810, calculates the Qr-axis current *required to produce a demanded torque* in step 812 and *outputs the demanded Qr- and dr-axis currents* in step 814 to a pair of current controllers" (emphasis added)); *see also* Appx0799, Cols. 1:49-52, 2:29-32, Appx0801, Col. 5:20-23, 27-30. Indeed, Figure 8 of the '349 patent (provided again below for convenience) and the substantially similar Figure 2 of the '379 patent show, via the highlighted portion, that the demanded torque is mapped to the *IQdr demand* signal, and, notably, not to the IQdr actual signal.

[1] U.S. Patent No. 7,208,895, which is incorporated by reference in both the '349 patent and the '379 patent, explains that the intended dr-axis injection current is synonymous with the demanded dr-axis current. *See, e.g.*, Appx0734-0735, Cols. 4:67-5:4.



Appx0050.

The actual Q and d axis currents are only a measurement of the currents being delivered to the motor that are utilized in a feedback loop to obtain and maintain the demanded Q and d axis currents. Thus, the Board's conclusion that column 6, lines 1-7, of the '379 patent refers to actual Q and d axis current values—and, in turn, that "independent values of Q and d axis currents" of the challenged claims must also be referring to actual values—simply finds no basis in the specification and is inconsistent with a meaning a skilled artisan would have afforded the term at the time of invention.

Instead, in light of Figure 8 of the '349 patent and the description provided in the '379 patent discussed above, one of ordinary skill with knowledge of control

equations for sinewave commutation in the rotating frame of reference would understand that, "taken in context, the independent Q and d axis currents must necessarily be the Q and d axis currents the motor controller calculates are required by the system controller demands and that are used to set or produce the continuous phase sine wave commutated currents for the motor." Appx0753-0754, ¶ 12. And one skilled in the art would understand such currents are in turn "independent" if the control function that derives them will not express one in terms of the other. *See* The Oxford Dictionaries, http://www.oxforddictionaries.com/us/definition/american_english/independent#independent (last visited Nov. 3, 2016) (defining "independent" in mathematics as: "(of one of a set of axioms, equations, or quantities) incapable of being expressed in terms of, or derived or deduced from, the others").

Thus, the Board should have construed the term as requiring the motor controller to develop *demand* Q and d axis currents independently of each other, without relying on one to derive the other, and use those independently derived demand currents to create the signals that will drive the motor using sinewave commutation. Its construction that "independent values of Q and d axis currents" instead refers to *actual* currents should thus be reversed.

2. Hideji Does Not Disclose Independent Values of Q and d Axis Currents, and Thus Does Not Anticipate the '349 Patent's Invention.

Under this correct construction, Hideji clearly does not anticipate the '349 patent's invention. Namely, Hideji simply does not disclose independent values of demand Q and d axis currents. Hideji explains its control scheme with respect to Q axis and d axis current in the rotating frame of reference at paragraphs 0038 and 0039, and makes clear that the demand (or target) Q and d axis current values are *dependent* upon one another. Appx0201-0202, ¶¶ 0038-39. Hideji states that "by introducing the torque current Iq in direct proportion to the increase of the load acting on the brushless DC motor 30A, the flux current Id target value *is reduced on the basis of the following formula . . . The flux current Id target value is equal to* $k \times Iq^2$." Appx0201-0202, ¶¶ 0038-39 (emphasis added). Thus, in Hideji, the target value Id is expressed in terms of, or derived from, the target value Iq. Consequently, the target values of the Q and d axis currents are dependent rather than independent. There is no other disclosure in Hideji of developing an Id current in response to system controller signals that is not dependent on Iq.

Nonetheless, the Board concluded Hideji discloses such features via the "separate" currents coming from the three-phase/two-phase coordinate conversion part 36 of Hideji. Appx0037. However, under the proper construction of

"independent values of Q and d axis currents" discussed above, this conclusion is flawed for at least two reasons.

First, the currents coming from part 36 are simply a conversion of the phase currents labeled Iu and Iv being fed to the motor, and thus are merely a *transform into the rotating frame of reference of actual measured currents*. Appx0201, ¶ 0035. They are not the demanded currents calculated by the controller "in response to one or more control signals . . . to produce continuous phase currents in the [PM] motor." Appx0755-0756, ¶¶ 14-15. Thus, the identified currents are not the independent Q and d axis currents of the claim language.

Second, and perhaps most significantly, the Hideji system develops "torque current Iq target values" and "flux current Id target values" in the speed control part 38 and the phase control part 39, respectively. Appx0201-0202, ¶ 0037-39. Then, the target values are added or subtracted from the detected Iq and Id currents and the deviations are fed to the current control part 40. Appx0201-0202, ¶ 0038-39. The current control part 40 in turn "executes PI control based on the deviation between the torque current Iq target value . . . and the actual current Iq to calculate a torque voltage Vq (Vq-axis voltage), and executes PI control based on the deviation between the flux current Id target value . . . and the actual flux current Id target value to calculate a flux voltage Vd (Vd-axis voltage)." Appx0202, ¶ 0040.

It is thus the current control part 40 output that is used to create the continuous phase sinewave commutated currents for the motor after being transformed back out of the rotating frame of reference. Appx0202, ¶ 0041. Thus, for this disclosure to anticipate a "motor controller is configured for performing sinewave commutation, *using independent values of Q and d axis currents . . . to produce continuous phase currents in the permanent magnet motor*" as recited by claim 1 (emphasis added), it must show that independently derived Iq and Id values *are fed into the current control part 40*. However, as explained above, Iq and Id are not independent at this step because the difference signal is based upon target values of Iq and Id that are dependent. *See* Appx0201-0202, ¶ 0039 ("The flux current Id target value is equal to $k \times Iq^2$."). Accordingly, "the motor controller" is not using "independent values of Q and d axis current" to perform "sinewave commutation." Appx0757-0758, ¶ 18-19. Thus, Hideji does not anticipate the asserted claims.

3. Even if the Court Accepts the Board's Flawed Construction, Hideji Still Fails to Disclose Independent Values of Q and d Axis Currents.

Even accepting the Board's construction, that it is the "actual" Iq and Id that must be independent, Hideji fails to anticipate the relevant claims. At the outset, Hideji's actual Iq and Id are simply not "independent"; they instead are derived from the target Iq and Id values, which are dependent on one another, and thus too are

dependent. *See* Appx0212. Put another way, the Iq and Id target values depend on one another, *see* Appx0201-0202 ¶¶ 0038-39, which in turn are used to determine Vq and Vd, *see* Appx0202 ¶¶ 0040, which in turn are transformed into the stationary frame of reference and subjected to PWM to arrive at the actual currents, *see* Appx0202 ¶¶ 0041, which in turn are measured, digitally converted, and transformed back into the rotating frame of reference to arrive at actual Iq and Id, *see* Appx0201 ¶¶ 0034-35. *The actual Iq and Id, which are created by the target Iq and Id, are therefore themselves dependent upon one another.* The Board never addressed by what mechanism measuring a current that was dependently created converts the dependent current into an independent current.

And in any event, there is notably no discussion in Hideji of how Iq and Id are transformed in part 36. Hideji simply says it is, with no discussion of how. Appx0201, ¶ 0035, Appx0757, ¶ 17. Hideji cannot be understood to anticipate the claim term "using independent values of Q and d axis currents" based upon this sparse disclosure. *See Advanced Display Sys., Inc. v. Kent State Univ.*, 212 F.3d 1272, 1282 (Fed. Cir. 2000) ("[I]nvalidity by anticipation requires that the four corners of a single, prior art document describe every element of the claimed invention . . . .").

The Board appears to be suggesting that because the currents coming from part 36 are represented by two distinct lines in Figure 2, and thus are "separate," they are also independent. *See* Appx0037 (accepting Broad Ocean's position that "such transformation results in separate, independent values of Q and d axis currents determined from control signals received from the system controller"). The Board supports this conclusion by relying on Dr. Ehsani's opinion that "Hideji also discloses that the motor controller uses independent values of q- and d- axis currents." *See* Appx0037, Appx0489, ¶ 38.

However, Dr. Ehsani's opinion is based on his erroneous construction of "independent" that was expressly rejected by the Board; i.e., that "independent" means that the Q axis and d axis are orthogonal to each other. *See* Appx0479-0480, ¶ 13, Appx0481-0482, ¶ 17; *see also* Appx0178 ("Although we accept Dr. Ehsani's explanation that orthogonal magnetic fields are independent of each other, the claims refer specifically to scalar *values* of Q and d axis currents, not to vector fields."). Importantly, Dr. Ehsani never opined that Hideji discloses actual Q and d axis current values that are *developed independently of each other, without relying on one to derive the other*, which is the construction of independent ultimately accepted by the Board.

Moreover, Dr. Ehsani's opinion that "the motor controller [of Hideji] uses independent values of q- and d- axis currents," is conclusory and deserves no weight. Notably, even setting aside the construction issue explained above, he provides no context for why he believes Iq and Id are orthogonal (i.e., independent under his construction) at this point in the Hideji control scheme; he simply says it is so without explanation. *See* Appx0489, ¶ 38. Tellingly, although he opined that under "*ideal conditions*" the Q and d magnetic fields are orthogonal to one another and, similarly, that "[*i*]*deally*, id and iq are also independent of each other (orthogonal)," he did not attempt to establish that the feedback path of Hideji pointed to by the Board constitutes a machine operating under such "ideal conditions." Appx0479-0480, ¶ 13, Appx0481-0482, ¶ 17 (emphasis added). And because the Board relied on Dr. Ehsani's statement, and that statement alone, as evidence that the "separate" Iq and Id currents are also "independent," the Board's finding is not supported by substantial evidence (indeed, it is supported by *no* evidence).

In short, regardless of how the Court ultimately construes the term, Hideji fails to disclose "independent values of Q and d axis currents." Thus, the Court should reverse the Board's erroneous conclusion that Hideji anticipates the '349 patent's invention. *See Fresenius USA, Inc. v. Baxter Int'l, Inc.*, 582 F.3d 1288, 1300 (Fed. Cir. 2009) (explaining that when a court—or, as here, the Board—finds a claim

anticipated "without clearly identifying the corresponding structure in the prior art," the finding is not supported by substantial evidence and must be set aside).

CONCLUSION

For the reasons set forth above, Nidec requests that the Board's determination that claims 1-3, 8, 9, 12, 16, and 19 of U.S. Patent No. 7,626,349 are unpatentable be reversed and the case remanded to the Board for further proceedings.

Respectfully submitted,

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ADDENDUM

UNITED STATES COURT OF APPEALS
FOR THE FEDERAL CIRCUIT

NIDEC MOTOR CORPORATION,
Patent Owner/Appellant

v.

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

Proceeding No: IPR2014-01121[1]

NOTICE FORWARDING CERTIFIED LIST

A Notice of Appeal to the United States Court of Appeals for the Federal Circuit was timely filed July 8, 2016, in the United States Patent and Trademark Office in connection with the above identified *Inter Partes Review* proceeding. Pursuant to 35 U.S.C. § 143 a Certified List is this day being forwarded to the Federal Circuit.

Respectfully submitted,

Date: August 22, 2016

By: Macia L. Fletcher
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Under Secretary of Commerce for Intellectual Property and
Director of the United States
Patent and Trademark Office

[1] *Inter Partes* Review No. IPR2015-00762 was joined with IPR2014-01121.

CERTIFICATE OF SERVICE

The undersigned hereby certifies that a true and correct copy of the foregoing has been served on Appellant and Appellee via email this 22nd day of August, 2016, as follows:

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U.S. DEPARTMENT OF COMMERCE
United States Patent and Trademark Office

August 22, 2016
(Date)

THIS IS TO CERTIFY that the attached document is a list of the papers that comprise the record before the Patent Trial and Appeal Board (PTAB) for the *Inter Partes Review* proceeding identified below.

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

NIDEC MOTOR COPORATION,
Patent Owner.

Case: IPR2014-01121[1]
Patent No. 7,626,349 B2

By authority of the

DIRECTOR OF THE UNITED STATES PATENT AND TRADEMARK OFFICE

Marcia L. Fletcher

Certifying Officer

[1] *Inter Partes* Review No. 2015-00762 was joined with IPR2014-01121.

Prosecution History – IPR2014-01121

Date	Document
7/3/2014	Petition for Inter Partes Review
7/3/2014	Petitioners' Power of Attorney
7/24/2014	Notice of Filing Date Accorded to Petition
7/24/2014	Patent Owner's Mandatory Notices
7/28/2014	Petitioners' Reply to Notice of Filing Date Accorded to Petition
7/28/2014	Revised Petition for Inter Partes Review
7/31/2014	Notice of Accepting Corrected Petition
10/3/2014	Petitioners' Motion for Counsel to Withdraw from the Proceeding
10/20/2014	Petitioners' Power of Attorney
10/23/2014	Petitioners' First Supplemental Mandatory Notices
10/23/2014	Motion for Pro Hac Vice Admission - Baker
10/23/2014	Petitioners' Listing of Exhibits
10/24/2014	Patent Owner's Preliminary Response
10/30/2014	Decision - Motion to Withdraw Counsel and Motion for Pro Hac Vice Admission
11/4/2014	Order - Authorization for Motion to Correct Clerical Mistake in the Petition
11/10/2014	Petitioners' Motion to Submit a Corrected Exhibit and Maintain Filing Date
11/10/2014	Petitioners' Listing of Exhibits
11/17/2014	Patent Owner's Opposition to Motion to Correct Clerical Error
1/21/2015	Decision - Institution of Inter Partes Review
1/21/2015	Scheduling Order
2/4/2015	Petitioners' Request for Rehearing of Decision to the Motion to Submit a Corrected Exhibit and Maintain Filing Date, and the Resulting Denial of Institution of Inter Partes Review with Respect to the Anticipation Grounds Based on the Prior Art Hideji Reference
2/20/2015	Patent Owner's Notice Regarding Proposed Motions
2/20/2015	Petitioners' List of Anticipated Motions in Advance of Initial Conference Call
2/24/2015	Decision - Requests for Rehearing
2/25/2015	Order - Conduct of the Proceeding
3/24/2015	Notice of Deposition - Ehsani
3/24/2015	Patent Owner's Notice of Stipulation Regarding Amendment of Due Dates 1-3
5/8/2015	Patent Owner's Response (Redacted)
5/8/2015	Patent Owner's Appendix of Exhibits
5/8/2015	Patent Owner's Motion to Seal
7/16/2015	Notice of Deposition - Bokhart
7/16/2015	Notice of Deposition - Filla
8/21/2015	Petitioners' Motion To Seal
8/21/2015	Petitioners' Reply to Patent Owner's Response (Redacted)
8/21/2015	Petitioners' Listing of Exhibits
9/8/2015	Patent Owner's Notice of Stipulation Regarding Amendment of Due Date 4
9/8/2015	Notice of Deposition - Hu
9/9/2015	Notice of Deposition - Hofmann
9/10/2015	Order - Conduct of the Proceeding

Prosecution History – IPR2014-01121

Date	Document
9/15/2015	Notice of Deposition - Kessler
9/21/2015	Patent Owner's Request for Oral Argument
9/21/2015	Patent Owner's Appendix of Exhibits
9/21/2015	Petitioners' Motion to Exclude Evidence
9/21/2015	Petitioners' Request for Oral Argument
9/25/2015	Patent Owner's Motion to Seal
9/25/2015	Patent Owner's Motion to Exclude Evidence (Redacted)
9/25/2015	Patent Owner's Response to Petitioners' Motion to Exclude Evidence
9/25/2015	Patent Owner's Appendix of Exhibits
9/25/2015	Patent Owner's Motion to Seal
9/25/2015	Petitioners' Response to Patent Owner's Motion to Exclude Evidence
9/25/2015	Petitioners' Response to Patent Owner's Motion for Cross-Examination Observation of Hu
9/25/2015	Petitioners' Response to Patent Owner's Motion for Cross-Examination Observation of Kessler
9/25/2015	Petitioners' Response to Patent Owner's Motion for Cross-Examination Observation of Hofmann
9/25/2015	Petitioners' Motion to Seal
10/2/2015	Patent Owner's Motion to Seal
10/2/2015	Patent Owner's Reply in Support of its Motion to Exclude Evidence (Redacted)
10/2/2015	Petitioners' Listing of Exhibits
10/5/2015	Decision - Request for Rehearing, Institution Decision, and Motion for Joinder
10/5/2015	Petitioners' Reply to Patent Owner's Response to Petitioners' Motion to Exclude Evidence
10/5/2015	Petitioners' Motion to Accept Reply to Patent Owner's Response to Petitioners' Motion to Exclude Evidence
10/13/2015	Supplemental Scheduling Order
12/10/2015	Order - Conduct of the Proceeding
12/16/2015	Patent Owner's Response Regarding Hideji
12/16/2015	Patent Owner's Conditional Motion to Amend
12/16/2015	Patent Owner's Appendix of Exhibits
1/4/2016	Notice of Deposition - Blank
1/13/2016	Petitioners' Listing of Exhibits
1/13/2016	Petitioners' Opposition to Conditional Motion to Amend
1/13/2016	Petitioners' Reply to Patent Owner's Response Regarding Hideji
2/3/2016	Petitioners' Request for Oral Argument
2/3/2016	Patent Owner's Reply in Support of its Conditional Motion to Amend
2/3/2016	Patent Owner's Request for Oral Argument
2/8/2016	Order - Requests for Oral Argument
2/19/2016	Patent Owner's Objections to Petitioners' Demonstrative Exhibits
2/21/2016	Petitioners' Response to Patent Owner's Objections to Petitioners' Demonstrative Exhibits
3/22/2016	Oral Hearing Transcript

Prosecution History – IPR2014-01121

Date	Document
5/9/2016	Final Written Decision
5/9/2016	Order - Motion to Seal
6/22/2016	Joint Motion for Alternative Relief
6/23/2016	Order

Filed on behalf of Nidec Motor Corporation IPR2014-01121
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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

ZHONGSHAN BROAD OCEAN MOTOR CO., LTD.; BORAD OCEAN MOTOR, LLC; AND BROAD OCEAN TECHNOLOGIES, LLC
Petitioners

v.

NIDEC MOTOR CORPORATION
Patent Owner

Case No. IPR2014-01121
U.S. Patent No. 7,626,349

PATENT OWNER NIDEC MOTOR CORPORATION NOTICE OF APPEAL

Notice is hereby given, pursuant to 37 C.F.R. § 90.2(a), that Patent Owner Nidec Motor Corporation ("Nidec") appeals to the United States Court of Appeals for the Federal Circuit from the Final Written Decision entered on May 9, 2016 (Paper 86) (the "Final Written Decision"), and from all underlying orders, decisions, rulings and opinions, including without limitation the Decision to Initiate Trial for *Inter Partes* Review entered on January 21, 2015 (Paper 20) and the Decision Granting Petitioner's Request for Rehearing, Instituting *Inter Partes* Review, and Granting Motion for Joinder entered on October 5, 2015 (Paper 67).

In accordance with 37 C.F.R. § 90.2(a)(3)(ii), Nidec further indicates that the issues on appeal include, but are not limited to, i) whether the Board improperly instituted and joined IPR2015-00762 to this proceeding after the expiration of the statutory one-year bar set forth in 35 U.S.C. § 315(b); ii) whether claims 1-3, 8, 9, 12, 16 and 19 of U.S. Patent No. 7,626,349 are non-obvious over U.S. Patent No. 5,410,230 to Bessler, et al., and "Electronic Control of Torque Ripple in Brushless Motors" by Peter Franz Kocybik; iii) whether the Board improperly ignored Nidec's evidence of objective indicia of non-obviousness; iv) whether Petitioner failed to establish claims 1-3, 8, 9, 12, 16 and 19 of U.S. Patent No. 7,626,349 are anticipated by Japanese Patent Publication JP 2003-348885 to Hideji, and v) whether the Board improperly denied Nidec's Motion to Amend,

including all claim construction rulings as well as all other issues decided adversely to Nidec in any orders, decisions, rulings and opinions.

Simultaneous with this submission, a copy of this Notice of Appeal is being filed with the Patent Trial and Appeal Board and the Clerk's Office for the United States Court of Appeals for the Federal Circuit.

Dated: July 8, 2016

Respectfully Submitted,

/s/ Scott R. Brown

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ATTORNEYS FOR PATENT OWNER
NIDEC MOTOR CORPORATION

CERTIFICATE OF SERVICE

The undersigned hereby certifies that on the 8th day of July, 2016, the original of the foregoing *Patent Owner Nidec Motor Corporation's Notice of Appeal* was filed through the Patent Review Processing System (PRPS) and served via overnight courier on the following:

Director of the United States Patent and Trademark Office
c/o Office of the General Counsel
Madison Building East, 10B20
600 Dulaney Street
Alexandria, VA 22314-5793

/s/ Scott R. Brown

CERTIFICATE OF SERVICE

The undersigned hereby certifies that on the 8th day of July, 2016, a true and accurate copy of the foregoing *Patent Owner Nidec Motor Corporation's Notice of Appeal* was filed using CM/ECF system with the Clerk's Office of the United State Court of Appeals for the Federal Circuit and served via overnight courier:

United State Court of Appeals for the Federal Circuit
717 Madison Place, N.W., Suite 401
Washington, D.C. 20005

/s/ Scott R. Brown

CERTIFICATE OF SERVICE

The undersigned hereby certifies that on the 11th day of July, 2016, a true and accurate copy of the foregoing *Patent Owner Nidec Motor Corporation's Notice of Appeal* was served on the following counsel for Petitioner via electronic mail:

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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[1]
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

[1] 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[2], "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

[2] 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[3], "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.[4]

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.

[3]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.

[4] Judges Wood and Boucher disagree with Judges Medley, Arbes, and Tartal 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).

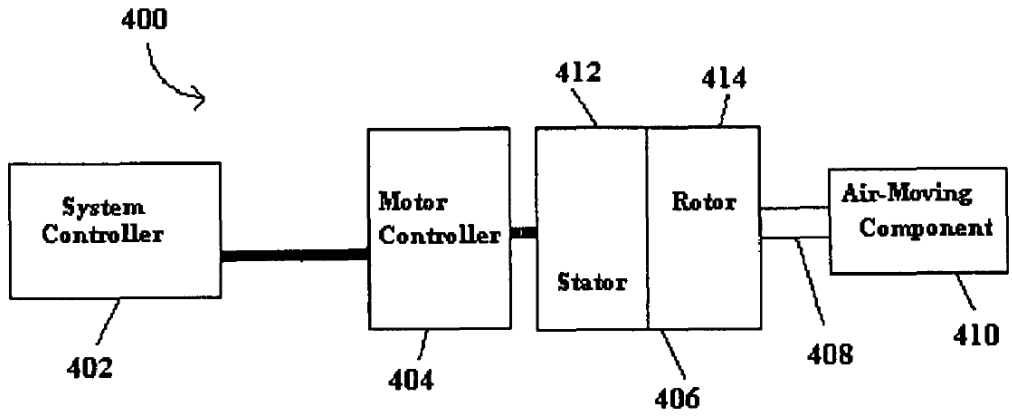
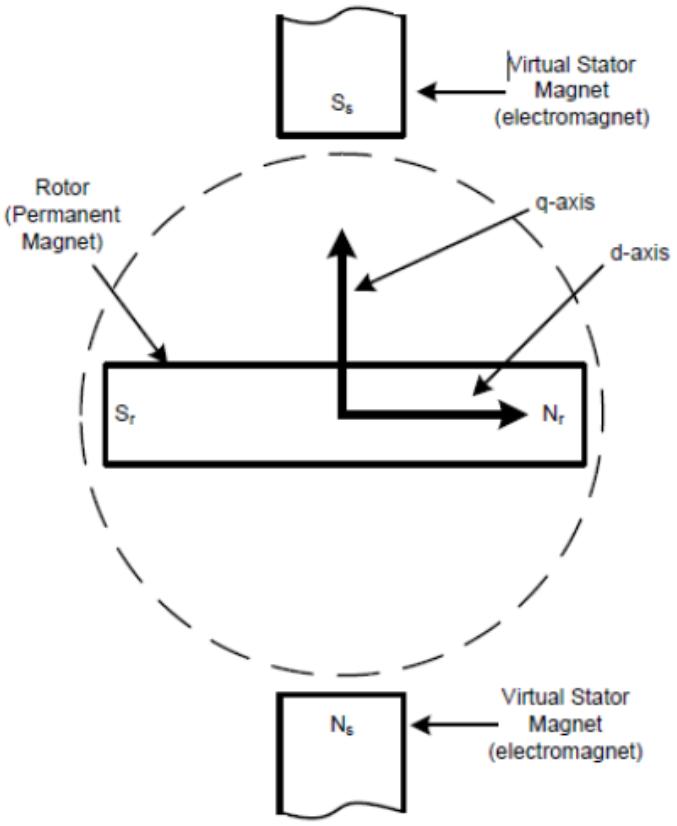


Figure 4

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[5] 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.

[5] 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.

IPR2014-01121
Patent 7,626,349 B2

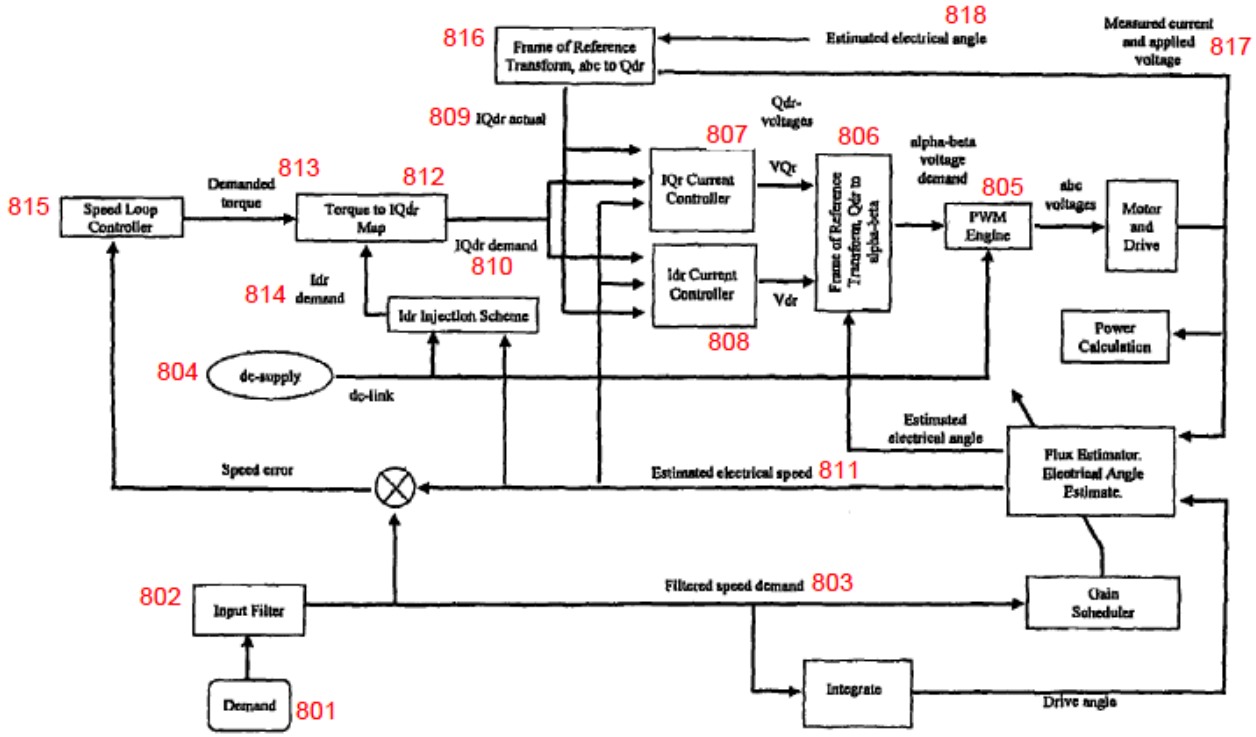


Figure 8

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 α-β voltage demand generated by frame of reference transform 806 using VQr and Vdr signals, as well as an estimated electrical angle. *Id.* at 27:19–29:8. The VQr and Vdr signals are supplied respectively by IQr current controller 807 and Idr current controller 808, which receive "IQdr actual" signal 809, "IQdr demand" signal 810, and estimated electrical speed 811 derived from filtered speed demand 803. *Id.* at 30:20–31:3, 32:10–18. The "IQdr actual" signal is a combination of signals along the Q and d axes, and the "IQdr demand" signal results from a conversion performed by torque to IQdr map 812 using demanded torque 813 (provided by speed loop controller 815, which is part of the motor controller) and Idr demand 814. *Id.* at 31:4–24, 26:18–23. The "IQdr 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.[6]

"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

[6] 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.[7]

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.

[7] Alternatively, the Motion would be dismissed because we do not rely on the evidence sought to be excluded in this Decision.

IPR2014-01121
Patent 7,626,349 B2

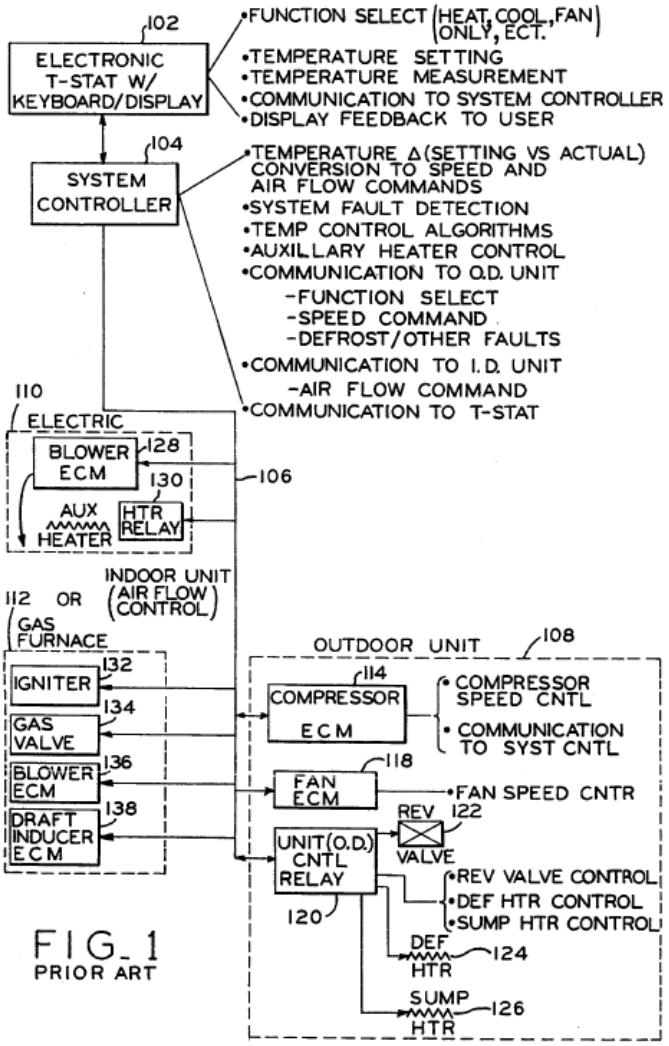


FIG. 1
PRIOR ART

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,[8] 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

[8] 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.[9] *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

[9] 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.[10]

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

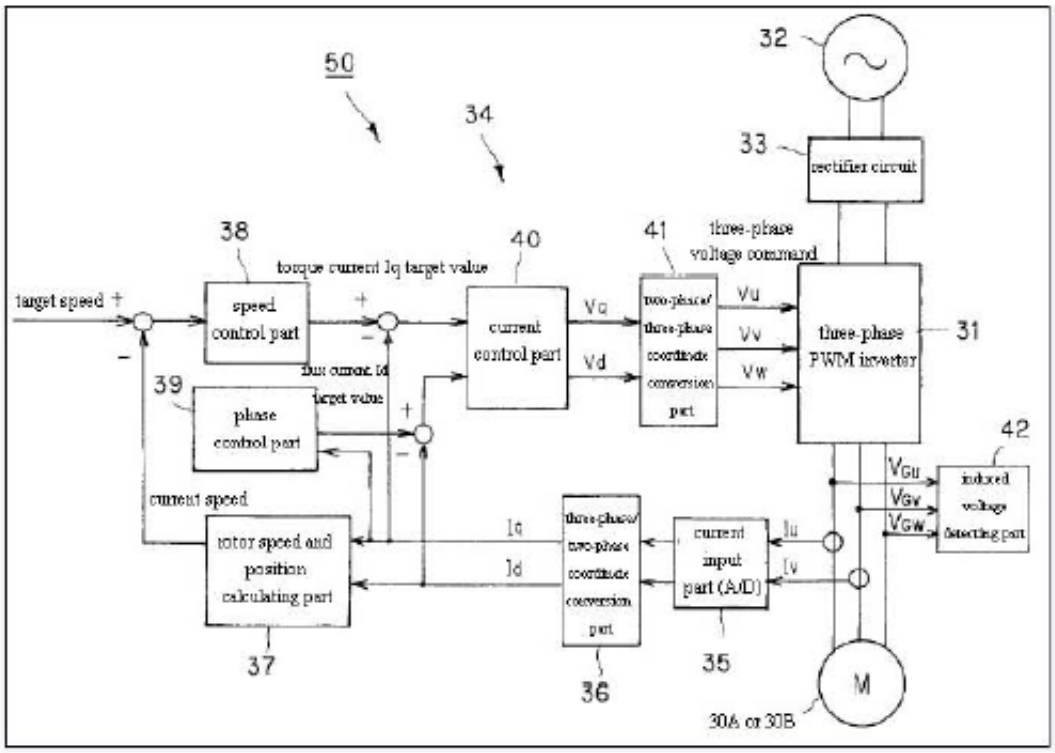
[10] Our conclusion would be unaffected by a determination that the preambles of the claims reciting an HVAC system are limiting. Although Kocybik is not directed explicitly to HVAC systems, Petitioner relies on Bessler for such a teaching. We are persuaded that a person of ordinary skill in the art 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.[11] Ex. 1005 ¶ 22. Figure 2 of Hideji is reproduced below.

【Fig. 2】



[11] 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.[12] Pet. 762, 23–24. Hideji discloses that

> [t]he three-phase/two-phase coordinate conversion part 36 converts the coordinates of the alternating current Iu and Iv 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.

[12] 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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US007626349B2

(12) **United States Patent**
Marcinkiewicz et al.

(10) **Patent No.: US 7,626,349 B2**
(45) **Date of Patent: Dec. 1, 2009**

(54) **LOW NOISE HEATING, VENTILATING AND/OR AIR CONDITIONING (HVAC) SYSTEMS**

(75) Inventors: **Joseph G. Marcinkiewicz**, St. Peters, MO (US); **Arthur E. Woodard**, Manchester, MO (US); **Prakash B. Shahi**, St. Louis, MO (US); **Mark E. Carrier**, Wildwood, MO (US); **Michael I. Henderson**, North Yorkshire (GB)

(73) Assignee: **Emerson Electric Co.**, St. Louis, MO (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 300 days.

(21) Appl. No.: **11/701,350**

(22) Filed: **Feb. 1, 2007**

(65) **Prior Publication Data**

US 2008/0185986 A1 Aug. 7, 2008

(51) **Int. Cl.**
H02P 21/00 (2006.01)

(52) **U.S. Cl.** **318/400.02**; 318/400.32; 318/599

(58) **Field of Classification Search** 318/400.02, 318/400.32, 400.34, 459, 500, 432, 599
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,410,230 A * 4/1995 Bessler et al. 318/471
5,426,354 A * 6/1995 Bausch 318/400.04
5,448,141 A * 9/1995 Kelley et al. 318/400.35
5,969,498 A * 10/1999 Cooke 318/799
6,326,750 B1 12/2001 Marcinkiewicz
6,756,757 B2 6/2004 Marcinkiewicz et al.
7,208,895 B2 4/2007 Marcinkiewicz et al.
2006/0290302 A1 12/2006 Marcinkiewicz et al.

OTHER PUBLICATIONS

"Closed-Loop Vector Yorque Control," www.worldservo.com/html/features/vector.htm; [retrieved on Nov. 22, 2006]; pp. 1-3.
"Sinewave Commutation," www.worldservo.com/html/features/sine.htm; [retrieved on Nov. 22, 2006]; pp. 1-3.

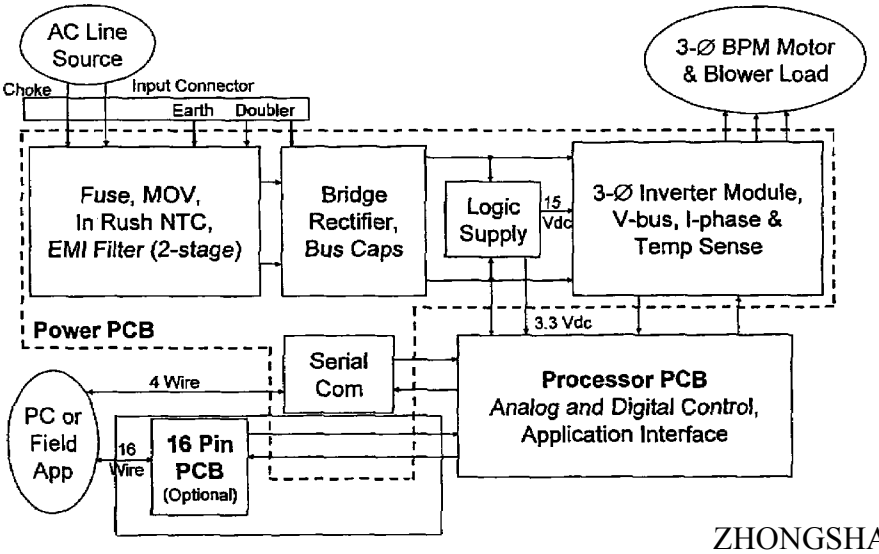
* cited by examiner

Primary Examiner—Rina I Duda
(74) *Attorney, Agent, or Firm*—Harness, Dickey & Pierce, P.L.C.

(57) **ABSTRACT**

A heating, ventilating and/or air conditioning (HVAC) system includes 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. The motor controller is configured for performing 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. By using sinewave commutation (in contrast to square wave commutation), the noise and vibration produced by the HVAC system is markedly reduced.

20 Claims, 4 Drawing Sheets



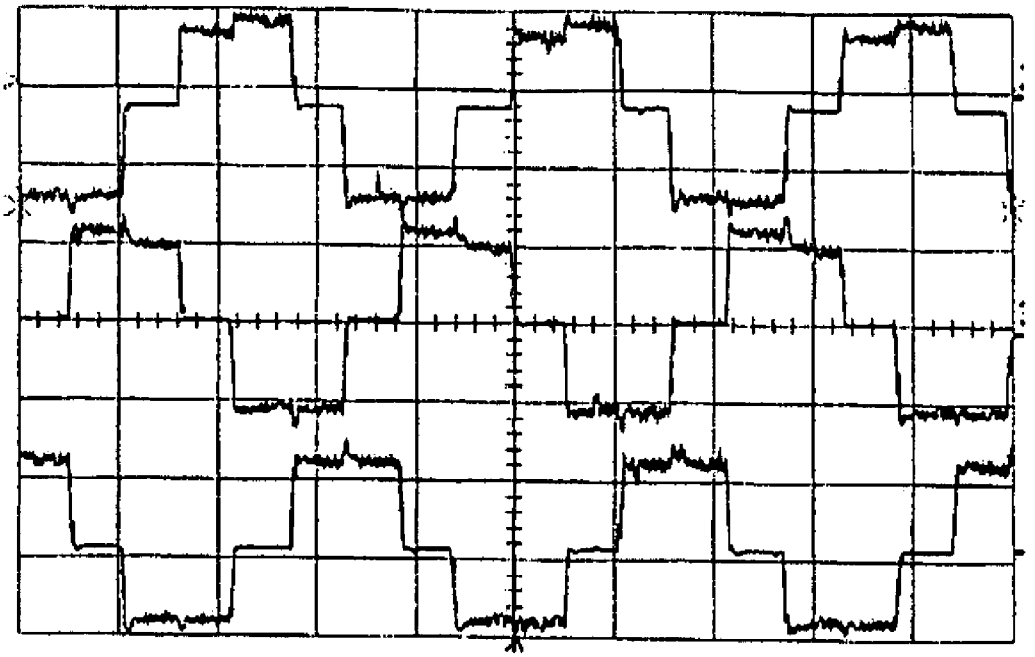


Figure 1
(Prior Art)

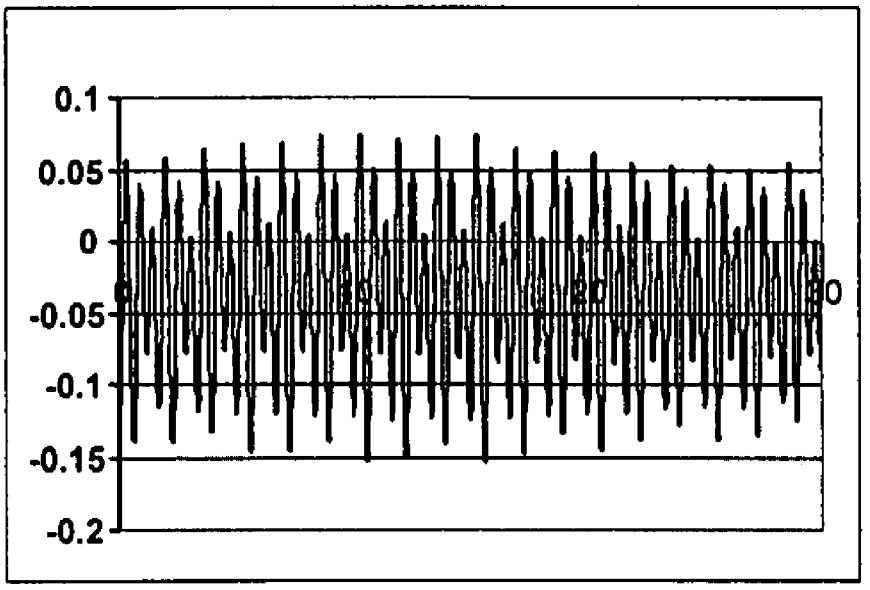


Figure 2
(Prior Art)

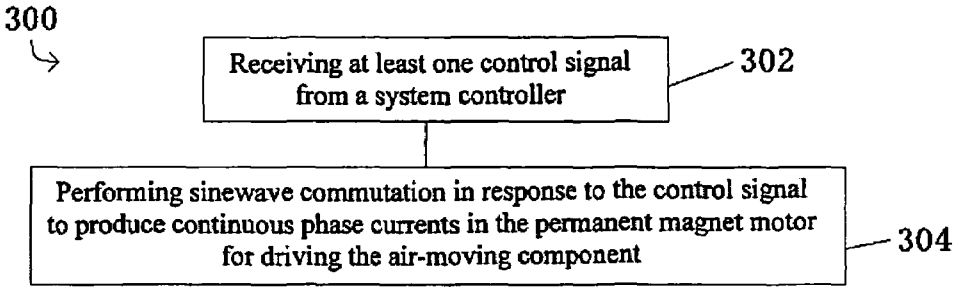


Figure 3

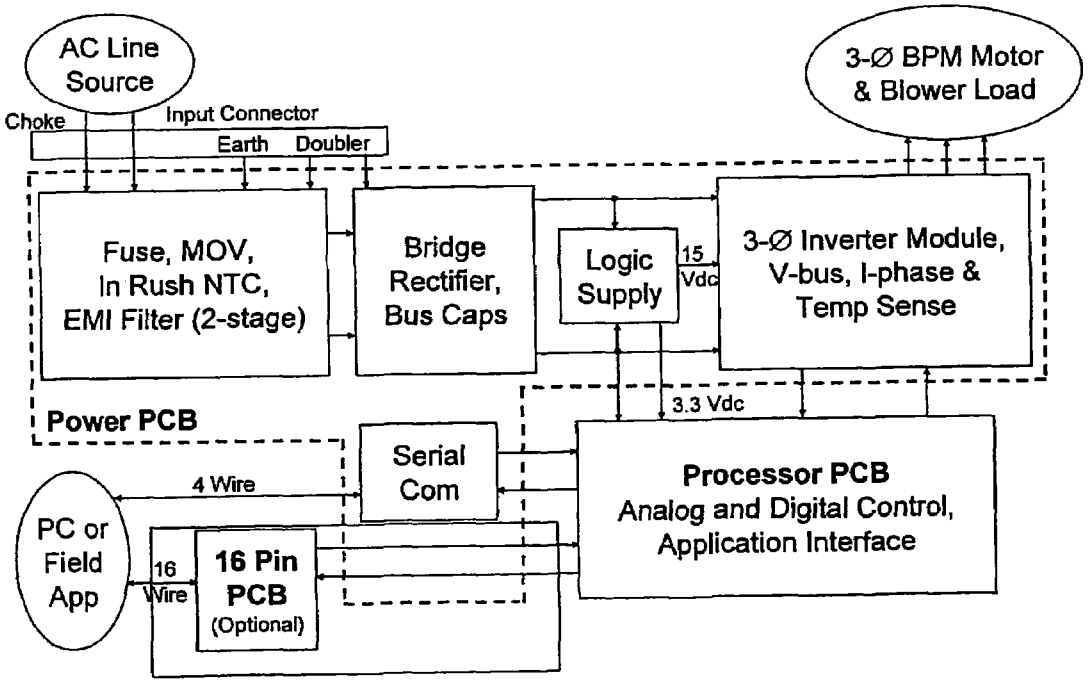


Figure 7

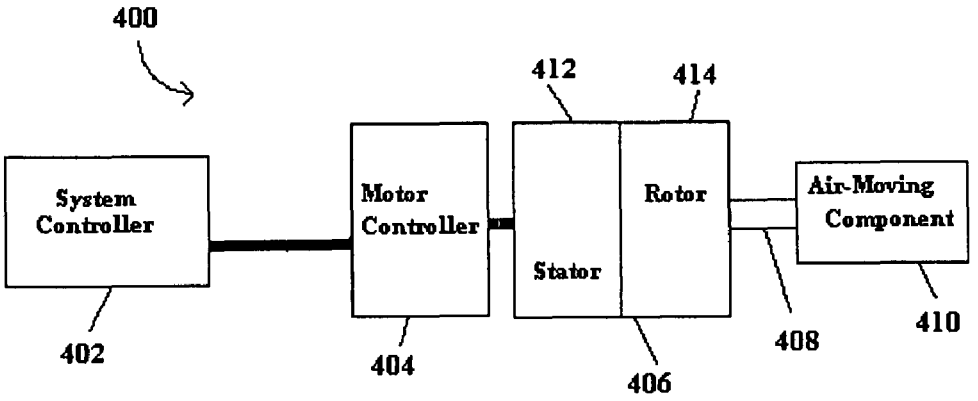


Figure 4

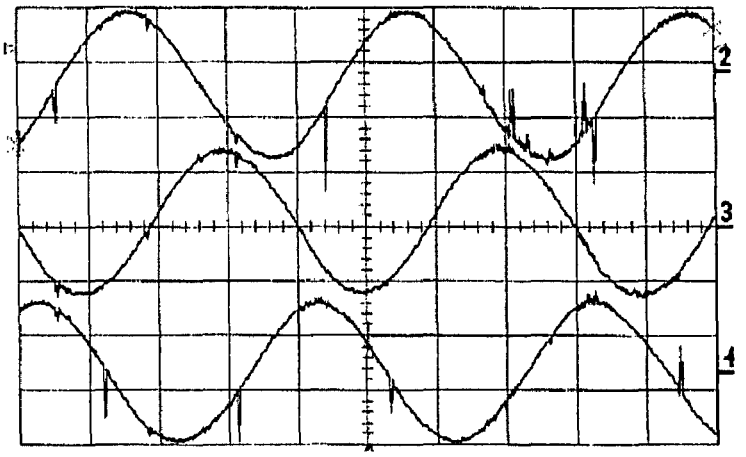


Figure 5

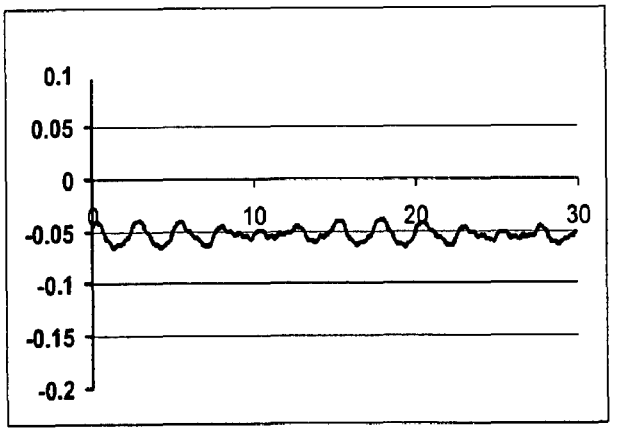


Figure 6

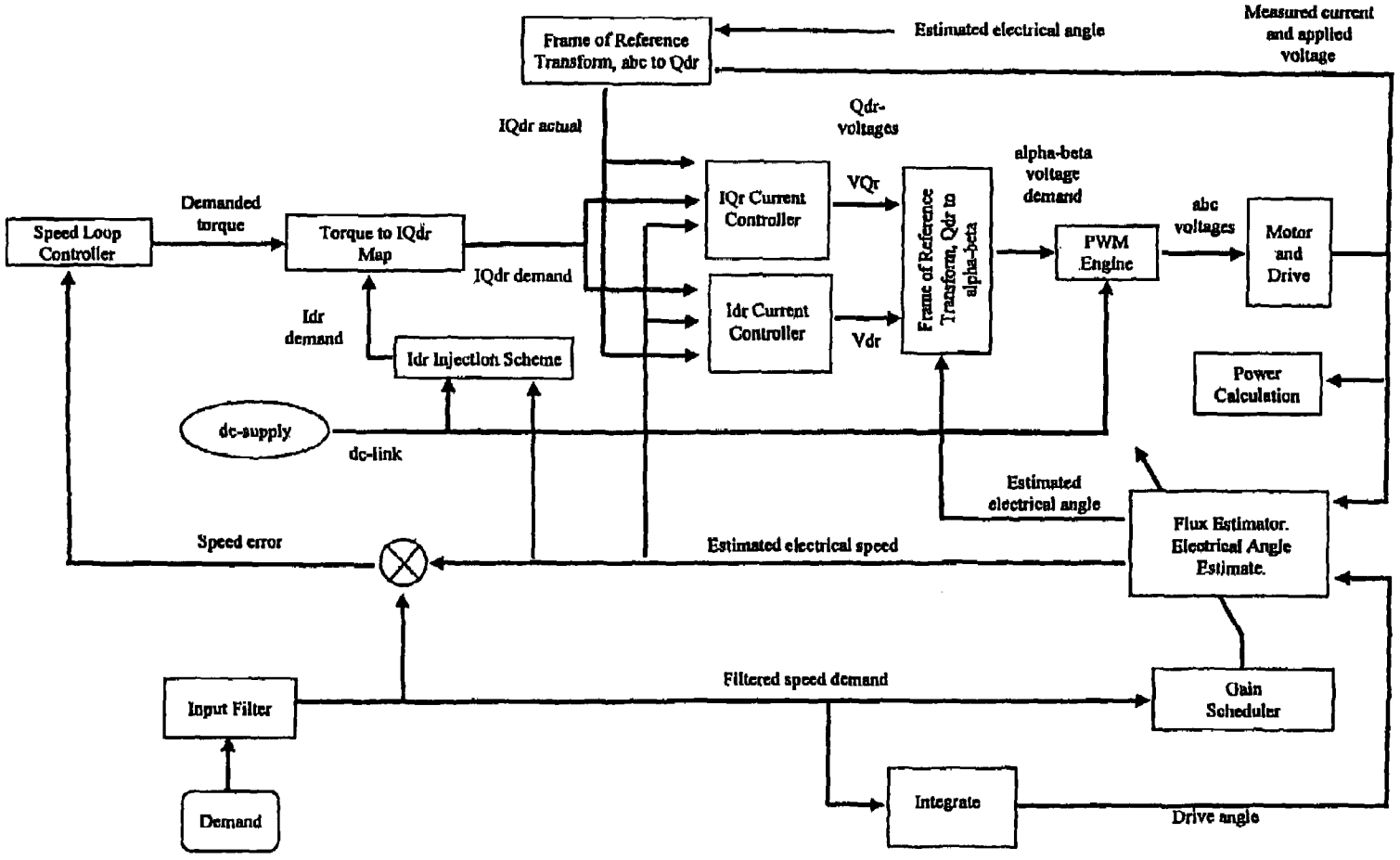

Frame of Reference Transform, abc to Qdr
Estimated electrical angle
Measured current and applied voltage
IQdr actual
Qdr- voltages
IQr Current Controller
VQr
Frame of Reference Transform, Qdr to alpha-beta
alpha-beta voltage demand
PWM Engine
abc voltages
Motor and Drive
Speed Loop Controller
Demanded torque
Torque to IQdr Map
IQdr demand
Idr demand
Idr Injection Scheme
Idr Current Controller
Vdr
Power Calculation
dc-supply
dc-link
Estimated electrical angle
Flux Estimator. Electrical Angle Estimate.
Speed error
Estimated electrical speed
Input Filter
Filtered speed demand
Gain Scheduler
Demand
Integrate
Drive angle

Figure 8

LOW NOISE HEATING, VENTILATING AND/OR AIR CONDITIONING (HVAC) SYSTEMS

FIELD

The present disclosure relates to heating, ventilating and/or air conditioning (HVAC) systems including HVAC systems employing one or more air-moving components such as a blower.

BACKGROUND OF THE INVENTION

The statements in this section merely provide background information related to the present disclosure and may not constitute prior art.

Various types of climate control systems are known in the art for providing heating, ventilating and/or air conditioning (HVAC). Many of these systems employ one or more air-moving components, including blowers (such as air handlers and circulation fans), condenser fans, draft inducers, etc. These air-moving components are commonly driven by electric motors. While single speed and multi-speed motors are sometimes used to drive air-moving components, discrete speed motors have largely been displaced in recent years by variable speed motors.

Variable speed motors for driving air-moving components in HVAC systems commonly employ square wave excitation and control techniques (sometimes referred to as "6-step" commutation). Typically, such variable speed motors use square wave control signals to control the application of positive and negative do voltages to the motor's three phase windings. At any given time, a positive dc voltage is applied to one of the phase windings, a negative dc voltage is applied to another one of the phase windings, and the third phase winding is unenergized or "open" (the unenergized phase winding is usually not truly left open, but rather "flies" into a catch diode or other device for dissipating residual winding current). By sequentially (and abruptly) rotating the application of positive and negative dc voltages among the three phase windings, a rotating magnetic field is created which causes rotation of the rotor for driving the air-moving component.

FIG. **1** illustrates the phase currents produced in a motor using known square wave commutation techniques (the current offsets are shifted in FIG. **1** to clearly illustrate all three phase currents). Because of the manner in which the phase windings are abruptly switched, with one phase winding unenergized at any given time, the resulting phase currents are discontinuous. As can be seen in FIG. **1**, each phase current has a zero voltage level for about one-third of each cycle.

The known square wave commutation techniques and resulting discontinuous phase currents produce relatively high cogging torque, as illustrated in FIG. **2**, as well as relatively high operating torque ripple and torque harmonics. This, in turn, produces undesirable acoustic noise and vibration in the motor and thus any HVAC system in which the motor is used. For these reasons, many known HVAC motors couple the rotatable assembly (also referred to as the rotor) to the motor shaft using a mechanical damping material to reduce noise and vibration.

Further, known square wave commutation techniques are considered relatively inefficient, and produce an efficiency loss in the motor on the order of about two percent (2%).

SUMMARY

According to one example of the present disclosure, a heating, ventilating and/or air conditioning (HVAC) system includes 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. The motor controller is configured for performing 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.

According to another example of the present disclosure, a method is provided 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 includes a permanent magnet motor having a stationary assembly and a rotatable assembly in magnetic coupling relation to the stationary assembly. The rotatable assembly is coupled in driving relation to the air-moving component. The method includes receiving at least one control signal from a system controller, and performing sinewave commutation in response to the control signal received from the system controller to produce continuous phase currents in the permanent magnet motor for driving the air-moving component.

According to yet another example of the present disclosure, a blower assembly for a heating, ventilating and/or air conditioning (HVAC) system includes a motor controller, a blower, 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 blower. The motor controller is configured for performing sinewave commutation in response to one or more control signals received from a system controller to produce continuous phase currents in the permanent magnet motor for driving the blower.

According to still another example of the present disclosure, a motor and controller assembly for HVAC systems includes a motor controller configured for receiving one or more control signals from an HVAC system controller, and for performing sinewave commutation in response to the received control signal(s) to produce continuous phase currents in the permanent magnet motor for driving an air-moving component when the air-moving component is coupled in driving relation to the permanent magnet motor.

Further areas of applicability will become apparent from the description provided herein. It should be understood that the description and specific examples are intended for purposes of illustration only and are not intended to limit the scope of the present disclosure.

BRIEF DESCRIPTION OF THE DRAWINGS

The drawings described herein are for illustration purposes only and are not intended to limit the scope of the present disclosure in any way.

FIG. **1** is a graph of discontinuous phase currents produced in a variable speed motor under square wave commutation control according to the prior art.

FIG. **2** is a graph illustrating the relatively high cogging torque of a prior art variable speed HVAC motor under square wave commutation control.

FIG. **3** is a block diagram of a method for driving an air-moving component of an HVAC system according to one embodiment of the present disclosure.

FIG. **4** is a block diagram of an HVAC system having a motor and motor controller for driving an air-moving component according to another embodiment of the present disclosure.

FIG. **5** is a graph of the continuous and substantially sinusoidal phase currents produced in the permanent magnet motor of FIG. **4** using sinewave commutation techniques.

FIG. **6** is a graph illustrating the relatively low cogging torque of the permanent magnet motor shown in FIG. **4** under sinewave commutation control.

FIG. **7** is a block diagram of an HVAC blower assembly according to another embodiment of the present disclosure.

FIG. **8** is a block diagram of a sensorless vector control scheme performed by the controller shown in FIG. **7**.

DETAILED DESCRIPTION

The following description is merely exemplary in nature and is not intended to limit the scope of the present disclosure nor its potential applications and uses.

According to one aspect of the present disclosure, a method is provided 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 includes a permanent magnet motor having a stationary assembly (stator) and a rotatable assembly (rotor) in magnetic coupling relation to the stationary assembly. The rotatable assembly is coupled in driving relation to the air-moving component. As illustrated in FIG. **3**, the method **300** includes receiving at least one control signal from a system controller (block **302**), and performing sinewave commutation in response to the control signal received from the system controller to produce continuous phase currents in the permanent magnet motor for driving the air-moving component (block **304**). Employing sinewave commutation in the HVAC system provides a number of advantages, including reducing the operating torque ripple of the permanent magnet motor, especially as compared to prior art motors that employ square wave commutation techniques. As a result, the acoustic noise produced by the HVAC system is likewise reduced.

One example of a system for practicing the method **300** of FIG. **3** will now be described with reference to FIG. **4**. It should be understood, however, that other systems may be employed for practicing the method of FIG. **3** without departing from the scope of this disclosure.

As shown in FIG. **4**, the system **400** includes a system controller **402**, a motor controller **404**, a permanent magnet motor **406** and an air-moving component **410**. The permanent magnet motor **406** includes a shaft **408**, a stationary assembly **412** and a rotatable assembly **414**. The rotatable assembly **414** is magnetically coupled to the stationary assembly **412**. The rotatable assembly **414** is coupled to the air-moving component, in this particular example via the shaft **408**, for driving rotation of the air-moving component **410**.

The motor controller **404** is configured for performing sinewave commutation in response to one or more (analog or digital) control signals received from the system controller **402** to produce continuous phase currents in the permanent magnet motor **406** for driving the air-moving component **410**. As shown in FIG. **4**, the motor controller **404** is coupled to the system controller **402** for receiving control signals directly from the system controller **402**. Such control signals may represent, for example, a desired torque or speed of the motor **406**. Alternatively, the control signals may represent a desired airflow to be produced by the air-moving component **410**.

For the particular embodiment shown in FIG. **4**, the motor controller **404** is configured for performing sinewave commutation using vector control to ensure the continuous phase currents produced in the permanent magnet motor are substantially sinusoidal. As appreciated by those skilled in the art, using vector control techniques (which involve transformation(s) to different frame(s) of reference) typically requires determining the rotor position. This can be accomplished using sensor(s) or sensorless techniques.

In the case where the air-moving component **410** is a blower and the motor controller **404** is configured to operate in a constant airflow mode (also called a constant cubic feet per minute (CFM) mode, in which the blower is controlled so as to provide a desired level of airflow), a vector control architecture provides a substantially constant torque over the operating range of the permanent magnet motor. Therefore, the constant airflow control laws need not address torque changes that could otherwise occur with changes in the speed, etc. Moreover, due to the dynamic response of the vector control architecture, there is substantially no interaction with the constant airflow control loop. Additional details regarding sensorless control techniques and sinewave commutation using vector control (as well as speed, torque and constant airflow control schemes, discussed below) are disclosed in U.S. Pat. Nos. 6,326,750, 6,756,757, 7,208,895 and 7,342,379, the entire disclosures of which are incorporated herein by reference.

The air-moving component **410** can be a blower, such as an air handler or circulation fan, an indoor or outdoor condenser fan, a draft inducer fan, etc. It should be understood, however, that other types of air-moving components can be coupled in driving relation to the rotatable assembly **414** without departing from the scope of this disclosure. Further, 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**.

In the embodiment of FIG. **4**, the permanent magnet motor **406** is a variable speed brushless permanent magnet (BPM) motor, such as a back-electromagnetic field (back-emf) BPM motor having a segmented stator. It should be understood, however, that other types of permanent magnet motors (including motors with embedded or surface magnets on the rotor or the stator, motors with segmented or non-segmented stators, and discrete speed(s) motors) can be employed without departing from the scope of this disclosure.

In the specific embodiment of FIG. **4**, the stationary assembly **412** includes three phase windings (not shown) and the motor controller **404** is configured for energizing all three of the phase windings at the same time. FIG. **5** illustrates the continuous and substantially sinusoidal phase currents produced in the three phase windings of the stationary assembly **412** (the current offsets are shifted in FIG. **5** to clearly illustrate all three phase currents). The phase currents are continuous because they each have substantially no period of zero voltage. The phase currents illustrated in FIG. **5** are not perfectly sinusoidal due to, among other things, the presence of harmonics in the motor's back emf. If desired, the motor controller **404** can be configured (using known techniques) to produce continuous phase currents that cancel effects of harmonic content in the permanent magnet motor's back emf. Additional details regarding cancelling the effects of harmonic content in the back emf are disclosed in the applications and patents referenced above.

By using sinewave commutation in the motor controller **404**, the efficiency of the motor **406** (and thus the system **400**)

is improved as compared to the square wave commutation techniques employed in the prior art. Further, because of the continuous phase currents produced in the permanent magnet motor, the resulting operating torque is substantially free of torque ripple that could otherwise produce acoustic noise and vibration. As a result, in the particular embodiment shown in FIG. **4**, the rotatable assembly **414** is coupled to the shaft **408** without using damping materials. Accordingly, the manufacturing cost of the permanent magnet motor **406** is reduced as compared to motors requiring damping materials to reduce acoustic noise. It should be understood, however, that damping materials may still be employed, if desired, without departing from the scope of this disclosure.

Additionally, the motor **406** shown in FIG. **4** produces relatively little cogging torque, as shown in FIG. **6**, particularly as compared to the cogging torque shown in FIG. **2** for prior art motors under square wave commutation control. This also helps reduce acoustic noise and vibration in the HVAC system **400**.

FIG. **7** illustrates a specific embodiment of the HVAC system of FIG. **4** in which the air-moving component is a blower. In the embodiment of FIG. **7**, the system controller is identified as a "PC or Field" application. FIG. **8** provides a block diagram of the sensorless vector control performed by the processor printed circuit board (PCB) shown in FIG. **7**.

Those skilled in the art will recognize that various changes can be made to the exemplary embodiments and implementations described above without departing from the scope of the present disclosure. Accordingly, all matter contained in the above description or shown in the accompanying drawings should be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. A heating, ventilating 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 control signals received from the system controller to produce continuous phase currents in the permanent magnet motor for driving the air-moving component.

2. The HVAC system of claim **1** wherein the stationary assembly includes a plurality of phase windings and the motor controller is configured for energizing all of the phase windings at the same time.

3. The HVAC system of claim **2** wherein the continuous phase currents are substantially sinusoidal.

4. The HVAC system of claim **3** wherein the rotatable assembly is coupled to the shaft without using a damping material.

5. The HVAC system of claim **3** wherein the air-moving component is a blower.

6. The HVAC system of claim **3** wherein the air-moving component is a draft inducer.

7. The HVAC system of claim **3** wherein the air-moving component is a condenser fan.

8. The HVAC system of claim **3** wherein the permanent magnet motor is a brushless permanent magnet (BPM) motor.

9. The HVAC system of claim **8** wherein the BPM motor is a back-emf BPM motor.

10. The HVAC system of claim **3** wherein the system controller includes a thermostat.

11. The HVAC system of claim **3** wherein the at least one control signal from the system controller represents a desired airflow for the air-moving component.

12. The HVAC system of claim **3** wherein the at least one control signal from the system controller represents a desired torque or speed of the permanent magnet motor.

13. The HVAC system of claim **3** wherein the motor controller is configured for performing sinewave commutation using vector control.

14. The HVAC system of claim **13** wherein the motor controller is configured for sensorlessly estimating a position of the rotatable assembly using a flux estimate produced using energization feedback from the permanent magnet motor.

15. The HVAC system of claim **3** wherein the motor controller is configured to produce continuous phase currents that cancel effects of harmonic content in the permanent magnet motor's back emf.

16. A blower assembly for a heating, ventilating and/or air conditioning (HVAC) system, the blower assembly comprising a motor controller, a blower, 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 blower, 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 control signals received from a system controller to produce continuous phase currents in the permanent magnet motor for driving the blower.

17. The blower assembly of claim **16** wherein the motor controller is configured for sensorlessly estimating a position of the rotatable assembly using a flux estimate produced using energization feedback from the permanent magnet motor.

18. The blower assembly of claim **17** wherein the motor controller is configured to produce continuous substantially sinusoidal phase currents that cancel harmonic content in the permanent magnet motor's back emf.

19. 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, the method comprising receiving at least one control signal from a system controller, and performing sinewave commutation, using independent values of Q and d axis currents, in response to the at least one control signal received from the system controller to produce continuous currents in the permanent magnet motor for driving said air-moving component.

20. The method of claim **19** wherein the air-moving component is a blower, and wherein receiving includes receiving at least one control signal representing a desired airflow for the blower, a desired torque of the permanent magnet motor, or a desired speed of the permanent magnet motor.

* * * * *

United States Court of Appeals for the Federal Circuit

Nidec Motor Corporation v. Zhongshan Broad Ocean Motor Co. et al., 2016-2321

CERTIFICATE OF SERVICE

I, Justin Crawford, being duly sworn according to law and being over the age of 18, upon my oath depose and say that on **November 7, 2016,** counsel of record has authorized me to electronically file the foregoing **Brief of Appellant** with the Clerk of Court using the CM/ECF System, which will serve via e-mail notice of such filing to all counsel registered as CM/ECF users, including any of the following:

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Paper copies will also be mailed to principal counsel, Steven F. Meyer, at the time paper copies are sent to the Court.

Upon acceptance by the Court of the e-filed document, six paper copies will be filed with the Court, via Federal Express, within the time provided in the Court's rules.

November 7, 2016

/s/ Justin Crawford
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CERTIFICATE OF COMPLIANCE

1. This brief complies with the type-volume limitation of Federal Rule of Appellate Procedure 32(a)(7)(B). The brief contains 13,750 words, excluding the parts of the brief exempted by Federal Rule of Appellate Procedure 32(a)(7)(B)(iii).

2. This brief complies with the typeface requirements of Federal Rule of Appellate Procedure 32(a)(5) and the type style requirements of Federal Rule of Appellate Procedure 32(a)(6). The brief has been prepared in a proportionally spaced typeface using Microsoft Word 2013 in 14-point Times New Roman font.

November 7, 2016

s/ Justin Crawford
Counsel for Appellant