Trials@uspto.gov
571-272-7822

Paper 28
Entered: March 26, 2015

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

CROCUS TECHNOLOGY S.A.,
Petitioner,

v.

NEW YORK UNIVERSITY,
Patent Owner.

Case IPR2014-00047
Patent 6,980,469 B2

Before MIRIAM L. QUINN, PHILLIP J. KAUFFMAN, and JAMES B. ARPIN, *Administrative Patent Judges.*

ARPIN, *Administrative Patent Judge*.

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

I. INTRODUCTION

A. Background

On October 10, 2013, Crocus Technology S.A. ("Petitioner") filed a Petition (Paper 2; "Pet.") challenging claims 1–20 and 22–35 of Patent No. US 6,980,469 B2 (Ex. 1001; "the '469 patent"). Petitioner relied upon the following references and declaration:

Exhibit	References and Declaration
1008	Patent No. US 5,695,864 to Slonczewski, issued Dec. 9. 1997 ("Slonczewski")
1009	English language translation of Patent Application Publication No. EP 1 225 593 A1 to Redon *et al.*, published July 24, 2002 ("Redon")
1010	Declaration of Sanjay K. Banerjee, Ph.D. ("Banerjee Declaration")
1011	Patent No. US 6,714,444 B2 to Huai *et al.*, filed Aug. 6, 2002, issued Mar. 30, 2004 ("Huai")
1012	Patent No. US 7,006,375 B2 to Covington, filed June 6, 2003, issued Feb. 28, 2006 ("Covington")

On January 17, 2014, New York University ("Patent Owner") filed a Preliminary Response (Paper 7; "Prelim. Resp."). In a Decision to Institute (Paper 8; "Dec. to Inst.") issued April 1, 2014, we[1] instituted *inter partes*

[1] After issuance of the Decision to Institute, Judge Kauffman replaced Judge Anderson as a member of this panel.

review of some of the challenged claims on the following grounds:

Claims	Statutory Basis	Applied Reference(s)
1, 5, 22, and 33	35 U.S.C. § 102(b)	Slonczewski
1–6, 14–20, 22–26, and 33–35	35 U.S.C. § 103(a)	Redon and Slonczewski
7, 8, 11, 12, 27, 30, and 31	35 U.S.C. § 103(a)	Redon, Slonczewski, and Huai
9, 10, 19, 28, and 29	35 U.S.C. § 103(a)	Redon, Slonczewski, and Covington

On July 1, 2014, Patent Owner filed a non-contingent Motion to Amend (Paper 18; "Mot. to Amend")), requesting cancellation of independent claims 1 and 22 and dependent claims 5 and 33. Mot. to Amend 1. Petitioner did not oppose the Motion to Amend. Therefore, we *grant* the Motion to Amend; and, except to the extent that challenged claims depend from independent claims 1 and 22, claims 1, 5, 22, and 33 are no longer under consideration in this *inter partes* review. On July 1, 2014, Patent Owner also filed a Patent Owner Response (Paper 17; "PO Resp."); and, on October 1, 2014, Petitioner filed a Reply (Paper 21; "Pet. Reply") to the Patent Owner Response.

Both parties requested oral argument. Papers 22 and 23. We granted the requests for oral hearing (Paper 25), and the oral hearing was conducted on February 10, 2014.[2]

[2] A transcript of the hearing is included in the record as Paper 26 ("Tr.").

We have jurisdiction under 35 U.S.C. § 6(c). This Final Written Decision is entered pursuant to 35 U.S.C. § 318(a).

B. Related Proceedings

The '469 patent is not involved in concurrent litigation or administrative proceedings. Pet. 1; *see* Paper 5, 1; Paper 12, 1; Paper 16, 1; Paper 24, 1. Pending U.S. Patent Application No. 13/264,685 and issued Patent Nos. US 7,170,778 B2; US 7,307,876 B2; US 7,573,737 B2; US 7,911,832 B2; US 8,363,465 B2; US 8,755,222 B2; and US 8,760,915 B2 claim priority to the '469 patent. *See* Paper 27, 1.

C. The '469 Patent

The '469 patent relates to magnetic devices "for memory cells that can serve as non-volatile memory," memory systems including such memory cells, and methods for making such memory cells. *See* Ex. 1001, col. 12, ll. 5–18; col. 13, ll. 9–26; col. 13, l. 60–col. 14, l. 5. Figure 4 of the '469 patent is reproduced below.

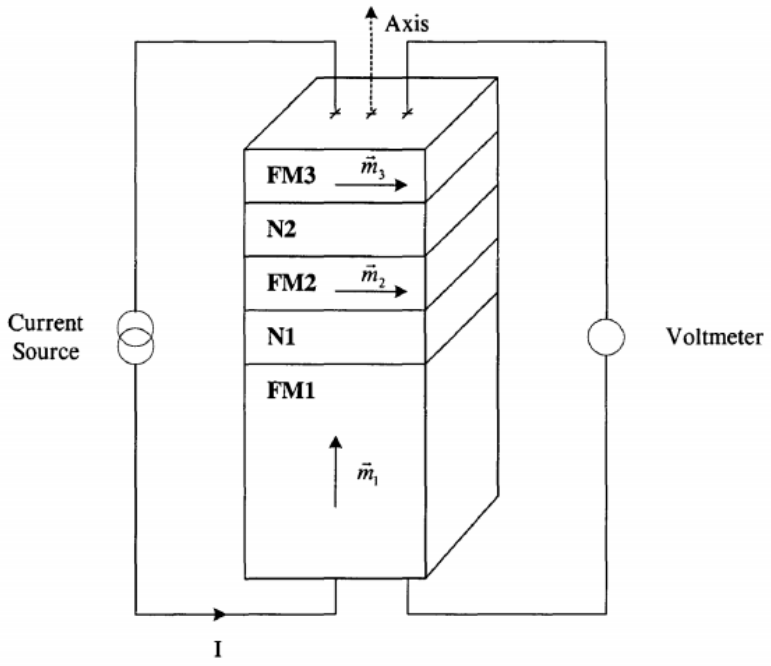


FIGURE 4

Figure 4 is illustrative of memory cells of a magnetic device according to the challenged claims.

Referring to Figure 4 of the ’469 patent, the memory cell of a magnetic device is depicted including at least five layers: (1) a pinned magnetic layer (FM1) with a fixed magnetization direction ($\vec{m}_1$); (2) a free magnetic layer (FM2) with a free, e.g., variable, magnetization direction ($\vec{m}_2$); (3) a first non-magnetic layer (N1) separating the pinned magnetic layer (FM1) and the free magnetic layer (FM2); (4) a read-out magnetic layer (FM3) with a fixed magnetization direction ($\vec{m}_3$); and (5) a second non-magnetic layer (N2) separating the free magnetic layer (FM2) and the read-out magnetic layer (FM3). *Id.* at Abstract; col. 6, ll. 36–67; Fig. 4. Petitioner’s Figures 1A-C are reproduced below. Pet. 4.

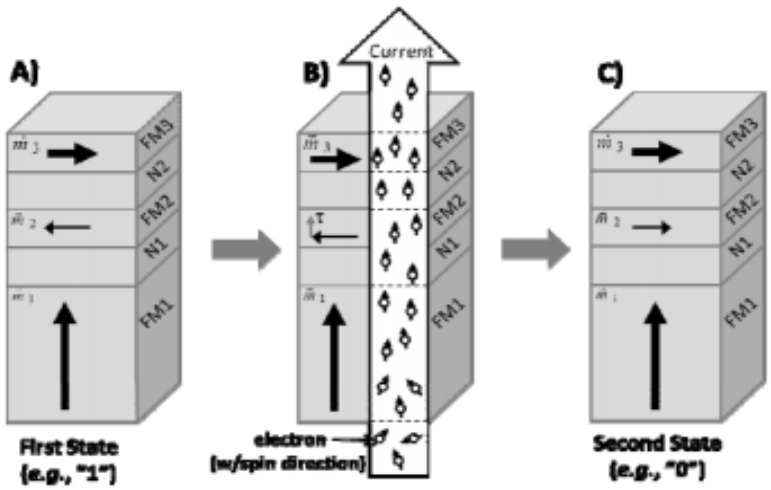


FIGURE 1

The process for changing the variable magnetization direction is depicted in Figures 1A–C.

Referring to Petitioner's Figures 1A-C, a current source supplies a current flow that traverses the magnetic cell. Ex. 1001, col. 3, ll. 10–13, Fig. 4; *see also* Pet. 3 (citing Petitioner's Fig. 1B (reproduced above)). The Specification of the '469 patent describes the writing of information to such memory cells. *See* Ex. 1001, col. 7, l. 1–col. 8, l. 51. As the current traverses from the pinned magnetic layer (FM1) to the free magnetic layer (FM2), the current flow transfers spin-angular momentum to the free magnetization layer and produces a torque (τ) on the magnetization direction ($\vec{m}_2$) of the free magnetic layer (FM2). *Id.* at col. 4, ll. 24–25; *see also* Pet. 4 (describing Petitioner's Fig. 1B).

The torque (τ) acting on the magnetization direction ($\vec{m}_2$) of the free magnetic layer (FM2) causes the magnetization vector of the free magnetic layer (FM2) to rotate around the direction of the demagnetization magnetic

field. Ex. 1001, col 3, ll. 20–37; Figs. 5A–E. Based on parameters of the current, e.g., duration of current application, the rotation may be controlled, so that the magnetization direction ($\vec{m}_2$) of the free magnetic layer (FM2) is in one of an initial and a final state, corresponding to "1" or "0," respectively. *Id.* at col. 8, ll. 1–9. The resistance across the magnetic cell is different for each of these two states. *Id.* at col. 1, ll. 40–42. Consequently, the resistance may be measured to determine the state, "1" or "0," of the magnetic cell. *Id.*

D. Status of the Claims

Of the challenged claims, claims 1, 14, and 22 are independent. As a result of our grant of the Motion to Amend, independent claims 1 and 22, as well as dependent claims 5 and 33, are cancelled. As to the challenged dependent claims, claims 2–4, 6, and 8–12 depend from cancelled claim 1, claims 15–20 and 34 depend from independent claim 14, and claims 23–31 and 35 depend from cancelled claim 22.

In view of Patent Owner's cancellation of the challenged independent claims 1 and 22, independent claim 14 became the focus of the parties' arguments. *See* Tr. 6:4–8; 15:24–16:7. Independent claim 14 is illustrative and is reproduced below:

14. A memory system comprising: a memory cell comprising:
    a pinned magnetic layer with a magnetization vector with a fixed magnetization direction;
    a free magnetic layer with at least one magnetization vector with a changeable magnetization direction;

> a first non-magnetic layer spatially separating said free magnetic layer and said pinned magnetic layer;
>
> a read-out magnetic layer with a magnetization vector with a fixed magnetization direction; and
>
> *a second non-magnetic layer that spatially separates said free magnetic layer and said read-out magnetic layer such that the mutual magnetic interaction between said free magnetic layer and said read-out magnetic layer is minimized*; and
>
> *an electric current source connected to said pinned magnetic layer and said read-out magnetic layer so that an electric current can traverse said memory cell*.

Ex. 1001, col. 13, ll. 9–24 (emphasis added). Disputed limitations are emphasized.

II. ANALYSIS

A. Claim Construction

In an *inter partes* review, "[a] claim in an unexpired patent shall be given its broadest reasonable construction in light of the specification of the patent in which it appears." 37 C.F.R. § 42.100(b); *see also* Office Patent Trial Practice Guide, 77 Fed. Reg. 48,756, 48,766 (Aug. 14, 2012) (Claim Construction); *In re Cuozzo Speed Techs., LLC*, No. 2014-1301, 2015 WL 448667 at *7 (Fed. Cir. Feb. 4, 2015) ("We conclude that Congress implicitly adopted the broadest reasonable interpretation standard in enacting the AIA."). Under the broadest reasonable construction standard, a claim term is presumed to have an ordinary and customary meaning as would be understood by one of ordinary skill in the art in the context of the

specification. *See In re Translogic Tech., Inc.*, 504 F.3d 1249, 1257 (Fed. Cir. 2007). A patent applicant may rebut that presumption by providing a definition of the term in the specification with reasonable clarity, deliberateness, and precision. *In re Paulsen*, 30 F.3d 1475, 1480 (Fed. Cir. 1994). In the absence of such a definition or other considerations, "limitations are not to be read into the claims from the specification." *In re Van Geuns*, 988 F.2d 1181, 1184 (Fed. Cir. 1993).

Neither Patent Owner nor Petitioner challenges our constructions of the terms as set forth in the Decision to Institute. Dec. to Inst. 8–14.

Claim Term	Construction from Decision to Institute
"bit of information" (Claim 6)	"a unit of information equivalent to the result of a choice between only two possible alternatives, represented as 0 and 1" *Id.* at 9–10.
"so that an electric current can traverse said memory cell" (Claim 14)	"so that an electric current is able to traverse said memory cell" *Id.* at 10–11.
"a means for measuring the resistance between said pinned magnetic layer and said read-out magnetic layer" (Claim 16)	"a voltmeter" and equivalents thereof *Id.* at 11–13.
"voltmeter" (Claims 17 and 26)	"any instrument for the measurement of potential difference between two points in volts" *Id.* at 13–14.

Consequently, the constructions of those terms are adopted for purposes of this Final Written Decision. In light of the parties' arguments in the Patent Owner Response and Petitioner's Reply and during the oral hearing, it is

appropriate for us to construe certain additional terms.

1. *"a first non-magnetic layer" and "a second non-magnetic layer" (Claims 1, 14, 22)*

We construe the terms "a first non-magnetic layer" and "a second non-magnetic layer" according to their ordinary and customary meanings as describing separate layers of material that are not magnetic in the recited magnetic devices, memory cells, and methods for making memory cells. The Specification of the '469 patent states that such non-magnetic layers may be comprised of metals or insulators. Ex. 1001, col. 1 ll. 21–23; col. 4, ll. 54–56 ("For the nonmagnetic layers, materials include (*but are not limited to*) Cu, Cr, Au, Ag, and Al." (emphasis added)); col. 11, ll. 40–43 (Referring to Figure 10, the nonmagnetic layer I2 may be an insulating layer made from a material such as Al_2O_3,). Other claims of the '469 patent also can be valuable sources of enlightenment as to the meaning of a term of a challenged claim. *Vitronics Corp. v. Conceptronic, Inc.*, 90 F.3d 1576, 1582 (Fed. Cir. 1996). Although we did not institute *inter partes* review with respect to claims 13 and 32, these claims further limit the recitations of "non-magnetic layers" in claims 1 and 22 to layers "comprised of at least one member of the group consisting of Cu, Cr, Au, Ag, and Al." *See, e.g., id.* at col. 13, ll. 6–8. Thus, we construe "a first non-magnetic layer" and "a second non-magnetic layer" to mean a layer that is not magnetic and that may comprise metals or insulators.

2. "mutual magnetic interaction" (Claims 1, 14, and 33–35)

Although both parties argued the significance of "mutual magnetic interaction" to the analysis of the grounds for unpatentability (Pet. 20–21, 22; PO Resp. 26–30; Pet. Reply 2–6), neither party proposes a construction for this term (Tr. 19:5–20:9; 29:23–30:6). As a first step in our analysis, although the Specification of the '469 patent does not define the term "mutual magnetic interaction," we understand the ordinary and customary meaning within the context of the Specification to mean the magnetically-mediated interaction of two or more magnets on each other, where both magnets are affected by the interaction, for example, the *exchange* of spin polarized electrons between magnetic layers across a separating layer. *See* Ex. 1038, 41:1–42:1.

Patent Owner's declarant, Dr. Edward Murdock, testified that mutual magnetic interaction may involve different types of electron exchange couplings. Ex. 2004 ¶¶ 121–129. In particular, Patent Owner's declarant described a "static" exchange coupling that occurs when two magnetic layers are separated by a thin metallic layer, e.g., a conductor, that is so thin that pinholes can form allowing current to flow between magnetic layers. *Id.* ¶¶ 120–121; *see* PO Resp. 28. According to Patent Owner's declarant, a "conventional" exchange coupling is different from the "static" exchange coupling. Such a "conventional" exchange coupling may occur "even when the spacer layer is thick enough to prevent pinholes from forming." *Id.* ¶ 122. Further, Patent Owner's declarant testified that that "the exchange coupling between two magnetic layers separated by an insulating layer

results in direct exchange coupling, not indirect exchange coupling." *Id.* ¶ 126. Patent Owner's declarant explains that, with respect to the layer separating two magnetic layers, there is an *oscillating* decrease in the exchange coupling with the increasing thickness of a non-magnetic, conducting layer and an *exponential* decrease in the exchange coupling with the increasing thickness of a non-magnetic, insulating layer. *Id.* ¶¶ 127–128 (reproducing Ex. 2007, Figs. 4 and 5); *see also* Ex. 2007, 411 (describing the oscillatory nature of couplings across non-magnetic, metallic layers). Thus, regardless of the composition of the non-magnetic separating layer, Patent Owner's declarant testified that mutual magnetic interaction decreases with the increasing thickness of separating layer.

Petitioner's declarant, Dr. Sanjay Banerjee, testified that "[t]he interaction of a fixed layer with a free layer is due to the propagation of spin polarized electrons between ferromagnetic films across the interlayer." Ex. 1010 ¶ 44 (citing Ex. 1033, 3). Moreover, Petitioner's declarant explained that there is no clear distinction between the effects of non-magnetic layers comprised of metals and of those comprised of insulators, and that conductivity and resistivity are reciprocal characteristics. Ex. 2005, 23:8–28:4.

Neither party suggests that either the claim language or the Specification of the '469 patent requires that "mutual magnetic interaction" is construed to exclude a particular type of exchange coupling. Tr. 19:23–20:9; 29:19–22; *see* Pet. Reply 2 n.2 (citing Ex. 1038, 39:23–40:20; Ex.

1010 ¶¶ 44, 74, 232, 238). Further, except for certain dependent claims,[3] independent claim 14 does not specify whether the non-magnetic layer separating the free magnetic layer from the read-our magnetic layer is a composed of conducting (metal) or insulating material. *See* Tr. 8:13–23; 16:11–17:20. Accordingly, we conclude that the phrase "mutual magnetic interaction," under the broadest but reasonable interpretation in light of the Specification of the '469 patent, does not exclude any particular type of exchange coupling, and means "the effect between two magnetic layers on each other," such as, for example, an exchange of spin polarized electrons between magnetic layers across a separating layer.

III. ASSERTED GROUNDS OF UNPATENTABILITY

A. Anticipation by Slonczewski

We instituted *inter partes* review of claims 1, 5, 22, and 33 of the '469 patent under 35 U.S.C. § 102(b) as anticipated by Slonczewski. Dec. to Inst. 15–22, 30. As noted above, Patent Owner has filed an unopposed and non-contingent Motion to Amend, requesting cancellation of claims 1, 5, 22, and 33 of the '469 patent. Mot. to Amend 1. Therefore, because we *grant* the non-contingent and unopposed Motion to Amend, this ground for unpatentability now is moot.

[3] *See supra* Sec. II.A.1. (discussing claims 13 and 32 of the '469 patent).

B. Obviousness Over Redon and Slonczewski

1. Overview

Petitioner argues that claims 2–4, 6, 14–20, 23–26, 34, and 35 are unpatentable under 35 U.S.C. § 103(a) as rendered obvious over Redon and Slonczewski. Pet. 50–51. A patent claim is unpatentable under 35 U.S.C. § 103(a) if the differences between the claimed subject matter and the prior art are "such that the subject matter[,] as a whole[,] would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains." *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). The question of obviousness is resolved on the basis of underlying factual determinations, including: (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of skill in the art; and (4) objective evidence of nonobviousness, i.e., secondary considerations.[4] *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).

2. Person of ordinary skill in the art

Petitioner's declarant proposes a definition for a person of ordinary skill in the art. Ex. 1010 ¶ 18. Patent Owner's declarant proposes an alternative, but overlapping, definition. Ex. 2004 ¶ 24. From our review of the applied references, we conclude that Patent Owner's declarant proposes too narrow a field of work experience for a person of ordinary skill in the

[4] Patent Owner does not argue that secondary considerations are present, which would render the challenged claims patentable over the applied references.

art. Therefore, for purposes of this decision, a person of ordinary skill in the art is one who has a Bachelor of Science degree in physics, electrical engineering, or a related field with an additional two years of graduate level study in physics, electrical engineering, or a related field, or at least two years of experience working with or researching magnetic memory technology.

3. Petitioner's arguments

Referring to its claim charts, Petitioner argues that Redon teaches or suggests the majority of the limitations of claims 2–4, 6, 14–20, 23–26, 34, and 35. Pet. 29–50. In particular, referring to Redon's Figure 2, Petitioner argues that Redon teaches or suggests a magnetic device having three magnetic layers separated by two non-magnetic layers and a current source for supplying current to traverse the magnetic device. Pet. 31 (depicting an annotated version of Redon's Fig. 2); *see also* Ex. 1009 ¶ 21.

Redon's Figure 2 is reproduced below.

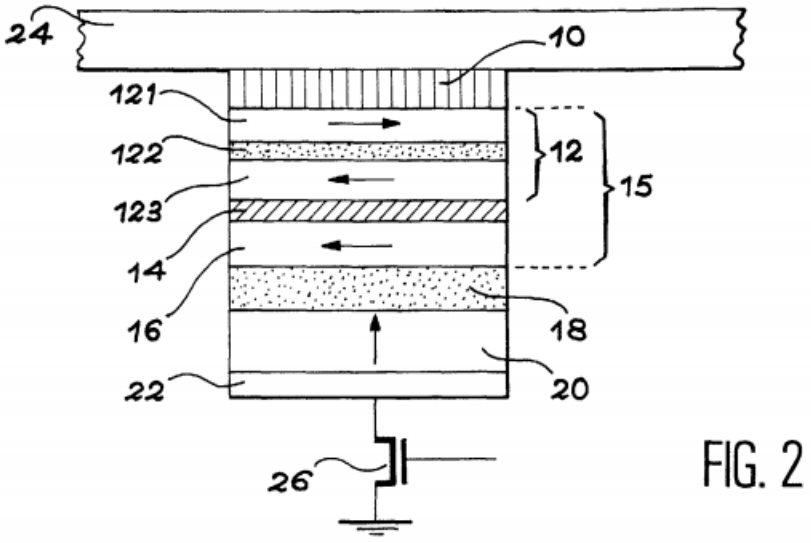


FIG. 2

Redon's Figure 2 depicts a spin-polarized magnetic device. Ex. 1009 ¶¶ 19, 21-23. The depicted magnetic device includes magnetic polarizing layer 20, e.g., the fixed magnetic layer, the magnetic field of which is perpendicular to the plane of the layer (*id.* ¶¶ 22, 32), and free magnetic layer 16 (*id.* ¶¶ 4, 21). *See* Pet. 29–30. Layers 16 and 20 are separated by metallic separating layer 18, e.g., first non-magnetic layer. Pet. 29–30 (citing Ex. 1009 ¶ 22; Ex. 1010 ¶¶ 102–117). Redon further depicts that trapped (e.g., read-out) layer 12 includes two magnetic layers 121 and 123, separated by insulating layer 122. Ex. 1009 ¶¶ 19, 21. Trapped layer 12 is separated from free layer 16 by insulating layer 14, e.g., a second non-magnetic layer. *Id.* ¶ 21.

With respect to independent claim 14, the claim charts set forth in the Petition demonstrate the correspondence of the teachings of Redon to the limitations of those claims. Pet. 34–36 (claim 1), 40–42 (claim 14), and 45–46 (claim 22). Claim 14 further recites "an electric current source connected to said pinned magnetic layer and said read-out magnetic layer so that an electric current can traverse said memory cell." Ex. 1001, col. 13, ll. 24–26.

Referring to Figure 2, Redon teaches that the magnetic device is disposed between power supply 24 and a current switching means, e.g., transistor 26. Ex. 1009 ¶ 22. Thus, current may traverse Redon's magnetic device and realign the magnetization of free magnetic layer 16. Pet. 42 (citing Ex. 1009 ¶¶ 12, 16, 22); *see also* Ex. 1010 ¶ 159 (discussing Ex. 1009, Figs. 3A, 3B, 6A, and 6B). Claim 24, which depends from claim 22, recites similar limitations to the quoted limitations of claim 14, and the limitations of the other dependent claims, challenged on these grounds,

allegedly are taught by Redon. Pet. 36–39 (claims 2–4, 6), 42-45 (claims 15–20), and 46–50 (claims 23–25 and 33–35).

Petitioner acknowledges, however, that Redon may not suggest modifying its magnetic device "to include a non-magnetic layer in a magnetic device to spatially separate a fixed layer from a free layer such that the mutual magnetic interaction between the free magnetic layer and the fixed layer (*i.e.*, pinned magnetic layer or the read-out magnetic layer) be minimized," as recited in independent claim 14. Pet. 50; *see* Pet. Reply 2. Petitioner argues, however, that Slonczewski teaches this limitation, and that a person of ordinary skill in the relevant art would have reason to combine the teachings of Redon and Slonczewski to achieve this limitation of the recited inventions. *Id.* at 51; *see* Pet. Reply 6–9.

Slonczewski's Figure 6 is reproduced below:

FIG. 6

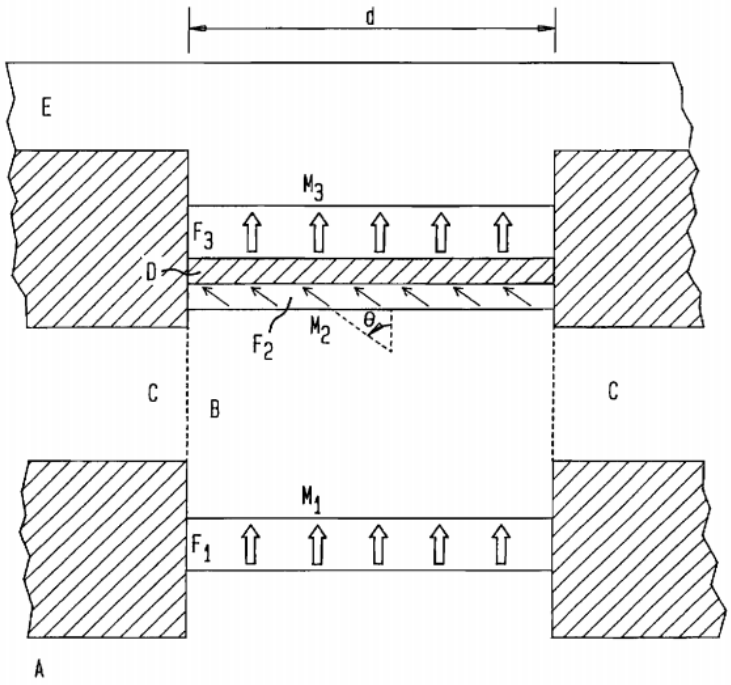


Figure 6 depicts a three terminal device, i.e., terminals A, C, and E, based on reflection-mode spin transfer. Ex. 1008, col. 2, ll. 6–7.

In particular, Figure 6 depicts a device structure having magnetic layers F_1, F_2, and F_3 (*id.* at col. 8, ll. 28–32), conducting terminal layers A, B, and E (*id.* at col. 10, ll. 50 and 56–59; col. 11, l. 11); and a non-magnetic layer D made from alumina ($AL_2O_{3)}$ or another insulator (*id.* at col. 11, ll. 1–4). Petitioner contends that layer F_1 discloses "a pinned magnetic layer with a magnetization vector with a fixed magnetization direction," i.e., M_1. Pet. 21 (referring to claim chart for claim 1). Similarly, Petitioner contends that layer F_2 allegedly discloses "a free magnetic layer with at least one magnetization vector with a changeable magnetization direction," i.e., M_2; and that layer F_3 allegedly discloses "a read-out magnetic layer with a

magnetization vector with a fixed magnetization direction," i.e., M_3. *Id.* at 21–22 (referring to claim chart for claim 1). Further, Petitioner contends that layers B and D, respectively, disclose claim 14's recitation of "a first non-magnetic layer spatially separating said free magnetic layer and said pinned magnetic layer" and "a second non-magnetic layer that spatially separates said free magnetic layer and said read-out magnetic layer." *Id.* at 21–22.

Regardless of whether it is a conductor or an insulator, Petitioner argues that, if the layer separating the magnetic free layer from the magnetic read-out layer is sufficiently thick, Slonczewski teaches that the mutual magnetic interaction between these layers may be reduced or minimized. Ex. 1008, Abstract; col. 1, ll. 33–36; col. 4, ll. 60–65; *see* Tr. 10: 15–20. Further, because layer D is a sufficiently thick insulating layer, Petitioner argues that layer D minimizes the mutual magnetic interaction between the free magnetic layer, i.e., layer F_2, and the read-out magnetic layer, i.e., layer F_3. Ex. 1008, col. 8, ll. 16–21; *see* Pet. 21; Tr. 11:12–17. Referring to Figure 6, Slonczewski explains that, "[i]n essence, magnet F3 behaves as a spinanalyzer of the electrons *passing through magnet F2 and spacer D*." Ex. 1008, col. 8, ll. 58–60 (emphasis added)

In particular, Petitioner argues that Slonczewski teaches that "[t]he electrons flow between the fixed and free ferromagnets through a non-magnetic metallic spacer which is thick enough to make the static inter-magnetic exchange coupling negligible." *See* Pet. 18 (quoting Ex. 1008, Abstract); *see* Pet. Reply 3. Moreover, Slonczewski teaches that the

thickness of the layer intervening between the fixed and free magnetic layers must be sufficient to prevent the exchange of electrons between the magnetic layers. Ex. 1008, col. 4, ll. 60–64; *see also id.* at col. 8, ll. 16–21 (insufficient thickness may result in "accidental bridges").

In addition, Petitioner argues that a person of ordinary skill in the art would have had reason to modify the teachings of Redon in view of the teachings of Slonczewski because both references are in the same field of endeavor, e.g., stacked magnetic memory devices; both are directed to solving the same problem, namely "creating a magnetic device that allows for fast data storage in high density memory systems"; both involve devices employing spin torque transfer; and both describe devices sharing the same structures. Tr. 9:24–10:9: *see* Pet. 51 (citing Ex. 1009 ¶¶ 1, 15; Ex. 1008, col. 1, ll. 5–11). Further, Redon expressly states its desire to improve upon the magnetic devices, such as those taught by Slonczewski. Ex. 1009 ¶¶ 9–10; *see* Tr. 10:5–9. As the U.S. Supreme Court explained, "if a technique has been used to improve one device, and a person of ordinary skill in the art would recognize that it would improve similar devices in the same way, using the technique is obvious unless its actual application is beyond his or her skill." *KSR*, 550 U.S. at 417.

4. Patent Owner's response

Patent Owner disagrees and contends that a person of ordinary skill in the art would not have reason to combine Redon and Slonczewski because, first, Redon and Slonczewski have different structures and solve different problems and, second, Slonczewski expressly teaches against using Redon's structure with Slonczewski's recited invention. PO Resp. 5.

a. Different structures

Referring to Slonczewski's Figures 1 and 6, Patent Owner contends that Slonczewski teaches two distinct structures for the magnetic device. *Id.* at 6–10. Slonczewski's Figure 1 is reproduced below:

FIG. 1

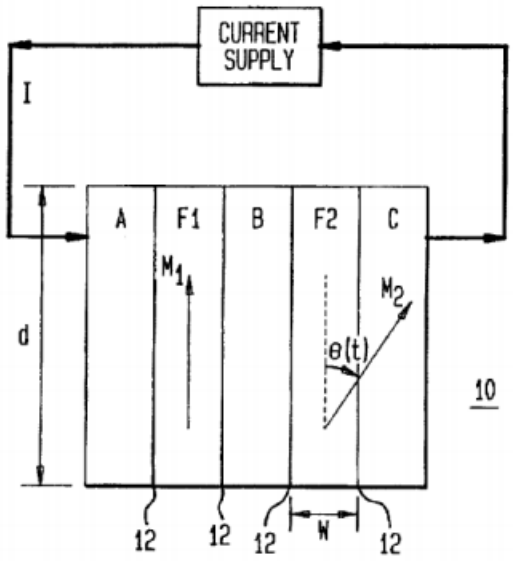
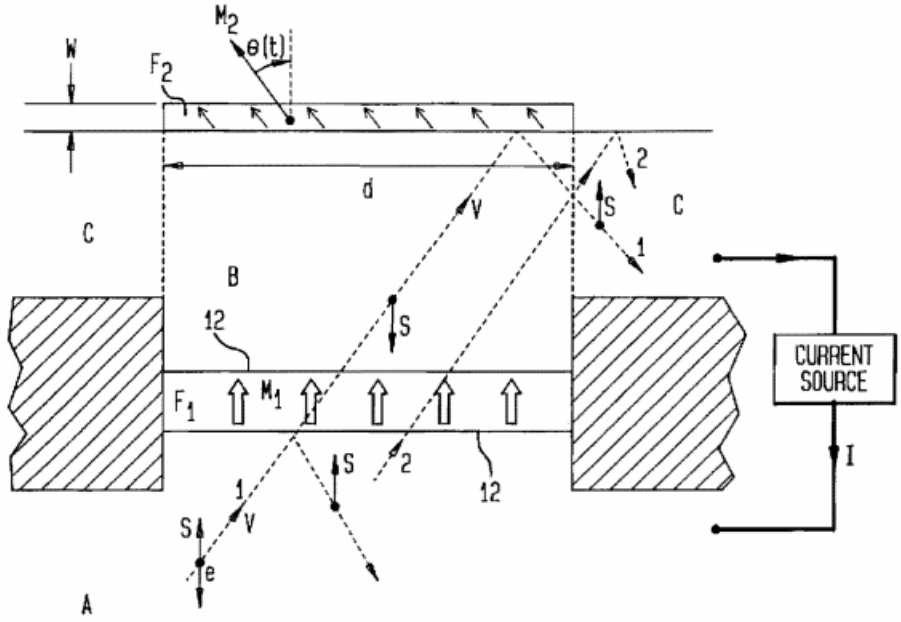


Figure 1 depicts magnetic device 10 comprising five conducting layers, including three non-magnetic, metallic layers A–C and two magnetic layers F1 and F2. Ex. 1008, col. 1, ll. 58–60; col 2, ll. 57–61. "Layer F1 is a fixed or pinned magnetic layer, and layer F2 is a free magnetic layer." PO

Resp. 6–7 (citing Ex. 2004 ¶ 31). Magnetic device 10 operates in the transmission mode with current I, generated by Current Supply, passing through all five layers of device 10 and changing the direction of magnetic vector M_2 in layer F2. *See* PO Resp. 6–7.

Patent Owner contends, however, that the magnetic devices depicted in Slonczewski's Figures 5 and 6 operate in the reflection mode and contain a layer that reflects current passing through the stacked layers, so that current is not transmitted through each of the stacked layers. *Id.* at 7–10. Slonczewski's Figure 5 is reproduced below:

FIG. 5



In Figure 5, a current source passes current I to layer A and receives returning current through layer C. Ex. 1008, col. 6, ll. 37–39. Electron-wave trajectories 1 and 2 are *reflected* from magnetic layer F_2, due to the

presence of "air or other insulator" lying above layer F_2. *Id.* at col. 6, l. 64–col. 7, l. 2.

Referring to Slonczewski's Figure 6, reproduced above, Patent Owner contends that the depicted embodiment shows a magnetic valve, which includes insulating layer D lying between magnetic layers F_2 and F_3 and non-magnetic metallic layer E lying above magnetic layer F_3. PO Resp. 8 (citing Ex. 2004 ¶¶ 37, 39); *see* Ex. 1008, col. 8, ll. 45–55. Patent Owner contends that "[t]he insulating layer in these devices *reflects* switching current through the conducting layers. Specifically, switching current flows through layers A, F1, B, and C in order to set the magnetic vector of the free layer." *Id.* (citing Ex. 2004 ¶ 38). Thus, Patent Owner concludes that, "[i]n all of Slonczewski's devices, the switching current *only* flows through good conductors, and not through any insulator." *Id.* at 9 (emphasis omitted, italics added; citing Ex. 2004 ¶ 45). Therefore, Patent Owner contends that reflection mode devices, such as those taught by Slonczewski's Figure 6, would not be operated in a transmission mode, as taught by Redon's Figure 2. *Id.* at 17–21, 26–28.

Nevertheless, Petitioner argues that claim 14 of the '469 patent does not specify whether the layer between the free magnetic layer and the read-out magnetic layer is a conducting layer or an insulating layer. Pet. Reply 4–5; Tr. 8:13–23; 16: 11–18; *but see* Tr. 16:19–17:4 (Patent Owner asserts that the second non-magnetic layer "could not be an insulator" because final clause of claim 14 requires that the current traverses the magnetic device.). As explained by Petitioner's declarant,

> Solids are characterized by what is known as the conductivity of the material, or the reciprocal of that, which is called the resistivity of the material. So if you categorize all solid, at one extreme you have very conductive materials, such as metals with a very low resistivity, and at the other extreme you have very low conductive materials which is a very high resistivity.

Ex. 2005, 24:7–15. Thus, according to Petitioner's declarant, insulators have conductive properties, and "this distinction between metals, normal metals, and insulators in this context is really a difference of degree of the amount of conductance of the material." *Id.* at 27:7–10; *see id.* at 25:2–26:3. Furthermore, Petitioner's declarant states that insulators are designed with a thickness that allows for quantum mechanical tunneling, which results in conductance through the insulator. *See id.* at 27:17–28:4. These explanations are consistent with Slonczewski's teaching that electrons pass through insulating layer D and magnet F_3 of the magnetic device, and are detected in conducting layer E, as a result of magnetic tunneling valve ("MTV") or giant magnetoresistance ("GMR"). Ex. 1008, col. 8, ll. 56–62. Therefore, we are not persuaded that Slonczewski's Figure 6 teaches that all current must be reflected from insulating layer, such as insulating layer D.

b. Different problems

Patent Owner further contends that Slonczewski teaches that its magnetic devices seek to achieve low energy dissipation. PO Resp. 10–11 (citing Ex. 1008, col. 8, ll. 1–25); *see* Ex. 2004 ¶ 45. Patent Owner contends that utilizing an insulating layer in the switching current's path, for example, as the second non-magnetic layer between the free magnetic layer and the

read-out magnetic layer, would increase the level of energy dissipation. PO Resp. 10–12. In particular, Slonczewski teaches that, unless the layer is sufficiently thick, conventional exchange coupling may occur between the free magnetic layer and the read-out magnetic layer. Ex. 1008, col. 8, ll. 13–21. Because using an insulating layer in a magnetic device operating in the transmission mode would increase the resistance R, the power dissipation measured by the equation: $P=I^2R$ would be increased by adding an insulating layer for a constant current I (PO Resp. 13–14 (citing Ex. 2002, 6996; Ex. 2004 ¶ 57)) and "would not be practiced in any of the devices made possible by [Slonczewski's] invention" (Ex. 1008, col. 8, ll. 23–25). *See* PO Resp. 11 (citing Ex. 2004 ¶¶ 54, 66); *see also* Ex. 1008, col. 11, l. 65–col. 12, l. 4 (discussing transmission mode and reflection mode applications).

Independent claim 14 does not describe that the "second non-magnetic layer" as a layer comprised of a metal (a conductor) or an insulator. *See supra* Sec. II.A.1.; Ex. 1001, col. 13, ll. 19–23; Tr. 8:13–23. Petitioner relies on Slonczewski to teach that *either* a conducting layer *or* an insulating layer of appropriate thickness would cause a minimization of mutual magnetic interaction. Pet. Reply 2; Tr. 7:21–23; 10:15–20.

Petitioner further argues that Redon, as modified in view of Slonczewski, does not eliminate the benefit of low power dissipation. Pet. Reply 12–14; *but see* PO Resp. 26 ("Redon's devices eliminate the benefit of low power dissipation that Slonczewski was seeking."). Patent Owner's declarant testifies, however, that Slonczewski describes the situation in which current is unchanged, but resistance is reduced. Ex. 1038, 96:8–

97:16; *see also* PO Resp. 14 ("With constant current, the resistance of the device governs power dissipation."). Each party's declarant agrees, however, that the two variable equation, $P=I^2R$, quantifies power dissipation. Ex. 1038, 96:8–15; Ex. 2005, 73:13–19; *see* Ex. 1008, col. 8, ll. 6–9.

Redon discloses that its magnetic device employs a low current density and describes how this low current density affects power dissipation in Redon's device. Pet. Reply 13 (citing Ex. 1009 ¶¶ 25, 27, 35, 36). Moreover, Redon also teaches the benefits of reducing resistance for reducing power dissipation. In particular, Redon teaches that, in known magnetic devices, "the stacking is formed by all electrically conducting layers, *in order to limit power dissipated*." Ex. 1009, ¶ 9 (emphasis added); *see* Ex. 2005, 24:7–15 (discussing the relationship between conductivity and resistivity). Petitioner argues that because power dissipation is determined by both current I and resistance R, a reduction in current *or* a reduction in resistance, both of which are taught by Redon, may lower power dissipation. *Id.*; *see* Tr. 14:1–10 (changes in current have a greater effect on power dissipation than proportional changes in resistance). We agree. Consequently, we are not persuaded by Patent Owner that Redon and Slonczewski are directed to different problems in the area of power dissipation.

c. Teaching away

As Patent Owner correctly notes, "[a] reference may be said to teach away when 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 applicant." PO Resp. 23 (quoting *In re Gurley*, 27 F.3d 551, 553 (Fed. Cir. 1994)). In particular, Patent Owner argues (1) that Slonczewski teaches away from its combination with Redon, as proposed by Petitioner; (2) that the teachings of Redon are not an improvement on the teachings of Slonczewski; and (3) that the teachings of Slonczewski, upon which we relied in our Decision to Institute, are not applicable to Redon. *Id.* at 23–29. For the reasons that follow, we are not persuaded that Slonczewski teaches away from Redon.

As discussed above, Patent Owner contends that Slonczewski teaches that the switching current flowing in a magnetic device, such as that depicted in Slonczewski's Figure 6, does not flow through an insulating layer, such as insulating layer D. *Id.* at 23. In particular, Patent Owner contends that low energy dissipation is a goal of Slonczewski's claimed magnetic devices and that Slonczewski teaches that such low energy dissipation is achieved by allowing the switching current to flow "only through conducting layers." *Id.* at 24 (citing Ex. 2004 ¶ 47). Further, Patent Owner contends that Slonczewski teaches that, because inserting an insulating layer into a stack of otherwise conducting layers would result in large energy dissipation, this structure "would not be practiced in any devices made possible by the [Slonczewski's] invention." *Id.* (emphasis omitted; quoting Ex. 1008, col. 8, ll. 24–25); *see* Ex. 2004 ¶¶ 45–67.

It is not enough for Patent Owner to demonstrate that there are differences between Redon and Slonczewski to show that the references teach away from Petitioner's proposed combination. *See In re Beattie*, 974

F.2d 1309, 1312–13 (Fed. Cir. 1992). Nevertheless, Patent Owner misunderstands Petitioner's reliance on the teachings of Slonczewski in combination with those of Redon.

Petitioner is not relying on the modification of Redon *to include an insulating layer*, as taught by Slonczewski, in order to achieve the magnetic devices, memory cells, and methods for making memory cells recited in the challenged claims of the '469 patent. Pet. Reply 9–10. Instead, Petitioner is relying on Slonczewski "for the limited teaching that a non-magnetic layer (like the first and second non-magnetic layers of Redon) would minimize the mutual magnetic interaction between any two magnetic layers (including the free magnetic layer, the read-out magnetic layer, and the pinned magnetic layer in the device of Redon)." *Id.* (citing Pet. 18–21, 22, 26–28, 50–51); *see id.* at 2–4; *see also* Tr. 6:4–15 ("We're only really here to discuss one issue and I'd like to talk about that issue in reference to Claim 14 . . . , and that one issue is this fundamental concept that when a non-magnet is placed between two magnets, you minimize the mutual magnetic interaction between those two magnets.").

Petitioner makes clear that this teaching does not depend on whether the non-magnetic layer is a conductor or an insulator. Pet. Reply 4; Tr. 7:21–23. Moreover, Patent Owner does not identify any persuasive evidence in Slonczewski or elsewhere that shows that a person of ordinary skill in the art would be discouraged or diverted from applying this teaching of Slonczewski to the teaching of Redon. Pet. Reply 10; *see In re Fulton*, 391 F.3d 1195, 1201 (Fed. Cir. 2004) (If a reference discloses a different

solution to a similar problem, it does not teach away from the claimed subject matter unless the reference also criticizes, discredits or otherwise discourages the solution claimed.). Although Slonczewski might not use an insulating layer in its claimed transmission mode embodiments, this is not sufficient evidence that a person of ordinary skill in the art would not apply other teachings of Slonczewski to those of Redon. *See* PO Resp. 24–25; Pet. Reply 10–11.

Patent Owner's other teaching away contentions equally are unpersuasive. Patent Owner contends that Redon does not suggest that one of its goals is to improve upon the devices taught by Slonczewski. PO Resp. 25–26. Nevertheless, as Petitioner points out, Redon identifies "inconveniences" resulting from the design of Slonczewski's magnetic devices. Pet. 51 (citing Ex. 1009 ¶ 9); Pet. Reply 9. We are persuaded that, based on the statement regarding Slonczewski in Redon, a person of ordinary skill in the art would have sufficient reason to consider and combine relevant teachings of Slonczewski to the teachings of Redon. Pet. Reply 9.

Patent Owner also contends that the teachings of Slonczewski, upon which we relied in our Decision to Institute, are inapplicable to Redon. PO Resp. 26–30. In particular, Patent Owner contends that the magnetic exchange coupling between two magnetic layers separated by a non-magnetic layer produces an oscillating and declining function with respect to the increasing thickness of a non-magnetic, conducting layer (PO Resp. 29 (citing Ex. 2007, Fig. 4)) and an exponentially declining function with

respect to the increasing thickness of a non-magnetic, insulating layer (*id.* (citing Ex. 2007, Fig. 5)). Patent Owner contends that a person of ordinary skill in the art would understand that these functions differ based on the composition of the separating layer. *Id.*

Nevertheless, Petitioner relies on the decline in the mutual magnetic interaction, rather than whether it is oscillating or exponential, in combining the teachings of Redon and Slonczewski. Pet. 18, 50–51; Pet. Reply 2–4. Further, we note that the challenged claims do not specify either the composition of the second non-magnetic layer (*see supra* Sec. II.A.1) or whether the mutual magnetic interaction is minimized exponentially or as a result of oscillations (*see supra* Sec. II.A.2). Therefore, we are not persuaded by Patent Owner's teaching-away arguments.

In view of the foregoing discussion, we are persuaded that Petitioner has demonstrated by a preponderance of the evidence that Redon and Slonczewski would have rendered obvious claims 2–4, 6, 14–20, 23–26, 34, and 35 of the '469 Patent.

C. Obviousness Over Redon, Slonczewski, and Huai

Petitioner argues that claims 7, 8, 11, 12, 27, 30, and 31 are unpatentable under 35 U.S.C. § 103(a) as rendered obvious over Redon, Slonczewski, and Huai. Pet. 51–57. We have reviewed Petitioner's claim charts demonstrating that all of the additional limitations of claims 7, 8, 11, 12, 27, 30, and 31 are taught or suggested by Huai. *See* Pet. 54–57. Further, we have reviewed Petitioner's arguments that a person of ordinary skill in the relevant art would have had reason to combine the teachings of Huai

with those of Redon and Slonczewski to achieve the apparatus and methods of the'469 patent recited in claims 7, 8, 11, 12, 27, 30, and 31. *Id*. at 52–54; *see KSR*, 550 U.S. at 417.

Patent Owner relies only on its arguments and evidence contesting the combination of Redon and Slonczewski to overcome Petitioner's arguments and evidence with respect to this ground for unpatentability.[5] Pet. Reply 14. Therefore, in view of the foregoing discussion of the combination of the teachings of Redon and Slonczewski, we are persuaded that Petitioner has demonstrated by a preponderance of the evidence that Redon, Slonczewski, and Huai would have rendered obvious claims 7, 8, 11, 12, 27, 30, and 31 of the '469 patent.

D. Obviousness Over Redon, Slonczewski, and Covington

Petitioner argues that claims 9, 10, 19, 28, and 29 are unpatentable under 35 U.S.C. § 103(a) as rendered obvious over Redon, Slonczewski, and Covington. Pet. 57–60. We have reviewed Petitioner's evidence that Covington teaches of suggests all of the additional limitations of claims 9, 10, 19, 28, and 29. Pet. 57–60. We also have reviewed Petitioner's evidence and arguments that a person of ordinary skill in the relevant art would have had reason to combine the teachings of Covington with those of Redon and Slonczewski to achieve the apparatus and methods of the'469

[5] In our Scheduling Order (Paper 9, 2), we cautioned Patent Owner that any arguments for patentability not raised in the Patent Owner Response will be deemed waived.

patent recited in claims 9, 10, 19, 28, and 29. Pet. 60; *see KSR*, 550 U.S. at 417.

Patent Owner relies only on its arguments and evidence contesting the combination of Redon and Slonczewski to overcome Petitioner's arguments and evidence with respect to this ground for unpatentability. Pet. Reply 14. Therefore, in view of the foregoing discussion of the combination of the teachings of Redon and Slonczewski, we are persuaded that Petitioner has demonstrated by a preponderance of the evidence that Redon, Slonczewski, and Covington would have rendered obvious claims 9, 10, 19, 28, and 29 of the '469 patent.

IV. CONCLUSION

As noted above, we *grant* Patent Owner's Motion to Amend requesting cancellation of claims 1, 5, 22, and 33 of the '469 patent. Based on the foregoing discussion, we conclude that Petitioner has demonstrated by a preponderance of the evidence that claims 2–4, 6–12, 14–20, 23–31, 34, and 35 are unpatentable under 35 U.S.C. § 103(a) over Redon and Slonczewski, alone or in combination with Huai or Covington.

V. ORDER

In consideration of the foregoing, it is

ORDERED that Patent Owner's Motion to Amend cancelling claims 1, 5, 22, and 33 is *granted*;

FURTHER ORDERED that Petitioner has shown by a preponderance

of the evidence that claims 2–4, 6–12, 14–20, 23–31, 34, and 35 of the ’469 patent are unpatentable on the following grounds:

A. Claims 2–4, 6, 14–20, 23–26, 34, and 35 under 35 U.S.C. § 103(a) as unpatentable over Redon and Slonczewski;

B. Claims 7, 8, 11, 12, 27, 30, and 31 under 35 U.S.C. § 103(a) as unpatentable over Redon, Slonczewski, and Huai; and

C. Claims 9, 10, 19, 28, and 29 under 35 U.S.C. § 103(a) as unpatentable over Redon, Slonczewski, and Covington; and

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

PETITIONER:

John M. Caracappa
Rose Acoraci
Scott Richey
STEPTOE & JOHNSON LLP
jcaracap@steptoe.com
racoraci@steptoe.com
srichey@steptoe.com
469IPR@steptoe.com

PATENT OWNER:

George E. Quillin
Troy D. Smith
FOLEY & LARDNER LLP
gquillin@foley.com
tdsmith@foley.com