APPENDIX A

NOTE: This disposition is nonprecedential.

United States Court of Appeals for the Federal Circuit

HITACHI METALS, LTD.,
Appellant

v.

ALLIANCE OF RARE-EARTH PERMANENT MAGNET INDUSTRY,
Appellee

2016-1824, 2016-1825

Appeals from the United States Patent and Trademark Office, Patent Trial and Appeal Board in Nos. IPR2014-01265, IPR2014-01266.

Decided: July 6, 2017

MARC A. HEARRON, Morrison & Foerster LLP, Washington, DC, argued for appellant. Also represented by BRIAN ROBERT MATSUI, SETH W. LLOYD; MEHRAN ARJOMAND, Los Angeles, CA.

KIRK T. BRADLEY, Alston & Bird LLP, Charlotte, NC, argued for appellee. Also represented by MICHAEL S. CONNOR; CHRISTOPHER BRANTLEY KELLY, Atlanta, GA.

Before LOURIE, TARANTO, and CHEN, *Circuit Judges*.

LOURIE, *Circuit Judge*.

Hitachi Metals, Ltd. ("Hitachi") appeals from final written decisions of the U.S. Patent and Trademark Office ("the PTO") Patent Trial and Appeal Board ("the Board") in two *inter partes* reviews ("IPRs"), concluding that claims 1, 5, and 6 of U.S. Patent 6,537,385 ("the '385 patent") and claims 1-4, 11, 12, and 14-16 of U.S. Patent 6,491,765 ("the '765 patent") would have been obvious at the time of their respective inventions and that claim 1 of the '385 patent was anticipated. *See All. of Rare-Earth Permanent Magnet Indus.*, IPR 2014-01265, 2016 Pat. App. LEXIS 1082, at *41 (P.T.A.B. Feb. 8, 2016) ("*'385 Decision*"); *All. of Rare-Earth Permanent Magnet Indus.*, IPR 2014-01266, 2016 Pat. App. LEXIS 1083, at *56 (P.T.A.B. Feb. 8, 2016) ("*'765 Decision*"). For the reasons set forth below, we *affirm* in part and *vacate and remand* in part.

BACKGROUND

Hitachi owns the '385 and '765 patents (together, "the challenged patents"), which have almost identical written descriptions and are directed to a process for manufacturing a powder used to produce rare-earth

magnets. *See, e.g.*, '765 patent col. 1 ll. 7-9.[1] Claim 1 of the '385 patent is representative and reads as follows:

> A method for manufacturing alloy powder for R—Fe—B rare earth magnets, comprising a first pulverization step of coarsely pulverizing an R—Fe—B alloy for rare earth magnets produced by a rapid cooling method and a second pulverization step of finely pulverizing the material alloy,
>
> > wherein said second pulverization step comprises a step of removing at least part of the powder in which the concentration of rare earth element is greater than the average concentration of rare earth element contained in the entire powder.

'385 patent col. 13 ll. 19-37. The "R—Fe—B" designation refers to a mixture of a rare earth element (R), iron (Fe), and boron (B). Dependent claim 5 requires the further step of cooling "a molten material alloy at a cooling rate in a range between 10^2 °C./sec and 10^4 °C./sec." *Id.* col. 14 ll. 1-4. Dependent claim 6 requires that the molten material alloy be cooled by a "strip casting method." *Id.* col. 14 ll. 5-6.

Claim 1 of the '765 patent is representative and reads as follows:

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[1] Because the challenged patents have almost identical written descriptions, we will refer only to the '765 patent written description for simplicity when discussing either patent.

> A method for manufacturing alloy powder for R—Fe—B rare earth magnets, comprising a first pulverization step of coarsely pulverizing a material alloy for rare earth magnets and a second pulverization step of finely pulverizing the material alloy,
>
> wherein said first pulverization step comprises a step of pulverizing the material alloy by a hydrogen pulverization method, and
>
> said second pulverization step comprises a step of removing at least part of fine powder having a particle size of 1.0 μm or less to adjust the particle quantity of the fine powder having a particle size of 1.0 μm or less to 10% or less of the particle quantity of the entire powder.

'765 patent col. 13 ll. 21-33. Dependent claim 3 requires that the fine pulverization step be performed "in a highspeed flow of gas," which dependent claim 4 requires to be "oxygen." *Id.* col. 13 ll. 39-43. Dependent claims 11 and 12 resemble claims 5 and 6, respectively, of the '385 patent, as discussed above. *Id.* col. 14 ll. 16-21.

The Alliance of Rare-Earth Permanent Magnet Industry ("the Alliance") filed requests for IPR of the challenged patents, which the PTO granted. The Board concluded that claims 1, 5, and 16 of the '385 patent and claims 1-4, 11, 12, and 14-16 of the '765 patent would have been obvious over various combinations of: (1) Japanese Patent 1993-283217 to Hasegawa

("*Hasegawa*"); (2) U.S. Patent 4,992,234 to Ohashi et al. ("*Ohashi*"); (3) U.S. Patent 5,383,978 to Yamamoto et al. ("*Yamamoto*"); and (4) Shuixiao He, *Rare Earth Permanent Magnet Milling Equipment—Jet Mill Closed Loop System*, 21 MAGNETIC MATERIALS AND PARTS, 48-51 (Oct. 1990) ("*He*"). The Board also concluded that claim 1 of the '385 patent was anticipated by *He*.

I. '385 Patent

The Board concluded that claims 1, 5, and 6 of the '385 patent would have been obvious over either *Hasegawa*, *Ohashi*, or *He* and *Yamamoto*, and that claim 1 was anticipated by *He*. In making its obviousness determinations, the Board relied on *Hasegawa, Ohashi*, and *He* for teaching every element of claim 1 except the "rapid cooling method," for which it relied on *Yamamoto*. Hitachi did not dispute those findings. Hitachi argued only that one of ordinary skill in the art would not have been motivated to combine those references.

A. Obviousness over *Ohashi/Hasegawa* and *Yamamoto*

The Board, crediting the Alliance's arguments, found that one of ordinary skill would have been motivated to combine *Ohashi* or *Hasegawa* with *Yamamoto* because it was understood that *Yamamoto*'s rapid cooling method produces a more uniform alloy, so one of ordinary skill would have been motivated to combine the references "in order to pulverize a more uniform R—Fe—B material alloy." '*385 Decision*, 2016 Pat. App.

LEXIS 1082, at *16-17, *21-22. Hitachi did not dispute that *Yamamoto*'s rapid cooling method would result in a more uniform alloy, but rather argued that one of ordinary skill would not have been motivated to pulverize a more uniform alloy because the consequence would have been a 50% or more reduction in yield. *See id.* at *18-19.

The Board rejected Hitachi's arguments, explaining that, even if Hitachi were correct that the combination would have resulted in a significantly diminished yield, such commercial considerations "do[ ] not control the obviousness determination," especially since the claims do not require a certain minimum yield. *Id.* at *21. Instead, the Board relied on the Alliance's evidence that the claimed steps were each known in the art and used for their known purpose and that the result of the combination would have been predictable. *Id.* at *21, *27-28. The Board found that a skilled artisan would have known how to combine the references because the ingot (*Ohashi* and *Hasegawa*) and strip casting (*Yamamoto*) methods were "interchangeable to those skilled in the art." *Id.* at *13, *27. Furthermore, the Board found that "design incentives," such as "lower cost [and a] more productive [process] better suited for higher volume manufacturing," would have led one of ordinary skill to pursue the combination. *Id.* at *21-22, *27-28.

Hitachi did not dispute that *Yamamoto* teaches the limitations of claims 5 and 6 of the '385 patent, and the Board concluded that those claims would also have

been obvious over *Ohashi* or *Hasegawa* and *Yamamoto* for the same reasons as claim 1.

B. Obviousness over *He* and *Yamamoto*

The Board also concluded that claims 5 and 6 would have been obvious over *He* and *Yamamoto*. The Board relied on *He* for teaching every limitation except for the cooling rate range of claim 5 and the "strip casting method" of claim 6, for which it relied on *Yamamoto*. Hitachi did not dispute that the references teach those limitations, but rather argued that there would not have been a motivation to combine them. The Board rejected the Alliance's argument that one of ordinary skill would have been motived to combine *He* with *Yamamoto*'s cooling rate because *Yamamoto*'s method would result in a more uniform alloy. *Id.* at *38-39. The Board found that the Alliance's evidence was lacking because it did not explain how *Yamamoto*'s particular cooling rate would differ from *He*'s disclosed "quick quenching," Joint Appendix ("J.A.") 705. *'385 Decision*, 2016 Pat. App. LEXIS 1082, at *38. However, the Board found persuasive the Alliance's evidence that the claims encompass nothing more than the "combination of prior art elements according to known methods to yield a predictable result." *Id.* at *39-40. Thus, the Board concluded that claims 5 and 6 would have been obvious over *He* and *Yamamoto*.

C. Anticipation by *He*

The Board found that *He* anticipated claim 1. The dispute before the Board focused on whether *He*'s disclosed "quick quenching," J.A. 705, constitutes the claimed "rapid cooling method," '385 patent col. 13 l. 22. Thus, the Board first construed "rapid cooling method." *'385 Decision*, 2016 Pat. App. LEXIS 1082, at *10-11. Hitachi argued that a skilled artisan would have interpreted *He*'s disclosed "quick quenching" method to be a "super-rapid cooling," rather than a "rapid cooling," method. Specifically, Hitachi argued, one of ordinary skill would have interpreted "quick quenching" as referring to "melt spinning," a super-rapid cooling method that employs cooling rates "in excess of 10^6 K s^{-1}," because strip casting methods were not known in 1990. *Id.* at *32-33. Hitachi argued that the written description defines the range of cooling rates covered by the term "rapid cooling" as being between 10^2-10^4 °C./sec and thus *He* does not disclose the "rapid cooling method" as properly construed.

The Board rejected Hitachi's construction based on principles of claim differentiation —it found that, because dependent claim 5 recites "a cooling rate in a range between 10^2 °C./sec and 10^4 °C./sec," claim 1's recitation of "rapid cooling method" must "encompass a broader range of cooling rates" and thus does not "necessarily exclude super-rapid cooling methods." *Id.* at *10-11. Under that construction, the Board found that *He*'s disclosed "quick quenching" constitutes the claimed "rapid cooling method" and that claim 1 was anticipated by *He*. *Id.* at *34.

II. '765 Patent

A. Obviousness over *Ohashi* and *Hasegawa*

The Board concluded that claims 1-4, 14, and 16 of the '765 patent would have been obvious over *Ohashi* and *Hasegawa*. In making its obviousness determination, the Board relied on *Ohashi* for teaching every element of claim 1, except the requirement that the "first pulverization step comprises a step of pulverizing the material alloy by a *hydrogen* pulverization method," '765 patent col. 13 ll. 26-28 (emphasis added), for which it relied on *Hasegawa*. Hitachi did not dispute those findings, but rather argued only that one of ordinary skill in the art would not have been motivated to combine the references.

The Board found that one of ordinary skill would have been motived to employ *Hasegawa*'s hydrogen pulverization method to "improve the coarse pulverization" taught by *Ohashi* because the Alliance's evidence shows that hydrogen pulverization "more easily crush[es] the material alloy." '*765 Decision*, 2016 Pat. App. LEXIS 1083, at *16-18. The Board credited the Alliance's evidence that hydrogen pulverization allows the process to occur "in one-fourth of the time required by [*Ohashi*'s] mechanical pulverization" and that it also "improves pulverization yield and pulverization efficiency." *Id.* at *29, *30 (internal quotation marks omitted). Further, the Board found that one of ordinary skill would have had a reasonable expectation of success in combining the references, which

disclose "well-known and common technique[s]," and that the results would have been predictable. *Id.* at *29.

As for dependent claims 2, 3, 14, and 16, Hitachi made no additional arguments and the Board concluded that those claims would have been obvious over *Ohashi* and *Hasegawa* for the same reasons as claim 1. *Id.* at *31.

Hitachi did, however, assert separate arguments relating to the Board's obviousness determination of claim 4, which depends from claim 3 and requires that the "pulverization step" be conducted "in a high-speed flow of gas" (claim 3), "wherein the gas comprises oxygen" (claim 4). '765 patent col. 13 ll. 39-43. Hitachi argued that *Ohashi* teaches the use of a high-speed flow of gas (i.e., an "air stream," J.A. 699) for *particle classification* only, not for *finely pulverizing* the alloy, as required by claim 4.

The Board rejected that argument, determining that claim 1, from which claim 4 depends, comprises two pulverization steps: (1) a *first pulverization* step of coarse pulverization; and (2) a *second pulverization* step, which in turn comprises the two "sub-step[s]" of (i) fine pulverization, a.k.a. "milling," and (ii) particle classification, i.e. removal of particles having a particular size. *'765 Decision*, 2016 Pat. App. LEXIS 1083, at *37. The Board concluded that the two sub-steps constitute one *continuous* process under the umbrella "second pulverization step"—thus, a reference teaching the second sub-step necessarily teaches the

umbrella "second pulverization step." *Id.* at *35-37. And the Board interpreted claim 4 as requiring a high-speed flow of oxygen for the umbrella step, not the first sub-step. *Id.* at *37-38. Under that interpretation, the Board found that *Ohashi* teaches "pulverization" using a "high-speed flow of [oxygen] gas," as recited in claim 4, because it teaches using an "air stream" for particle classification (i.e., the second sub-step) and an "air stream" necessarily includes some amount of oxygen gas. *Id.* at *38.

B. Obviousness over *Ohashi*, *Hasegawa*, and *Yamamoto*

The Board concluded that dependent claims 11 and 12 would have been obvious over *Ohashi, Hasegawa*, and *Yamamoto.* Hitachi again disputed only the combinability of those references for the same reasons it had previously articulated. The Board rejected those arguments, finding a motivation to combine *Ohashi* and *Hasegawa* for the same reasons as for claim 1 of the '765 patent and a motivation to combine either *Ohashi* or *Hasegawa* with *Yamamoto* for the same reasons as for claim 1 of the '385 patent.

Hitachi timely appealed to this court. We have jurisdiction pursuant to 28 U.S.C. § 1295(a)(4)(A).

DISCUSSION

We review the Board's legal conclusions de novo and its factual findings for substantial evidence. *In re*

Gartside, 203 F.3d 1305, 1316 (Fed. Cir. 2000). A finding is supported by substantial evidence if a reasonable mind might accept the evidence as adequate to support the conclusion drawn therefrom. *Consol. Edison Co. v. NLRB*, 305 U.S. 197, 217 (1938). Obviousness is a question of law based on underlying facts. *Apple Inc. v. Samsung Elecs. Co.*, 839 F.3d 1034, 1047 (Fed. Cir. 2016) (en banc). What the prior art teaches, whether a person of ordinary skill in the art would have been motivated to combine references, and whether a reference teaches away from the claimed invention are questions of fact. *Id.* at 1047-48; *In re Mouttet*, 686 F.3d 1322, 1330 (Fed. Cir. 2012).

On appeal, Hitachi argues that the Board erred in: (1) finding a motivation to combine the references in its obviousness determinations for both of the challenged patents; (2) construing "rapid cooling method" and finding, under that construction, that *He* anticipates claim 1 of the '385 patent; and (3) construing claim 4 of the '765 patent and thus in its obviousness determination of that claim. We discuss each of the challenged patents in turn.

I. '385 Patent

A. Obviousness over *Ohashi* or *Hasegawa* and *Yamamoto*

The Board concluded that claims 1, 5, and 6 of the '385 patent would have been obvious over *Hasegawa* or *Ohashi* in view of *Yamamoto*.

Hitachi makes almost identical arguments for both of the combinations relied upon by the Board—namely, that one of skill in the art would not have been motivated to combine *Ohashi* or *Hasegawa* with *Yamamoto* because the results of pulverizing the more uniform alloy produced by *Yamamoto*'s rapid cooling method would be a 50% or more reduction in yield and a lower quality magnet.

Hitachi argues that the Board erred in dismissing its evidence regarding the potentially lower yield as a "commercial [consideration that] does not control the obviousness determination." *'385 Decision*, 2016 Pat. App. LEXIS 1082, at *20. Hitachi notes the apparent contradiction between that reasoning and the Board's subsequent finding that one of skill in the art would be motivated to combine the references due to "design incentives," such as "lower cost [and a] more productive [process] better suited for higher volume manufacturing." *Id.* at *21-22, *27, *28. Hitachi also disputes the Board's findings that all of the claims would have been obvious because they "represent the combination of prior art elements according to known methods to yield a predictable result." *See, e.g.*, *id.* at *21 (citing *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 416 (2007)). Hitachi argues that those findings are merely "boilerplate" recitations that state a *conclusion*, not a *reason* to combine the references.

The Alliance responds that the factual findings underpinning the Board's obviousness determinations were supported by substantial evidence.

We conclude that the Board did not err in determining that claims 1, 5, and 6 of the '385 patent would have been obvious over *Ohashi* or *Hasegawa* in view of *Yamamoto*. We do agree with Hitachi that the Board applied internally inconsistent reasoning in rejecting Hitachi's evidence on the basis that "commercial [considerations] do[] not control the obviousness determination," *id.* at *20, while also finding that one of skill in the art would have been motivated to combine the references due to "design incentives," *id.* at *21. If the Board's analysis had stopped there, we might remand for further analysis that is not internally inconsistent.

However, the Board made additional findings to support its obviousness determinations, including that one of skill in the art would have known to mitigate the alleged reduction in yield by adjusting the jet mill settings during pulverization. *See, e.g.*, *id.* at *19, *28 (citing expert testimony that "a person of ordinary skill would have known to adjust basic, fundamental jet milling settings to accommodate the uniform particle size and shape distribution of the strip cast alloy" (internal quotation marks and brackets omitted)). That finding was supported by substantial record evidence. *See* J.A. 788.

Hitachi points to countervailing testimony by the same expert that, while a skilled artisan would have known *to* adjust the settings, they would not have known *how* to do so, as the "multi-parameter compositional experimentation" required would be beyond the capabilities of one of ordinary skill. J.A. 972. However, we do not "reweigh evidence on appeal." *In re NTP, Inc.*,

654 F.3d 1279, 1292 (Fed. Cir. 2011). We must accept the Board's finding so long as a "reasonable mind might accept [the evidence upon which it relied] as adequate to support [its] conclusion." *Consol. Edison Co.*, 305 U.S. at 217. The Board reviewed the competing evidence and made a factual determination that a skilled artisan would not have been demotivated by the potential reduction in yield. We see no error in that finding, which was a reasonable interpretation of the record evidence.

In light of the foregoing, the Board found that the claims were directed to nothing more than a "combination of prior art elements according to known methods to yield a predictable result." *'385 Decision*, 2016 Pat. App. LEXIS 1082, at *21, *24. The Supreme Court has advised that a combination of known elements is likely to be obvious when it yields predictable results. *KSR*, 550 U.S. at 416. And substantial evidence supports the Board's findings that the prior art elements were well-known, one of ordinary skill would have known how to combine them, and the results of so doing would have been predictable. *See '385 Decision*, 2016 Pat. App. LEXIS 1082, at *18, *20, *27, *39.

B. Obviousness over *He* and *Yamamoto*

The Board found that claims 5 and 6 would have also been obvious over *He* and *Yamamoto*. As for those claims, Hitachi repeats several of its arguments regarding the Board's determinations of obviousness over *Ohashi* or *Hasegawa* and *Yamamoto*. Namely,

Hitachi disputes the Board's finding that the claims are directed to nothing more than the "combination of prior art elements according to known methods to yield a predictable result." *Id.* at *39-40. Hitachi argues that such findings are merely boilerplate recitations that state a *conclusion*, not a *reason* to combine the references. Furthermore, Hitachi challenges the credibility of the Alliance's expert declaration, relied upon by the Board, as making bald assertions that lack evidentiary support.

We affirm the Board's conclusion that claims 5 and 6 would have been obvious over *He* and *Yamamoto* for the reasons discussed above regarding the obviousness of claim 1, 5, and 6 over *Ohashi/Hasegawa* and *Yamamoto.* We see no legal error in the Board's analysis, and we do not reweigh evidence on appeal.

C. Anticipation by *He*

The Board found that *He* anticipated claim 1. On appeal, Hitachi challenges the Board's construction of "rapid cooling method," arguing, as it did before the Board, that one of ordinary skill would have understood "rapid cooling method" to be distinct from "super rapid cooling." Hitachi asserts that, at the time of the invention, one of ordinary skill would have recognized three categories of methods for preparing alloys for sintered rare-earth magnets: (1) traditional cooling methods, such as ingot casting; (2) rapid cooling methods, such as strip casting; and (3) super-rapid cooling methods, such as melt spinning. Hitachi submitted

evidence—expert testimony and other printed publications—indicating that one of ordinary skill would have understood the three categories to be distinct, such that "rapid cooling" refers to a method that is faster than ingot casting, but not so fast that it enters the domain of super-rapid cooling. Hitachi argues that the written description defines the range of cooling rates covered by the term because it states: "In the rapid cooling method, the molten alloy is cooled at a rate in the range between 10^2 °C./sec and 10^4 °C./sec." '385 patent col. 1 ll. 46-47. In contrast, Hitachi argues, super rapid cooling methods were understood by those of skill in the art as exceeding 10^6 degrees per second. Therefore, Hitachi argues, one of skill in the art would have understood *He*'s disclosed "quick quenching" to be a "super rapid cooling" method rather than the claimed "rapid cooling method" and thus *He* did not anticipate claim 1.

The Alliance responds that the Board correctly construed "rapid cooling method." The Alliance argues that the written description provides a clear definition of the term when it describes rapid cooling as "typified by a strip casting method," wherein "a molten material alloy is put into contact with a single chill roll, twin chill rolls, a rotary chill disk, a rotary cylindrical chill mold, or the like, to be rapidly cooled thereby producing a solidified alloy thinner than an ingot cast alloy." *Id*. col. 1 ll. 39-45. The Alliance contends that the Board correctly adopted that definition, finding in it no exclusion of rates in excess of 10^6 °C./sec. Furthermore, the Alliance argues, claim 5, which depends from claim 1,

recites "a cooling rate in a range between 10^2 and 10^4 °C./sec," *id.* col. 14 l. 4, and claim 6, which depends from claim 5, specifies that the rapid cooling method is a "strip casting method," *id.* col. 14 l. 6. Thus, the Alliance maintains, claim l's recitation of "rapid cooling method" must encompass rates outside of the range recited in claim 5 and methods other than the strip casting recited in claim 6, and therefore claim 1 was anticipated by *He.*

We agree with the Alliance that the doctrine of claim differentiation requires that the scope of "rapid cooling method" covered by claim 1 be broader than the range specified in dependent claim 5 (10^2-10^4 °C./sec). *See id.* col. 14 ll. 1-4. Hitachi argues that, even if claim differentiation requires the range of claim 1 to be slightly broader than 10^2-10^4 °C./sec, it does not require the range to be so broad as to include rates in excess of 10^6 degrees per second, which one of ordinary skill would understand to constitute super-rapid cooling.

However, nowhere does the written description accord with Hitachi's argument, nor does it anywhere indicate that "rapid cooling" must exclude cooling at rates in excess of 10^6 degrees per second. Rather, the written description states that "[i]n a *preferred embodiment*, the material alloy for rare earth magnets is obtained by cooling a molten material alloy at a cooling rate in the range between 10^2 °C./sec and 10^4 °C./sec." *Id.* col. 3 ll. 51-54 (emphasis added). The patent expressly refers to the range recited by claim 5 as a "preferred embodiment." *Id.* Thus, "rapid cooling method," as recited in claim 1, must encompass a broader range

than that recited in claim 5 and nowhere does the specification cap the range at 10^6 degrees per second. Consequently, the Board's construction of "rapid cooling method" as not *excluding* "super rapid cooling" is supported by the intrinsic record and we affirm that construction.

Hitachi premises the remainder of its challenges to the Board's anticipation finding on its proposed construction of "rapid cooling method." Thus, because we affirm the Board's construction, we affirm its finding that *He* anticipated claim 1. Accordingly, the Board was correct in concluding that claim 1, as properly construed, was anticipated by *He*.

II. '765 Patent

A. Obviousness over *Ohashi* and *Hasegawa*

The Board concluded that claims 1-4, 14, and 16 of the '765 patent would have been obvious over *Ohashi* and *Hasegawa*. Hitachi challenges the Board's findings that one of ordinary skill would have been motivated to employ *Hasegawa*'s hydrogen pulverization to "improve the coarse pulverization" taught by *Ohashi* because the Alliance's evidence shows that hydrogen pulverization "more easily crush[es] the material alloy," and hydrogen pulverization was a "well-known and common technique" that would have yielded predictable results when substituted for *Ohashi*'s mechanical pulverization. '*765 Decision*, 2016 Pat. App. LEXIS 1083, at *16-18, *29 (internal quotation marks omitted).

Hitachi contends that the Board erred in accepting the bald assertions of the Alliance's expert that lacked supporting evidence. Hitachi points to its evidence that, in order to substitute *Hasegawa*'s hydrogen pulverization for *Ohashi*'s mechanical pulverization, the solid alloy must accordingly be changed to the proper microstructure, but changing the microstructure of the solid alloy would completely alter *Ohashi*'s operating principle. Thus, Hitachi argues, the combination would have required more than ordinary skill. Furthermore, Hitachi contends that the Board improperly shifted the burden by requiring Hitachi to show that the combination would have been *beyond* the capability of one of ordinary skill.

The Alliance responds that substantial evidence supports the Board's finding of a motivation to combine.

We agree with the Alliance that substantial evidence supports the Board's findings for claims 1, 2, 14, and 16. The Board credited the Alliance's evidence that one of ordinary skill would have been motived to employ *Hasegawa*'s hydrogen pulverization to "improve the coarse pulverization" taught by *Ohashi* because the Alliance's evidence shows that hydrogen pulverization "more easily crush[es] the material alloy," *id.* at *16-18; hydrogen pulverization allows the process to occur "in one-fourth of the time required by [*Ohashi*'s] mechanical pulverization," *id.* at *29; hydrogen pulverization "improves pulverization yield and pulverization efficiency" over mechanical pulverization, *id.* at *29 (internal quotation marks omitted); one of

ordinary skill would have had a reasonable expectation of success in combining the references, which disclose "well-known and common technique[s]," *id.* at *29; and the results would have been predictable, *id.* We conclude that the foregoing constitutes substantial evidence to support the Board's determination.

Hitachi primarily disputes the credibility of the Alliance's evidence and presents its own competing evidence. But we do not reweigh the evidence considered by the Board and, in this case, we conclude that its interpretation of the evidence was reasonable.

B. Obviousness of Claim 4

Hitachi separately argues that claim 4 would not have been obvious over *Ohashi* and *Hasegawa.* Hitachi contends that the Board improperly construed claim 4.

Hitachi argues that the specification contradicts the Board's construction—i.e., that a high-speed flow of gas for *particle classification*, as taught by *Ohashi*, satisfies the limitations of claims 3 and 4—because it distinguishes between the two sub-steps of fine pulverization and particle classification as *separate* steps, rather than one continuous step. Hitachi points to the language of claim 1, which recites that the "second pulverization step of finely pulverizing the material alloy . . . comprises a step of *removing at least part of the fine powder*," '765 patent col. 13 ll. 24-31 (emphasis added), and argues that the fine pulverization step must be *finished* before the particle classification step, otherwise there would be no fine powder to remove.

Furthermore, Hitachi argues, the written description repeatedly distinguishes the act of fine pulverization conducted in the milling chamber of the apparatus from the particle classification performed in the classifier, and requires a high-speed flow of gas for the *pulverization*. Finally, Hitachi argues that *Ohashi* leads away from claim 4 by teaching that the pulverization should be conducted in a "non-oxidizing or inert gas" and oxygen is indisputably an oxidizing gas.

The Alliance responds that the Board properly interpreted the specification. First, the Alliance argues, claim 1 recites "a second pulverization step of *finely pulverizing* the material alloy, . . . wherein *said second pulverization step comprises a step of removing* at least part of the fine powder," *id.* col. 13 ll. 24-31 (emphasis added), and thus indicates that the particle classification (i.e., "remov[al]") is *part of* the "second pulverization step." Second, the Alliance contends that the written description repeatedly describes "fine pulverization" as including a step of removing the fine powder. *See, e.g.*, *id.* Abstract ("In the second pulverization step, easily oxidized super-fine powder . . . is removed . . . "); *id.* col. 4 ll. 56-62 ("In the method according to the present invention, after a material alloy . . . is coarsely pulverized and *before a fine pulverization step is finished*, at least part of R-rich super-fine powder . . . is removed. . . .") (emphasis added).

We agree with Hitachi that the Board misconstrued claim 4. As an initial matter, the parties seem to agree that, as recited in claim 1, the *fine pulverization* and *particle classification* are sub-steps of the

umbrella "second pulverization step." They disagree only as to whether claim 4's requirement of a high-speed flow of gas comprising oxygen pertains to the umbrella step or to the first sub-step. We agree with Hitachi that claim 4 requires the use of a high-speed flow of gas comprising oxygen for the first *sub-step* of claim 1—the fine pulverization—rather than the umbrella "second pulverization step."

The passages of the written description which the Alliance cite merely confirm that the particle classification step is a sub-step of the umbrella "second pulverization step," which, as we noted above, the parties do not dispute. The issue is whether claim 4 requires a high-speed oxygen-containing gas for the umbrella step, or for the first sub-step. We conclude that it refers to the latter; and the passages relied on by the Alliance do not contradict that interpretation.

The written description explains that "[i]n the second pulverization step, the alloy is preferably finely pulverized using a high-speed flow of gas" containing oxygen, *id.* col. 3 ll. 27-30, and that "[t]he alloys may be finely pulverized using a jet mill," *id.* col. 3 l. 46. Thus, it is clear that the high-speed gas is associated with the fine pulverization *conducted in the jet mill*. And the written description clearly distinguishes the jet milling apparatus from the particle classifier for performing the two *distinct* sub-steps—fine pulverization and particle classification, respectively. For example, the patent explains that "when a *jet mill is used to perform fine pulverization under a high-speed flow of inert gas*, a gas flow classifier . . . may be provided *following the*

jet mill to enable effective removal of R-rich super-fine powder. . . . [A] *jet mill* is used for the fine pulverization." *Id.* col. 5 ll. 23-30 (emphases added). *See also*, *e.g.*, *id.* col. 3 ll. 47-50 ("The alloys may be finely pulverized *using a jet mill*. In a preferred embodiment, a *classifier* is provided *following the jet mill* for classifying powder output from the jet mill." (emphases added)); *id.* col. 6 ll. 55-57 ("Next, the coarsely pulverized powder . . . is finely pulverized (or milled) *with a jet mill*. To the jet mill used in this embodiment, *a cyclone classifier is connected* for removal of the fine powder." (emphasis added)).

In fact, in every instance where the written description refers to pulverization using a high-speed flow of gas, it refers to the milling apparatus, i.e., "jet mill" or "pulverizer," rather than the particle "classifier." *See, e.g.*, *id.* col. 5 ll. 23-26 ("[W]hen a *jet mill is used to perform the fine pulverization under a high-speed flow of inert gas*, a gas flow classifier . . . may be provided *following the jet mill* to enable effective removal of R-rich super-fine powder. . . ." (emphasis added)); *id.* col. 6 l. 58-col. 7 l. 13 (discussing Figure 2, which shows the jet milling chamber, i.e., "pulverizer 14," and the "classifier 16," and explaining that the "material [is] pulverized with the pulverizer 14 [and] . . . classified with the cyclone classifier 16," wherein "*pulverizer* 14 *includes . . . nozzle fittings 28* for receiving nozzles *through which an inert gas . . . is jet at high speed*" (emphases added)); *id.* col. 8 ll. 15-20 ("The material to be pulverized fed into the pulverizer 14 is rolled up with high-speed jets of inert gas . . . and

swirl[ed] together with high-speed gas flows inside the pulverizer 14. While swirling, the particles of material are *finely milled* by mutual collision with each other." (emphases added)); *id.* col. 10 l. 47-53 (referring to "the jet mill and the cyclone classifier connected to each other" and "a high speed flow gas *for the jet mill."* (emphasis added)).

Thus, we reverse the Board's construction of claim 4 and conclude that it requires a high-speed flow of gas (claim 3) comprising oxygen (claim 4) for the "fine pulverization" that occurs in the first *sub-step—for* example, by "pulverizer 14" shown in Figure 2. Under the correct construction, the Board's obviousness determination as to claim 4 must therefore be vacated. The Board premised its finding that *Ohashi*'s use of an air stream for *particle classification* (the second sub-step) taught the limitations of claim 4 on its interpretation that claim 4 requires a high-speed flow of gas for the *umbrella step* and that the two sub-steps constitute one *continuous* process under the umbrella step. Under that interpretation, the Board found that *Ohashi*'s disclosure of a high-speed flow of gas for the second sub-step constituted a teaching of gas for the entire umbrella step. But the correct construction precludes such a finding. *Ohashi*'s use of an air stream for *particle classification only* cannot meet the limitation of claim 4, which requires the use of a high-speed flow of gas comprising oxygen for *fine pulverization.*

Therefore, because we reverse the Board's claim construction, we vacate its obviousness determination as to claim 4 and remand for further consideration

under the proper construction. We note that, on appeal, Hitachi did not argue claim 3 separately from claim 1, as it did for claim 4. However, our conclusion with respect to the construction of claim 4 necessarily raises a question with respect to the construction and obviousness of claim 3. Thus, because we reverse the Board's construction of claim 4, we also vacate its obviousness determination as to claim 3.

We also suggest that, on remand, the Board consider Hitachi's argument that *Ohashi* teaches away from the invention of claim 4 because *Ohashi* teaches that the pulverization should be conducted in a "non-oxidizing or inert gas," and oxygen, even under the Board's definition of "oxidizing gas," *see, e.g.*, *'765 Decision*, 2016 Pat. App. LEXIS 1083, at *21-22, is undeniably an oxidizing gas. In fact, the written description explains that oxygen is employed to *intentionally* oxidize the alloy and thus "control[] . . . the oxygen content of the finely pulverized alloy powder." '765 patent col. 9 ll. 30 ("The finely pulverized powder particles are *coated with an oxide layer* as described above." (emphasis added)).

Although Hitachi raised that argument before the Board, the Board's explanation in rejecting it was seemingly non-responsive. *See '765 Decision*, 2016 Pat. App. LEXIS 1083, at *38-39. In fact, the Alliance acknowledged during oral argument that the Board did not address Hitachi's argument and asserted that, if we reverse the Board's claim construction, we should remand for the issue to be decided by the Board. Oral argument at 18:30-19:50, *Hitachi Metals, Ltd. v. All. of*

Rare-Earth Permanent Magnet Indus., Nos. 16-1824, -1825 (Fed. Cir. June 8, 2017) ("At APPX53 is where the Board addresses the argument and doesn't reach it."), *available at* http://oralarguments.cafc.uscourts.gov/default.aspx?fi=2016-1824.mp3.

C. Obviousness over *Ohashi*, *Hasegawa*, and *Yamamoto*

The Board concluded that dependent claims 11 and 12 would have been obvious over *Ohashi, Hasegawa*, and *Yamamoto*. Hitachi makes the same arguments regarding the combinability of *Ohashi* and *Hasegawa* with *Yamamoto* that it asserts in connection with the '385 patent, as discussed above. Thus, we affirm the Board's obviousness determinations as to claims 11 and 12 for the same reasons we stated above.

In sum, we affirm the Board's conclusion that claims 1, 5, and 6 of the '385 patent would have been obvious over *Ohashi*, *Hasegawa*, or *He* and *Yamamoto*, and that claim 1 was anticipated by *He*. We also affirm the Board's conclusion that claims 1, 2, 14, and 16 of the '765 patent would have been obvious over *Ohashi* and *Hasegawa* and that claims 11 and 12 would have been obvious over *Ohashi, Hasegawa*, and *Yamamoto*. However, we reverse the Board's construction of claim 4 of the '765 patent and thus vacate its obviousness determination as to claims 3 and 4 and remand for further consideration consistent with this opinion.

CONCLUSION

We have considered the remaining arguments but find them to be unpersuasive. For the foregoing reasons, we affirm-in-part and vacate-in-part the decision of the Board and remand for further consideration consistent with this opinion.

AFFIRMED-IN-PART, VACATED-IN-PART, AND REMANDED

COSTS

No costs

APPENDIX B

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Paper No. 37
Filed: February 8, 2016

UNITED STATES PATENT
AND TRADEMARK OFFICE

BEFORE THE PATENT
TRIAL AND APPEAL BOARD

ALLIANCE OF RARE-EARTH
PERMANENT MAGNET INDUSTRY,
Petitioner,

v.

HITACHI METALS, LTD.,
Patent Owner.

Case IPR2014-01266
Patent 6,491,765 B2

Before MICHAEL P. TIERNEY, MICHELLE R. OSINSKI, and JO-ANNE M. KOKOSKI, *Administrative Patent Judges.*

OSINSKI, *Administrative Patent Judge.*

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

I. INTRODUCTION

A. Background

Alliance of Rare-Earth Permanent Magnet Industry ("Petitioner") filed a Corrected Petition (Paper 13, "Pet.") requesting an *inter partes* review of claims 1-4, 11, 12, and 14-16 of U.S. Patent No. 6,491,765 B2 (Ex. 1001, "the '765 patent"). On February 13, 2015, pursuant to 35 U.S.C. § 314, we instituted an *inter partes* review of claims 1-4, 11, 12, and 14-16 on the following grounds of unpatentability asserted by Petitioner:

Reference	Basis	Claims
Ohashi[1] and Hasegawa[2]	§ 103(a)	1-4 and 14-16
Ohashi, Hasegawa, and Yamamoto[3]	§ 103(a)	11 and 12
Ohashi, Hasegawa, and Kishimoto[4]	§ 103(a)	15

Decision to Institute (Paper 17, "Dec. Inst."), 22.

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[1] Ohashi et al., US 4,992,234 (issued Feb. 12, 1991) ("Ohashi," Ex. 1004).

[2] Hasegawa, JP 1993-283217 (published Oct. 29, 1993) ("Hasegawa," Ex. 1009 and Ex. 1005 (English translation)). Hasegawa is a Japanese language document. Unless indicated otherwise, all citations to Hasegawa in this decision will refer to its certified English language translation.

[3] Yamamoto et al., US 5,383,978 (issued Jan. 24, 1995) ("Yamamoto," Ex. 1007).

[4] Kishimoto et al., US 5,485,224 (issued Jan. 23, 1996) ("Kishimoto," Ex. 1008).

Hitachi Metals, Ltd. ("Patent Owner") filed a Patent Owner Response (Paper 26, "PO Resp."), and Petitioner filed a Reply (Paper 29, "Pet. Reply").

Petitioner relies on the Declaration of John Ormerod Ph.D. in support of its Petition (Ex. 1002). Patent Owner relies on the Declaration of Laura H. Lewis (Ex. 2002) in support of its Response. Petitioner refers to the deposition testimony of Dr. Lewis (Ex. 1012). Patent Owner refers to the deposition testimony of Dr. Ormerod (Ex. 2004).

We heard oral argument on November 6, 2015. A transcript is entered in the record as Paper 36 ("Tr.").

We have jurisdiction under 35 U.S.C. § 6(c). This Final Written Decision is issued pursuant to 35 U.S.C. § 318(a) and 37 C.F.R. § 42.73.

We determine Petitioner has shown by a preponderance of the evidence that claims 1-4, 11, 12, and 14-16 of the '765 patent are unpatentable under 35 U.S.C. § 103(a).

B. Related Proceedings

Petitioner represents that the '765 patent was asserted in International Trade Commission Investigation No. 337-TA-855, which was terminated before adjudication of any validity issues. Pet. 5.

Patent Owner represents that *Inter Partes* Review No. IPR2014-01265 of U.S. Patent No. 6,537,385 B2

("the '385 patent")[5] also is related to this proceeding. Paper 12, 2.

C. The '765 Patent

The '765 patent relates to methods for manufacturing neodymium-iron-boron magnets, referred to as R—Fe—B type rare earth magnets. Ex. 1001, Abstr., 1:6-8, 1:15-18. The method includes a first step of coarsely pulverizing a material alloy to a size on the order of several hundred micrometers or less using a hydrogen embrittlement apparatus, and a second step of finely pulverizing the material alloy to an average particle size on the order of several micrometers with, for example, a jet mill. *Id.* at 1:24-34.

During the second pulverization step, super-fine powder that is rich in the rare earth element (R) (i.e., powder having a particle size of 1 μm or less) is produced. *Id.* at 2:18-22. These R-rich super-fine powder particles oxidize easily as compared to other particles, such that "oxidation of the rare earth element vigorously proceeds during the manufacturing process steps." *Id.* at 2:28-30. The rare earth element, thus, is consumed by reacting with oxygen, and "the production amount of the $R_2T_{14}B$ crystal phase as the major phase decreases." *Id.* at 2:31-32. The result is a reduction in the coercive force and remanent flux density of the resultant magnet, and deterioration of the squareness of the demagnetization curve. *Id.* at 2:33-36.

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[5] The '385 patent is a divisional of the '765 patent. Ex. 1001.

In an effort to improve and stabilize the magnet properties even when a material alloy including an R-rich phase is used, the '765 patent describes the additional step of "removing at least part of fine powder having a particle size of 1.0 μm or less to adjust the particle quantity of the fine powder having a particle size of 1.0 μm or less to 10% or less of the particle quantity of the entire powder." *Id.* at 3:5-10.

Table I of the '765 patent is reproduced below.

TABLE 1

Sample No.	Percentage of super-fine powder (%)	IHc (kA/m)	Br (T)	Sinter density (g/cm^3)	Oxygen amount (ppm)
1	0.5	1,009	1.42	7.65	2,900
2	1.0	1,003	1.42	7.60	3,050
3	3.0	1,003	1.41	7.65	3,200
4	5.0	995	1.40	7.60	3,500
5	7.0	987	1.38	7.52	4,000
6	10.00	963	1.36	7.45	5,300
7	13.0	812	1.32	7.30	7,400
8	15.0	692	1.29	7.00	8,500

As reported in Table I above, oxygen increases, and coercive force iHc and residual magnetic flux density Br deteriorate, as the percentage of super-fine powder in the entire powder increases. *Id.* at 11:29-38. When the percentage of super-fine powder is 10.0% or less, excellent magnetic properties, including a coercive force iHc of 900 kA/m or more and a residual magnetic flux density Br of 1.35 T or more, are obtained. *Id.* at 11:39-44.

In a preferred embodiment, the molten material alloy is cooled by a strip casting method, which is a rapid cooling method. *Id.* at 1:38-39, 3:55-56. In a preferred embodiment, the material alloy is obtained by cooling a molten material alloy at a cooling rate in a range between 10^{2}° C/sec and 10^{4}° C/sec. *Id.* at 1:45-47, 3:51-54. Alloys prepared by rapid cooling methods, as compared to ingot casting methods (in which a molten alloy is poured into a mold and cooled comparatively slowly), have a fine structure, are small in grain size, have a wide area of grain boundaries, and have a good dispersion of the R-rich phase. *Id.* at 1:37-39, 1:64-2:4. Although the preferred embodiment is applied to a rapidly solidified alloy produced by a strip casting method, it also is applicable to an alloy produced by an ingot method. *Id.* at 12:24-29.

D. Illustrative Claim

Claim 1 is illustrative of the claimed subject matter and is reproduced below.

> 1. A method for manufacturing alloy powder for R—Fe—B rare earth magnets, comprising a first pulverization step of coarsely pulverizing a material alloy for rare earth magnets and a second pulverization step of finely pulverizing the material alloy,
>
> wherein said first pulverization step comprises a step of pulverizing the material alloy by a hydrogen pulverization method, and
>
> said second pulverization step comprises a step of removing at least part of fine powder having a particle size of 1.0 um or less to adjust the particle quantity of the fine powder having a particle size of 1.0 um or less to 10% or less of the particle quantity of the entire powder.

Ex. 1001, 13:21-33.

II. DISCUSSION

A. Claim Construction

In an *inter partes* review, claim terms in an unexpired patent are interpreted according to their broadest reasonable construction in light of the specification of the patent in which they appear. 37 C.F.R. § 100(b); *see 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*, 84 U.S.L.W. 3218 (Jan. 15, 2016) (No. 15446). Claim terms are given their

ordinary and customary meaning as understood by one of ordinary skill in the art in the context of the entire disclosure. *In re Translogic Tech., Inc.*, 504 F.3d 1249, 1257 (Fed. Cir. 2007).

In the Decision to Institute, we interpreted "particle quantity" as "amount of particles," without considering whether any particular common metrics should be excluded. Dec. Inst. 7. The parties do not dispute this interpretation in the Patent Owner Response or in the Petitioner Reply. We adopt the above claim construction based on our previous analysis, and see no reason to deviate from that construction for purposes of this Decision.

B. Level of Ordinary Skill in the Art

Petitioner sets forth a level of ordinary skill in the art in terms of academic qualifications (i.e., a bachelor's or master's degree in materials science, metallurgical engineering, or physics) and a corresponding number of years of "work or research experience in the field of rare-earth magnets." Ex. 1002 ¶ 28. In particular, Petitioner states that if the academic qualifications are a bachelor's degree, the corresponding number of years of work or research experience is identified as two to four years, and if the academic qualifications are a master's degree, then the corresponding number of years of work or research experience is identified as one to two years. *Id.*

Patent Owner disagrees with respect to the corresponding number of years of work or research

experience that are necessary to be a person of ordinary skill in the art. In particular, Patent Owner proffers that a person of ordinary skill in the art would hold either (a) a bachelor's degree in the same fields identified by Petitioner, but only one to two years of additional work or research experience; or (b) a master's degree in the same fields identified by Petitioner, but only one year of additional work or research experience. PO Resp. 3 (citing Ex. 2002 ¶ 60). Patent Owner submits that this level of ordinary skill was arrived at by considering "the specific problems and technical hurdles involved in rare earth magnets; the evolution and sophistication of manufacturing rare earth magnets; and the educational level of a person working in the rare earth magnet industry at the time of the invention." *Id.* (citing Ex. 2002 ¶¶ 62-65; *Envtl. Designs, Ltd. v. Union Oil Co.*, 713 F.2d 693, 696 (Fed. Cir. 1983)). Although Patent Owner and Petitioner disagree on the years of experience possessed by a person of ordinary skill in the art, neither party provides a sufficient and credible explanation as to how the alleged difference in years of experience impacts this proceeding.

To determine the level of ordinary skill in the art in this case, we consider the type of problems encountered in the art, the prior art solutions to those problems, and the sophistication of the technology. *Custom Accessories, Inc. v. Jeffrey-Allan Indus. Inc.*, 807 F.2d 955, 962 (Fed. Cir. 1986). We are also guided by the level of ordinary skill in the art as reflected by the prior

art of record. *Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001).

The '765 patent indicates that the material alloy can be produced by ingot casting or rapid cooling methods typified by strip casting and centrifugal casting (Ex. 1001, 1:36-41, 12:24-29), and refers to a "known strip casting method" (*Id.* at 5:37-38). The prior art of record also describes differences between the resulting alloy obtained by ingot casting methods and the resulting alloy obtained by strip casting methods. *See, e.g.*, Ex. 1007, 1:15-2:3. Thus, a skilled artisan would have some knowledge of strip casting methods and how such methods would affect the resulting alloy as compared to an alloy produced by ingot casting methods. The prior art of record also describes various mechanical pulverization techniques, as well as a hydrogen pulverization process. *See, e.g.*, Ex. 1005 ¶ 2. The prior art of record also compares the resulting fine powder of the hydrogen pulverization process to that produced by mechanical pulverization. *Id.* A skilled artisan, therefore, would also need some knowledge of hydrogen pulverization methods and how they differ from mechanical pulverization. We acknowledge the sophistication of the rare earth magnet technology, but consider that one of ordinary skill in the art would be aware of all the pertinent prior art.

Based on all of the evidence, we conclude that a person of ordinary skill in the art at the time of the '765 patent, through education or experience, would have knowledge of various methods to produce the material alloy (e.g., ingot casting and strip casting)

and various pulverization techniques (e.g., mechanical pulverization and hydrogen pulverization), and would have knowledge of the differences between the methods and techniques, as the resulting material alloys.

C. Obviousness of Claims 1-4, 14, and 16 over Ohashi and Hasegawa

1. Overview of Ohashi

Ohashi discloses a method for the preparation of a permanent magnet composed of a rare earth element, iron, and boron. Ex. 1004, 1:6-16. Ohashi discloses rough pulverization of an alloy ingot via various types of pulverizing machines, such as stamp mills, jaw crushers, Braun mills, and the like, and fine pulverization via jet mills, ball mills, and the like. *Id.* at 4:38-46. Ohashi recognizes that "a magnetic alloy powder containing extremely fine particles are highly susceptible to the oxidation by the atmospheric oxygen," (*id.* at 3:41-43), and discloses that "the alloy under pulverization is strictly prevented against oxidation by the atmospheric oxygen by conducting the pulverization in an atmosphere of a non-oxidizing or inert gas such as nitrogen, argon and the like" (*id.* at 4:46-50).

Ohashi further discloses "particle size classification of the alloy powder for compression molding into a powder compact to be sintered, by which particles having a finer particle diameter . . . are removed so as to effectively prevent oxidation of the too fine particles." *Id.* at Abstr. Ohashi discloses that particle classification can be conducted using "screens of an

appropriate mesh opening, rotative force, air stream and the like as well as a combination of these different principles." *Id.* at 5:1-4. Ohashi discloses removing particles having a diameter smaller than 2 μm from the alloy powder. *Id.* at 2:45-46, 4:19-22, 4:64-67. Ohashi also discloses that "[i]t is important that the volume fraction of the fine particles having a diameter smaller than 2 μm in the alloy powder after the particle size classification does not exceed 1% or, preferably, 0.5%." *Id.* at 5:50-53.

2. Overview of Hasegawa

Hasegawa discloses that the alloy used to make rare-earth magnets is generally obtained by conventional powder metallurgy. Ex. 1005 ¶ 2. Hasegawa further discloses that melted cast ingots of rare-earth magnets have a multi-phase crystal structure including the main phase $R_2Fe_{14}B$, and an Nd-rich (i.e., rare earth-rich) phase. *Id.* ¶ 3. In Hasegawa, melted cast ingot is pulverized using mechanical pulverization techniques or a method that "involves causing hydrogen to be absorbed into the melted cast ingot of a rare-earth-iron-boron based magnet and allowing disintegration to occur to produce a coarse powder." *Id.* Hydrogen pulverization can produce pulverized powder in about one-fourth of the time of mechanical pulverization and can also cause the rare-earth rich phase to be more easily pulverized. *Id.* After coarse pulverization by mechanical or hydrogen pulverization, the powder is then finely pulverized using a jet mill. *Id.*

Hasegawa further discloses that the rare earth-rich phase oxidizes more readily than the main phase, and that if the rare earth-rich phase is excessively pulverized, a magnet obtained from such a fine powder may include excessive oxide phase and lack good magnetic properties. *Id.* To combat this known problem, Hasegawa discloses that wind power is used to remove R-rich phase fine powder during a particle classification step following pulverization. *Id.* ¶ 4; Ex. 1002 ¶ 66. The remaining powder having lower concentrations of rare earth is compacted compressively, sintered, and heat-treated. Ex. 1005 ¶ 4. The method allows rare earth-iron-boron magnets of high coercivity and high energy product to be obtained by using "classifiers that employ wind power to remove Nd-rich phase [(i.e., rare earth rich phase)] that includes large quantities of oxygen due to excessive pulverization and thus improve sinterability and reduce the oxide phase that is present at the grain boundaries." *Id.* ¶ 5.

3. Obviousness of Claims 1-4, 14, and 16

a. Claim 1

Petitioner alleges that independent claim 1 would have been obvious over Ohashi and Hasegawa. Pet. 15-20. Petitioner relies on Ohashi for every element of independent claim 1, except for the recitation that the "first pulverization step comprises a step of pulverizing the material alloy by a *hydrogen* pulverization method." *Id.* at 17 (emphasis added). Petitioner argues that Hasegawa "teaches coarse pulverization using

hydrogen treatment or pulverization to more easily crush a material alloy." *Id.* (citing Ex. 1005, Abstr., ¶¶ 2-6; Ex. 1002 ¶¶ 66, 70-71). Patent Owner does not dispute that Ohashi teaches every element of independent claim 1 except for the first pulverization step comprising a step of pulverizing the material alloy by a hydrogen pulverization method, nor that Hasegawa teaches hydrogen pulverization. *See* PO Resp. 5-12.

Petitioner argues that "[o]ne of ordinary skill would have been motivated to combine Ohashi and Hasegawa because both Ohashi and Hasegawa are in the same field of making [R—Fe—B] magnets using known and standard processes such as jet milling and classification to coarsely and finely pulverize a material alloy into fine powder." Pet. 16 (emphasis omitted). Petitioner also provides expert testimony that:

> Because hydrogen pulverization taught by *Hasegawa* was a well-known and common technique for coarse pulverization in a non-oxidizing gas environment to crush more easily an [R—Fe—B] material alloy, one of ordinary skill would have been motivated to use the hydrogen pulverization technique disclosed in *Hasegawa* to improve the coarse pulverization of an [R—Fe—B] material alloy taught by *Ohashi* that suggests using a non-oxidizing gas. . . . Moreover, one of ordinary skill would have been motivated to combine these prior art teachings of *Ohashi* and *Hasegawa* according to known methods to yield predictable results. Such a modification also would have been obvious because it would

> have involved the use of known process of hydrogen pulverization to improve a similar method of coarsely pulverizing an [R—Fe—B] material alloy.

Ex. 1002 ¶ 71 (*cited at* Pet. 17) (citations omitted).

Patent Owner counters that simply because references relate to the same technical field, this alone is not a demonstration of the obviousness of their combination. PO Resp. 7 (citing *Ex Parte Bogwardt*, 2012-009099, 3 (PTAB Oct. 14, 2014)). Petitioner's rationale underlying the obviousness of the combination of Ohashi and Hasegawa does not rest on the references being in the same technical field, but rather is based, at least in part, on hydrogen pulverization being able to more easily crush the material alloy, as well as the combination of known prior elements to achieve a predictable result. *See* Pet. 17 (citing Ex. 1002 ¶ 71).

Patent Owner also counters that Petitioner's challenge rests on a faulty premise that Hasegawa's hydrogen pulverization is a "similar method" to Ohashi's mechanical pulverization. PO Resp. 5, 7. Patent Owner argues that hydrogen pulverization involves "hydrogen chemically react[ing] with the R—Fe—B material alloy to form hydrides which in turn cause the alloy to crack and crumble or 'decrepitate.'" *Id.* at 7-8. Patent Owner argues that mechanical pulverization, on the other hand, "involves the direct contact between a crushing apparatus and the alloy to be crushed, resulting in random pulverization of the alloy." *Id.* at 8. Although there can be no doubt that mechanical

pulverization is different than chemical pulverization, simply because there are differences between two references is insufficient to establish that such references teach away from any combination thereof. *See In re Beattie*, 974 F.2d 1309, 1312-13 (Fed. Cir. 1992). Petitioner's reasoning to utilize hydrogen pulverization in place of mechanical pulverization to more easily crush the material alloy, and that the combination of known prior art elements achieves a predictable result, is not negated by the differences between mechanical and chemical pulverization.

To the extent Patent Owner is arguing that the utilization of hydrogen pulverization in place of mechanical pulverization is not predictable (*See* Tr. 40:20-41:2 (citing Ex. 2002 ¶ 90)), Patent Owner has merely pointed out that one of ordinary skill in the art would have to account for differences between the two pulverization mechanisms. Patent Owner, however, has not explained persuasively that such an accounting for differences between the two pulverization mechanisms would have been beyond the capability of one of ordinary skill in the art. *See KSR Intl Co. v. Teleflex Inc.*, 550 U.S. 398, 421 (2007) ("A person of ordinary skill is also a person of ordinary creativity, not an automaton."). Although Patent Owner argues that "if you make a change in any part of this total process, then you are going to have to look and investigate to see do you need to make compensations in other parts of the process as well . . . [a]nd that simply is going to be beyond what one of ordinary skill in the art would be able to do here" (Tr. 62:20-25), Patent Owner again only

points to expert testimony that explains that one would need to change the composition of the alloy to compensate for differences between the pulverization mechanisms (*Id.* at 63:1-6 (citing Ex. 2002 ¶ 90)), not that such changes would have been beyond the level of ordinary skill in the art. Moreover, as described above, we have concluded that a person of ordinary skill in the art at the time of the '765 patent would have knowledge of the differences between mechanical and hydrogen pulverization techniques, and the resulting material alloys.

Patent Owner further counters that Ohashi specifically seeks to avoid conducting pulverization in an atmosphere of an oxidizing or non-inert gas. PO Resp. 9 (citing Ex. 1004, 4:45-50). Patent Owner elaborates that "hydrogen gas functions as an *oxidizing gas* in the specific context of hydrogen pulverization" and is a non-inert gas in direct contrast to the non-oxidizing or inert gas desired in Ohashi. *Id.* at 10.

The word "oxidize" means "[1] To combine with oxygen; make into an oxide. [2] To increase the positive charge or valence of (an element) by removing electrons." American Heritage Dictionary, Houghton Mifflin Company (2000, 2003), *available at* http://literature.proquestlearning.com/home.do (last visited Feb. 3, 2016) (Ex. 3001). We determine that, considering the context of the patent, it is more likely than not than Ohashi's reference to a "non-oxidizing gas" refers to a gas that does not cause an element to combine with oxygen or be made into an oxide (in accordance with the first definition cited above), rather than a gas that

does not increase the positive charge or valence of an element by removing electrons (in accordance with the second cited definition). Our determination is based on Ohashi's statements that "a magnetic alloy powder containing extremely fine particles are highly susceptible to the *oxidation by the atmospheric oxygen*" (Ex. 1004, 3:41-43 (emphasis added)), "the adverse influences *due to the increased oxygen content* in the alloy powder can be overcome when the alloy powder does not contain extremely fine particles" (*id.* at 3:45-48 (emphasis added)), "fine particles in a powder of neodymimum-iron-boron magnet alloys are rapidly oxidized *by the atmospheric oxygen* already in the course of pulverization in a non-oxidizing atmosphere and there-after *to greatly increase the oxygen content* in the alloy powder" (*id.* at 3:51-56 (emphasis added)), "a great improvement could be obtained in the magnetic properties of the permanent magnets as a result of the *decrease in the oxygen content of the alloy powder*" (*id.* at 3:61-64 (emphasis added)), "it is essential that the alloy under pulverization is strictly prevented against oxidation *by the atmospheric oxygen*" (*id.* at 4:45-47 (emphasis added)), and "Table 1 . . . shows the oxygen contents and the magnetic properties of the thus obtained sintered permanent magnets" (*id.* at 7:19-21 (emphasis added)). These statements demonstrate that Ohashi is concerned with the oxygen content of the alloy, rather than whether the alloy has undergone a removal of electrons.

Petitioner has shown sufficiently that the hydrogen gas of the hydrogen pulverization method *is*

a non-oxidizing gas in that it does not cause an element of the magnet alloy to combine with oxygen or be made into an oxide. Pet. Reply 4-5 (citing Ex. 1012, 77:9-13). The hydrogen pulverization method of Hawegawa, therefore, is in accordance with Ohashi's teachings of conducting the pulverization in an atmosphere of a non-oxidizing *or* inert gas.[6] Accordingly, we are not persuaded that modification of Ohashi to utilize a hydrogen pulverization method as taught by Hasegawa is contrary to the teachings of Ohashi.

Patent Owner also contends that "unexpected results, reflected in Table 1 of the '765 Patent, provides probative evidence of non-obviousness." PO Resp. 6; *see also id.* at 12-21 (setting forth arguments regarding evidence of secondary considerations such as unexpected results). More particularly, Patent Owner argues that "the inventors unexpectedly discovered that the magnetic properties of a final magnet do not start to significantly deteriorate until the magnet powder comprises *more* than 10% superfine powder." *Id.* at 15 (citing Ex. 1001, 10:60-11:10). In addition, Patent Owner argues that this 10% threshold refers to particles having a size of 1 μm or less and that the "retention of particles, including in the range from 1 μm to 2 μm, contributes to

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[6] We agree with Patent Owner that the hydrogen gas of Hasegawa's hydrogen pulverization method "is certainly a non-inert gas." PO Resp. 9. We determine, however, that Ohashi requires the pulverization be conducted in the atmosphere of a non-oxidizing gas *or* inert gas, but not necessarily both. Because we have found the hydrogen gas of Hasegawa's hydrogen pulverization method to be a non-oxidizing gas, it is immaterial whether or not it is inert.

the unexpected results of Table 1." *Id.* at 16 (citing Ex. 1001, 3:62-64, 4:21-23, 8:64-66, claim 14).

We agree with Patent Owner that when secondary considerations are present, they must be considered with respect to the determination of obviousness. *See Stratoflex v. Aeroquip Corp.*, 713 F.2d 1530, 1538 (Fed. Cir. 1983) ("[E]vidence rising out of the so-called 'secondary considerations' must always when presented be considered en route to a determination of obviousness.").

Patent Owner fails to provide a credible and sufficient explanation as to how the evidence of asserted unexpected results (i.e., a lack of significant deterioration of magnetic properties) is commensurate in scope with the claims. In order to establish unexpected results for a claimed invention, objective evidence of nonobviousness must be commensurate in scope with the claims which the evidence is offered to support. *In re Clemens*, 622 F.2d 1029, 1035-36 (CCPA 1980). Furthermore, to show unexpected results the claimed invention must be compared with the closest prior art. *In re Fracallossi*, 681 F.2d 792, 794 (CCPA 1982); *In re Reuter*, 670 F.2d 1015, 1023 (CCPA 1981); *In re Fenn*, 639 F.2d 762, 765 (CCPA 1981).

To the extent that Patent Owner is arguing that the 10% threshold of fine powder might account for the asserted unexpected results (PO Resp. 15-16), the step of adjusting the particle quantity of the fine powder having a particle size of 1 μm or less to 10% or less was already described in Ohashi. Patent Owner fails to

provide comparative data showing unexpected results with respect to the improved magnetic properties of its claimed invention vis-à-vis the disclosure of Ohashi. In other words, Patent Owner fails to establish that improved magnetic properties are due to features recited in claim 1 and not present in Ohashi.

To the extent that Patent Owner is arguing that retention of particles in the range of 1 μm to 2 μm might account for the asserted unexpected results (PO Resp. 16, 20), this feature is not claimed. The only feature that Patent Owner points to as distinguishing the claimed invention from Ohashi's prior art method for manufacturing alloy powder for rare earth magnets is the use of hydrogen pulverization in place of Ohashi's mechanical pulverization (PO Resp. 5-21); however, Patent Owner has not presented sufficient and credible evidence that the feature of hydrogen pulverization contributes to the unexpected results. On this record Patent Owner fails to provide sufficient and credible evidence that its alleged unexpected result is commensurate in scope with the claims. Consequently, we are not persuaded by Patent Owner's contentions in relation to unexpected results.

We have also considered Patent Owner's argument that Ohashi teaches away from using more than 1% of sub-2 μm powder in the final magnet powder. PO Resp. 18. In particular, Patent Owner argues that Ohashi "warned of the dangers of producing magnets using powder containing fine particles of *smaller than 2 μm*." *Id.* at 17 (citing Ex. 1004, 3:34-65). Further, Patent Owner argues that Ohashi "specifically wants to

'*ensure substantial absence* of fine particles having a *diameter smaller than 2 μm*' in the magnet powder." *Id.* at 18 (citing Ex. 1004, 5:37-39). Patent Owner's argument fails to take into account the actual language of claim 1, which does *not* require that a certain amount of sub-2 μm powder be retained, but rather requires that "the particle quantity of the fine powder having a particle size of 1.0 μm or less [be adjusted] to 10% or less of the particle quantity of the entire powder." Ex. 1001, 13:32-34. That is, the claim sets only an upper limit on the amount of fine powder having a particle size of 1.0 μm or less (i.e., 10%), but no lower limit. Ohashi's teaching of eliminating sub-2 μm powder would not lead a person of ordinary skill in the art away from the *claimed* language of reducing sub-1 μm powder to less than 10% (which would encompass 0% as there is no lower limit), so the teachings of Ohashi and the claim language are entirely consistent. *See In re Haruna*, 249 F.3d 1327, 1335 (Fed. Cir. 2001) (quoting *Tec Air, Inc. v. Denso Mfg. Mich., Inc.*, 192 F.3d 1353, 1360 (Fed. Cir. 1999)) ("A reference may be said to teach away when a person of ordinary skill, upon reading the reference, . . . would be led in a direction divergent from the path that was taken by the applicant.").

In considering the entirety of the record, we are persuaded that a person of ordinary skill in the art would have been motivated to modify Ohashi's method for the preparation of a permanent magnet of a magnetic alloy comprising a rare earth element, iron, and boron to incorporate Hasegawa's hydrogen pulverization technique in place of Ohashi's mechanical

pulverization techniques in order to be able to more easily crush the material alloy. Pet. 17 (citing Ex. 1004, 4:45-50; Ex. 1005 ¶¶ 2-6, Abstract); Pet. Reply 3 (quoting Ex. 1005 ¶ 2) ("hydrogen pulverization can produce pulverized rare-earth alloy material in 'one-fourth of the time required with mechanical pulverization,' which 'reduces pulverization time and improves pulverization yield and pulverization efficiency.'"); Ex. 1002 ¶¶ 66, 70-71.

We are also persuaded that there would have been a reasonable expectation of success in modifying Ohashi to incorporate Hasegawa's hydrogen pulverization technique in place of Ohashi's mechanical pulverization techniques. Ex. 1002 ¶ 71 (explaining that hydrogen pulverization "was a well-known and common technique for coarse pulverization" and would have involved only the use of known method to achieve predictable results); Pet. Reply 3 (quoting Ex. 1005 ¶ 2 ("by 1992 hydrogen pulverization 'was generally used as the method for the manufacture of rare-earth-iron-boron based magnet powder.'"); *see DyStar Textilfarben GmbH & Co. Deutschland KG v. C. H. Patrick Co.*, 464 F.3d 1356, 1360 (Fed. Cir. 2006) ("consider[ing] whether a person of ordinary skill in the art would have been motivated to combine to the prior art to achieve the claimed invention and whether there would have been a reasonable expectation of success in doing so" in determining whether a claimed invention would have been obvious). Petitioner has presented sound reasoning with rational underpinnings in urging that an ordinarily skilled artisan would have

utilized Hasegawa's hydrogen pulverization technique with Ohashi's method of producing a permanent magnet alloy in order to be able to more easily crush the material alloy. After considering Petitioner's and Patent Owner's positions, as well as their supporting evidence, we conclude that Petitioner has demonstrated, by a preponderance of the evidence, that independent claim 1 of the '765 patent would have been obvious over the combined teachings of Ohashi and Hasegawa under 35 U.S.C. § 103(a).

b. Claims 2, 3, 14, and 16

Patent Owner directs no credible arguments specifically to any of dependent claims 2, 3, 14, and 16 with regard to the challenge for obviousness over Ohashi and Hasegawa. Instead, Patent Owner argues the purported deficiencies of Ohashi and Hasegawa that it argued with respect to independent claim 1. PO Resp. 21. For the same reasons as described above, we are not persuaded of any deficiencies in the combination of Ohashi and Hasegawa in Petitioner's challenge.

Claim 2 depends from claim 1, and further recites that "the average concentration of the rare earth element contained in the fine powder having a particle size of 1.0 μm or less is greater than the average concentration of the rare earth element contained in the entire powder." Ex. 1001, 13:35-39. Petitioner contends that Ohashi teaches that "excessive pulverization of R—Fe—B alloys produces R-rich superfine powder having particles 1 μm or less." Pet. 21 (citing Ex. 1004,

1:57-63, 2:28-60, 3:3-10, 4:37-41, 4:64-5:10, 5:50-53; Ex. 1001, 2:19-22; Ex. 1002 ¶¶ 39-41, 46, 54, 78-80). Petitioner also presents expert testimony that

> in *Ohashi*, one of ordinary skill would recognize that the particles finer than 2 μm or less remaining in the powder after classification necessarily are R-rich and naturally and inherently have an average rare earth concentration greater than the average rare earth concentration in the entire powder containing other non-rare earth elements such as the main $R_2Fe_{14}B$ phase.

Ex. 1002 ¶ 78 (citing Ex. 1001, 1:46-63; Ex. 1002 ¶¶ 39-41) (*cited at* Pet. 22).

Patent Owner does not dispute this conclusion of Petitioner's expert. *See* PO Resp. 21. We credit Dr. Ormerod's testimony that Ohashi inherently discloses that the concentration of rare earth element contained in powders having a particle size of 2 μm or less is greater than the average concentration of rare earth element contained in the entire powder.

Claim 3 depends from claims 1 or 2, and further recites that "in said pulverization step, the alloy is finely pulverized in a high-speed flow of gas." Ex. 1001, 13:40-42. Petitioner contends that Ohashi teaches that "coarse powder is 'finely pulverized in a jet mill with a jet stream of nitrogen gas.'" Pet. 22 (quoting Ex. 1004, 6:45-48). Petitioner explains that Ohashi teaches that "classification can use 'air stream and the like.'" *Id.* at 23 (quoting Ex. 1004, 5:1-4; Ex. 1002 ¶ 81).

Claim 14 recites depends from claim 1 and further requires that "the average particle size of the powder obtained in said second pulverization step is in a range between 2 μm to 10 μm." Ex. 1001, 14:25-27. Petitioner contends that Ohashi teaches that "the 'alloy powder as pulverized have an average particle diameter in the range from 3 μm to 10 μm and contain at least 90% by volume.'" Pet. 24 (quoting Ex. 1004, 4:58-60; Ex. 1002 ¶ 83).

Claim 16 recites "preparing alloy powder for R—Fe—B rare earth magnets by the method of claim 1; and compacting the alloy powder for R—Fe—B rare earth magnets to produce a permanent magnet." Ex. 1001, 14:31-36. Petitioner contends that Ohashi teaches that "the 'obtained alloy powder after particle size classification to remove too fine particles was compression-molded in a metal mold' in making a permanent magnet." Pet. 23-24 (quoting Ex. 1004, 6:66-7:9; Ex. 1002 ¶¶ 85-86).

We credit Dr. Ormerod's testimony that Ohashi teaches the limitations of dependent claims 2, 3, 14, and 16 and are persuaded that Petitioner presents sufficient evidence, as outlined above, to support a conclusion that the combination of Ohashi and Hasegawa renders obvious the subject matter of dependent claims 2, 3, 14, and 16. After considering Petitioner's and Patent Owner's positions, as well as their supporting evidence, we conclude that Petitioner has demonstrated, by a preponderance of the evidence, that dependent claims 2, 3, 14, and 16 of the '765

patent would have been obvious over the combination of Ohashi and Hasegawa under 35 U.S.C. § 103(a).

c. Claim 4

Claim 4 recites "[t]he method of claim 3, wherein the gas [i.e., the high-speed flow of gas in which the alloy is finely pulverized] comprises oxygen." Ex. 1001, 13:43-44. Petitioner asserts that "[d]uring fine pulverization, *Ohashi* discloses that '[a]pplicable methods for the particle size classification' include 'air stream and the like.'" Pet. 22-23 (quoting Ex. 1002 ¶ 82; Ex. 1004, 4:68-5:3). Petitioner further provides expert testimony that "oxygen . . . cannot be entirely removed from the jet milling and classification processes as understood by one of ordinary skill." Ex. 1002 ¶ 82). Petitioner asserts "any other gas present in the milling chamber will also begin to move at high speed" when "a high-speed flow of gas is emitted from nozzles into the milling chamber." Pet Reply. 16 (citing Ex. 1012, 112:15-22).

Patent Owner first argues the purported deficiencies of Ohashi and Hasegawa that it argued with respect to independent claim 1. PO Resp. 21. For the same reasons as described above, we are not persuaded of any deficiencies in the combination of Ohashi and Hasegawa in Petitioner's challenge.

Patent Owner next argues that Ohashi's "particle size classification" is after the fine pulverization, such that the disclosed air stream of Ohashi "is not a high-speed flow of gas for finely pulverizing the alloy," but

"an air stream used for particle classification." PO Resp. 23-24. Patent Owner's argument implies that fine pulverization is completed prior to particle size classification. The Specification's statements that "[t]he alloys may be finely pulverized using a jet mill" and "[i]n a preferred embodiment, a classifier is provided following the jet mill for classifying a powder output from the jet mill" (Ex. 1001, 3:46-49) appear to support Patent Owner's interpretation that fine pulverization occurs in a jet mill and is finished before particle size classification occurs in a classifier.

Petitioner responds that "the process of removing fine powder (the cyclone classification step) is included in the claimed "second pulverization step" such that "'pulverizing' encompasses both the process of milling the alloy powder in the jet mill chamber and the process of classifying the powder in the jet mill's cyclone." Pet. Reply 17. The Specification's statements that "[t]he method for manufacturing alloy powder for R—Fe—B type rare earth magnets . . . includes . . . *a second pulverization step of finely pulverizing the material alloy*, wherein . . . *the second pulverization step comprises* a step of removing at least part of fine powder" (*id.* at 2:66-3:7 (emphasis added)); that "*before a fine pulverization step is finished*, at least part of R-rich super-fine powder, i.e., powder having a particle size of 1 μm or less, is removed to adjust the particle quantity of the R-rich super-fine powder to 10% or less of the particle quantity of the entire powder" (*id.* at 4:58-62) (emphasis added); and that "[a]s the example of the present invention, *in the fine pulverization*

process using the jet mill and the cyclone classifier connected to each other, the pressure of the gas in the cyclone classifier was controlled to change the amount of super-fine powder contained in the collected powder" (*id.* at 10:46-50 (emphasis added)), appear to support Petitioner's interpretation that fine pulverization comprises both the milling that occurs in the jet mill and the particle classification that occurs in the cyclone. Based on the above portions of the Specification, we determine the broadest reasonable interpretation consistent with the Specification is that the second pulverization step of finely pulverizing the material alloy is not completed after milling in the jet mill, but rather includes *both* a first sub-step of milling and a second sub-step of particle classification.

We are not persuaded that Patent Owner's argument (i.e., that Ohashi lacks the second pulverization step of finely pulverizing the material alloy in a high speed flow of gas that comprises oxygen) is based on the claim language being given the broadest reasonable interpretation in light of the Specification. Because we have determined that particle classification is part of finely pulverizing the material alloy in a high-speed flow of gas, Petitioner's reliance on Ohashi's particle size classification including an air stream (Pet. 22-23 (quoting Ex. 1002 ¶ 82; Ex. 1004, 4:68-5:3)) is sufficient to meet the language of claim 4.

As to Patent Owner's additional argument that the only carrier gas disclosed for Ohashi's air-stream particle size classifier is nitrogen (PO Resp. 24 (citing Ex. 1004, 6:54-62)), we are not persuaded that this

reference to nitrogen as the carrier gas in "Example 1" negates Ohashi's previous disclosure of an "air stream," which one of ordinary skill in the art would recognize comprises some amount of oxygen. *See* Pet. Reply 18 (citing Ex. 1002 ¶ 82).

We have also considered Patent Owner's arguments that "stating that 'some amount of oxygen [] cannot be entirely removed from the jet milling [] process[]' is not the same as finely pulverizing an alloy in a high-speed flow of gas comprising oxygen" (PO Resp. 25 (citing Ex. 1002 ¶ 82)), and that Ohashi teaches away from finely pulverizing the alloy in a high-speed flow of gas comprising oxygen because "[a] person of ordinary skill reading *Ohashi* would be led away from the '765 Patent, which finely pulverizes the alloy in a high-speed flow of gas comprising oxygen to intentionally coat the surfaces of the powder with a thin oxide layer." *Id.* at 26, 28 (citing Ex. 2002 ¶ 100). These arguments, however, are not persuasive considering that our determination is based on the express disclosure of Ohashi's air stream for particle classification as opposed to relying on any residual oxygen in the jet mill of Ohashi or Hasegawa and/or the modification of Ohashi.

We credit Dr. Ormerod's testimony that Ohashi teaches the limitations of dependent claim 4 and are persuaded that Petitioner presents sufficient evidence, as outlined above, to support a conclusion that the combination of Ohashi and Hasegawa renders obvious the subject matter of dependent claim 4. After considering Petitioner's and Patent Owner's positions, as well

as their supporting evidence, we conclude that Petitioner has demonstrated, by a preponderance of the evidence, that dependent claim 4 of the '765 patent would have been obvious over the combined teachings of Ohashi and Hasegawa under 35 U.S.C. § 103(a).

D. Obviousness of Claims 11 and 12 over Ohashi, Hasegawa, and Yamamoto

1. Overview of Yamamoto

Yamamoto discloses that "[p]ermanent magnet alloy ingots are generally produced by a metal mold casting method consisting in casting molten alloy in a metal mold." Ex. 1007, 1:15-17. Yamamoto also discloses a method for producing a rare earth metal magnet alloy by "a strip casting system combined with a twin roll, a single roll, a twin belt or the like." *Id.* at 1:59-61. Yamamoto suggests that "an ingot produced by this method has a composition more uniform than that obtained with the metal mold casting method," but that sufficient improvement has not yet been seen. *Id.* at 1:62-2:3. Yamamoto further discloses "melting a rare earth metal-iron alloy to obtain a molten alloy and solidifying the molten alloy uniformly at a cooling rate of 10 to 1000° C./sec." *Id.* at 2:34-36.

2. Obviousness of Claims 11 and 12

Petitioner alleges that claims 11 and 12 would have been obvious over the combination of Ohashi, Hasegawa, and Yamamoto. Pet. 24-26. Claim 11 depends from claim 1 and further recites "the step of producing

the alloy for rare earth magnets by cooling a melt of the alloy at a cooling rate in the range between 10^2°C./sec and 10^4°C./sec." Ex. 1001, 14:16-19. Claim 12 depends from claim 11 and further requires that "the melt of the alloy is cooled by a strip casting method. *Id.* at 14:20-21. Petitioner argues that Yamamoto teaches "a rapid cooling (strip cast) method in making a material alloy more uniformly for making powders of an R—Fe—B magnet." Pet. 24, 26 (citing Ex. 1007, Abstr., 1:8-14, 2:32-37, 6:16-29, Fig. 1). Petitioner argues that Yamamoto "teaches rapid cooling in the claimed range to solidify the molten alloy more uniformly." *Id.* at 26 (citing Ex. 100, Abstr., 2:32-37; Ex. 1002 ¶¶ 90-92).

Patent Owner argues the purported deficiencies of Ohashi and Hasegawa that it argued with respect to independent claim 1. PO Resp. 21. For the same reasons as described above, we are not persuaded of any deficiencies in the combination of Ohashi and Hasegawa in Petitioner's challenge. Patent Owner does not dispute that Ohashi and Hasegawa teach every element of claims 11 and 12 except for the alloy being cooled at a cooling rate in the claimed range (claim 11) or being cooled by a strip casting method (claim 12), nor that Yamamoto teaches the claimed cooling rate range and cooling by a strip casting method. PO Resp. 28-45.

Petitioner further argues that "[o]ne of ordinary skill would have been motivated to use a material alloy formed by the rapid cooling method taught by Yamamoto with the pulverization techniques taught

by Ohashi and Hasegawa in order to pulverize an [R—Fe—B] alloy more uniformly." Pet. 24 (citing Ex. 1002 ¶¶ 87-89) (emphasis omitted). Petitioner also alleges that the rapid cooling (strip cast) method of Yamamoto, and the ingot method of Ohashi and Hasegawa, "are well known and interchangeable to one of ordinary skill." *Id.* (citing Ex. 1001, 1:35-45; Ex. 1002 ¶¶ 42-43, 87-89). Petitioner provides expert testimony that "one of ordinary skill would have been motivated to combine these prior art teachings of *Ohashi, Hasegawa*, and *Yamamoto* according to known methods to yield predictable results. Such a modification also would have been obvious because it would have involved the use of known techniques to improve a similar method." Ex. 1002 ¶ 92 (*cited at* Pet. 26).

Patent Owner counters that one of ordinary skill in the art would not have been motivated to combine the teachings of Ohashi, Hasegawa, and Yamamoto to arrive at the claimed invention. PO Resp. 28-45. Patent Owner does not appear to dispute Petitioner's contention that strip casting would result in a more uniform alloy. In particular, Patent Owner acknowledges that utilizing a strip casting method generates an alloy with the R-rich phase distributed *uniformly* along the boundaries of columnar $R_2Fe_{14}B$ grains having a mean width of about 5-25 μm, as compared to an alloy generated by ingot casting, which results in *randomly* dispersed regions of R-rich phase and α-Fe dendrites with columnar $R_2Fe_{14}B$ grains having a mean width of about 50-150 μm. *Id.* at 31-32 (citing Ex. 2009, 476).

Patent Owner, however, does dispute that generating a more uniform alloy would motivate a person of ordinary skill in the art to utilize a strip casting method in connection with the pulverization process of Ohashi as modified by Hasegawa. PO Resp. 28-45. Patent Owner contends that the more uniform composition of a strip cast alloy, as compared to an ingot cast alloy, would result in a smaller average particle size and a powder distribution that is relatively uniform in particle size and shape during hydrogen pulverization. *Id.* at 33 (citing Ex. 2002 ¶ 108; Ex. 2010, 3277, Fig. 6; Ex. 1001, 2:18-23, 8:66-9:3). Patent Owner recognizes that "finely milled $R_2Fe_{14}B$ phase particles [on the order of 1-5 μm] improve the density of the magnet, thereby positively impacting the magnetic resonance and coercivity as well as the mechanical integrity of the final magnet" (*id.* at 38 (citing Ex. 2002 ¶ 112)), but explains that more finely milled particles would then have to be removed as part of Ohashi's particle removal step, thereby resulting in a significantly diminished yield (*id.* at 30-31, 35-37). Patent Owner argues that Petitioner "ignores the[] consequences of changing *Ohashi's* recipe" (*id.* at 40) and "did not take into account the effect of an increased amount of superfine powder from the 'more uniform material alloy' on *Ohashi's* or *Hasegawa's* removal classification teachings" (*id.* at 41).

Petitioner, however, has supported its conclusion of obviousness based on the interchangeability of ingot casting and strip casting and the combination of prior art elements according to known methods to yield a

predictable result. Pet. 24, 26 (citing Ex. 1002 ¶ 92). Petitioner has shown, and Patent Owner has not disputed, that the claimed elements are known in the art, albeit not combined in a single reference, and are used for their known purpose. *Id.* at 25-26. We are persuaded that Petitioner has shown sufficiently that a person of ordinary skill in the art would have known how to combine Yamamoto's strip casting method having a cooling rate in the claimed range with the pulverization technique of Ohashi as modified by Hasegawa using known methods. *See* Ex. 1002 ¶ 43 ("Rare earth elements . . . are collected and are melted together to form a cast alloy using known techniques to one of ordinary skill such as the ingot cast method or a strip cast method."); *see also* Ex. 1001, 1:36-45, 12:24-29 (referring to material alloy being produced by two types of methods—ingot casting and rapid cooling—and stating that the present invention was applicable to both an ingot method and a rapid cooling method); Ex. 1002 ¶ 87 ("The ingot or strip cast methods are interchangeable to those skilled in the art."). Petitioner has also shown that a person of ordinary skill in the art would have recognized the results of the combination to be predictable. Ex. 1002 ¶ 92; Pet. Reply 24 ("[A] person of ordinary skill would have known how to mitigate the reduction in yield that [Patent Owner] suggests would be inherently present in the modified Ohashi process.").

Patent Owner argues that "magnet manufacturing is a far more complicated process than the Petitioner's arguments make it out to be," and that "if you

make a change in any part of this total process, then you are going to have to . . . investigate to see do you need to make compensations in other parts of the process as well. And that simply is going to be beyond what one of ordinary skill in the art would be able to do." Tr. 62:9-11, 20-25. Patent Owner further argues that the difference in the level of ordinary skill proffered by Patent Owner and Petitioner will affect whether the skilled artisan is able to modify the rare-earth magnet manufacturing process while taking into account critical parameters. *See id.* at 64:3-13. Patent Owner also argues that "fine-tuning or optimization of [the subject matter of the '765 patent] is going far beyond that of the level of ordinary skill of both of what [Patent Owner's expert] and of what [Petitioner's expert] have defined." *Id.* at 65:25-66:2.

Although Patent Owner argues that fine-tuning the magnet-making process to achieve desired characteristics is beyond the level of ordinary skill, Patent Owner has not explained persuasively that the combination of Yamamoto's strip casting at particular cooling rates with the pulverization techniques of Ohashi as modified by Hasegawa would have been *unpredictable* to one of ordinary skill in the art. That is, one of skill in the art would have understood that changing the method of producing the alloy would affect the resulting alloy (as described above), even if one of skill in the art would not have known exactly how to fine-tune the magnet making process to achieve the same alloy. Moreover, given the only slight differences between the levels of ordinary skill proffered by Petitioner and

Patent Owner, we are not persuaded that having slightly fewer number of years of experience of work and research in the field of rare earth magnets (as proffered by Patent Owner) would significantly change what would be predictable to a person of ordinary skill in the art, considering that the person of ordinary skill is a hypothetical person aware of all of the pertinent prior art. The parties fail to provide a credible explanation on this record as to how the alleged difference in experience levels for a person of ordinary skill in the art would alter our analysis of the record.

Patent Owner also argues that one with ordinary skill in the art, for various considerations, such as diminished yield, would not have implemented a strip casting method having cooling rates in the claimed range in connection with the pulverization technique of Ohashi as modified by Hasegawa. PO Resp. 28-42. Whether implementation of Yamamoto's strip casting method makes commercial sense does not control the obviousness determination. Patent Owner has not provided persuasive reasoning or evidence to support its contention that one of skill believed there to be some technological incompatibility that prevented the combination of Yamamoto's strip casting method having cooling rates in the claimed range with the pulverization technique of Ohashi as modified by Hasegawa; that the combination was unpredictable in some way; or that one with ordinary skill in the art would not have known how to use Yamamoto's strip casting method with the pulverization technique of Ohashi as modified by Hasegawa. *See Orthopedic Equip. Co. v.*

United States, 702 F.2d 1005, 1013 (Fed. Cir. 1983) ("[T]he fact that the two [prior art disclosures] would not be combined by businessmen for economic reasons is not the same as saying that it could not be done because skilled persons in the art felt that there was some technological incompatibility that prevented their combination. Only the latter fact is telling on the issue of nonobviousness.").

We appreciate Patent Owner's argument that "an invention 'composed of several elements is not proved obvious merely by demonstrating that each of its elements was, independently, known in the prior art." PO Resp. 40 (citing *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 418 (2007)). Petitioner, however, has set forth a sufficient rationale to arrive at what is claimed. Specifically, Petitioner has demonstrated that the claims represent the combination of prior art elements according to known methods to yield a predictable result. *See KSR*, 550 U.S. at 416 ("The combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results."). This is itself a sufficient reason with rational underpinning to support a conclusion of obviousness. This is especially true where the evidence supports that consideration of design incentives, such as the provision of a "lower cost, more productive [process] better suited for higher volume manufacturing" would have led one of ordinary skill to pursue the predictable combination of elements. Pet. Reply 24 (citing Ex. 2003, 109:10-20).

Patent Owner also argues that "one of the purposes of *Ohashi* is 'to effectively prevent oxidation of the too fine particles' (PO Resp. 43 (citing Ex. 1004, Abstr.)), and that "[h]ydrogen pulverizing a strip cast alloy, however, increases the likelihood of oxidation of the pulverized particles (*id.* at 44 (citing Ex. 2014, 3:1-21; Ex. 1001, 2:5-7; Ex. 1005, Abstr., ¶ 3)). Patent Owner continues that "[g]iven this increased likelihood of oxidation when coarsely pulverizing a strip cast alloy via hydrogen pulverization, modifying *Ohashi* to use *Yamamoto's* strip cast alloy and *Hasegawa's* hydrogen pulverization would render *Ohashi* unsatisfactory for its intended purpose of preventing oxidation." *Id.* at 45 (citing Ex. 2002 ¶ 113).

We disagree with Patent Owner. The use of strip casting to produce an alloy for producing an R—Fe—B type rare earth magnet and the use of hydrogen pulverization to coarsely pulverize the alloy to produce an R—Fe—B type rare earth magnet is not inconsistent with Ohashi's described purpose of "the preparation of an alloy-type permanent magnet mainly composed of a rare earth element, . . . iron and boron having outstandingly high stability against otherwise possible changes in the magnetic properties in the lapse of years for service." Ex. 1004, 1:10-15. Modifying Ohashi in accordance with the teachings of Hasegawa and Yamamoto would not impede the broad intended purpose of Ohashi. Like Ohashi, both Hasegawa and Yamamoto are directed to methods of producing rare earth magnets. In addition, Ohashi contemplates removal of fine powder to address concerns that even

conducting the pulverization in an atmosphere of a non-oxidizing or inert gas "is still insufficient so that oxidation of the alloy powder proceeds faster or slower throughout the processes of pulverization, transportation, storage and subsequent processing resulting in a decrease or poor reproducibility of the magnetic properties of the permanent magnets prepared from the alloy powder." *Id.* at 1:64-2:2.

In considering the entirety of the record, we are persuaded that a person of ordinary skill in the art would have combined the teachings of Ohashi and Hasegawa with the teachings of Yamamoto according to known methods to yield a predictable result. We credit Dr. Ormerod's testimony that the claimed elements were known in the art and were used for their known purposes (Ex. 1002 ¶¶ 90-94), that a person of ordinary skill in the art could have combined the known elements by known methods (*id.* ¶ 87), and that one of ordinary skill would have recognized the results of the combination to be predictable (*id.* ¶ 92). We also credit the evidence supporting that consideration of design incentives, such as the provision of a "lower cost, more productive [process] better suited for higher volume manufacturing" would have led one of ordinary skill to pursue the predictable combination of elements. Pet. Reply 24 (citing Ex. 2003, 109:10-20).

Petitioner has presented sound reasoning with rational underpinnings in urging that an ordinarily skilled artisan would have utilized Yamamoto's strip casting method having cooling rates in the claimed range in connection with the pulverization technique

of Ohashi as modified by Hasegawa. After considering Petitioner's and Patent Owner's positions, as well as their supporting evidence, we conclude that Petitioner has demonstrated, by a preponderance of the evidence, that dependent claims 11 and 12 of the '765 patent would have been obvious over the combined teachings of Ohashi, Hasegawa, and Yamamoto under 35 U.S.C. § 103(a).

E. Obviousness of Claim 15 over Ohashi, Hasegawa, and Kishimoto

1. Overview of Kishimoto

Kishimoto discloses "a process for producing rare earth iron-based sintered permanent magnets of high performance, which predominantly comprise one or more rare earth metals, boron, and iron . . . and to a powder mixture for use in compaction to produce rare earth iron sintered permanent magnets by such a process." Ex. 1008, 1:5-10. Kishimoto further discloses the addition of "a small proportion of a lubricant . . . to the powder in order to ensure mobility of the alloy powder during compaction and facilitate mold release." *Id.* at 2:35-39. Kishimoto explains that if the mobility of the alloy powder is insufficient, "friction between the powder and the mold . . . may cause flaws, delaminations, or cracks to occur on the surface of the die or green compact," or may inhibit rotation of the powder that is "required to align the readily magnetizable axes of individual particles of the alloy powder along the direction of the applied magnetic field so as to develop magnetic anisotropy." *Id.* at 2:40-48.

2. Obviousness of Claim 15

Patent Owner directs no credible arguments specifically to dependent claim 15 with regard to the challenge for obviousness over Ohashi, Hasegawa, and Kishimoto. Instead, Patent Owner argues the purported deficiencies of Ohashi and Hasegawa that it argued with respect to independent claim 1, stating that Kishimoto does not make up for these deficiencies. PO Resp. 22. For the same reasons as described above, we are not persuaded of any deficiencies in the combination of Ohashi and Hasegawa in Petitioner's challenge.

Claim 15 depends from claim 1 and further recites "the step of adding a lubricant to the powder obtained in said pulverization step." Ex. 1001, 14:28-30. Petitioner alleges that claim 15 would have been obvious over the combination of Ohashi, Hasegawa, and Kishimoto. Pet. 26-28. Petitioner relies on the combination of Ohashi and Hasegawa for every element of claim 15, except for the recitation of "adding a *lubricant* to the powder obtained in said pulverization step." *Id.* at 27-28 (emphasis added). Petitioner argues that Kishimoto teaches that "before compaction 'a small proportion of a lubricant is normally added to the powder in order to ensure mobility of the alloy powder during compaction and facilitate mold release.'" *Id.* at 27 (quoting Ex. 1008, 2:35-40). Petitioner argues that "[o]ne of ordinary skill would have been motivated to add a lubricant taught by Kishimoto to the fine alloy powder taught in Ohashi and Hasegawa in order to

ensure the mobility of the alloy powder and assist in compaction." *Id.*; Ex. 1002 ¶ 95.

We credit Dr. Ormerod's testimony that Kishimoto teaches the limitations of dependent claim 15 and that one of skill in the art would have been motivated to modify the method of Ohashi and Hasegawa to add a lubricant as taught by Kishimoto, as outlined above. We are persuaded that Petitioner presents sufficient evidence, as outlined above, to support a conclusion that the combination of Ohashi, Hasegawa, and Kishimoto renders obvious the subject matter of dependent claim 15. After considering Petitioner's and Patent Owner's positions, as well as their supporting evidence, we conclude that Petitioner has demonstrated, by a preponderance of the evidence, that dependent claim 15 of the '765 patent would have been obvious over the combination of Ohashi, Hasegawa, and Kishimoto under 35 U.S.C. § 103(a).

III. CONCLUSION

We determine Petitioner has established, by a preponderance of the evidence, that claims 1-4, 14, and 16 are unpatentable under 35 U.S.C. § 103(a) as obvious over the combination of Ohashi and Hasegawa; claims 11 and 12 are unpatentable under 35 U.S.C. § 103(a) as obvious over the combination of Ohashi, Hasegawa, and Yamamoto; and claim 15 is unpatentable under 35 U.S.C. § 103(a) as obvious over the combination of Ohashi, Hasegawa, and Kishimoto.

IV. ORDER

For the reasons given, it is

ORDERED that claims 1-4, 11, 12, and 14-16 of the '765 patent have been shown by a preponderance of the evidence to be unpatentable.

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.

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APPENDIX C

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Paper No. 39
Filed: February 8, 2016

UNITED STATES PATENT
AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL
AND APPEAL BOARD

ALLIANCE OF RARE-EARTH PERMANENT
MAGNET INDUSTRY,
Petitioner,

v.

HITACHI METALS, LTD.,
Patent Owner.

Case IPR2014-01265
Patent 6,537,385 B2

Before MICHAEL P. TIERNEY, MICHELLE R. OSINSKI, and JO-ANNE M. KOKOSKI, *Administrative Patent Judges.*

OSINSKI, *Administrative Patent Judge.*

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

I. INTRODUCTION

A. Background

Alliance of Rare-Earth Permanent Magnet Industry ("Petitioner") filed a Corrected Petition (Paper 13, "Pet.") requesting an *inter partes* review of claims 1, 5, and 6 of U.S. Patent No. 6,537,385 B2 (Ex. 1001, "the '385 patent"). On February 13, 2015, pursuant to 35 U.S.C. § 314, we instituted an *inter partes* review of claims 1, 5, and 6 on the following grounds of unpatentability asserted by Petitioner:

Reference	Basis	Claims
Hasegawa[1] and Yamamoto[2]	§ 103(a)	1, 5, and 6
Ohashi[3] and Yamamoto	§ 103(a)	1, 5, and 6
He[4]	§ 102(b)	1
He and Yamamoto	§ 103(a)	5 and 6

Decision to Institute (Paper 17, "Dec. Inst."), 6, 19-20.

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[1] Hasegawa, JP 1993-283217 (published Oct. 29, 1993) ("Hasegawa," Ex. 1008 and Ex. 1004 (English translation)). Hasegawa is a Japanese language document. Unless indicated otherwise, all citations to Hasegawa in this decision will refer to its certified English language translation.

[2] Yamamoto et al., US 5,383,978 (issued Jan. 24, 1995) ("Yamamoto," Ex. 1007).

[3] Ohashi et al., US 4,992,234 (issued Feb. 12, 1991) ("Ohashi," Ex. 1005).

[4] Shuixiao He, *Rare Earth Permanent Magnet Milling Equipment—Jet Mill Closed Loop System*, 21 MAGNETIC MATERIALS AND PARTS, 48-51 (Oct. 1990) ("He," Ex. 1009 and Ex. 1006 (English translation)). He is a Chinese language document. Unless indicated otherwise, all citations to He in this decision will refer to its certified English language translation.

Hitachi Metals, Ltd. ("Patent Owner") filed a Patent Owner Response (Paper 26, "PO Resp."), and Petitioner filed a Reply (Paper 31, "Pet. Reply").

Petitioner relies on the Declaration of John Ormerod Ph.D. in support of its Petition (Ex. 1002). Patent Owner relies on the Declaration of Laura H. Lewis (Ex. 2002) in support of its Response. Petitioner refers to the deposition testimony of Dr. Lewis (Ex. 1010). Patent Owner refers to the deposition testimony of Dr. Ormerod (Ex. 2003).

We heard oral argument on November 6, 2015. A transcript is entered in the record as Paper 38 ("Tr.").

We have jurisdiction under 35 U.S.C. § 6(c). This Final Written Decision is issued pursuant to 35 U.S.C. § 318(a) and 37 C.F.R. § 42.73.

We determine Petitioner has shown by a preponderance of the evidence that claims 1, 5, and 6 of the '385 patent are unpatentable under 35 U.S.C. § 103(a).

B. Related Proceedings

Petitioner represents that the '385 patent was asserted in International Trade Commission Investigation No. 337-TA-855, which was terminated before adjudication of any validity issues. Pet. 5.

Patent Owner represents that *Inter Partes* Review No. IPR2014-01266 of U.S. Patent No. 6,491,765 B2

("the '765 patent")[5] also is related to this proceeding. Paper 12, 2.

C. The '385 Patent

The '385 patent relates to methods for manufacturing neodymium-iron-boron magnets, referred to as R—Fe—B type rare earth magnets. Ex. 1001, Abstr., 1:6-8, 1:15-18. The method includes a first step of coarsely pulverizing a material alloy to a size on the order of several hundred micrometers or less using a hydrogen embrittlement apparatus, and a second step of finely pulverizing the material alloy to an average particle size on the order of several micrometers with, for example, a jet mill. *Id.* at 1:24-34.

During the second pulverization step, super-fine powder that is rich in the rare earth element (R) (i.e., powder having a particle size of 1 μm or less) is produced. *Id.* at 2:18-22. These R-rich super-fine powder particles oxidize easily as compared to other particles such that "oxidation of the rare earth element vigorously proceeds during the manufacturing process steps." *Id.* at 2:28-30. The rare earth element, thus, is consumed by reacting with oxygen, and "the production amount of the $R_2T_{14}B$ crystal phase as the major phase decreases." *Id.* at 2:31-32. The result is a reduction in the coercive force and remanent flux density of the resultant magnet, and deterioration of the squareness of the demagnetization curve. *Id.* at 2:33-36.

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[5] The '385 patent is a divisional of the '765 patent. Ex. 1001.

In an effort to improve and stabilize the magnet properties even when a material alloy including an R-rich phase is used, the '385 patent describes the additional step of "removing at least part of [the] powder in which the concentration of the rare earth element is greater than the average concentration of the rare earth element contained in the entire powder, to reduce the average concentration of oxygen bound with the rare earth element contained in the powder." *Id.* at 3:20-26.

Table I of the '385 patent is reproduced below.

TABLE I

Sample No.	Percentage of super-fine powder (%)	IHc (kA/m)	Br (T)	Sinter density (g/cm^3)	Oxygen amount (ppm)
1	0.5	1,009	1.42	7.65	2,900
2	1.0	1,003	1.42	7.60	3,050
3	3.0	1,003	1.41	7.65	3,200
4	5.0	995	1.40	7.60	3,500
5	7.0	987	1.38	7.52	4,000
6	10.0	963	1.36	7.45	5,300
7	13.0	812	1.32	7.30	7,400
8	15.0	692	1.29	7.00	8,500

As reported in Table I above, oxygen increases, and coercive force iHc and residual magnetic flux density Br deteriorate, as the percentage of super-fine powder in the entire powder increases. *Id.* at 11:29-38. When the percentage of super-fine powder is 10.0% or less, excellent magnetic properties, including a coercive force iHc of 900 kA/m or more and a residual magnetic flux density Br of 1.35 T or more, are obtained. *Id.* at 11:39-44.

In a preferred embodiment, the molten material alloy is cooled by a strip casting method, which is a rapid cooling method. *Id.* at 1:38-39, 3:55-56. In a preferred embodiment, the material alloy is obtained by cooling a molten material alloy at a cooling rate in a range between 10^{2}° C/sec and 10^{4}° C/sec. *Id.* at 1:45-47, 3:51-54. Alloys prepared by rapid cooling methods, as compared to ingot casting methods (in which a molten alloy is poured into a mold and cooled comparatively slowly), have a fine structure, are small in grain size, have a wide area of grain boundaries, and have a good dispersion of the R-rich phase. *Id.* at 1:37-39, 1:64-2:4. Although the preferred embodiment is applied to a rapidly solidified alloy produced by a strip casting method, it also is applicable to an alloy produced by an ingot method. *Id.* at 12:24-29.

D. Illustrative Claim

Claim 1 is illustrative of the claimed subject matter, and is reproduced below.

> 1. A method for manufacturing alloy powder for R—Fe—B rare earth magnets, comprising a first pulverization step of coarsely pulverizing an R—Fe—B alloy for rare earth magnets produced by a rapid cooling method and a second pulverization step of finely pulverizing the material alloy,
>
> wherein said second pulverization step comprises a step of removing at least part of the powder in which the concentration of rare earth element is greater than the average concentration of rare earth element contained in the entire powder.

Ex. 1001, 13:19-30.

II. DISCUSSION

A. Claim Construction

In an *inter partes* review, claim terms in an unexpired patent are interpreted according to their broadest reasonable construction in light of the specification of the patent in which they appear. 37 C.F.R. § 100(b); *see 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*, 84 U.S.L.W. 3218 (Jan. 15, 2016) (No. 15446). Claim terms are given their ordinary and customary meaning as understood by one of ordinary skill in the art in the context of the entire disclosure. *In re Translogic Tech., Inc.*, 504 F.3d 1249, 1257 (Fed. Cir. 2007).

In the Decision to Institute, we interpreted "concentration of rare earth element" as "the amount of rare earth element in a powder in comparison to the amount of all the elements in the powder." Dec. Inst. 7. The parties do not dispute this interpretation in the Patent Owner Response or in the Petitioner Reply. We adopt the above claim construction based on our previous analysis, and see no reason to deviate from that construction for purposes of this Decision.

The interpretation of the claim term "rapid cooling method" is relevant to our analysis for the Final Written Decision. Patent Owner urges that "one of ordinary skill in the art would understand the ordinary and customary meaning of 'rapid cooling method' to refer to a cooling mechanism different and faster than ingot casting, but not cooled so fast that it exceeds rapid cooling and enters the domain of super-rapid cooling." PO Resp. 8 (citing Ex. 2002 ¶¶ 81-82). Patent Owner contends that this proposed interpretation is consistent with the Specification of the '385 patent, including dependent claims 5 and 6, as well as the ordinary and customary usage of the term. *Id.* Patent Owner's expert points to the language of the Specification stating that "a rapidly cooled method" is "typified by a strip casting method and a centrifugal casting method." Ex. 2002 ¶ 81 (quoting Ex. 1001, 1:35-40). We conclude that such language indicates only that strip casting and centrifugal casting are typical *examples* of rapid cooling methods or *exemplify* rapid cooling methods, not that rapid cooling methods necessarily exclude super-rapid cooling methods.

Petitioner contends that the term "rapid cooling method" should be construed as a cooling method in which "a molten material alloy is put into contact with a single chill roll, twin chill rolls, a rotary chill disk, a rotary cylindrical chill mold, or the like, to be rapidly cooled thereby producing a solidified alloy thinner than an ingot cast alloy.'" Pet. Reply 6 (quoting Ex. 1001, 1:41-45). Petitioner contends that such a construction comports with the clear definition set forth in the Specification. *Id.* at 3. Petitioner further argues that the doctrine of claim differentiation supports Petitioner's proposed construction in that dependent claim 5 "specifically recites cooling the alloy material at a rate 'in the range between 10^{2}°C/sec and 10^{4}°C/sec'" such that the rapid cooling method of claim 1 must include cooling rates outside of this range. *Id.* at 4 (citing Ex. 1001, 14:1-5). We agree with Petitioner. The additional language of the Specification stating that "[i]n a preferred embodiment, the material alloy for rare earth magnets is obtained by cooling a molten material alloy at a cooling rate in a range between 10^{2}°C./sec and 10^{4}°C./sec" (Ex. 1001, 3:51-54), along with the same language appearing in dependent claim 5, supports that rapid cooling methods can encompass a broader range of cooling rates such that the reference to the particular range was necessary to ensure specific protection directed to a narrower and preferred range of cooling rates.[6]

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[6] If the upper limit of rapid cooling methods were understood by those of ordinary skill in the art to be limited to "something close to 10,000 degrees Celsius per second" as argued by Patent

We adopt Petitioner's proposed construction for a "rapid cooling method" as "a cooling method in which a molten material alloy is put into contact with a single chill roll, twin chill rolls, a rotary chill disk, a rotary cylindrical chill mold, or the like, to be rapidly cooled thereby producing a solidified alloy thinner than an ingot cast alloy."

B. Obviousness of Claims 1, 5, and 6 over Hasegawa and Yamamoto

1. Overview of Hasegawa

Hasegawa discloses that an alloy used to make rare-earth magnets is generally obtained by conventional powder metallurgy. Ex. 1004 ¶ 2. Hasegawa further discloses that melted cast ingots of rare-earth magnets have a multi-phase crystal structure including a main phase $R_2Fe_{14}B$, and an Nd-rich (i.e., rare earth-rich) phase. *Id.* ¶ 3. In Hasegawa, melted cast ingot is pulverized using mechanical pulverization techniques or a method that "involves causing hydrogen to be absorbed into the melted cast ingot of a rare-earth-iron-boron based magnet and allowing disintegration

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Owner, reference to such an upper limit as a preferred embodiment and in dependent claim 5 would appear to be superfluous. *See* Tr. 70:8-11. We have also considered the statement in the Specification that "[i]n the rapid cooling method, the molten alloy is cooled at a rate in the range between 10[]^{2}°C./sec and 10^{4}°C./sec" (Ex. 1001, 1:45-47), but, in the context of the entire Specification, we consider this to be a statement of a particular cooling rate in accordance with the invention, rather than an express definition clearly and deliberately limiting the term "rapid cooling" to a particular cooling rate.

to occur to produce a coarse powder." *Id.* Hydrogen pulverization can produce pulverized powder in about one-fourth of the time of mechanical pulverization and can also cause the rare-earth rich phase to be more easily pulverized. *Id.* After coarse pulverization by mechanical or hydrogen pulverization, the powder is then finely pulverized using a jet mill. *Id.*

Hasegawa further discloses that the rare earth-rich phase oxidizes more readily than the main phase, and that if the rare earth-rich phase is excessively pulverized, a magnet obtained from such a fine powder may include excessive oxide phase and lack good magnetic properties. *Id.* To combat this known problem, Hasegawa discloses that wind power is used to remove R-rich phase fine powder during a particle classification step following pulverization. *Id.* ¶ 4; Ex. 1002 ¶ 66. The remaining powder having lower concentrations of rare earth is compacted compressively, sintered, and heat-treated. Ex. 1004 ¶ 4. The method allows rare earth-iron-boron magnets of high coercivity and high energy product to be obtained by using "classifiers that employ wind power to remove Nd-rich phase [(i.e., rare earth rich phase)] that includes large quantities of oxygen due to excessive pulverization and thus improve sinterability and reduce the oxide phase that is present at the grain boundaries." *Id.* ¶ 5.

2. Overview of Yamamoto

Yamamoto discloses that "[p]ermanent magnet alloy ingots are generally produced by a metal mold

casting method consisting in casting molten alloy in a metal mold." Ex. 1007, 1:15-17. Yamamoto also discloses a method for producing a rare earth metal magnet alloy by "a strip casting system combined with a twin roll, a single roll, a twin belt or the like." *Id.* at 1:59-61. Yamamoto states that "an ingot produced by this method has a composition more uniform than that obtained with the metal mold casting method," but that sufficient improvement has not yet been seen. *Id.* at 1:62-2:3. Yamamoto further discloses "melting a rare earth metal-iron alloy to obtain a molten alloy and solidifying the molten alloy uniformly at a cooling rate of 10 to 1000° C./sec." *Id.* at 2:34-36.

3. Obviousness of Claims 1, 5, and 6

a. Claim 1

Petitioner alleges that independent claim 1 would have been obvious over the combination of Hasegawa and Yamamoto. Pet. 17-20. Petitioner relies on Hasegawa for every element of independent claim 1, except for the recitation of "an R—Fe—B alloy for rare earth magnets produced by a *rapid cooling method.*" *Id.* at 18 (emphasis added). Petitioner argues that Yamamoto teaches "a rapid cooling (strip cast) method in making a strip cast R—Fe—B material alloy more uniformly that is pulverized into magnet powder." *Id.* at 17 (citing Ex. 1007, Abstr., 1:8-14, 2:32-37). Patent Owner does not dispute that Hasegawa teaches every element of independent claim 1 except for the alloy being

produced by a rapid cooling method, nor that Yamamoto teaches a rapid cooling method. *See* PO Resp. 9-20.

Petitioner argues that "[o]ne of ordinary skill would have been motivated to use the R—Fe—B material alloy formed by the rapid cooling method taught by Yamamoto with the pulverization techniques taught by Hasegawa in order to pulverize a more uniform R—Fe—B material alloy." *Id.* (citing Ex. 1002 ¶ 59) (emphasis omitted). Petitioner further argues that "one of o[r]dinary skill knows that material alloys produced by either the ingot or strip cast methods produce R-rich superfine powder (particles 1 μm or less), which are removed and taught in Hasegawa." *Id.* (citing Ex. 1001, 12:24-29; Ex. 1002 ¶¶ 34-35, 51-52, 59, Illustration 8) (emphasis omitted). *Id.* Petitioner also provides expert testimony that "one of ordinary skill would have been motivated to combine these prior art teachings of *Hasegawa* and *Yamamoto* according to known methods to yield predictable results. Such a modification would have been obvious because it would have involved the use of known techniques to improve a similar method." Ex. 1002 ¶ 64 (*cited at* Pet. 18).

Patent Owner counters that one of ordinary skill in the art would not have been motivated to combine the teachings of Hasegawa and Yamamoto to arrive at the claimed invention. PO Resp. 10-20. Patent Owner does not appear to dispute Petitioner's contention that strip casting would result in a more uniform alloy. In particular, Patent Owner acknowledges that utilizing a rapid cooling method generates an alloy

with the R-rich phase distributed *uniformly* along the boundaries of columnar $R_2Fe_{14}B$ grains having a mean width of about 5-25 μm, as compared to an alloy generated by ingot casting which results in *randomly* dispersed regions of R-rich phase and α-Fe dendrites with columnar $R_2Fe_{14}B$ grains having a mean width of about 50-50 μm. *Id.* at 11 (citing Ex. 2005, 476).

Patent Owner, however, does dispute that generating a more uniform alloy would motivate a person of ordinary skill in the art to utilize a rapid cooling method in connection with the pulverization process of Hasegawa. PO Resp. 10-20. Patent Owner elaborates that the more uniform composition of a strip cast alloy, as compared to an ingot cast alloy, would result in a smaller average particle size and a powder distribution that is relatively uniform in particle size and shape during hydrogen pulverization. *Id.* at 12-13 (citing Ex. 2002 ¶ 41; Ex. 2006, 4). Patent Owner recognizes that "finely milled $R_2Fe_{14}B$ phase particles [on the order of 1-5 μm] improve the density of the magnet, thereby positively impacting the magnetic resonance and coercivity as well as the mechanical integrity of the final magnet," but explains that more finely milled particles would then have to be removed as part of Hasegawa's particle classification step, thereby resulting in a significantly diminished yield. *Id.* at 16-17 (citing Ex. 2002 ¶ 93). Patent Owner argues that Petitioner "fail[ed] to consider the[ ] consequences of changing *Hasegawa's* starting alloy." *Id.* at 18.

Petitioner has shown, and Patent Owner has not disputed, that the claimed elements (i.e., steps) are

known in the art, albeit not combined in a single reference, and are used for their known purpose. Pet. 18-20; *see* Tr. 77:8-19. We are persuaded that Petitioner has shown that a person of ordinary skill in the art would have known how to combine Yamamoto's rapid cooling method (in place of Hasegawa's ingot casting method) with Hasegawa's pulverization and particle classification technique using known methods. *See* Ex. 1002 ¶ 35 ("Rare earth elements . . . are collected and are melted together to form a cast alloy using known techniques to one of ordinary skill such as the ingot cast method or a strip cast method."); *see also* Ex. 1001, 1:36-45, 12: 24-29 (referring to material alloy being produced by two types of methods—ingot casting and rapid cooling—and stating that the present invention was applicable to both an ingot method and a rapid cooling method); Ex. 1002 ¶ 51 ("The ingot or strip cast methods are interchangeable to those skilled in the art."). Petitioner has also shown sufficiently that a person of ordinary skill in the art would have recognized the results of the combination to be predictable. Ex. 1002 ¶ 64; *see also* Pet. Reply 13 (citing Ex. 2011, 2) ("[Petitioner] agrees with [Patent Owner] that a person of ordinary skill would have known that a hydrogen pulverized strip cast alloy has a narrower particle size and shape distribution in comparison to a typical ingot cast alloy. . . . [A] person of ordinary skill would have known to adjust basic, fundamental jet milling settings to accommodate the uniform particle size and shape distribution of the strip cast alloy.")).

Patent Owner argues that "the problem with the combination is that the predictable result says that, for example, in the case of the Hasegawa/Yamamoto combination, you are going to throw out 50 percent of your powder." Tr. 77:23-78:2. Patent Owner argues that one with ordinary skill in the art, for various considerations, such as diminished yield, would not have implemented a rapid cooling method in connection with Hasegawa's pulverization and particle classification techniques. PO Resp. 10-20. Whether implementation of Yamamoto's rapid cooling method makes commercial sense does not control the obviousness determination. The challenged claims are not limited to an industrial scale economically viable process. Specifically, the claims do not recite a minimum required yield that would distinguish the prior art teachings. Patent Owner has not provided persuasive reasoning or evidence to support its contention that one of skill believed there to be some technological incompatibility that prevented the combination of Yamamoto's rapid cooling method with Hasegawa's pulverization and particle classification techniques; that the combination was unpredictable in some way; or that one with ordinary skill in the art would not have known how to use Yamamoto's rapid cooling method with Hasegawa's pulverization and particle classification techniques. *See Orthopedic Equip. Co. v. United States*, 702 F.2d 1005, 1013 (Fed. Cir. 1983) ("[T]he fact that the two [prior art disclosures] would not be combined by businessmen for economic reasons is not the same as saying that it could not be done because skilled persons in the art felt that there was some technological

incompatibility that prevented their combination. Only the latter fact is telling on the issue of nonobviousness.").

We appreciate Patent Owner's argument that "an invention 'composed of several elements is not proved obvious merely by demonstrating that each of its elements was, independently, known in the prior art." PO Resp. 19 (citing *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 418 (2007)). Petitioner, however, has set forth a sufficient rationale to arrive at what is claimed. Specifically, Petitioner has demonstrated that the claims represent the combination of prior art elements according to known methods to yield a predictable result. *See KSR*, 550 U.S. at 416 ("The combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results."). This is itself a sufficient reason with rational underpinning to support a conclusion of obviousness. This is especially true where the evidence supports that consideration of design incentives, such as the provision of a "lower cost, more productive [process] better suited for higher volume manufacturing" would have led one of ordinary skill to pursue the predictable combination of elements. Pet. Reply 15 (citing Ex. 2003, 109:10-20).

After considering Petitioner's and Patent Owner's positions, as well as their supporting evidence, we conclude that Petitioner has demonstrated, by a preponderance of the evidence, that independent claim 1 of the '385 patent would have been obvious over the

combination of Hasegawa and Yamamoto under 35 U.S.C. § 103(a).

b. Claims 5 and 6

Claim 5 depends from claim 1, and further includes "the step of producing the R—Fe—B alloy for rare earth magnets by cooling a molten material alloy at a cooling rate in a range between 10^2°C./sec and 10^4°C./sec." Ex. 1001, 14:1-4. Claim 6 depends from claim 5 and further recites that "the molten material alloy is cooled by a strip casting method." *Id.* at 14:5-6. With respect to claim 5, Petitioner argues that Yamamoto teaches solidifying a molten alloy uniformly at a cooling rate of 10 to 1000 °C/second. Pet. 20 (citing Ex. 1007, Abstr., 2: 32-37; Ex. 1002 ¶¶ 59, 71). With respect to claim 6, Petitioner argues that Yamamoto teaches " . . . a system for producing a permanent magnet alloy ingot by a strip casting method using a single roll." *Id.* at 21 (quoting Ex. 1007, 6: 16-29); *see also* Ex. 1007, Fig. 1; Ex. 1002 ¶¶ 72-73 (explaining that Yamamoto teaches that molten alloy is solidified under cooling conditions).

Petitioner provides expert testimony that "one of ordinary skill would have been motivated to combine these prior art teachings of *Hasegawa* and *Yamamoto* according to known methods to yield predictable results. Such a modification also would have been obvious because it would have involved the use of known techniques to improve a similar method." Ex. 1002 ¶ 71 (*cited at* Pet. 20).

Patent Owner does not dispute that Yamamoto teaches the claimed cooling rate range, nor cooling by a strip casting method. *See* PO Resp. 9-20. Patent Owner instead relies on the same argument that one of ordinary skill in the art would not be motivated to combine the rapid cooling method of Yamamoto with Hasegawa's pulverization and particle classification techniques as it did with respect to claim 1. *Id.* at 20. For the same reasons as described above in connection with independent claim 1, we determine that Petitioner has provided articulated reasoning with rational underpinning for combining the references based on the combination of prior art elements according to known methods to yield a predictable result.

After considering Petitioner's and Patent Owner's positions, as well as their supporting evidence, we conclude that Petitioner has demonstrated, by a preponderance of the evidence, that claims 5 and 6 of the '385 patent would have been obvious over the combination of Hasegawa and Yamamoto under 35 U.S.C. § 103(a).

C. Obviousness of Claims 1, 5, and 6 over Ohashi and Yamamoto

1. Overview of Ohashi

Ohashi discloses a method for the preparation of a permanent magnet composed of a rare earth element, iron, and boron. Ex. 1005, 1:6-16. Ohashi discloses rough pulverization of an alloy ingot via various types of pulverizing machines, such as stamp mills, jaw crushers, Braun mills, and the like, and fine

pulverization via jet mills, ball mills, and the like. *Id.* at 4:38-46. Ohashi recognizes that "a magnetic alloy powder containing extremely fine particles are highly susceptible to the oxidation by the atmospheric oxygen," (*id.* at 3:41-43), and discloses that "the alloy under pulverization is strictly prevented against oxidation by the atmospheric oxygen by conducting the pulverization in an atmosphere of a non-oxidizing or inert gas such as nitrogen, argon and the like" (*id.* at 4:46-50).

Ohashi further discloses "particle size classification of the alloy powder for compression molding into a powder compact to be sintered, by which particles having a finer particle diameter . . . are removed so as to effectively prevent oxidation of the too fine particles." *Id.* at Abstr. Ohashi discloses that particle classification can be conducted using "screens of an appropriate mesh opening, rotative force, air stream and the like as well as a combination of these different principles." *Id.* at 5:1-4. Ohashi discloses removing particles having a diameter smaller than 2 μm from the alloy powder. *Id.* at 2:45-46, 4:19-22, 4:64-67. Ohashi also discloses that "[i]t is important that the volume fraction of the fine particles having a diameter smaller than 2 μm in the alloy powder after the particle size classification does not exceed 1% or, preferably, 0.5%." *Id.* at 5:50-53.

2. Obviousness of Claims 1, 5, and 6

a. Claim 1

Petitioner alleges that independent claim 1 would have been obvious over the combined disclosures of Ohashi and Yamamoto. Pet. 21-25. Petitioner relies on Ohashi for every element of independent claim 1 except for the recitation of "an R—Fe—B alloy for rare earth magnets produced by a *rapid cooling method.*" *Id.* at 21 (emphasis added). Petitioner relies on the same teachings in Yamamoto relating to a rapid cooling method and the same reasoning for combining Ohashi and Yamamoto as that for combining Hasegawa and Yamamoto as described above. *Id.* at 21-23 (citing Ex. 1001, 12:24-29, Ex. 1002 ¶¶ 34-35, 51-52, 74, 76-78, Illustration 8). Patent Owner does not dispute that Ohashi teaches every element of independent claim 1 except for the alloy being produced by a rapid cooling method, nor that Yamamoto teaches a rapid cooling method. PO Resp. 21-29.

Patent Owner again argues that Petitioner fails to weigh the advantages and disadvantages of using a rapid cooling method to produce a more uniform alloy and that one of ordinary skill in the art would not utilize Yamamoto's strip casting method with the pulverization and particle classification techniques of Ohashi. *Id.* at 28-29. For the same reasons as described above in connection with the challenge based on the combination of Hasegawa and Yamamoto, Patent Owner's arguments do not persuasively rebut Petitioner's rationale relating to the combination of prior

art elements according to known methods to yield a predictable result in light of design incentives that would have prompted one of ordinary skill in the art to pursue the predictable combination. Pet. 23 (citing Ex. 1002 ¶ 78); Pet. Reply 15 (citing Ex. 2003, 109:10-20).

Petitioner has shown, and Patent Owner has not disputed, that the claimed elements (i.e., steps) are known in the art, albeit not combined in a single reference, and are used for their known purpose. *Id.* at 22-25; *see* Tr. 77:8-19. Petitioner has shown sufficiently that a person of ordinary skill in the art would have known how to combine Yamamoto's rapid cooling method with Ohashi's pulverization and particle classification technique using known methods. *See* Ex. 1002 ¶ 35 ("Rare earth elements . . . are collected and are melted together to form a cast alloy using known techniques to one of ordinary skill such as the ingot cast method or a strip cast method."); *see also* Ex. 1001, 1:36-45, 12: 24-29 (referring to material alloy being produced by two types of methods—ingot casting and rapid cooling—and stating that the present invention was applicable to both an ingot method and a rapid cooling method); *see also* Ex. 1002 ¶ 51 ("The ingot or strip cast methods are interchangeable to those skilled in the art."). Petitioner has also shown sufficiently that a person of ordinary skill in the art would have recognized the results of the combination to be predictable. Ex. 1002 ¶ 78; *see also* Pet. Reply 13 (citing Ex. 2011, 2) ("[Petitioner] agrees with [Patent Owner] that a person of ordinary skill would have known that a hydrogen pulverized strip cast alloy has a narrower particle

size and shape distribution in comparison to a typical ingot cast alloy. . . . [A] person of ordinary skill would have known to adjust basic, fundamental jet milling settings to accommodate the uniform particle size and shape distribution of the strip cast alloy.")). Petitioner also provides evidence of design incentives that would have prompted one of ordinary skill in the art to pursue the predictable combination. Pet. Reply 15 (citing Ex. 2003, 109:10-20).

After considering Petitioner's and Patent Owner's positions, as well as their supporting evidence, we conclude that Petitioner has demonstrated, by a preponderance of the evidence, that independent claim 1 of the '385 patent would have been obvious over the combination of Ohashi and Yamamoto under 35 U.S.C. § 103(a).

b. Claims 5 and 6

With respect to dependent claim 5, Petitioner argues that Yamamoto teaches solidifying a molten alloy uniformly at a cooling rate of 10 to 1000 °C/second. Pet. 24 (citing Ex. 1007, Abstr., 2: 32-37; Ex. 1002 ¶ 82). With respect to dependent claim 6, Petitioner argues that Yamamoto teaches " . . . a system for producing a permanent magnet alloy ingot by a strip casting method using a single roll." *Id.* at 24-25 (quoting Ex. 1007, 6: 16-29); *see also* Ex. 1007, Fig. 1; Ex. 1002 ¶ 83 (explaining that Yamamoto teaches that molten alloy is solidified under cooling conditions).

Petitioner provides expert testimony that "one of ordinary skill would have been motivated to combine these prior art teachings of *Ohashi* and *Yamamoto* according to known methods to yield predictable results. Such a modification also would have been obvious because it would have involved the use of known techniques to improve a similar method." Ex. 1002 ¶ 82 (*cited at* Pet. 24).

Patent Owner does not dispute that Yamamoto teaches the claimed cooling rate range, nor cooling by a strip casting method. *See* PO Resp. 21-29. Patent Owner, instead, relies on the argument that one of ordinary skill in the art would not be motivated to combine the rapid cooling method of Yamamoto with Ohashi's pulverization and particle classification techniques. *Id.* at 29. For the same reasons as described above in connection with independent claim 1, we determine that Petitioner has provided articulated reasoning with rational underpinning for combining the references based on the combination of prior art elements according to known methods to yield a predictable result.

After considering Petitioner's and Patent Owner's positions, as well as their supporting evidence, we conclude that Petitioner has demonstrated, by a preponderance of the evidence, that dependent claims 5 and 6 of the '385 patent would have been obvious over the combined teachings of Ohashi and Yamamoto under 35 U.S.C. § 103(a).

D. Anticipation of Claim 1 by He

1. Overview of He

He discloses that "crude rare earth permanent magnet materials [can be] made from smelting method or quick quenching or reduction diffusion." Ex. 1006, 49. He further discloses that NdFeB material for rare earth permanent magnets can be made by crushing ingots into crude granules with hydrogen burst processing. *Id.* He discloses that the crude materials can be made finer in a milling compartment and then can be transferred to the separator. *Id.* He discloses that qualified fine powders can be separated and enter the cyclone separating device for settling, and ultra-fine powders that cannot be settled enter a filter with gas and are separated and collected. *Id.* at 49-50. He discloses that "[a]s far as rare earth permanent magnet powders are concerned, the normal ultra fine particles should have a granularity of less than 1 μm and their weight should be about 0.1% of the qualified powders." *Id.*

2. Anticipation of Claim 1

Petitioner alleges that independent claim 1 is anticipated by He. Pet. 25-28. Patent Owner argues only that He fails to disclose a rapid cooling method. PO Resp. 29-33. Petitioner asserts that He's reference to quick quenching meets the claim limitation that the "R—Fe—B alloy for rare earth magnets [are] produced by a rapid cooling method." Pet. 26 (citing Ex. 1006, 49; Ex. 1002 ¶ 87). According to Petitioner "quick

quenching is rapid cooling as understood by one of ordi[na]ry skill." Ex. 1002 ¶ 87.

Patent Owner argues that Petitioner's conclusory assertion regarding the equivalence of quick quenching and rapid cooling should be given little weight and that "the evidence suggests that 'quick quenching' does *not* encompass strip casting." PO Resp. 31. In particular, Patent Owner argues that strip casting was not commercially available as of He's publication date and that quick quenching most likely refers to "'melt spinning' which has '[c]ooling rates *in excess of* 10^6 *K* s^{-1}' according to Dr. Ormerod's 1989 publication." *Id.* at 31-32 (citing Ex. 2004, 245; Ex. 2013; Ex. 2014, 38).

We need not decide whether quick quenching refers specifically to strip casting. We need only decide whether quick quenching discloses a "rapid cooling method" as that claim term as been construed for purposes of this proceeding.[7] Patent Owner's first argument that *strip casting* in particular was not commercially available as of He's publication date is not persuasive evidence that He's quick quenching cannot be rapid cooling, because rapid cooling is not

[7] As discussed above, we have determined the broadest reasonable interpretation of the claim term "rapid cooling method" is "a cooling method in which a molten material alloy is put into contact with a single chill roll, twin chill rolls, a rotary chill disk, a rotary cylindrical chill mold, or the like, to be rapidly cooled thereby producing a solidified alloy thinner than an ingot cast alloy." Such a construction does not limit a "rapid cooling method" to a strip casting method.

limited to strip casting in accordance with our construction of that term.

Patent Owner's second argument that He's quick quenching likely refers to melt spinning is also not persuasive evidence that He's quick quenching cannot be rapid cooling. In support of this argument, Patent Owner presented evidence that"[m]elt spinning consists of melting the alloy. . . . The melt . . . is sprayed . . . on to a rotating water cooled copper wheel or disc. Cooling rates in excess of 10^6 K s^{-1} are obtained." PO Resp. 8 (citing Ex. 2004, 245), 32; Ex. 2002 ¶ 85 ("[M]elt spinning . . . is a process in which the molten alloy is ejected onto a rapidly spinning wheel to cool at rates on the order of 10^5-10^7 degrees per second and form ribbons of nanocrystalline material."). According to Patent Owner, that rate of cooling is higher "than the maximum cooling rate" described in the '385 patent. *Id.* at 32. As set forth above, however, we do not agree with Patent Owner that "rapid cooling method" as used in claim 1 is limited to a particular cooling rate. Instead, we are persuaded that this evidence shows that melt spinning does meet the "rapid cooling method" limitation as we have construed it, because it describes a molten material being rapidly cooled to produce a solidified alloy thinner than an ingot cast alloy through contact with a rotary chill disk.

In addition to the evidence in the record supporting that quick quenching is melt spinning, and melt spinning is a process that comports with the construction of a "rapid cooling method" (Ex. 2002 ¶ 85; Ex. 2004, 245), Petitioner also presented expert testimony

that He's reference to quick quenching would be understood by one of ordinary skill in the art to be rapid cooling. Pet. Reply 23 (citing Ex. 1002 ¶ 87; Ex. 2003, 114:16-18). Accordingly, we find sufficient evidence in the record to support that quick quenching discloses a rapid cooling method in accordance with the broadest reasonable interpretation of the term "rapid cooling method."

After considering Petitioner's and Patent Owner's positions, as well as their supporting evidence, we conclude that Petitioner has demonstrated, by a preponderance of the evidence, that independent claim 1 of the '385 patent is anticipated by He under 35 U.S.C. § 102(b).

E. Obviousness of Claims 5 and 6 over He and Yamamoto

With respect to dependent claim 5, Petitioner argues that Yamamoto teaches solidifying a molten alloy uniformly at a cooling rate of 10 to 1000 °C/second. Pet. 29 (citing Ex. 1007, Abstr., 2: 32-37; Ex. 1002 ¶ 93). With respect to dependent claim 6, Petitioner argues that Yamamoto teaches " . . . a system for producing a permanent magnet alloy ingot by a strip casting method using a single roll." *Id.* (quoting Ex. 1007, 6: 16-29); *see also* Ex. 1007, Fig. 1; Ex. 1002 ¶ 94 (explaining that Yamamoto teaches that molten alloy is solidified under cooling conditions).

Petitioner argues that "[o]ne of ordinary skill would have been motivated to use a material alloy

formed by the rapid cooling method taught by Yamamoto with the pulverization techniques taught by He that also teaches a material alloy formed by rapid cooling in order to pulverize a more uniform material alloy." *Id.* at 28 (emphasis omitted). Petitioner also provides expert testimony that "one of ordinary skill would have been motivated to combine these prior art teachings of [*He*] and *Yamamoto* according to known methods to yield predictable results. Such a modification also would have been obvious because it would have involved the use of known techniques to improve a similar method." Ex. 1002 ¶ 93 (*cited at* Pet. 29).[8]

Patent Owner does not dispute that Yamamoto teaches the claimed cooling rate range, nor cooling by a strip casting method. *See* PO Resp. 33-37. Patent Owner counters that one of ordinary skill in the art would not have been motivated to combine the teachings of He and Yamamoto to arrive at the claimed invention for the stated reason of pulverizing a more uniform alloy. PO Resp. 36-37. In particular, Patent Owner disputes that modifying He's quick quenching method to utilize the claimed cooling rate range of 10^2°C./sec and 10^4°C./sec would result in a more uniform alloy. Patent Owner argues that "replacing *He's* 'quick quenching' with the slower cooling methods

[8] We consider Petitioner's reference to "Hasegawa" instead of "He" in the quoted portion of paragraph 93 of Exhibit 1002 to be an inadvertent typographical error. Taken in context, in which Heading "C" refers to "He" (Ex. 1002, 45), subheading "2" refers to "*He* in view of *Yamamoto*" (*id.* at 50), and the remainder of paragraph 93 refers to "He" (*id.* at 51), we consider Petitioner clearly to have intended to refer to "He," not "Hasegawa."

disclosed in *Yamamoto* would actually result in a *less homogeneous material alloy.*" *Id.* at 36 (citing Ex. 2015, Fig. 9).

Petitioner responds that Patent Owner's argument "is based on the assumption that He's disclosure of 'quick quenching' refers to melt-spinning," but He does not refer to melt-spinning. Pet. Reply 24. Even if we were to agree with Petitioner that He does not necessarily refer to melt-spinning, we are not persuaded that Petitioner has explained sufficiently how utilizing Yamamoto's particular cooling rate would result in a more uniform alloy, considering the lack of explanation by Petitioner regarding how Yamamoto's cooling rate would differ from that already provided by He's quick quenching. Petitioner further responds that even if He were referring to melt-spinning, "[Patent Owner] disregards the fact that strip casting was a well-known, highly advantageous process at the time of the invention." *Id.* Even if we were to agree with Petitioner that strip casting provides certain advantages, this does not support provide evidentiary support for Petitioner's *articulated* rationale of pulverizing a more uniform alloy as set forth in its Petition. We are persuaded by Patent Owner's argument and determine that Petitioner's first articulated rationale, namely, producing a more uniform alloy for pulverization, lacks evidentiary rational underpinning.

Petitioner, however, has also supported its conclusion of obviousness based on the combination of prior art elements according to known methods to yield a predictable result. Pet. 29 (citing Ex. 1002 ¶ 93).

Petitioner has shown, and Patent Owner has not disputed, that the claimed elements (i.e., steps) are known in the art, albeit not combined in a single reference, and are used for their known purpose. Pet. 25-29; *see* Tr. 77:8-19. We are persuaded that Petitioner has shown that a person of ordinary skill in the art would have known how to combine He's quick quenching with Yamamoto's particular cooling range of 10^2°C./sec to 10^4°C./sec and Yamamoto's strip casting method using known methods and would have recognized the results of the combination to be predictable. *See* Ex. 1002 ¶ 93; Pet. Reply 24 (citing Ex. 2005, 1) (describing strip casting as "similar to melt spinning"). Petitioner also provides evidence that one of ordinary skill in the art would have pursued the predictable combination. Pet. Reply 24 (citing Ex. 2003, 108:14-19) (explaining that even when melt-spinning and strip casting were both well-known, most high-volume manufacturers utilized strip casting). We determine that Petitioner has provided articulated reasoning with rational underpinning for combining the references based on the combination of prior art elements according to known methods to yield a predictable result.

After considering Petitioner's and Patent Owner's positions, as well as their supporting evidence, we conclude that Petitioner has demonstrated, by a preponderance of the evidence, that dependent claims 5 and 6 of the '385 patent would have been obvious over the combined teachings of He and Yamamoto under 35 U.S.C. § 103(a).

III. CONCLUSION

We determine Petitioner has established by a preponderance of the evidence that: claims 1, 5, and 6 are unpatentable under 35 U.S.C. § 103(a) as obvious over the combination of Hasegawa and Yamamoto; claims 1, 5, and 6 are unpatentable under 35 U.S.C. § 103(a) as obvious over the combination of Ohashi and Yamamoto; claim 1 is unpatentable under 35 U.S.C. § 102(b) as anticipated by He; and claims 5 and 6 are unpatentable under 35 U.S.C. § 103(a) as obvious over the combination of He and Yamamoto.

IV. ORDER

In consideration of the foregoing, it is:

ORDERED that claims 1, 5, and 6 of the '385 patent have been shown by a preponderance of the evidence to be unpatentable.

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.

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APPENDIX D

NOTE: This order is nonprecedential.

United States Court of Appeals for the Federal Circuit

HITACHI METALS, LTD.,
Appellant

v.

ALLIANCE OF RARE-EARTH PERMANENT MAGNET INDUSTRY,
Appellee

2016-1824, 2016-1825

Appeals from the United States Patent and Trademark Office, Patent Trial and Appeal Board in Nos. IPR2014-01265, IPR2014-01266.

ON PETITION FOR PANEL REHEARING

Before LOURIE, TARANTO, and CHEN, *Circuit Judges.*

PER CURIAM.

ORDER

Appellant Hitachi Metals, Ltd. filed a petition for panel rehearing.

Upon consideration thereof,

IT IS ORDERED THAT:

The petition for panel rehearing is denied.

The mandate of the court will issue on August 30, 2017.

FOR THE COURT

August 23, 2017
Date

/s/ Peter R. Marksteiner
Peter R. Marksteiner
Clerk of Court