Trials@uspto.gov
Tel: 571-272-7822

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.

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

---

[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).

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

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

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.

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	10.0	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 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. 15-446). 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 Int'l 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

[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.

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 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 non-obviousness 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.

FOR PETITIONER:

Michael S. Connor
Haiou Qin
Christopher B. Kelly
H. James Abe
ALSTON & BIRD LLP
mike.connor@alston.com
haiou.qin@alston.com
chris.kelly@alston.com
james.abe@alston.com

FOR PATENT OWNER:

Mehran Arjomand
Robert J. Hollingshead
Curt Lowry
Akira Irie
MORRISON & FOERSTER LLP
marjomand@mofo.com
rhollingshead@mofo.com
clowry@mofo.com
airie@mofo.com