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Paper 45
Entered: February 22, 2018

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 MICHELLE R. OSINSKI, SUSAN L. C. MITCHELL, and JO-ANNE M. KOKOSKI, *Administrative Patent Judges.*

OSINSKI, *Administrative Patent Judge*.

DECISION ON REMAND
35 U.S.C. § 144 and 37 C.F.R. § 42.5(a)

I. INTRODUCTION

A. Background

We address this case on remand after a decision by the U.S. Court of Appeals for the Federal Circuit in *Hitachi Metals, Ltd. v. Alliance of Rare-Earth Permanent Magnet Industry*, 699 F. App'x 929 (Fed. Cir. 2017) ("*Hitachi*").

As 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.

[1] Ohashi et al., US Patent No. 4,992,234 (issued Feb. 12, 1991) (Ex. 1004, "Ohashi").
[2] Hasegawa, JP 1993-283217 (published Oct. 29, 1993) (Ex. 1009 and Ex. 1005 (English translation), "Hasegawa"). 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 Patent No. 5,383,978 (issued Jan. 24, 1995) (Ex. 1007, "Yamamoto").
[4] Kishimoto et al., US Patent No. 5,486,224 (issued Jan. 23, 1996) (Ex. 1008, "Kishimoto").

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

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

A consolidated oral hearing was held on November 6, 2015, in relation to this proceeding and related Case No. IPR2014-01265 involving the same parties. A transcript of the consolidated oral hearing was entered in the record as Paper 36 ("Tr.").

On February 8, 2016, we issued a Final Written Decision in this proceeding in accordance with 35 U.S.C. § 318(a) and 37 C.F.R. § 42.73 (Paper 37, "Final Dec."). We determined that Petitioner had proven, by a preponderance of the evidence, that claims 1–4, 14, and 16 of the '765 patent were unpatentable as obvious over the combination of Ohashi and Hasegawa; claims 11 and 12 of the '765 patent were unpatentable as obvious over the combination of Ohashi, Hasegawa, and Yamamoto; and claim 15 of the '765 patent was unpatentable as obvious over the combination of Ohashi, Hasegawa, and Kishimoto. Final Dec. 36.

Patent Owner appealed the Final Written Decision to the United States Court of Appeals for the Federal Circuit ("Federal Circuit"). Paper 38. On July 6, 2017, the Federal Circuit affirmed that claims 1, 2, 14, and 16 of the '765 patent would have been obvious over the combined teachings of Ohashi

and Hasegawa,[5] and that claims 11 and 12 of the '765 patent would have been obvious over the combined teachings of Ohashi, Hasegawa, and Yamamoto.

The Federal Circuit reversed our claim construction with respect to claim 4, vacated our obviousness determination with respect to claims 3 and 4, and remanded for further consideration consistent with the opinion. *Hitachi*, 699 F. App'x at 941–42. The mandate, releasing jurisdiction of the remanded case to the Board, issued on August 30, 2017.

On October 6, 2017, and at the request of the parties, we granted additional briefing to permit the parties to address how the Federal Circuit's decision affects this proceeding (Paper 39, "Remand Order"). The Remand Order limited the post-remand briefing to the evidence already of record. Petitioner and Patent Owner each filed the authorized briefing (Paper 40, "PO Opening Remand Br."; Paper 41, "Pet. Opening Remand Br."; Paper 42, "PO Reply Remand Br."; and Paper 43, "Pet. Reply Remand Br.").

In view of the guidance from the Federal Circuit, and for the reasons set forth below, we determine that Petitioner has proved by a preponderance

[5] Although the Federal Circuit did not specifically affirm that dependent claim 15 would have been obvious over Ohashi, Hasegawa, and Kishimoto, the Federal Circuit's reason for vacating and remanding in connection with dependent claims 3 and 4 has no applicability to the Board's analysis for claim 15. In connection with claim 15, the Board determined that Petitioner presented sufficient evidence that Kishimoto teaches the limitations of claim 15 and that one of skill in the art would have been led to modify the method of Ohashi and Hasegawa to incorporate the teachings of Kishimoto. Final Dec. 35-36. During the *inter partes* review, Patent Owner directed no arguments specifically to claim 15 and relied on the purported deficiencies of Ohashi and Hasegawa that it argued with respect to independent claim 1. *Id.* at 34-35.

of the evidence that claim 3 is unpatentable as obvious over the combination of Ohashi and Hasegawa, but has failed to prove by a preponderance of the evidence that claim 4 is unpatentable as obvious over the combination of Ohashi and Hasegawa.

B. 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.

In order to prevent oxidation of the R-rich super-fine powder particles, pulverization "may ideally be performed in an inert atmosphere," but that is "difficult to realize . . . in a mass-production scale in production

facilities." *Id*. at 2:37–41. The '765 patent instead describes performing the second step of fine pulverization "in an inert atmosphere containing a trace amount of oxygen to intentionally coat the surfaces of finely pulverized powder particles with a thin oxide film to thereby suppress fast oxidation of the powder particles in the atmosphere." *Id*. at 2:42–47. The concentration of oxygen in the high speed flow of gas used in the second step of fine pulverization "is preferably adjusted to be in the range between 0.05% and 3% by volume." *Id*. at 3:29–32. More broadly, "the oxygen amount in the high-speed flow of gas used during the fine pulverization should preferably be reduced to about 0.02% to about 5% by volume." *Id*. at 9:12–16.

Because even the use of an intentional trace amount of oxygen may not improve sufficiently the final magnet properties, 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" in a further effort to improve and stabilize the final magnet properties. *Id*. at 2:48–53, 3:5–10. Table 1 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 1 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.

C. Relevant Claims

Claims 3 and 4 are the only claims at issue in this Decision. Claim 3 depends directly from independent claim 1 or its dependent claim 2, and claim 4 depends directly from claim 3. Ex. 1001, 13:39–43. Claims 1, 3, and 4 are 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 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.

Ex. 1001, 13:21–33.

> 3. The method of claim 1 or 2, wherein in said pulverization step, the alloy is finely pulverized in a high-speed flow of gas.[6]

Id. at 13:39–41.

[6] We consider dependent claim 3 to be referring to the "second pulverization step" of independent claim 1, considering the explicit reference to the alloy being "finely pulverized."

4. The method of claim 3, wherein the gas comprises oxygen.

Id. at 13:42–43.

II. ANALYSIS

A. Final Written Decision

In the Final Written Decision, we took the view that the second pulverization step of claims 1, 3, and 4 does not *include* fine pulverization as a sub-step, but *is* fine pulverization. *See* Final Dec. 23. Accordingly, we considered the question before us to be whether the second step of fine pulverization is merely a single step of milling or includes two sub-steps of milling and particle classification. *See id.* at 23–24. We construed fine pulverization to include the two sub-steps of milling and particle classification. *Id.* at 24. This construction was informed by the Specification which states 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" (Ex. 1001, 2:66–3:7 (emphasis added)); "*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 "[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)).

We acknowledged that 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) could be considered to support an alternative position that fine pulverization occurs only in a jet mill and is completed before particle size classification occurs in a classifier. Final Dec. 23. We, however, ultimately determined that the broadest reasonable interpretation consistent with the entirety of 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 that occurs in the jet mill and a second sub-step of particle classification that occurs in a cyclone. Because we determined that particle classification is part of finely pulverizing the material alloy in a high-speed flow of gas, we found 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)) to be sufficient to meet the language of claim 4. Final Dec. 24.

B. Federal Circuit Decision

Based on its recognition that "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,'" the Federal Circuit identified the disagreement between the parties as whether the high-speed flow of gas pertains to the umbrella step (i.e., the second pulverization step comprising the sub-steps of both fine pulverization and particle classification) or only to the first sub-step of fine pulverization. *Hitachi*, 699 F. App'x at 939. The Federal Circuit then construed claim 4 to require that the high speed flow of

gas comprising oxygen be used specifically in connection with the sub-step of fine pulverization only, "rather than the umbrella 'second pulverization step.'" *Id.* In that regard, the Federal Circuit found that "it is clear that the high-speed gas is associated with the fine pulverization *conducted in the jet mill*." *Id.* at 940. The Federal Circuit, therefore, "reverse[d] the Board's construction of claim 4 and conclude[d] 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." *Id.* Based on the Federal Circuit's analysis, we understand the Federal Circuit's construction of dependent claims 3 and 4 to mean that the high speed flow of gas must be used in connection specifically with milling, and not merely in connection with particle classification.

C. Obviousness Over the Combination of 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). For

example, Ohashi discloses fine pulverization of coarse powder into a fine powder "in a jet mill with a jet stream of nitrogen gas." *Id.* at 6:46–48.

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, a 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*. ¶ 2. 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*. ¶ 4. Hasegawa discloses that "[a]fter the hydrogen treatment, it is acceptable to subject the coarse powder to a dehydrogenation treatment of 100 to 900ºC in a vacuum or in argon gas so as to reduce the oxidation activity of the coarse powder." *Id*. ¶ 6.

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*. ¶ 3. 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 Claim 3

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." As set forth above, and in accordance with the Federal Circuit's claim construction, the high-speed flow of gas must be used in connection with the milling step. 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). Because (i) Petitioner specifically relies on Ohashi's disclosure of a jet stream of gas used in a jet mill (for milling), and (ii) dependent claim 3 does not specify any particular type of gas (such that nitrogen gas is sufficient), we find that Petitioner presents sufficient evidence to support a conclusion that the combination of Ohashi and Hasegawa renders obvious the subject matter of dependent claim 3.

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 3 of the '765 patent would have been obvious over the combination of Ohashi and Hasegawa under 35 U.S.C. § 103(a).

4. Obviousness of Claim 4

Claim 4 depends from claim 3 and further recites that "the gas comprises oxygen." Petitioner contends that "[o]ne of ordinary skill would have been motivated to combine [the teachings of] *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 (citing Ex. 1004, 4:38–52; Ex. 1005 ¶¶ 4–6). We understand Petitioner to be relying on Hasegawa at least for the first pulverization step of claim 1 being a hydrogen pulverization method, which is not disclosed by Ohashi. *Id.* at 17 (stating "*Hasegawa* teaches coarse pulverization using hydrogen treatment or pulverization to more easily crush a material alloy.")

With respect to dependent claim 4, Petitioner contends that "*Hasegawa* discloses finely pulverizing coarse powder by jet milling and wind power, which would include some amount [of] oxygen that cannot be entirely removed from jet milling and classification." *Id.* at 22–23 (citing Ex. 1005 ¶¶ 4–5; Ex. 1002 ¶ 82). Petitioner does not clearly explain how the teachings of Ohashi and Hasegawa are being combined and/or relied upon in connection with dependent claim 4, but we generally understand Petitioner to be relying on Hasegawa for both a first step comprising a hydrogen pulverization method and a second step of jet milling.[7]

Petitioner asserts that claim 4 does not include a limitation that would require any particular amount of oxygen, let alone any particular amount that would be necessary to intentionally coat the surfaces of finely pulverized powder particles. Pet. Reply 16 (relying on claim differentiation to assert that claim 4 extends to an oxygen content "below 0.05% by volume"); *see also id.* at 19. Petitioner further asserts that claim 4 does not include a limitation that would require the high speed flow of gas comprising oxygen to "be supplied to and emitted from nozzles in a jet milling chamber." *Id.* at 19. Instead, Petitioner asserts that reliance on residual oxygen moving at

[7] Patent Owner argues that the wind power referenced by Petitioner in the Petition is used for particle classification, and not milling. PO Resp. 25; Ex. 2002 ¶ 102. We agree. *See* Ex. 1005 ¶¶ 5, 6, 8, 12. Therefore, to the extent Petitioner's argument is based on oxygen that would be present during the sub-step of particle classification in Hasegawa from such wind power, as opposed to the sub-step of milling, such a position is foreclosed by the requirement that the high-speed flow of gas in which the alloy is finely pulverized be specifically limited to a flow of gas in which the alloy is being milled. We consider Petitioner's argument only as it relates to residual oxygen that may be present in the jet mill specifically during the sub-step of milling.

high speeds in the milling chamber when another gas (that does not necessarily contain oxygen) is emitted at high speeds from nozzles into the milling chamber is sufficient to meet the language of the claim. *Id.*

We agree. We construe claim 4 to require only a high speed flow of gas having at least some oxygen present, but not necessarily any particular amount of oxygen (e.g., an amount that meets a numerical threshold or is sufficient to perform any particular function). *See* Pet. Opening Remand Br. 5. The language of claim 4 is broader than any particular examples within the Specification, and we decline to import, as a limitation of claim 4, specific characteristics or functionality associated with the oxygen in a high speed flow of gas that finely pulverizes an alloy that may be described in the Specification. *See Superguide Corp. v. DirecTV Enterps., Inc.*, 358 F.3d 870, 875 (Fed. Cir. 2004) ("Though understanding the claim language may be aided by the explanations contained in the written description, it is important not to import into a claim limitations that are not a part of the claim. For example, a particular embodiment appearing in the written description may not be read into a claim when the claim language is broader than the embodiment."); *In re Van Geuns*, 988 F.2d 1181, 1184 (Fed. Cir. 1993) ("[L]imitations are not to be read into the claims from the specification."). We agree with Petitioner that the '765 patent "is clear that trace amounts of oxygen *are* sufficient for particle coating." Pet. Reply Remand Br. 3 (citing Ex. 1001, 2:42–47). Any more precise numerical amount of oxygen by volume referred to in the Specification is described merely as a preference. Ex. 1001, 3:29–32; 9:12–20.

We also agree that claim 4 should not be construed as requiring oxygen to be emitted from nozzles into the milling chamber, but reasonably

extends to oxygen (e.g., residual oxygen *not* intentionally provided in the milling chamber) moving at high speeds in the milling chamber when another gas is emitted at high speeds from nozzles into the milling chamber. Although the Specification describes an exemplary embodiment in which the oxygen is provided specifically in the inert gas that flows from the nozzles, we do not view this exemplary embodiment within the Specification as precluding the broad language of claim 4 from reasonably extending to a high speed flow of gas that merely comprises residual oxygen left within the jet mill, rather than oxygen emitted through the nozzles into the jet mill. Ex. 1001, 9:12–20 ("A pulverization method including control of the oxygen concentration in the high-speed flow gas is described in Japanese Patent Examined Publication No. 6-6728. . . . [T]he oxygen amount in the inert gas may be adjusted to the range of 0.05% to 3% by volume"); *id.* at 10:50–53 ("Nitrogen gas (99% by volume) with the addition of oxygen as (1% by volume) was used as a high-speed flow gas for the jet mill."); *see, e.g.*, *Liebel-Flarsheim Co. v. Medrad Inc.*, 358 F.3d 898, 906 (Fed. Cir. 2004) (expressly rejecting the contention that if a patent describes only a single embodiment, the claims of the patent must be construed as being limited to that embodiment).

With respect to residual oxygen that might be left in the milling chamber during the step of milling, Petitioner 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; *see also* Pet. Reply 18 (quoting Ex. 2002, ¶ 99) (emphasis added) ("*nearly all* of the oxygen is removed from the jet mill chamber prior to the fine pulverization step"). Petitioner also 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). Petitioner asserts that "it would have been entirely obvious to a person of ordinary skill that the jet milling processes disclosed in both Ohashi and Hasegawa would necessarily involve finely pulverizing alloy powder in a high-speed flow of gas that includes residual oxygen." Pet. Opening Remand Br. 10; *see also id.* at 12 ("[B]oth [Petitioner's] expert (Dr. Ormerod) and [Patent Owner's] expert (Prof. Lewis) have confirmed that it would have been well-known to a person of ordinary skill that some amount of oxygen could not be removed from the milling chamber." (citing Ex. 1002 ¶ 82; Ex. 2002 ¶ 99)). Petitioner also states that "*Hasegawa* discloses that some oxygen is contained in the alloy powder after pulverization." Pet. 23 (citing Ex. 1005 ¶¶ 9–14; Ex. 1002 ¶ 82).

Patent Owner argues that reliance on residual oxygen is deficient in meeting the language of the claim. PO Resp. 25.[8] In particular, Patent

[8] We are urged by the Federal Circuit to "consider [Patent Owner'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' . . . is undeniably an oxidizing gas." *Hitachi*, 699 F. App'x at 941. Although we have considered Patent Owner's argument and agree that "one reading Ohashi would not interpret that reference as suggesting the addition of oxygen into the high speed flow of gas used to jet mill the alloy powder" (Ex. 2002, ¶ 100), we do not find such argument dispositive in that we do not view the Petitioner's argument to be based on modifying Ohashi so as to provide for "the intentional introduction of oxygen into the jet milling gas" (*id.*), but rather to be based on residual oxygen that may already exist within the milling chamber in Ohashi as modified (just as Ohashi alone

Owner provides expert testimony that "[a]ny residual oxygen left over (which would be a near-zero amount that is ideally not detectable by machine measurement) would not be sufficient to coat the finely pulverized particles as taught in the '765 patent." Ex. 2002, ¶ 99; *see also* PO Resp. 25 (citing Ex. 2002, ¶¶ 99, 102) ("Although an alloy may contact an oxygen molecule at some point during a jet milling process (*e.g.*, left-over oxygen in the jet mill chamber), *Hasegawa* does not disclose or suggest that the high-speed flow of gas used in jet milling contains oxygen.").[9] In light of our construction of claim 4 discussed above, we are not persuaded by Patent Owner's arguments that reliance on residual oxygen is insufficient. We, however, consider whether Petitioner has sufficiently established that there is residual oxygen in the jet mill of Ohashi/Hasegawa.

Petitioner does not show where Ohashi or Hasegawa *explicitly* discloses the use of oxygen in connection with milling of a material alloy during fine pulverization. Rather, Petitioner appears to rely on Hasegawa as

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may have residual oxygen despite its stated efforts to maintain an inert atmosphere), without the need to intentionally add oxygen.

[9] We also consider expert testimony indicating that "[t]he process of hydrogen pulverization is . . . carried out as carefully as possible, and typically one might purge and flush a container three different times to try to scavenge as much oxygen as possible. Whatever oxygen is left in there is pretty in[]consequential for the processing." Ex. 1012, 68:23–69:4. We also consider expert testimony that "it is not desirable to have air containing atmospheric oxygen inside of the jet mill chamber since the fine powder generated inside of the jet mill chamber during fine pulverization is extremely reactive—pyrophoric—and will explode and catch fire if exposed to air" and that "prior to introduction of powder to be milled, it is common to repeatedly evacuate ('purge') the air from the jet mill chamber and replace ('backfill') it with some sort of inert gas such as argon or more typically nitrogen." Ex. 2002 ¶ 99.

inherently disclosing the use of oxygen in connection with milling of a material alloy during fine pulverization because of residual oxygen that cannot be entirely removed from jet milling. Pet. 22–23 (citing Ex. 1005 ¶¶ 4–5; Ex. 1002 ¶ 82). Petitioner does not explain why there must be residual oxygen in the system other than an allusion to the wind power disclosed by Hasegawa. Pet. 22–23. Hasegawa, however, contemplates treatment in a vacuum or in argon gas prior to fine pulverization in a jet mill. Ex. 1005 ¶ 6. We are not persuaded that Petitioner has provided a sufficient basis in fact and/or technical reasoning to support that there would necessarily be residual oxygen during milling of a material alloy when finely pulverizing the material alloy. "[Extrinsic] evidence must make clear that the missing descriptive matter is necessarily present in the thing described in the reference, and that it would be so recognized by persons of ordinary skill." *Continental Can Co. USA, Inc. v. Monsanto Co.*, 948 F.2d 1264, 1269 (Fed. Cir. 1991); *see also Southwire Co. v. Cerro Wire LLC*, 870 F.3d 1306, 1311 ("While '[w]e have recognized that inherency may supply a missing claim limitation in an obviousness analysis,' *PAR Pharm., Inc. v. TWI Pharm., Inc.*, 773 F.3d 1186, 1194–95 (Fed. Cir. 2014) (collecting cases), we have emphasized that 'the limitation at issue necessarily must be present' in order to be inherently disclosed by the reference, *id.*" (emphasis added).). We are not persuaded by the limited testimony of Dr. Ormerod (Ex. 1002 ¶ 82) that it is clear that oxygen is *necessarily* present in the jet mill. Even if the existence of some undetectable amount of oxygen in the milling chamber is highly probable, such a probability is not sufficient to establish an inherent disclosure. *See In re Oelrich*, 666 F.2d 578, 581 (CCPA 1981) ("Inherency . . . may not be established by possibilities or

probabilities. The mere fact that a certain thing may result from a given set of circumstances is not sufficient.").

As to Petitioner's reliance on Hasegawa's disclosure that some oxygen is contained in the alloy powder after pulverization (Pet. 23 (citing Ex. 1005 ¶¶ 9–14; Ex. 1002 ¶ 82)), the fact that Hasegawa teaches some oxygen may be contained in the resulting alloy powder (Ex. 1005, Table 1) does not support that such oxygen necessarily was in the milling chamber during milling of a material alloy when finely pulverizing the material alloy. Rather, we agree with Patent Owner that such oxygen may have been introduced into the alloy during subsequent processing steps, such as the wind power classification. *See, e.g.*, PO Resp. 25–26 (Patent Owner arguing that "the oxygen contained in the alloy powder after pulverization most likely came from the coarse pulverization process or the wind power classification."). Accordingly, we remain unpersuaded that the Petitioner has sufficiently established that oxygen is necessarily present in the high-speed flow of gas in the milling chamber during milling of a material alloy when finely pulverizing the material alloy in the processes described in either Ohashi or Hasegawa. *See, e.g.*, Ex. 1004, 4:37–52 (disclosing conducting milling in the atmosphere of a non-oxidizing or inert gas); Ex. 1005 ¶¶ 5–6 (disclosing the use of a hydrogen treatment on coarse powder, followed by a dehydrogenation treatment conducted in a vacuum or argon gas so as to reduce oxidation activity of the coarse powder, and then the fine pulverization or milling of the coarse powder with a dry pulverizer such as a jet mill).

After considering Petitioner's and Patent Owner's positions, as well as their supporting evidence, we conclude that Petitioner has not demonstrated,

by a preponderance of the evidence that dependent claim 4 of the '765 patent would have been obvious over the combination of Ohashi and Hasegawa under 35 U.S.C. § 103(a).

Petitioner also urges us to consider Patent Owner's alleged admission that "as early as 1994 (the publication date of Japanese Patent Publication No. 6-6728), it was well-known in the art that a controlled mixture of oxygen and nitrogen could be used as a high-speed flow of gas in a jet mill to form an oxide coating on powder particles." Pet. Reply Remand Br. 6 (citing PO Opening Remand Br. 10–11 and Ex. 1001, 2:42–47, 3:29–32, 9:12–20). More particularly, Petitioner argues that Patent Owner's "admission that it was well-known to intentionally provide controlled amounts of oxygen in a jet mill's high-speed flow of gas should be knowledge imputed to a [person of ordinary skill]." *Id.* at 7. According to Petitioner, with this imputed knowledge, a person of ordinary skill in the art "considering Ohashi and Hasegawa would have found it obvious that oxygen could be intentionally provided in controlled amounts in Ohashi or Hasegawa's jet milling machines to provide an oxide coating on the powder particles" and "would not have been dissuaded by Ohashi's recommendation to avoid oxidation." *Id.*

Even if we were to accept that Patent Owner's admission constitutes background knowledge that may be imputed to a hypothetical person of ordinary skill for purposes of an obviousness analysis, we do not view Petitioner as providing any arguments based on the obviousness of the intentional introduction of oxygen into the jet mill. Rather, Petitioner's argument is based on residual oxygen that may already exist within the milling chamber in Ohashi as modified by Hasegawa. *See* Pet. 22–23

("*Hasegawa* . . . would include some amount [of] oxygen that cannot be entirely removed from jet milling and classification," as opposed to clearly suggesting the obviousness of intentionally introducing oxygen into Ohashi's jet mill). Petitioner must put forth its case in its Petition. To contend now that admitted prior art and knowledge of a person of ordinary skill support the contention that it would have been obvious to modify the combination of Ohashi and Hasegawa so as to intentionally introduce oxygen in controlled amounts into a jet mill, regardless of Ohashi's "teaching that the pulverization should be conducted in a 'non-oxidizing or inert gas' and oxygen is indisputably an oxidizing gas" (*Hitachi*, 699 F. App'x at 939), is too late. *See* 37 C.F.R. § 42.104(b)(4) ("the *petition* must set forth . . . [*h*]*ow* the construed claim is unpatentable under the statutory grounds identified . . . . The petition must specify where each element of the claim is found in the prior art patents or printed publications relied upon.") (emphasis added).

III. CONCLUSION

Upon reviewing anew the record developed during trial, and in light of the Federal Circuit's construction of claim 4, we determine that Petitioner has demonstrated by a preponderance of the evidence that claim 3 of the '765 patent is unpatentable under § 103(a) over the combined teachings of Ohashi and Hasegawa, but has not demonstrated by a preponderance of the evidence that claim 4 of the '765 patent is unpatentable under § 103(a) over the combined teachings of Ohashi and Hasegawa.

IV. ORDER

In consideration of the foregoing, it is

ORDERED that claim 3 of the ’765 patent has been shown to be unpatentable;

FURTHER ORDERED that claim 4 of the ’765 patent has not been shown to be unpatentable; and

FURTHER ORDERED that, because this Decision on Remand amounts to 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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