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BEFORE THE PATENT TRIAL AND APPEAL BOARD

Ex parte TAKESHI NISHIUCHI, FUTOSHI KUNIYOSHI, RINTARO ISHII, and TSUNEHIRO KAWATA

Appeal 2019-001808
Application 14/780,264
Technology Center 1700

Before JEFFREY B. ROBERTSON, JAMES C. HOUSEL, and JANE E. INGLESE, *Administrative Patent Judges*.

INGLESE, *Administrative Patent Judge*.

DECISION ON APPEAL

Appellant[1] requests our review under 35 U.S.C. § 134(a) of the Examiner's decision to finally reject claims 12–14, 19, 22, and 23[2]. We have jurisdiction over this appeal under 35 U.S.C. § 6(b).

We AFFIRM.

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[1] We use the word "Appellant" to refer to "applicant" as defined in 37 C.F.R. § 1.42. Appellant identifies Hitachi Metals, Ltd. as the real party in interest. Appeal Brief filed July 20, 2018 ("Appeal Br.") at 2.
[2] Final Office Action entered February 22, 2018 ("Final Act.").

CLAIMED SUBJECT MATTER

Appellant claims an R-T-B-based[3] sintered magnet that includes an $Nd_2Fe_{14}B$ compound as a main phase. Appeal Br. 4–6. Claim 12 illustrates the subject matter on appeal, and is reproduced below with contested language italicized:

> 12. An R-T-B based sintered magnet including an $Nd_2Fe_{14}B$ compound as a main phase comprising:
>
> the main phase;
>
> a first grain boundary phase located between two main phases; and
>
> a second grain boundary phase located between three or more main phases,
>
> wherein *the first grain boundary phase has an average maximum thickness of 10 nm or more and 30 nm or less*, and
>
> the composition of the R-T-B based sintered magnet comprises:
>
> R: 14.01 atomic % or more and 14.8 atomic % or less, wherein R is Nd and/or Pr,
>
> B: 5.42 atomic % or more and 5.44 atomic % or less,
>
> Ga: 0.47 atomic % or more and 0.57 atomic % or less,
>
> Al: 0.69 atomic % or less, including 0 atomic %, and
>
> balance being T, wherein T is Fe or transition metal elements comprising Fe, and inevitable impurities,
>
> wherein the R-T-B based sintered magnet satisfies the following inequality expression (2):
>
> 1.03 ≤ <Ga>/(1/17 x 100 - <B>) ≤ 1.24 (2)
>
> wherein <Ga> is the amount of Ga in terms of atomic %, and <B> is the amount of B in terms of atomic %, and
>
> wherein an atomic ratio of the amount of B to the amount of R satisfies the following inequality expression (4):
>
> 0.37 ≤ <B>/<R> ≤ 0.42 (4)
>
> wherein <B> is the amount of B in terms of atomic %, and <R> is the amount of R in terms of atomic %.

---

[3] According to the Specification, "R" is at least one of rare-earth elements and "T" is a transition metal element. Spec. ¶ 2. B is the atomic symbol for boron.

Appeal Br. 20–21 (Claims Appendix) (emphasis added).

REJECTION

The Examiner maintains the rejection of claims 12–14, 19, 22, and 23 under 35 U.S.C. § 103 as unpatentable over Nakajima et al. (WO 2013/008756 A1, published January 17 2013[4]) in the Examiner's Answer entered November 9, 2018 ("Ans.").

FACTUAL FINDINGS AND ANALYSIS

Upon consideration of the evidence relied upon in this appeal and each of Appellant's contentions, we affirm the Examiner's rejection of claims 12–14, 19, 22, and 23 under 35 U.S.C. § 103 for the reasons set forth in the Final Action, the Answer, and below.

We review appealed rejections for reversible error based on the arguments and evidence the appellant provides for each issue the appellant identifies. 37 C.F.R. § 41.37(c)(1)(iv); *Ex parte Frye*, 94 USPQ2d 1072, 1075 (BPAI 2010) (precedential) (*cited with approval in In re Jung*, 637 F.3d 1356, 1365 (Fed. Cir. 2011) (Explaining that even if the Examiner had failed to make a prima facie case, "it has long been the Board's practice to require an applicant to identify the alleged error in the examiner's rejections.")).

[4] Appellant does not contest the Examiner's reliance on Nakajima et al. (US 2014/0132377 A1, published May 15, 2014) as an English translation of Nakajima et al. (WO 2013/008756 A1, published January 17, 2013). Citations to "Nakajima" in this decision, therefore, refer to the published U.S. patent application.

Claims 12–14 and 19

Appellant presents arguments directed to independent claim 12, and does not separately address dependent claims 13, 14, and 19. Appeal Br. 7–13. We accordingly select claim 12 as representative, and decide the appeal as to claims 12–14 and 19 based on claim 12 alone. 37 C.F.R. § 41.37(c)(1)(iv).

Nakajima discloses an R-T-B-based sintered magnet that includes a main phase primarily containing $R_2F_{14}B$, where R is a rare earth element, and a grain boundary. Nakajima Abstr., ¶¶ 1, 19. Nakajima discloses that the grain boundary contains an R-rich grain boundary phase having a high concentration of rare earth elements, and a transition metal-rich grain boundary phase having a lower concentration of rare earth elements and a higher concentration of transition metal elements, relative to the R-rich grain boundary phase. Nakajima ¶¶ 19, 21.

Nakajima discloses numerous embodiments of the R-T-B-based sintered magnet of Nakajima's invention, and in one embodiment, referred to as the "First Embodiment," the sintered magnet includes 13 % to 15 % rare earth elements (R), 4.5 % to 6.2 % boron (B), 0.1 % to 2.4 % of one or more metals (M) selected from aluminum (Al), gallium (Ga), and copper (Cu), and the balance consisting of a transition metal (T) containing essentially iron (Fe). Nakajima ¶¶ 79, 82. The ranges of the concentrations of R, B, and Ga in the sintered magnet of Nakajima's First Embodiment encompass the corresponding R, B, and Ga concentration ranges recited in claim 12. *See* Final Act. 3.

Nakajima discloses that to improve the coercive force of the sintered magnet of the First Embodiment, the ratio of the concentration of B to the total concentration of rare earth elements (TRE), or B/TRE, in the magnet is preferably 0.355 to 0.38 (¶ 92), which the Examiner finds "overlaps the recited B/R [of formula (4)] in claim 12." Final Act. 4.

The Examiner finds that Experimental Example 44 of Nakajima describes producing an R-T-B-based sintered magnet from an alloy including 14.83 % rare earth elements (11.05 % Nd and 3.78 % Py), 5.34 % B, 0.54 % Ga, and 0.49 % Al. Final Act. 4; *see also* Nakajima ¶¶ 212–221, Table 1. As the Examiner acknowledges, the concentration of rare earth elements (14.83 %) and B (5.34 %) in the magnet of Example 44 are slightly outside the corresponding concentration ranges for these elements recited in claim 12 (14.01 % to 14.8 %, and 5.42 % to 5.44 %, respectively). Final Act. 2–4. Nakajima discloses that the magnet of Example 44 exhibited a coercive force (Hcj) of 19.6 kOe and a remanence (Br) of 13.2 kG (Nakajima Table 4; *see also* Nakajima ¶ 227), which the Examiner determines correspond to a coercive force of 1.56 MA/m and a remanence of 1.32 T. Final Act. 4; Ans. 7.

The Examiner finds that because the R-T-B-based sintered magnet disclosed in Nakajima "has a composition overlapping" the composition of the R-T-B-based sintered magnet recited in claim 12, Nakajima's R-T-B-based sintered magnet renders the magnet of claim 12 prima facie obvious. Final Act. 3.

Appellant argues that "Nakajima does not disclose the feature of claim 12 that 'the first grain boundary phase has an average thickness of 10 nm or more and 30 nm or less.'" Appeal Br. 13.

The Examiner finds, however, that although Nakajima "is silent on the average thickness of the first grain boundary phase located between two main phases as recited in claim 12," the thickness of the first grain boundary of a sintered magnet is determined by the composition of the alloy used to produce the magnet, and the method of producing the magnet, which Appellant does not dispute. *Compare* Final Act. 4 and Ans. 4, *with* Appeal Br. 7–13 and Reply Br. 4–5. The Examiner finds that because the composition of Nakajima's R-T-B-based sintered magnet "overlaps" the composition of the R-T-B-based sintered magnet recited in claim 12, and because Nakajima's magnet is produced by substantially the same process as the magnet of claim 12, "one of ordinary skill in the art would expect that the first grain boundary phase in the magnet of Nakajima et al. to meet the first grain boundary phase thickness limitation recited in claim 12." Final Act. 5; Ans. 4–5.

More specifically, the Examiner finds that Nakajima discloses that the process for producing the R-T-B-based sintered magnet of Nakajima's invention involves press molding a powder-form R-T-B-based alloy to obtain a green compact, sintering the green compact at a temperature of 900ºC to 1200ºC, thermally treating the green compact at 800ºC, thermally treating the green compact at 500ºC, and cooling the resulting R-T-B-based sintered magnet. Final Act. 5 and Ans. 4–5 (citing Nakajima ¶ 220). As the Examiner finds, this process disclosed in Nakajima involves the same sequence of process steps that Appellant's Specification describes for producing the R-T-B-based sintered magnet of Appellant's invention, and Nakajima's process uses sintering and heat treatment temperatures that are the same as, or include, those used in the process described in Appellant's Specification. Final Act. 5 and Ans. 5 (citing Nakajima ¶ 220 and Spec. ¶¶ 49–51).

Furthermore, as discussed above, Nakajima discloses an R-T-B-based sintered magnet including a main phase primarily containing $R_2F_{14}B$, an R-rich grain boundary phase (first grain boundary phase), and a transition metal-rich grain boundary phase (first grain boundary phase), in which the concentration ranges of R, B, and Ga in the sintered magnet encompass the corresponding R, B, and Ga concentration ranges recited in claim 12, and the range of the preferred ratio of the concentration of B to the concentration of R encompasses the range of formula (4) in claim 12. Nakajima, therefore, discloses an R-T-B-based sintered magnet having a composition that includes the R-T-B-based sintered magnet recited in claim 12, and Nakajima discloses producing the R-T-B-based sintered magnet by a process that is substantially similar to, or the same as, the process disclosed in Appellant's Specification for producing the R-T-B-based sintered magnet of claim 12.

The Examiner, therefore, has a reasonable basis for finding that the R-rich grain boundary phase (first grain boundary phase) in Nakajima's R-T-B-based sintered magnet would have an average maximum thickness of 10 nm to 30 nm as recited in claim 12. *In re Best*, 562 F.2d 1252, 1255 (CCPA 1977) (citation and footnote omitted) ("Where . . . the claimed and prior art products are identical or substantially identical, or are produced by identical or substantially identical processes, the PTO can require an applicant to prove that the prior art products do not necessarily or inherently possess the characteristics of his claimed product. []Whether the rejection is based on 'inherency' under 35 U.S.C. § 102, on 'prima facie obviousness' under 35 U.S.C. § 103, jointly or alternatively, the burden of proof is the same, and its fairness is evidenced by the PTO's inability to manufacture products or to obtain and compare prior art products.").

The burden, therefore, shifts to Appellant to show that the R-rich grain boundary phase (first grain boundary phase) of Nakajima's R-T-B-based sintered magnet would not have an average maximum thickness of 10 nm to 30 nm, as recited in claim 12. *Best*, 562 F.2d at 1255. On the record before us, Appellant does not meet this burden. Although Appellant argues that the first grain boundary of the R-T-B-based sintered magnet of Nakajima's Example 44 would be thinner than 10 nm because the B and R contents of the magnet of Example 44 "are outside of the ranges of the composition recited in claim 12," and although Appellant argues that magnets of "other examples" of Nakajima "are also outside of the ranges of the composition recited in claim 12, and would have a first grain boundary <u>thinner than 10 nm</u>" (Appeal Br. 12), Nakajima's disclosures are not limited to the referenced experimental examples. Rather, as discussed above, Nakajima broadly discloses an R-T-B-based sintered magnet having a composition that would include an R-T-B-based sintered magnet as recited in claim 12, which is produced by substantially the same process as the magnet of claim 12. Appellant's arguments directed to select experimental examples in Nakajima do not demonstrate that an R-T-B-based sintered magnet as broadly disclosed in Nakajima would not have an R-rich grain boundary phase (first grain boundary phase) with an average maximum thickness of 10 nm to 30 nm, as recited in claim 12.

Appellant argues that unexpected results set forth in Tables 1–3 of their Specification show that the R-T-B-based sintered magnet of claim 12 would not have been obvious. Appeal Br. 12. Appellant argues that the results for samples 1, 2, and 6–9 in Tables 1–3 show that if at least one of R, B, and Ga has a content outside the respective ranges for these elements recited in claim 12, and if both Formulas 2 and 4 in claim 12 are not met, "a first grain boundary thickness is thinner than 10 nm, and Hcj of the sample is not so high." *Id.* Appellant argues that, in contrast, "when all of the R, B and Ga contents of a sample fall within the very narrow ranges of contents thereof recited in claim 12, the first grain boundary thickness of the sample is 10 nm or more, and both Br and Hcj of the sample are sufficiently high." *Id*. Appellant argues that these results show that the R-T-B-based sintered magnet of claim 12 "provides unexpectedly superior results and is not obvious." *Id.*

It is well-established, however, that "when unexpected results are used as evidence of nonobviousness, the results must be shown to be unexpected compared with the closest prior art." *In re Baxter Travenol Labs.*, 952 F.2d 388, 392 (Fed. Cir. 1991) (citation omitted).

We point out initially that Appellant's Specification indicates that high Br and high Hcj are achieved in the R-T-B-based sintered magnet of Appellant's invention "through the existence of a first grain boundary phase having a thickness of 5 nm or more and 30 nm or less." Spec. ¶ 23. As discussed above, the Examiner finds that Example 44 of Nakajima describes producing an R-T-B-based sintered magnet that includes concentrations of rare earth elements and boron that are outside, but close to, the corresponding concentration ranges for these elements recited in claim 12. The amounts of Ga and Al included in the magnet of Example 44, however, fall within the corresponding concentration ranges for these elements recited in claim 12, as set forth above. The Examiner's reliance on the R-T-B-based sintered magnet of Example 44 of Nakajima reasonably indicates that this particular magnet exemplified in Nakajima has a composition closest to that of the R-T-B-based sintered magnet of claim 12.

Tables 1–3 in Appellant's Specification do not provide a comparison between the first grain boundary thickness of the magnet of Nakajima's Example 44 and the magnets of samples 3–5, 10, and 11, which include concentrations of R, B, and Ga that fall within the ranges recited in claim 12, and satisfy formulas (2) and (4) recited in the claim. Spec. ¶¶ 53–54, 57. The Examiner, however, includes the following table in the Answer to provide a comparison between the coercive force (Hcj) and remanence (Br) exhibited by the R-T-B-based sintered magnet of Nakajima's Example 44 (expressed in units that correspond to those used in Appellant's Specification), and the R-T-B-based sintered magnets of Appellant's samples 1, 2, and 6–9 (Ans. 6–7):

Table 2	Example 44 Of Nakajima	Sample No. 3	Sample No. 4	Sample No. 5	Sample No. 10	Sample No. 11
Br (T)	1.32	1.36	1.30	1.30	1.33	1.35
Hcj (MA/m)	1.56	1.55	1.57	1.60	1.52	1.53

As this comparison shows, although the concentrations of rare earth elements and boron in the magnet of Nakajima's Example 44 are outside the corresponding concentration ranges for these elements recited in claim 12, the magnet of Example 44 nonetheless exhibits both a coercive force and a remanence comparable to the coercive force and remanence exhibited by the magnets of Appellant's samples 3–5, 10, and 11. Nakajima ¶¶ 53–54 (Tables 1 and 2). In view of this comparison, and contrary to Appellant's arguments, the high coercive strength exhibited by the magnets of samples 3–5, 10, and 11 would not have been unexpected to one of ordinary skill in the art at the time of Appellant's invention, due to Nakajima's disclosure of an R-T-B-based sintered magnet exhibiting a comparable coercive strength. Notably, on the record before us, Appellant does not direct us to any statement in the Specification attesting to the unexpected nature of the results obtained for samples 3–5, 10, and 11, or to any other persuasive evidence or averment evincing that the results actually would have been unexpected by one of ordinary skill in the art at the time of Appellant's invention. *In re Geisler*, 116 F.3d 1465, 1471 (Fed. Cir. 1997) ("Geisler made no such assertion [that results were unexpected] in his application. Nor did Geisler submit any such statement through other evidentiary submissions, such as an affidavit or declaration under Rule 132 . . . . Instead, the only reference to unexpected results was a statement by Geisler's counsel . . . that Geisler's results were 'surprising.'").

Appellant's arguments and the relied-upon disclosures in the Specification, therefore, do not establish that the R-T-B-based sintered magnet of claim 12 exhibits a significant, unexpected difference in coercive strength or first grain boundary thickness compared to an R-T-B-based sintered magnet as disclosed in Nakajima. Appellant, therefore, does not meet its burden of demonstrating that the R-T-B-based sintered magnet of claim 12 imparts results that would have been unexpected by one of ordinary skill in the art at the time of Appellant's invention relative to the closest prior art. *In re Klosak*, 455 F.2d 1077, 1080 (CCPA 1972) ("[T]he burden of showing unexpected results rests on he who asserts them.")

Therefore, considering the totality of the evidence relied upon in this appeal, a preponderance of the evidence weighs in favor of the Examiner's conclusion of obviousness. We, accordingly, sustain the Examiner's rejection of claims 12–14 and 19 under 35 U.S.C. § 103 as unpatentable over

Nakajima.

Claim 22

Claim 22 depends from claim 12 and recites that "(i) the first grain boundary phase contains Fe or (Fe + Co), and the Fe or (Fe + Co) is present in the first grain boundary phase in a content of 20 atomic % or less, or (ii) the first grain boundary phase does not contain Fe or (Fe + Co)."

As discussed above, Nakajima discloses an R-T-B-based sintered magnet including a grain boundary containing an R-rich grain boundary phase having a high concentration of rare earth elements, and a transition metal-rich grain boundary phase having a lower concentration of rare earth elements and a higher concentration of transition metal elements relative to the R-rich grain boundary phase. Nakajima ¶¶ 19, 21.

Appellant argues that "as illustrated in Nakajima's Fig. l0(b), the R-rich phase (shown in white) is not in contact with two main phases (shown in gray), and thus would not satisfy the requirement of the first grain boundary phase located between two main phases in addition to having an Fe or (Fe+Co) content of 20 % or less." Appeal Br. 16. Appellant argues that Nakajima's transition metal-rich grain boundary phase "might be considered as a first grain boundary phase (particularly a grain boundary phase in contact with two $R_2T_{14}B$ main phases)," but Nakajima discloses that the transition metal-rich phase preferably contains 50 % to 70 % of a transition metal essentially containing Fe, which is "far from" an Fe or (Fe+Co) content of 20 % or less as recited in claim 22. Appeal Br. 15 (citing Nakajima ¶ 81).

Claim 12, from which claim 22 depends recites, however, "a first grain boundary phase *located between* two main phases." Claim 12 does not recite that the first grain boundary phase is "in contact with" two main phases, as Appellant argues. We find no definition or limiting description of the first grain boundary phase in Appellant's Specification that would require the phase to be "in contact with" two main phases, and Appellant does not identify any such disclosure in the Specification. Appeal Br. 14–16. Accordingly, under the broadest reasonable interpretation of the plain language of claim 12, the R-rich grain boundary phase illustrated in Figure 10(b) of Nakajima corresponds to the recited "first grain boundary phase" because the (white) R-rich phase is *located between* two (gray) main phases. *In re ICON Health & Fitness, Inc.*, 496 F.3d 1374, 1379 (Fed. Cir. 2007) (citation omitted) (During prosecution of patent applications, "the PTO must give claims their broadest reasonable construction consistent with the specification . . . .Therefore, we look to the specification to see if it provides a definition for claim terms, but otherwise apply a broad interpretation.").

As the Examiner finds (Ans. 8–9), Nakajima discloses that the R-rich grain boundary phase "is a phase in which the concentration of all atoms of R which is rare earth elements is 70 [] % or more," and Nakajima further discloses that the R-rich grain boundary phase "may contain, substantially, only R." Nakajima ¶¶ 81, 88. These disclosures, in view of Nakajima's illustration in Figure 10(b) showing the R-rich phase positioned between two main phases, would have suggested a (first) grain boundary phase located between two main phases that includes 20 % or less of Fe or Fe+Co, as recited in claim 22.

We, accordingly, sustain the Examiner's rejection of claim 22 under 35 U.S.C. § 103 as unpatentable over Nakajima.

Claim 23

Claim 23 depends from claim 12 and recites that the R-T-B-based sintered magnet does not contain Dy (Dysprosium).

Appellant argues that Nakajima teaches away from an R-T-B-based sintered magnet as recited in claim 23 because Nakajima's First Embodiment, in which B/TRE is preferably 0.355 to 0.38, which the Examiner relies on in rejecting claim 12 (as discussed above), requires Formula 1 ($0.0049Dy+0.34 \leq B/TRE \leq 0.0049Dy+0.36$) to be met. Appeal Br. 17. Appellant argues that when Dy is zero, Formula 1 becomes $0.34 \leq B/TRE \leq 0.36$, and because Nakajima discloses that TRE ranges from 13 % to 15 %, the largest amount of B that would satisfy this formula is 5.40 % (5.40/15=0.36), which is below the lower limit of the B concentration recited in claim 12. *Id.* Appellant argues that Nakajima's disclosure that "[w]hen the amount of B is beyond the range of the above Formula 1, the generation amount of the transition metal-rich phase becomes insufficient, and the coercive force does not sufficiently improve" (Nakajima ¶ 87), "teaches away from the [R-T-B-based sintered magnet of the] present invention" that has a boron concentration that does not satisfy Nakajima's Formula 1 when Dy is zero as recited in claim 23. Appeal Br. 17–18.

As discussed above, however, Nakajima discloses numerous embodiments of the R-T-B-based sintered magnet of Nakajima's invention. In response to Appellant's argument, the Examiner finds in the Answer that Nakajima discloses an embodiment that does not require Formula 1 to be met, in which the R-T-B-based sintered magnet includes 0% to 65 % Dy, 13 % to 15 % rare earth elements (R), 5 % to 6 % B, 0.1 % to 2.4 % of one or more metals (M) selected from Al, Ga, and Cu, and the balance consisting of a transition metal containing essentially Fe (T), where B/TRE is preferably 0.355 to 0.38. Ans. 11 (citing Nakajima ¶¶ 49–52). The Examiner determines that this embodiment disclosed in Nakajima renders the R-T-B-based sintered magnet of claim 23 prima facie obvious. Ans. 11.

Appellant argues in the Reply Brief that one of ordinary skill in the art considering Nakajima as a whole would consider the embodiment described in paragraphs 49–52 and relied-upon by the Examiner as rendering claim 23 prima facie obvious to be within Nakajima's "First Embodiment," because Nakajima's description of the "First Embodiment" in paragraphs 85–92 discloses features of paragraphs 49–52. Reply Br. 6–7. Appellant argues that Formula 1, therefore, must be met in the embodiment described in paragraphs 49–52 of Nakajima. *Id*.

Although Nakajima's description of the "First Embodiment" discloses certain features of the embodiment described in paragraphs 49–52 of Nakajima, the same holds true for Nakajima's description of a "Second Embodiment" in paragraphs 162 to 185, and description of a "Third Embodiment" in paragraphs 186 to 211. Simply because embodiments of Nakajima's invention share similarities and overlapping features do not mean that the numerous embodiments described in the reference are not separate embodiments with distinct features. We find no actual disclosure in Nakajima indicating that the embodiment described in paragraphs 49–52 is within, or part of, Nakajima's "First Embodiment" that requires Formula 1 to be met, and Appellant does not identify any such disclosure. And significantly, paragraphs 49–52 make no mention of Formula 1. Consequently, Appellant's arguments are unpersuasive of reversible error in the Examiner's determination that the embodiment described in paragraphs

49–52 of Nakajima renders claim 23 prima facie obvious.

We, accordingly, sustain the Examiner's rejection of claim 23 under 35 U.S.C. § 103 as unpatentable over Nakajima.

CONCLUSION

Claims Rejected	**35 U.S.C. §**	**Basis**	**Affirmed**	**Reversed**
12–14, 19, 22, and 23	103	Nakajima	12–14, 19, 22, and 23	

No time period for taking any subsequent action in connection with this appeal may be extended under 37 C.F.R. § 1.136(a)(1)(iv).

AFFIRMED