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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE
THE PATENT TRIAL AND APPEAL BOARD

Ex parte GANJIANG FENG,¹
Michael Douglas Arnett, and Shan Liu

Appeal 2018-000089
Application 14/193,198
Technology Center 1700

Before MARK NAGUMO, BRIAN D. RANGE, and LILAN REN,
Administrative Patent Judges.

Opinion for the Board filed by *Administrative Patent Judge*
MARK NAGUMO

Opinion concurring filed by *Administrative Patent Judges*
BRIAN D. RANGE and LILAN REN

DECISION ON APPEAL

We vacate the Decision mailed December 20, 2018, in favor of this substitute Decision because the concurring opinion of the original Decision included some inadvertent typographical errors.

¹ The applicants under 37 C.F.R. § 1.46, and hence the appellants under 35 U.S.C. § 134, are the real parties in interest, identified as the inventors, Ganjiang Feng, Michael Douglas Arnett, and Shan Liu, and the assignee, General Electric Company. (Appeal Brief, filed 21 April 2017 (“Br.”), 1.)

General Electric Company, and the inventors, Ganjiang Feng, Michael Douglas Arnett, and Shan Liu (“Feng”) timely appeal under 35 U.S.C. § 134(a) from the Final Rejection² of all pending claims 1–3, 5–13, and 15–20. We have jurisdiction. 35 U.S.C. § 6. We affirm.

OPINION

A. Introduction³

The subject matter on appeal relates to nickel [Ni]-based superalloys disclosed as being useful for “[h]ot gas path components of gas turbines and aviation engines, particularly turbine blades, vanes, nozzles, seals and stationary shrouds [that] operate at elevated temperatures, often in excess of 2,000 °F” (Spec. 1 [0003].) Such components are said to be fabricated from single crystals of superalloy comprising, typically, rhenium (Re) at 1–3 percent by weight, with some superalloys comprising as much as 6% Re. (*Id.*) The record indicates that rhenium is well known in the Ni-superalloy art as a “potent solid solution strengthener.” (O’Hara,⁴ col. 4, ll. 13–14.) One such Ni-superalloy is disclosed as being available from General Electric Company under the name “René N2,” referred to in the Specification generically as “N2Re.” (Spec. 1 [0004].)

² Office Action mailed 21 March 2017 (“Final Rejection”; cited as “FR”).

³ Application 14/193,198, *Article and method for forming article*, filed 28 February 2014. We refer to the “198 Specification,” which we cite as “Spec.”

⁴ Kevin Swayne O’Hara et al., *Nickel-base superalloy composition and its use in single-crystal articles*, U.S. Patent No. 6,905,559 B2 (2005), assigned to General Electric Co. and cited in the information disclosure statement (“IDS”) filed 28 February 2014.

Rhenium, however, is said to be one of the most expensive materials, and the processing of single-crystal parts is said to be time-consuming and costly. (*Id.* at 2 [0007].) Alloys without rhenium, such as “R108” are said to be available (*id.* at [0005]), and to have mechanical properties comparable to N2Re. However, R108 is said to be significantly inferior in hot corrosion resistance and oxidation resistance compared to N2Re. (*Id.* at [0006].)

Feng seeks patent protection for articles (independent claim 1) and methods of preparing articles (independent claim 12) made from an alloy with little or no rhenium, that has corrosion and oxidation resistance at elevated temperatures, as well as being “highly castable” and having other desirable features. It appears from the record that the “highly castable” condition is associated with “generally equiaxed, randomly oriented grains,” that are produced using conventional casting techniques (Shah,⁵ col. 1, ll. 24–27). Thus, the more difficult and expensive single-crystal manufacturing technology, which results in no internal grain boundaries,⁶ can be avoided when using the alloys of the claimed invention.

Claim 1 is representative and reads:

An article comprising an equiaxed grain structure and a composition, wherein the composition comprises, by weight percent:

about 6.2% to about 6.5% aluminum (Al);

up to about 0.04% titanium (Ti);

about 3.9% to about 4.3% tantalum (Ta);

⁵ The full citation for Shah is at 4 n.10, *infra*.

⁶ The presence of grain boundaries requires grain boundary strengthening elements such as C, B, Zr, or Hf for strength at high temperatures. (Shah col. 2, ll. 1–6.)

about 12.0% to about 12.5% chromium (Cr);
about 7.0% to about 8.0% cobalt (Co);
about 0.40% to about 0.75% molybdenum (Mo);
about 4.7% to about 5.1% tungsten (W);
about 0.08% to about 0.12% silicon (Si);
about 0.47% to about 0.53% hafnium (Hf);
about 0.005% to about 0.010% boron (B);
about 0.06% to about 0.10% carbon (C);
up to about 0.02% zirconium (Zr);
up to about 0.1 % lanthanum (La);
up to about 0.03% yttrium (Y);
up to about 0.01% rhenium (Re); and
balance nickel (Ni) and incidental impurities.

(Claims App., Br. 17.)

The Examiner maintains the following grounds of rejection^{7, 8}:

- A. Claims 1, 2, 5–12, and 16–18 stand rejected under 35 U.S.C. § 103 in view of the combined teachings of Shaw⁹ and Shah.¹⁰

⁷ Examiner’s Answer mailed 31 July 2017 (“Ans.”).

⁸ Because this application was filed after the 16 March 2013, effective date of the America Invents Act, we refer to the AIA version of the statute. References to the pre-AIA statute in the record appear to be typographical or word-processing errors.

⁹ Stewart Walter Ker Shaw et al., *Nickel alloy with good stress-rupture strength*, U.S. Patent No. 3,832,167 (1974).

¹⁰ Dilip M. Shah and David N. Duhl, *Single crystal articles having reduced anisotropy*, U.S. Patent No. 4,915,907 (1990).

- A1. Claims 3, 13, and 15 stand rejected under 35 U.S.C. § 103 in view of the combined teachings of Shaw, Shah, and Schilke.¹¹
- A2. Claims 19 and 20 stand rejected under 35 U.S.C. § 103 in view of the combined teachings of Shaw, Shah, and Bly.¹²
- B. Claims 1, 2, 5–12, and 15–18 stand rejected under 35 U.S.C. § 103 in view of the combined teachings of Lund¹³ and Shah.
- B1. Claims 3 and 13 stand rejected under 35 U.S.C. § 103 in view of the combined teachings of Lund, Shah, and Schilke.
- B2. Claims 19 and 20 stand rejected under 35 U.S.C. § 103 in view of the combined teachings of Lund, Shah, and Bly

B. Discussion

The Board’s findings of fact throughout this Opinion are supported by a preponderance of the evidence of record.

The Federal Circuit has explained that on appeal, the appellant must not only show the existence of error, but also that the error was harmful because it affected the decision below. *In re Jung*, 637 F.3d 1356, 1365 (Fed. Cir. 2011) (“even assuming that the examiner had failed to make a prima facie case, the Board would not have erred in framing the issue as one of “reversible error.”); *In re Chapman*, 595 F.3d 1330, 1338 (Fed. Cir. 2010), quoting *Shinseki v. Sanders*, 556 U.S. 396, 409 (2009) (“the

¹¹ Peter W. Schilke and David N. Duhl, *Gas turbine blade tip alloy and composite*, U.S. Patent No. 4,152,488 (1979).

¹² Kenneth B. Bly and Donald S. Mills, *Pressure pouring in a vacuum environment*, U.S. Patent No. 3,635,791 (1972).

¹³ Carl H. Lund et al., *High temperature castable alloys and castings*, U.S. Patent No. 3,677,747 (1972).

burden of showing that an error is harmful normally falls upon the party attacking the agency's determination.”).

Feng focuses on claim 1, and does not present substantively separate arguments for the patentability of the remaining claims. We therefore focus our attention on claim 1, with which the remaining claims stand or fall.

Feng does not dispute, with respect to both Shaw (Br. 4–9) and Lund (*id.* at 11–15), the Examiner's finding (FR3, 1st para., and Table 1 at FR3–4) that the ranges of elements recited in the references overlap the ranges recited in claim 1. Nor does Feng challenge the Examiner's finding (FR 3, 4th para.) that Shah would have suggested that equiaxed grain structures arise with conventional casting described by Shaw. Consideration of FR 3–4, Table 1 (comparing Shaw to the claimed alloy), and FR 7–8, Table 2 (comparing Lund to the claimed alloy) shows that the “overlap” for most elements is the range recited in the appealed claims. On this basis, the Examiner holds that the selection of values within the disclosed ranges would have been *prima facie* obvious. (*Id.* at 3, 2d para.)

Feng's principal argument for patentability is based on “the most reasonable and conservative estimate” of the number of species encompassed by Shaw's disclosure. (*Id.* at 5, last para.) Feng posits that the range of each element recited in the appealed claims represents a single species, so an estimate of the number of species encompassed by Shaw for that element corresponds to the broad range disclosed by Shaw divided by the relatively narrow range required by claim 1. (*Id.*) The corresponding estimate of the total number of species is then the product of those ratios for each element, which is approximately 20 trillion (20×10^{12}) for Shaw

(*id.* at 7, l. 2), and approximately 13 trillion for Lund (*id.* at 13, l. 4–5). That huge number of species cannot, Feng urges, render the superalloy of the appealed claims obvious.

What is the state of the art, particularly what is known, and what are considered conventional analyses, are questions of fact. *Cf. In re Wands*, 858 F.2d 731, 737 (Fed. Cir. 1988) (discussing the many factual considerations underlying a determination of whether necessary experimentation would have been undue). Feng’s principal argument is not persuasive because it lacks evidence that the underlying assumptions would have been accepted by persons having ordinary skill in the art. In particular, Feng does not direct our attention to evidence of record supporting the assumption that the range recited for any given element represents a single species, and that a larger range contains directly proportionately more species having distinct and non-predictable properties. Thus, although Feng criticizes the Examiner for not making express findings regarding “the predictability of the technology, and the similarity of structure, properties, and utilities of the closest disclosed prior art species of record and the claimed species” (Br. 7, 1st full para., 2d sentence), the burden on appeal was for Feng to show harmful error in the Examiner’s implicit assumption, based on the presumption that the claims of the references reflect a single invention. While there are many ways this might be done, ranging from a demonstration of distinct and unpredictable sensitivity of product properties to composition (or conditions of manufacture), to statements from credible authorities such as technical treatises or review articles published close to the critical date, Feng has presented us with mere arguments of counsel. Even if not unreasonable, an argument will not suffice when facts in

evidence are required. *Cf. In re Mayne*, 104 F.3d 1339, 1344 (Fed. Cir. 1997) (“Even were it obvious to a practitioner of the art [that the BGH or HGH would have been expected to be inactive when fused to similar, recognized enterokinase cleavage site], applicants have the burden to provide the PTO with evidence showing that such is the case.”).

Feng urges further that, “none of the ‘average’ or specific compositions actually disclosed or discussed in Shaw come[] anywhere close to overlapping with the present claims.” (Br. 4, 2d full para., penultimate sentence; *cf. id.* at 11, last para., last sentence (similar, regarding Lund).) This observation, unembellished by a discussion of the state of the art, such as noted in the previous paragraph, amounts to no more than an invitation to the Board to scour the record for facts that might support the further inference that the references would not have led the routineer in the particular direction reported by the present inventors. We decline the invitation to such an undertaking, in the first instance, as our primary role is review, not examination de novo.

Finally, Feng argues that the Examiner erred further by not considering that O’Hara, describing the N2Re alloy, represents the closest prior art. (*Id.* at 9–11 (regarding Shaw); 15, 2d para., regarding Lund.) What is the closest prior art reference is a question of fact, “premised on the notion that the *teachings* of the closest prior art references are sufficiently similar so that the testing of one compound showing unexpected results would provide the same information as to the relevant teachings of the other equally close references.” *In re Johnson*, 747 F.2d 1456, 1461 (Fed. Cir. 1984). Feng may have been trying to improve over O’Hara by obtaining rhenium-free polycrystalline equiaxed alloys that nonetheless have

properties comparable to the NR2Re alloy taught by O'Hara. However, Feng does not explain why the routineer would have considered O'Hara to be closer and thus have been more likely, starting from O'Hara, to remove the rhenium, present as a critical element at 1–3% , than to select compositions within the ranges taught by Shaw or by Lund for modification. We are therefore not persuaded of harmful error in this regard.

We conclude that Feng has not demonstrated harmful error in the appealed rejections. We therefore affirm.

C. Order

It is ORDERED that the rejection of claims 1–3, 5–13, and 15–20 is affirmed.

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).

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BEFORE
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Technology Center 1700

Before MARK NAGUMO, BRIAN D. RANGE, and LILAN REN,
Administrative Patent Judges.

RANGE, *Administrative Patent Judge*, concurring, with
REN, *Administrative Patent Judge*, joining in concurrence.

We agree with and adopt the analysis provided by the majority. We write to provide additional analysis.¹⁴

Appellants' primary argument is that *if* each relatively narrow range recited by claim 1 were considered an independent species and *if* the broader range taught by the Shaw or Lund references were considered a genus having many narrower ranges (per Appellants' argument, species), then the vast number of species within the prior art's genus would mean that *prima facie* obviousness could not be established merely by the Examiner finding

¹⁴ This concurring opinion corrects various non-substantive typographical errors present in the previously issued concurring opinion.

that the claimed range overlaps the prior art's broader range. Appeal Br. 4–7, 11–14 (citing *In re Baird*, 16 F.3d 380, 383 (Fed. Cir. 1994)).

While the creativity of Appellants' argument is appreciated, the argument fails for the reasons set forth in the majority opinion and also because the argument does not legally comport with existing precedent. Our reviewing court has repeatedly held that a prima facie case of obviousness typically exists where ranges of a claimed composition overlap ranges taught by the prior art. *See, e.g., In re Harris*, 409 F.3d 1339, 1341 (Fed. Cir. 2005); *In re Peterson*, 315 F.3d 1325, 1329 (Fed. Cir. 2003); *see also In re Woodruff*, 919 F.2d 1575, 1577 (Fed. Cir. 1990) (holding that prior art teaching of “about 1–5%” overlapped with claimed concentration requiring “more than 5%”); *Iron Grip Barbell Co. v. USA Sports, Inc.*, 392 F.3d 1317, 1322 (Fed. Cir. 2004) (holding that there is a presumption of obviousness “where there is a range disclosed in the prior art, and the claimed invention falls within that range” but the presumption may be rebutted by showing a teaching away or unexpected results). Indeed, our reviewing court has held that even ranges whose overlap is merely touching (or near touching) at an end point may be sufficient absent some evidence of differing properties. *See In re Brandt*, 886 F.3d 1171, 1175 (Fed. Cir. 2018) (affirming Board's decision that prior art teaching between 6 and 25 pounds per cubic foot was sufficient for a prima facie obviousness rejection of a claim reciting less than 6 pounds per cubic foot); *In re Geisler*, 116 F.3d 1465, 1469 (Fed. Cir. 1997) (acknowledging that a claimed invention was rendered prima facie obvious by a prior art reference whose disclosed range overlapped the claimed range).

The facts of *In re Geisler*, 116 F.3d 1465 (Fed. Cir. 1997), illustrate the problem with Appellants' approach relative to existing law. There, our reviewing court affirmed the Board's decision that a claimed thickness range of 50–100 Angstroms was rendered prima facie obvious by a prior art reference that taught 100–600 Angstroms. *Id.* at 1469. By Appellants' analysis, the only “species” in common between the claim and the art was at exactly 100 Angstroms—mathematically speaking, this is an infinitely small overlapping range. An infinite number of such “species” of this small range exist within the broader 100–600 range taught by the prior art, yet prima facie obviousness was nonetheless established. *See also In re Malagari*, 499 F.2d 1297, 1303 (CCPA 1974) (claimed invention is rendered prima facie obvious by the teachings of a prior art reference that discloses a range that touches the range recited in the claim).

Appellants' proffered genus/species analysis relies on the reasoning of *In re Baird*, 16 F.3d at 383. Appeal Br. 5. The *In re Baird* decision related to a prior art reference that provided a chemical formula that encompassed more than 100 million diphenols and only one of those diphenols was the claimed bisphenol A. *In re Baird*, 16 F.3d at 382. In that circumstance, our reviewing court held that the reference did “not teach or fairly suggest the selection of bisphenol A.” *Id.* at 383.

Selection of one particular molecule from millions of possibilities is different in kind from selecting a narrow range of amounts of known ingredients to a composition within a broader range. Here, the prior art references' teaching of relatively broad ranges fairly suggests that any choice within the range could be achieved with a reasonable expectation of success. *See, e.g.*, Shaw claim 1; Lund Table 1. Because of unpredictability

within the chemical arts, no such suggestion necessarily follows with regard to all possible substituents of a molecule. *See, e.g., In re Marzocchi*, 439 F.2d 220, 223–24 (CCPA 1971) (referring to the “well-known unpredictability of chemical reactions”).

Appellants also cite the MPEP statement that “if the reference’s disclosed range is so broad as to encompass a very large number of possible compositions, this **might** present a situation analogous to the obviousness of a species when the prior art broadly discloses a genus.” Appeal Br. 4–5 (quoting MPEP § 2144.05(1)) (emphasis added). The MPEP’s statement, in turn, originates from a footnote from our reviewing court’s *In re Peterson* decision. *In re Peterson*, 315 F.3d at 1330, n. 2 (Fed. Cir. 2003). In that footnote, the court expressly declined to determine whether or not a disclosed range may be too broad to render *prima facie* obvious a narrower range within it:

Although ranges that are not especially broad invite routine experimentation to discover optimum values, rather than require nonobvious invention, we do not have here any assertion that the disclosed range is so broad as to encompass a very large number of possible distinct compositions. **We thus do not need to decide whether a disclosed range of such breadth might present a situation analogous to our cases involving the failure of a very broad disclosed genus of substances to render *prima facie* obvious specific substances within its scope.** *See, e.g., In re Baird*, 16 F.3d 380, 29 USPQ2d 1550 (Fed.Cir.1994); *In re Jones*, 958 F.2d 347, 21 USPQ2d 1941 (Fed.Cir.1992).

Id. (emphasis added). *In re Petersen* and the MPEP both identify the possibility that a claimed narrow range within a broad range *might* present a situation akin to *In re Baird*, but neither *In re Petersen* nor the MPEP affirmatively state that the *In re Baird* analysis must or should be applied to

range cases.

If there is any logical tension between our reviewing court's rationale of *In re Baird* and its decisions addressing overlapping ranges, it is beyond our purview to resolve the tension. Rather, we are bound by statute and the precedent of our reviewing courts. As explained above, the greater weight of the precedent holds that overlapping ranges are sufficient to establish prima facie obviousness especially where, as here, the record lacks evidence that properties within the claimed range differ from those for the broader range taught by the art. Establishment of the prima facie case of obviousness shifts the burden to a patentee to show facts supporting the opposite conclusion (by, for example, establishing unexpected results). *In re Piasecki*, 756 F.2d 1468, 1472 (Fed. Cir. 1984).

We therefore affirm the rejection of claims 1–3, 5–13, and 15–20 for the reasons provided by the majority opinion and also for the additional reasons explained above.