

# United States Court of Appeals for the Federal Circuit

02-1129  
(Serial no. 08/365,392)

IN RE LANCE G. PETERSON and IOANNIS VASATIS

James T. Hosmer, Nixon & Vanderhye P.C., of Arlington, Virginia, argued for appellants. With him on the brief was Leonard C. Mitchard.

William LaMarca, Associate Solicitor, Office of the Director of the United States Patent and Trademark Office, of Arlington, Virginia, argued for the Director. With him on the brief were John M. Whealan, Solicitor, and Joseph Piccolo, Associate Solicitor.

Appealed from: United States Patent and Trademark Office  
Board of Patent Appeals and Interferences

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DECIDED: January 8, 2003

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Before LOURIE, BRYSON, and DYK, Circuit Judges.

LOURIE, Circuit Judge.

Lance G. Peterson and Ioannis Vasatis (collectively, "Peterson") appeal from the decision of the U.S. Patent and Trademark Office ("PTO") Board of Patent Appeals and Interferences affirming the rejection of claims 1-7 of U.S. Patent Application 08/365,392 as obvious under 35 U.S.C. § 103. Ex Parte Wood, Appeal No. 1998-0535, Paper No. 19 (B.P.A.I. Apr. 23, 2001). Because substantial evidence supports the Board's factual findings and the Board did not err in its conclusion of obviousness, we affirm.

## BACKGROUND

On December 28, 1994, Mr. Peterson filed U.S. Patent Application 08/365,392, which is directed to a nickel-base single-crystal superalloy used in the manufacture of industrial gas turbine engines exposed to high temperatures. The claimed composition includes a relatively small amount of rhenium and aims to improve a single-crystal alloy's mechanical strength without reducing its hot corrosion resistance. Representative claim 5 recites:

A nickel-base superalloy having special utility in the production of single crystal gas turbine engine blades consisting essentially of about 1 to 3 percent rhenium, about 14 percent chromium, about 9.5 percent cobalt, about 3.8 percent tungsten, about 2 percent tantalum, about 1.5 percent molybdenum, about 0.05 percent carbon, about 0.004 percent boron and, respectively, from about 3 to 4.8 percent aluminum, from about 4.8 percent to about 3 percent titanium, and balance substantially nickel.

(emphases added). Peterson and the Board considered that the other claims stand or fall with claim 5, and we will therefore consider only claim 5.

The examiner rejected claims 1-7 under 35 U.S.C. § 103 as obvious over the following prior art references: (1) published European Patent Application 240,451 (“Shah”); (2) published European Patent Application 076,360 (“Wukusick”) alone or in view of U.K. Patent 2,153,848 (“Duhl”); and (3) U.S. Patent 3,619,182 (“Bieber”) in view of Wukusick. For each ground of rejection, the examiner found a prima facie case of obviousness based on the overlapping element ranges of the prior art compositions and the claimed composition. Peterson responded by arguing that his invention would not have been obvious because the prior art disclosed only the optional use of rhenium and did not suggest that controlled amounts of rhenium would result in advantageous mechanical properties. Peterson also pointed to the unexpected results achieved by his invention: namely, the increased stress rupture life resulting from the addition of a small amount of rhenium. The examiner rejected those arguments in a final office action, finding that Peterson had failed to show criticality of the selected amount of rhenium commensurate in scope with the claims.

The Board affirmed the examiner’s rejection. First, the Board found that the disclosure of overlapping ranges in Shah, Wukusick, and Bieber each established a prima facie case of obviousness. With respect to the rejection based primarily on Wukusick, the Board determined that the claimed range of “about 14 percent chromium” encompassed Wukusick’s teaching to use up to 12% chromium. Secondly, the Board found that Peterson had failed to show that the claimed alloy possesses properties that would have been considered unexpected by a person of ordinary skill in the art. Specifically, the Board found that Peterson had not compared the claimed invention with the closest prior art (Wukusick’s Alloy 2) and had not shown that the claimed range of

rhenium was critical to improving stress rupture life. Thus, the Board concluded that Peterson's evidence of nonobviousness did not outweigh the evidence of obviousness and affirmed the examiner's rejection of claims 1-7.

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

## DISCUSSION

The ultimate determination whether an invention would have been obvious under 35 U.S.C. § 103 is a legal conclusion based on underlying findings of fact. In re Kotzab, 217 F.3d 1365, 1369, 55 USPQ2d 1313, 1316 (Fed. Cir. 2000). We review the Board's legal conclusion of obviousness de novo and its underlying factual determinations for substantial evidence. In re Gartside, 203 F.3d 1305, 1316, 53 USPQ2d 1769, 1776 (Fed. Cir. 2000). Whether an invention has produced unexpected results and whether a reference teaches away from a claimed invention are questions of fact. In re Mayne, 104 F.3d 1339, 1343, 41 USPQ2d 1451, 1455 (Fed. Cir. 1997) (unexpected results); Para-Ordnance Mfg. v. SGS Importers Int'l, 73 F.3d 1085, 1088, 37 USPQ2d 1237, 1239 (Fed. Cir. 1995) (teaching away). Under the substantial evidence standard, we affirm the Board's factual determinations if they are based upon "such relevant evidence as a reasonable mind might accept as adequate to support a conclusion." In re Gartside, 203 F.3d at 1312, 53 USPQ at 1773 (quoting Consolidated Edison Co. v. NLRB, 305 U.S. 197, 217 (1938)).

On appeal, Peterson argues that the cited prior art does not establish a prima facie case of obviousness because it does not suggest the claimed combination of "about 1 to 3 percent rhenium" with "about 14 percent chromium" to create an alloy having improved strength. As to the first ground of rejection, Peterson contends that a skilled artisan would not have assumed from Shah that using the claimed amounts of

rhodium and chromium would improve alloy strength because Shah defines very broad ranges for rhodium (0-7%) and chromium (3-18%), mentions rhodium only as an optional ingredient, and discloses a preferred alloy containing no rhodium. With respect to the second ground of rejection, Peterson asserts that the Board misconstrued the phrase “about 14 percent chromium” to include 12% chromium. Peterson also argues that Wukusick only discloses the optional use of rhodium and does not suggest the combined use of rhodium and chromium in the amounts claimed. As to the final ground of rejection, Peterson argues that Bieber does not mention rhodium as a component in its alloys and even warns that increasing the chromium content to improve corrosion resistance will have “catastrophic effects” on other properties.

Peterson alternatively argues that, even if a prima facie case of obviousness were established, the Board erred in determining that the evidence of nonobviousness was insufficient to rebut the prima facie case. Peterson points out that the claimed invention was the first to achieve the combination of corrosion resistance and improved strength for nickel-base single-crystal superalloys. Peterson thus contends that the examiner and the Board failed to appreciate the criticality of and the unexpected results achieved by the claimed combination of about 1-3% rhodium with, among other elements, about 14% chromium. Peterson further argues that Wukusick and Bieber teach away from the claimed invention by warning that high chromium contents can adversely affect alloy strength.

The PTO responds that the Board correctly found that the claimed composition would have been obvious based on any one of the three grounds of rejection because Shah, Wukusick, and Bieber all disclose ranges of elements that overlap the claimed ranges. The PTO argues that the Board properly interpreted the phrase “about 14

percent chromium” to include Wukusick’s 12% chromium because Example I in Peterson’s application discloses a superalloy containing 12.03% chromium.

The PTO further responds that the Board correctly determined that Peterson failed to overcome the prima facie case of obviousness. The PTO contends that substantial evidence supports the Board’s findings that Wukusick does not teach away from the invention and that Peterson failed to show unexpected results. Specifically, the PTO points out that Peterson’s specification shows improved performance in stress rupture life only for 2% rhenium, rather than for the full claimed range of about 1-3% rhenium, and that Peterson failed to compare his results with the closest prior art.

#### A. The Prima Facie Case of Obviousness

A prima facie case of obviousness typically exists when the ranges of a claimed composition overlap the ranges disclosed in the prior art. E.g., In re Geisler, 116 F.3d 1465, 1469, 43 USPQ2d 1362, 1365 (Fed. Cir. 1997); In re Woodruff, 919 F.2d 1575, 1578, 16 USPQ2d 1934, 1936-37 (CCPA 1976); In re Malagari, 499 F.2d 1297, 1303, 182 USPQ 549, 553 (CCPA 1974). Such is the case here. Claim 5 of Peterson’s application recites and Shah discloses superalloys having the following compositions:

	<u>Claim 5</u>	<u>Shah</u>
Rhenium	about 1-3%	0-7%
Chromium	about 14%	3-18%
Cobalt	about 9.5%	0-20%
Tungsten	about 3.8%	0-18%
Tantalum	about 2%	0-15%
Molybdenum	about 1.5%	0-4%
Carbon	about 0.05%	at least 0.002%
Boron	about 0.004%	at least 0.002%
Aluminum	about 3-4.8%	3-8%
Titanium	about 4.8% to about 3%	0-5%
Nickel	balance	balance

Clearly, Peterson’s application and Shah contain overlapping ranges, as each range listed in Peterson’s claim 5 lies within the corresponding range disclosed in Shah. Thus, Shah’s ranges encompass Peterson’s.

Peterson argues that, despite that overlap, it would not have been prima facie obvious to select the claimed narrower ranges of rhenium and chromium from Shah's broader ranges of those elements. We disagree. In cases involving overlapping ranges, we and our predecessor court have consistently held that even a slight overlap in range establishes a prima facie case of obviousness. E.g., In re Woodruff, 919 F.2d at 1578, 16 USPQ2d at 1936-37 (concluding that a claimed invention was rendered obvious by a prior art reference whose disclosed range ("about 1-5%" carbon monoxide) abutted the claimed range ("more than 5% to about 25%" carbon monoxide)); In re Malagari, 499 F.2d at 1303, 182 USPQ at 553 (concluding that a claimed invention was rendered prima facie obvious by a prior art reference whose disclosed range (0.020-0.035% carbon) overlapped the claimed range (0.030-0.070% carbon)); see also In re Geisler, 116 F.3d at 1469, 43 USPQ2d at 1365 (acknowledging that a claimed invention was rendered prima facie obvious by a prior art reference whose disclosed range (50-100 Angstroms) overlapped the claimed range (100-600 Angstroms)). We have also held that a prima facie case of obviousness exists when the claimed range and the prior art range do not overlap but are close enough such that one skilled in the art would have expected them to have the same properties. Titanium Metals Corp. v. Banner, 778 F.2d 775, 783, 227 USPQ 773, 779 (Fed. Cir. 1985) (concluding that a claim directed to an alloy containing "0.8% nickel, 0.3% molybdenum, up to 0.1% maximum iron, balance titanium" would have been prima facie obvious in view of a reference disclosing alloys containing 0.75% nickel, 0.25% molybdenum, balance titanium and 0.94% nickel, 0.31% molybdenum, balance titanium).

In light of that case law, we conclude that a prima facie case of obviousness was made out in this case. Selecting a narrow range from within a somewhat broader range disclosed in a prior art reference is no less obvious than identifying a range that simply

overlaps a disclosed range. In fact, when, as here, the claimed ranges are completely encompassed by the prior art, the conclusion is even more compelling than in cases of mere overlap. The normal desire of scientists or artisans to improve upon what is already generally known provides the motivation to determine where in a disclosed set of percentage ranges is the optimum combination of percentages. See In re Boesch, 617 F.2d 272, 276, 205 USPQ 215, 219 (CCPA 1980) (“[D]iscovery of an optimum value of a result effective variable in a known process is ordinarily within the skill of the art.” (citations omitted)).<sup>1</sup> We therefore conclude that a prior art reference that discloses a range encompassing a somewhat narrower claimed range is sufficient to establish a prima facie case of obviousness. That is not to say that the claimed composition having a narrower range is unpatentable. Rather, the existence of overlapping or encompassing ranges shifts the burden to the applicant to show that his invention would not have been obvious, as we discuss below. Accordingly, because Shah’s ranges encompass Peterson’s, we conclude that the Board did not err in determining that Shah renders Peterson’s claimed composition prima facie obvious.<sup>2</sup>

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<sup>1</sup> 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).

<sup>2</sup> Consequently, we need not address the prima facie obviousness arguments based on the Wukusick, Duhl, and Bieber references. We note, however, that those references are less convincing than Shah in creating a prima facie case of obviousness. There is no genuine overlap between Wukusick’s disclosed range of 7-12% chromium and Peterson’s claimed range of “about 14 percent chromium.” Peterson’s only mention of an alloy having about 12% chromium is of a test alloy in its comparative Example I; it is not an example of Peterson’s invention. Duhl and Bieber do not even mention rhenium, let alone disclose compositions with rhenium.

## B. Rebuttal of the Prima Facie Case

We turn next to Peterson's attempt to rebut the prima facie case of obviousness. In general, an applicant may overcome a prima facie case of obviousness by establishing "that the [claimed] range is critical, generally by showing that the claimed range achieves unexpected results relative to the prior art range." In re Geisler, 116 F.3d at 1469-70, 43 USPQ2d at 1365 (alteration in original) (quoting In re Woodruff, 919 F.2d at 1578, 16 USPQ2d at 1936). That same standard applies when, as here, the applicant seeks to optimize certain variables by selecting narrow ranges from broader ranges disclosed in the prior art. See In re Geisler, 116 F.3d at 1470, 43 USPQ2d at 1365 ("Only if the 'results of optimizing a variable' are 'unexpectedly good' can a patent be obtained for the claimed critical range." (quoting In re Antoine, 559 F.2d 618, 620, 195 USPQ 6, 8 (CCPA 1977))); In re Wertheim, 541 F.2d 257, 267, 191 USPQ 90, 100 (CCPA 1976) (recognizing that "ranges which overlap or lie inside ranges disclosed by the prior art may be patentable if the applicant can show criticality in the claimed range by evidence of unexpected results"). Moreover, the applicant's showing of unexpected results must be commensurate in scope with the claimed range. See In re Greenfield, 571 F.2d 1185, 1189, 197 USPQ 227, 230 (CCPA 1978) ("Establishing that one (or a small number of) species gives unexpected results is inadequate proof, for 'it is the view of this court that objective evidence of non-obviousness must be commensurate in scope with the claims which the evidence is offered to support.'" (quoting In re Tiffin, 448 F.2d 791, 792, 171 USPQ 294, 294 (CCPA 1971))).

We agree with the PTO that substantial evidence supports the Board's finding that Peterson failed to show that the addition of rhenium results in unexpected improvements in alloy strength for the entire claimed range of "about 1 to 3 percent" rhenium. The specification includes several examples of superalloy compositions and

their respective strengths, measured by average rupture life. Of most relevance are the following data disclosed in those examples: Example I, which contains no rhenium, resulted in an average rupture life of about 34 hours. Example II, which includes 1% rhenium, resulted in an average rupture life of about 57 hours. Example III, which contains 2% rhenium, resulted in an average rupture life of about 114 hours.

Although those data show that alloy strength improved with the addition of rhenium, they do not evidence unexpected results for the entire claimed range of about 1-3% rhenium. From the few data points provided, the most significant improvement in stress rupture life occurred with the addition of 2% rhenium. However, the Board's implicit conclusion that the addition of rhenium in the lower portion of the claimed range did not produce unexpected results (i.e., the addition of 1% rhenium increased stress rupture life from 34 hours to only 57 hours) is supported by substantial evidence, and there are no data to show that the addition of rhenium in the uppermost portion of the claimed range (i.e., 3% rhenium) would lead to unexpected results. In fact, the only data that report the stress rupture life of an alloy having 3% rhenium seem to suggest the opposite. In an experiment similar to that demonstrated by Examples III, Example IV includes no rhenium and resulted in an average rupture life of about 148 hours. Example V, which contains 2% rhenium, resulted in an average rupture life of about 275 hours. Example VI, which contains 3% rhenium but less titanium than Examples IV and V, resulted in an average rupture life of only about 130 hours. Thus, the only data for an alloy containing 3% rhenium actually show a decrease in average rupture life as compared with alloys having 0% or 2% rhenium. Moreover, whether an applicant has shown unexpected results is a question of fact, on which we defer to the Board. We therefore conclude that substantial evidence supports the Board's finding that Peterson

has not shown unexpected results that are commensurate in scope with the claimed range of “about 1-3 percent” rhenium.

Alternatively, an applicant may rebut a prima facie case of obviousness by showing that the prior art teaches away from the claimed invention in any material respect. In re Geisler, 116 F.3d at 1469, 43 USPQ2d at 1365 (quoting In re Malagari, 499 F.2d at 1303, 182 USPQ at 553). Peterson contends that the prior art teaches away from the claimed invention in that Wukusick teaches that the amount of chromium must be reduced when rhenium is added to a nickel-base superalloy for strength purposes. Peterson also argues that Bieber teaches away from the invention by warning that a high chromium content can have “catastrophic effects” on alloy strength.

We agree with the PTO that substantial evidence supports the Board’s finding that the prior art does not teach away from the claimed invention. Although the Board did not expressly address “teaching away” in the context of Peterson’s attempt to rebut the prima facie case of obviousness, it did find that the Shah, Wukusick, and Bieber references teach the invention and themselves establish prima facie cases of obviousness. Implicitly, then, the Board found that those references do not teach away from Peterson’s invention. Certainly the Shah reference, the rejection on which we have affirmed the Board’s decision, does not teach away from the invention. While it mentions a preferred alloy that does not contain rhenium, it does not disparage or otherwise discourage the use of alloys containing rhenium. Although Wukusick and Bieber may suggest upper limits on chromium content in order to avoid adverse effects on alloy strength, they disclose alloys containing as much as 12% and 14% chromium, respectively. Moreover, Wukusick expressly teaches that adding rhenium will improve high-temperature strength. Thus, substantial evidence supports the Board’s factual finding that the prior art does not teach away from Peterson’s combination of about 1-

3% rhenium with about 14% chromium. We thus conclude that the Board did not err in its determination that Peterson failed to rebut the prima facie case of obviousness or in its ultimate conclusion that Peterson's claimed superalloy would have been obvious under § 103.

#### CONCLUSION

Substantial evidence supports the Board's findings that Peterson's claimed element ranges are encompassed by the ranges disclosed in the Shah reference, that Peterson did not show unexpected results commensurate in scope with the claimed range of rhenium, and that the prior art does not teach away from the claimed invention. Thus, the Board did not err in concluding that claims 1-7 would have been obvious under § 103. Accordingly, the Board's decision is

AFFIRMED.