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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Ex parte JÖRG PETER FEIST and
JOHN RAYMENT NICHOLLS

Appeal 2018-003460
Application 12/937,310
Technology Center 1700

Before JAMES C. HOUSEL, N. WHITNEY WILSON, and
DEBRA L. DENNETT, *Administrative Patent Judges*.

Opinion for the Board filed by *Administrative Patent Judge* DENNETT,.

Opinion concurring filed by *Administrative Patent Judge* HOUSEL.

DENNETT, *Administrative Patent Judge*.

DECISION ON APPEAL

STATEMENT OF THE CASE

Appellants appeal under 35 U.S.C. § 134(a) from a final rejection of claims 1–5, 92, and 107–119.¹ We have jurisdiction under 35 U.S.C. § 6(b).

We REVERSE.

¹ Claims 6–17, 91, and 105 are withdrawn from consideration and, thus, are not subject to the appealed rejections. Final Act. 1.

The claims are directed to components coated with thermal barrier coatings. Such components typically are used in the aviation and power generation industries and are subjected to high temperatures. Spec. 1. Claim 1, reproduced below from the Claims Appendix, illustrates the claimed subject matter:

1. A component coated with a thermal barrier coating (TBC), wherein the TBC includes an outer surface layer and at least one underlying layer, wherein the outer surface layer has a thickness of at least 20% and not more than 50% of a thickness of the TBC, has a lower average porosity than the at least one underlying layer and includes an additional phase therewithin.

REFERENCES

The Examiner relies on the following prior art in rejecting the claims on appeal:

Subramanian ("Subramanian '539")	US 6,387,539 B1	May 14, 2002
Subramanian ("Subramanian '137")	US 6,703,137 B2	Mar. 9, 2004
Spitsberg et al. ("Spitsberg")	US 6,875,529 B1	Apr. 5, 2005
Floyd et al. ("Floyd")	US 2007/0036997 A1	Feb. 15, 2007
Feist et al. ("Feist")	WO 2007/023293 A2	Mar. 1, 2007
Yang et al., <i>Role of $Y_4Al_2O_9$ in High Temperature Oxidation Resistance of $NiCoCrAlY-ZrO_2 \cdot Y_2O_3$ Coatings</i> , 23 J. Mater. Sci. Technol., 568–570 (2007).		

REJECTIONS

The Examiner maintains and Appellants seek review of the following rejections as obvious under 35 U.S.C. § 103(a):

(1) Claims 1–3, 107, 109–111, 116, 118, and 119 over Floyd in view of Spitsberg;

(2) Claims 4 and 5 over Floyd in view of Spitsberg, and further in view of Subramanian '539;

(3) Claims 108 and 117 over Floyd in view of Spitsberg, and further in view of Subramanian '137;

(4) Claims 112–114 over Floyd in view of Spitsberg, and further in view of Feist;

(5) Claims 112 and 115 over Floyd in view of Spitsberg, and further in view of Yang;

(6) Claim 92 over Floyd in view of Spitsberg, and further in view of Feist; and

(7) Claim 92 over Floyd in view of Spitsberg, and further in view of Yang. Final Act. 2–8; App. Br. 6–22.

OPINION

All of the rejections in this case require the combination of at least Floyd and Spitsberg to find obviousness of the claims. Final Act. 2–8. Our decision in this case turns on whether one of ordinary skill in the art at the time of the invention would have had a reasonable expectation of success in combining these two references, as required to provide a prima facie case of obviousness.

The Examiner rejects independent claim 1 over Floyd in view of Spitsberg. *Id.* at 2–3. The Examiner finds that Floyd discloses a multilayer thermal barrier coating (TBC) comprising an outer layer that is substantially less porous than an inner layer, but is silent with respect to the relative thickness of the inner and outer layers. *Id.* at 3. The Examiner finds that Spitsberg discloses a TBC comprising an inner and outer layer wherein the

outer layer is thinner than the inner layer, the inner layer comprising from 50% to 95% of the total thickness of the TBC. *Id.* The Examiner concludes that it would have been obvious to use inner and outer TBC layers having the relative thickness as disclosed in Spitsberg in the TBC of Floyd. *Id.* In other words, the Examiner combines the porosity of the TBC outer layer taught by Floyd with the relative thickness of the TBC inner and outer layers taught by Spitsberg to achieve the invention claimed in claim 1. The Examiner finds that Spitsberg teaches the same sort of structure as Floyd because Spitsberg discloses that the outer layer is denser than the inner layer and has a reduced porosity. Ans. 9.

Appellants argue that the skilled artisan would not have contemplated modifying the TBC taught by Floyd with the TBC taught by Spitsberg. App. Br. 9–11.

Floyd discloses a TBC with an inner layer that is porous, and an outer layer that is “substantially free of interconnected porosity.” Floyd ¶¶ 21, 22. Floyd describes the outer layer of the TBC as being “much thinner” than the inner layer, and “very thin with respect to the inner layer.” *Id.* ¶¶ 19, 22. Spitsberg discloses a TBC with an inner layer comprising 50% to 95% of the thickness of the TBC. Spitsberg col. 6, ll. 46–51. Presumably, 5% to 50% of the thickness comprises the outer layer. Spitsberg teaches that “making the outer layer [] denser, i.e., [] reducing its porosity” provides the benefits of additional impact and erosion resistance. Spitsberg col. 7, l. 65–col. 8, l. 1. This denser outer layer has a fraction of porosity of about 0.20 or less, typically about 0.10 to about 0.20 (i.e., about 10% to about 20%). Spitsberg col. 8, ll. 1–3.

Appellants contend that Spitsberg's teaching of an outer layer having 10% to 20% porosity is contrary to Floyd's teaching of an outer layer that is substantially free of pores. App. Br. 9–10. Appellants argue that the skilled artisan would have had no reasonable expectation of success in combining Floyd and Spitsberg. *Id.* at 12. According to Appellants, one of ordinary skill in the art would have understood that combining Floyd's very thin outer layer having substantially no porosity with Spitsberg, which teaches the claimed relative layer thickness but 10% to 20% porosity, would promote failure of the TBC due to reduced strain tolerance and cracking. *Id.* at 10. In support, Appellants cite to the Specification and Subramanian '137, a reference cited by the Examiner in other rejections. *See id.*

The Specification indicates that sintering on the surface of a TBC causes formation of a surface layer that is much denser than the underlying bulk of the TBC, which does not experience high surface temperatures. Spec. 2, 3rd and 4th paragraphs. The much denser, sintered outer layer causes the TBC to have reduced strain tolerance that will cause cracking. *Id.* Subramanian '137 indicates that a dense top (outer) layer will have relatively lower thermal strain tolerance due to its lower pore content, thus the outer layer is segmented (and, therefore, less dense) to provide additional strain relief in that layer. Subramanian '137, col. 4, l. 66–col. 5, l. 6.

Appellants also argue that the Examiner errs in finding that Floyd and Spitsberg teach the same sort of structure because both references teach an outer layer that is denser than the inner layer. Reply Br. 3–4. As Appellants point out, Spitsberg teaches that additional impact and erosions resistance benefits can be obtained by making the outer layer denser, but does not teach

making the outer layer denser than the inner layer. *Id.* at 4; *see also* Spitsberg col. 7, l. 65—col. 8, l. 1.

A reasonable expectation of success is a necessary part of a prima facie case of obviousness. *In re Vaeck*, 947 F.2d 488, 493 (Fed. Cir. 1991). “Both the suggestion [to combine references] and the reasonable expectation of success must be founded in the prior art, not in the applicant’s disclosure.” *Id.* Whether or not a person of ordinary skill in the art would have had a reasonable expectation that a particular combination of references would work is a pure question of fact. *Alza Corp. v. Mylan Labs., Inc.*, 464 F.3d 1286, 1289 (Fed. Cir. 2006).

On the record before us, Appellants persuade us that the skilled artisan would not have combined the references with a reasonable expectation of success by providing some evidence of technological incompatibility. *See Orthopedic Equip. Co., Inc. v. U.S.*, 702 F.2d 1005, 1013 (Fed. Cir. 1983). The Examiner fails to provide a prima facie case of obviousness by combining the teaching of Floyd and Spitsberg. We, therefore, reverse the rejection of claim 1 as obvious over the references.

Because the rejections of all of the pending claims require the combination of Floyd and Spitsberg to support obviousness, we reverse these rejections for the reasons above.

DECISION

The rejections of claims 1–5, 92, and 107–119 is reversed.

REVERSED

HOUSEL, *Administrative Patent Judge, concurring*

I concur in the judgment of the Board that, based on Appellants' arguments and evidence, the Examiner fails to establish a prima facie case of obviousness by the combined teachings of Floyd and Spitsberg. However, I write separately because, in my view, Floyd alone anticipates claim 1 under 35 U.S.C. § 102(b), or in the alternative, renders obvious the subject matter of claim 1 under 35 U.S.C. § 103(a).

Anticipation is established when an entire prior art range, a preferred prior art range, or exemplified or listed prior art value is within a claimed range. *Atofina v. Great Lakes Chemical Corp.*, 441 F.3d 991, 999–1000; *Titanium Metals Corp. v. Banners*, 778 F.2d 775, 781; *In re Perkins*, 346 F.2d 981, 983 (CCPA 1965). Further, when there is substantial overlap between the ranges disclosed in the prior art and recited in the claims such that one of ordinary skill in the art could readily envisage the claimed range from the prior art range, anticipation is established. *Perricone v. Medicis Pharma. Corp.*, 432 F.3d 1368, 1376–77 (Fed. Cir. 2005); *In re Schaumann*, 572 F.2d 312, 315 (CCPA 1978); *see also, Atlas Powder Co. IRECO Inc.*, 190 F.3d 1342, 1345 (Fed. Cir. 1999).

Although the Examiner finds that “Floyd is silent to the thickness ration claimed” (Final Act. 3), I disagree. To the contrary, Floyd not only teaches a thermal barrier coating having a porous inner layer and a much thinner outer densified, substantially non-porous layer (Floyd ¶¶ 15, 19–21), but also that, in an exemplary embodiment, the inner layer is between about 1 to about 10 mils (or 25–250 μm) and the outer layer is less than about 1 mil (or 25 μm), preferably no greater than 0.2 mils (or 5 μm) (*id.* ¶ 22). Given Floyd's inner layer thickness range of 25–250 μm and outer layer

thickness range of 5–25 μm , the possible range of Floyd’s outer layer thickness is 2–50% of the inner layer thickness.² Thus, there is substantial overlap between the range disclosed in Floyd and the range recited in claim 1.

Appellants fail to direct our attention to any disclosure or evidence establishing any criticality to the smaller recited range, much less establishing any difference in property or performance for the smaller recited range, over the broader range disclosed by Floyd. Indeed, we note Appellants disclose a range of outer layer thickness to TBC thickness of at least 2% but not more than 50% (Spec. 3:30–31 and 7:1–11). Therefore, in my view, one of ordinary skill in the art would readily envisage the claimed range from Floyd’s range, thereby establishing anticipation.

In the alternative, a prima facie case of obviousness is established when a recited narrow range is within a broader prior art range. *In re Harris*, 409 F.3d 1339, 1341 (Fed. Cir. 2005); *In re Peterson*, 315 F.3d 1325, 1329–30 (Fed. Cir. 2003). Such is clearly the case here regarding the ratio of outer layer thickness to TBC thickness. Further, as stated above, Appellants fail to establish any criticality or difference in property or performance for the smaller recited range as compared to the broader range disclosed by Floyd. Accordingly, in my view, the component of claim 1

² Floyd’s TBC thickness is the sum of the inner and outer layer thicknesses. Floyd’s minimum outer layer thickness, 5 μm , divided by the maximum TBC thickness, 255 μm , yields a ratio of outer layer thickness to TBC thickness of about 2%. Floyd’s maximum outer layer thickness, 25 μm , divided by the minimum TBC thickness, 50 μm , yields a ratio of outer layer thickness to TBC thickness of 50%.

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would have been prima facie obvious to one of ordinary skill in the art in view of Floyd.