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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Ex parte CHRISTIAN BISCHOF, THORSTEN ROLF BOGER, GREGORY ALBERT MERKEL, ZHEN SONG, CAMERON WAYNE TANNER, PATRICK DAVID TEPESCH, and ELIZABETH MARIE VILENO

Appeal 2019-002949
Application 13/906,108
Technology Center 1700

Before JULIA HEANEY, MONTÉ T. SQUIRE, 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 1–7 and 38–42.[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 Corning Incorporated as the real party in interest. Appeal Brief filed October 2, 2017 ("Appeal Br.") at 2.

[2] Claims 8–32 are withdrawn from consideration. Final Office Action entered May 3, 2017 ("Final Act.") at 1.

CLAIMED SUBJECT MATTER

Claim 1 illustrates the subject matter on appeal, and is reproduced below with contested subject matter italicized:

> 1. A formed ceramic substrate comprising
> *an aluminum titanate phase comprising at least 75% by weight Al_2TiO_5*,
> wherein said formed ceramic substrate comprises an elemental sodium content of less than about 1200 ppm,
> and has a porosity of at least about 55%.

Appeal Br. 15 (Claims Appendix) (emphasis and spacing added).

REJECTION

The Examiner maintains the rejection of claims 1–7 and 38–42 under 35 U.S.C. § 103 as unpatentable over Beutel[3] in view of Merkel[4] and Voskoboynikov[5] in the Examiner's Answer entered February 6, 2018 ("Ans.").

FACTUAL FINDINGS AND ANALYSIS

Upon consideration of the evidence relied upon in this appeal and each of Appellant's contentions,[6] we affirm the Examiner's rejection of claims 1–7 and 38–42 under 35 U.S.C. § 103, for the reasons set forth in the Final Action, the Answer, and below.

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[3] Beutel et al., US 2011/0165051 A1, published July 7, 2011.
[4] Merkel et al., US 2010/0237007 A1, published September 23, 2010.
[5] Voskoboynikov et al., US 2007/0004953 A1, published January 4, 2007.
[6] Although Appellant "requests an Examiner's amendment" to correct an asserted error in Appellant's Specification, we note that this matter is not within our jurisdiction to review. Appeal Br. 8. Because the Examiner does not indicate in the Answer that the Examiner entered the requested amendment to the Specification (Ans. 3–7), we do not reconsider "all of the rejections taking this into account" as Appellant requests. Appeal Br. 9.

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")).

Appellant presents arguments directed to the subject matter of claim 1 only, to which we accordingly limit our discussion. Appeal Br. 8–13; 37 C.F.R. § 41.37(c)(1)(iv).

Beutel teaches disposing a chabazite (zeolite) catalyst on a substrate. Beutel ¶¶ 3, 93. Beutel teaches that "[t]he substrate may be any of those materials typically used for preparing catalysts," such as a ceramic substrate having a honeycomb structure. Beutel ¶¶ 94. The Examiner finds that "Beutel does not teach that the substrate must contain aluminum titanate," and relies on Merkel for suggesting use of a substrate comprising an aluminum titanate phase for Beutel's catalyst. Final Act. 3.

Merkel discloses that aluminum titanate is one of the few materials used in catalytic converter substrates and diesel particulate filters that can be made with low thermal expansion and high volumetric heat capacity. Merkel ¶ 5. Merkel discloses a composite ceramic body having a honeycomb structure (substrate) used as a diesel particulate filter comprising a first crystalline phase comprised predominantly of a solid solution of aluminum titanate and magnesium dititanate ($MgTi_2O_5$–Al_2TiO_5), and a second crystalline phase comprising cordierite ($Mg_2Al_4Si_5O_{18}$). Merkel ¶¶

11, 14, 20, 32. Merkel discloses that the aluminum titanate and magnesium dititanate phase preferably exhibits a pseudobrookite crystal structure, and "in one embodiment, the composition of the pseudobrookite phase comprises from approximately 20% to 35% $MgTi_2O_5$ [magnesium dititanate] by weight." Merkel ¶ 21.

The Examiner determines that because Merkel discloses that the first crystalline phase is comprised *predominantly* of a solid solution of aluminum titanate and magnesium dititanate and preferably exhibits a pseudobrookite crystal structure, and because Merkel does not provide any disclosure or suggestion of including compounds other than aluminum titanate and magnesium dititanate in the first crystalline (pseudobrookite) phase, Merkel's disclosure that the pseudobrookite phase comprises from approximately 20% to 35% $MgTi_2O_5$ would have suggested that the first pseudobrookite phase includes 65% to 80% aluminum titanate. Ans. 6.

The Examiner concludes that it would have been obvious to one of ordinary skill in the art before the effective filing date of the present application to use Merkel's composite ceramic body including aluminum titanate as the substrate for Beutel's catalyst, in view of Merkel's disclosure that aluminum titanate is one of the few materials that has low thermal expansion and high volumetric heat capacity. Final Act. 3.

The Examiner finds that although "[n]either Beutel nor Merkel teaches that the substrate has a low sodium content," Beutel discloses that "sodium contamination is known to degrade the zeolite structure of such catalysts under hydrothermal aging, and the alkali metal content is preferably less than 100 ppm." Final Act. 3 (citing Beutel ¶ 9). The Examiner also finds that "Voskoboynikov teaches that contaminants such as

alkali metal in refractory materials such as catalyst supports can poison the catalyst and should be eliminated." Final Act. 3 (citing Voskoboynikov ¶¶ 6, 8).

In view of these disclosures in Beutel and Voskoboynikov, the Examiner further concludes that it would have been obvious to one of ordinary skill in the art before the effective filing date of the present application "to reduce the sodium content of the substrate as much as possible, including to values below 100 ppm, in order to avoid poisoning the catalyst." Final Act. 4.

Appellant argues that "Voskoboynikov neither teaches nor suggests a composition comprising aluminum titanate," and "the skilled artisan would not turn to Voskoboynikov in order to arrive at the claimed invention" because Voskoboynikov discloses substrates made of silicoaluminophosphate (SAPO), and "phosphorus acts as a poison to catalyst materials." Appeal Br. 9.

Appellant's arguments, however, do not address the basis for the Examiner's reliance on Voskoboynikov, and are improperly based on Voskoboynikov alone, without taking into consideration what the combined disclosures of all of the applied prior art references would have suggested to one of ordinary skill in the art. *In re Merck & Co.*, 800 F.2d 1091, 1097 (Fed. Cir. 1986) ("Non-obviousness cannot be established by attacking references individually where the rejection is based upon the teachings of a combination of references."); *In re Keller*, 642 F.2d 413, 425 (CCPA 1981) (The test for obviousness "is what the combined teachings of the references would have suggested to those of ordinary skill in the art.").

As discussed above, the Examiner's reliance on Voskoboynikov is

limited to Voskoboynikov's disclosure that contaminants such as alkali metals in catalyst supports can poison the catalyst and should be eliminated. As the Examiner finds, and discussed below, Merkel would have suggested forming a ceramic honeycomb catalyst substrate as disclosed in Beutel from a composition having a first crystalline phase including 75% by weight aluminum titanate as recited in claim 1. Beutel's disclosure that sodium contamination degrades zeolite catalysts under hydrothermal aging, and Voskoboynikov's disclosure that alkali metal contaminants in catalyst supports can poison the catalyst, would have led one of ordinary skill in the art to limit, to the greatest extent possible, the amount of sodium present in Beutel's catalyst support formed using Merkel's aluminum titanate composition, such as limiting the elemental sodium content in the substrate to less than about 1200 ppm, as recited in claim 1. *In re Boesch*, 617 F.2d 272, 276 (CCPA 1980)("[D]iscovery of an optimum value of a result effective variable . . . is ordinarily within the skill of the art."); *In re Aller*, 220 F.2d 454, 456 (CCPA 1955)("[W]here the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation.").

Appellant argues that Merkel's disclosure that the pseudobrookite phase is comprised "***predominantly of***" an Al_2TiO_5–$MgTi_2O_5$ solid solution indicates that other components may be included in the pseudobrookite phase, and Merkel's disclosure of a pseudobrookite phase comprising approximately 20% to 35% $MgTi_2O_5$, therefore, "is not dispositive to whether or not it contains 65–80% Al_2TiO_5, as asserted by the Examiner." Appeal Br. 10–11. Appellant argues that because Merkel suggests that other components may be present in the pseudobrookite phase, an aluminum

titanate phase containing 65–80% Al_2TiO_5 "does not necessarily flow" from Merkel's disclosure that the pseudobrookite phase comprises from approximately 20% to 35% $MgTi_2O_5$. Appeal Br. 11. Appellant argues that, therefore, "Merkel does not teach or fairly suggest a formed ceramic substrate comprising an aluminum titanate phase comprising at least 75% by weight Al_2TiO_5." *Id.*

Appellant's arguments do not identify reversible error in the Examiner's rejection, for the following reasons.

As the Examiner finds and discussed above, Merkel discloses a composite ceramic body comprising a first crystalline phase comprised predominantly of aluminum titanate and magnesium dititanate ($MgTi_2O_5$–Al_2TiO_5), and a second crystalline phase comprising cordierite ($Mg_2Al_4Si_5O_{18}$). As the Examiner finds in the Answer (Ans. 6–7), Merkel discloses that the weight fraction of aluminum titanate (Al_2TiO_5) in the ceramic body may be from 0.3 to 0.75 (30% to 75% by weight), the weight fraction of magnesium dititanate ($MgTi_2O_5$) in the ceramic body may be from 0.075 to 0.3 (7.5% to 30% by weight), the weight fraction of cordierite ($Mg_2Al_4Si_5O_{18}$) in the ceramic body may be from 0.02 to 0.5 (2% to 50% by weight), and the weight fraction of certain other additional oxides in the ceramic body may be zero—indicating that inclusion of the additional oxides is optional. Merkel ¶ 20 (disclosing embodiments in which "the compositions of the ceramic bodies of the invention are expressed in terms of weight fractions of oxides and oxide combinations to comprise, on an oxide basis, $a(Al_2TiO_5)+b(MgTi_2O_5)+c(2MgO.2Al_2O_3.5SiO_2)$[or $(Mg_2Al_4Si_5O_{18})$]
$+d(3Al_2O_3.2SiO_2)+e(MgO.Al_2O_3)+f(2MgO.TiO_2)+g(Y_2O_3)+h(La_2O_3)+i(Fe_2$

$O_3.TiO_2)+j(TiO_2)$, wherein a, b, c, d, e, f, g, h, i, and j are weight fractions of each component such that (a+b+d+e+f+g+h+i+j)=l.00. To that end, the weight fraction of each component can be in the respective ranges as follows: 0.3≤a≤0.75, 0.075≤b≤0.3, 0.02≤c≤0.5," and d, e, f, g, h, i, and j may each be zero).

Thus, although Merkel does disclose that the first crystalline phase is comprised *predominantly* of a solid solution of aluminum titanate and magnesium dititanate, Merkel nonetheless also explicitly discloses a ceramic body that includes *only* aluminum titanate, magnesium dititanate, and cordierite, by disclosing that the inclusion of additional oxide components in the ceramic body is optional.

Contrary to Appellant's arguments, when considered together, the above disclosures in Merkel reasonably would have suggested a ceramic body including a first crystalline phase comprised of 30% to 75% by weight aluminum titanate and 7.5% to 30% by weight magnesium dititanate, and a second crystalline phase comprising 2% to 50% by weight cordierite. The overlap between the weight percentage of aluminum titanate in the first crystalline phase suggested by Merkel (30% to 75%) and the weight percentage of aluminum titanate in the aluminum titanate phase recited in claim 1 ("at least 75% by weight Al_2TiO_5") renders the recited range prima facie obvious. *In re Peterson*, 315 F.3d 1325, 1329–330 (Fed. Cir. 2003) ("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 . . . .").

The burden, therefore, shifts to Appellant to show the criticality of the aluminum titanate weight percentage range recited in claim 1. *In re*

Woodruff, 919 F.2d 1575, 1578 (Fed. Cir. 1990) (indicating that in cases in which the difference between the claimed invention and the prior art is some range or other variable within the claims, the applicant must show that the particular range is critical, generally by showing that the claimed range achieves unexpected results relative to the prior art range.).

On the record before us, Appellant does not meet this burden because Appellant does not direct us to any persuasive reasoning or evidence demonstrating that the aluminum titanate weight percentage range recited in claim 1 is critical. Nor does Appellant direct us to any showing—such as experimental data—establishing that the recited aluminum titanate weight percentage rang achieves 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.

Appellant argues that "Merkel actually teaches away from the use of at least 75% by weight Al_2TiO_5 as recited in claim 1" because Merkel discloses that "'[a]luminum titanate (AT) and composites containing large fractions of aluminum titanate have several disadvantages' including, among other things, metastability below about 1200°C, the relationship between the thermal stability and grain size, the formation of microcracks, and high thermal cycling growth." Appeal Br. 12 (quoting Merkel ¶ 6). Appellant argues that because Merkel teaches away from using "large fractions of aluminum titanate," one of ordinary skill in the art would not have been led to use an aluminum titanate phase including at least 75% by weight Al_2TiO_5 to arrive at the claimed invention. Appeal Br. 12.

Appellant's arguments, again, do not identify reversible error in the Examiner's rejection.

The paragraph of Merkel cited by Appellant as disclosing "several disadvantages" of aluminum titanate, and composites containing large fractions of aluminum titanate (paragraph 6), is part of the "Technical Background" of Merkel, and must be considered together with the entirety of the remaining disclosures in the reference. The preceding paragraph of the reference describes *advantages* of aluminum titantate, indicating that "[a]luminum titanate is one of the few materials that can be made with low thermal expansion and also has higher volumetric heat capacity than cordierite." Merkel ¶ 5. In the following paragraph, quoted by Appellant, Merkel explains that "pure aluminum titanate" and composites containing "large fractions" of aluminum titanate "have several disadvantages." Merkel ¶ 6. The reference, however, does not provide any indication, numerical or otherwise, of what constitutes a "large" fraction of aluminum titanate. *Id.*

The following two paragraphs of Merkel explain that including additives—such as $MgTi_2O_5$—with aluminum titanate, and including a second phase, in addition to the aluminum titanate phase, addresses many of the described disadvantages of "pure aluminum titanate," and composites containing "large fractions" of aluminum titanate. Merkel ¶¶ 7, 8. Merkel then describes the composite ceramic composition of Merkel's invention, which, as discussed above, Merkel discloses may include 30% to 75% by weight aluminum titanate. Merkel ¶¶ 10, 20.

Thus, rather than teaching away from "the use of at least 75% by weight Al_2TiO_5 as recited in claim 1" as Appellant argues, Merkel explicitly teaches using 75% by weight aluminum titanate in a first phase of a composition used to form a composite ceramic body, to address the disadvantages of pure aluminum titanate, and composites containing large

fractions of aluminum titanate. One of ordinary skill in the art seeking to produce a ceramic honeycomb substrate as disclosed in Beutel, therefore, reasonably would have been led to use Merkel's composition including 75% by weight aluminum titanate to form the substrate, in view of Merkel's disclosure of forming a ceramic body having a honeycomb structure from the composition, and disclosure that aluminum titanate advantageously provides low thermal expansion and high volumetric heat capacity. Merkel ¶¶ 5, 32.

We, accordingly, sustain the Examiner's rejection of claims 1–7 and 38–42 under 35 U.S.C. § 103.

CONCLUSION

Claims	35 U.S.C. §	Reference(s)/Basis	Affirmed	Reversed
1–7, 38–42	103	Beutel, Merkel, Voskoboynikov	1–7, 38–42	

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