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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Ex parte NATALIE WALI

Appeal 2020-001608
Application 14/042,323
Technology Center 3700

Before JENNIFER D. BAHR, EDWARD A. BROWN, and CARL M. DeFRANCO, *Administrative Patent Judges*.

BROWN, *Administrative Patent Judge*.

DECISION ON APPEAL

STATEMENT OF THE CASE

Appellant[1] seeks review under 35 U.S.C. § 134(a) of the Examiner's decision rejecting claims 21–34. We have jurisdiction 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 Honeywell International Inc. as the real party in interest. Appeal Br. 1.

CLAIMED SUBJECT MATTER

Claims 21, 31, and 33 are independent claims. Claim 33, reproduced below, illustrates the claimed subject matter.

> 33. A turbine engine component comprising:
> a substrate in the form of the turbine engine component;
> a bond coating on and over the substrate;
> a thermal barrier coating or an environmental barrier coating on and over the bond coating; and
> a calcia-magnesia-alumina-silica (CMAS) protection ceramic top coating on and over the thermal barrier coating or the environmental barrier coating, wherein the CMAS protection ceramic top coating entirely a magnetoplumbite phase material with a layered crystal structure selected from the group consisting of: $MAl_{12}O_{19}$, $MAl_{11}O_{19}$, and $MAl_{11}O_{18}$, where M is a cation selected independently from the group consisting of: Mg^{2+}, La^{3+}, Gd^{3+}, Mn^{2+}, Si^{4+}, Na^{+}, K^{+}, Ca^{2+}, Ba^{2+}, Fe^{+}, Fe^{3+}, and Ti^{4+}, wherein the CMAS protection ceramic top coating comprises an outermost layer over the substrate, and wherein the CMAS protection ceramic top coating comprises a plurality of laminar layers that are peelable from one another upon the deposition of a CMAS material thereto.

Appeal Br. 14 (Claims App.).

REJECTION[2]

Claims 21–34 are rejected under 35 U.S.C. § 103 as unpatentable over Nagaraj (US 7,226,668 B2, issued June 5, 2007), Pracht (US 7,618,911 B2, issued Nov. 17, 2009), and Berndt (US 2010/0086757 A1, published Apr. 8, 2010). Final Act. 5–19.

[2] The rejection of claims 31–34 under 35 U.S.C. § 112(a), written description requirement, has been withdrawn. Ans. 3; Final Act. 4.

ANALYSIS

Appellant argues the rejection of claims 21–34 together.[3] Appeal Br. 6–9. We select claim 33 as representative of the group to decide the appeal as to the rejection, and claims 21–32 and 34 stand or fall with claim 33. *See* 37 C.F.R. § 41.37(c)(1)(iv).

As to claim 33, the Examiner finds that Nagaraj discloses a turbine engine component comprising a bond coating on and over a substrate, a thermal barrier coating (TBC) or an environmental barrier coating on and over the bond coating, and a calcia-magnesia-alumina-silica (CMAS) protection ceramic top coating on and over the thermal barrier coating or environmental barrier coating. Final Act. 16–17 (citing Nagaraj, col. 3, ll. 18–21, 30–39). The Examiner also finds that the CMAS protection ceramic top coating comprises a plurality of laminar layers that are peelable from one another upon the deposition of a CMAS material thereto, as claimed. *Id.* at 17. The Examiner concedes that Nagaraj does not explicitly disclose that the CMAS protection ceramic top coating is entirely a magnetoplumbite phase material with a layered crystal structure selected from the recited group. *Id.*

The Examiner relies on Pracht as teaching a turbine component comprising a bond coating on and over a substrate, a thermal barrier coating on and over the bond coating, and a CMAS protection ceramic top coating entirely of a magnetoplumbite phase material, which

[3] The heading of Appellant's argument is "Obviousness Rejection of Claim 21: Nagaraj in view of Pracht and Berndt." Appeal Br. 6 (boldface omitted). However, as Appellant's argument is not specific to any one of claims 21–34, we treat the argument as directed to these claims as a group.

comprises an outermost layer (i.e., top layer) over the substrate. Final Act. 17–18 (citing Pracht, col. 1, ll. 24–57, col. 2, ll. 1–8, col. 4, ll. 14–18). The Examiner finds that Pracht's magnetoplumbite phase material has a layered crystal structure and is selected from the group consisting of: $MAl_{12}O_{19}$, $MAl_{11}O_{19}$, and $MAl_{11}O_{18}$, where M is a cation selected independently from the group consisting of: Mg^{2+}, La^{3+}, Gd^{3+}, Mn^{2+}, Si^{4+}, Na^{+}, K^{+}, Ca^{2+}, Ba^{2+}, Fe^{+}, Fe^{3+}, and Ti^{4+}, as claimed. *Id.* at 17 (citing Pracht, col. 2, ll. 51–col. 3, l. 21).

The Examiner further finds that Berndt teaches a turbine component having a protection ceramic top coating (top coat 4) comprising a plurality of laminar layers. Final Act. 18 (citing Berndt, Fig. 1).

The Examiner concludes that it would have been obvious to replace the CMAS protection ceramic top coating of Nagaraj with Pracht's CMAS protection ceramic top coating, comprising a plurality of laminar layers as taught by Berndt. Final Act. 18–19. The Examiner finds that the laminar layers would be peelable from each other upon deposition of a CMAS material to the CMAS protection ceramic top coating. *Id.* at 19. The Examiner explains that the proposed modification is a simple substitution of one known element (i.e., "an alkaline earth aluminate protective top ceramic coating protecting the TBC coating on a turbine component of Nagaraj") for another (i.e., "a[n] alkali earth metal magnetoplumbite phase material protective top ceramic coating protecting the TBC coating on a turbine component . . . as taught by Pracht") to obtain predictable

results (i.e., "providing protection for the substrate and further for the TBC coating applied to the substrate"). *Id.*

Nagaraj discloses that, in gas turbine engine components having a thermal barrier coating exposed to high temperature, that coating can comprise yttria-stabilized zirconia (YSZ), for example. Nagaraj, col. 1, ll. 24–47. Nagaraj discloses that thermal barrier coatings can have porous surface structures, which "can be important in the ability of these thermal barrier coating[s] to tolerate strains occurring during thermal cycling and to reduce stresses due to the differences between the coefficient of thermal expansion (CTE) of the coating and the CTE of the underlying bond coat layer/substrate." *Id.* at col. 2, ll. 6–13, 21–26. Delamination and spalling of outer thermal barrier coatings having porous surface structures typically occurs when molten CMAS infiltrates the structures and solidifies, causing stresses to build within the coatings. *Id.* at col. 2, ll. 27–50.

Nagaraj discloses a thermal barrier coating in articles that operate at high temperatures and are exposed to environmental contaminants, and, particularly, CMAS. Nagaraj, col. 2, ll. 51–67. Nagaraj discloses a coated article 10 comprising a bond coat 18 on a substrate 14, and a thermal barrier coating 22 on the bond coat 18. *Id.* Fig. The thermal barrier coating 22 includes an inner layer 26 and an outer layer 30 having an exposed surface 34. *Id.* Suitable ceramic thermal barrier coating materials for the inner layer 26 include YSZ. *Id.* at col. 5, ll. 4–12. The outer layer 30 comprises a CMAS-reactive material to protect the thermal barrier coating against CMAS contaminants deposited on the exposed surface 34. *Id.* at col. 7, ll.

35–41. The CMAS-reactive material comprises an alkaline earth aluminate, alkaline earth aluminosilicate, or a mixture thereof, wherein the alkaline earth is selected from the group consisting of barium, strontium, and mixtures thereof. *Id.* at col. 3, ll. 30–39, col. 4, ll. 36–63.

Pracht describes that YSZ generally has a lower CTE than the underlying metal layer, and, under thermal stress, this CTE difference causes the formation of cracks. Pracht, col. 1, ll. 49–52. Pracht discloses a heat-insulating material comprising a magnetoplumbite phase material with a layered crystal structure having a formula, as recited. According to Pracht, the heat-insulating material consistently has "a layered structure having a characteristic lamellar crystalline structure." *Id.* at col. 2, ll. 51–53. The heat-insulating material may be deposited on components subjected to high thermal stress and prevent peeling of the layer under alternating temperature stresses. *Id.* at col. 3, ll. 47–52.

Appellant contends that Nagaraj discloses that YSZ thermal barrier coatings are subject to spalling and peeling due to CMAS attachment in high-temperature operations. Appeal Br. 6. Appellant asserts, "Nagaraj is directed to a coating for the protection against CMAS deposits; and, in order to do so, there must be a CMAS protective **outer** layer." Reply Br. 2.[4] Appellant contends that, in contrast, Pracht does not disclose CMAS-induced spalling/peeling, but rather, discloses that a YSZ heat-insulating layer will, under thermal stress, peel off the underlying metal layer due to a CTE mismatch. Appeal Br. 6. According to Appellant, Pracht discloses

[4] The pages of the Reply Brief are unnumbered. Herein, we refer to the first page as page 1, the second page as page 2, etc.

magnetoplumbite materials as a *replacement* for YSZ, or other heat-insulating layer. *Id.* at 7. Appellant contends that Pracht is directed to an outer thermal barrier coating with improved protection against a failure mechanism that is unrelated to CMAS. *Id.*

Appellant submits that a skilled artisan might find it obvious to use Pracht's magnetoplumbite material as the thermal barrier coating of Nagaraj, because, as disclosed by Pracht, this would prevent cracking due to CTE mismatch with the underlying metal layer. Appeal Br. 7. However, Appellant asserts, because Pracht does not address CMAS, a person of ordinary skill in the art would have no reason to eliminate Nagaraj's outer coating alkaline earth aluminates or alkaline earth aluminosilicates. *Id.* at 7–8. Appellant contends that Nagaraj teaches a YSZ thermal barrier, and Pracht teaches an improved thermal barrier coating as compared to YSZ alone. *Id.* at 8. Thus, Appellant contends, the combination would have a first metal layer, a second magnetoplumbite layer as the intermediate layer, and a third alkaline earth aluminates or alkaline earth aluminosilicates layer as the outer layer. *Id.*

Appellant's contentions are unpersuasive. First, we disagree that Pracht's teachings are limited to using the heat-insulating material comprising a magnetoplumbite phase material as a *replacement* for YSZ, or other heat-insulating thermal barrier layer. Appeal Br. 7. We note, for example, that Pracht discloses a "most practical" compound that has both the heat-insulating material and YSZ. Pracht, col. 4, ll. 14–17; *see* Ans. 6 ("Pracht teaches the magnetoplumbite material in addition to and as an outer or top layer of the thermal barrier layer" (citing Pracht, col 4, ll. 14–17)).

Second, although Nagaraj discloses that YSZ thermal barrier coatings experience spalling and peeling due to CMAS attachment in high-temperature operations, Nagaraj also discloses that CTE differences between the thermal barrier coating and the underlying bond coat attribute to delamination and spalling of thermal barrier coatings subjected to CMAS attachment, as discussed above. Nagaraj also discloses that the composition of outer layer 30 of TBC 22 depends upon the CTE characteristics desired for TBC 22. Nagaraj, col. 7, ll. 55–62. Accordingly, Nagaraj teaches that the CTE characteristics of the TBC subjected to CMAS attachment are also a factor. In view of this disclosure in Nagaraj, we are not persuaded that Nagaraj is only concerned with a failure mechanism that is completely different from the failure mechanism described in Pracht. Appeal Br. 7.

Third, the Examiner's proposed modification of Nagaraj would replace the outer layer, which can be applied over YSZ, with Pracht's heat-insulating material comprising a magnetoplumbite phase material, which Pracht likewise teaches can be used with YSZ. The Examiner finds that both Nagaraj and Pracht teach spalling of YSZ thermal barrier coatings and applying a protection layer over the thermal barrier coating to mitigate this spallation or peeling. Ans. 4. The Examiner's reason for modifying Nagaraj in view of Pracht to result in the claimed turbine engine component comprising the recited CMAS protection ceramic top coating crystal structure and composition is not required to be the same as that relied on by Appellant. As long as the prior art suggests the claimed subject matter, it is inconsequential that the prior art had a different purpose or solved a separate problem. *See In re Fulton*, 391 F.3d 1195, 1202 (Fed. Cir. 2004) ("the Board need not have found the combination of [references] to be desirable

for the reason stated in [Appellant's] application"); *In re Lintner*, 458 F.2d 1013, 1016 (CCPA 1972) ("The fact that [A]ppellant uses [a claimed element] for a different purpose does not alter the conclusion that its use in a prior art composition would be prima facie obvious from the purpose disclosed in the references.").

Moreover, although Pracht does not describe CMAS related failure of coatings, the Examiner's position is that the component of Nagaraj, as modified by Pracht, would predictably perform, and react to CMAS, similar to the claimed invention when placed in the same conditions. Ans. 5. As to performance in an environment containing CMAS, the Examiner submits that the fact Appellant has recognized another advantage, which would flow naturally from following the suggestion of the prior art, cannot be the basis for patentability when the differences would otherwise be obvious. Ans. 4 (citing *Ex parte Obiaya,* 227 USPQ 58, 60 (BPAI 1985)).

Appellant further contends that Berndt relates to building-up a thermal barrier coating layer-by-layer, where each layer uses different size ceramic particles, but does not relate to CMAS protection or magnetoplumbite materials, which are *inherently* laminar. Appeal Br. 8. The Examiner responds that Berndt teaches that using a plurality of layers of the top layer can extend the life of the component. Ans. 8.

Moreover, Pracht discloses a heat insulating layer comprising a magnetoplumbite phase material with a layered crystal structure, and describes that the heat-insulating material consistently has "a layered structure having a characteristic lamellar crystalline structure." Pracht, col. 2, ll. 51–53. In view of this disclosure, Appellant does not apprise us of error in the Examiner's finding that the combination would comprise a

"CMAS protection ceramic top coating comprises a plurality of laminar layers that are peelable from one another upon the deposition of a CMAS material thereto," as claimed.

For the foregoing reasons, we sustain the rejection of claim 33, and claims 21–32 and 34, which fall with claim 33, as unpatentable over Nagaraj, Pracht, and Berndt.

DECISION SUMMARY

In summary:

Claim(s) Rejected	35 U.S.C. §	Reference(s)/Basis	Affirmed	Reversed
21–34	103	Nagaraj, Pracht, Berndt	21–34	

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

AFFIRMED