

UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE BOARD OF PATENT APPEALS  
AND INTERFERENCES

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*Ex parte* YIPING HU, FEDERICO RENTERIA  
and MURALI MADHAVA

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Appeal 2008-1541  
Application 10/819,816  
Technology Center 1762

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Decided: March 25, 2008

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Before BRADLEY R. GARRIS, CATHERINE Q. TIMM, and  
LINDA M. GAUDETTE, *Administrative Patent Judges*.

TIMM, *Administrative Patent Judge*.

DECISION ON APPEAL

Appellants appeal under 35 U.S.C. § 134(a) from the Examiner's decision rejecting claims 13 and 16-23. We have jurisdiction under 35 U.S.C. § 6(b).

We AFFIRM.

## I. BACKGROUND

The invention relates to a method for applying a wear resistant coating to a turbine blade by cold gas-dynamic spraying the coating onto the blade, performing a hot isostatic pressing (“HIP”) treatment and performing at least one heat treatment. Claims 13, 17, 19 and 21 are illustrative of the subject matter on appeal:

13. A method for applying a wear resistant coating to a turbine blade, the method comprising the steps of:

cold gas-dynamic spraying powder materials to form a coating on at least a portion of the turbine blade;

performing a hot isostatic pressing on the coated turbine blade; and  
heat treating the coated turbine blade after performing the hot isostatic pressing.

17. The method of claim 16 wherein the wear resistant coating is formed on edge of the z-notch shroud.

19. The method of claim 18 further comprising the step of performing a rapid cooling of between 45 and 60 degrees F per minute to a desired temperature level after the hot isostatic pressing.

21. The method of claim 13 wherein the step of cold gas-dynamic spraying particles to form a coating on at least a portion of the turbine blade comprises forming a coating thickness of between 0.010 to 0.220 inches.

The Examiner relies on the following prior art references to show unpatentability:

Cretella et al. (“Cretella”)

US 4,291,448

Sep. 29, 1981

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Kenton	US 4,302,256	Nov. 24, 1981
DeLuca et al. (“DeLuca”)	US 5,788,785	Aug. 4, 1998
Arnold	US 5,956,845	Sep. 28, 1999
Seth et al. (“Seth”)	US 6,780,458	Aug. 24, 2004
Raj	US 6,838,191	Jan. 4, 2005
Slattery	US 2005/0084701	Apr. 21, 2005

The Examiner made the following rejections:

1. Claims 13, 16, 18 and 20 under 35 U.S.C. § 103(a) as obvious over Seth in view of Raj and DeLuca;
2. Claims 13, 16, 18, 20 and 22 under 35 U.S.C. § 103(a) as obvious over Seth in view of Slattery and DeLuca;
3. Claim 17 under 35 U.S.C. § 103(a) as obvious over Seth in view of Raj, DeLuca and Cretella;
4. Claim 17 under 35 U.S.C. § 103(a) as obvious over Seth in view of Slattery, DeLuca and Cretella;
5. Claims 19 and 23 under 35 U.S.C. § 103(a) as obvious over Seth in view of Raj, DeLuca and Kenton;
6. Claims 19 and 23 under 35 U.S.C. § 103(a) as obvious over Seth in view of Slattery, DeLuca and Kenton;
7. Claim 21 under 35 U.S.C. § 103(a) as obvious over Seth in view of Raj, DeLuca and Arnold; and
8. Claim 21 under 35 U.S.C. § 103(a) as obvious over Seth in view of Slattery, DeLuca and Arnold.

Appellants contend that the following groups of claims are separately patentable: (1) claims 13, 16, 18, 20 and 22, (2) claim 17, (3) claims 19 and 23, and (4) claim 21. Accordingly, we decide these grounds of rejection on the basis of claims 13, 17, 19 and 21. *See* 37 C.F.R. § 41.37(c)(1)(vii).

## II. DISCUSSION

### *Claims 13, 16, 18, 20 and 22*

First, we address claims 13, 16, 18, 20 and 22. Claims 13, 16, 18 and 20 stand rejected under 35 U.S.C. § 103(a) as obvious over Seth in view of Raj and DeLuca, and claims 13, 16, 18, 20 and 22 stand rejected under 35 U.S.C. § 103(a) as obvious over Seth in view of Slattery and DeLuca. Because separate arguments were not provided for the dependent claims, we decide these grounds of rejection based on claim 13.

Appellants argue that Seth teaches away from the combination of the cold spray technique taught by Seth with further heat treatments. (App. Br. 5 and 9). The Examiner responds that the particular statement relied upon by Appellants does not teach away from the combination and that reliance on the teachings in the other references supports combining a cold spray technique with heat treatments. (Ans. 15-16 and 26-27). Appellants also argue that neither Raj nor Slattery suggests HIP (i.e., hot isostatic pressing) or heat treatment following a cold spraying method. (App. Br. 5-6 and 9). The Examiner responds by pointing out the broad teachings of Raj and Slattery and that these references are relied upon in combination with Seth and DeLuca. (Ans. 17-18 and 26-27). Appellants also argue that there would be no motivation to combine the free-standing component methods taught by DeLuca to a cold sprayed coating. (App. Br. 6 and 9). The Examiner responds by emphasizing the fact that the combination of references teach the invention rather than relying on DeLuca alone and points to the “desirable microstructure benefits for a metal material” taught by DeLuca. (Ans. 18 and 28).

Thus, the issues on appeal arising from the contentions of Appellants and the Examiner are: (1) does Seth teach away from combining a cold spray-coating method with heat treatment; and (2) have the Appellants shown that the Examiner reversibly erred in combining the teachings of Seth, Raj and DeLuca or, alternatively, the teachings of Seth, Slattery and DeLuca in the rejections under consideration?

We answer both questions (1) and (2) in the negative and conclude that Seth does not teach away from combining a cold spray coating method with heat treatment and that the Examiner has not reversibly erred in combining the teachings of the cited references. In fact, we adopt the Examiner's well-reasoned and cogent findings and conclusions and add the following primarily for emphasis.

First, we address the question of whether Seth teaches away from combining a cold spray coating method with a heat treatment. A reference "teaches away" when an artisan upon reading it would be discouraged from following the path set out in the reference or would be led in a direction divergent from the path that was taken by the applicant. *See In re Gurley*, 27 F.3d 551, 553 (Fed. Cir. 1994). As an example, a reference may teach away from a use when that use would render the result inoperable. *McGinley v. Franklin Sports, Inc.*, 262 F.3d 1339, 1354 (Fed. Cir. 2001); *see also In re Fulton*, 391 F.3d 1195, 1201 (Fed. Cir. 2004) (explaining that there is no teaching away when the "disclosure does not criticize, discredit, or otherwise discourage the solution claimed").

Seth teaches that "the heat input during the application of a wear alloy coating may cause warping of a relatively thin substrate member such as a turbine blade" and "may melt or otherwise metallurgical [sic,

metallurgically] degrade properties of an underlying single crystal or directionally stabilized substrate material or a proximate brazed joint.” (Seth, col. 2, ll. 9-15). Thus, Seth teaches undesirable results may occur from using a heat or thermal process for applying a wear resistant coating. This teaching does not instruct one of ordinary skill in the art that a subsequent heat treatment after cold spray coating would never be appropriate.

Seth also teaches that, in applying a “wear alloy” with the use of “a cold spray process” that “imparts only a small amount of heat to the underlying substrate material,” “no heat-treating of the component is required after the coating deposition, unlike prior art thermal processes.” (Seth, col. 5, ll. 35-54). As the Examiner notes “Seth indicates that a heat treating [sic, treatment] is not understood to be necessary in its process, not that performing a heat treatment would destroy the invention,” and that heat treatments would not “change the principle of operation of Seth” nor render Seth inoperable. (Ans. 15-16 and 26). The instruction in Seth, that heat treatment is not required, does not suggest to one of ordinary skill in the art that a heat treatment would never be suitable for combination with the benefits provided by a cold spray coating method. Further, as discussed in detail below, Raj and Slattery both provide sufficient rationale for combining a cold spray coating method with a subsequent heat treatment that may or may not have been fully appreciated by Seth. Therefore, we decline to read Seth as teaching away from the use of a subsequent heat treatment after a cold spray coating method, as suggested by Appellants.

We now address the question of whether Appellants have shown that the Examiner reversibly erred in combining the teachings of Seth, Raj and DeLuca or, alternatively, the teachings of Seth, Slattery and DeLuca.

The Appellants have the burden of showing that the Examiner reversibly erred. *See In re Kahn*, 441 F.3d 977, 985-86 (“On appeal to the Board, an applicant can overcome a rejection by showing insufficient evidence of prima facie obviousness or by rebutting the prima facie case with evidence of secondary indicia of nonobviousness.” (emphasis omitted)).

According to *KSR Int'l Co. v. Teleflex Inc.*, 127 S. Ct. 1727, 1742 (2007), “[o]ne of the ways in which a patent's subject matter can be proved obvious is by noting that there existed at the time of invention a known problem for which there was an obvious solution encompassed by the patent's claims.” *See also In re Kahn*, 441 F.3d 977, 987-88, (Fed. Cir. 2006)(“consider what the combined teachings, knowledge of one of ordinary skill in the art, and the nature of the problem to be solved as a whole would have suggested to those of ordinary skill in the art.”).

We first determine that the teachings of Raj are properly combined with the teachings of Seth. Raj teaches the application of a bond coat by a variety of techniques including “low pressure or vacuum plasma spray,” “cold spraying, arc spraying, physical vapor deposition, chemical vapor deposition and other similar techniques.” (Raj, col. 2, ll. 44-49). In an example, Raj also teaches: “The bond coat was then deposited on the substrate by low pressure or vacuum plasma spraying and this was followed by depositing the NiAl top coat by the same process. Consolidation of the overlay and bond coats was conducted by hot isostatically pressing (HIP) at

suitable pressure, temperatures, and hold times.” (Raj, col. 4, ll. 35-40). We also note that Figures 1 and 2 of Raj illustrate the differences between sprayed coatings before (Figure 1) and after (Figure 2) consolidation via HIP. (Raj, col. 4, ll. 44-48). Thus, Figures 1 and 2 demonstrate to one of ordinary skill in the art the benefits of adding a HIP procedure to spray coating methods for consolidation of coating.

We agree with the Examiner that Raj teaches broadly the use of HIP following cold spraying (or any of several spraying techniques) for the benefit of consolidation of the coatings. (Ans. 17-18). We find Appellants’ arguments regarding the use of only “thermal plasma spraying” with HIP in the example unpersuasive because a reference may be relied upon for all that it would have reasonably suggested to one having ordinary skill in the art. *Merck & Co v. Biocraft Labs.*, 874 F.2d 804, 807 (Fed. Cir. 1989)(“the fact that a specific [embodiment] is taught to be preferred is not controlling, since all disclosures of the prior art, including unpreferred embodiments, must be considered”); *see also In re Susi*, 440 F.2d 442, 446 n.3 (disclosed examples and preferred embodiments do not constitute a teaching away from a broader disclosure or non-preferred embodiments). Therefore, we conclude that one of ordinary skill in the art, knowing from the teaching of Raj that consolidation via HIP benefits coatings applied by a cold-spray method, would have been motivated to use a subsequent HIP process after the cold-spray coating application taught by Seth.

For similar reasons, we determine that the teachings of Slattery are properly combined with the teachings of Seth. Slattery teaches that “the gas used for cold spraying can become trapped in the deposited material, thereby affecting the ductility or other properties of the material” (Slattery, ¶ [0004])

and that “[d]uring the deposition of the structural material 16 on the base member 14, small amounts of the hydrogen gas are trapped in pockets, bubbles, gaps, or other voids.” (Slattery, ¶ [0034]). Slattery teaches that “[a]s a result of the HIP treatment, discontinuities in the preform can be removed, such as by consolidating the structural material 16 to reduce or eliminate bubbles, gaps, or other voids formed during cold spraying.” (Slattery, ¶ [0042]). As such, Slattery also teaches the benefits of consolidation with HIP after a cold spray process, such as the cold spray coating of Seth, to address pockets, bubbles, gaps or voids caused by the cold spray process. Therefore, we conclude that one of ordinary skill in the art, knowing from the teaching of Slattery that consolidation via HIP benefits coatings applied by a cold-spray method, would have been motivated to use a subsequent HIP process after the cold-spray coating application taught by Seth.

We next determine that the teachings of DeLuca are properly combined with the teachings of Seth as modified by Raj or Slattery. DeLuca teaches that

[t]he superalloy ... was thermally processed using the following parameters: HIP at 2165° F. (1185° C.) for 4 hours at 25 ksi (172 MPa); solutioned at 2165° F. (1185° C.) for two hours; rapid vacuum cooled to below 1000° F. (538° C.); precipitation heat treated at 1975° F. (1079° C.) for four hours; air cooled to room temperature; aged at 1600° F. (871° C.) for 20 hours; and air cooled to room temperature.

(DeLuca, col. 5, ll. 16-23). As such, DeLuca teaches HIP followed by a heat treatment “to provide marked increases in the fatigue resistance and crack

propagation when used in more common applications, such as gas turbine engines.” (DeLuca, col. 2, ll. 41-49).

We note that Seth has already taught that “the heat input during the application of a wear alloy coating may cause warping of a relatively thin substrate member such as a turbine blade” and “may melt or otherwise metallurgical [sic, metallurgically] degrade properties of an underlying single crystal or directionally stabilized substrate material or a proximate brazed joint.” (Seth, col. 2, ll. 9-15). Thus, based on the teachings of Seth, one of ordinary skill in the art would have appreciated that a subsequent HIP treatment, as taught by Raj and Slattery, after the cold spray coating application of Seth may cause similar damage to the underlying structure as does a thermal spray coating technique. As such, Seth provides an appropriate rationale for adding the subsequent heat treatment teachings of DeLuca to bolster the underlying turbine materials.<sup>1</sup>

Therefore, we find that one of ordinary skill in the art, knowing from the teaching of Seth that a heat treatment, such as the HIP treatment suggested by Raj and Slattery, may cause defects in the underlying

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<sup>1</sup> We note that Slattery also teaches that the underlying material (base member 14) “can undergo a material treatment, such as hot isostatic pressing (HIP), heat treating, aging, quenching, stretching, annealing, or solution annealing, to obtain desired mechanical or chemical properties, as is known in the art.” (Slattery, ¶ [0042]). Thus, it appears that Slattery alone suggests the use of certain “material treatments” that are “known in the art” to be appropriate for treating an underlying material, such as heat treating, aging and quenching (or rapid cooling). Nonetheless, the Examiner relies on DeLuca for processes directed to “high strength nickel base superalloy material” that are used in “common applications, such as gas turbine engines.” (DeLuca, col. 2, ll. 41-49).

materials, would have been motivated to use the heat treatments taught by DeLuca to bolster the underlying superalloy of the turbine.

We also conclude that the Appellants have not shown that the Examiner reversibly erred in combining the teachings of Seth, Raj and DeLuca in rejecting claims 13, 16, 18 and 20 or, alternatively, the teachings of Seth, Slattery and DeLuca in rejecting claims 13, 16, 18, 20 and 22.

*Claim 17*

We next turn to separately argued claim 17. To reject claim 17, the Examiner adds Cretella as further evidence of what was known in the art at the time of the invention with respect to the application of a wear resistant coating to the edges of a z-notch shroud.

Appellants argue that the “plasma spraying” teaching of Cretella does not suggest that “a cold sprayed wear resistant coating on the z-notch shroud of a turbine blade would adequately provide the necessary protection and durability.” (App. Br. 6-7, and 10). The Examiner responds that “the suggestion to apply the cold sprayed coating as claimed to a z-notch is clearly provided in the primary reference to Seth which provides the cold gas-dynamic spraying of the wear resistant coating, and the suggestion to use the process for ‘combustion turbine z-notch shrouds.’” (Ans. 21 and 30).

Thus, the issue on appeal arising from the contentions of Appellants and the Examiner is: have the Appellants shown that the Examiner reversibly erred in combining the teachings of Cretella with the teachings of Seth, Raj and DeLuca or, alternatively, the teachings of Seth, Slattery and DeLuca? We answer this question in the negative.

Seth further teaches that “the process and [wear resistant] coating described herein...is especially useful for ... combustion turbine z-notch

shrouds.” (Seth, col. 6, ll. 64-67). Based on the teachings of Seth, one skilled in the art would have appreciated that a wear resistant coating would be suitable for those locations of the combustion turbine z-notch shrouds that wear. We note that one skilled in the art of combustion turbines would also have been aware of the locations that particularly wear, i.e., the edges. Thus, Seth alone provides a sufficient suggestion to support the obviousness of applying the coating to z-notch shroud edges. Nonetheless, the Examiner supplements the evidence of obviousness with Cretella, which teaches “restoring the shroud of a turbine blade which has become worn, and particularly those edges of the shroud in the vicinity of what is commonly known as the Z-notch.” (Cretella, abstract; col. 1, ll. 33-40). We conclude that one skilled in the art reading Cretella would have discerned that the edges of the z-notch shroud, as required by claim 17, are a suitable location for applying the wear resistant coating of Seth. We further conclude that the Appellants have not shown that the Examiner reversibly erred in combining Cretella with the references used to reject claim 13.

*Claims 19 and 23*

We next turn to separately argued claims 19 and 23. Both claims 19 and 23 recite a step of “performing a rapid cooling of between 45 and 60 degrees F per minute to a desired temperature level after the hot isostatic pressing.” We select claim 23 to represent the issues on appeal. To reject claims 19 and 23, the Examiner adds Kenton as further evidence of what was known in the art with respect to the use of a rapid cooling step following a HIP step.

Appellants argue that “there is no reason for a person of ordinary skill in the art to read [the cast forming process of] Kenton and determine that the

heat treatments disclosed therein are suitable or even desirable following formation of a coating using a cold spraying process.” (App. Br. 8 and 11). The Examiner responds that Kenton “provides clarification as to what a desirable rapid cool down would be when HIP treating a metal alloy.” (Ans. 22 and 32).

Thus, the issue on appeal arising from the contentions of Appellants and the Examiner is: have the Appellants shown that the Examiner reversibly erred in combining the teachings of Kenton with the teachings of Seth, Raj and DeLuca or, alternatively, the teachings of Seth, Slattery and DeLuca? We answer this question in the negative.

Along with the Examiner, we note that DeLuca teaches a HIP treatment followed by a rapid cooling step, which is then followed by heat treatment and aging steps. (DeLuca, col. 5, ll. 16-23). We note that based on the teachings of DeLuca alone one skilled in the art would have been able to optimize the particular degree of rapid cool down to obtain a desirable result. *See Pfizer, Inc. v. Apotex, Inc.*, 480 F.3d 1348, 1368 (Fed. Cir. 2007) (discovery of an optimum value of a variable in a known process is usually obvious); *see also In re Aller*, 220 F.2d 454, 456 (CCPA 1955) (“[I]t is not inventive to discover the optimum or workable ranges by routine experimentation.”).

Nonetheless, the Examiner supplements the evidence with Kenton which teaches a method for manufacturing superalloy products, such as a turbine blade, that includes “[f]ollowing completions of the HIP treatment, the parts are rapidly cooled in situ at a cooling rate over 20°C. per minute, preferably at least about 30° C. per minute, e.g., about 30° to 50° C. or 60° C. per minute or higher.” (Kenton, col. 6, ll. 18-21). A change of 25°C equates

to a change of 45°F, and a change of 30°C equates to a change of 54°F, which are within the range of claims 19 and 23. Kenton provides further evidence that those of ordinary skill in the art would have used temperatures within the claimed range when cooling the product of Seth after a HIP treatment of Raj or Slattery. Therefore, we conclude that the Appellants have not shown that the Examiner reversibly erred in combining the teachings of Kenton with the teachings of Seth, Raj and DeLuca or, alternatively, the teachings of Seth, Slattery and DeLuca.

*Claim 21*

We next turn to separately argued claim 21. To reject claim 21, the Examiner adds Arnold as further evidence of what was known in the art at the time of the invention with respect to applying a wear resistant coating in a thickness of between 0.010 and 0.220 inches.

Appellants argue that “[the rejections of claim 21] should not be sustained at least for the same reasons set forth previously regarding independent claim 13, from which claim 21 depends.” (App. Br. 8 and 12).

Since Appellants argue only that dependent claim 21 is patentable because it depends from claim 13, we sustain the rejection for the reasons provided above with respect to claim 13.

### III. CONCLUSION

The totality of the evidence weighs in favor of the Examiner’s determination that Seth does not teach away from combining a subsequent heat treatment step with a cold spray coating and that Seth, Raj and DeLuca or, alternatively, Seth, Slattery and DeLuca are properly combined references to reject claims 13, 16, 18, 20 and 22. The totality of the evidence weighs in favor of concluding that Cretella is properly combined

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with the references used to reject claim 13 in the rejection of claim 17. The totality of the evidence weighs in favor of concluding that Kenton is properly combined with the references used to reject claim 13 in the rejection of claims 19 and 23. The totality of the evidence weighs in favor of concluding Arnold is properly combined with the references used to reject claim 13 in the rejection of claim 21. Appellants have provided no effective argument nor submitted any evidence to sufficiently rebut a prima facie case of obviousness of claims 13 and 16-23.

#### IV. DECISION

The decision of the Examiner is affirmed.

#### V. TIME PERIOD FOR RESPONSE

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

AFFIRMED

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HONEYWELL INTERNATIONAL, INC.  
101 COLUMBIA ROAD  
P.O. BOX 2245  
MORRISTOWN, NJ 07962-2245