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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Ex parte IGOR TSYPKAYKIN and ANDRE SAXER

Appeal 2018-003828
Application 13/117,166
Technology Center 2100

Before CAROLYN D. THOMAS, JEREMY J. CURCURI, and GREGG I. ANDERSON, *Administrative Patent Judges*.

ANDERSON, *Administrative Patent Judge*.

DECISION ON APPEAL

Appellants appeal under 35 U.S.C. § 134(a) from the Examiner's rejection of claims 1, 3, and 5.[1] Claims 2 and 4 were cancelled previously. We have jurisdiction under 35 U.S.C. § 6(b).

We affirm.

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[1] In this Decision, we refer to the Final Office Action ("Final Act.," mailed May 4, 2017), the Appeal Brief ("Br.," filed October 24, 2017), the Examiner's Answer ("Ans.," mailed December 22, 2017), the original Specification ("Spec.," filed May 27, 2011), and the Final Decision on Appeal in Appeal 2015-006898 ("'6898 Dec.," mailed September 22, 2016).

I. STATEMENT OF THE CASE

A. The Invention

Appellants' invention relates to gas turbine blades and the surrounding shroud. Spec. ¶ 2. Specifically, Appellants disclose a method for producing a turbine blade that optimizes the contact surfaces between the interlocking surfaces of the abutting shroud segments of adjacent blades of a rotor blade row. *Id.* ¶ 7. The narrowly delimited contact surfaces with high pressure stresses can be reliably avoided without forfeiting the necessary sealing tightness between the adjacent shroud segments. *Id.*

More specifically, the invention takes into account deformation of the blade attached to the shroud resulting from operation induced loads, including pressure variations between shroud segments. Spec. ¶ 15. The loads of interlocking adjacent shroud surfaces in an unloaded state does not take deformation into account. *Id.* Design of the blades according to the invention maintains contact over a large area between the adjacent interlocked shroud segments in the loaded state. *Id.*

Independent claim 1, reproduced below, is illustrative:

> 1. A method for optimizing the contact surfaces of abutting shroud segments of adjacent blades of a rotor blade row of a gas turbine, the method comprising the steps of:
>
> a) providing a 3-D model of an individual blade, the individual blade including a shroud segment delimited in a circumferential direction by contact surfaces including an interlocking surface and wedge surfaces disposed on each side of the interlocking surface, the interlocking surface and wedge surfaces being arranged in a zig-zag manner;
>
> b) calculating ~~a geometry~~ <u>deformation behavior</u> of the <u>entire</u> individual blade based on the 3-D model using a

computer, the calculating including consideration <u>of the deformation behavior due to at least one</u> of centrifugal forces, temperature stresses, pressure loads experienced in a loaded state of the blade during operation, material used for the blade, blade wall thicknesses, blade length, blade shape and operating location of the individual blade in combination with adjacent blades;

c) ~~optimizing the contact surfaces within the 3-D model,~~ <u>determining an unloaded geometry of each shroud segment of the abutting shroud segments</u> including the interlocking surface and wedge surfaces, [[of]][2] <u>within the 3-D model based on the calculated deformation behavior that will cause each shroud segment to deform to a desired geometry such that</u> the abutting shroud segments of adjacent blades in the loaded state of the blade ~~such that the optimized~~, <u>with</u> adjacent respective interlocking surfaces and wedge surfaces, will be substantially parallel and ~~so as~~ to thereby avoid an increase in contact pressure between the respective contact surfaces as a result of ensuing operating temperature of the blades; <u>and</u>

d) ~~determining a geometry of the interlocking surfaces and of the wedge surfaces in an unloaded state corresponding to the optimized contact surfaces in the loaded state of the blade within the 3-D model; and~~

~~e)~~ producing a blade for a rotor blade row of a gas turbine according to the determined geometry.

Br. 11–12;[3] *see also* Ans. 6 (Examiner's all but identical comparison of claims); *see also* Br., Claims App'x 1 (claim 1 as appealed).

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[2] Appellants' brackets. Br. 12.

[3] Deletions from claim 1 from 6898 Decision shown with strike through and additions being underscored. Similar annotations are shown for claims 3 and 5. *Id.* at 13–15.

B. The Rejections

1. Claims 1, 3, and 5 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Boegli et al. (US 2007/0231143 A1, published Oct. 4, 2007) ("Boegli"), Durcan (US 6,223,524 B1, issued May 1, 2001), and Paquet et al. (US 2005/0079058 A1, published Apr. 14, 2005) ("Paquet"). Final Act. 5–18.

2. Claims 1, 3, and 5 are rejected on the basis of *res judicata* based on the Final Decision on Appeal in Appeal 2015-006898 of the Patent Trial and Appeal Board ("PTAB") dated September 22, 2016. *See* MPEP §§ 706.03(w), 706.07(h)(XI)(A); Final Act. 2–3.

C. Issues

Only those arguments actually made by Appellants in the Briefs have been considered in this Decision. Arguments that Appellants did not make in the Briefs are waived. *See* 37 C.F.R. § 41.37(c)(1)(iv)(2012).

Appellants' arguments present the following issues:

1. Has the Examiner erred by finding that the combination of Boegli, Durcan, and Paquet teaches or reasonably suggests "calculating <u>deformation behavior</u> of the <u>entire</u> individual blade based on the 3-D model using a computer," as recited in claim 1[4] under 35 U.S.C. § 103? Br. 8–10 (emphasis added); *see also* Section I.A above (showing changes to claim 1 from the '6898 Decision).

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[4] Claim 3 includes identical language. Claim 5 recites similar language, i.e., the "unloaded shroud segment is configured to deform," but does not recite 3-D modeling. Appellants do not separately argue claims 3 or 5 and we address claim 1 as representative.

2. Has the Examiner erred by concluding claims 1, 3 and 5 are rejected under *res judicata* over the prior '6898 Decision of the Patent Trial and Appeal Board? *Id.* at 11–19.

II. ANALYSIS

Independent claim 1, reproduced above, is a method claim including steps a, b, c, and d. Appellants contest only step b of claim 1. Br. 8–10 ("There is no disclosure in the Boegli publication of calculating deformation behavior of the entire individual blade including the airfoil portions based on the 3-D model using a computer.").

A. Overview of Prior Art

The Examiner finds Boegli teaches adjusting the gaps, i.e., "'contact surfaces,'" between adjacent shroud segments of blades in a turbomachine. Final Act. 6 (citing Boegli ¶ 3). The Examiner also cites to Boegli's teaching that the gaps are reduced during operation. *Id.* (citing Boegli ¶ 11). The Examiner quotes from Boegli that "'the shroud elements of the blades are thus adjacent to one another and thus form a shroud which is closed on the circumference.'" *Id.* (citing Boegli ¶ 3). The Examiner then finds that "[r]educing the gaps between the shroud elements during the operation of the blades is optimizing the contact surfaces." *Id.*

The Examiner cites to Durcan, which relates to blades of a gas turbine (*see* Durcan, Abstract), as teaching

> "[u]sually <u>the blade geometry</u> and disk geometry are complex with non-uniform stress and temperature distributions. A Finite Element Model (FEM) and Finite Element Analysis (FEA) are often used to determine the blade and disk stress distributions,

> temperature distributions, and blade tip radial deflection at various operating conditions."

See Final Act. 6–7 (quoting Durcan 6:54–60). The Examiner finds that "[a] Finite Element Model of a blade is a 3D model." *Id.* at 7. Appellants do not contest this finding by the Examiner.

Paquet is concerned with "determining a desired shroud design for a given turbine blade design." Paquet ¶ 10. Paquet's Figures 2 and 3 show contact faces of a turbine blade shroud arranged in a zigzag pattern. *Id.* ¶ 21, Figs. 2, 3. The Examiner relies on the preceding disclosures of Paquet to show the recited "the interlocking surface and wedge surfaces being arranged in a zig-zag manner." Final Act. 7.

B. "calculating deformation behavior"

As set forth above, Appellants dispute that the cited combination teaches "calculating *deformation behavior* of the *entire* individual blade based on the 3-D model using a computer" limitation, as recited in step b of claim 1. Br. 8–10 (emphasis added). The Examiner relies on Boegli and Durcan to teach step b. Final Act. 7–8.

Appellants first argue that Boegli does not teach that the shape of the "entire" blade, including airfoil sections, is compensated under operational conditions. Br. 8. Instead, according to Appellants, the compensation disclosed in Boegli is only for the "platform sections . . . to such an extent that a gap which is as small as possible is produced between the shroud elements." *Id.* (citing Boegli ¶ 13). Appellants argue, Boegli describes the "platform sections" as part of the shroud, *a fortiori*, not of the "entire individual blade." *Id.* ("the first platform section <u>of the shroud element</u>"); *see also* Boegli ¶ 6 (second column, lines 1–6).

We are not persuaded by Appellants' argument and agree with and adopt as our own the Examiner's response to the argument that

> Boegli figure 1 depicts blades 3a, 3b, and 3c which each clearly depict an "entire blade." . . . Boegli figure 1 depicts the "blade sections" 4a, 4b, and 4c. These blade sections clearly correspond to an airfoil portion of the blade.

Ans. 4–5 (citing Boegli ¶ 46; Durcan, Fig. 4). We also adopt the Examiner's finding that "the inclination angle formed between platform sections of adjacent blades during the operation of the blade arrangement is considering the location of the blade in combination with adjacent blades." Final Act. 8 (citing Boegli ¶¶ 3–4 (discussing "the adjacent blade"), Figs. 2c, 2d, 2e (illustrating platform sections and blade airfoil sections)). We also agree with the Examiner that "airfoil" is not recited and, in any event, is disclosed in Boegli. Ans. 4 (citing Boegli, Figs. 1, 4a, 4b (illustrating "blade sections" including an airfoil portion)).

With respect to the recited 3-D modelling by computer, Appellants argue that Durcan "determine the blade and disk stress distributions, temperature distributions, and <u>blade tip radial deflection</u> at various operating conditions." Br. 8–9 (citing Durcan, Fig. 4). Appellants would limit Durcan's teachings to the blade tip and assert Durcan does not disclose "using the finite element analysis and finite element model to calculate deformation behavior of an *entire blade* based on a 3-D model using a computer." *Id.* at 9 (emphasis added).

The Examiner relies on Durcan's disclosure at column 6, set forth above. Final Act. 7–8 (citing Durcan 6:54–60 (describing calculating operational blade stress using "Finite Element Model (FEM) and Finite Element Analysis (FEA)")). The Examiner finds, and Appellants do not dispute that "[u]sing a computer is obvious with the teaching of finite element analysis (FEA)." *Id.* at 8. The Examiner also reasons

> [o]ne having ordinary skill in the art would have found it motivated [sic] to use finite element modeling into the system of designing a turbine blade with a shroud for the purpose of "determin[ing] the blade and disk stress distributions, temperature distributions, and blade tip radial deflection at various operating conditions."

Id. at 9 (citing Durcan, 6:58–60).

We are not persuaded by Appellants' argument and adopt the Examiner's findings and reasons set out above. We have already determined that Boegli teaches determining the geometry of an "entire" blade above. Durcan is not relied on for the "entire blade" recitation. Nonetheless, the Examiner finds, and we agree, Durcan also calculates "a deformation of the entire blade" using finite element analysis. Final Act. 4 (citing Durcan 6:54–60).

We sustain the Examiner's rejection of claim 1 on Boegli, Durcan, and Paquet. Appellants make no additional arguments relating to claims 3 and 5, contending they are patentable for reasons similar to those discussed in connection with claim 1. Br. 10. We, therefore, sustain the Examiner's rejection of claims 3 and 5 on the same grounds.

C. Res Judicata

The Examiner also rejects the claims based on the '6898 Decision, which is final. Final Act. 2. As represented in Section I.A above, Appellants argue its amended claims here are patentably different because "the currently appealed claims recite more by a blade that has a first geometry will deform to a second geometry during operation of a gas turbine." Br. 16–17 (citing Spec. ¶ 3).

We agree with the Examiner's conclusion that the amendments to limitation b, are synonymous, i.e., "not patentably distinct" from claim 1 that was finally rejected in the '6898 Decision. Final Act. 2 (citing MPEP §§ 706.03(w), 706.07(h)(XI)(A)). We also agree with the Examiner that "[b]oth sets of claim language are clearly synonymous with calculating a shape, 'the calculating including consideration of . . . centrifugal forces, temperatures stresses, [other verbatim conditions].'" Ans. 7 (brackets in original); *see also* Final Act. 2 ("'calculating deformation behavior of the *entire* individual blade' is a calculation of the changed shape of the blade."); *id.* at 3 (citing Dictionary.com definition of "geometry" as "the shape or form of a surface or solid."). We adopt the Examiner's finding that "geometry is synonymous with shape." Final Act. 3.

We responded to Appellants' arguments to patentability in Section III.B above. We agree with the Examiner that the change from "geometry" to "deformation behavior" is not one upon which patentability may rest.

Thus, we sustain the Examiner's rejection of claims 1, 3, and 5 based on *res judicata*.

IV. CONCLUSION

The Examiner did not err in rejecting claims 1, 3, and 5 under § 103 or on *res judicata*.

V. DECISION

The Examiner's decision rejecting claims 1, 3, and 5 is affirmed.

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