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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Ex parte JAY A. MORRISON

Appeal 2014-003095
Application 12/486,274
Technology Center 3700

Before NEAL E. ABRAMS, ANNETTE R. REIMERS, and ERIC C. JESCHKE, *Administrative Patent Judges*.

ABRAMS, *Administrative Patent Judge*.

DECISION ON APPEAL

STATEMENT OF THE CASE

Jay A. Morrison (Appellant) appeals under 35 U.S.C. § 134 from the Examiner's Final decision rejecting claims 1, 5–12, 15–17, 20 and 23. We have jurisdiction under 35 U.S.C. § 6(b).

We AFFIRM-IN-PART.

THE INVENTION

The invention is directed to stationary airfoil having an improved trailing edge. Claim 1, reproduced below, is illustrative of the claimed subject matter.

> 1. An airfoil comprising:
>
> a suction side and a pressure side joined along a trailing edge;
>
> wherein a trailing edge portion of the airfoil is configured to take a wavelike form along a radial direction of the airfoil;
>
> wherein an amplitude of said wavelike form varies from a maximum value at the trailing edge to zero at a predetermined distance along a chord length of the airfoil;
>
> and wherein said amplitude of said wavelike form at said trailing edge is approximately equal to a thickness of the trailing edge.

THE PRIOR ART

The Examiner relies upon the following as evidence of unpatentability:

Presz, Jr. et al. ("Presz")	US 4,830,315	May 16, 1989
Burke et al. ("Burke")	US 7,247,003 B2	July 24, 2007
Wood et al. ("Wood")	US 2009/0013532 A1	Jan. 15, 2009

THE REJECTIONS

The following rejections stand under 35 U.S.C. § 103(a);

Claims 1, 5 and 7 on the basis of Presz and "Engineering Expedient."[1]

Claim 6 on the basis of Presz and Engineering Expedient.

Claim 8 on the basis of Presz, Engineering Expedient, and Wood.

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[1] Explained *infra* at 3.

Claims 9–11, 15, 16, 20 and 23 on the basis of Presz and Wood.

Claims 12 and 17 on the basis of Presz, Wood and Burke.

OPINION

Claims 1, 5 and 7
Obviousness — Presz and Engineering Expedient

Independent claim 1 recites an airfoil having a suction side and a pressure side. Among the limitations is that the airfoil comprises a trailing edge having a trailing edge portion configured to a wave-like form with an amplitude that "varies from a maximum value at the trailing edge to zero at a predetermined distance along a chord of the airfoil," and wherein the "amplitude [at said] trailing edge is approximately equal to a thickness of the trailing edge." App. Br. 3. With reference to Figure 9, the Examiner has found that all of the subject matter recited in independent claim 1 is disclosed in Presz, except for the limitation regarding the amplitude of the wavelike form at the trailing edge. Final Act. 6. However, it is the Examiner's position that this limitation would have been obvious "as an *engineering expedient* for the purpose of providing a desired operating angle of attack" (Final Act. 6, (emphasis added)), based upon the following reasoning:

> It is common practice for engineers in the art of airfoil design to consider the amplitude of the wavelike form at the trailing edge. This common practice is further supported by Presz, Jr. et al. disclosing that "optimizing the size and shape of the troughs and ridges may have to be done by trial and error, and will depend, for example, on the desired operating angle of attack and the nominal airfoil cross-sectional shape," (Column 8, Line 9-13), and the wavelike form (troughs and ridges) may "encompass any amplitude which provides beneficial results" (Column 8, Line 25-27).

Id.

As explained in detail on pages 3 and 4 of the Appeal Brief, Appellant disputes the Examiner's conclusion, arguing that Presz does not specifically disclose the amplitude of troughs and ridges 32, 34, 38 and 40, shown in Figures 5A and 5B, but teaches that the amplitude encompasses "any amplitude which provides beneficial results," which is described as being "at least the same as and most preferably about twice the maximum thickness T of the separation region (col. 8 lines 19-20)." Appellant argues that, as shown in Presz Figures 1 and 3, to achieve the "beneficial results," the maximum thickness of the separation region is much greater than the thickness of the trailing edge, and urges that "even the minimum amplitude is much greater than the thickness of the trailing edge." Appeal Br. 4. With reference to Presz column 8, lines 24 and 25, Appellant points out that Presz "warns against a design in which the amplitude is too low," as this "may result in delaying the onset of separation, without preventing it completely." *Id.* Appellant goes on to state that it would not be "common practice for engineers" to disregard the teachings of Presz and "reduce the amplitude of the troughs and ridges [] to below a minimum[], thereby removing beneficial results and introducing known performance disadvantages which undermine the performance of the airfoil." *Id.* Thus, Appellant concludes, "the proposed modification would render Presz [] unsatisfactory for its intended purpose of delaying or preventing boundary layer separation. Accordingly, the rejection is fatally deficient, since the proposed modification [] cannot be used to support the rejection of independent claim 1, per MPEP 2143.01." *Id. See also* Reply Br. 2–3.

We are persuaded by Appellant's arguments that the evidence provided by the Examiner does not establish that Appellant's claim 1 would have been obvious to one of ordinary skill in the art. Presz states that the objectives of the invention are reducing the drag on an airfoil at high loading, increasing lift capabilities, reducing the tendency to stall, eliminating two-dimensional boundary layer separation on the surface, and operating at higher angles of attack. Presz col. 3, ll. 5–14. To accomplish these objectives, Presz teaches that the airfoil have a "thin trailing edge" with a "series of alternating, adjoining troughs and ridges forming wave-like surface undulations which terminate at the trailing edge. . . . Consequently, the trailing edge has a wave-like shape." *Id.* at col. 3, ll. 19–30. Presz describes this arrangement in the following manner:

> To have the desired effect of preventing or reducing streamwise two-dimensional boundary layer separation on the airfoil surface, it is believed that the sum of the depth and height of the troughs and ridges respectively at the trailing edge (i.e., the peak-to-peak wave amplitude at the trailing edge) will need to be substantially greater than the 99% boundary layer thickness immediately forward of the upstream ends of the troughs. It is believed that best results are obtained when peak to peak amplitude at the trailing edge is comparable to the thickness of the separation bubble (or wake) which would be expected to occur at the trailing edge at a selected angle of attack for which the airfoil is designed, if the airfoil did not incorporate the troughs and ridges of the present invention. This will generally result in trough depth and ridge heights many times larger (often orders of magnitude larger) than the boundary layer thickness.

Col. 3, l. 54–col. 4, l. 3.

Thus, Presz teaches that the objectives of the invention are accomplished by the airfoil having a thin trailing edge, and that the amplitude of the troughs and ridges is related to the thickness of the

boundary layer on the surface of the airfoil. There is no mention in Presz of a relationship between the amplitude of the troughs and ridges and the thickness of the trailing edge of the airfoil. Therefore, we cannot agree with the Examiner that one of ordinary skill in the art would have been motivated to relate the amplitude of the troughs and ridges to the thickness of the trailing edge in the manner recited in Appellant's claim 1, based upon Presz' broad statement that "optimizing the size and shape of the troughs and ridges may have to be done by trial and error, and will depend upon, for example, on the desired operating angle of attack and the nominal airfoil cross-sectional shape" (*see* Final Act. 6; *see also* Ans. 5).

The rejection of independent claim 1 and dependent claims 5 and 7 is not sustained.

Claim 6
Obviousness – Presz and Engineering Expedient

Claim 6 adds to claim 1 the requirement that the wavelength of the wavelike form along the trailing edge of the airfoil "is in a range of 2-4 times the thickness of the trailing edge." The Examiner's position is that "it appears that Presz, Jr. et al. teaches a wavelength (see Figure 1 of the Detailed Action) of the wavelike form along the trailing edge is a range of 2-4 times a thickness of the trailing edge (Column 9, Line 48-58; Figure 9)." Final Act. 8. As an alternative, it is the Examiner's view that Presz shows this limitation in Figure 15 and, because Appellant has not disclosed that this wave form solves any stated problem or is for any particular purpose, it would have been an obvious matter of design choice to so modify the Presz wave form. *Id.* at 8–9.

Be that as it may, as stated *supra*, it is our decision that the combined teachings of Presz and Engineering Expedient fail to render obvious the subject matter recited in claim 1, from which claim 6 depends, and therefore the Examiner's rejection of claim 6 also is not sustained.

Claim 8
Obviousness – Presz, Engineering Expedient and Wood

Claim 8 further limits claim 1 by requiring that the wavelike form recited in claim 1 comprise "a tapered square wave form comprising alternating flat levels having different relative elevations joined by respective sloped sections joining the alternating flat levels." The Examiner has cited Wood for this teaching, concluding that it would have been obvious to so modify the Presz airfoil in such a manner in view of the showing in Wood's Figure 8. Final Act. 9.

However, the teachings of Wood fail to overcome the deficiencies noted *supra* in the rejection of claim1, and therefore the rejection of claim 8 also is not sustained.

Claims 9–11, 15, 16, 20 and 23
Obviousness – Presz and Wood

Independent claim 9 is directed to a system comprising a stationary airfoil and a rotating airfoil. The Examiner has found that Presz discloses all of the subject matter recited in claim 9 except for "[t]he wavelike form [that] comprises a tapered square wave form comprising alternating flat levels having different relative elevations joined by respective sloped sections joining the alternating levels." Final Act. 11. However, the Examiner takes the position that this feature is taught by Wood, and it would have been obvious to one of ordinary skill in the art to modify the waveform of Presz by "replacing" it with the one disclosed by Wood "for the purpose of

reducing the amplitude of the wake flow," because Presz "discloses that 'optimizing the size and shape of the troughs and ridges may have to be done by trial and error, and will depend, for example, on the desired operating angle of attack and the nominal airfoil cross-sectional shape,' (Column 8, Line 9-13)." Final Act. 11–12. In response to Appellant's arguments in the Appeal Brief, the Examiner has further explained that

> *the modification of the waveform of Presz, Jr. et al. has been done only to the shape of the wavelike form and not the chord.* No "second modification" has been done to equalize the chord of the Presz, Jr. et al. as argued by the Appellant (Page 9 of Appeal Brief). Since the chord of Presz, Jr. et al. has always remained constant, there is no need to modify the chord and *only the shape of the wavelike pattern has been modified as taught by Wood.*

Ans. 21 (emphasis added).

Appellant initially argues that the modification proposed by the Examiner would not have been obvious because Wood teaches that, as shown in Figure 7, the trailing edge of the disclosed airfoil has varying chord lengths, and this would cause the Presz airfoil to be unsatisfactory for its intended purpose. *See* App. Br. 6–9. Appellant also asserts that the proposed modification was the result of "impermissible hindsight reconstruction" of the Wood airfoil. *Id.* at 9. On pages 3 and 4 of the Reply Brief, Appellant contends that the Examiner set forth the rejection in terms of "replacing it (wave form of Presz) with the tapered square wave as taught by Wood et al.," and that such "replacing" necessarily would necessarily also cause the modified Presz airfoil to comprise the varying chord lengths of Wood, and thus not disclose the Appellant's claimed invention.

Based upon the Examiner's explanation on page 21 of the Answer (*supra* at 8), our understanding of the rejection is that the Examiner's proposed modification to Presz is limited to modifying the *cross-sectional shape* of the trailing edge portion of the airfoil from the curvilinear shape shown in Presz' Figures 9 and 10 to a tapered square-like cross-sectional shape, as disclosed in Wood's Figure 8, with the chord length disclosed by Presz remaining constant along the trailing portion of the airfoil rather than being variable, as in Wood. We are not convinced otherwise by Appellant's arguments in the Appeal Brief (pages 7–9), which focus upon the variable chord lengths in the Wood arrangement, or in the Reply Brief (pages 2–4), which reinforce the position set forth in the Appeal Brief and add that because the Examiner used the term "replacing" in the original statement of the rejection, the variable chord lengths of Wood must be part of the modification to Presz. Nor are we persuaded by Appellant's arguments that one of ordinary skill in the art would *not* have been motivated to make the proposed modification to the Presz airfoil in view of Presz' teaching that "optimizing the size and shape of the troughs and ridges may have to be done by trial and error, and will depend, for example, on the desired operating angle of attack and the nominal airfoil cross-sectional shape." Adv. Act. 2. It is our view that this teaching of Presz provides the necessary motivation for one of ordinary skill in the art to combine the references in the manner proposed by the Examiner, and overcomes Appellant's assertion that the Examiner arrived at the modification by the hindsight afforded by viewing Appellant's disclosure. Regarding Appellant's argument suggesting that the proposed modification would render the Presz airfoil unsatisfactory for its intended purpose and therefore cannot be used to support the rejection

(App. Br. 8, 9), we point out that Appellant has not provided evidence or persuasive argument in support of this conclusion.

Therefore, although we have carefully considered all of Appellant's arguments with regard to claim 9, we have concluded that the combined teachings of Presz and Wood render the subject matter recited in claim 9 obvious, and the rejection of claim 9 is sustained. Because Appellant has chosen to allow dependent claims 10, 11 and 20 to stand or fall with claim 9, from which they depend (App. Br. 9), the like rejection of these claims also is sustained.

Independent claim 15 is directed to a system comprising a row of stationary airfoils upstream of a row of rotating airfoils. Appellant has argued claim 15 separately from claim 9, although it recites that each stationary airfoil comprise the same wavelike form at the trailing edge as was present in claim 9. Again, the Examiner acknowledges that this feature is not present in Presz, but finds that it is disclosed in Figure 8 of Wood, and that it would have been obvious to modify the Presz structure to incorporate it, based upon the same reasoning as was advanced in the rejection of claim 9. *See* Final Act. 13, 14. Appellant's arguments regarding this rejection are the same as those made against the rejection of claim 9. *See* App. Br. 10, 11.

The rejection of claim 15 is sustained for the same reasons as claim 9. Appellant has stated that dependent claims 16 and 23 stand or fall with claim 9 (App. Br. 11), and therefore the rejection of these two claims also is sustained.

Claims 12 and 17
Obviousness – Presz and Wood

Claim 12 depends from claim 9, and claim 17 from claim 15. Appellant has chosen to have these claims stand or fall with the claims from which they depend. App. Br. 11. This being the case the rejection of these two claims is sustained.

DECISION

The rejection of claims 1, 5 and 7 as being obvious in view of Presz and Engineering Expedient, is not sustained.

The rejection of claim 6 as being obvious in view of Presz and Engineering Expedient, is not sustained.

The rejection of claim 8 as being obvious in view of Presz, Engineering Expedient, and Wood, is not sustained.

The rejection of claims 9–11, 15, 16, 20 and 23 as being obvious in view of Presz and Wood, is sustained.

The rejection of claims 12 and 17 as being obvious in view of Presz, Wood and Burke, is sustained.

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

AFFIRMED-IN-PART