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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Ex parte HIDEO IIZUKA, YASUHIKO TAKEDA, and HISAYOSHI FUJIKAWA

Appeal 2018-003161
Application 12/987,261
Technology Center 1700

Before N. WHITNEY WILSON, BRIAN D. RANGE, and LILAN REN, *Administrative Patent Judges*.

WILSON, *Administrative Patent Judge.*

DECISION ON APPEAL

Appellants[1] appeal under 35 U.S.C. § 134(a) from the Examiner's January 13, 2017 decision finally rejecting claims 1–23 ("Final Act."). We have jurisdiction over the appeal under 35 U.S.C. § 6(b).

We reverse.

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[1] Appellants identify Toyota Motor Engineering and Manufacturing North America, Inc. as the real party in interest (Appeal Br. 1).

CLAIMED SUBJECT MATTER

Appellants' disclosure relates to solar cells having a double groove diffraction grating (i.e., a diffraction grating with alternating wide and narrow grating elements) which is configured to transmissively diffract normal incident light into the cell to maximize light pathlength within the cell (Appeal Br. 1). This is said to maximize light absorption by a photovoltaic portion of the cell (*id.*). Claim 1 is representative of the claimed invention, and is reproduced below from the Claims Appendix to the Appeal Brief:

> 1. A solar cell comprising:
>
> a light-absorbing layer responsive to impinging polarized light to produce electrical energy;
>
> first and second electrodes of opposite polarity for deriving electrical energy from the light-absorbing layer; said electrodes being disposed parallel to one another on opposite sides of and generally parallel to the light-absorbing layer; and
>
> a solid transparent substrate having two parallel plane surfaces, one of said surfaces contactingly overlying one of the electrodes and having embedded in said contactingly overlying surface a double groove diffraction grating comprising regularly spaced double width dielectric diffraction grating elements arranged substantially along the entirety of said surface and integral with said substrate for transmissively coupling a selected first order component of normal S-polarized light incident on substantially the entirety of a surface of the light-absorbing layer into the light absorbing layer with greater than 50% coupling efficiency.

REJECTIONS

I. Claims 1, 4–6, 11, and 15 are rejected under 35 U.S.C. § 103(a) as unpatentable over Ramamoorthy[2] in view of Saarinen[3] and Pietarinen.[4]

II. Claims 2, 3, 8–10, 13, 14, 18, and 19 are rejected under 35 U.S.C. § 103(a) as unpatentable over Ramamoorthy in view of Saarinen and Pietarinen, and further in view of Duerr.[5]

III. Claims 7, 12, 16, 17, and 20–23 are rejected under 35 U.S.C. § 103(a) as unpatentable over Ramamoorthy in view of Saarinen and Pietarinen, and further in view of Mizuno.[6]

DISCUSSION

The Examiner finds that Ramamoorthy discloses each limitation of claim 1, except that it does not disclose that the diffraction grating is a double grooved diffraction grating comprising regularly spaced double width dielectric diffraction grating elements arranged substantially along the entirety of said surface and integral with said substrate for transmissively coupling only a selected first order component of the normal S-polarized light incident on substantially the entirety of a surface of the light-absorbing layer into the light absorbing layer with greater than 50% coupling efficiency (Final Act. 3–4, citing Ramamoorthy, Figs. 10A and 13).

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[2] Ramamoorthy et al., US 2009/0242019 A1, published October 1, 2009.
[3] Saarinen et al., "*Asymmetric beam deflection by doubly grooved binary gratings*," Applied Optics, Vol. 33, No. 14, pp. 2401–2405 (May 10, 1995).
[4] Pietarinen et al., "*Double Groove Broadband Gratings*," Optics Express, Vol. 16, No. 18, pp. 13824–13830 (September 1, 2008).
[5] Duerr et al., US 2008/0245410 A1, published October 9, 2008.
[6] Mizuno, US 6,350,945 B1, issued February 26, 2002.

The Examiner finds that Saarinen discloses that double grooved diffraction gratings offer enhanced 1st order diffraction and larger critical angles, and Pietarinen teaches that double diffraction gratings can be used to transmissively couple light (Final Act. 4). Therefore, according to the Examiner it would have been obvious

> to have modified the diffraction grating in the cell of Ramamoorthy[]. to include a transmissively double-groove 1st order diffraction grating geometry suggested by Saarinen[] and Pietarinen[] because the simple substitution of a known element known in the prior art to perform the same function, in the instant case a diffraction grating for directing radiation, is a matter of obviousness (see MPEP 2143 B) and because it would provide for enhanced 1st order diffraction efficiency and larger critical angles of incident light.

(Final Act. 5.)

Appellants argue, inter alia, the Examiner's "simple substitution" of Saarinen's double diffraction grating (modified as suggested by Pietarinen to make it transmissive rather than reflective) is improper, particularly because a person of skill in the art would not have had a reasonable expectation of success in making the recited combination (Appeal Br. 6–8). Moreover, according to Appellants, modifying the art to achieve the claimed diffraction properties would have required more than routine experimentation/optimization from someone of skill in the art.

Appellants contend (Appeal Br. 6) that Saarinen explicitly states that its disclosures regarding the properties of its double diffraction gratings are specific to reflective (rather than transmissive) gratings, and states that its teachings are not applicable to transmissive double diffraction gratings which, according to Saarinen, can only occur at limited incidence angles

(citing Saarinen 2401). Therefore, according to Appellants, "the transmissive double groove diffraction gratings having greater than 50% coupling into of normal S-polarized light into a 1st order diffraction component of the present claims represent a surprising result" (Appeal Br. 6).

Appellants also cite to a Rule 132 Declaration of Dr. Hideo Iizuka (one of the inventors of the application on appeal) as evidence that the diffraction properties of transmissive and reflective diffraction gratings are governed by different physical principals, so that knowledge of how to create a reflective diffraction grating having the claimed properties would not have allowed a person of ordinary skill in the art to make a transmissive diffraction grating having those same properties (Appeal Br. 6–7; *see* Iizuka Decl. ¶¶ 9–12). For example, Dr. Iizuka points to published literature which shows that metallic, reflective gratings (like those disclosed by Saarinen) will not accommodate modes with high electromagnetic amplitude in the grating ridges, which are required to achieve the diffraction properties set forth in claim 1 (Iizuka Dec. ¶ 10).

The Examiner has not disputed the evidence set forth in the Iizuka Declaration (*see* Ans. 26–28). Instead, the Examiner relies on disclosure in Saarinen of specific dimensions for its gratings and disclosure in Pietarinen of specific dimensions for its gratings as evidence that a person of skill in the art would have known to vary these parameters to achieve the results set forth in the claimed device (*id.*). However, the evidence from the Iizuka Declaration shows that design parameters from reflective grating as discussed in Saarinen, if transferred to a transmissive grating like Pietarinen, would not have been expected to yield the same diffraction properties, such

as those set forth in the claims, and that more than routine experimentation would have been required to arrive at the claimed diffraction properties (Iizuka Decl. ¶ 12).

To establish a prima facie case of obviousness, the Examiner must show that each and every limitation of the claim is described or suggested by the prior art or would have been obvious based on the knowledge of those of ordinary skill in the art or the inferences and creative steps a person of ordinary skill in the art would have employed. *In re Fine*, 837 F.2d 1071, 1074 (Fed. Cir. 1988); *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 417 (2007). In the absence of a proper prima facie case of obviousness, an applicant who complies with the other statutory requirements is entitled to a patent. *In re Rouffet*, 149 F.3d 1350, 1355 (Fed. Cir. 1998); *see also In re Oetiker*, 977 F.2d 1443, 1445 (Fed. Cir. 1992). In order to justify rejecting a claim as unpatentable, the Examiner must also articulate some "reasoning with some rational underpinning to support the legal conclusion of obviousness." *In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006). This reasoning must show that "there was an apparent reason to combine the known elements in the fashion claimed." *KSR*, 550 U.S. at 418. Finally, evidence showing there was no reasonable expectation of success may support a conclusion of nonobviousness. *In re Rinehart*, 531 F.2d 1048, 1054 (CCPA 1976).

We conclude that the preponderance of evidence of record does not support the rejection of claim 1. The evidence does not support a finding that a person of skill in the art would have had a reasonable expectation that a transmissive diffraction grating having the claimed diffraction properties could have been constructed based on the teachings of Saarinen and

Pietarinen. Accordingly, we reverse the rejection of claim 1.

The basis for our reversal of the rejection of claim 1 over Ramamoorthy in view of Saarinen and Pietarinen is common to the rejection of each of the independent claims. Accordingly, we reverse the rejection of each of those claims, and the claims which depend from them, for the same reasons.

CONCLUSION

We REVERSE the rejection of claims 1, 4–6, 11, and 15 under 35 U.S.C. § 103(a) as unpatentable over Ramamoorthy in view of Saarinen and Pietarinen.

We REVERSE the rejection of claims 2, 3, 8–10, 13, 14, 18, and 19 under 35 U.S.C. § 103(a) as unpatentable over Ramamoorthy in view of Saarinen and Pietarinen, and further in view of Duerr.

We REVERSE the rejection of claims 7, 12, 16, 17, and 20–23 under 35 U.S.C. § 103(a) as unpatentable over Ramamoorthy in view of Saarinen and Pietarinen, and further in view of Mizuno.

REVERSED