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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
13/721,206	12/20/2012	Yohei KAN	NG10679US	6131
22203	7590	09/20/2019	EXAMINER	
KUSNER & JAFFE Paragon Center II 6150 Parkland Boulevard Suite 105 Mayfield Heights, OH 44124			KIRBY, BRIAN R	
			ART UNIT	PAPER NUMBER
			3747	
			NOTIFICATION DATE	DELIVERY MODE
			09/20/2019	ELECTRONIC

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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Ex parte YOHEI KAN

Appeal 2017-011498
Application 13/721,206
Technology Center 3700

Before NINA L. MEDLOCK, PHILIP J. HOFFMANN, and
AMEE A. SHAH, *Administrative Patent Judges*.

SHAH, *Administrative Patent Judge*.

DECISION ON APPEAL¹

The Appellant² appeals under 35 U.S.C. § 134(a) from the Examiner's final decision rejecting claims 1–4, 7, and 8. We have jurisdiction under 35 U.S.C. § 6(b).

We AFFIRM.

¹ Throughout this Decision, we refer to the Appellant's Appeal Brief ("Appeal Br.," filed Oct. 14, 2016), Reply Brief ("Reply Br.," filed Apr. 14, 2017), and Specification ("Spec.," filed Dec. 20, 2012, as amended Aug. 28, 2015), and to the Examiner's Answer ("Ans.," mailed Feb. 22, 2017) and Final Office Action ("Final Act.," mailed Feb. 24, 2016).

² According to the Appellant, the real party in interest is "NGK SPARK PLUG CO., LTD." Appeal Br. 3.

STATEMENT OF THE CASE

The Appellant's invention "relates to a ceramic heater in which a heat-generating element is held in a substrate, to a method of manufacturing the ceramic heater, and to a heating apparatus having the ceramic heater."

Spec. 1.

Claims 1 and 4 are the independent claims on appeal. Claim 1 (Appeal Br. 36 (Claims App.)) is illustrative of the subject matter on appeal and is reproduced below (with added bracketing for reference):

1. A ceramic heater comprising:

[(a)] a substrate formed from an electrically insulating ceramic and extending rearward from a forward end of the ceramic heater in a direction of an axis, and

[(b)] a heat-generating element having a heat-generating portion formed from an electrically conductive ceramic which contains silicon nitride and an electrically conductive material, said heat-generating portion disposed in a forward end portion of the substrate, and having a shape resembling a letter U as viewed along the direction of the axis,

[(c)] wherein the heat-generating portion has a fracture toughness of $4.3 \text{ MPa}\cdot\text{m}^{0.5}$ or more.

REJECTIONS

I. Claim 1 stands rejected under pre-AIA 35 U.S.C. § 102(b) as being anticipated by Watanabe et al. (US 6,621,052 B2, iss. Sept. 16, 2003) ("Watanabe").

II. Claims 1–4, 7, and 8 stand rejected under pre-AIA 35 U.S.C. § 103(a) as being unpatentable over Sekiguchi et al. (US 2011/0114622 A1, pub. May 19, 2011) ("Sekiguchi) in view of Watanabe.

III. Claims 2–4, 7, and 8 stand rejected under pre-AIA 35 U.S.C. § 103(a) as being unpatentable over Watanabe in view of Sekiguchi.

ANALYSIS

*Rejection I – 35 U.S.C. § 102(b)*³

The Appellant contends that the Examiner’s anticipation rejection of independent claim 1 is in error because Watanabe does not disclose:

the claimed heat-generating portion of the ceramic heater, which contains silicon nitride and an electrically conductive material, has a fracture toughness of 4.3 MPa·m^{0.5} or more when it is disposed in a forward end portion of the substrate and has a shape resembling a letter U as viewed along the direction of the axis.

Appeal Br. 9. After careful review of the record, we are not persuaded that the Examiner erred.

The Examiner finds, in relevant part, that Watanabe discloses a U-shaped heat-generating portion (element 10) of a heating element (element 11) formed from silicon nitride-tungsten carbide composite sintered material, as recited in limitation (b), with a fracture toughness of 44.3 MPa·m^{0.5} or more, as recited in limitation(c). *See* Final Act. 5 (citing Watanabe, col. 6, l. 13–col. 7, l. 18).

Watanabe “provide[s] a silicon nitride–tungsten carbide composite sintered material which is endowed with high strength, can attain reduction of electrical resistance, exhibits reliable characteristics under wide ranges of firing conditions, and prevents generation of tungsten silicide, which is a brittle substance.” Watanabe, col. 1, ll. 60–65. Silicon nitride powder, tungsten carbide powder, an oxide of a rare earth element, and silicon

³ The rejections are addressed in the order presented in the Final Action.

dioxide powder, serving as raw materials, were mixed to attain raw material powder mixtures. *See id.* at col. 4, ll. 39–45. The mixtures were wet-mixed in water, dried in a hot bath, and fired to yield sintered materials. *See id.* at col. 4, ll. 46–53. Each of the sintered materials was subjected to various measurements, including fracture toughness that was obtained according to JIS R1607 (1990). *See id.* at col. 5, ll. 13–34. Certain sintered materials had a fracture toughness in the range of 4.7–5.8 MPa·m^{0.5}. *See id.* at col. 6, ll. 14–25. Watanabe also provides for a glow plug with a ceramic heater 1 in the shape of a rod (*see id.* at col. 7, ll. 22–28), with a ceramic resistor 10 provided in the front end of heater 1. *See id.* at col. 8, ll. 40–50. The resistor 10 is “formed of a conductive ceramic material (i.e., the silicon nitride–tungsten carbide composite sintered material of the invention)” and has, in part, a first resistor portion 11 that functions as a resistance heating element. *See id.* at col. 8, ll. 45–52.

The Appellant does not contest the Examiner’s findings that Watanabe discloses the heat-generating element and heating portion as recited in claim 1’s limitation (b). Rather, the Appellant argues that Watanabe does not disclose the fracture toughness as recited in limitation (c) because:

As is known by those having ordinary skill in the art, fracture toughness is easily affected by tensile stress. For example, a fracture toughness of a material to which tensile stress is applied will be less than a fracture toughness of a material to which no tensile stress is applied. As such, the fracture toughness of the conductive ceramic materials of Watanabe and the fracture toughness of the claimed heat-generating portion are not comparable.

Appeal Br. 10. The Appellant cites to U.S. Patent No. 5,948,306 to Konishi et al., as support for the proposition that “electrically conductive ceramics that constitute ceramic heating elements (e.g., the claimed heat-generating portion) are known by those having ordinary skill in the art to be exposed to higher stresses and strains when embedded within ceramic bodies (e.g., the claimed substrate).” *Id.* at 11–12. Thus, one of ordinary skill in the art would “conclu[de] that a fracture toughness of a conductive ceramic component will be significantly greater than a fracture toughness of the same conductive ceramic component exposed to tensile stresses when embedded within a ceramic insulator of a ceramic heater.” *Id.* at 12. The Appellant contends that “the conductive ceramic materials of Watanabe are not under tensile stress during fracture toughness determination, because the conductive ceramic materials are not embedded in an insulating ceramic during testing.” *Id.* Thus, the Appellant contends, “the fracture toughness of the conductive ceramic materials taught by Watanabe must be inherently less than the disclosed range of 4.7–5.8 MPa·m^{0.5} when considering the effect of tensile stress.” *Id.* at 13.

Even were we to assume that the Appellant’s contentions are accurate, the Appellant has not adequately shown that Watanabe’s fracture toughness would be less than 4.3 MPa·m^{0.5}. At best, the Appellant shows that Watanabe’s fracture toughness would be some amount less than 4.7 or 5.8 MPa·m^{0.5}. The Appellant does not show by evidence or technical reasoning how much less the fracture toughness would be. For example, if the fracture toughness, when taking into account the stresses, was 0.3 MPa·m^{0.5} less, it would still be at least 4.4 MPa·m^{0.5}; if the corrected fracture toughness was 1 MPa·m^{0.5} less, it could still be 4.8 MPa·m^{0.5}. Thus, even under a lesser

fracture toughness taking into account tensile stresses, Watanabe's fracture toughness can still be $4.3 \text{ MPa}\cdot\text{m}^{0.5}$ or more.

Based on the foregoing, we are not persuaded of error in the Examiner's finding that Watanabe discloses the heat-generating portion having a fracture toughness of $4.3 \text{ MPa}\cdot\text{m}^{0.5}$ or more. Thus, we sustain the rejection of independent claim 1 under 35 U.S.C. § 102(b).

Rejection II – 35 U.S.C. § 103(a)

The Appellant contends that the Examiner's rejection of claims 1–4, 7, and 8 as obvious over Sekiguchi in view of Watanabe is in error for the same reasons as presented for the rejection of claim 1 as anticipated by Watanabe. *See* Appeal Br. 15–21, 28–34. Specifically, the Appellant repeats the arguments presented *supra* that the Examiner's finding that Watanabe, upon which the Examiner relies, teaches the heat-generating portion having a fracture toughness of $4.3 \text{ MPa}\cdot\text{m}^{0.5}$ or more is in error. *See id.*

Because we are not persuaded of error in the Examiner's finding that Watanabe discloses the heat-generating portion having a fracture toughness of $4.3 \text{ MPa}\cdot\text{m}^{0.5}$ or more, we sustain the rejection of claims 1–4, 7, and 8 under 35 U.S.C. § 103(a) as obvious over Sekiguchi in view of Watanabe.

Rejection III – 35 U.S.C. § 103(a)

The Appellant contends that the Examiner's rejection of claims 2–4, 7, and 8 as obvious over Watanabe in view of Sekiguchi is in error for the same reasons as presented for the rejection of claim 1 as anticipated by Watanabe. *See* Appeal Br. 14, 21–28. Specifically, the Appellant repeats the arguments presented *supra* that the Examiner's finding that Watanabe,

upon which the Examiner relies, teaches the heat-generating portion having a fracture toughness of $4.3 \text{ MPa}\cdot\text{m}^{0.5}$ or more is in error. *See id.*

Because we are not persuaded of error in the Examiner's finding that Watanabe discloses the heat-generating portion having a fracture toughness of $4.3 \text{ MPa}\cdot\text{m}^{0.5}$ or more, we sustain the rejection of claims 2–4, 7, and 8 under 35 U.S.C. § 103(a) as obvious over Watanabe in view of Sekiguchi.

DECISION

The Examiner's rejection of claim 1 under pre-AIA 35 U.S.C. § 102(b) as anticipated by Watanabe is AFFIRMED.

The Examiner's rejections of claims 1–4, 7, and 8 under pre-AIA 35 U.S.C. § 103(a) as being unpatentable over Sekiguchi and Watanabe are 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