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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Ex parte TAKAO FUKUMIZU, HIROSHI MATSUMORI, YOICHI ASANO, and TAKUMA YAMAWAKI

Appeal 2018-001833
Application 14/221,865
Technology Center 1700

Before TERRY J. OWENS, AVELYN M. ROSS, and JANE E. INGLESE, *Administrative Patent Judges*.

INGLESE, *Administrative Patent Judge*.

DECISION ON APPEAL

Appellant[1] requests our review under 35 U.S.C. § 134(a) of the Examiner's decision to finally reject claims 1, 3, 4, 11, and 12. We have jurisdiction over this appeal under 35 U.S.C. § 6(b).

We REVERSE.

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[1] Appellant is the applicant, Honda Motor Company, Ltd., which, according to the Appeal Brief, is the real party in interest. Appeal Brief filed May 19, 2017 ("App. Br."), 3.

STATEMENT OF THE CASE

Appellant claims a membrane electrode assembly comprising a solid polymer electrolyte membrane sandwiched between an anode and a cathode. App. Br. 5–9. Independent claims 1 and 12 illustrate the subject matter on appeal and are reproduced below:

> 1. A membrane electrode assembly comprising a solid polymer electrolyte membrane sandwiched between an anode and a cathode,
>
> wherein the anode contains a first electrode catalyst layer facing the electrolyte membrane, and *the anode further comprises a first piled body comprising a first gas diffusion layer and a first porous layer interposed between the first electrode catalyst layer and the first gas diffusion layer*,
>
> wherein the cathode contains a second electrode catalyst layer facing the electrolyte membrane, and *the cathode further comprises a second piled body comprising a second gas diffusion layer and a second porous layer interposed between the second electrode catalyst layer and the second gas diffusion laye*r, each of the first and second porous layers being thermally compression-bonded to the corresponding gas diffusion layer to form the first and second piled bodies,
>
> each of the first porous layer and the second porous layer having a thickness in a range of 10 to 50 micrometers and a porosity in a range of 20 to 50 percent, with the porosity of the second porous layer being greater than the porosity of the first porous layer,
>
> wherein each of the first porous layer and the second porous layer comprises an electron-conductive substance and a water-repellent resin, and is configured to resist deformation of the electrolyte membrane,
>
> wherein the first piled body has a percolation pressure higher than that of the second piled body,
>
> wherein the first piled body has a percolation pressure in a range of 25 to 120 kPa and the second piled body has a percolation pressure in a range of 5 to 25 kPa, and
>
> wherein the thickness of the first porous layer is equal to or greater than the thickness of the second porous layer.

12. A membrane electrode assembly comprising a solid polymer electrolyte membrane sandwiched between an anode and a cathode,

wherein the anode contains a first electrode catalyst layer facing the electrolyte membrane, and *the anode further comprises a first piled body comprising a first gas diffusion layer and a first porous layer interposed between the first electrode catalyst layer and the first gas diffusion layer*, each of the first and second porous layers being thermally compression-bonded to the corresponding gas diffusion layer to form the first and second piled bodies,

each of the first porous layer and the second porous layer having a thickness in a range of 10 to 50 micrometers and a porosity in a range of 20 to 50 percent, with the porosity of the second porous layer being greater than the porosity of the first porous layer,

wherein each of the first porous layer and the second porous layer comprises an electron-conductive substance and a water-repellent resin, and is configured to resist deformation of the electrolyte membrane,

wherein the cathode contains a second electrode catalyst layer facing the electrolyte membrane, and *the cathode further comprises a second piled body comprising a second gas diffusion layer and a second porous layer interposed between the second electrode catalyst layer and the second gas diffusion layer*,

wherein the first and second porous layers, respectively, are configured to cover edge portions of the corresponding electrode catalyst layers,

wherein the first piled body has a percolation pressure higher than that of the second piled body, and

wherein the first piled body has a percolation pressure in a range of 25 to 120 kPa and the second piled body has a percolation pressure in a range of 5 to 25 kPa.

App. Br. 24–26 (Claims Appendix) (emphasis added).

The Examiner sets forth the following rejections in the Final Office Action entered September 21, 2016 ("Final Act."), and maintains the rejections in the Examiner's Answer entered September 26, 2017 ("Ans.")[2]:

I. Claims 1, 3, 11, and 12 under 35 U.S.C. § 103 as unpatentable over Ji et al. (US 2012/0178010 A1, published July 12, 2012) (hereinafter "Ji") in view of Sugawara et al. (US 6,194,094 B1, issued February 27, 2001) (hereinafter "Sugawara") and Xie (US 2005/0260476 Al, published November 24, 2005); and

II. Claim 4 under 35 U.S.C. § 103 as unpatentable over Ji in view of Sugawara, Xie, and Ohma (US 2009/0035634 A1, published February 5, 2009).

DISCUSSION

Upon consideration of the evidence relied upon in this appeal and each of Appellant's contentions, we reverse the Examiner's rejections of claims 1, 3, 4, 11, and 12 under 35 U.S.C. § 103 for the reasons set forth in the Appeal Brief and below.

As set forth above, independent claims 1 and 12 both require the claimed membrane electrode assembly to include an anode and a cathode comprising a piled body comprising a gas diffusion layer and a porous layer interposed between an electrode catalyst layer and the gas diffusion layer.

The Examiner finds that Ji discloses a fuel cell membrane electrode assembly including membrane 30 (a solid polymer electrolyte membrane) sandwiched between anode catalyst layer 32 and cathode catalyst layer 34.

[2] The Advisory Action entered February 8, 2017 indicates that the Reply filed January 23, 2017 overcame the rejection of claims 1, 3, 4, 11, and 12 under 35 U.S.C. § 112(b).

Final Act. 4 (citing Ji Abstract; ¶ 21; Fig. 3). The Examiner finds that Ji discloses that the membrane electrode assembly also includes a first plied body comprising first microporous layer 36 and anode diffusion media 14, and a second plied body comprising second microporous layer 38 and cathode diffusion media 16. Final Act. 4–5 (citing Ji ¶ 22; Fig. 3). The Examiner finds that first and second microporous layers 36, 38 disclosed in Ji correspond to the first and second gas diffusion layers recited in claims 1 and 12, and anode and cathode diffusion media 14, 16 disclosed in Ji correspond to the first and second porous layers recited in claims 1 and 12. Final Act. 4–5. The Examiner finds that Ji does not disclose the materials used to make the anode and cathode diffusion media 14, 16 (first and second porous layers), and the Examiner relies on Xie to address this feature. Final Act. 6–7.

The Examiner finds that Xie discloses first and second porous layers containing carbon black (an electron-conductive substance) and an ion-exchange resin (a water-repellent resin). Final Act. 6–7 (citing Xie ¶ 60). The Examiner concludes that it would have been obvious to one of ordinary skill in the art at the time of the effective filing date to use the first and second porous layers disclosed in Xie "for that of Ji" because Xie teaches that the layers have "resistance to sticking by carbon fibers." Final Act. 7.

The preponderance of the evidence relied-upon in this appeal, however, does not support the Examiner's conclusion of obviousness, for reasons expressed by Appellant, as discussed below.

Ji discloses fuel cell 10 comprising membrane electrode assembly 12 including membrane 30 sandwiched between anode catalyst layer 32 and cathode catalyst layer 34. ¶¶ 19, 21; Fig. 3. Ji discloses that anode diffusion

media 14 is interposed between membrane electrode assembly 12 and electrically conductive upper plate 18, and cathode diffusion media 16 is interposed between membrane electrode assembly 12 and electrically conductive lower plate 20. ¶¶ 19, 21; Fig. 3. Ji discloses that anode and cathode diffusion media 14, 16 each include microporous layers 36, 38 "located on the side of the anode or cathode DM [diffusion media] proximate the respective catalyst layer 32, 34."[3] ¶ 22.

Ji indicates that during operation of fuel cell 10 an H_2 stream (fuel feed stream) flows through channel 40, and concurrently, an air or pure O_2 stream (oxidant feed stream) flows through channel 42. ¶ 23; Fig. 3. Ji discloses that the H_2 stream flows through anode diffusion media 14 to anode catalyst 32, which causes the H_2 to be oxidized into protons (H^+). *Id.* Ji discloses that the protons flow through membrane layer 30 to cathode catalyst 34 where the protons combine with the O_2 stream and electrons to form water. *Id.* By disclosing that the protons combine with the O_2 stream at cathode catalyst 34, Ji implicitly indicates that O_2 stream entering channel 42 flows through cathode diffusion media 16 to cathode catalyst 34. Thus, one of ordinary skill in the art would have understood that flow of H_2 through anode diffusion media 14 to anode catalyst 32, and flow of O_2 through cathode diffusion media 16 to cathode catalyst 34, are critical to the operation of fuel cell 10 disclosed in Ji.

[3] In view of the unequivocal indication in Ji that microporous layers 36, 38 are "located on the side of the anode or cathode DM [diffusion media] proximate the respective catalyst layer 32, 34," placement in Figure 3 of reference numerals 36, 38 in layers of anode diffusion media 14 and cathode diffusion media 16 proximate upper and lower plates 18, 20, rather than anode 32 and cathode 34, appears to be an inadvertent error.

Xie discloses membrane electrode assembly 9 for a polymer electrolyte fuel cell that includes electrolyte membrane 2 sandwiched between catalyst layer 5 for fuel and catalyst layer 6 for oxidizing agent. ¶¶ 2, 48, 49; Figs. 2A and 2B. Xie discloses that membrane electrode assembly 9 also includes gas diffusion layer 3 for fuel composed of electrically conductive fibers and positioned on the side of catalyst layer 5 for fuel not facing electrolyte membrane 2, and gas diffusion layer 4 for oxidizing agent composed of electrically conductive fibers and positioned on the side of catalyst layer 6 for oxidizing agent not facing electrolyte membrane 2. ¶¶ 7, 48, 49; Figs. 2A and 2B.

Xie discloses positioning a reinforcement layer including a plurality of microbodies having resistance to gas permeability, and an electrolyte component having ionic conductivity, between the catalyst layer for fuel and the electrolyte membrane, between the catalyst layer for oxidizing agent and the electrolyte membrane, or inside the electrolyte membrane to "restrain the electrically conductive fibers of the gas diffusion layer for fuel and/or the gas diffusion layer for oxidizing agent from sticking into the electrolyte membrane." ¶¶ 25–27. Xie discloses an embodiment in which reinforcement layer 11 is positioned between electrolyte membrane 2 and catalyst layer 6 for oxidizing agent, and exemplifies a reinforcement layer comprised of carbon black microbodies and an ion-exchange resin. ¶¶ 48, 49, 60; Figs. 2A and 2B.

The Examiner refers to the reinforcement layer disclosed in Xie as a "porous layer," and as discussed above, proposes using Xie's exemplified reinforcement layer comprised of carbon black microbodies and an ion-exchange resin as the anode diffusion media 14 and cathode diffusion media

16 in Ji's membrane electrode assembly 12. Final Act. 6–7. As Appellant points out (App. Br. 18–19), and as discussed above, however, Xie discloses that the reinforcement layer is resistant to gas permeability. *See, e.g.*, Xie ¶¶ 8, 25, 26, 30, 32, 52. As also discussed above, one of ordinary skill in the art would have understood that flow of H_2 through Ji's anode diffusion media 14, and flow of O_2 through Ji's cathode diffusion media, are critical to the operation of Ji's fuel cell 10. It follows that one of ordinary skill in the art also would have understood that the Examiner's proposed use of Xie's reinforcement layer, which is resistant to gas permeability, for Ji's gas permeable anode and cathode diffusion media would at the very least negatively impact the efficiency of Ji's fuel cell, and would likely render it inoperable, as Appellant argues. App. Br. 19–20.

Consequently, the Examiner does not provide a persuasive, reasoned explanation, supported by objective evidence, for why one of ordinary skill in the art would have been led to use Xie's exemplified reinforcement layer comprised of carbon black microbodies and an ion-exchange resin as the anode diffusion media 14 and cathode diffusion media 16 in Ji's membrane electrode assembly 12. Accordingly, the Examiner fails to establish that the combined disclosures of Ji, Sugawara,[4] and Xie would have suggested a membrane electrode assembly including an anode and cathode that each comprise a piled body comprising a gas diffusion layer and a porous layer interposed between an electrode catalyst layer and the gas diffusion layer, as required by claims 1 and 12. It follows that the Examiner fails to establish a prima facie case of obviousness of the subject matter recited in claims 1 and

[4] The Examiner does not rely on Sugawara for any disclosure that cures the deficiencies of Ji and Xie discussed above. Final Act. 5–6.

12 within the meaning of 35 U.S.C. § 103(a). *See In re Oetiker*, 977 F.2d 1443, 1445 (Fed. Cir. 1992) ("[T]he examiner bears the initial burden, on review of the prior art or on any other ground, of presenting a *prima facie* case of unpatentability.").

We accordingly do not sustain the Examiner's rejection of claims 1 and 12 under 35 U.S.C. § 103(a), and also of claims 3, 4, and 11, which each depend from either claim 1 or claim 12.

DECISION

We reverse the Examiner's rejections of claims 1, 3, 4, 11, and 12 under 35 U.S.C. § 103.

REVERSED