

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

BUTAMAX™ ADVANCED BIOFUELS LLC,
Petitioner,

v.

GEVO, INC.,
Patent Owner.

Case IPR2014-00402
Patent 8,373,012 B2

Before CHRISTOPHER L. CRUMBLY, GEORGIANNA W. BRADEN,
and ZHENYU YANG, *Administrative Patent Judges*.

YANG, *Administrative Patent Judge*.

FINAL WRITTEN DECISION
35 U.S.C. § 318(a) and 37 C.F.R. § 42.73

INTRODUCTION

Butamax™ Advanced Biofuels LLC (“Petitioner”) filed a Petition to institute an *inter partes* review of claims 1–15 of U.S. Patent No. 8,373,012 B2 (“the ’012 patent,” Ex. 1001). Paper 2 (“Pet.”). On August 8, 2014, the Board instituted trial to review patentability of the challenged claims. Paper 11 (“Dec.”). Thereafter, Gevo, Inc. (“Patent Owner”) filed a Response (Paper 16 (“PO Resp.”)), and Petitioner filed a Reply (Paper 17).

The Board has jurisdiction under 35 U.S.C. § 6(c) and issues this final written decision pursuant to 35 U.S.C. § 318(a) and 37 C.F.R. § 42.73. We conclude Petitioner has established by a preponderance of the evidence that claims 1–15 of the ’012 patent are unpatentable.

The ’012 Patent

The ’012 patent relates to methods for making a renewable jet fuel blendstock that meets ASTM blendstock requirements. Ex. 1001, Abstract. The methods comprise fermenting a biomass-derived feedstock, dehydrating the resulting alcohols to produce olefins, oligomerizing the olefins to form unsaturated oligomers, and hydrogenating the unsaturated oligomers to form the renewable jet fuel. *Id.* at 5:24–67.

Among the challenged claims, claim 1 is the sole independent claim. It reads:

1. A process for preparing renewable jet fuel blendstock comprising:
 - (a) treating biomass to form a feedstock;
 - (b) fermenting the feedstock with one or more species of microorganism, thereby forming isobutanol;

- (c) dehydrating at least a portion of the isobutanol obtained in step (b), thereby forming a dehydration product comprising isobutene;
- (d) oligomerizing at least a portion of the dehydration product, thereby forming a product comprising one or more C₈, one or more C₁₂, and one or more C₁₆ unsaturated oligomers; and
- (e) hydrogenating at least a portion of the product of step (d) in the presence of hydrogen, thereby forming a renewable jet fuel blendstock comprising one or more C₁₂ and one or more C₁₆ saturated alkanes;
- (f) adjusting the ratio of C₁₂ and C₁₆ saturated alkanes provided by step (e) to form a renewable jet fuel blendstock which meets or exceeds the requirements of ASTM D7566-10a for hydroprocessed synthesized paraffinic kerosene (SPK).

Reviewed Grounds of Unpatentability

The Board instituted trial to review the patentability of the challenged claims on the following grounds:

Claim(s) Challenged	Basis	References
1–12, 14, and 15	§ 103	Gruber ¹ and ASTM D7566-09 ²
13	§ 103	Gruber, ASTM D7566-09, and Mossman ³

¹ Gruber et al., Int’l Pub. No. WO 2009/079213 A2, published on June 25, 2009 (Ex. 1003, “Gruber”).

² *Standard Specification for Aviation Turbine Fuel Containing Synthesized Hydrocarbons*, Designation: D7566-09, published in September 2009 (Ex. 1004, “ASTM D7566-09”).

³ Mossman et al., U.S. Patent No. 6,239,321 B1, issued on May 29, 2001 (Ex. 1005, “Mossman”).

ANALYSIS

Claim Construction

In an *inter partes* review, the Board interprets a claim term in an unexpired patent according to its broadest reasonable construction in light of the specification of the patent in which it appears. 37 C.F.R. § 42.100(b); *see also In re Cuozzo Speed Techs., LLC*, No. 2014-1301, 2015 WL 4097949, *8 (Fed. Cir. 2015). Under that standard, absent any special definitions, we assign claim terms their ordinary and customary meaning, as understood by a person of ordinary skill in the art, in the context of the entire patent disclosure. *In re Translogic Tech., Inc.*, 504 F.3d 1249, 1257 (Fed. Cir. 2007).

Neither party proposes any claim construction. We determine that no term requires express claim construction for purposes of this Decision.

Priority Date

The '012 patent issued from an application filed on May 9, 2011. Ex. 1001. It claims priority to Provisional Application No. 61/332,561 (“the '561 provisional”), filed on May 7, 2010. *Id.*

In the Decision to Institute, we concluded that, based on the record at that time, the challenged claims are not entitled to the priority of the '561 provisional filing date. Dec. 5–7. As a result, we analyzed the claims based on a priority date of May 9, 2011. *Id.* at 7.

In its Response, Patent Owner does not dispute the priority-date determination as set forth in the Decision to Institute. Having considered the complete record developed at trial, we see no reason to change our conclusion that the priority date of the challenged claims is May 9, 2011.

Thus, Gruber, ASTM D7566-09, and Mossman all qualify as prior art under 35 U.S.C. § 102(b).

Prior Art Disclosures

Gruber

Gruber is directed to methods for preparing renewable compositions derived from fermentation of biomass. Ex. 1003, Abstract. In one embodiment, Gruber teaches a method comprising:

- (a) treating biomass to form a feedstock;
- (b) fermenting the feedstock with one or more species of microorganism, thereby forming one or more C₂-C₆ alcohols;
- (c) dehydrating at least a portion of the one or more C₂-C₆ alcohols obtained in step (b), thereby forming a product comprising one or more C₂-C₆ olefins;
- (d) isolating the one or more C₂-C₆ olefins;
- (e) oligomerizing at least a portion of the one or more C₂-C₆ olefins isolated in step (d), thereby forming a product comprising one or more C₆-C₂₄ unsaturated oligomers; and
- (f) optionally hydrogenating at least a portion of the product of step (e) in the presence of hydrogen, thereby forming a product comprising one or more C₆-C₂₄ saturated alkanes.

Id. at 4:30–5:10.

ASTM D7566

ASTM D7566 is the Standard Specification for Aviation Turbine Fuel Containing Synthesized Hydrocarbons. Ex. 1004, 1. According to the standard, “the number immediately following the designation [D7566] indicates the year of original adoption or, in the case of revision, the year of last revision.” *Id.* ASTM D7566-09 provides detailed requirements for chemical and physical properties of jet fuels containing synthesized

hydrocarbons. *Id.* at 4–5. SPK is a synthetic blending component in aviation turbine fuels. *Id.* at 7. ASTM D7566-09 also provides detailed requirements for chemical and physical properties of hydroprocessed SPK. *Id.* at 8.

Mossman

Mossman teaches a process for upgrading a feedstock comprising lower oligomers and higher oligomers of isobutylene by oligomerizing the lower oligomer fraction thereof to higher molecular weight components. Ex. 1005, Abstract. In Mossman, lower oligomers include monomers, dimers, and trimers, and upgraded higher oligomers refer to tetramers and other higher oligomers. *Id.* at 4:50–53.

Obviousness over Gruber and ASTM D7566-09

Petitioner argues that claims 1–12, 14, and 15 would have been obvious over Gruber and ASTM D7566-09. Pet. 17–32. Petitioner relies on the Declaration of Dr. Joseph T. Joseph to support the Petition (Ex. 1009). Patent Owner presents no expert testimony or any other evidence to support its patentability argument.

After reviewing the complete record, we conclude Petitioner has shown by a preponderance of the evidence that one of ordinary skill in the art⁴ would have had a reason to combine the teachings of Gruber and ASTM

⁴ The parties do not dispute the level of skill in the art. We also note that “[a] specific finding on the level of skill in the art is not . . . required where the prior art itself reflects an appropriate level and a need for testimony is

D7566-09, and in doing so, would have had a reasonable expectation of success in arriving at the claimed invention.

Claim 1

Petitioner refers to Gruber for teaching producing jet fuel by:

(1) producing isobutanol, a C₄ alcohol, by fermenting a biomass-derived feedstock; (2) dehydrating isobutanol to form isobutylene, a C₄ olefin; (3) oligomerizing isobutylene to form a mixture of unsaturated hydrocarbons suitable for jet fuel; (4) hydrogenating to the oligomers formed in step (3) to form saturated hydrocarbons; and (5) blending the product of step (4) with other components to form a product that meets all jet fuel specifications. Pet. 17–22 (citing Ex. 1003, 51:21–30). According to Petitioner, Gruber teaches that, depending on the catalyst and the reaction conditions, the unsaturated oligomers are primarily dimers (C₈ olefins), trimers (C₁₂ olefins), and tetramers (C₁₆ olefins). *Id.* at 22 (citing Ex. 1003, 29:17–20). Thus, Petitioner asserts that Gruber teaches each of steps (a)–(e) of claim 1. *Id.* at 17–22. Patent Owner does not dispute this assertion.

Petitioner refers to Gruber’s analysis of several experimental jet fuel blends with various ratios of C₈, C₁₂, and C₁₆ hydrocarbons to “understand the impact of chemical composition on key physical properties.” *Id.* at 20, 23 (citing Ex. 1003, 69:32–70:3, Table 1). Citing the Joseph Declaration, Petitioner contends that a skilled artisan would have known that jet fuels and jet fuel blendstocks have a preference for C₁₂ and C₁₆ hydrocarbons. *Id.* (citing Ex. 1009 ¶ 61). Thus, Petitioner argues that one of ordinary skill in the art would have specifically adjusted the ratio of C₁₂ and C₁₆ saturated

not shown.” *Litton Indus. Prods., Inc. v. Solid State Sys. Corp.*, 755 F.2d 158, 163-64 (Fed. Cir. 1985).

hydrocarbons, as recited in step (f). *Id.* (citing Ex. 1009 ¶ 61). Patent Owner does not dispute this argument, either.

Petitioner acknowledges that Gruber does not discuss ASTM D7566 specifically. *Id.* at 23. Petitioner, however, refers to several passages in Gruber as teaching that its renewable jet fuel must meet ASTM specifications for jet fuel. *Id.* at 20–21, 23 (citing, for example, Ex. 1003, 24:13–17, 44:26–30). Petitioner asserts that “the ASTM standards for transportation fuels are not merely guidelines or suggestions, they were typically incorporated into the FAA approval process.” *Id.* at 23; *see also* Ex. 1009 ¶ 21 (Dr. Joseph testifying that by the late 1990s, government agencies such as the EPA and FAA adopted the ASTM standards regarding transportation fuels as part of obtaining approval). According to Dr. Joseph, “ASTM D7566 was first published in September 2009 (as ASTM D7566-09), and a POSA would have reasonably expected that, in keeping with its tradition, the FAA would incorporate ASTM D7566 into its approval process for jet fuels containing synthesized hydrocarbons.” Ex. 1009 ¶ 21. As a result, Petitioner contends, a skilled artisan “would have had a reason to ensure that Gruber’s jet fuel blendstocks . . . would meet ASTM D7566-09’s requirements for hydroprocessed SPK.” Pet. 24 (citing Ex. 1009 ¶¶ 62–63).

In addition, Petitioner argues, a skilled artisan would have had a reasonable expectation of success modifying the process in Gruber so the renewable jet fuel blendstock meets or exceeds the requirements of ASTM D7566-09, because it would have required no more than routine optimization. *Id.* at 24. For instance, Petitioner refers to Example 37 of Gruber for teaching preparing jet fuel blends with C₈, C₁₂, and C₁₆ hydrocarbons in different ratios. *Id.* According to Petitioner, one of

ordinary skill in the art would have used similar, well-known techniques to adjust the ratio of C₁₂ and C₁₆ saturated alkanes to meet the ASTM standards, and such techniques would have produced predictable results. *Id.*

Patent Owner does not dispute either the reason to combine Gruber with ASTM D7566-09 or the reasonable expectation of success in doing so. Instead, Patent Owner argues that Gruber does not disclose ASTM D7566. PO Resp. 4–7.⁵ Patent Owner contends that Petitioner improperly relies on an inherency theory to support its obviousness conclusion. *Id.* at 5–6. According to Patent Owner, the obviousness challenge must fail because Gruber does not “necessarily and inevitably” provide a renewable jet fuel blendstock that meets or exceeds the requirements of ASTM D7566-10a. *Id.* at 6–7. We disagree with Patent Owner.

As an initial matter, we reject Patent Owner’s position that to establish *prima facie* obviousness, “each claim limitation must be provided by the prior art or inherently be present in the applied references.” *Id.* at 4. As the Supreme Court instructed, “there must be some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness,” but such reasoning “need not seek out precise teachings directed to the specific subject matter of the challenged claim.” *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 418 (2007). Instead, the background knowledge possessed by a person having ordinary skill in the art is an integral part of an obviousness analysis. *Id.*

In this case, whether Gruber inherently discloses ASTM D7566 is irrelevant to our analysis, because Petitioner does not rely on inherency to

⁵ We assign page numbers sequentially to Patent Owner’s Response as the document itself does not include any.

establish obviousness. Indeed, Petitioner points to Gruber for suggesting that renewable jet fuel must meet ASTM specifications for jet fuels. Pet. 23. Petitioner also relies on the knowledge of a skilled artisan that U.S. government agencies would adopt ASTM D7566, which provides the requirements for jet fuels containing synthesized hydrocarbons, to regulate their sale and use. *Id.* at 26 (citing Ex. 1009 ¶ 21). After reviewing the complete record, we determine that one of ordinary skill in the art would have had a reason to modify the teachings of Gruber to make a renewable jet fuel blendstock that meets or exceeds the requirement of ASTM D7566-09, and would have had a reasonable expectation of success in doing so.

Patent Owner correctly points out that claim 1 recites ASTM D7566-10a, not ASTM D7566-09. PO Resp. 7. Petitioner, however, asserts that the only difference between the two is that ASTM D7566-10a allows no more than 0.1 mg/kg of lithium in the SPK, whereas ASTM D7566-09 does not specify such a limitation. Pet. 24–25. Citing the Joseph Declaration, Petitioner contends that “the methods used to remove or reduce the amount of the metals specified in ASTM D7566-09, particularly alkali metals such as sodium and potassium, would have also removed or reduced lithium, as required by ASTM D7566-10a.” *Id.* at 25 (citing Ex. 1009 ¶ 65). Thus, Petitioner argues, one skilled in the art would have had a reasonable expectation of success that meeting the requirements of ASTM D7566-09 would also meet the requirements of ASTM D7566-10a for hydroprocessed SPK. *Id.* (citing Ex. 1009 ¶ 65).

Patent Owner does not dispute Dr. Joseph’s testimony or Petitioner’s argument. Patent Owner, however, asserts that “ASTM D7566-09 does not provide any disclosure or guidance regarding a process which provides a

renewable jet fuel blendstock” as recited in claim 1, or how an ordinary artisan would have modified Gruber to render claim 1 obvious. PO Resp. 7. Patent Owner errs in attacking the references individually. *See In re Keller*, 642 F.2d 413, 425 (CCPA 1981) (explaining that one may not show non-obviousness by attacking references individually where the rejection is based upon the teachings of a combination of references). Here, Petitioner challenged claim 1 based on the combined teachings of Gruber and ASTM D7566-09. Pet. 17–27. As explained above, Gruber teaches each of steps (a)–(e) of claim 1. It also teaches adjusting the ratio of C₁₂ and C₁₆ saturated hydrocarbons, as recited in step (f). In addition, the teachings of Gruber and the knowledge in the art would have provided the reasons and know-how to modify the process in Gruber so that the resultant jet fuel blendstock meets or exceeds the ASTM requirements. In other words, one of ordinary skill in the art would not have looked to ASTM D7566-09 for such teachings. As such, the fact that ASTM D7566-09 does not teach a process for making a jet fuel blendstock does not change our obviousness conclusion.

After considering Petitioner’s analysis, supported by Dr. Joseph’s testimony, we determine that one of ordinary skill (1) would have had a reason to modify the teachings of Gruber to arrive at a process for preparing a renewable jet fuel blendstock that meets or exceeds the requirement of ASTM D7566-09, and (2) would have had a reasonable expectation of success that meeting the requirements of ASTM D7566-09 would also meet the requirements of ASTM D7566-10a.

Claims 2–12, 14, and 15

Petitioner points out that claims 2–8 and 9–11 in Gruber recite the same limitations as those in challenged claims 2–8 and 10–12, respectively. Pet. 27–31. In addition, Petitioner refers to Gruber for teaching using Amberlyst-35 to trimerize olefins, which it argues it satisfies the limitations recited in challenged claim 9. *Id.* at 30 (citing Ex. 1003, 76:14–15). Furthermore, Petitioner contends that Gruber teaches blending the renewable jet fuel blendstock prepared according to its process with conventional jet fuels derived from petroleum and with aromatics, and thus, satisfies the requirements of challenged claims 14 and 15. *Id.* at 32 (citing Ex. 1003, 34:32–34, 47:7–8); *see also* Ex. 1003, 51:30–33 (teaching blending aliphatic and aromatic hydrocarbons, and blending biofuel with petroleum based components, both to produce a product that meets all jet fuel specifications); *id.* at claim 16 (reciting combining saturated alkanes “with one or more C₁₀–C₁₄ aromatic hydrocarbons, thereby forming a jet fuel”). Patent Owner does not dispute any of these assertions. Based on the evidence of record, we determine that Gruber teaches the additional limitations recited in dependent claims 2–12, 14, and 15.

Obviousness over Gruber, ASTM D7566-09, and Mossman

Petitioner argues that claim 13 would have been obvious over Gruber, ASTM D7566-09, and Mossman. Pet. 32–37. Claim 13 reads:

13. The process of claim 1, further comprising:
 - a. separating at least a portion of said product comprising one or more C₁₂ and one or more C₁₆ unsaturated oligomers produced in step (d); and
 - b. combining the separated portion with the dehydration product of step (c) prior to said oligomerization step[; and]

- c. adjusting the ratio of C₁₂ and C₁₆ saturated alkanes provided by step (e) by recycling at least a portion of the C₈ unsaturated oligomers formed in step (d) back to the oligomerization step, thereby increasing the amount of C₁₆ unsaturated oligomers.

Mossman teaches a method to upgrade lower oligomers of isobutylene to higher oligomers, comprising (a) fractionating a mixture of a feedstock (including monomers, dimers, trimers, tetramers, pentamers, and other higher oligomers) and oligomerization product recycled in subsequent step (c) to separate the lower oligomers from the higher oligomers (Ex. 1005, 4:60–65, 5:31–38); (b) oligomerizing the lower oligomers from step (a) to form a mixture of higher oligomers and unreacted lower oligomers (*id.* at 5:57–66); (c) recycling the oligomerization product mixture from step (b) to be fractionated in step (a) (*id.* at 7:1–7); and (d) recovering the higher oligomer fraction separated in step (a) (*id.* at 7:7–9). *See* Pet. 35. Because isobutylene is a C₄ hydrocarbon, Petitioner asserts, the lower oligomers in Mossman would be C₄, C₈, and C₁₂ hydrocarbons, and the higher oligomers would be C₁₆ hydrocarbons. *Id.* at 36.

Citing the Joseph Declaration, Petitioner asserts that the properties of jet fuels depend on their C₈–C₁₆ hydrocarbon composition. Pet. 33 (citing Ex. 1009 ¶ 78); *see also* Ex. 1003, Table 1 (showing jet fuel blends with different ratios of C₈, C₁₂, and C₁₆ hydrocarbons have different physical properties). Gruber refers to several methods for controlling the molecular weight distribution of oligomers, including, specifically, methods to form primarily tetramers and pentamers as taught in Mossman. Pet. 33 (citing Ex. 1003, 29:34–30:8). Thus, Petitioner contends, one skilled in the art looking to control the hydrocarbon composition and properties of jet fuels

would have had a reason to combine the teachings of Gruber and Mossman. *Id.* (citing Ex. 1009 ¶ 78).

Specifically, Petitioner argues that an ordinary artisan would have modified the process of Gruber with the teachings of Mossman to (1) separate a portion of the oligomerization product of Gruber, which comprises C₈, C₁₂, and C₁₆ oligomers; (2) combine the separated, C₈ oligomers portion from step (1) with isobutene from the dehydration step of Gruber; and (3) recycle the combination of step (1) back to the oligomerization step of Gruber to increase the proportion of C₁₆ oligomers. Pet. 36. According to Petitioner, one of ordinary skill in the art would have had a reasonable expectation of successfully doing so, because Mossman teaches that its process can be used with any conventional oligomerization method. *Id.* at 37 (citing Ex. 1005, 6:10–18); *see also* Ex. 1005, 4:66–5:1 (teaching the method of Mossman is useful in conjunction with any other method that produces oligomers of isobutene). As a result, Petitioner argues, a skilled artisan would have had a reason and the know-how to arrive at the process of claim 13 with a reasonable expectation of success in doing so. Pet. 37.

Patent Owner does not dispute these arguments. Instead, Patent Owner repeats that ASTM D7566-09 is different from ASTM D7566-10a, and that ASTM D7566-09 does not teach any process to make a renewable jet fuel blendstock. PO Resp. 9. As explained above, we find neither argument persuasive. Patent Owner also contends that Mossman, “silent with respect to any ASTM standards,” cannot remedy the deficiencies of Gruber and ASTM D7566-09. *Id.* We are not persuaded by this argument either. As explained above, we do not find deficiencies in the combination

of Gruber and ASTM D7566-09 in rendering claim 1 obvious. Here, Petitioner relies on Mossman not for teaching ASTM standards—ASTM D7566-09 provides such information—but for supplying the additional limitations of claim 13. Pet. 35–37. Thus, the fact Mossman does not discuss any ASTM standards is of no consequence in our obviousness analysis.

After reviewing Petitioner’s analysis, supported by specific references to Mossman and Dr. Joseph’s testimony, we determine that one of ordinary skill in the art would have had a reason to combine the teachings of Gruber, ASTM D7566-09, and Mossman, and in doing so, would have had a reasonable expectation of success in arriving at the process of claim 13.

CONCLUSION

Petitioner has shown, by a preponderance of the evidence, that claims 1–12, 14, and 15 of the ’012 patent would have been obvious over the combination of Gruber and ASTM D7566-09. Petitioner also has shown, by a preponderance of the evidence, that claim 13 would have been obvious over the combination of Gruber, ASTM D7566-09, and Mossman.

ORDER

Accordingly, it is

ORDERED that claims 1–15 of the ’012 patent are determined to be unpatentable;

FURTHER ORDERED that because this is a final written decision, parties to the proceeding seeking judicial review of the decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

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