

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

DONGHEE AMERICA, INC. and DONGHEE ALABAMA, LLC,
Petitioner,

v.

PLASTIC OMNIUM ADVANCED INNOVATION AND RESEARCH,
Patent Owner.

Case IPR2017-01945
Patent 9,399,326 B2

Before MITCHELL G. WEATHERLY, CHRISTOPHER M. KAISER, and
ROBERT L. KINDER, *Administrative Patent Judges*.

KAISER, *Administrative Patent Judge*.

FINAL WRITTEN DECISION
35 U.S.C. § 318; 37 C.F.R. § 42.73

INTRODUCTION

A. Background

Donghee America, Inc. and Donghee Alabama, LLC (collectively, “Petitioner”) filed a Petition (Paper 2, “Pet.”) requesting an *inter partes* review of claims 1, 13, 25–27, 33, 34, and 44 of U.S. Patent No. 9,399,326 B2 (Ex. 1001, “the ’326 patent”). Plastic Omnium Advanced Innovation and Research (“Patent Owner”) did not file a Preliminary Response. On February 1, 2018, we instituted trial. Paper 7 (“Inst. Dec.”). On April 30, 2018, we added to the trial those asserted grounds on which we had not originally instituted trial. Paper 11. During the trial, Patent Owner filed a Response (Paper 17, “PO Resp.”), Petitioner filed a Reply (Paper 25), and Patent Owner filed a Sur-Reply (Paper 27). We held a hearing, the transcript of which has been entered into the record. Paper 33 (“Tr.”).

We have jurisdiction under 35 U.S.C. § 6, and we issue this Final Written Decision pursuant to 35 U.S.C. § 318(a) and 37 C.F.R. § 42.73. We conclude that Petitioner has established by a preponderance of the evidence that claims 25–27, 33, 34, and 44 of the ’326 patent are unpatentable, and we conclude that Petitioner has not established by a preponderance of the evidence that claims 1 and 13 are unpatentable.

B. Related Matters

The parties note that the ’326 patent is asserted in *Plastic Omnium Advanced Innovation and Research v. Donghee America, Inc. et al.*, C.A. No. 16-cv-00187-LPS-CJB (D. Del.). Pet. 2; Paper 5, 1.

C. The Asserted Grounds of Unpatentability

Petitioner contends that claims 1, 13, 25–27, 33, 34, and 44 of the ’326 patent are unpatentable based on the following grounds (Pet. 13–67):¹

Statutory Ground	Basis	Challenged Claims
§ 103	Ishimaru ²	1, 13, 25–27, 33, 34, and 44
§ 103	Ishimaru and Staargaard ³	1, 13, 25–27, 33, 34, and 44
§ 103	Van Schaftingen ⁴ and Staargaard	25 and 33

D. The ’326 Patent

The ’326 patent, titled “Method for Fastening an Accessory in a Plastic Fuel Tank,” issued on July 26, 2016. Ex. 1001, at [45], [54]. “Fuel tanks on board vehicles of various kinds generally have to meet imperviousness and permeability standards.” *Id.* at 1:9–10. “One means sometimes used is to incorporate certain accessories and pipe work within the tanks, thus eliminating their interface with the external surroundings.” *Id.* at 1:21–24. The ’326 patent is intended “to provide a method that allows an accessory based on a material different from that of the tank to be fastened inside a plastic fuel tank . . . quickly, easily, without consuming

¹ Petitioner also relies on a declaration from Dr. David O. Kazmer. Ex. 1006.

² Ishimaru et al., Japanese Patent Application Publication No. P2003-291208A, published Oct. 14, 2003 (English translation and Japanese original both provided) (Ex. 1003, “Ishimaru”).

³ Staargaard et al., US 2004/0072006 A1, published Apr. 15, 2004 (Ex. 1005, “Staargaard”).

⁴ Van Schaftingen et al., US 2001/0015513 A1, published Aug. 23, 2001 (Ex. 1004, “Van Schaftingen”).

excessive amounts of material and without the risk of damaging the barrier layer or of creating excessive internal tensions.” *Id.* at 1:56–61.

E. Illustrative Claims

Claims 1, 13, 25–27, 33, 34, and 44 of the ’326 patent are challenged.

Claims 1 and 25 are independent and illustrative; they recite:

1. A method for stake-fastening an accessory into a multilayer plastic fuel tank comprising a thermoplastic outer layer and either a fuel-impermeable inner layer or fuel-impermeable inner surface treatment,

wherein the accessory has a wall portion which

is equipped with at least one orifice which passes through the wall portion of the accessory, and

said at least one orifice has a variation along a plane perpendicular to the wall of the accessory that is tailored to make it easier to force molten plastic through the orifice,

said method comprising:

melting at least some of the plastic of which the wall of the tank is made to form molten plastic;

forcing some of the molten plastic through the orifice of the accessory without becoming detached from the remainder of the molten plastic and without rupturing the fuel-impermeable inner layer or fuel-impermeable inner surface treatment of the multilayer plastic fuel tank wall, thereby forming molten plastic protruding through the orifice of the accessory;

shaping the protruding molten plastic to provide a self-formed plastic rivet, and allowing the molten plastic to solidify; and

closing the multilayer plastic fuel tank with the stake-fastened accessory therein; whereby the size and shape of the orifice and/or of the solidified multilayer plastic are such that the accessory is mechanically fastened to the

inside wall of the multilayer plastic fuel tank by at least some of the solidified plastic.

Ex. 1001, 7:2–31.

25. A multilayer plastic fuel tank equipped with at least one accessory or support for an accessory stake-fastened to the inner wall of the fuel tank, wherein:

the wall of the fuel tank comprises an outer layer of thermoplastic polymer and a barrier layer of thermoplastic resin impermeable to fuel;

at least one accessory or support for an accessory is in direct contact with part of the inner wall of the fuel tank;

said at least one accessory or support for an accessory having a wall portion which

is equipped with at least one orifice which passes through the wall portion of the accessory or support for an accessory, and

said at least one orifice has a variation along a plane perpendicular to the wall of the accessory that is tailored to make it easier to force molten plastic through the orifice;

said at least one orifice having had some of the thermoplastic polymer of the outer layer and some of the barrier layer of the fuel tank wall forced in the molten state into and through the at least one orifice to form at least one thermoplastic protrusion from the opposite end of said at least one orifice and solidified without becoming detached from the fuel tank wall and without rupturing the barrier layer of thermoplastic resin impermeable to fuel; and

the protrusion having been shaped to overhang the at least one orifice and stake-fasten the at least one accessory or support for an accessory to the fuel tank wall without rupturing the barrier layer of the protrusion and said protrusion holds the accessory in a non-removable mechanical connection to the inside wall of the multilayer plastic fuel tank.

Id. at 8:51–9:16.

ANALYSIS

A. Claim Construction

In an *inter partes* review, we construe claim terms in an unexpired patent according to their broadest reasonable construction in light of the specification of the patent in which they appear.⁵ 37 C.F.R. § 42.100(b) (2017); *see Cuozzo Speed Techs. LLC v. Lee*, 136 S. Ct. 2131, 2144 (2016) (upholding the use of the broadest reasonable interpretation standard).

Claim terms generally are given their ordinary and customary meaning, as would be understood by one of ordinary skill in the art in the context of the entire disclosure. *In re Translogic Tech., Inc.*, 504 F.3d 1249, 1257 (Fed. Cir. 2007). The parties propose three terms for construction: “accessory,” “self-formed plastic rivet,” and the phrases “shaping the protruding molten plastic” (claim 1) and “the protrusion having been shaped” (claim 25). Pet. 9–12; PO Resp. 14–16.

1. “Accessory”

Petitioner proposes construing “accessory” as “any object or functional device generally associated with the fuel tank in its conventional mode of use or of operation and which collaborates therewith in order to perform certain useful functions or a support for one or several of such devices.” Pet. 10. Patent Owner agrees with this proposed construction. PO Resp. 16. Moreover, this construction is taken directly from the ’326 patent,

⁵ A recent amendment to this rule does not apply here because the Petition was filed before November 13, 2018. *See Changes to the Claim Construction Standard for Interpreting Claims in Trial Proceedings Before the Patent Trial and Appeal Board*, 83 Fed. Reg. 51,340 (Oct. 11, 2018) (amending 37 C.F.R. § 100(b) effective November 13, 2018).

which states that “‘accessory’ is intended to denote” the construction Petitioner offers. Ex. 1001, 3:5–10. When an inventor defines specific terms used to describe an invention, we will give effect to those definitions, as long as they are set out “with reasonable clarity, deliberateness, and precision,” “so as to give one of ordinary skill in the art notice of the change” in meaning. *In re Paulsen*, 30 F.3d 1475, 1480 (Fed. Cir. 1994). Accordingly, we adopt Petitioner’s proposed construction of “accessory.”

2. “Self-Formed Plastic Rivet”

Petitioner proposes construing “self-formed plastic rivet” as “a protrusion formed in-situ from molten plastic from the wall of the tank.” Pet. 10–11. Patent Owner disagrees and proposes “protrusion of plastic formed from the molten plastic wall of the fuel tank.” PO Resp. 14–15. Patent Owner argues that adopting Petitioner’s construction might cause “self-formed plastic rivet” to cover rivets formed from “some extraneous material such as a metal or plastic rivet introduced into and through the tank wall.” *Id.* We disagree; Petitioner’s construction makes clear that the “self-formed plastic rivet” is “formed . . . from the wall of the tank.” Ultimately, however, the only differences between the parties’ two constructions are (1) that Petitioner’s construction does not state that the protrusion is made of plastic and (2) that Patent Owner’s construction does not make clear that the rivet is formed in-situ. Given that the specification of the ’326 patent states that “‘self-form[ing]’ a plastic rivet” is “form[ing] the rivet in-situ from molten plastic from the wall of the tank,” Ex. 1001, 3:39–41, we determine that in-situ formation should be part of the proper construction. And adding to Petitioner’s proposed construction a statement that the protrusion is made of plastic follows logically from the portion of Petitioner’s proposed

construction that states that the “self-formed plastic rivet” is “formed . . . from molten plastic.” Accordingly, we construe “self-formed plastic rivet” as “a protrusion of plastic formed in-situ from molten plastic from the wall of the tank.”

3. *“Shaping the Protruding Molten Plastic” or “The Protrusion Having Been Shaped”*

Claim 1 recites “shaping the protruding molten plastic,” and claim 25 recites “the protrusion having been shaped.” Ex. 1001, 7:2–31, 8:51–9:16. Petitioner proposes construing these phrases to have the same meaning, “manipulating or allowing the protruding molten plastic to form a shape.” Pet. 11–12. Patent Owner argues that these phrases should be construed as “shaping the protruding molten plastic to provide a self-formed plastic rivet” and “the protruding molten plastic having been shaped to overhan[g] the at least one orifice,” respectively. PO Resp. 15–16. In its argument, Patent Owner makes clear that the “shaping” need not necessarily involve manipulating the plastic with any tools; instead, “the self-formed rivet can be shaped by the natural flow of plastic through the orifice.” *Id.* at 16 (citing Ex. 2001 ¶¶ 47–49). Thus, both parties agree that “shaping” the molten plastic can take the form either of “manipulating” the plastic into a shape or of “allowing” the plastic to form a shape. The difference between the two proposed constructions is that Petitioner argues that forming “a shape” is sufficient, and Patent Owner argues that the “shape” must be “a self-formed plastic rivet” or must “overhang the at least one orifice.”

It is not clear that there is any practical difference between these constructions. The challenged claims use the phrases “shaping the protruding molten plastic” and “the protrusion having been shaped” only in

the phrases “shaping the protruding molten plastic to provide a self-formed plastic rivet” and “the protrusion having been shaped to overhang the at least one orifice.” Ex. 1001, 7:2–31, 8:51–9:16. Thus, even if we were to construe “shaping the protruding molten plastic” and “the protrusion having been shaped” to permit any “shape” rather than just a “self-formed plastic rivet” or an overhang of the orifice as the product of the shaping step, the challenged claims are still limited to methods in which the step of “shaping the protruding molten plastic” produces a “self-formed plastic rivet” or an overhang of the orifice. Because both proposed constructions result in the same claim scope, they both are reasonable. Consistent with the applicable version of 37 C.F.R. § 42.100(b), we choose the broadest reasonable construction. Accordingly, we construe “shaping the protruding molten plastic” as “manipulating or allowing the protruding molten plastic to form a shape,” and we construe “the protrusion having been shaped” as “the protrusion having been manipulated or allowed to form a shape.”

B. Asserted Obviousness over Ishimaru

Petitioner argues that the subject matter of claims 1, 13, 25–27, 33, 34, and 44 would have been obvious to a person of ordinary skill in the art given the teachings of Ishimaru. Pet. 13–33.

1. Ishimaru

Ishimaru relates to “a production method for a resin hollow article capable of producing molded products that offer excellent gas barrier properties.” Ex. 1003, at [57]. The molded products may include “an automotive fuel tank.” *Id.* ¶ 18. In the method of Ishimaru, “a resin preform” is “maintained at a moldable temperature, a lost core is disposed in the preform tube; and the preform having the lost core disposed therein is

maintained at a moldable temperature and set in a press device,” where it is molded. *Id.* ¶ 6. Ishimaru also teaches attaching a pre-molded “sub-tank” to the tank. *Id.* ¶ 34. Ishimaru teaches accomplishing this by creating a “through-hole” with a “reverse-tapered shape (with the diameter becoming smaller in the direction of the outer wall)” in the sub-tank, allowing “a part of the preform . . . to penetrate the through-hole . . . during the press-molding.” *Id.* “In this manner, the sub-tank . . . can be even more securely attached to the outer wall.” *Id.*

2. Analysis

Petitioner argues that a person of ordinary skill in the art would have had reason to modify the teachings of Ishimaru and that those modified teachings teach or suggest every limitation of claims 1, 13, 25–27, 33, 34, and 44. Pet. 13–33. Patent Owner argues that Ishimaru fails to teach several limitations of the challenged claims and that a person of ordinary skill in the art would not have modified Ishimaru in the way that Petitioner argues. PO Resp. 19–34.

a. Claims 1 and 13

Claim 1 recites a limitation that requires “closing the multilayer plastic fuel tank with the stake-fastened accessory therein.” Ex. 1001, 7:26–27. Claim 13 depends from claim 1, *id.* at 8:1–2, so it contains all the limitations of claim 1. 37 C.F.R. § 1.75(c). Petitioner argues that Ishimaru teaches or suggests this limitation. Pet. 23–24 (citing Ex. 1003 ¶ 7, Fig. 14; Ex. 1006 ¶¶ 70–74). Patent Owner argues that these claims require that there be a “stake-fastened accessory” inside the fuel tank at the time the fuel tank is closed, but that Ishimaru only teaches attaching its accessories during or after mold closure. PO Resp. 25–26 (citing Ex. 1001, 1:62–2:14, 5:3–19,

7:2–31; Ex. 1003 ¶ 27; Ex. 2001 ¶ 70). Thus, according to Patent Owner, although Ishimaru may have an accessory inside the fuel tank when the tank is closed, it does not have a “stake-fastened accessory” inside the fuel tank at that time. *Id.*

We agree with Patent Owner. Claim 1 recites a “method for stake-fastening an accessory,” and most steps of the method recite “an accessory” or “the accessory,” as opposed to a “stake-fastened accessory.” Ex. 1001, 7:2–31. The recitation in most limitations of an “accessory” but in the final limitation of a “stake-fastened accessory” suggests that “stake-fastened accessory” is not merely an alternative way to refer to an accessory that may or may not have been stake-fastened yet. Instead, a “stake-fastened accessory” is an “accessory” that has been stake-fastened, so claim 1 requires stake-fastening the accessory before the fuel tank is closed.

Petitioner argues that interpreting claim 1 this way would exclude from its scope “a preferred embodiment.” Reply 8–9 (citing *MBO Labs., Inc. v. Becton, Dickinson & Co.*, 474 F.3d 1323, 1333 (Fed. Cir. 2007)). Specifically, Petitioner points to a portion of the specification of the ’326 patent stating that “advantageously, the stake-fastening occurs at the time of moulding of the tank by” any of three separate processes, two of which incorporate older patent applications by reference. Ex. 1001, 4:43–53; *see* Reply 8.

But Petitioner’s argument reads this disclosure too broadly. Petitioner is correct that Patent Application EP 1110697 describes attaching accessories to the inside of a fuel tank during mold closure and that this application is incorporated by reference in the ’326 patent. Ex. 1001, 4:43–53; Ex. 1012 ¶ 34 (describing a “device for anchoring [a preassembled]

structure [comprising accessories] to the internal wall of the [fuel tank]” that is “secured by welding to the wall of the [fuel tank] during closure of the mold”). The process is incorporated by reference in general terms, stating “advantageously, the stake-fastening occurs at the time of moulding the tank by . . . blow-moulding a parison comprising at least one cut-out (as described in Patent Application EP 1110697).” Ex. 1001, 4:43–53. Other processes, including “thermoforming sheets” and “compressing/ blow-moulding sheets,” are also noted in this section, which suggests that the blow-molding process of EP 1110697 is not the only “advantageous[]” way of carrying out the invention of the ’326 patent. *Id.* Moreover, the ’326 patent goes on to modify the process incorporated from EP 1110697. It states that, “[w]hen the tank is produced by blow-moulding . . . , the stake-fastening is preferably performed with the aid of an insert on the mould side . . . and a counterform actuated by a ram on the core side.” *Id.* at 4:62–5:2. The ’326 patent then goes on to provide a more detailed view of this type of “preferabl[e]” process, in which an “accessory” is stake-fastened to a portion of the fuel tank before the fuel tank is closed. *Id.* at 5:3–19. Thus, the actual preferred embodiment of the ’326 patent is not merely the blow-molding process of EP 1110697, but rather a blow-molding process in which stake-fastening occurs, the mold is opened and the core removed, and the tank is closed around the now-stake-fastened accessory. Accordingly, we are not persuaded that interpreting claim 1 to require stake-fastening the accessory before tank closure excludes a preferred embodiment from the scope of the claim.

Thus, claim 1 requires that the accessory be stake-fastened before the fuel tank is finally closed. Petitioner does not argue, let alone prove, that

Ishimaru teaches or suggests stake-fastening the accessory before the tank is closed. Pet. 23–24 (arguing that “FIG. 14 [of Ishimaru] shows the accessory is contained within the closed fuel tank” and that “Ishimaru teaches closing the plastic fuel tank”). Moreover, Ishimaru only teaches attaching the accessories to the internal tank walls during or after closure of the tank. In Ishimaru’s process, “the core 30 and preform 14 are pushed into the lower mold 54,” after which “the upper mold 52 is aligned with the lower mold 54,” and press-molding takes place. Ex. 1003 ¶ 27. The press-molding both closes the ends of the tube making the fuel tank and “integrally joins the [accessories] 22, 24, and 28 provided in the core 30 to the outer wall 10.” *Id.* Accordingly, Ishimaru does not teach or suggest “closing the multilayer plastic fuel tank with the stake-fastened accessory therein.”

For these reasons, Petitioner has not shown by a preponderance of the evidence that Ishimaru teaches or suggests the subject matter of claim 1 or of claim 13.

b. Claim 25

As Petitioner argues, Pet. 25–28, claim 25 recites a preamble and six limitations: “[a] multilayer plastic fuel tank equipped with at least one accessory or support for an accessory stake-fastened to the inner wall of the fuel tank,” “the wall of the fuel tank comprises an outer layer of thermoplastic polymer and a barrier layer of thermoplastic resin impermeable to fuel,” “at least one accessory or support for an accessory is in direct contact with part of the inner wall of the fuel tank,” “said at least one accessory or support for an accessory having a wall portion which is equipped with at least one orifice which passes through the wall portion of the accessory or support for an accessory,” “said at least one orifice has a

variation along a plane perpendicular to the wall of the accessory that is tailored to make it easier to force molten plastic through the orifice,” “said at least one orifice having had some of the thermoplastic polymer of the outer layer and some of the barrier layer of the fuel tank wall forced in the molten state into and through the at least one orifice to form at least one thermoplastic protrusion from the opposite end of said at least one orifice and solidified without becoming detached from the fuel tank wall and without rupturing the barrier layer of thermoplastic resin impermeable to fuel,” and “the protrusion having been shaped to overhang the at least one orifice and stake-fasten the at least one accessory or support for an accessory to the fuel tank wall without rupturing the barrier layer of the protrusion and said protrusion holds the accessory in a non-removable mechanical connection to the inside wall of the multilayer plastic fuel tank.” Ex. 1001, 8:51–9:16.

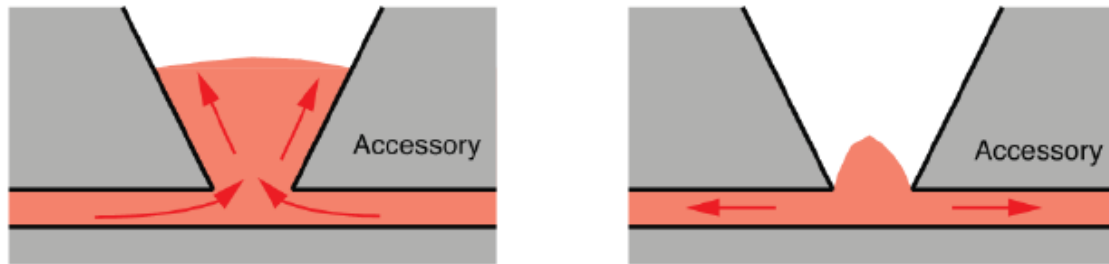
(1) Preamble

Petitioner argues that Ishimaru teaches or suggests the preamble of claim 25, “[a] multilayer plastic fuel tank equipped with at least one accessory or support for an accessory stake-fastened to the inner wall of the fuel tank.” Pet. 13–17, 25. Ishimaru teaches a multilayer plastic fuel tank equipped with at least one accessory. Ex. 1003 ¶¶ 19 (“fuel tank 1” has “an outer wall 10” that “has a laminate structure (not shown) on which a surface layer composed mainly of high-density polyethylene (HDPE) is on both sides of a gas barrier layer”), 34 (“the sub-tank 21 can be even more securely attached to the outer wall 10”). Patent Owner does not dispute this evidence. PO Resp. 19–34.

With respect to the portion of the preamble requiring that the accessory be “stake-fastened to the inner wall of the fuel tank,” Petitioner argues that Ishimaru teaches or suggests stake-fastening accessories inside plastic fuel tanks. Pet. 14–15 (citing Ex. 1003, at [57], ¶¶ 18, 34, Fig. 14; Ex. 1006 ¶¶ 46–47). Patent Owner argues that Ishimaru does not teach or suggest stake-fastening its accessories because it relates only to a “welding aid to make the attachment to the tank wall more secure.” PO Resp. 19–23 (citing Ex. 1003 ¶¶ 27, 33, 34, Fig. 9, Fig. 10; Ex. 2001 ¶¶ 62–65).

As an initial matter, we agree with Patent Owner that claim 1 requires that the stake-fastening process result in a protrusion of solidified plastic that cooperates with the accessory orifice in a way that causes the accessory to become mechanically fastened to the wall of the fuel tank. Ex. 1001, 7:32–35. Accordingly, if Ishimaru teaches only an aid to welding an accessory to the tank wall, it does not teach a stake-fastening method. On the other hand, the method of claim 1 need only “compris[e]” an orifice and solidified plastic whose “size and shape . . . are such that the accessory is mechanically fastened to the tank.” *Id.* at 7:20–35. In patent claims, “comprising” means that the named elements are essential, but other elements may be added and still form a construct within the scope of the claim. *Genentech, Inc. v. Chiron Corp.*, 112 F.3d 495, 501 (Fed. Cir. 1997). Accordingly, if Ishimaru teaches stake-fastening in addition to welding, the additional teaching does not preclude us from relying on Ishimaru’s teaching of stake-fastening. Thus, the only question for us is whether Ishimaru teaches a method of stake-fastening, not whether Ishimaru limits the method it teaches to use with welding.

On the record developed at trial, we agree with Petitioner that Ishimaru teaches a method of stake-fastening its accessory to a fuel tank wall. Patent Owner's declarant, Professor Tim Osswald, testifies that Ishimaru's process would result in some molten plastic entering the reverse-tapered orifice in Ishimaru's accessory but not in the molten plastic filling any entire cross-section of the reverse-tapered orifice. Ex. 2001 ¶ 65. Professor Osswald provides two figures of his own, reproduced below, that illustrate this testimony.



Id. The figure reproduced above on the left depicts a large amount of plastic wall material entering the reverse-tapered orifice in an accessory and filling the entire cross-section of that orifice to some unspecified depth. *Id.* The figure reproduced above on the right depicts plastic wall material largely moving away from the reverse-tapered orifice when the accessory is pushed against the wall, with only a small portion of the plastic entering the orifice and failing to fill the entire cross-section of the orifice to any substantial depth at all. *Id.* Professor Osswald testifies that the figure on the right illustrates what would occur if a person of ordinary skill in the art were to carry out Ishimaru's process better than does the figure on the left. *Id.*

If true, this would mean that Ishimaru's process could not result in any mechanical connection between the accessory and the wall. The problem with this testimony is that it is inconsistent with the language of

Ishimaru, which specifies that its process results in the accessory being “even more securely attached to the outer wall.” Ex. 1003 ¶ 34. If the plastic enters Ishimaru’s reverse-tapered orifice only in the way described by Professor Osswald, it is not clear how it would improve the security of the attachment of the accessory to the wall. Neither Patent Owner nor Professor Osswald explains how Professor Osswald’s interpretation of Ishimaru’s process satisfies the language of Ishimaru requiring such an improvement. We credit the express language of Ishimaru over Professor Osswald’s interpretation of the reference, and we find that Ishimaru teaches a process in which a solidified protrusion of molten plastic cooperates with a reverse-tapered orifice in an accessory to more securely attach the accessory to the wall of a fuel tank. Accordingly, Ishimaru teaches or suggests the preamble of claim 25.

(2) “The wall of the fuel tank comprises an outer layer of thermoplastic polymer and a barrier layer of thermoplastic resin impermeable to fuel”

Petitioner argues that Ishimaru teaches a fuel tank wall with an outer layer of thermoplastic polymer and a barrier layer of thermoplastic resin that is impermeable to fuel. Pet. 15–16, 25. Petitioner is correct. Ishimaru teaches a multilayer plastic fuel tank with a gas barrier layer sandwiched between two layers of high-density polyethylene. Ex. 1003 ¶ 19 (“fuel tank 1” has “an outer wall 10” that “has a laminate structure (not shown) on which a surface layer composed mainly of high-density polyethylene (HDPE) is on both sides of a gas barrier layer”). The gas barrier layer “is composed mainly of ethylene-vinyl alcohol copolymer resin (EVOH).” *Id.* Patent Owner does not dispute Petitioner’s argument or evidence on this

point, including whether HDPE and EVOH are a thermoplastic polymer and a thermoplastic resin, respectively. PO Resp. 19–34. Accordingly, Ishimaru teaches or suggests this limitation of claim 25.

(3) “At least one accessory or support for an accessory is in direct contact with part of the inner wall of the fuel tank”

Petitioner argues that Ishimaru teaches or suggests this limitation. Pet. 25–26 (citing Ex. 1003, Fig. 14; Ex. 1006 ¶ 79). We agree, and Patent Owner does not dispute Petitioner’s argument or evidence on this point. PO Resp. 19–34. Figure 14 of Ishimaru depicts sub-tank 21 in direct contact with the inner surface of outer wall 10. Ex. 1003, Fig. 14. Accordingly, Ishimaru teaches or suggests this limitation of claim 25.

(4) “Said at least one accessory or support for an accessory having a wall portion which is equipped with at least one orifice which passes through the wall portion of the accessory or support for an accessory”

Petitioner argues that Ishimaru teaches or suggests this limitation. Pet. 14–15, 26 (citing Ex. 1003 ¶ 34, Fig. 14; Ex. 1006 ¶¶ 46–47). We agree, and Patent Owner does not dispute Petitioner’s argument or evidence on this point. PO Resp. 19–34. Ishimaru teaches that sub-tank 21 has “bottom surface 23” in which there is a “through-hole 25 in reverse-tapered shape.” Ex. 1003 ¶ 34; *see also* Ex. 1003, Fig. 14 (depicting through-hole 25 passing through bottom surface of sub-tank 21). Accordingly, Ishimaru teaches or suggests this limitation of claim 25.

(5) *“Said at least one orifice has a variation along a plane perpendicular to the wall of the accessory that is tailored to make it easier to force molten plastic through the orifice”*

Petitioner argues that “Ishimaru in combination with the knowledge of a POSITA teaches this limitation.” Pet. 16–17, 26 (citing Ex. 1003 ¶ 29, Fig. 11; Ex. 1006 ¶¶ 50–57). Specifically, Petitioner argues that a person of ordinary skill in the art would have known “that rounding the corners of an orifice makes it easier to force molten plastic through the orifice.” *Id.* at 16. Patent Owner disagrees, arguing that a person of ordinary skill in the art would not have modified the structure of Ishimaru in this way. PO Resp. 27–29.

There is evidence to support Petitioner’s argument. First, Ishimaru describes the purpose of its orifice as allowing “a part of the preform . . . to penetrate the through-hole . . . during press-molding” in order to “more securely attach[]” the sub-tank “to the outer wall.” Ex. 1003 ¶ 34. Because Ishimaru teaches causing a portion of the plastic of the tank wall to penetrate the orifice in order to attach an accessory to the wall, a person of ordinary skill in the art would have been motivated to cause molten plastic to flow into the orifice. Petitioner’s declarant, Dr. David O. Kazmer, testifies that a person of ordinary skill in the art of molding plastics would have been aware that rounding the corners of a mold around and through which molten plastic was expected to flow would “assist the flow of plastic in the mold.” Ex. 1006 ¶¶ 51–54. Because a person of ordinary skill in the art would have been motivated to cause molten plastic from the tank wall to flow into the orifice, as taught by Ishimaru, and because a person of ordinary skill in the art would have known that rounding the corners of the orifice would assist in

forcing the plastic into the orifice, a person of ordinary skill in the art would have been motivated to round the corners of the orifice.

Patent Owner argues for several reasons that, despite this evidence, a person of ordinary skill in the art would not have rounded the corners of Ishimaru's orifice. First, Patent Owner argues that Ishimaru teaches away from the use of rounded corners. PO Resp. 27–28 (citing Ex. 1003 ¶ 34; Ex. 2001 ¶¶ 70–72). Specifically, Patent Owner argues that Ishimaru's teaching that its orifice has a reverse-tapered shape “with the diameter becoming smaller in the direction of the outer wall” is a teaching away from any other shape, such as a shape in which the corners are rounded sufficiently to cause a portion of the orifice to have a diameter that increases in the direction of the outer wall. *Id.* But the language of Ishimaru does not teach away from any orifice shape. *See In re Fulton*, 391 F.3d 1195, 1201 (Fed. Cir. 2004) (even if it discloses a different solution to a similar problem, a reference does not teach away unless it also criticizes, discredits, or otherwise discourages the claimed solution). The language of Ishimaru teaches an orifice “with the diameter becoming smaller in the direction of the outer wall,” but it does not disparage the use of modified versions of this shape. Ex. 1003 ¶ 34. Accordingly, Ishimaru does not teach away from an orifice with rounded corners.

Patent Owner next argues that Ishimaru's teaching of rounded corners in other portions of its disclosure and omission of rounded corners when discussing the “through-hole” in its “sub-tank” means that a person of ordinary skill in the art would have interpreted Ishimaru as teaching that rounding the corners of the reverse-tapered through-hole was not “deemed desirable or possible.” PO Resp. 28 (citing Ex. 1003 ¶ 29; Ex. 2001 ¶ 72).

Patent Owner is correct that one portion of Ishimaru, disclosing how to join two portions of the tank wall when pinching the tank closed, describes using a corner with a radius. Ex. 1003 ¶ 29, Fig. 11. Patent Owner also is correct that the portion of Ishimaru discussing the through-hole does not disclose rounding the corners of the orifice. Ex. 1003 ¶ 34, Fig. 14. We are not persuaded, however, that Patent Owner is correct that this disclosure must be interpreted as teaching a person of ordinary skill in the art that rounding the corners of the orifice was either undesirable or impossible. First, of course, there is no rule requiring that a prior-art reference used in an obviousness argument must itself disclose all limitations of a claim arranged as in the claim; to require this would be to collapse the obviousness and anticipation inquiries. Thus, the mere silence of Ishimaru regarding whether the corners of its “through-hole” are rounded does not necessarily mean that Ishimaru cannot be relied upon as an obviousness reference. Moreover, the disclosure of rounded corners in another portion of Ishimaru has possible explanations other than that Ishimaru considered rounded corners in this particular context to be undesirable or impossible. Instead, Ishimaru might have considered rounded corners in this context to be optional but may have considered rounded corners in the pinch-off context to be necessary. Accordingly, we do not agree with Patent Owner that Ishimaru teaches that rounding the corners in the context of a “through-hole” was unachievable, and we continue to credit Petitioner’s evidence of a reason to modify the teachings of Ishimaru.

Finally, Patent Owner argues that a person of ordinary skill in the art would not have rounded the corners of Ishimaru’s orifice because the purpose of the orifice is solely to provide an aid to welding, and rounding

the corners would frustrate this purpose by reducing the flat surface in contact with the outer wall of the tank that could be used for welding Ishimaru's sub-tank to Ishimaru's fuel tank. PO Resp. 29 (citing Ex. 2001 ¶¶ 62–65). Professor Osswald testifies that the purpose of Ishimaru's reverse-tapered orifice "is merely [to serve as] a welding aid." Ex. 2001 ¶ 62. But this testimony is inconsistent with the text of Ishimaru. The process of Ishimaru results in the accessory being "even more securely attached to the outer wall." Ex. 1003 ¶ 34. If the plastic enters Ishimaru's reverse-tapered orifice only in the way described by Professor Osswald, it is not clear how it would improve the security of the attachment of the accessory to the wall. Neither Patent Owner nor Professor Osswald explains how Professor Osswald's interpretation of Ishimaru's process satisfies the language of Ishimaru requiring such an improvement. Faced with a choice between Ishimaru's express language and Professor Osswald's interpretation of Ishimaru, we credit the express language of the reference and find that Ishimaru teaches a process in which a solidified protrusion of molten plastic cooperates with a reverse-tapered orifice in an accessory to more securely attach the accessory to the wall of a fuel tank. Thus, we disagree with Patent Owner's argument that the decrease in contact area due to rounded corners would dissuade a person of ordinary skill in the art from rounding the corners of Ishimaru's orifice. Instead, the increased ability to force molten plastic into the orifice to improve the attachment of Ishimaru's sub-tank to the fuel tank wall would encourage a person of ordinary skill in the art to round the corners.

For these reasons, we find that a person of ordinary skill in the art would have had a reason to modify the teachings of Ishimaru to arrive at this limitation of claim 25.

(6) *“Said at least one orifice having had some of the thermoplastic polymer of the outer layer and some of the barrier layer of the fuel tank wall forced in the molten state into and through the at least one orifice to form at least one thermoplastic protrusion from the opposite end of said at least one orifice and solidified without becoming detached from the fuel tank wall and without rupturing the barrier layer of thermoplastic resin impermeable to fuel”*

Petitioner argues that Ishimaru teaches or suggests this limitation. Pet. 18–23, 26–27 (citing Ex. 1003 ¶¶ 19, 34, 40, Fig. 14; Ex. 1006 ¶¶ 60–69). There is evidence to support this argument. Ishimaru teaches forcing the material of its tank wall through its orifice. Ex. 1003 ¶ 34 (“a part of the preform 14 can be caused to penetrate the through-hole 25 during the press-molding”). Ishimaru also teaches making its fuel tank from a multilayer laminate. *Id.* ¶ 19. Dr. Kazmer testifies that a person of ordinary skill in the art would have understood that Ishimaru’s fuel tank “would lack any utility” if its fuel-impermeable layer were ruptured by the manufacturing process. Ex. 1006 ¶ 62. Dr. Kazmer also testifies that, because of the viscous flow of the plastic layers, Ishimaru’s multilayer structure would be preserved in the forcing of a portion of the tank wall through the orifice in the sub-tank. *Id.* ¶ 64. Finally, Dr. Kazmer testifies that a person of ordinary skill in the art would have understood that, in the Ishimaru structure modified to have rounded corners, the molten plastic wall material could be forced to protrude from the opposite end of the orifice if sufficient pressure

were applied and that a person of ordinary skill in the art would have been motivated to do so in order to achieve “both the form and function of a plastic rivet.” *Id.* ¶ 67.

In our decision on institution, we found that Petitioner had not directed us to sufficient evidence to show that Ishimaru teaches or suggests melting the tank wall to produce tank wall material that is in the molten state. Inst. Dec. 8–9. Patent Owner echoed this finding during the trial, arguing that Ishimaru does not teach or suggest using molten plastic to attach an accessory to a fuel tank. PO Resp. 17–18. Based on the final record before us, however, we are persuaded that the preponderance of evidence now of record supports a finding that Ishimaru teaches or suggests melting some of the plastic of the tank wall to form molten plastic.

Ishimaru teaches that the walls of its tank are “maintained at a moldable temperature” while the tank is placed in a mold and the accessories are placed inside the tank. Ex. 1003 ¶¶ 6, 9. In addition, Ishimaru teaches causing the plastic at a moldable temperature “to penetrate the through-hole” in the accessory that is being attached to the tank wall during the molding of the tank. *Id.* ¶ 25. In our decision on institution, we considered this evidence insufficient to show that Ishimaru’s plastic was molten, because plastic that is soft and moldable is not necessarily above its melting point. Inst. Dec. 8. But the record developed during trial includes considerable testimony from Patent Owner’s own declarant, Professor Osswald, contradicting this view. Ex. 1009, 80:17–19 (“molten plastic is basically understood by somebody in the art” as plastic that “can be shaped” or “formed”), 82:19–20 (“molten plastic . . . [c]ertainly . . . is not defined by a temperature”), 83:18–20 (“as long as the material can be formed and

flow, . . . we have a molten plastic”); Ex. 1010, 33:18–22 (in Ishimaru, “[t]he plastic is molten”).

Patent Owner argues that, because Ishimaru teaches only pushing a small amount of wall material into the orifice to act as a welding aid, a person of ordinary skill in the art would not have interpreted Ishimaru as teaching or suggesting causing the barrier layer to protrude into the orifice. PO Resp. 32–33 (citing Ex. 2001 ¶ 78). As discussed above, the argument that Ishimaru is restricted to causing a small amount of molten plastic to enter its orifice as a welding aid is inconsistent with the language of Ishimaru, which teaches the accessory being “even more securely attached to the outer wall.” Ex. 1003 ¶ 34. Without some explanation of how pushing a small amount of molten plastic into the orifice helps make the attachment of the accessory to the wall more secure, this argument is unpersuasive. Professor Osswald does not provide such an explanation in the testimony cited by Patent Owner. Ex. 2001 ¶ 78.

For these reasons, we find that Ishimaru teaches or suggests this limitation of claim 25.

(7) “The protrusion having been shaped to overhang the at least one orifice and stake-fasten the at least one accessory or support for an accessory to the fuel tank wall without rupturing the barrier layer of the protrusion and said protrusion holds the accessory in a non-removable mechanical connection to the inside wall of the multilayer plastic fuel tank”

Petitioner argues that Ishimaru teaches or suggests this limitation. Pet. 18–24, 26–27 (citing Ex. 1003 ¶¶ 7, 19, 34, 40, Fig. 14; Ex. 1006 ¶¶ 60–74). We agree, and Patent Owner does not dispute Petitioner’s

argument or evidence on this point. PO Resp. 19–34. Dr. Kazmer testifies that the protrusion of molten plastic beyond the top of the orifice takes a “spherical” shape that overhangs the upper edges of Ishimaru’s orifice before solidifying, “provid[ing] both the form and function of a plastic rivet.” Ex. 1006 ¶ 67. As discussed above, this provides a non-removable mechanical connection to the inside wall of the fuel tank, and this occurs without rupturing the fuel barrier layer. Accordingly, Ishimaru teaches or suggests this limitation of claim 25.

Because Ishimaru teaches all limitations of claim 25 except for the “orifice ha[ving] a variation along a plane perpendicular to the wall of the accessory that is tailored to make it easier to force molten plastic through the orifice,” and because a person of ordinary skill in the art would have had a reason to modify the teachings of Ishimaru to arrive at this limitation, we conclude that Petitioner has shown by a preponderance of the evidence that claim 25 would have been obvious to a person of ordinary skill in the art over the teachings of Ishimaru.

c. Claim 26

Claim 26 depends from claim 25 and adds limitations requiring that “the outer layer of thermoplastic polymer [be] high density polyethylene” and that “the barrier layer of fuel impermeable resin [be] a copolymer of ethylene and partially [hydrolyzed] vinyl acetate or high density polyethylene which has been surface treated so as to render it impermeable to fuel.” Ex. 1001, 9:17–22. Petitioner argues that Ishimaru teaches these limitations. Pet. 28 (citing Ex. 1003 ¶ 19; Ex. 1006 ¶¶ 86–87). We agree, and Patent Owner does not dispute this evidence or argument. PO Resp. 19–34. Ishimaru teaches using a high-density polyethylene layer on each side of

a fuel-impermeable layer that is made of a copolymer of ethylene and vinyl alcohol, which is hydrolyzed vinyl acetate. Ex. 1003 ¶ 19; Ex. 1006 ¶¶ 86–87. Accordingly, we conclude that Petitioner has shown by a preponderance of the evidence that claim 26 would have been obvious to a person of ordinary skill in the art over the teachings of Ishimaru.

d. Claim 27

Claim 27 depends from claim 25 and adds a limitation requiring “the opening of the at least one orifice in direct contact with part of the inner wall of the fuel tank” to be “angularly shaped to encourage the thermoplastic material of which the wall is made to flow through said orifice without rupturing the barrier layer of the fuel tank wall.” Ex. 1001, 9:23–28.

Petitioner argues that a person of ordinary skill in the art would have had reason to modify the teachings of Ishimaru to arrive at this limitation.

Pet. 28–30 (citing Ex. 1006 ¶¶ 49–56, 62–64, 89). Patent Owner repeats its argument regarding the limitation of claim 25 requiring the “orifice [to have] a variation along a plane perpendicular to the wall of the accessory that is tailored to make it easier to force molten plastic through the orifice.” PO Resp. 33 (citing Ex. 2001 ¶ 79). As discussed above with respect to claim 25, we find that Ishimaru teaches or suggests forcing the multilayer wall material through an orifice in an accessory without rupturing its fuel-impermeable layer, and we find that a person of ordinary skill in the art would have had reason to modify the teachings of Ishimaru to vary the orifice along a plane perpendicular to the wall so as to “make it easier to force molten plastic through the orifice.” Accordingly, we conclude that Petitioner has shown by a preponderance of the evidence that claim 27

would have been obvious to a person of ordinary skill in the art over the teachings of Ishimaru.

e. Claim 33

Claim 33 depends from claim 25 and adds a limitation requiring “a support for an accessory equipped with at least one orifice which passes through the support for an accessory.” Ex. 1001, 10:10–12. Petitioner argues that a person of ordinary skill in the art would have found this limitation obvious given the teachings of Ishimaru. Pet. 30–32; Reply 15–16. There is evidence to support this argument. First, Ishimaru teaches attaching a “plate with holes” to the tank wall. Ex. 1003 ¶ 20. Because the plate has holes in it, if it were to act as a support for an accessory, it would satisfy the requirement of claim 33 for a support equipped with an orifice that passes through the support. Dr. Kazmer testifies that a person of ordinary skill in the art would have known that the “plate with holes” “could be used to attach other accessories to the fuel tank.” Ex. 1006 ¶ 92. Moreover, the ’326 patent makes clear that a support for an accessory is itself an accessory. Ex. 1001, 3:5–10 (defining “accessory” as including “a support for one or several” accessories). Thus, because, as discussed above, Ishimaru teaches or suggests attaching accessories to a fuel tank wall, we are persuaded that one of skill in the art would have understood that Ishimaru also suggests attaching supports for accessories to a tank wall.

Patent Owner argues that Ishimaru does not teach or suggest “a support for an accessory that has an orifice to attach the accessory to the tank wall by way of stake-fastening.” PO Resp. 33–34 (citing Ex. 2001 ¶ 80). But claim 33 does not require that the support have “an orifice to

attach the accessory to the tank wall by way of stake-fastening.” *Id.* Instead, claim 33 recites merely “a support for an accessory” that is “equipped with at least one orifice which passes through” it. Ex. 1001, 10:10–12. The orifice need not be used for stake-fastening. *Id.*

For these reasons, we conclude that Petitioner has shown by a preponderance of the evidence that claim 33 would have been obvious to a person of ordinary skill in the art over the teachings of Ishimaru.

f. Claim 34

Claim 34 depends from claim 25 and adds a limitation requiring “an accessory equipped with at least one orifice which passes through the accessory.” Ex. 1001, 10:13–15. Petitioner argues that Ishimaru teaches this limitation. Pet. 32. We agree, and Patent Owner does not dispute this evidence or argument. PO Resp. 19–34. Ishimaru teaches “sub-tank 21” with “through-hole 25 in reverse-tapered shape.” Ex. 1003 ¶ 34. Ishimaru’s sub-tank is an accessory because it is associated with Ishimaru’s fuel tank and because it collaborates with the fuel tank to perform useful functions. Ex. 1001, 3:5–10. Thus, Ishimaru teaches an accessory equipped with an orifice passing through it. Accordingly, we conclude that Petitioner has shown by a preponderance of the evidence that claim 34 would have been obvious to a person of ordinary skill in the art over the teachings of Ishimaru.

g. Claim 44

Claim 44 depends from claim 25 and adds a limitation requiring that the accessory of claim 25 be “a ventilation device.” Ex. 1001, 10:42–43. Petitioner argues that Ishimaru teaches or suggests this limitation. Pet. 24, 32–33 (citing Ex. 1003 ¶ 20; Ex. 1006 ¶¶ 75–76). Specifically, Petitioner

argues that Ishimaru’s “cut-off valve” is a ventilation device. *Id.* Patent Owner does not argue the nonobviousness of claim 44, but, with respect to claim 13, which also recites a ventilation device, Patent Owner argues both that Ishimaru fails to teach any ventilation device and that Ishimaru does not teach attaching its cut-off valve by stake-fastening it to the fuel tank wall. PO Resp. 29–31 (citing Ex. 1003 ¶ 11; Ex. 2001 ¶¶ 73–75).

Ishimaru describes its cut-off valve as “let[ting] the air that builds up in the upper part of the fuel tank 1 escape when fuel is pumped into the fuel tank 1.” Ex. 1003 ¶ 20. Dr. Kazmer testifies that a person of ordinary skill in the art “would understand that a device that allows built up air to escape from the tank is a ventilation device.” Ex. 1006 ¶ 75. Patent Owner argues that the cut-off valve of Ishimaru is not a ventilation device, but Patent Owner does not cite any evidence to support this argument. PO Resp. 29. Accordingly, we are persuaded by Petitioner’s evidence that Ishimaru’s cut-off valve is a ventilation device.

Patent Owner also argues that Ishimaru fails to teach or suggest attaching its cut-off valve to the tank wall by stake-fastening. *Id.* at 29–31. According to Patent Owner, Ishimaru requires the upper side of its lost core with embedded accessories, where the cut-off valve must be placed, to be smooth so that the fuel tank preform can be easily slid over the lost core. *Id.* (citing Ex. 1003 ¶ 11; Ex. 2001 ¶¶ 73–75). But Ishimaru teaches that even the smooth side of its lost core may have some “protrusions and recesses,” so it does not require any side of the lost core to be completely smooth. Ex. 1003 ¶ 11. Moreover, to the extent the catching described by Patent Owner was a problem, Ishimaru teaches a solution that allows for roughness on multiple sides of the lost core: rotating the lost core and the preform after

the core has been slid against the preform. *Id.* ¶¶ 11, 32–33. Thus, Ishimaru suggests attaching the cut-off valve using the same method it teaches for attaching any accessory.

For these reasons, we conclude that Petitioner has shown by a preponderance of the evidence that claim 44 would have been obvious to a person of ordinary skill in the art over the teachings of Ishimaru.

C. Asserted Obviousness over Ishimaru and Staargaard

Petitioner argues that the subject matter of claims 1, 13, 25–27, 33, 34, and 44 would have been obvious to a person of ordinary skill in the art given the teachings of Ishimaru and Staargaard. Pet. 33–50.

1. Staargaard

Staargaard relates to “a method of attaching plastic to a metal substrate and a part made by the method.” Ex. 1005, at [57]. The method “can be used in any application where a plastic component is secured with a metal component.” *Id.* ¶ 33. Figure 2 of Staargaard is reproduced below:

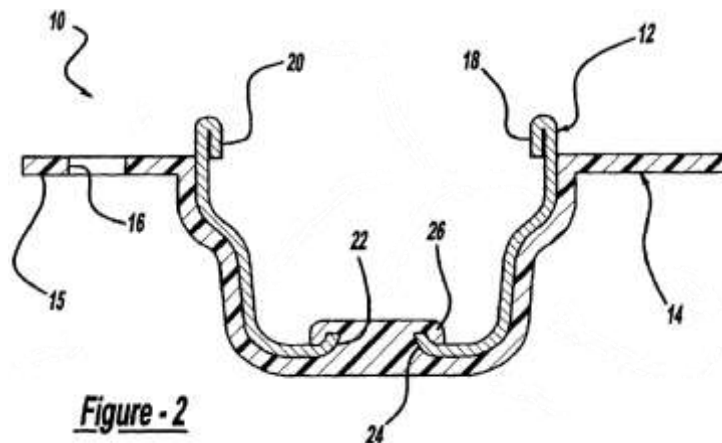


Figure 2 of Staargaard depicts “a cross sectional view” of “a part made in accordance with” Staargaard’s invention. *Id.* ¶¶ 13–14. In Figure 2, “plastic component 14 is disposed through the lower opening 22 in the metal component 12.” *Id.* ¶ 26. The plastic component “further includes a

flange 26,” which “extends beyond the edges 24 of the lower opening 22.” *Id.* This “secure[s] or lock[s]” the plastic component “to the metal component.” *Id.* Staargaard teaches molding the plastic component through the metal component using a tool and die. *Id.* ¶ 9. The tool “provides a mold cavity on one side of the opening 22 in the metal component 12 to permit molding of the flange 26.” *Id.* ¶ 31. Staargaard teaches that the molding of the plastic material through the opening may be accomplished either by injection molding or by blow molding. *Id.* ¶¶ 30, 32.

2. Analysis

Petitioner argues that a person of ordinary skill in the art would have had reason to combine the teachings of Ishimaru with the teachings of Staargaard and that those combined teachings teach or suggest every limitation of claims 1, 13, 25–27, 33, 34, and 44. Pet. 33–50. Patent Owner argues that the combination of Ishimaru and Staargaard fails to teach several limitations of the challenged claims and that a person of ordinary skill in the art would not have combined the teachings of Staargaard with those of Ishimaru. PO Resp. 35–47.

a. Claims 1 and 13

As discussed above, claims 1 and 13 recite a limitation that requires “closing the multilayer plastic fuel tank with the stake-fastened accessory therein.” Ex. 1001, 7:26–27, 8:1–2. Petitioner relies on Ishimaru to teach or suggest this limitation. Pet. 23–24, 45 (citing Ex. 1003 ¶ 7, Fig. 14; Ex. 1006 ¶¶ 70–74). As discussed above, however, we agree with Patent Owner that claims 1 and 13 require that the accessory be stake-fastened before the fuel tank is finally closed, and Petitioner has not shown that Ishimaru teaches or suggests this limitation.

Accordingly, Petitioner has not shown by a preponderance of the evidence that the combination of Ishimaru and Staargaard teaches or suggests the subject matter of claim 1 or of claim 13.

b. Claim 25

As Petitioner argues, Pet. 46–48, claim 25 recites a preamble and six limitations: “[a] multilayer plastic fuel tank equipped with at least one accessory or support for an accessory stake-fastened to the inner wall of the fuel tank,” “the wall of the fuel tank comprises an outer layer of thermoplastic polymer and a barrier layer of thermoplastic resin impermeable to fuel,” “at least one accessory or support for an accessory is in direct contact with part of the inner wall of the fuel tank,” “said at least one accessory or support for an accessory having a wall portion which is equipped with at least one orifice which passes through the wall portion of the accessory or support for an accessory,” “said at least one orifice has a variation along a plane perpendicular to the wall of the accessory that is tailored to make it easier to force molten plastic through the orifice,” “said at least one orifice having had some of the thermoplastic polymer of the outer layer and some of the barrier layer of the fuel tank wall forced in the molten state into and through the at least one orifice to form at least one thermoplastic protrusion from the opposite end of said at least one orifice and solidified without becoming detached from the fuel tank wall and without rupturing the barrier layer of thermoplastic resin impermeable to fuel,” and “the protrusion having been shaped to overhang the at least one orifice and stake-fasten the at least one accessory or support for an accessory to the fuel tank wall without rupturing the barrier layer of the protrusion and said protrusion holds the accessory in a non-removable mechanical

connection to the inside wall of the multilayer plastic fuel tank.” Ex. 1001, 8:51–9:16.

(1) Preamble and Reason to Combine

Petitioner argues that the combination of Ishimaru and Staargaard teaches or suggests the preamble of claim 25, “[a] multilayer plastic fuel tank equipped with at least one accessory or support for an accessory stake-fastened to the inner wall of the fuel tank.” Pet. 34–38, 46. Ishimaru teaches a multilayer plastic fuel tank equipped with at least one accessory. Ex. 1003 ¶¶ 19 (“fuel tank 1” has “an outer wall 10” that “has a laminate structure (not shown) on which a surface layer composed mainly of high-density polyethylene (HDPE) is on both sides of a gas barrier layer”), 34 (“the sub-tank 21 can be even more securely attached to the outer wall 10”). Patent Owner does not dispute this evidence. PO Resp. 19–34.

With respect to the portion of the preamble requiring that the accessory be “stake-fastened to the inner wall of the fuel tank,” Petitioner argues that Staargaard teaches or suggests stake-fastening metal components to plastic and that a person of ordinary skill in the art would have been motivated to use the method of Staargaard in stake-fastening Ishimaru’s accessories inside Ishimaru’s plastic fuel tank. Pet. 34–38 (citing Ex. 1005 ¶¶ 9, 24–27, 32, 33, Fig. 2; Ex. 1006 ¶¶ 99–107).

Patent Owner argues that Ishimaru does not teach or suggest stake-fastening its accessories because it relates only to a “welding aid to make the attachment to the tank wall more secure.” PO Resp. 19–23 (citing Ex. 1003 ¶¶ 27, 33, 34, Fig. 9, Fig. 10; Ex. 2001 ¶¶ 62–65). As discussed above, however, we find that Ishimaru teaches the stake-fastening required by the preamble of claim 25.

With respect to Staargaard teaching stake-fastening generally, Patent Owner argues that Staargaard does not teach fastening an accessory to a fuel tank or other hollow container. PO Resp. 35–36. As discussed above, the stake-fastening process of claim 25 must result in a protrusion of solidified plastic that cooperates with the accessory orifice in a way that causes the accessory to become mechanically fastened to the wall of the fuel tank. Ex. 1001, 7:32–35. Although Staargaard does not itself teach attaching an accessory to a fuel tank, it does teach a process that results in a protrusion of solidified plastic that cooperates with an orifice on a part in a way that causes the part to become mechanically fastened to the plastic. Ex. 1005 ¶¶ 9, 24–27, 32, 33, Fig. 2. Thus, Staargaard teaches a general stake-fastening method, albeit not one used in attaching an accessory to a fuel tank.

Petitioner argues that a person of ordinary skill in the art would have had a reason to combine Staargaard’s teaching of general stake-fastening using an orifice with a curved entrance with Ishimaru’s teaching of stake-fastening an accessory inside a fuel tank. Pet. 36–38 (citing Ex. 1005 ¶ 32; Ex. 1006 ¶¶ 106–107). Specifically, Petitioner argues that using Staargaard’s orifice to carry out Ishimaru’s stake-fastening method “would make it easier to force molten plastic through the orifice and join the components together.” *Id.* There is evidence to support this argument. Staargaard teaches that the edges of its orifice are “preferably curved or bent upward, toward the interior of the metal component” that is being attached to the plastic. Ex. 1005 ¶ 24. Dr. Kazmer testifies that this orifice design “enhances the flow of molten plastic through the orifice.” Ex. 1006 ¶ 107. As discussed above, Ishimaru describes the purpose of its orifice as allowing

“a part of the preform . . . to penetrate the through-hole . . . during press-molding” in order to “more securely attach[]” the sub-tank “to the outer wall.” Ex. 1003 ¶ 34. Because Ishimaru teaches causing a portion of the plastic of the tank wall to penetrate the orifice in order to attach an accessory to the wall, a person of ordinary skill in the art would have been motivated to follow teachings that would cause molten plastic to flow into the orifice.

Patent Owner argues for several reasons that, despite this evidence, a person of ordinary skill in the art would not have replaced Ishimaru’s orifice with Staargaard’s orifice. First, Patent Owner argues that Staargaard is not analogous art to the ’326 patent because Staargaard does not relate either to fuel tanks or hollow containers. PO Resp. 31 (citing Ex. 2005, 65:11–70:8). We are not persuaded by this argument. Contrary to Patent Owner’s argument, *id.* at 35–36, Staargaard is not limited to “the context of car front end modules.” Instead, Staargaard teaches using its process “in any application where a plastic component is secured with a metal component.” Ex. 1005 ¶ 33; *see* Ex. 1005 ¶¶ 9 (describing the invention as “a method of attaching a plastic component to a metal component”), 11 (clarifying that the “specific examples . . . are intended for purposes of illustration only and are not intended to limit the scope of the invention”). Moreover, even if Patent Owner is correct that the field of endeavor of the ’326 patent is limited to either fuel tanks or hollow bodies, the test for analogous art permits the use of any reference that is “reasonably pertinent to the problem with which the inventor was concerned.” *In re Kahn*, 441 F.3d 977, 986–87 (Fed. Cir. 2006) (citing *In re Oetiker*, 977 F.2d 1443, 1447 (Fed. Cir. 1992)). The object of the ’326 patent is “to provide a method that allows an accessory based on a material different from that of the tank to be fastened inside a

plastic fuel tank.” Ex. 1001, 1:56–58. As a reference pertaining to “a method of attaching a plastic component to a metal component,” Staargaard is concerned with very nearly the same problem as the ’326 patent, and it certainly is pertinent to the problem solved by the ’326 patent. Ex. 1005 ¶ 9. Thus, we find that Staargaard is analogous art to the ’326 patent.

Patent Owner also repeats the arguments, discussed above, that Ishimaru teaches away from the use of rounded corners and that Ishimaru’s teaching of rounded corners in some contexts but not in the context of its stake-fastening orifice would lead a person of ordinary skill in the art away from rounding the corners of the orifice. As discussed above, we do not find either of these arguments persuasive.

For these reasons, we find that a person of ordinary skill in the art would have had a reason to combine the teachings of Staargaard with those of Ishimaru and that the combination of those references teaches or suggests the preamble of claim 25.

(2) “The wall of the fuel tank comprises an outer layer of thermoplastic polymer and a barrier layer of thermoplastic resin impermeable to fuel”

Petitioner argues that Ishimaru teaches a fuel tank wall with an outer layer of thermoplastic polymer and a barrier layer of thermoplastic resin that is impermeable to fuel. Pet. 15–16, 34, 46. Petitioner is correct. Ishimaru teaches a multilayer plastic fuel tank with a gas barrier layer sandwiched between two layers of high-density polyethylene. Ex. 1003 ¶ 19 (“fuel tank 1” has “an outer wall 10” that “has a laminate structure (not shown) on which a surface layer composed mainly of high-density polyethylene (HDPE) is on both sides of a gas barrier layer”). The gas barrier layer “is

composed mainly of ethylene-vinyl alcohol copolymer resin (EVOH).” *Id.* Patent Owner does not dispute Petitioner’s argument or evidence on this point, including whether HDPE and EVOH are a thermoplastic polymer and a thermoplastic resin, respectively. PO Resp. 35–47. Accordingly, the combination of Ishimaru and Staargaard teaches or suggests this limitation of claim 25.

(3) *“At least one accessory or support for an accessory is in direct contact with part of the inner wall of the fuel tank”*

Petitioner argues that Ishimaru teaches or suggests this limitation. Pet. 25–26, 46 (citing Ex. 1003, Fig. 14; Ex. 1006 ¶ 79, 129–130). We agree, and Patent Owner does not dispute Petitioner’s argument or evidence on this point. PO Resp. 35–47. Figure 14 of Ishimaru depicts sub-tank 21 in direct contact with the inner surface of outer wall 10. Ex. 1003, Fig. 14. Accordingly, the combination of Ishimaru and Staargaard teaches or suggests this limitation of claim 25.

(4) *“Said at least one accessory or support for an accessory having a wall portion which is equipped with at least one orifice which passes through the wall portion of the accessory or support for an accessory”*

Petitioner argues that both Ishimaru and Staargaard teach or suggest this limitation. Pet. 14–15, 34–36, 47 (citing Ex. 1003 ¶ 34, Fig. 14; Ex. 1005 ¶¶ 9, 24–27, 33, Fig. 2; Ex. 1006 ¶¶ 46–47, 99–105). We agree, and Patent Owner does not dispute Petitioner’s argument or evidence on this point. PO Resp. 35–47. Ishimaru teaches that sub-tank 21 has “bottom surface 23” in which there is a “through-hole 25 in reverse-tapered shape.” Ex. 1003 ¶ 34; *see also* Ex. 1003, Fig. 14 (depicting through-hole 25 passing

through bottom surface of sub-tank 21). Moreover, Staargaard teaches attaching a metal component to plastic by providing a “lower opening” in the metal component through which some of the plastic can be forced. Ex. 1005 ¶ 24, Fig. 2. Accordingly, the combination of Ishimaru and Staargaard teaches or suggests this limitation of claim 25.

(5) *“Said at least one orifice has a variation along a plane perpendicular to the wall of the accessory that is tailored to make it easier to force molten plastic through the orifice”*

Petitioner argues that the combination of Ishimaru and Staargaard teaches or suggests this limitation. Pet. 16–17, 34–38, 47 (citing Ex. 1003 ¶ 29, Fig. 11; Ex. 1005 ¶¶ 9, 24–27, 32, 33, Fig. 2; Ex. 1006 ¶¶ 50–57, 99–107). Specifically, Petitioner argues that a person of ordinary skill in the art would have known that using Staargaard’s orifice in Ishimaru’s stake-fastening process would make it easier to force molten plastic through the orifice. *Id.* at 36–38. As discussed above with respect to the reason to combine Ishimaru and Staargaard, Patent Owner disagrees, arguing that a person of ordinary skill in the art would not have combined the teachings of the references. PO Resp. 36–41.

As discussed above, we find that a person of ordinary skill in the art would have had a reason to combine the teachings of Staargaard with those of Ishimaru. Specifically, we find that a person of ordinary skill in the art would have had a reason to use Staargaard’s orifice in the stake-fastening method of Ishimaru. As noted, the reason to do so would have been to make it easier to force molten plastic from the tank wall into and through the orifice in the accessory being attached to the wall. Ex. 1006 ¶ 107. A person of ordinary skill in the art would have expected such an improvement

because Staargaard's orifice has its edges bent or curved up away from the source of the plastic being forced into the orifice. *Id.*; see Ex. 1005 ¶ 24, Fig. 2. Thus, the diameter of the orifice in the Staargaard-Ishimaru combination varies along a plane perpendicular to the wall to which the accessory is being attached, and this variation makes it easier to force molten plastic through the orifice.

For these reasons, we find that the combination of Ishimaru and Staargaard teaches or suggests this limitation of claim 25.

(6) *“Said at least one orifice having had some of the thermoplastic polymer of the outer layer and some of the barrier layer of the fuel tank wall forced in the molten state into and through the at least one orifice to form at least one thermoplastic protrusion from the opposite end of said at least one orifice and solidified without becoming detached from the fuel tank wall and without rupturing the barrier layer of thermoplastic resin impermeable to fuel”*

Petitioner argues that the combination of Ishimaru and Staargaard teaches or suggests this limitation. Pet. 18–21, 40–43, 47 (citing Ex. 1003 ¶¶ 19, 22, 34, Fig. 14; Ex. 1005 ¶¶ 26, 30, Fig. 2; Ex. 1006 ¶¶ 60–69, 110–114). There is evidence to support this argument. Ishimaru teaches making its fuel tank from a multilayer laminate. Ex. 1003 ¶ 19. Ishimaru also teaches forcing the material of its tank wall through its orifice. *Id.* ¶ 34 (“a part of the preform 14 can be caused to penetrate the through-hole 25 during the press-molding”). Staargaard teaches pushing some plastic material through an orifice without becoming detached from the remainder of the plastic, and Staargaard teaches the plastic protruding from the other end of the orifice before solidifying. Ex. 1005 ¶¶ 26, 30, Fig. 2. Dr. Kazmer

testifies that a person of ordinary skill in the art would have understood that Ishimaru's fuel tank "would lack any utility" if its fuel-impermeable layer were ruptured by the manufacturing process. Ex. 1006 ¶ 62. Dr. Kazmer also testifies that, because of the viscous flow of the plastic layers, Ishimaru's multilayer structure would be preserved in the forcing of a portion of the tank wall through the orifice in the sub-tank. *Id.* ¶ 64, 113.

In our decision on institution, we found that Petitioner had not directed us to sufficient evidence to show that Ishimaru teaches or suggests melting the tank wall to produce tank wall material that is in the molten state. Inst. Dec. 8–9. Patent Owner echoed this finding during the trial, arguing that Ishimaru does not teach or suggest using molten plastic to attach an accessory to a fuel tank. PO Resp. 17–18. Based on the final record before us, however, we are persuaded that the preponderance of evidence now of record supports a finding that Ishimaru teaches or suggests melting some of the plastic of the tank wall to form molten plastic.

Ishimaru teaches that the walls of its tank are "maintained at a moldable temperature" while the tank is placed in a mold and the accessories are placed inside the tank. Ex. 1003 ¶¶ 6, 9. In addition, Ishimaru teaches causing the plastic at a moldable temperature "to penetrate the through-hole" in the accessory that is being attached to the tank wall during the molding of the tank. *Id.* ¶ 25. In our decision on institution, we considered this evidence insufficient to show that Ishimaru's plastic was molten, because plastic that is soft and moldable is not necessarily above its melting point. Inst. Dec. 8. But the record developed during trial includes considerable testimony from Patent Owner's own declarant, Professor Osswald, contradicting this view. Ex. 1009, 80:17–19 ("molten plastic is basically

understood by somebody in the art” as plastic that “can be shaped” or “formed”), 82:19–20 (“molten plastic . . . [c]ertainly . . . is not defined by a temperature”), 83:18–20 (“as long as the material can be formed and flow, . . . we have a molten plastic”); Ex. 1010, 33:18–22 (in Ishimaru, “[t]he plastic is molten”).

For these reasons, we find that the combination of Ishimaru and Staargaard teaches or suggests this limitation of claim 25.

(7) *“The protrusion having been shaped to overhang the at least one orifice and stake-fasten the at least one accessory or support for an accessory to the fuel tank wall without rupturing the barrier layer of the protrusion and said protrusion holds the accessory in a non-removable mechanical connection to the inside wall of the multilayer plastic fuel tank”*

Petitioner argues that the combination of Ishimaru and Staargaard teaches or suggests this limitation. Pet. 18–24, 40–46, 48 (citing Ex. 1003 ¶¶ 7, 19, 22, 34, 40, Fig. 14; Ex. 1005 ¶¶ 9, 26, 30, 31, Fig. 2; Ex. 1006 ¶¶ 60–74, 110–114, 117–124, 134). We agree, and Patent Owner does not dispute Petitioner’s argument or evidence on this point. PO Resp. 35–47. Dr. Kazmer testifies that the protrusion of molten plastic beyond the top of the orifice takes a “spherical” shape that overhangs the upper edges of Ishimaru’s orifice before solidifying, “provid[ing] both the form and function of a plastic rivet.” Ex. 1006 ¶ 67. Moreover, Staargaard teaches forming the protruding plastic into a flange that overhangs the edges of the orifice before the plastic solidifies. Ex. 1005 ¶¶ 9, 26, Fig. 2. As discussed above, this provides a non-removable mechanical connection to the inside wall of the fuel tank, and this occurs without rupturing the fuel barrier layer.

Accordingly, the combination of Ishimaru and Staargaard teaches or suggests this limitation of claim 25.

Because the combination of Ishimaru and Staargaard teaches all limitations of claim 25, and because a person of ordinary skill in the art would have had a reason to combine the teachings of Staargaard with the teachings of Ishimaru, we conclude that Petitioner has shown by a preponderance of the evidence that claim 25 would have been obvious to a person of ordinary skill in the art over the combined teachings of Ishimaru and Staargaard.

c. Claim 26

Claim 26 depends from claim 25 and adds limitations requiring that “the outer layer of thermoplastic polymer [be] high density polyethylene” and that “the barrier layer of fuel impermeable resin [be] a copolymer of ethylene and partially [hydrolyzed] vinyl acetate or high density polyethylene which has been surface treated so as to render it impermeable to fuel.” Ex. 1001, 9:17–22. Petitioner argues that Ishimaru teaches these limitations. Pet. 28, 48 (citing Ex. 1003 ¶ 19; Ex. 1006 ¶¶ 86–87). We agree, and Patent Owner does not dispute this evidence or argument. PO Resp. 35–47. Ishimaru teaches using a high-density polyethylene layer on each side of a fuel-impermeable layer that is made of a copolymer of ethylene and vinyl alcohol, which is hydrolyzed vinyl acetate. Ex. 1003 ¶ 19; Ex. 1006 ¶¶ 86–87. Accordingly, we conclude that Petitioner has shown by a preponderance of the evidence that claim 26 would have been obvious to a person of ordinary skill in the art over the combined teachings of Ishimaru and Staargaard.

d. Claim 27

Claim 27 depends from claim 25 and adds a limitation requiring “the opening of the at least one orifice in direct contact with part of the inner wall of the fuel tank” to be “angularly shaped to encourage the thermoplastic material of which the wall is made to flow through said orifice without rupturing the barrier layer of the fuel tank wall.” Ex. 1001, 9:23–28. Petitioner argues that the combination of Ishimaru and Staargaard teaches or suggests this limitation. Pet. 28–30, 49 (citing Ex. 1006 ¶¶ 49–56, 62–64, 89, 137). Patent Owner repeats its argument regarding the limitation of claim 25 requiring the “orifice [to have] a variation along a plane perpendicular to the wall of the accessory that is tailored to make it easier to force molten plastic through the orifice.” PO Resp. 45. As discussed above with respect to claim 25, we find that the combination of Ishimaru and Staargaard teaches or suggests forcing the multilayer wall material through an orifice in an accessory without rupturing its fuel-impermeable layer, and we find that a person of ordinary skill in the art would have had reason to combine the teachings of Ishimaru and Staargaard to arrive at a process in which molten tank wall material is forced through an orifice that varies along a plane perpendicular to the wall so as to “make it easier to force molten plastic through the orifice.” Accordingly, we conclude that Petitioner has shown by a preponderance of the evidence that claim 27 would have been obvious to a person of ordinary skill in the art over the combined teachings of Ishimaru and Staargaard.

e. Claim 33

Claim 33 depends from claim 25 and adds a limitation requiring “a support for an accessory equipped with at least one orifice which passes

through the support for an accessory.” Ex. 1001, 10:10–12. Petitioner argues that a person of ordinary skill in the art would have found this limitation obvious given the teachings of Ishimaru. Pet. 30–32, 49–50 (citing Ex. 1006 ¶¶ 90–93, 143); Reply 15–16. There is evidence to support this argument. First, Ishimaru teaches attaching a “plate with holes” to the tank wall. Ex. 1003 ¶ 20. Because the plate has holes in it, if it were to act as a support for an accessory, it would satisfy the requirement of claim 33 for a support equipped with an orifice that passes through the support. Dr. Kazmer testifies that a person of ordinary skill in the art would have known that the “plate with holes” “could be used to attach other accessories to the fuel tank.” Ex. 1006 ¶ 92. Moreover, the ’326 patent makes clear that a support for an accessory is itself an accessory. Thus, because, as discussed above, Ishimaru teaches or suggests attaching accessories to a fuel tank wall, it also teaches or suggests attaching supports for accessories.

Patent Owner argues that neither Ishimaru nor Staargaard teaches or suggests “a support for an accessory that has an orifice to attach the accessory to the tank wall by way of stake-fastening.” PO Resp. 33–34, 46–47. But claim 33 does not require that the support have “an orifice to attach the accessory to the tank wall by way of stake-fastening.” *Id.* Instead, claim 33 recites merely “a support for an accessory” that is “equipped with at least one orifice which passes through” it. Ex. 1001, 10:10–12. The orifice need not be used for stake-fastening. *Id.* Because Ishimaru teaches a support with an orifice, the fact that Staargaard does not is irrelevant to the obviousness analysis.

For these reasons, we conclude that Petitioner has shown by a preponderance of the evidence that claim 33 would have been obvious to a

person of ordinary skill in the art over the combined teachings of Ishimaru and Staargaard.

f. Claim 34

Claim 34 depends from claim 25 and adds a limitation requiring “an accessory equipped with at least one orifice which passes through the accessory.” Ex. 1001, 10:13–15. Petitioner argues that Ishimaru teaches this limitation. Pet. 32, 50 (citing Ex. 1006 ¶¶ 94–97). We agree, and Patent Owner does not dispute this evidence or argument. PO Resp. 35–47.

Ishimaru teaches “sub-tank 21” with “through-hole 25 in reverse-tapered shape.” Ex. 1003 ¶ 34. Ishimaru’s sub-tank is an accessory because it is associated with Ishimaru’s fuel tank and because it collaborates with the fuel tank to perform useful functions. Ex. 1001, 3:5–10. Thus, Ishimaru teaches an accessory equipped with an orifice passing through it. Accordingly, we conclude that Petitioner has shown by a preponderance of the evidence that claim 34 would have been obvious to a person of ordinary skill in the art over the combined teachings of Ishimaru and Staargaard.

g. Claim 44

Claim 44 depends from claim 25 and adds a limitation requiring that the accessory of claim 25 be “a ventilation device.” Ex. 1001, 10:42–43. Petitioner argues that Ishimaru teaches or suggests this limitation. Pet. 24, 32–33, 50 (citing Ex. 1003 ¶ 20; Ex. 1006 ¶¶ 75–76). Specifically, Petitioner argues that Ishimaru’s “cut-off valve” is a ventilation device. *Id.* Patent Owner does not argue the nonobviousness of claim 44, but, with respect to claim 13, which also recites a ventilation device, Patent Owner argues both that Ishimaru fails to teach any ventilation device and that Ishimaru does not teach attaching its cut-off valve by stake-fastening it to

the fuel tank wall. PO Resp. 29–31, 43–44 (citing Ex. 1003 ¶ 11; Ex. 2001 ¶¶ 73–75, 101–103).

Ishimaru describes its cut-off valve as “let[ting] the air that builds up in the upper part of the fuel tank 1 escape when fuel is pumped into the fuel tank 1.” Ex. 1003 ¶ 20. Dr. Kazmer testifies that a person of ordinary skill in the art “would understand that a device that allows built up air to escape from the tank is a ventilation device.” Ex. 1006 ¶ 75. Patent Owner argues that the cut-off valve of Ishimaru is not a ventilation device, but Patent Owner does not cite any evidence to support this argument. PO Resp. 29. Accordingly, we are persuaded by Petitioner’s evidence that Ishimaru’s cut-off valve is a ventilation device.

Patent Owner also argues that Ishimaru fails to teach or suggest attaching its cut-off valve to the tank wall by stake-fastening. *Id.* at 29–31. According to Patent Owner, Ishimaru requires the upper side of its lost core with embedded accessories, where the cut-off valve must be placed, to be smooth so that the fuel tank preform can be easily slid over the lost core. *Id.* (citing Ex. 1003 ¶ 11; Ex. 2001 ¶¶ 73–75). But Ishimaru teaches that even the smooth side of its lost core may have some “protrusions and recesses,” so it does not require any side of the lost core to be completely smooth. Ex. 1003 ¶ 11. Moreover, to the extent the catching described by Patent Owner was a problem, Ishimaru teaches a solution that allows for roughness on multiple sides of the lost core: rotating the lost core and the preform after the core has been slid against the preform. *Id.* ¶¶ 11, 32–33. Thus, Ishimaru suggests attaching the cut-off valve using the same method it teaches for attaching any accessory.

For these reasons, we conclude that Petitioner has shown by a preponderance of the evidence that claim 44 would have been obvious to a person of ordinary skill in the art over the combined teachings of Ishimaru and Staargaard.

D. Asserted Obviousness over Van Schaftingen and Staargaard

Petitioner argues that the subject matter of claims 25 and 33 would have been obvious to a person of ordinary skill in the art given the teachings of Van Schaftingen and Staargaard. Pet. 50–67.

1. Van Schaftingen

Van Schaftingen relates to a “[p]rocess for manufacturing hollow plastic bodies, especially motor-vehicle fuel tanks.” Ex. 1004, at [57]. In the process of Van Schaftingen, a “parison is cut twice over its entire length . . . so as to produce two separate sheets.” *Id.* ¶ 25. These separate sheets “are held apart at a sufficient distance from each other so that it is possible to insert between them, before [molding], an object intended to be incorporated inside the hollow body.” *Id.* ¶ 27. The tank of Van Schaftingen may be a “multilayered structure[] consisting of stacked layers fastened to one another,” where the “external layers” may be “made of high-density polyethylene,” with a “central barrier layer made of ethylene-vinyl alcohol copolymer.” *Id.* ¶¶ 14, 45. The accessory to be inserted into the fuel tank of Van Schaftingen may be a “ventilation device[.]” *Id.* ¶ 32. The “preferred method of fastening” the accessories of Van Schaftingen to the tank “is welding.” *Id.* ¶ 39.

2. Analysis

Petitioner argues that a person of ordinary skill in the art would have had reason to combine the teachings of Van Schaftingen with the teachings

of Staargaard and that those combined teachings teach or suggest every limitation of claims 25 and 33. Pet. 50–67. Patent Owner argues that a person of ordinary skill in the art would not have combined the teachings of these two references and, if they had done so, they would not have arrived at the invention of either challenged claim. PO Resp. 48–54.

a. Claim 25

As Petitioner argues, Pet. 52–65, claim 25 recites a preamble and six limitations: “[a] multilayer plastic fuel tank equipped with at least one accessory or support for an accessory stake-fastened to the inner wall of the fuel tank,” “the wall of the fuel tank comprises an outer layer of thermoplastic polymer and a barrier layer of thermoplastic resin impermeable to fuel,” “at least one accessory or support for an accessory is in direct contact with part of the inner wall of the fuel tank,” “said at least one accessory or support for an accessory having a wall portion which is equipped with at least one orifice which passes through the wall portion of the accessory or support for an accessory,” “said at least one orifice has a variation along a plane perpendicular to the wall of the accessory that is tailored to make it easier to force molten plastic through the orifice,” “said at least one orifice having had some of the thermoplastic polymer of the outer layer and some of the barrier layer of the fuel tank wall forced in the molten state into and through the at least one orifice to form at least one thermoplastic protrusion from the opposite end of said at least one orifice and solidified without becoming detached from the fuel tank wall and without rupturing the barrier layer of thermoplastic resin impermeable to fuel,” and “the protrusion having been shaped to overhang the at least one orifice and stake-fasten the at least one accessory or support for an accessory

to the fuel tank wall without rupturing the barrier layer of the protrusion and said protrusion holds the accessory in a non-removable mechanical connection to the inside wall of the multilayer plastic fuel tank.” Ex. 1001, 8:51–9:16.

(1) Preamble and Reason to Combine

Petitioner argues that the combination of Van Schaftingen and Staargaard teaches or suggests the preamble of claim 25, “[a] multilayer plastic fuel tank equipped with at least one accessory or support for an accessory stake-fastened to the inner wall of the fuel tank.” Pet. 52–58.

Van Schaftingen teaches a “[p]rocess for manufacturing hollow plastic bodies, especially motor-vehicle fuel tanks,” including installing accessories into the tanks by attaching them to the walls of the tanks. Ex. 1004, at [57], ¶¶ 31, 34. The accessories of Van Schaftingen are defined identically to our construction of “accessory,” and examples include “ventilation devices.” *Id.* ¶ 32.

Although Van Schaftingen does not teach or suggest attaching its accessories to the walls of the tanks by stake-fastening, Petitioner argues that Staargaard teaches or suggests stake-fastening metal accessories to plastic components. Pet. 52–55 (citing Ex. 1004, at [57], ¶¶ 14, 31, 32, 34, Fig.;⁶ Ex. 1005 ¶¶ 9, 33, Fig. 2; Ex. 1006 ¶¶ 148–165). Patent Owner does not dispute this evidence or argument. PO Resp. 48–54. We agree with Petitioner. As discussed above, the stake-fastening process requires a protrusion of solidified plastic that cooperates with the accessory orifice in a way that causes the accessory to become mechanically fastened to the wall

⁶ Van Schaftingen contains only a single, unnumbered figure.

of the fuel tank. Ex. 1001, 7:32–35. Staargaard’s process results in a protrusion of plastic penetrating and flowing over the edge of an orifice in a metal part before hardening to hold the plastic and the metal part together. Ex. 1005 ¶¶ 9, 24–27, 33, Fig. 2. Accordingly, we find that the combination of Van Schaftingen and Staargaard teaches or suggests the preamble of claim 25.

In addition, Petitioner argues that a person of ordinary skill in the art would have had a reason to combine the teachings of Van Schaftingen with those of Staargaard. Pet. 55–58. There is evidence to support a reason to combine these references. Van Schaftingen teaches attaching accessories to the tank wall but does not describe any means for doing so other than welding. Ex. 1004 ¶ 34. Dr. Kazmer testifies that a person of ordinary skill in the art would have understood that welding is “only suitable when the two materials being welded have similar processing temperatures and are chemically compatible such that they flow and adhere to form a strong weld interface.” Ex. 1007 ¶ 163. According to Dr. Kazmer, “the weld interface will tend to be strongest when the accessory and fuel tank to be fastened are made of the same or similar materials.” *Id.* ¶ 164. Thus, a mechanical attachment process, such as that taught by Staargaard, would have provided a person of ordinary skill in the art with a means of attaching accessories made of a broader range of materials than would Van Schaftingen’s welding process. This would be useful in carrying out the fuel tank manufacturing process of Van Schaftingen because Van Schaftingen teaches using a wide variety of materials in constructing its fuel tank. Ex. 1004 ¶¶ 13–15.

With respect to the portion of the preamble requiring that the accessory be “stake-fastened to the inner wall of the fuel tank,” Petitioner

argues that Staargaard teaches or suggests stake-fastening metal components to plastic and that a person of ordinary skill in the art would have been motivated to use the method of Staargaard in stake-fastening Van Schaftingen's accessories inside Van Schaftingen's plastic fuel tank. Pet. 55–58 (citing Ex. 1005 ¶¶ 9, 24–27, 32, 33, Fig. 2; Ex. 1006 ¶¶ 99–107).

With respect to Staargaard teaching stake-fastening generally, Patent Owner argues that Staargaard does not teach fastening an accessory to a fuel tank or other hollow container. PO Resp. 49. As discussed above, the stake-fastening process of claim 25 must result in a protrusion of solidified plastic that cooperates with the accessory orifice in a way that causes the accessory to become mechanically fastened to the wall of the fuel tank. Ex. 1001, 7:32–35. Although Staargaard does not itself teach attaching an accessory to a fuel tank, it does teach a process that results in a protrusion of solidified plastic that cooperates with an orifice on a part in a way that causes the part to become mechanically fastened to the plastic. Ex. 1005 ¶¶ 9, 24–27, 32, 33, Fig. 2. Thus, Staargaard teaches a general stake-fastening method, albeit not one used in attaching an accessory to a fuel tank.

Petitioner argues that a person of ordinary skill in the art would have had a reason to combine Staargaard's teaching of general stake-fastening with Van Schaftingen's teaching of attaching an accessory inside a fuel tank. Pet. 55–58 (citing Ex. 1004 ¶ 13; Ex. 1006 ¶¶ 160–165). Specifically, Petitioner argues that using Staargaard's stake-fastening method to carry out Van Schaftingen's attachment of accessories to the inside wall of a fuel tank would allow for the use of accessories made from materials with melting points different from the material used to make the fuel tank. *Id.* There is

evidence to support this argument. Dr. Kazmer testifies that attaching accessories to the fuel tank mechanically rather than chemically would create a manufacturing advantage by allowing the use of accessories and fuel tanks made from different materials. Ex. 1006 ¶ 163. Staargaard teaches that its fastening method may be used “in any application where a plastic component is secured with a metal component,” suggesting the utility of its method in situations where the materials from which the two components are made are quite different. Ex. 1005 ¶ 33. And Van Schaftingen teaches making plastic fuel tanks from any of a wide variety of materials, including “[a]ny type of thermoplastic polymer or copolymer whose melting point is below the decomposition temperature,” which creates the possibility of requiring the attachment of an accessory made from a different material than the fuel tank. Ex. 1004 ¶ 13. Because a person of ordinary skill in the art would have known that mechanical attachment methods could be used with accessories made from different materials than the fuel tank, because Van Schaftingen teaches a wide variety of possible tank materials, and because Staargaard teaches attaching a component made from one material to a component made from a different material, a person of ordinary skill in the art would have been motivated to use Staargaard’s fastening method to attach Van Schaftingen’s accessories to Van Schaftingen’s fuel tank.

Patent Owner argues that, despite this evidence, a person of ordinary skill in the art would not have combined the teachings of Van Schaftingen with those of Staargaard. First, Patent Owner argues that Staargaard is not analogous art to the ’326 patent because Staargaard does not relate either to fuel tanks or hollow containers. PO Resp. 48–49 (citing Ex. 2005, 65:11–70:8). We are not persuaded by this argument. Contrary to Patent

Owner's argument, *id.* at 49, Staargaard is not limited to "the context of car front end modules." Instead, Staargaard teaches using its process "in any application where a plastic component is secured with a metal component." Ex. 1005 ¶ 33; see Ex. 1005 ¶¶ 9 (describing the invention as "a method of attaching a plastic component to a metal component"), 11 (clarifying that the "specific examples . . . are intended for purposes of illustration only and are not intended to limit the scope of the invention"). Moreover, even if Patent Owner is correct that the field of endeavor of the '326 patent is limited to either fuel tanks or hollow bodies, analogous art includes references that are "reasonably pertinent to the problem with which the inventor was concerned." *In re Kahn*, 441 F.3d 977, 986–87 (Fed. Cir. 2006) (citing *In re Oetiker*, 977 F.2d 1443, 1447 (Fed. Cir. 1992)). The object of the '326 patent is "to provide a method that allows an accessory based on a material different from that of the tank to be fastened inside a plastic fuel tank." Ex. 1001, 1:56–58. As a reference pertaining to "a method of attaching a plastic component to a metal component," Staargaard is concerned with very nearly the same problem as the '326 patent, and it certainly is pertinent to the problem solved by the '326 patent. Ex. 1005 ¶ 9. Thus, we find that Staargaard is analogous art to the '326 patent.

Patent Owner also argues that it would not "be apparent how to modify the tooling of Van Schaftingen to incorporate Staargaard's injection molding equipment." PO Resp. 49. But Staargaard is not limited to use in an injection molding process and may also be used in a blow molding process like that in Van Schaftingen.⁷ Ex. 1005 ¶ 32 (teaching that, although

⁷ Professor Osswald testifies that Staargaard's disclosure of "alternative forming techniques" such as "blow molding" relates only to "making

injection molding is preferred, “any other suitable forming technique may be use[d],” including “blow molding”). Moreover, “[c]ombining the teachings of references does not involve an ability to combine their specific structures.” *In re Nievelt*, 482 F.2d 965, 968 (CCPA 1973); *see also In re Keller*, 642 F.2d 413, 425–26 (CCPA 1981) (“The test for obviousness is not whether the features of a secondary reference may be bodily incorporated into the structure of the primary reference Rather, the test is what the combined teachings of the references would have suggested to those of ordinary skill in the art.”).

For these reasons, we find that a person of ordinary skill in the art would have had a reason to combine the teachings of Staargaard with those of Van Schaftingen and that the combination of those references teaches or suggests the preamble of claim 25.

(2) “*The wall of the fuel tank comprises an outer layer of thermoplastic polymer and a barrier layer of thermoplastic resin impermeable to fuel*”

Petitioner argues that Van Schaftingen teaches a fuel tank wall with an outer layer of thermoplastic polymer and a barrier layer of thermoplastic resin that is impermeable to fuel. Pet. 58–59 (citing Ex. 1006 ¶ 166).

Petitioner is correct. Van Schaftingen’s tank “has external layers made of high-density polyethylene and a central barrier layer made of ethylene vinyl alcohol copolymer (EVOH) surrounded by two layers of adhesive made of

part 10, not [to] attaching plastic component 14 to metal component 12.” Ex. 2001 ¶ 118. But Staargaard describes part 10 as made up of metal component 12 and plastic component 14. Ex. 1005 ¶¶ 18, 28. Accordingly, “making part 10” is the same as “attaching plastic component 14 to metal component 12.”

maleic-anhydride-grafted polyethylene.” Ex. 1004 ¶ 45. Patent Owner does not dispute Petitioner’s argument or evidence on this point, including whether HDPE and EVOH are a thermoplastic polymer and a thermoplastic resin, respectively. PO Resp. 48–54. Accordingly, the combination of Van Schaftingen and Staargaard teaches or suggests this limitation of claim 25.

(3) “At least one accessory or support for an accessory is in direct contact with part of the inner wall of the fuel tank”

Petitioner argues that Van Schaftingen teaches or suggests this limitation. Pet. 59 (citing Ex. 1006 ¶¶ 167–168). We agree, and Patent Owner does not dispute Petitioner’s argument or evidence on this point. PO Resp. 48–54. Van Schaftingen teaches a “preassembled structure” with “at least one device for anchoring this structure to the internal wall of the hollow body.” Ex. 1004 ¶ 34. Van Schaftingen also teaches that an accessory “is supported by [the] preassembled structure.” *Id.* ¶ 33. Accordingly, the combination of Van Schaftingen and Staargaard teaches or suggests this limitation of claim 25.

(4) “Said at least one accessory or support for an accessory having a wall portion which is equipped with at least one orifice which passes through the wall portion of the accessory or support for an accessory”

Petitioner argues that Staargaard teaches or suggests this limitation. Pet. 60 (citing Ex. 1005 ¶¶ 9, 24–27, Fig. 2; Ex. 1006 ¶¶ 169–172). We agree, and Patent Owner does not dispute Petitioner’s argument or evidence on this point. PO Resp. 48–54. Staargaard teaches attaching a metal component to plastic by providing a “lower opening” in the metal component through which some of the plastic can be forced. Ex. 1005 ¶ 24,

Fig. 2. Accordingly, the combination of Van Schaftingen and Staargaard teaches or suggests this limitation of claim 25.

(5) *“Said at least one orifice has a variation along a plane perpendicular to the wall of the accessory that is tailored to make it easier to force molten plastic through the orifice”*

Petitioner argues that Staargaard teaches or suggests this limitation. Pet. 61 (citing Ex. 1005, Fig. 2; Ex. 1006 ¶¶ 173–174). There is evidence to support this argument. Staargaard teaches an opening in which the edges of the opening “are preferably curved or bent upward, toward the interior of the metal component.” Ex. 1005 ¶ 24, Fig. 2. Dr. Kazmer testifies that a person of ordinary skill in the art would have known that an orifice shape like that in Staargaard would make it easier to force molten plastic to flow through the orifice. Ex. 1006 ¶ 173. Thus, when Staargaard’s stake-fastening method is used in attaching Van Schaftingen’s accessories to the inner wall of Van Schaftingen’s fuel tank, the diameter of the orifice varies along a plane perpendicular to the wall to which the accessory is being attached, and this variation makes it easier to force molten plastic through the orifice.

Patent Owner argues that Van Schaftingen and Staargaard cannot be combined because Van Schaftingen operates by pressing a component against the fuel tank wall and Staargaard does not press any component against a plastic preform. PO Resp. 50–51 (citing Ex. 2001 ¶¶ 120–126). As discussed above, however, we find that a person of ordinary skill in the art would have had a reason to incorporate Staargaard’s attachment process into Van Schaftingen’s fuel tank manufacturing process.

For these reasons, we find that the combination of Van Schaftingen and Staargaard teaches or suggests this limitation of claim 25.

(6) *“Said at least one orifice having had some of the thermoplastic polymer of the outer layer and some of the barrier layer of the fuel tank wall forced in the molten state into and through the at least one orifice to form at least one thermoplastic protrusion from the opposite end of said at least one orifice and solidified without becoming detached from the fuel tank wall and without rupturing the barrier layer of thermoplastic resin impermeable to fuel”*

Petitioner argues that the combination of Van Schaftingen and Staargaard teaches or suggests this limitation. Pet. 61–64. There is evidence to support this argument. Van Schaftingen teaches making its fuel tank from a multilayer laminate with a barrier layer. Ex. 1004 ¶ 45. Staargaard teaches pushing some plastic material through an orifice without becoming detached from the remainder of the plastic, and Staargaard teaches the plastic protruding from the other end of the orifice before solidifying. Ex. 1005 ¶¶ 26, 30, Fig. 2. Dr. Kazmer testifies that a person of ordinary skill in the art would have understood that Staargaard’s process could be used with Van Schaftingen’s multilayer plastic tank wall. Ex. 1006 ¶ 177. Dr. Kazmer also testifies that, because of the viscous flow of the plastic layers, Van Schaftingen’s multilayer structure would be preserved in the forcing of a portion of the tank wall through the orifice in the sub-tank. *Id.* Finally, Dr. Kazmer testifies that a person of ordinary skill in the art would have pursued such a process in order to “maintain the integrity and utility of the fuel tank.” *Id.*

Patent Owner argues that Staargaard fails to teach a barrier layer. PO Resp. 51–52 (citing Ex. 2001 ¶¶ 128–130). But Staargaard’s lack of a fuel

barrier layer is immaterial because Van Schaftingen teaches such a layer, and Petitioner relies on the combination of both references. Ex. 1004 ¶ 45.

For these reasons, we find that the combination of Van Schaftingen and Staargaard teaches or suggests this limitation of claim 25.

(7) *“The protrusion having been shaped to overhang the at least one orifice and stake-fasten the at least one accessory or support for an accessory to the fuel tank wall without rupturing the barrier layer of the protrusion and said protrusion holds the accessory in a non-removable mechanical connection to the inside wall of the multilayer plastic fuel tank”*

Petitioner argues that Staargaard teaches or suggests this limitation. Pet. 64–65. There is evidence to support this argument. Staargaard teaches plastic protruding through the orifice and overhanging it on the other side to create a flange that attaches the metal component to the plastic component. Ex. 1005 ¶ 31, Fig. 2. Dr. Kazmer testifies that this flange creates a non-removable mechanical connection between the two components. Ex. 1006 ¶¶ 180–181. Moreover, Staargaard teaches that the flange causes the plastic component to be “secured or locked to the metal component.” Ex. 1005 ¶ 26. As discussed above, this occurs without rupturing the fuel barrier layer.

Patent Owner argues that Petitioner fails to “describe how [a] rivet is created when using Van Schaftingen’s blow-molding equipment.” PO Resp. 52. But Petitioner’s argument is not that Van Schaftingen teaches forming a rivet. Instead, Petitioner argues that Staargaard’s teaching of a particular method of attaching one component to another would have been used with Van Schaftingen’s process of making a fuel tank with accessories

attached to the walls in order to create a new process in which a fuel tank would be made with accessories attached to the walls using Staargaard's attachment method.

Patent Owner also argues that, if Petitioner's argument is that "Staargaard's die/tooling structure would be incorporated in Van Schaftingen," Petitioner fails to "explain how this tooling would be removed from Van Schaftingen's tank after the rivet is created." PO Resp. 53 (citing Ex. 2001 ¶ 126). As noted above, however, "[c]ombining the teachings of references does not involve an ability to combine their specific structures." *Nievelt*, 482 F.2d at 968. Petitioner's obviousness argument does not rely on incorporating "Staargaard's die/tooling structure" into Van Schaftingen. Instead, as discussed above, a person of ordinary skill in the art would have understood from Van Schaftingen the benefits of attaching accessories generally and would have sought out a way to attach those accessories mechanically, finding such a method in Staargaard, then would have created a process that incorporated both teachings, not both structures. Moreover, to the extent that this new process required removing a structure from the tank, Van Schaftingen teaches doing so. Ex. 1004 ¶ 46 (teaching the use of a robot to place accessories in the tank).

For these reasons, we find that the combination of Van Schaftingen and Staargaard teaches or suggests this limitation of claim 25.

Because the combination of Van Schaftingen and Staargaard teaches all limitations of claim 25, and because a person of ordinary skill in the art would have had a reason to combine the teachings of Staargaard with the teachings of Van Schaftingen, we conclude that Petitioner has shown by a preponderance of the evidence that claim 25 would have been obvious to a

person of ordinary skill in the art over the combined teachings of Van Schaftingen and Staargaard.

b. Claim 33

Claim 33 depends from claim 25 and adds a limitation requiring “a support for an accessory equipped with at least one orifice which passes through the support for an accessory.” Ex. 1001, 10:10–12. Petitioner argues that the combination of Van Schaftingen and Staargaard teaches or suggests this limitation. Pet. 66–67. There is evidence to support this argument. First, Van Schaftingen teaches supporting an accessory with a “preassembled structure.” Ex. 1004 ¶ 34. Van Schaftingen teaches attaching this accessory support to the wall of the fuel tank. *Id.* ¶ 35. Although Van Schaftingen’s accessory is not equipped with an orifice, Staargaard teaches designing a component with an orifice so that the component can be attached to a plastic component. Ex. 1005 ¶ 24, Fig. 2. Because Van Schaftingen teaches attaching its preassembled structure to the tank wall, and because Staargaard teaches attaching one component to another by, in part, placing an orifice in the first component, the combination of the references suggests placing Staargaard’s orifice in Van Schaftingen’s preassembled structure.

Patent Owner argues that neither Van Schaftingen nor Staargaard individually discloses “any accessory equipped with a support having an orifice.” PO Resp. 54. But Petitioner does not rely on either reference individually to teach the additional limitation of claim 33. Instead, Petitioner argues that the combination of the two references suggests this limitation. As discussed above, the record developed at trial supports that argument. Patent Owner also argues that a person of ordinary skill in the art

would not have combined the teachings of Staargaard with those of Van Schaftingen. *Id.* But, as discussed above, we find that a person of ordinary skill in the art would have combined the teachings of these two references.

For these reasons, we conclude that Petitioner has shown by a preponderance of the evidence that claim 33 would have been obvious to a person of ordinary skill in the art over the combined teachings of Van Schaftingen and Staargaard.

CONCLUSION

Upon consideration of the Petition, Response, Reply, Sur-Reply, and the evidence before us, we determine that Petitioner has proven by a preponderance of the evidence that claims 25–27, 33, 34, and 44 would have been obvious either over Ishimaru alone or over the combination of Ishimaru and Staargaard. We also determine that Petitioner has not proven by a preponderance of the evidence that claims 1 and 13 would have been obvious over either of these grounds. Finally, we determine that Petitioner has proven by a preponderance of the evidence that claims 25 and 33 would have been obvious over the combination of Van Schaftingen and Staargaard.

ORDER

It is hereby

ORDERED that Petitioner has proven by a preponderance of the evidence that claims 25–27, 33, 34, and 44 of U.S. Patent No. 9,399,326 B2 are unpatentable;

FURTHER ORDERED that Petitioner has not proven by a preponderance of the evidence that claims 1 and 13 of U.S. Patent No. 9,399,326 B2 are unpatentable;

FURTHER ORDERED that, pursuant to 35 U.S.C. § 318(b), upon expiration of the time for appeal of this decision, or the termination of any such appeal, a certificate shall issue canceling claims 25–27, 33, 34, and 44 of U.S. Patent No. 9,399,326 B2 and confirming the patentability of claims 1 and 13 of U.S. Patent No. 9,399,326 B2; and

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.

IPR2017-01945
Patent 9,399,326 B2

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