

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

DELTA T, LLC,
Petitioner,

v.

MACROAIR TECHNOLOGIES, INC.,
Patent Owner.

IPR2021-01214
Patent 8,579,588 B1

Before HUBERT C. LORIN, TINA E. HULSE, and SCOTT C. MOORE,
Administrative Patent Judges.

HULSE, *Administrative Patent Judge.*

JUDGMENT
Final Written Decision
Determining All Challenged Claims Unpatentable
35 U.S.C. § 318(a)

I. INTRODUCTION

Delta T, LLC (“Petitioner”)¹ filed a Petition requesting an *inter partes* review of claim 15 of U.S. Patent No. 8,579,588 B1 (Ex. 1001, “the ’588 patent”), owned by MacroAir Technologies, Inc. (“Patent Owner”). Paper 2 (“Pet.”). After preliminary briefing on the Petition (Papers 6–8), we instituted an *inter partes* review of claim 15 of the ’588 patent. Paper 10 (“Dec. Inst.”), 26. Patent Owner then filed a Response to the Petition (Paper 13, “PO Resp.”), Petitioner filed a Reply (Paper 23, “Pet. Reply”), and Patent Owner filed a Sur-reply (Paper 30, “PO Sur-reply”).

An oral hearing was held on October 20, 2022, a transcript of which has been entered in the record. Paper 36 (“Tr.”).

We have authority under 35 U.S.C. § 6. We issue this Final Written Decision under 35 U.S.C. § 318(a) and 37 C.F.R. § 42.73. For the reasons that follow, we determine Petitioner has shown by a preponderance of the evidence that claim 15 of the ’588 patent is unpatentable as obvious.

A. *Real Parties-in-Interest*

Petitioner identifies itself as the real party-in-interest. Pet. 53. Patent Owner identifies itself as the real party-in-interest. Paper 5, 2.

B. *Related Proceeding*

The parties state that the ’588 patent has been asserted against Petitioner in a pending case before the U.S. District Court for the Central District of California: *Delta T LLC v. MacroAir Technologies, Inc.*, No. 5:20-cv-00728-GW (C.D. Cal.). Pet. 53; Paper 5 at 2.

¹ Because Petitioner’s trade name is Big Ass Fans, it is occasionally referred to in the papers as “BAF.”

C. The '588 Patent

The '588 patent relates to a hub assembly for large cooling fans. Ex. 1001, 1:14–15. Large industrial fans can have blades that exceed eight feet in length. *Id.* at 1:26–27. Given the size and weight of the fan blades, the mounting between the blades and the hub can be complicated, because the forces on the hub can be significant. *Id.* at 1:31–35. The Specification notes that in one prior art patent, the hub is formed of a casted metal component that is bolted to the fan blade at a plurality of different locations and is a single integrated unit. *Id.* at 1:44–47. With such a casted hub, however, “when a hub blade does break, the entire hub assembly has to be disassembled and replaced and then reassembled which increases the cost and time of repair.” *Id.* at 1:50–52.

The '588 patent explains that a need exists “for an improved fan assembly that is less expensive to manufacture, easier to repair and provides a better system for transmitting forces between the hub assembly and the fan blade.” *Id.* at 1:59–62. In addressing this need, the Specification states that “[b]y interconnecting the arm members to the hub in a detachable manner, it is easier and less expensive to replace hubs with broken or otherwise damaged arm members.” *Id.* at 2:15–17. Moreover, the Specification states that “the arm members and the fan blades are contoured so as to engage with each other along some or all of the length of the arm member so that the interactive force between the two can be distributed and not concentrated at the fasteners that secure the members together.” *Id.* at 2:18–22.

Figure 6, reproduced below, is an exploded view of the fan with blades.

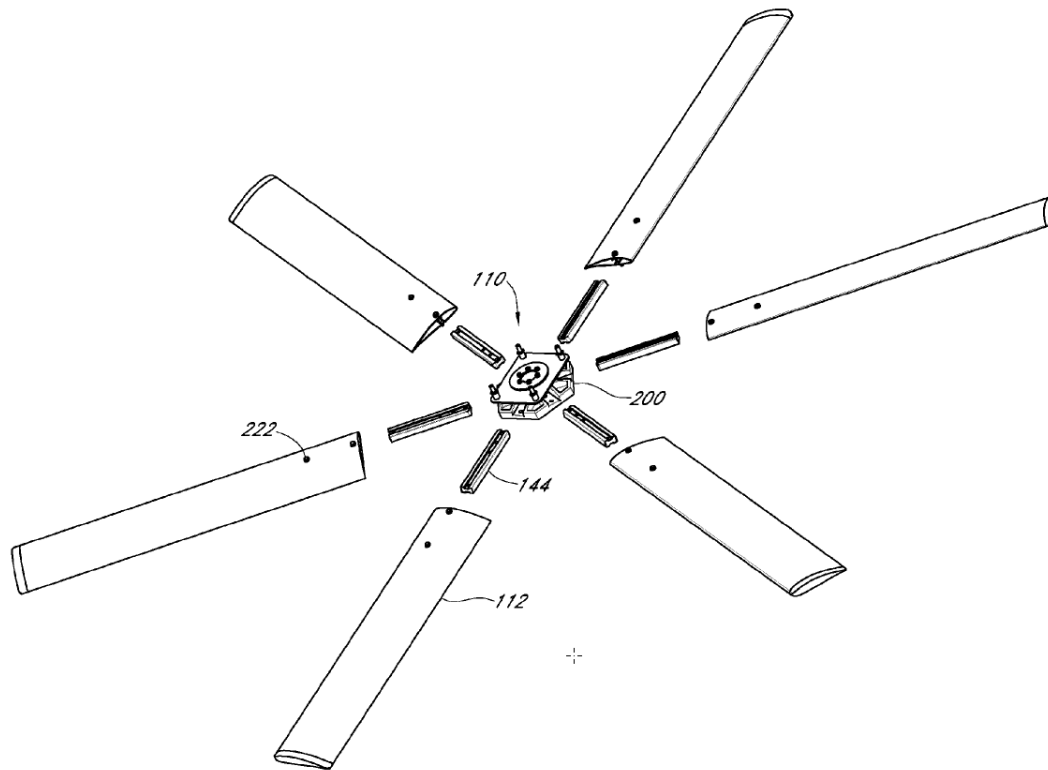


Figure 6 shows hub 110, including main portion 200, arms 144, blades 112, and securing holes 222. *Id.* at 5:3–33.

Figure 3A shows hub 110 in greater detail and is reproduced below in an exploded perspective view:

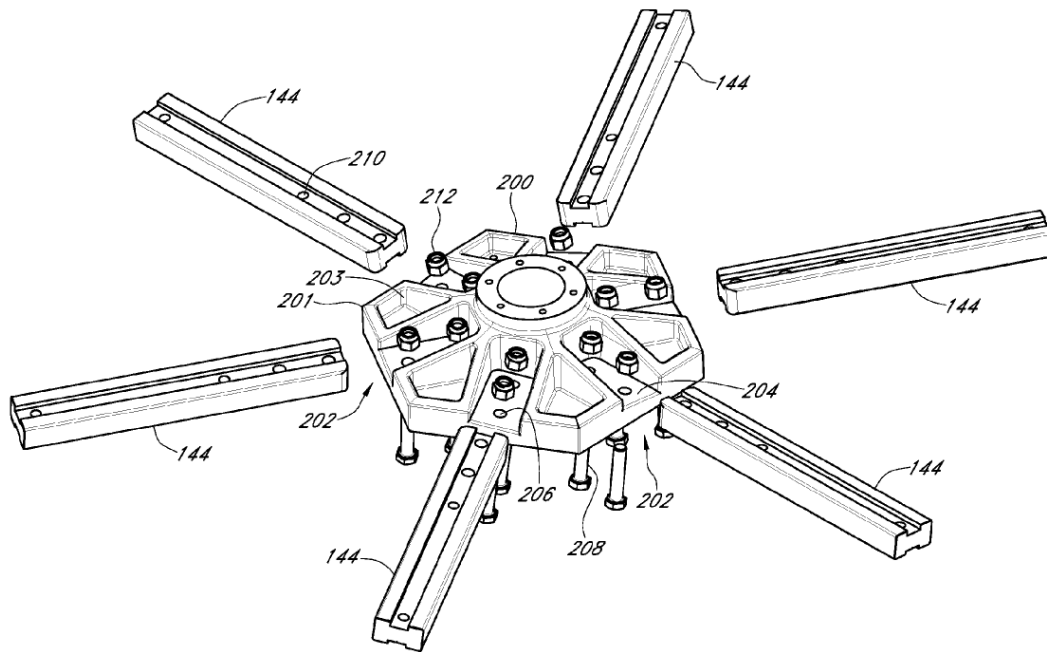


Figure 3A shows fan hub main portion 200 with slots 202 that receive arms 144. *Id.* at 4:24–26. The Specification states “arms 144 are bolted or otherwise fastened to the hub 110 which allows for easier replacement of the arms 144 should the arms become damaged.” *Id.* at 4:14–17. The arms engage the fan blades so that “force from the hub 110 is more uniformly transferred to the fan blade 112 along the length of the arm 144 thereby reducing pressure points or stress points on the arm 144 which reduces the likelihood of fatigue and failure of the arm 144 at the connection point.” *Id.* at 4:17–23.

D. Challenged Claim

Petitioner challenges only claim 15 of the '588 patent. Claim 15 recites:

15. A hub and blade assembly for a cooling fan having a motor, the hub assembly comprising:
- a hub member that defines openings wherein the hub member is engaged with the motor so as to be rotated by the motor,
 - a plurality of arm members that are positioned within the openings of the hub member so as to extend outward therefrom wherein the plurality of arm members is detachably secured in the openings;
 - a plurality of fan blades that are mounted to the arm members;
- wherein the plurality of arm members comprise a constant cross section along their length.

Ex. 1001, 6:66–7:11.

E. The Asserted Ground of Unpatentability

Petitioner asserts that claim 15 would have been unpatentable as obvious under 35 U.S.C. § 103(a)² over Madsen.³

² The Leahy-Smith America Invents Act (“AIA”), Pub. L. No. 112–29, 125 Stat. 284 (2011), amended 35 U.S.C. § 103, effective March 16, 2013. Because the application from which the '588 patent issued has an effective filing date before that date, the pre-AIA version of § 103(a) applies.

³ Madsen, US 2009/0123284 A1, published May 14, 2009 (“Madsen,” Ex. 1006). The Madsen application was filed on November 7, 2008 (Ex. 1006, (22)), which predates the earliest possible effective filing date of the '588 patent (Ex. 1001, (60)). Madsen is, therefore, prior art under 35 U.S.C. § 102(e). Petitioner argues that if Patent Owner attempts to antedate Madsen, Madsen is entitled to the filing date of its provisional application. Pet. 23–33. Because Patent Owner has not challenged the prior art status of Madsen in its Response, we need not address Petitioner’s priority argument in this Decision. *See generally* PO Resp.

Petitioner also relies on the Declarations of Dr. Anthony G. Sheard. Ex. 1002; Ex. 1024. Patent Owner relies on the Declarations of Dr. David C. Paulus. Ex. 2001; Ex. 2015.

II. ANALYSIS

A. Level of Ordinary Skill in the Art

In determining the level of ordinary skill in the art, we consider the type of problems encountered in the art, the prior art solutions to those problems, the rapidity with which innovations are made, the sophistication of the technology, and the educational level of active workers in the field. *Custom Accessories, Inc. v. Jeffrey-Allan Indus., Inc.*, 807 F.2d 955, 962 (Fed. Cir. 1986).

Petitioner asserts that a person of ordinary skill in the art at the time of the invention “would be someone with a working knowledge of mechanical devices including fans or other rotary devices such as turbines or components of HVAC systems.” Pet. 9. Petitioner also asserts the “person would have gained this knowledge through an undergraduate or graduate education in mechanical engineering or a related field, and at least two years of experience working in the design or manufacture of fans or other rotary machines,” and that “experience and education levels may vary between POSAs: a higher level of education or skill might make up for less experience, and vice versa.” *Id.* at 9–10 (citing Ex. 1002 ¶ 27).

Patent Owner asserts that an “individual of ordinary skill in the art would have been a person having a bachelor’s degree in the mechanical arts, including but not limited to mechanical engineering with at least two years of experience in the field.” PO Resp. 4.

We do not discern a substantive difference between the parties’ respective definitions of the level of ordinary skill in the art, nor do the

parties assert that there exists any such difference. Although Petitioner’s definition includes specific knowledge of fans or other rotary machines, we understand Patent Owner’s broader definition to include such knowledge. We, therefore, adopt Petitioner’s definition of the level of ordinary skill in the art as reasonable and consistent with the level of skill reflected in the prior art. *See Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001) (explaining the prior art itself may reflect an appropriate level of skill in the art).

We also find Drs. Sheard and Paulus are qualified to opine on the perspective and understanding of a person of ordinary skill in the art, as they have at least ordinary skill in the art. *See* Ex. 1002 ¶¶ 3–11; Ex. 1003; Ex. 2001 ¶¶ 4–11; Ex. 2002; *see also Kyocera Senco Indus. Tools Inc. v. Int’l Trade Comm’n*, 22 F. 4th 1369, 1376–77 (Fed. Cir. 2022) (“To offer expert testimony from the perspective of a skilled artisan in a patent case—like for claim construction, validity, or infringement—a witness must at least have ordinary skill in the art.”).

B. Claim Construction

1. Legal Standard

In an *inter partes* review, the Board applies the same claim construction standard that would be used to construe the claim in a civil action under 35 U.S.C. § 282(b). 37 C.F.R. § 100(b) (2021). Under that standard, claim terms “are generally given their ordinary and customary meaning” as understood by a person of ordinary skill in the art at the time of the invention. *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312–13 (Fed. Cir. 2005) (en banc). “In determining the meaning of the disputed claim limitation, we look principally to the intrinsic evidence of record, examining the claim language itself, the written description, and the prosecution

history, if in evidence.” *DePuy Spine, Inc. v. Medtronic Sofamor Danek, Inc.*, 469 F.3d 1005, 1014 (Fed. Cir. 2006) (citing *Phillips*, 415 F.3d at 1312–17). Extrinsic evidence is “less significant than the intrinsic record in determining ‘the legally operative meaning of claim language.’” *Phillips*, 415 F.3d at 1317 (internal citation omitted).

2. District Court Constructions

In the related district court proceeding, the district court construed certain claim terms of the ’588 patent. Ex. 1014. Petitioner proposes claim constructions that are consistent with the district court’s constructions. Pet. 10–17. Patent Owner states that it “adopts the district court’s claim constructions for the purposes of this Response.” PO Resp. 10 (citing Ex. 1014). The district court has construed the following ’588 patent claim terms:

Term	Construction
“hub assembly”	“a hub with multiple parts that are assembled together” (Ex. 1014, 13–14)
“openings”	“one or more locations where the arm members may be detachably secured” (Ex. 1014, 12–13)
“detachably secured”	“arm members are removable from the hub without damage to the hub” (Ex. 1014, 8–10)

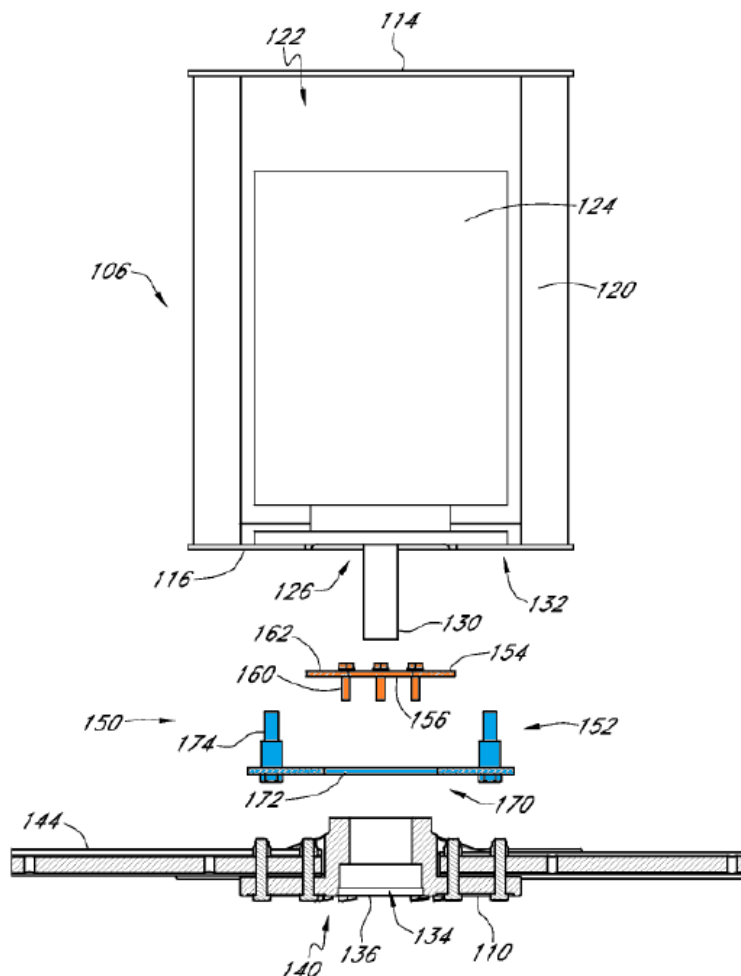
Because the parties agree to adopt the district court’s constructions, we adopt and apply those constructions in this Decision.

During trial, it became apparent that the parties dispute the meaning of two additional terms of claim 15: “secured” and “in the openings.” We discuss each term below.

3. “secured”

In its Response, Patent Owner asserts the term “secured” means “fixed or attached firmly so that it cannot be moved or lost.” PO Resp. 14. Moreover, Patent Owner asserts that being “secured” does not allow for rotation within the openings. *See id.* at 16 (stating if mounting blade of Madsen “were secured within the opening . . . the mounting blades could not then rotate within the openings”). In the Sur-reply, Patent Owner argues an express construction of “secured” is unnecessary because, “in the context of claim 15, the ordinary meaning of ‘secured’ is well understood to require the arm members to be firmly attached to the hub.” PO Sur-reply 10. During the hearing, Patent Owner also pointed to Figure 3A of the ’588 patent as support that the arm members must be “actually attached to the hub . . . so that it actually stays attached to the hub while it’s in operation.” Tr. 57:12–15.

Petitioner argues that Patent Owner’s construction is inconsistent with the agreed construction of the phrase “detachably secured” as meaning “arm members are removable from the hub without damage to the hub.” Pet. Reply 10–11. Nevertheless, Petitioner provides several dictionary definitions for “secure” (*see* Ex. 1029; Ex. 1030), and concludes that a person of ordinary skill in the art would understand “secured” to “encompass any connection in which an element is captured so as to not be likely to be lost or come loose.” *Id.* at 12 (citing Ex. 1024 ¶ 63). Petitioner also asserts that its proposed construction is consistent with the Specification and its disclosure of a “securing assembly.” *Id.* Petitioner annotates Figure 2A of the ’588 patent, which is reproduced below:



Pet. Reply 13 (reproducing Ex. 1001, Fig. 2A). Annotated Figure 2A depicts an exploded view of a fan having motor shaft 130, hub 110, and interface 150 between them, which receives securing assembly 152 comprised of first member 154 (shown in red) and second member 170 (shown in blue). Ex. 1001, 3:41–43.

According to Petitioner, the Specification teaches that the securing assembly “inhibits the hub from falling when the motor shaft breaks or the hub otherwise disengages from the shaft.” Pet. Reply 12 (quoting Ex. 1001, 3:41–45). Moreover, Petitioner asserts the securing assembly allows for at least some relative rotation because “securing assembly 152 prevents the hub from ‘falling away from the motor mount’ (i.e., prevents the hub from

becoming lost or coming loose), while engagement between the first member 154 and the second member 170 of the securing assembly allows for relative rotation between the hub 110 and the motor mount 106.” *Id.* at 13–14 (citing Ex. 1024 ¶ 67).

As an initial matter, we disagree with Petitioner that Patent Owner’s proposed construction for “secured” is inconsistent with the agreed-upon construction for “detachably secured.” Whether the arm members are removable from the hub without damage to the hub focuses on the meaning of the term “detachably” rather than “secured.” We, therefore, do not find it improper to seek construction of the term “secured,” particularly because its meaning is clearly in dispute and is relevant to our analysis. *See Homeland Housewares, LLC v. Whirlpool Corp.*, 865 F.3d 1372, 1375 (Fed. Cir. 2017) (stating that, like district courts, when parties raise an actual dispute regarding the proper scope of claims, “the Board also must resolve such disputes in the context of IPRs”) (citing *O2 Micro Int’l Ltd. v. Beyond Innovation Tech. Co.*, 521 F.3d 1351, 1360 (Fed. Cir. 2008)).

Moreover, we agree with Patent Owner that many of the dictionary definitions provided by Petitioner are irrelevant to the ’588 patent. For example, as one allegedly supporting definition of “secure,” Petitioner cites: “to put beyond hazard of losing or of not receiving,” as in to “*secure* the blessings of liberty.” Pet. Reply 12; Ex. 1030, 5. That definition, however, is identified as a “[l]egal [d]efinition of *secure*,” and is clearly not relevant to the hub assembly claimed in the ’588 patent. *See* Ex. 1030, 5. Similarly, the definition “free from risk of loss; safe,” as in “[h]er papers were secure in the vault,” is also inapplicable to the claimed invention. Pet. Reply 12; Ex. 1029, 1. These overly broad definitions of “secure” suffer from the long-recognized drawback of relying on general dictionaries for claim

construction. *See Phillips*, 415 F.3d at 1321 (“Indiscriminate reliance on definitions found in dictionaries can often produce absurd results.”) (quoting *Liebscher v. Boothroyd*, 258 F.2d 948, 951 (CCPA 1958)).

Rather than rely on the definitions of “secure” from a general dictionary, we focus on the Specification as the “single best guide to the meaning of a disputed term.” *Phillips*, 415 F.3d at 1315 (internal citation omitted). The Specification describes the use of nuts and bolts that can be used to fix or attach the arms into the slots of the hub. Ex. 1001, 4:47–51 (stating “nuts 212 can then be used to *secure* the arms 144 in the slots 202”) (emphasis added). But that is not the only use of “secure” in the Specification. As Petitioner notes, the Specification also describes a “*securing* assembly 152 that inhibits the hub from falling when the motor shaft breaks or the hub otherwise disengages from the shaft.” *Id.* at 3:42–45 (emphasis added). We also credit Dr. Sheard’s explanation of the operation of the ’588 patent’s securing assembly as allowing for rotational movement while preventing loss:

[T]he hub 110 of the ’588 Patent is “secured” to the motor mount 106 by way of the “securing assembly 152.” This securing assembly prevents the hub from “falling away from the motor mount” (i.e., prevents the hub from becoming lost or coming loose), but the relative engagement between the first member 154 and the second member 170 of the securing assembly continues to allow for relative rotation between the hub 110 and the motor mount 106. This relative rotation between the hub 110 and the motor mount 106 of the ’588 Patent is not only allowed, but is absolutely necessary if the hub is going to rotate so that the fan blades may turn.

Ex. 1024 ¶ 67.

Patent Owner argues that the securing assembly is irrelevant to the construction of “secured” because it does not refer specifically to the arm members being detachably secured in the openings. PO Sur-reply 13. We disagree. Claim terms must be read in light of the specification and must not import limitations from the specification into the claims. *Phillips*, 415 F.3d at 1323. Moreover, we presume the specification uses a word consistently throughout the patent, even if describing a different embodiment. *See Energy Transp. Grp., Inc. v. William Demant Holding A/S*, 697 F.3d 1342, 1349–50 (Fed. Cir. 2012) (relying on the specification’s use of the word “programmable” to describe a different embodiment to construe the same term in the claim, as “there is no reason to construe the term ‘programmable’ differently when used to describe [the embodiment of the claimed invention]”); *see also Phillips*, 415 F.3d at 1314 (noting “claim terms are normally used consistently throughout the patent”). Thus, we decline to limit the construction of “secured” to the preferred embodiment, as proposed by Patent Owner, and consider the Specification’s description of the “securing assembly” to inform the meaning of “secured” as encompassing rotational movement and preventing loss.

Accordingly, we construe the term “secured” to mean the arm members are “fixed or attached (while allowing for rotational movement) so that the arm members cannot be lost.”

4. “*in the openings*”

Although the parties agree to the constructions of the terms “detachably secured” and “openings,” the parties dispute the definition of the phrase “detachably secured *in the openings*.” Specifically, the parties dispute whether the point of attachment where the arm members are secured must be in the openings, as Patent Owner asserts (*see* PO Resp. 17), or if

that point of attachment can be outside of the openings as long as the arm member is “in the openings,” as Petitioner asserts (*see* Pet. Reply 15–16).

As support, both parties cite the claim limitation “a plurality of arm members that are positioned within the openings of the hub member so as to extend outward therefrom wherein the plurality of arm members is detachably secured in the openings.” Petitioner asserts this limitation demonstrates that “the arm members are positioned in the openings and are detachably secured in that position in the opening.” Tr. at 71:8–9. According to Petitioner, Patent Owner could have expressly claimed the fasteners are located in the openings if that was the intent, but it did not. *Id.* at 73:18–20.

Patent Owner, on the other hand, argues that this claim phrase has two limitations: “one of them has to do with position within the openings and another that has to do with secured within the openings shows that it’s the securing itself that is within the openings.” *Id.* at 81:1–5. Patent Owner also points to Figure 3A of the ’588 patent, noting that the arm members slide into the slots in the hub member, and the arm members are secured in the slots using nuts and bolts. *Id.* at 81:5–10.

Having considered the parties’ respective arguments and evidence, we find Patent Owner’s construction improperly imports limitations from the Specification into the claim. Although the preferred embodiment shown in Figure 3A has the points of attachment in the slots of the hub, nothing in the Specification suggests that the arm members must be attached to the hub in those locations. *See Liebel-Flarsheim Co. v. Medrad, Inc.*, 358 F.3d 898, 906 (“Even when the specification describes only a single embodiment, the claims of the patent will not be read restrictively unless the patentee has demonstrated a clear intention to limit the claim scope using words or

expressions of manifest exclusion or restriction.”) (internal quotations omitted).

We also note that dependent claim 18 expressly claims the preferred embodiment, reciting “wherein the arm members are coupled to the bottom surface [of the openings] by a plurality of fasteners that extend through the bottom surface and the arm members.” *See* Ex. 1001, 7:22–24 (claim 18). Thus, because claim 18 depends indirectly from claim 15, claim 15 is presumed not to include that limitation. *See Phillips*, 415 F.3d at 1315 (“[T]he presence of a dependent claim that adds a particular limitation gives rise to a presumption that the limitation in question is not present in the independent claim.”).

We find the Federal Circuit’s decision in *Energy Transportation Group v. William Demant Holding A/S*, 697 F.3d 1342 (Fed. Cir. 2012), to be instructive. There, the claims related to hearing aids and recited a “programmable filter” to reduce acoustic feedback. *Id.* at 1348–49. The district court construed the term “programmed” broadly to mean “provided with one or more values so as to produce a response.” *Id.* at 1348–49. The defendants, however, argued the district court erred by not limiting “programmed” to require that the values in the claimed invention are “externally calculated.” *Id.* at 1349. The Federal Circuit rejected the defendants’ argument, stating, “Nothing in the [patent] claims indicates the plain and ordinary meaning of ‘programmed’ should be limited to external or fixed programming. The claims do not specify where the programming occurs, how frequently it occurs, or what structure provides the programming.” *Id.* Moreover, the court held that “the specification gives no reason to construe the claims to require that an external computer calculate

the values programmed into the filter.” *Id.* As such, the Federal Circuit affirmed the district court’s construction.

Similarly, here, claim 15 does not specify where the point of attachment for securing the arm members should occur or what structure provides that securing. Moreover, nothing in the Specification compels us to construe the claims to require that the point of attachment of the arm members must be in the openings of the hub.

Accordingly, having considered the parties’ respective arguments and evidence, we determine “wherein the plurality of arm members is detachably secured in the openings” refers to the arm members being detachably secured in the opening, and not that the point of attachment for detachably securing the arm members must be in the opening.

We find we do not need to construe any other terms for purposes of our Decision. *See Wellman, Inc. v. Eastman Chem. Co.*, 642 F.3d 1355, 1361 (Fed. Cir. 2011) (“[C]laim terms need only be construed ‘to the extent necessary to resolve the controversy.’” (quoting *Vivid Techs., Inc. v. Am. Sci. & Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999))).

C. Principles of Law

To prevail in this *inter partes* review of the challenged claim, Petitioner must prove unpatentability by a preponderance of the evidence. 35 U.S.C. § 316(e); 37 C.F.R. § 42.1(d). “In an [*inter partes* review], the petitioner has the burden from the onset to show with particularity why the patent it challenges is unpatentable.” *Harmonic Inc. v. Avid Tech., Inc.*, 815 F.3d 1356, 1363 (Fed. Cir. 2016) (citing 35 U.S.C. § 312(a)(3) (2012) (requiring *inter partes* review petitions to identify “with particularity . . . the evidence that supports the grounds for the challenge to each claim”)). This burden of persuasion never shifts to the patent owner. *See Dynamic*

Drinkware, LLC v. Nat'l Graphics, Inc., 800 F.3d 1375, 1378 (Fed. Cir. 2015) (discussing the burden of proof in *inter partes* review).

A claim is unpatentable under 35 U.S.C. § 103(a) if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which that subject matter pertains. *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). The question of obviousness is resolved on the basis of underlying factual determinations including: (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of ordinary skill in the art; and (4) objective evidence of nonobviousness when presented.⁴ *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).

In analyzing the obviousness of a combination of prior art elements, it can be important to identify a reason that would have prompted one of skill in the art “to combine . . . known elements in the fashion claimed by the patent at issue.” *KSR*, 550 U.S. at 418. A precise teaching directed to the specific subject matter of a challenged claim is not necessary to establish obviousness. *Id.* Rather, “any need or problem known in the field of endeavor at the time of invention and addressed by the patent can provide a reason for combining the elements in the manner claimed.” *Id.* at 420. Accordingly, Petitioner must show that “a skilled artisan would have been motivated to combine the teachings of the prior art references to achieve the claimed invention, and that the skilled artisan would have had a reasonable

⁴ We note that objective evidence of nonobviousness has not been presented in this proceeding and, therefore, does not factor into the analysis of this Decision.

expectation of success in doing so.” *In re Magnum Oil Tools Int’l, Ltd.*, 829 F.3d 1364, 1381 (Fed. Cir. 2016) (internal quotations and citations omitted).

We now analyze the instituted ground of unpatentability in accordance with these principles.

D. Alleged Obviousness over Madsen

Petitioner asserts that claim 15 is unpatentable as obvious over Madsen. Pet. 34–51. Patent Owner opposes Petitioner’s assertion. PO Resp. 10–23. Having considered the arguments and evidence presented at trial, we determine that Petitioner has shown by a preponderance of the evidence that the challenged claim is unpatentable as obvious over Madsen.

1. Madsen (Ex. 1006)

Madsen “relates generally to rotary fans with elongated blades configured to move large volumes of air at low rotational speeds.” Ex. 1006 ¶ 4. Madsen describes advantages of “varying the blade angle to allow startup with a zero or very small angle, and increasing the blade angle automatically once the fan is rotating.” *Id.* ¶ 13. Madsen also describes advantages of providing bidirectional airflow using “positive and negative blade angles.” *Id.* ¶¶ 13–14. Madsen’s fan thus “provides improved air circulation and thermal control in a building by incorporating fan blades of a more versatile shape, and by providing the ability to vary the blade angles as well as rotational speed.” *Id.* ¶ 19.

In Madsen, “[e]ach fan blade terminates at the base of the blade with a tubular socket by which the blade is affixed to a rotatable shaft terminated by an offset crank arm ending in a crank pin,” where the “rotatable shaft is captured in a hollow hub that holds and radially positions the fan blades.” *Id.* ¶ 20. Figure 3 of Madsen, reproduced below, shows a side view of a fan assembly:

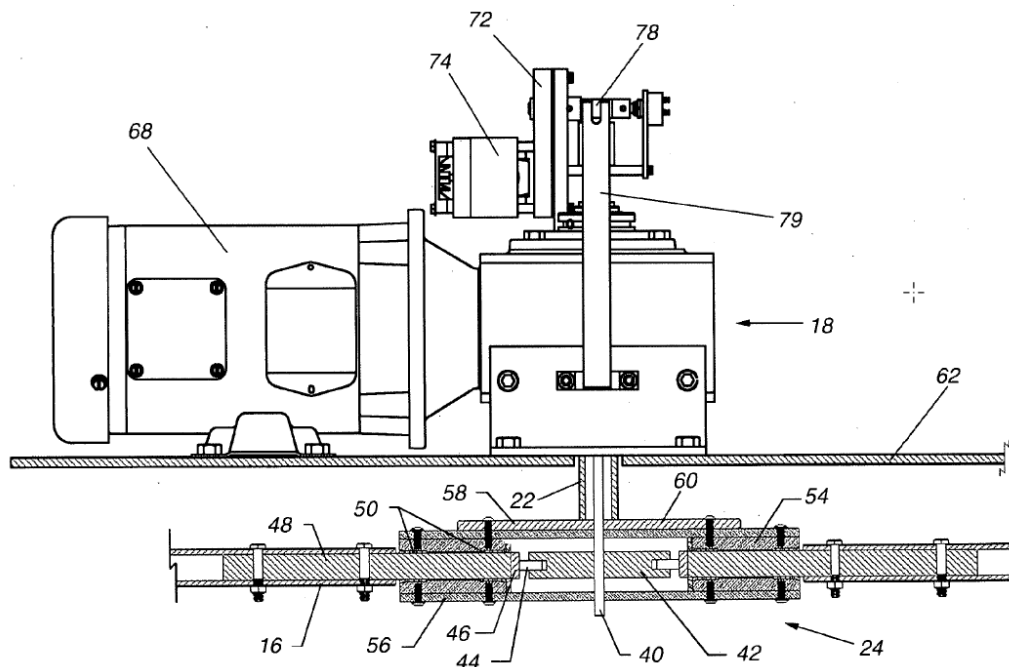


Figure 3 shows drive motor 68, drive assembly 18, drive shaft 22, and hub assembly 24. *Id.* ¶¶ 46–47. Figure 3 also shows the parts of the hub assembly that permit rotation of the fan blades to enable positive or negative airflow. The parts include fan blade 16, fan blade mounting shaft 48, bearings 50, bearing housing 54, top and bottom hub plates 58 and 56, pitch control rod 40, grooved disk 42, crank arm 46, and crank pin 44. *Id.* ¶ 48.

A top view of Madsen's hub assembly is shown in Figure 5, reproduced below:

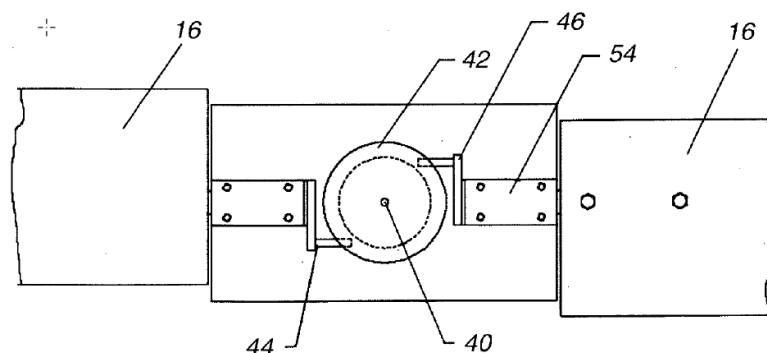


Figure 5 shows fan blade 16, bearing housing 54, pitch control rod 40, grooved disk 42, crank pin 44, and crank arm 46. *Id.* ¶ 48.

Madsen teaches that the fan blades may have their pitch changed by moving pitch control rod 40 up or down, which raises or lowers disk 42, thereby raising or lowering crank pins 44. *Id.* ¶¶ 49–50. This twists fan blade 16 via fan blade mounting shaft 48 and crank arm 46. *Id.*

Hub assembly 24 “encloses the fan blade mounting shafts 48.” *Id.* ¶ 50. Specifically, “[f]an blade mounting shaft 48 is captured by bearings 50 that are contained in bearing housing 54. Bearing housing 54 is held in place by the top and bottom hub plates 56 and 58 respectively.” *Id.* ¶ 48.

2. Analysis

Petitioner and its expert provide a detailed analysis explaining how Madsen teaches or suggests each limitation of claim 15. Pet. 34–51; Ex. 1002 ¶¶ 110–163. We have considered the evidence and argument presented and find that Madsen teaches each limitation of claim 15.⁵ For example, for the “hub member” limitation, Madsen teaches hub 24 with openings defined by bearing housings 54 alone, or in combination with top and bottom hub plates 56 and 58. *Id.* ¶ 48, Fig. 3, Fig. 5; *see also* Ex. 1002 ¶¶ 134–135. Madsen also teaches that the hub member’s tubular shaft 22 is driven by hollow shaft direct drive assembly 18, which is driven by drive motor 68. Ex. 1006, Fig. 3, ¶ 48; *see also* Ex. 1002 ¶ 136. We also find Madsen teaches “a plurality of arm members that are positioned within the openings of the hub member so as to extend outward therefrom” and “a plurality of fan blades that are mounted to the arm members” in teaching a plurality of blades 16 attached to fan blade mounting shafts 48 that are positioned within the openings of bearing housings 54, and extend outward

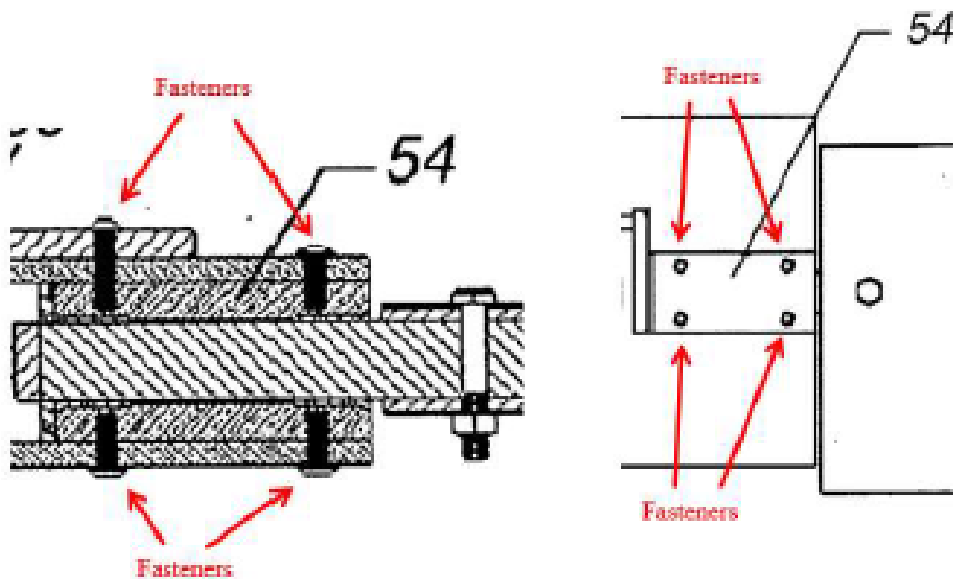
⁵ Because neither party asserts the preamble is limiting, we need not address the preamble of claim 15 for purposes of our Decision.

from the hub member. Ex. 1006, Fig. 2, Fig. 3, Fig. 5, ¶¶ 42, 48; *see also* Ex. 1002 ¶¶ 138–142, 153. Patent Owner does not dispute Madsen’s teachings of these limitations of claim 15. *See generally* PO Resp.

Rather, Patent Owner argues that Madsen does not teach or suggest that the “plurality of arm members is detachably secured in the openings” or that the “plurality of arm members comprise a constant cross section along their length.” PO Resp. 10–23. We address each of these arguments below.

a) *“the plurality of arm members is detachably secured in the openings in the openings”*

Petitioner argues that Madsen “implicitly discloses” arm members that are detachably secured in the openings. Petitioner notes that Figures 3 and 5 show that bearing housings 54 include a plurality of unlabeled fastening devices. Pet. 39–40. Petitioner’s annotated Figures 3 and 5 are reproduced below:



Pet. 41. Petitioner’s annotated Figures 3 and 5 include arrows that point to the unlabeled fastening devices. Madsen states “hub assembly 24 comprises the bottom hub plate 56, the top hub plate 58, the bearings 50, the bearing

housings 54, the driving flange 60 and all associated fasteners.” Ex. 1006 ¶ 50. According to Petitioner’s expert, Dr. Sheard, a person of ordinary skill in the art would understand the term “fasteners” to be “hardware that mechanically joins or affixes two or more objects together,” and that “[t]hese fasteners, as understood by the POSA are used to create non-permanent joints, such as joints that may be removed or dismantled without damaging the joined components.” Ex. 1002 ¶ 141.

Alternatively, to the extent Madsen does not explicitly teach the limitation, Petitioner and its expert assert that a person of ordinary skill in the art would have modified Madsen to include detachably secured mounting shafts because it was known that bearings are subject to wear and may need repair, replacement, or maintenance and that using removable fasteners would have prevented damage to the hub. Pet. 42; Ex. 1002 ¶¶ 143–146. Petitioner also asserts that a person of ordinary skill in the art would have known that modifying Madsen’s mounting shafts to be detachably secure “would allow for interchangeability of parts with the same hub, such as different sized fan blades” and would be “more economical to design detachable mounting shafts” so a single-sized hub could be used with different-sized mounting shafts. Pet. 43; Ex. 1002 ¶¶ 147–150.

Accordingly, Petitioner asserts a person of ordinary skill in the art would have had a reason to modify Madsen to use detachably secured mounting shafts “because it was an alternative attachment structure that was well known in the art and would have yielded a well-known and predictable result.” Pet. 43 (citing Ex. 1002 ¶ 151).

In response, Patent Owner notes that the construction of “detachably secured” means that “arm members are removable from the hub without damage to the hub.” PO Resp. 10. Patent Owner argues that removing

Madsen's arm members would require substantial disassembly and rebuilding of the hub assembly that would be considered "damage" to the hub. *Id.* at 11–12. Specifically, Patent Owner argues that to detach the fan blade mounting shaft, "a user would have to remove the driving flange 60, the top plate 58, the bottom plate 56, the bearing housing 54 and bearings 50, and disconnect it from the crank pin 44." *Id.* at 11. Moreover, asserts Patent Owner, a person of ordinary skill in the art would take an easier approach and replace the fan blade by removing the nuts and bolts from blade fastener holes 38, as seen in Figure 8. *Id.* at 12. Figure 8, as annotated by Patent Owner, is reproduced below:

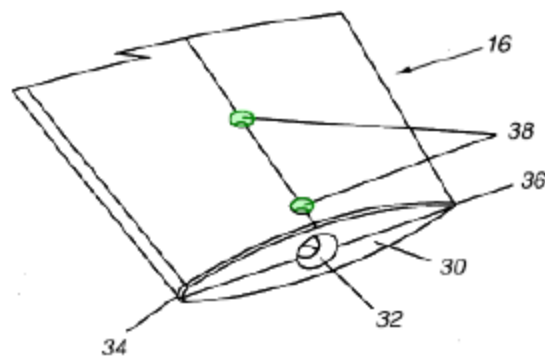


Fig. 8

PO Resp. 13. Annotated Figure 8 illustrates the base of the fan blade and shows blade fastener holes 38 in green that are used to fasten blade 16 to fan blade mounting shaft 48. Ex. 1006 ¶ 51.

Patent Owner also argues that because "secured" means "fixed or attached firmly so it that it cannot be moved or lost," Madsen would not work for its intended purpose if the mounting blade were secured within the opening, because the blades could not rotate within the openings to change the pitch angle of the blades. PO Resp. 16 (citing Ex. 1007 ¶ 17). Instead, argues Patent Owner, a person of ordinary skill in the art would understand the fan blade mounting shaft is secured to crank arm 46, which is not "in the

openings,” as required by the claim. *Id.* at 17. Without the crank arm, the fan blade mounting shaft would slip out of the fan when the fan rotates due to the centrifugal forces. *Id.* at 18.

Having considered the parties’ respective arguments and evidence presented at trial, we find Petitioner has the better position. We are persuaded that a person of ordinary skill in the art, seeing the unlabeled fasteners identified by Petitioner, would have found it obvious to use removable fasteners such as screws or bolts to detachably secure the mounting shafts in the openings formed by the bearing housings. *See* Ex. 1006, Figs. 3 and 5 (reproduced and annotated at Pet. 41).

We credit the testimony of Dr. Sheard that a person of ordinary skill in the art would have been motivated to make the fan blade mounting shaft of Madsen detachably secured in the openings of the hub to “allow for the replacement of worn or broken parts, or for replacement of parts according to an ordinary course of maintenance.” Ex. 1002 ¶ 119. Dr. Sheard explains that the bearings of Madsen facilitate the rotation of the fan blade mounting arms within the bearing housing and are subject to wear and tear by the nature of the friction to which they are exposed during normal use. *Id.* ¶ 120. Thus, we are persuaded that a person of ordinary skill in the art would understand that the bearings of Madsen may need to be repaired, replaced, or maintained over time, which would require a user to access the inside of the bearing housing. *Id.* According to Dr. Sheard, “the [person of ordinary skill in the art’s] general knowledge of the need to repair, replace, or maintain fan parts such as bearings would motivate the [ordinary artisan] to combine this knowledge with Madsen in order to make the bearing housing 54 detachable from the hub.” *Id.* Moreover, as Dr. Sheard further explains, we find that the ordinary artisan “would be motivated to make the

unlabeled fasteners illustrated in Figure 3 of Madsen . . . to be removable fasteners (e.g. screws, bolts, or other threaded fasteners). This use of removable fasteners provides a well known and easy manner for the user to access these parts in need of replacement.” *Id.* Dr. Sheard opines that because fans of different sizes may require blades of different lengths and fan blade mounting shafts of different designs, a person of ordinary skill in the art would have been motivated to make a single hub that accommodates different mounting shafts and blade lengths using a detachably secured mounting shaft. *Id.* ¶ 123. In doing so, manufacturers could avoid the cost of making multiple different hubs for different sized mounting shafts and would allow the end user the advantage of choosing different blades lengths and types for a given hub. *Id.* Thus, we are persuaded that these known problems in the art would have motivated a person of ordinary skill to modify Madsen to use a detachably secured mounting shaft. *See ABT Sys., LLC v. Emerson Elec. Co.*, 797 F.3d 1350, 1360 (Fed. Cir. 2015) (“It is well settled that, even where references do not explicitly convey a motivation to combine, any need or problem known in the field of endeavor at the time of invention and addressed by the patent can provide a reason for combining the elements in the manner claimed.”) (internal quotations and citation omitted).

Finally, we find a preponderance of the evidence supports Petitioner’s assertion that because detachably secured connections between an intermediate arm member and hub were well known to a person of ordinary skill in the art, it would have been obvious to combine those known connections with the design of Madsen “as an art equivalent type of connection, yielding the predictable result of restraining movement of the intermediate arm member with respect to the hub.” *Id.* ¶ 124; *see also KSR*,

550 U.S. at 416 (“The combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results.”).

We are not persuaded by Patent Owner’s arguments in response. First, Patent Owner asserts that Petitioner’s unpatentability theory is new. PO Sur-reply 2. Specifically, Patent Owner asserts the Petition argued that simply removing the fasteners would release the mounting shaft from the bearings and did not assert that removing the bearing housing would also be required to detach the mounting shaft. *Id.* Although we agree with Patent Owner that the Petition did not explicitly state that the bearing housing must also be removed to detach the mounting shaft from the hub, we disagree that it is an improper new argument in the Reply. The Petition asserted that a person of ordinary skill in the art would have understood that the bearing housings are held in place by the removable fasteners, and that “the removal of these fasteners would result in the fan blade mounting shafts 48 no longer being ‘captured’ in the openings therein.” Pet. 41–42. Patent Owner clearly understood what Petitioner was arguing, as Patent Owner asserted that to remove the mounting shaft from the hub after removing the fasteners, “a user would have to remove the driving flange 60, the top plate 58, the bottom plate 56, *the bearing housing* 54 and bearings 50, and disconnect it from the crank pin 44.” PO Resp. 11 (emphasis added). Thus, Patent Owner acknowledged that, under Petitioner’s theory set forth in the Petition, at least the bearing housing would have to be removed to remove the mounting shaft once the fasteners were loosened or removed. Given Patent Owner’s understanding of the Petition is consistent with Petitioner’s argument, we find Petitioner’s argument in the Reply is a proper clarification of the argument made in the Petition and not an improper new

theory of unpatentability. *See Genzyme Therapeutic Prod. Ltd. P'ship v. Biomarin Pharm. Inc.*, 825 F.3d 1360, 1366 (Fed. Cir. 2016) (noting “the introduction of new evidence in the course of the trial is to be expected in *inter partes* review trial proceedings”).

We are also not persuaded by Patent Owner’s argument that Petitioner’s theory requires such substantial disassembly that it amounts to “damage to the hub,” according to the construction of “detachably secured.” Patent Owner essentially seeks a construction of a construction; that is, the parties dispute what constitutes “damage to the hub.” Patent Owner argues that, at the very least, removing Madsen’s mounting shaft requires removing the bearing housing from the hub. PO Sur-reply 5. Patent Owner reasons that because the bearing housing is an essential part of the hub, the hub could not function properly without the bearing housing and is therefore damaged when the bearing housing is removed. *Id.* at 6. We find this argument misinterprets Petitioner’s theory. To detachably secure the arm member, the fan does not need to function while the arm is detached. We agree with Petitioner’s expert, Dr. Sheard, that “[w]hether or not a hub assembly is ‘considered operable’ *once the arm member has been detached* has no bearing on the construction or interpretation of the term ‘detachably secured.’ Rather, the phrase ‘detachably secured’ relates to the effect of removal on the hub itself during the act of detachment.” *See* Ex. 1024 ¶ 73. Dr. Sheard further explains, “[i]f the hub is damaged in the detachment, then the element is *not* detachably secured. If the hub is not damaged in the detachment, then the element *is* detachably secured.” *Id.*

We find the district court’s claim construction order to shed light on the meaning of “damage.” The district court noted, “[i]n describing previous systems that the [Patent Owner’s] Patents-in-Suit supposedly improve upon,

the patents state, ‘when a hub blade does break, the entire hub assembly has to be disassembled and replaced and then reassembled which increases the cost and time of repair.’” Ex. 1014, 11⁶ (quoting Ex. 1001, 1:49–52).

Moreover, Patent Owner admitted, “the primary purpose of making the arms ‘detachably removable’ is to replace damaged arm members *without having to replace the entire hub/arm assembly*.” *Id.* (emphasis added). The district court then concluded, “[t]hus, the hub itself cannot be damaged when the arm members are detached *or else the entire hub assembly would have to be disassembled and replaced*.” *Id.* (emphasis added). Given the district court’s explanation, we interpret “damage to the hub” to mean that the hub is damaged in such a way that it must be replaced. We find that interpretation to be the most consistent with the ’588 patent Specification and Patent Owner’s statements during the district court proceeding.⁷

Patent Owner also argues that, given the drastic disassembly required, a person of ordinary skill in the art would have taken an easier approach just to replace a damaged blade. PO Resp. 11–12. We note that Petitioner’s reasons to modify Madsen are not limited to replacing damaged blades. Rather, Petitioner also asserts, for example, that it would have been obvious to detachably secure the mounting shaft to use different sized mounting shafts and to replace worn bearings in the bearing housing, both of which require removing the mounting shaft from the bearing housing opening. *See*

⁶ Unless stated otherwise, we cite the page numbers of the exhibit rather than the page number of the document.

⁷ Patent Owner also argues that Petitioner fails to explain how a person of ordinary skill in the art could modify Madsen to remove the mounting shafts without removing the bearing housings because doing so damages the hub. PO Sur-reply 9–10. Because we reject the argument that removing the bearing housings damages the hub, this argument fails, as well.

Pet. 42 (citing Ex. 1002 ¶¶ 144–146); *see also* Pet. Reply 20 (citing Ex. 1002 ¶¶ 149–150). Thus, we are not persuaded by Patent Owner’s teaching away argument.

Finally, Patent Owner argues that because “secured” means “fixed or attached firmly so that it cannot be moved or lost,” Madsen’s intended purpose of changing the pitch angle of the cooling fan blades could not work because the mounting shaft could not rotate within the openings if they were secured with the unlabeled fasteners identified by Petitioner. PO Resp. 16. Alternatively, Patent Owner argues that a person of ordinary skill in the art would understand the mounting shaft to be secured by the crank arm, which is not within the opening of the bearing housing. *Id.* at 17.

We disagree with both arguments. As explained above, we construe the term “secured” to mean “fixed or attached so that it cannot be lost.” *See supra* Section II.B.3. We note that our construction does not preclude the arm member from rotating, as long as it is attached so that it cannot be lost. We find Madsen’s mounting shaft is secured, because it is contained within the opening of the bearing house and attached to the crank arm, which is engaged with the groove of disk 42. The parties agree that engagement with the disk prevents the mounting shaft from moving radially outward and being lost while the fan spins. *See* Ex. 1006, Figs. 3 and 5; Ex. 1024 ¶ 59; Ex. 2020, 27:19–28:13 (Petitioner), 60:25–61:1 (Patent Owner stating “there’s no real evidentiary dispute. There’s no dispute among the experts as to what secures the mounting shaft to the hub and it’s the crank arm”). Thus, we find Madsen’s mounting shaft is “secured,” within the meaning of the claim.

The final issue is whether Madsen’s mounting shaft is “detachably secured in the openings.” As explained above, we construe this claim phrase

as referring to the arm members being detachably secured in the opening, and not that the mechanism for detachably securing the arm member (i.e., the crank arm and pin) must be in the opening. *See supra* Section II.B.4. There is no dispute that the mounting shaft is in the opening of the bearing housing and is detachably secured in that opening, even if the crank arm is outside of that opening. *See* Ex. 1006, Figs. 3 and 5. Thus, we find that Madsen's mounting shaft satisfies this limitation.

Accordingly, having considered the arguments and evidence presented at trial, we find Petitioner has shown by a preponderance of the evidence that a person of ordinary skill in the art would have found it obvious to modify Madsen to detachably secure the arm members in the openings of the hub member.

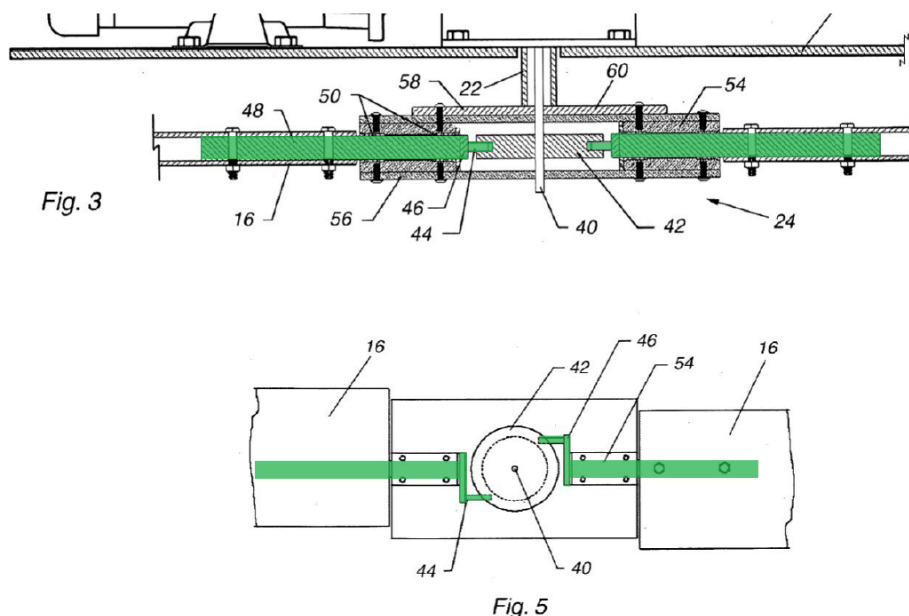
b) *“wherein the plurality of arm members comprise a constant cross section along their length”*

Petitioner asserts that Madsen teaches “wherein the plurality of arm members comprise a constant cross section along their length” or renders it obvious. Pet. 45–51 (citing Ex. 1002 ¶¶ 154–159). Petitioner reasons that for the fan blade mounting shaft to be able to rotate within the bearings to alter the pitch of the blades, the fan blade mounting shafts must be cylindrical in shape. Moreover, according to Petitioner, the cylindrical shaft is received by a cylindrical crimp tube and the figures would suggest to a person of ordinary skill that the circular cross-section would be constant along the entire length of the mounting shaft. Pet. 48–50 (citing Ex. 1002 ¶¶ 157–159).

Alternatively, Petitioner argues a person of ordinary skill in the art would have been motivated to design the mounting shafts to have a constant cross-section along their length, because it was well known that bearings are

generally round. As such, building cylindrical shafts with a constant cross-section would have been obvious, because it was “one of the easiest, cheapest, and most widely used ways of forming a shaft, absent a reason to alter the cross-section along the length of the shaft.” Pet. 50 (citing Ex. 1002 ¶ 160).

In response, Patent Owner argues that a person of ordinary skill in the art would have understood the “arm members” of Madsen to “consist of crank pin 44, crank arm 46 and fan blade mounting shaft 48.” PO Resp. 18. To illustrate its argument, Patent Owner annotates Figures 3 and 5 of Madsen, which are reproduced below:



Id. Patent Owner’s annotated figures highlight in green crank pin 44, crank arm 46, and fan blade mounting shaft 48. Patent Owner asserts that Figures 3 and 5 disclose that crank pin 44 and crank arm 46 “are permanently attached to fan blade mounting shaft 48 by welding or brazing.” *Id.* at 19 (citing Ex. 1006, Figs. 3 and 5). Patent Owner also notes that Madsen states “[e]ach fan blade terminates at the base of the blade with a tubular socket by which the blade is affixed to a rotatable shaft **terminated**

by an offset crank arm ending in a crank pin.” *Id.* at 19 (quoting Ex. 1006 ¶ 20). Thus, according to Patent Owner, a person of ordinary skill in the art “would understand an object ‘terminated by’ a feature would include that feature as the outer boundary of the object because this part of the specification lists the physical integrations between multiple parts.” *Id.* Accordingly, Patent Owner argues that because the crank arm and pin are an integral part of the rotatable shaft, Madsen’s arm members must include the crank arm and pin and therefore do not have a constant cross section along their length. *Id.* at 19–20.

We are not persuaded by Patent Owner’s argument. Specifically, we are not persuaded that Madsen’s crank pin and crank arm are necessarily part of the “arm members” required by the claim. Although we agree that the mounting shaft and crank arm are physically joined together in Madsen (*see* PO Sur-reply 16), that does not necessitate a finding that the crank arm constitutes part of the “arm member” of the claim. Madsen teaches the crank arm must be coupled to the mounting shaft to change the pitch of the blades. Ex. 1006 ¶ 20 (“[A]xial movement of the disk causes the crank pins to drive the crank arms thereby rotating the rotatable shafts and thereby changing the angle of the fan blades.”). But changing the pitch of the fan blades is not taught by the ’588 patent Specification and is not a limitation recited in claim 15. That Madsen teaches the shaft is “terminated” by a crank pin and crank arm does not preclude us from considering the fan blade mounting shaft alone to be the “arm member” of the claim. According to claim 15, the “arm members” must simply have the following requirements: (1) be “positioned within the openings of the hub member so as to extend outward therefrom”; (2) be “detachably secured in the openings”; (3) have a “plurality of fan blades that are mounted to the arm members”; and

(4) “comprise a constant cross section along their length.” Ex. 1001, 7:4–11 (claim 15). Madsen’s fan blade mounting shaft alone may constitute the “arm members compris[ing] a constant cross section along their length” as long as it satisfies the other requirements for the “arm member” in the claim. As discussed above, we find that the fan blade mounting shaft satisfies each of these limitations of claim 15. We, therefore, find Madsen’s crank arm and pin are not part of the “arm member” of claim 15, and instead constitute additional elements that are permissible under the open-ended “comprising” transition term of the claim. *See CIAS, Inc. v. Alliance Gaming Corp.*, 504 F.3d 1356, 1360 (Fed. Cir. 2007) (“In the patent claim context the term ‘comprising’ is well understood to mean ‘including but not limited to.’”) (internal citation omitted).

Moreover, we are persuaded that the preponderance of the evidence supports Petitioner’s assertion that Madsen teaches the fan blade mounting shaft is a cylindrical shaft with a constant cross-section. Although the figures of Madsen do not explicitly show the shaft has a constant cross-section, we credit the testimony of Dr. Sheard that a person of ordinary skill in the art would have had a reason to make the shaft with a constant cross-section along its length given the rotational function of the shaft within a bearing, the round shape of the tubular socket, and the ease and lower cost of manufacturing. Ex. 1002 ¶¶ 160–162.

Patent Owner’s remaining arguments depend on our finding that the crank arm and pin are not part of the “arm member.”⁸ *See* PO Resp. 20–22.

⁸ We note that Patent Owner appears to rely on the disclosure of thrust bearing 52 in the Madsen Provisional Application. *See* PO Resp. 20, 22. Although we continue to question the propriety of relying on that disclosure from the Madsen Provisional (*see* Dec. Inst. 24 n.4), we need not address

Because we reject that argument, we are not persuaded by any of Patent Owner's remaining arguments.

Thus, having considered the arguments and evidence presented at trial—which did not include evidence of secondary indicia of nonobviousness—we determine Petitioner has shown by a preponderance of the evidence that a person of ordinary skill in the art would have found it obvious to modify Madsen to achieve the claimed invention with a reasonable expectation of success.

III. CONCLUSION

For the foregoing reasons, we conclude that Petitioner has established by a preponderance of the evidence that claim 15 of the '588 patent is unpatentable as obvious over Madsen.

In summary:

Claim	35 U.S.C. §	Reference(s)/Basis	Claim Shown Unpatentable	Claim Not Shown Unpatentable
15	103(a)	Madsen	15	

IV. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that claim 15 of U.S. Patent No. 8,579,588 B1 is held unpatentable as obvious; and

that argument given our finding that the mounting shaft alone satisfies the constant cross-section limitation.

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

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Patent 8,579,588 B1

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