

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

EVAPCO DRY COOLING, INC.,
Petitioner,

v.

SPG DRY COOLING USA LLC,
Patent Owner.

IPR2021-00687
Patent 10,551,126 B2

Before NEIL T. POWELL, GEORGE R. HOSKINS, and
SEAN P. O'HANLON, *Administrative Patent Judges*.

O'HANLON, *Administrative Patent Judge*.

JUDGMENT
Final Written Decision
Determining No Challenged Claims Unpatentable
35 U.S.C. § 318(a)

I. INTRODUCTION

A. Background

Evapco Dry Cooling, Inc. (“Petitioner”) filed a Petition for *inter partes* review of claims 1–20 (“the challenged claims”) of U.S. Patent No. 10,551,126 B2 (Ex. 1001, “the ’126 patent”). Paper 2 (“Pet.”), 1. SPG Dry Cooling USA LLC (“Patent Owner”) filed a Preliminary Response. Paper 7 (“Prelim. Resp.”). On September 24, 2021, we instituted an *inter partes* review of the challenged claims on all grounds raised in the Petition. Paper 11 (“Institution Decision” or “Inst. Dec.”), 48.

Subsequent to institution, Patent Owner filed a Patent Owner Response (Paper 21, “PO Resp.”), Petitioner filed a Reply to the Patent Owner Response (Paper 26, “Pet. Reply”), and Patent Owner filed a Sur-reply to Petitioner’s Reply (Paper 34, “PO Sur-reply”). An oral hearing was held on June 23, 2022. A transcript of the hearing has been entered into the record. Paper 41 (“Tr.”).

In our Scheduling Order, we notified the parties that “any arguments for patentability not raised in the [Patent Owner] response may be deemed waived.” *See* Paper 12, 10; *see also* Patent Trial and Appeal Board Consolidated Trial Practice Guide 66 (Nov. 2019) (“The patent owner response . . . should identify all the involved claims that are believed to be patentable and state the basis for that belief.”).¹

For the reasons that follow, we conclude that Petitioner has failed to prove, by a preponderance of the evidence, that any of the challenged claims is unpatentable.

¹ *Available at* <https://www.uspto.gov/TrialPracticeGuideConsolidated>.

B. Real Parties in Interest

Petitioner identifies itself and its parent company, Evapco, Inc., as real parties in interest. Pet. 119.

Patent Owner identifies itself as the sole real party in interest.
Paper 4, 2.

C. Related Matters

The parties indicate that the '126 patent is the subject of the following district court proceeding:

SPG Dry Cooling USA LLC v. Evapco Dry Cooling, Inc.,
No. 3-20-cv-20131 (D.N.J. filed December 22, 2020).

Pet. 119; Paper 4, 2; Paper 6, 2. The parties further note various patents and patent applications in the priority chain of the '126 patent and petitions for *inter partes* review concerning two of the identified patents. Pet. 119; Paper 4, 2; Paper 6, 2.

D. The Challenged Patent

The '126 patent discloses “a mechanical draft cooling tower that utilizes air cooled condenser modules.” Ex. 1001, 1:22–23. Figures 1 and 2 illustrate the air-cooled condenser module and are reproduced below.

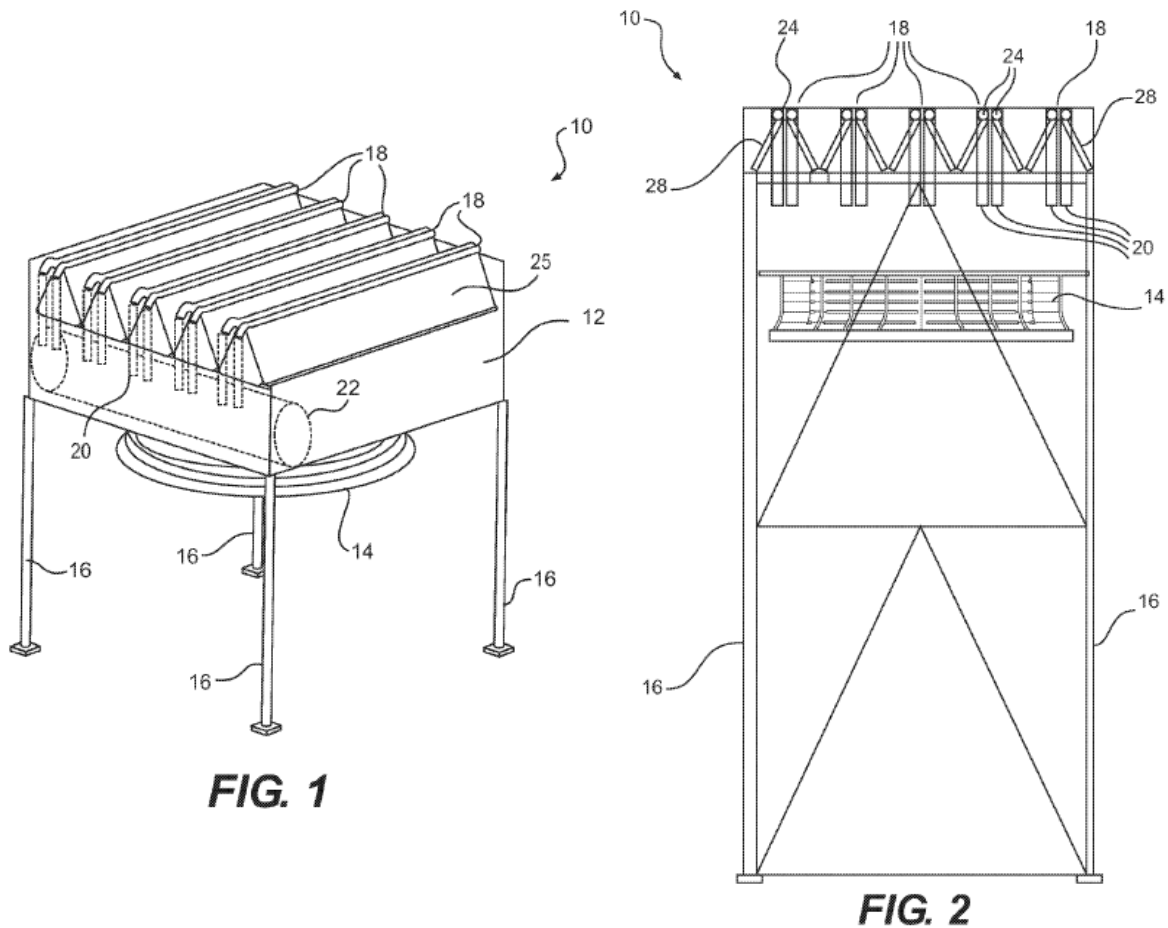


Figure 1 is a perspective view of air-cooled condenser module 10, and Figure 2 is a side view of the air-cooled condenser module. *Id.* at 4:5–10. The air-cooled condenser module includes multiple A-type geometry deltas 18, with each delta comprising two tube bundle assemblies 28. *Id.* at 4:57–60. Each tube bundle assembly includes a series of finned tubes to conduct heat transfer and a condensate header 27. *Id.* at 4:49–50, 4:63–66, 5:11–14, Fig. 4. The air-cooled condenser module also includes a fan disposed within fan shroud 14. *Id.* at 4:43–47.

The cooling towers are used to remove heat from steam or another industrial process fluid flowing through the tubes by a mechanical draft of a cooling fluid, such as atmospheric air, generated by the fan. Ex. 1001,

1:23–30. Steam flows in through main steam duct 22 and enters finned tubes 25 via risers 20 and manifolds 24. *Id.* at 4:53–58.

Each delta 18 is comprised of two individual heat exchange bundle assemblies 28, each bundle assembly including a series of finned tubes 25. Ex. 1001, 4:63–66. Each tube is approximately two meters long and each bundle is approximately 12 meters long. *Id.* at 4:66–5:1, Fig. 4. The bundles of each pair preferably are positioned at an angle of approximately 20°–30° on either side of vertical. *Id.* at 5:1–10. This A-type delta configuration allows the bundles to self-support one another. *Id.* at 6:39–43. Each module typically consists of five deltas 18. *Id.* at 6:37–39, Figs. 1–2. The '126 patent purports that this provides a relatively large number of tubes that, combined with the relatively short tube length, increases heat transfer efficiency. *Id.* at 5:14–53.

E. The Challenged Claims

Petitioner challenges claims 1–20 of the '126 patent. Pet. 1. Claims 1, 12, and 20 are independent. Claim 1 is illustrative of the challenged claims and is reproduced below.

1. A mechanical draft modular air cooled condenser comprising:

a first condenser pair including:

a first condenser bundle panel having a first top end and a first bottom end;

a first manifold disposed near the first top end;

a first condensate header connected to the first bottom end;

a second condenser bundle panel consecutive to the first condenser bundle panel, the second condenser bundle

- panel having a second top end and a second bottom end; and
- a second condensate header connected to the second bottom end, the second condensate header parallel to the first condensate header, the first bottom end of the first condenser bundle panel and the second bottom end of the second condenser bundle converging toward each other;
- a second condenser pair including:
 - a third condenser bundle panel consecutive to the second condenser bundle panel, the third condenser bundle panel having a third top end and a third bottom end, the second top end of the second condenser bundle panel and the third top end of the third condenser bundle panel converging toward each other;
 - a second manifold disposed near the second top end and the third top end, the first condensate header and the second condensate header disposed horizontally between and vertically below the first manifold and the second manifold;
 - a third condensate header connected to the third bottom end, the third condensate header parallel to the first condensate header and parallel to the second condensate header;
 - a fourth condenser bundle panel consecutive to the third condenser bundle panel, the fourth condenser bundle panel having a fourth top end and a fourth bottom end; and
 - a fourth condensate header connected to the fourth bottom end, the fourth condensate header parallel to the third condensate header, the third bottom end of the third condenser bundle panel and the fourth bottom end of the fourth condenser bundle converging toward each other;
- a shroud that houses a single fan, the single fan positioned to create a draft to flow over the first condenser bundle panel,

over the second condenser bundle panel, over the third condenser bundle panel, and over the fourth condenser bundle panel; and

a support frame that supports the first, second, third, and fourth condenser bundle panels.

Ex. 1001, 6:60–7:46.

F. Instituted Grounds of Unpatentability

The Petition relies on the following prior art references:

Name	Reference	Exhibit
Schulenberg	US 3,073,575, issued January 15, 1963	1004
EPRI	<i>Air-Cooled Condenser Design, Specification, and Operation Guidelines</i> , Final Report, Electric Power Research Institute, December 2005	1005
Kröger	Detlev G. Kröger, <i>Air-Cooled Heat Exchangers and Cooling Towers: Thermal-Flow Performance Evaluation and Design</i> , PennWell Corp., 2004	1006
O’Kane	CA 2 444 475, issued February 16, 2010	1009
Schabosky	US 2009/0178279 A1, published July 16, 2009	1010

We instituted trial based on all asserted claims and grounds of unpatentability as follows:

Claim(s) Challenged	35 U.S.C. §	Reference(s)
1–20	103(a) ²	EPRI, Kröger

² The application resulting in the ’126 patent claims priority to a date prior to the date when the Leahy-Smith America Invents Act (“AIA”), Pub. L. No. 112–29, 125 Stat. 284 (2011), took effect. Thus, we refer to the pre-AIA version of section 103.

Claim(s) Challenged	35 U.S.C. §	Reference(s)
5, 6, 15	103(a)	EPRI, Kröger, Schabosky, O’Kane
1–20	103(a)	Schulenberg, Kröger
5, 6, 15	103(a)	Schulenberg, Kröger, Schabosky, O’Kane

Pet. 1. Petitioner submits a declaration of Anthony Jacobi, Ph.D. (Ex. 1003, “Jacobi Declaration”) in support of its contentions. Petitioner also submits a second declaration of Dr. Jacobi (Ex. 1030) in support of its Reply. Patent Owner submits declarations of Emad Y. Tanbour, Ph.D. (Ex. 2007) and David Sanderlin (Ex. 2008) in support of its contentions.

II. ANALYSIS

A. Principles of Law

“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) (requiring *inter partes* review petitions to identify “with particularity . . . the evidence that supports the grounds for the challenge to each claim”)). Petitioner bears the burden of persuasion to prove unpatentability of each challenged claim by a preponderance of the evidence. 35 U.S.C. § 316(e). This burden never shifts to Patent Owner. *Dynamic Drinkware, LLC v. Nat’l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015).

A patent claim is unpatentable under 35 U.S.C. § 103(a) if the differences between the claimed subject matter 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 the 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 skill in the art, and (4) when in evidence, any objective evidence of nonobviousness. *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).

B. Level of Ordinary Skill in the Art

The level of ordinary skill in the art is “a prism or lens” through which we view the prior art and the claimed invention. *Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001). The person of ordinary skill in the art is a hypothetical person presumed to have known the relevant art at the time of the invention. *In re GPAC Inc.*, 57 F.3d 1573, 1579 (Fed. Cir. 1995). In determining the level of ordinary skill in the art, we may consider certain factors, including the “type of problems encountered in the art; prior art solutions to those problems; rapidity with which innovations are made; sophistication of the technology; and educational level of active workers in the field.” *Id.* (internal quotation marks and citation omitted).

Petitioner contends that a person having ordinary skill in the art at the time of the invention (“POSITA”) “would have had at least a Bachelor’s degree in an academic area emphasizing chemical engineering, mechanical engineering, or a similar discipline, and at least two years of experience in the field working with heat exchangers.” Pet. 4 (citing Ex. 1003 ¶ 12).

Patent Owner does not contest Petitioner's proposed definition or offer one of its own. *See generally* PO Resp.

We find Petitioner's description to be consistent with the problems and solutions disclosed in the patent and prior art of record, and adopt it as our own for purposes of this Decision. *See, e.g., GPAC*, 57 F.3d at 1579 (approving the determination of the level of ordinary skill in the art by appeal to the references of record).

C. Claim Construction

In an *inter partes* review, claims are construed using the same claim construction standard that would be used to construe the claims in a civil action under 35 U.S.C. § 282(b), including construing the claims in accordance with the ordinary and customary meaning of such claims as understood by one of ordinary skill in the art and the prosecution history pertaining to the patent. 37 C.F.R. § 42.100(b). Thus, we apply the claim construction standard as set forth in *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005) (en banc). In addition to the specification and prosecution history, we also consider use of the terms in other claims and extrinsic evidence including expert and inventor testimony, dictionaries, and learned treatises, although extrinsic evidence is less significant than the intrinsic record. *Id.* at 1312–17. Usually, the specification is dispositive, and it is the single best guide to the meaning of a disputed term. *Id.* at 1315.

Petitioner contends that “no express constructions are required.”
Pet. 4.

Patent Owner does not propose a construction for any claim term. *See generally* PO Resp.

We determine that we need not explicitly construe any claim terms to resolve the parties’ controversies. *See Realtime Data, LLC v. Iancu*, 912 F.3d 1368, 1375 (Fed. Cir. 2019) (quoting *Vivid Techs., Inc. v. Am. Sci. & Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999)) (“The Board is required to construe ‘only those terms that . . . are in controversy, and only to the extent necessary to resolve the controversy.’” (alteration in original)).

D. Overview of the Asserted Prior Art

1. Schulenberg

Schulenberg discloses an air-cooled surface condenser. Ex. 1004, 1:9–17. Figure 3 illustrates a vertical section view of the condenser and is reproduced below.

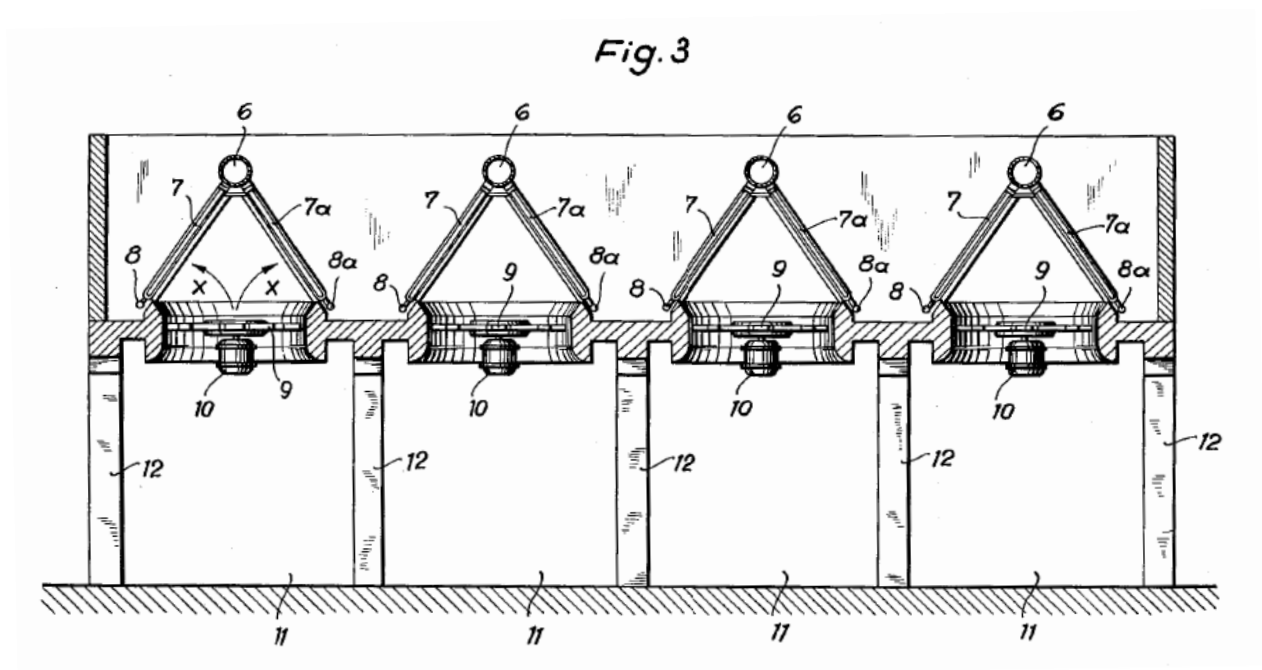


Figure 3 is a vertical section view of the condenser. *Id.* at 3:29–30. Steam from an electric generator enters the condenser via steam distribution conduits 6 and passes into condenser elements 7, 7a. *Id.* at 3:49–67, Fig. 1.

The condenser elements are arranged in roof-shape to form an equilateral triangle with lower ends connected to condenser collecting conduits 8, 8a. *Id.* at 3:68–4:2. Blowers 9 are positioned beneath the condenser elements. *Id.* at 4:2–7. The blowers draw air through suction apertures 12 provided in the sides of chamber 11 and force the drawn air upwards through the condenser elements. *Id.* at 4:22–27.

Each condenser element includes multiple rows of parallel ribbed tubes. Ex. 1004, 4:43–55, Figs. 4–5. This arrangement, however, causes the tubes in the different rows to experience different condensation conditions due to the drop in the temperature difference between the cooling air and steam as the air passes through the rows of tubes. *Id.* at 5:35–42, Fig. 5 (showing direction of cooling air flow “x”). Ensuring that the cooling air is cold enough for tubes further away from the fan, however, can lead to condensate freezing within the tubes positioned closer to the fans. *Id.* at 5:42–6:5, Fig. 5. To overcome this problem, Schulenberg provides throttling devices that limit the amount of steam that can enter the tubes positioned further away from the fans. *Id.* at 2:29–50, 6:6–11. Such throttling devices may be in the form of nozzles (*id.* at 6:11–14, Fig. 6) or diaphragms (*id.* at 6:39–45, Fig. 7). The cross-sectional areas of these throttling devices are gauged based on the steam temperature and the mean cooling air temperature in the region of the respective rows of tubes so that condensate from all tube rows enters condensate collecting chamber 19 at the same temperature. *Id.* at 6:14–29, 6:49–56. The blowers can be regulated so that condensation occurs along substantially the entire length of the tubes. *Id.* at 6:29–38.

2. EPRI

EPRI is a technical report issued by the Electric Power Research Institute that “provides information to guide the development and specification of [air-cooled condenser (‘ACC’)] design conditions.” Ex. 1005, v.³ Figure 2-6 provides a schematic drawing of an ACC and is reproduced below.

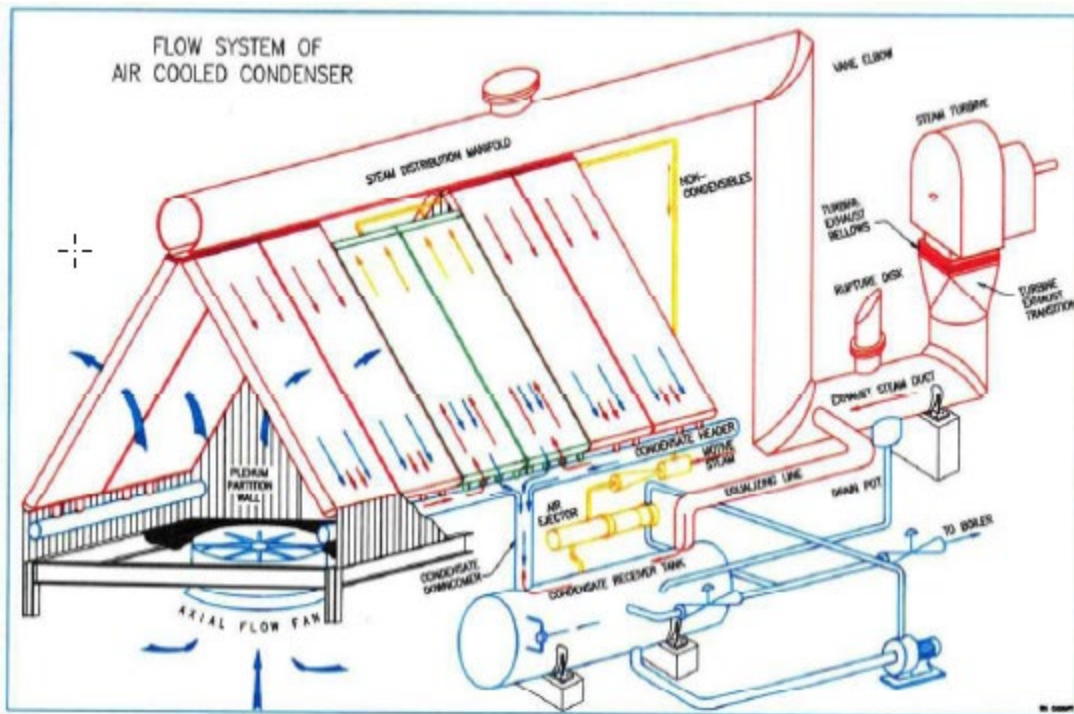


Figure 2-6

Figure 2-6 is a schematic of an ACC. *Id.* at 2-8. Exhaust steam from a turbine is ducted from the turbine exit through a series of ducts to a steam distribution manifold. *Id.* at 2-5. The “steam distribution manifold . . . runs horizontally along the apex of a row of finned-tube, air-cooled heat

³ We note that Petitioner cites to the document pagination rather than the exhibit pagination. *See, e.g.*, Pet. 11. We likewise cite to the document pagination for consistency.

exchangers arranged in an A-frame (or delta) configuration. A typical full-scale ACC consists of several such rows, sometimes referred to as ‘streets’ or ‘lanes.’” *Id.* “Each row consists of several cells,” and “[e]ach cell consists of several bundles of finned tubes arranged in parallel, inclined rows in both walls of the A-frame cell.” *Id.* “Steam from the steam distribution manifold enters the tubes at the top, condenses on the inner tube walls and flows downward (concurrent with remaining uncondensed steam) to condensate headers at the bottom of the bundles.” *Id.* “Large axial flow fans . . . are located in the floor of the cells” and “provid[e] forced-draft air cooling to the finned-tube heat exchangers.” *Id.*

3. Kröger

Kröger is a handbook intended “to provide modern analytical and empirical tools for evaluation of the thermal-flow performance or design of air-cooled heat exchangers and cooling towers.” Ex. 1006, x.⁴ Kröger describes, *inter alia*, a hybrid system that combines features of an air-cooled heat exchanger and a wet-cooling tower. *Id.* at 27. One example of such a hybrid system includes auxiliary dry/wet coolers located outside the cooling tower. *Id.* at 30. “These coolers consist of heat exchanger bundles arranged in a V-configuration below an axial flow fan.” *Id.* This auxiliary cooler is pictured in Figure 1.3.3 reproduced below.

⁴ We note that Petitioner cites to the document pagination rather than the exhibit pagination. *See, e.g.*, Pet. 23. We likewise cite to the document pagination for consistency.



Figure 1.3.3 is a picture of auxiliary dry/wet cooling cells. *Id.*

4. *O’Kane*

O’Kane relates to a method and package system for transporting large longitudinal items such as wind turbine blades and towers. Ex. 1009, 1:4–10. O’Kane discloses that the frames of the package system have widths that are preferably smaller than or the same size as the width of a standard freight container. *Id.* at 9:5–7. In particular, O’Kane discloses that the width of a standard freight container is approximately eight feet, the height is approximately eight feet, and the length is twenty or forty feet. *Id.* at 9:7–13.

5. *Schabosky*

Schabosky discloses “a method for setting up a condensation facility.” Ex. 1010 ¶ 1. One objective of Schabosky is to improve preassembly of

pipe bundles that are to be connected to form a delta. *Id.* ¶ 7. Figure 1 of Schabosky illustrates a pipe bundle assembly and is reproduced below.

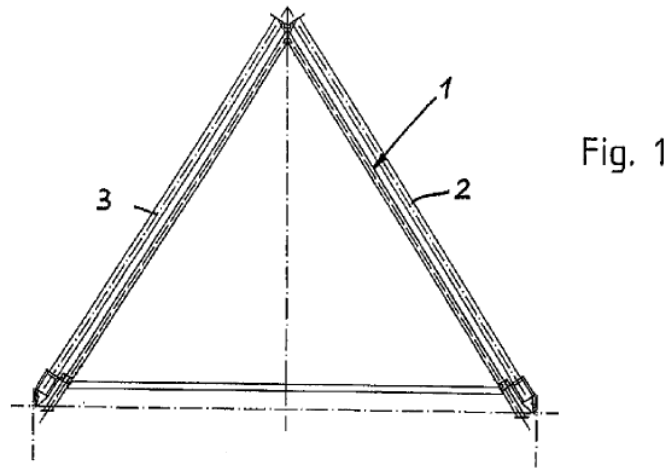


Figure 1 depicts roof-shaped preassembly frame 1 on which pipe bundles 2, 3 are placed for connection. *Id.* ¶ 25. The pipe bundles are connected to each other at their roof ridge region to form a heat exchanger delta. *Id.* At installation, a crane moves the preassembly frame and connected pipe bundles into position for welding the heat exchanger delta to a steam distribution line. *Id.*

E. Petitioner's Challenges

The Petition presents two challenges to independent claim 1, one based on EPRI and Kröger (Pet. 8–25) and one based on Schulenberg and Kröger (*id.* at 62–81). In each challenge, Petitioner relies on the primary reference (EPRI or Schulenberg) to disclose a condenser substantially as recited in claim 1, and on Kröger to teach a shroud and fan. *Id.* at 8–25, 62–81. Petitioner argues that an ordinarily skilled artisan “would have recognized that using a single large fan as opposed to multiple smaller fans would have provided the benefit of generating the same volumetric flow rate

but by using just one fan operating at a lower speed.” *Id.* at 9 (citing Ex. 1003 ¶ 43), 63–64 (citing Ex. 1003 ¶ 138). Petitioner also argues that “[t]he use of a single large fan in place of multiple smaller ones would have been a matter of simple design choice” and “was common practice well before the Critical Date” of the ’126 patent. *Id.* at 11 (citing Ex. 1003 ¶ 44), 65 (citing Ex. 1003 ¶ 139).

In the Institution Decision, we determined that Petitioner met the reasonable likelihood threshold for institution of an *inter partes* review. In doing so, we advised the parties that whether the Petition sets forth adequate reasoning to modify the systems of the primary references was an issue to be determined based on a fully developed record. *See* Inst. Dec. 36 (“Whether the Petition sets forth adequate reasoning to modify the EPRI condenser system to use a single fan is an issue that ultimately will be decided in view of a fully developed record.”). We also noted that Petitioner’s arguments were supported by the testimony of Dr. Jacobi and that Patent Owner did not submit the declaration of an expert witness to support its contentions advanced in the Preliminary Response. *See id.* at 35 (“Petitioner’s assertions of the benefits resulting from this modification are supported by the testimony of its declarant. Notably, Patent Owner does not submit the declaration of an opposing expert witness.” (citation omitted)), 36 (“Patent Owner’s arguments, which are not supported by expert testimony, do not persuade us to disregard Dr. Jacobi’s testimony.”), 37 (“Notably, Patent Owner does not rely on any expert testimony.”).

In the Response, Patent Owner argues that, prior to its invention, no known air-cooled condenser system had a single fan associated with multiple condenser deltas and the Petition does not assert any references

disclosing an air-cooled condenser system having a single fan associated with multiple condenser deltas. PO Resp. 15–19. Thus, according to Patent Owner, Petitioner’s contentions are based on impermissible hindsight reasoning. *Id.* at 26–27. Patent Owner argues that making the fan “larger” so as to create a draft over multiple condenser bundle panels, as asserted in the Petition, would necessitate doubling the size of the fans of the primary references. *See, e.g., id.* at 2, 15–16, 22–23, 29–30; *see also* Ex. 2007 ¶ 58 (Dr. Tanbour testifying, “[I]n my opinion, the Petition proposes doubling the size of *Schulenberg*’s and *EPRI*’s fans to cause air from a single fan to flow onto four *Schulenberg* or *EPRI* condenser bundle panels.”). Patent Owner relies on the testimony of Dr. Tanbour (Ex. 2007) and Mr. Sanderlin (Ex. 2008) in support of its arguments.

As noted above, Petitioner’s rationale for modifying EPRI’s or Schulenberg’s systems is to “us[e] a single large fan as opposed to multiple smaller fans.” Pet. 9, 63–64. Petitioner’s arguments are unclear, however, because the Petition does not identify what “large” means. Nor does the Petition identify the original size of the fans to be modified or the size of the resulting “large” fans. Dr. Jacobi’s testimony is substantially the same as the arguments set forth in the Petition and similarly fails to address the meaning of “large” or the size of the original or modified fans. *See, e.g.,* Ex. 1003 ¶¶ 43, 138.

During the hearing, however, Petitioner conceded that making the fans “larger” to provide flow over multiple tube bundles, as set forth in the Petition, would require doubling the size of the existing fans. Tr. 19:15–20:13. Petitioner further suggested that “larger” could mean

making the fan “2.5 times larger [or] three times larger.”⁵ *Id.* at 20:14–15. Thus, the parties agree that the Petition modifies the fans of the primary references (EPRI and Schulenberg) to include a fan that is approximately double the size of the original fans.⁶

⁵ On rebuttal, Petitioner stated that a reference included in the record appeared to show a fan cooling multiple deltas, where the fan does not span the width of two deltas. Tr. 57:19–58:2 (citing Ex. 2002, Fig. 1). We note, however, that the reference does not appear to address the size of the fan or heat exchanger elements, and does not appear to indicate that its figures are drawn to scale. *See Hockerson-Halberstadt, Inc. v. Avia Group Int’l, Inc.*, 222 F.3d 951, 956 (Fed. Cir. 2000) (“Under our precedent, . . . it is well established that patent drawings do not define the precise proportions of the elements and may not be relied on to show particular sizes if the specification is completely silent on the issue.”); *see also* Pet. Reply 10–11 (Petitioner arguing that EPRI does not indicate that Figure 2-6 “is drawn to scale or meant to convey actual dimensions”). Moreover, Petitioner did not elaborate at the hearing or otherwise regarding the disclosure of this reference or to explain how the reference is applicable to the combinations of references set forth in the Petition and discussed at length during Petitioner’s argument-in-chief. Furthermore, Petitioner’s reference to Figure 1 of Exhibit 2002 does not appear to be compatible with its modified versions of EPRI Figure 2-6 (*see* Pet. 9) and Schulenberg Figure 3 (*see id.* at 63), each of which illustrates a fan spanning the width of multiple deltas.

⁶ Petitioner notes that, in the Institution Decision, we interpreted the Petition as not proposing that the size of the EPRI fan be doubled. Pet. Reply 8 (quoting Inst. Dec. 35). As we explained in the hearing (*see* Tr. 23:19–24:7), our statement in the Institution Decision was in response to Patent Owner’s citing in its Preliminary Response to pages 9–10 of the Petition (*see* Prelim. Resp. 36–37), which discusses, “[b]y way of example,” benefits resulting from “replacing four small fans with a single fan of twice the diameter.” As we also explained in the hearing (*see* Tr. 24:4–6) and set forth above, Patent Owner makes different arguments in its Response that if one were to increase the size of the fan to cover multiple deltas, the fan would have to double in size. Petitioner’s counsel indicated that he understood the distinction between Patent Owner’s Preliminary Response and Response. *See id.* at 24:8.

Having determined that the Petition proposes to double the size of the original (that is, unmodified) fans of the primary references, we must next determine the size of the original fans. As noted above, the Petition does not address the size of the original fans. Patent Owner argues that EPRI's fan is 8.5–12 meters in diameter and Schulenberg has “presumably similarly sized fans.” PO Resp. 29 (citing Ex. 2007 ¶ 88). Dr. Tanbour notes that EPRI discloses that air-cooled condenser tubes are typically 9–12 meters long and air-cooled condenser fans are typically 8.5–12 meters in diameter. Ex. 2007 ¶ 36 (citing Ex. 1005, 2-5, 5-2). Dr. Tanbour testifies that an ordinarily skilled artisan “would have understood that *Schulenberg*'s fans would have been approximately the same size as those described in *EPRI*.” *Id.* ¶ 53.

Petitioner argues that Patent Owner's assumption that the EPRI fan would have a diameter of 8.5–12 meters is incorrect because “it was a known design option to design ACCs with smaller diameters due to, among other things, performance, job-site, and shipping constraints.” Pet. Reply 9 (citing Ex. 1030 ¶ 24). Petitioner argues that “EPRI makes clear that fan size is a design parameter that can vary widely depending on desired performance and/or design requirements.” *Id.* at 11 (citing Ex. 1030 ¶ 27).

We agree that EPRI discloses that typical air-cooled condensers have fans that are 8.5–12 meters in diameter. Ex. 1005, 2-5 (disclosing 8.5–10 meter diameters), 5-2 (disclosing 10–12 meter diameters). We note that Petitioner similarly relies on EPRI to disclose conventional air-cooled condensers. *See, e.g.*, Pet. 5 (“[A] POSITA would have understood that the various examples [of EPRI], for instance those reflected in Figures 2-5, 2-6, and 4-1, work together to inform a POSITA concerning different aspects of a conventional ACC system . . .”).

Petitioner does not explain persuasively why we should not consider EPRI's original fan to have such a diameter. Petitioner argues that "it was a known design option to design ACCs with smaller diameters due to, among other things, performance, job-site, and shipping constraints." Pet. Reply 9; *see also* Ex. 1030 ¶ 24 (Dr. Jacobi providing substantially the same opinion in his second declaration). This suggestion that an ordinarily skilled artisan would have used a smaller than typical air-cooled condenser seems to be incompatible with Petitioner's argument to modify EPRI's system to use a larger fan. *See* Pet. 9. We note that EPRI says fans having a diameter of approximately 10 meters "are optimized for shipping and erection" Ex. 1005, 5-2. And as noted by Patent Owner, Petitioner does not explain persuasively why an ordinarily skilled artisan would use a smaller than typical air-cooled condenser and then modify it only to have a larger fan. *See* PO Sur-reply 1-2 ("If a POSITA had a small fan and wanted to instead use a fan twice as big, then a POSITA would have made the associated delta twice as big too."). Furthermore, Petitioner does not explain adequately how the larger fan would comport with the hypothetical constraints set forth by Petitioner that would lead an ordinarily skilled artisan to select a smaller system to start with.

Petitioner's argument also contradicts the unrebutted evidence of record that the trend in the air-cooled condenser industry was to provide larger deltas and corresponding larger fans. Mr. Sanderlin testifies that, "[p]rior to [Patent Owner's] introduction of its patented ACC, manufacturers in the ACC market had been designing their ACCs essentially the same way for forty years," having "longer tubes bundled into A-frames or deltas" with "each delta [being] supplied with a flow of ambient air from an axial flow

fan dedicated to that one delta.” Ex. 2008 ¶¶ 13, 15. Mr. Sanderlin testifies that, for

at least during the twenty years before [Patent Owner’s] introduction of its patented ACC, the trend in the ACC industry was to continue designing ACCs to have only one delta associated with only one fan, but generally to make the delta size (and thus the corresponding fan size) larger and larger.

Id. ¶ 18. Mr. Sanderlin includes data with his declaration that he contends supports his interpretation of this trend in the ACC industry. *Id.* ¶ 20 (citing *id.* at Ex. C). We note that Dr. Jacobi does not contradict this testimony; to the contrary, Dr. Jacobi appears to agree with Mr. Sanderlin. *See* Ex. 1030 ¶ 35; *see also* Tr. 27:11–28:21 (Petitioner’s counsel failing to identify rebuttal of Mr. Sanderlin’s testimony when requested during the hearing).

Thus, the evidence of record indicates that an ordinarily skilled artisan would have selected an air-cooled condenser with large deltas and large fans. For the foregoing reasons, we agree with Patent Owner that an ordinarily skilled artisan would understand EPRI’s fan, as used in the Petition, to have a typically-used diameter of 8.5–12 meters.

Regarding Schulenberg’s fan, Petitioner argues that Dr. Tanbour’s assertion that a skilled artisan would have understood Schulenberg’s fan to be the same size as the EPRI fan is flawed. Pet. Reply 14–17 (citing Ex. 2007 ¶ 53). Petitioner argues that a skilled artisan would look to contemporary references to ascertain the size of Schulenberg’s system. *Id.* at 15. Petitioner argues that Modine⁷ is such a reference, and Modine discloses a tube delta having a width of “approximately 3.3 meters.” *Id.* (citing Ex. 1003 ¶¶ 132, 218; Ex. 1030 ¶ 34; Ex. 1008, 3:3–11, Fig. 2); *see*

⁷ US 3,707,185, issued December 26, 1972 (Ex. 1008).

also Ex. 1030 ¶ 34 (Dr. Jacobi opining that the width of Schulenberg’s deltas is “less than 3 meters at best”). Petitioner notes that the application resulting in Schulenberg was filed in 1957 and argues that Dr. Tanbour’s reasoning contradicts Mr. Sanderlin’s testimony that tube delta and fan sizes increased in the twenty year time period prior to the ’126 patent. *Id.* at 14–15 (citing Ex. 2008 ¶ 18).

We are not persuaded by Petitioner’s arguments. Rather than merely stating that Schulenberg discloses a fan that is the same size as that of EPRI, Dr. Tanbour opines,

[I]n my opinion, a POSITA reviewing *Schulenberg*’s teachings would have understood them, as of the Critical Date, to disclose a scale consistent with a POSITA’s knowledge and the technology available as of the Critical Date—i.e., with the scale disclosed in *EPRI* that accomplishes *Schulenberg*’s goal of efficiently condensing steam. Ex. 1004, 1:9-17. A POSITA would thus have constructed *Schulenberg*’s system to have fans sized 8.5–12 meters and deltas sized 9–12 meters, (Ex. 1005, at 2-5, 5-2) as disclosed in *EPRI* and as consistent with the scale at the time to effectively condense steam from then existing power plants as known to a POSITA at the time.

Ex. 2007 ¶ 53; *see also* PO Sur-reply 17, n.6 (“As the [Patent Owner Response] explained, a POSITA modifying *Schulenberg* at the Critical Date would have followed the ACC sizing known at the Critical Date as technologically effective.” (citing Ex. 2007 ¶¶ 53, 59)). This testimony is consistent with the un rebutted evidence of record that, for decades preceding the ’126 patent, the trend in the air-cooled condenser industry was to provide larger deltas and corresponding larger fans. *See* Ex. 2008 ¶¶ 13, 15, 18–20. This testimony—and Patent Owner’s arguments—is also consistent with the timing of the obviousness inquiry, which is assessed “at the time the

invention was made.” *See* 35 U.S.C. § 103(a). Conversely, Petitioner’s arguments improperly attempt to shift the obviousness inquiry to a time more than 50 years prior to the time of invention. *See* Pet. Reply 14–15.

The unrebutted evidence of record indicates that, at the time of invention of the ’126 patent, an ordinarily skilled artisan would have selected an air-cooled condenser with large deltas and large fans. For the foregoing reasons, we agree with Patent Owner that, on this record, Petitioner has not shown that an ordinarily skilled artisan would use Schulenberg’s antiquated deltas with modern-sized fans as Petitioner suggests in its Reply. Petitioner has not shown that such an artisan would have modified Schulenberg’s system only to include larger fans; rather, the unrebutted evidence of record indicates that such an artisan would also make the deltas bigger. Thus, we agree with Patent Owner that Schulenberg’s fan, as used in the Petition, would have a diameter typical for the time of invention of the ’126 patent and that EPRI discloses this typical size to be 8.5–12 meters in diameter.

We next consider whether the Petition sets forth adequate reasoning to modify the systems of the primary references to include a larger fan. For the reasons stated above, the Petition proposes to double the size of the fans of EPRI and Schulenberg, which would result in a fan having a diameter of 17–24 meters. *See* PO Resp. 2. Petitioner argues that it would have been obvious to modify EPRI’s condenser system to use such a fan in order to “generat[e] the same volumetric flow rate but by using just one fan operating at a lower speed,” thereby reducing noise, vibration, complexity, and cost. Pet. 9–10; *see also* Ex. 1003 ¶ 43 (citing Ex. 1016 ¶ 73) (Dr. Jacobi presenting essentially the same contentions). Petitioner argues that the

combination yields a predictable result because it “does not change the hallmark aspects of either . . . reference[]” and “[t]he respective teachings would work together in combination just as they did apart.” Pet. 10–11 (citing Ex. 1003 ¶ 44). Petitioner also argues that “[t]he use of a single large fan in place of multiple smaller ones would have been a matter of simple design choice” and “was common practice well before the Critical Date.” *Id.* at 11 (citing Ex. 1003 ¶ 44). Petitioner argues that it would have been obvious to modify Schulenberg’s system to use a single large fan in place of multiple smaller fans for substantially the same reasons. *Id.* at 62–65, 78–80 (citing Ex. 1003 ¶¶ 138–139).

Patent Owner argues that Petitioner’s asserted rationale for making the fans of EPRI and Schulenberg larger is unconvincing. PO Resp. 21–26. Regarding Petitioner’s assertion of cost reduction, Patent Owner asserts that neither Petitioner nor its declarant explains adequately how a larger, custom-built air-cooled condenser fan would cost less than two standard air-cooled condenser fans. *Id.* at 22–23 (citing Ex. 1005, 3-23, 4-5; Ex. 2007 ¶¶ 70–73; Ex. 2008 ¶ 20). Regarding Petitioner’s assertion of noise reduction, Patent Owner asserts that EPRI teaches that, to reduce noise, an ordinarily skilled artisan would change the number of blades, the speed, and the power of the fan rather than the fan size. *Id.* at 23 (citing Ex. 1005, 3-22–3-23; Ex. 2007 ¶ 75). Patent Owner also argues that the Petition “presents no evidence” that the asserted larger fan and its necessarily larger motor would be less noisy than two smaller fans and associated motors. *Id.* at 24 (citing Ex. 2007 ¶ 78). Regarding energy efficiency, Patent Owner asserts that the Petition does not explain adequately how the proposed larger fan would increase energy efficiency, especially given that the larger fan would necessarily

require a larger motor. *Id.* at 25–26 (citing Ex. 2007 ¶¶ 81–82). Patent Owner asserts that “the horsepower needed to power a fan increases by the square of the fan’s diameter,” but the Petition “never accounts for the energy needs required to power its enlarged fan.” *Id.* at 26 (citing Ex. 2007 ¶ 82). Patent Owner also argues that Petitioner has failed to set forth a reasonable expectation of success for substantially the same reasons. *See, e.g.*, PO Sur-reply 2, 17.

We are persuaded by Patent Owner’s arguments. Petitioner’s declarant, Dr. Jacobi, relies on a reference disclosing a fan used in a refrigerator (*see* Ex. 1016), but Dr. Jacobi does not explain persuasively how the purported benefits of doubling the size of such a small fan would hold true when doubling the size of a large fan used in an air-cooled condenser. *See* Ex. 1003 ¶¶ 43 (citing Ex. 1016 ¶ 73), 138 (citing Ex. 1016 ¶ 73). Thus, Dr. Jacobi’s testimony amounts largely to unsupported assertions. *See* 37 C.F.R. § 42.65(a) (“Expert testimony that does not disclose the underlying facts or data on which the opinion is based is entitled to little or no weight.”). Nor did Petitioner’s counsel provide a link between the small refrigerator fans of Exhibit 1016 and the large fans of an air-cooled condenser when asked during the hearing. *See* Tr. 59:21–61:11; *see also id.* at 22:8–23:18 (Petitioner’s counsel failing to identify argument regarding the feasibility of a large fan when asked during the hearing). Patent Owner’s declarant, Dr. Tanbour, opines that Dr. Jacobi’s analysis is “deeply flawed,” testifying that “[a]rbitrarily increasing fan size may be feasible in refrigerators and other smaller devices with, for example, 24-centimeter diameter fans, where such fans are common, commercially available, off-the-shelf items. But the Petition never demonstrates that it is possible in

ACC systems with 8.5–12-meter diameter fans.” Ex. 2007 ¶ 54.

Dr. Tanbour further testifies that a fan of the size proposed in the Petition would have structural, vibration, and tip speed challenges, including weight-induced bending, decreased efficiency, increased blade flexure, flutter-induced structural integrity issues, and increased vortex shedding and noise.

Id. ¶¶ 60–63. Neither Petitioner nor Dr. Jacobi persuasively refutes

Dr. Tanbour’s contentions.

We acknowledge that Kröger’s Figure 1.3.3 shows a heat exchange system using three top-mounted fans, wherein each fan blows air over four heat exchanger bundles arranged in two V-configurations. *See* Ex. 1006, 30 (Fig. 1.3.3). However, it is undisputed that these heat exchangers are used to cool water, not steam, so they are not air-cooled “condensers” as recited in claim 1 and as disclosed by EPRI and Schulenberg. *See, e.g.*, Ex. 2006, 18:6–20:1 (Dr. Jacobi testifying that the structure in Kröger’s Figure 1.3.3 is used to cool “condensate” which is “mostly water,” and “is not the condenser in [Kröger’s] system”); Ex. 2007 ¶ 26 (Dr. Tanbour explaining that EPRI and Schulenberg are condensers that “are designed to condense the exhaust steam (a gas),” whereas the structure in Kröger’s Figure 1.3.3 “is designed to cool water (a liquid)”). Moreover, the structure in Kröger’s Figure 1.3.3 is a hybrid cooling system, using the air from the fans *and* water deluged over the outside of the heat exchanger bundles, to cool the water inside of the heat exchangers bundles. *See* Ex. 1006, 30–31. By contrast, EPRI and Schulenberg rely solely on air flow to condense steam into water.

Dr. Tanbour testifies that, because of the resulting “less imposing” cooling requirements of Kröger’s air flow versus EPRI’s and Schulenberg’s air flows, the structure in Kröger’s Figure 1.3.3 is “a fraction of the size” of

the condensers in EPRI and Schulenberg. Ex. 2007 ¶ 37. Specifically, according to Dr. Tanbour, Kröger’s fan shrouds are about 4 meters in diameter (*see id.* (citing Ex. 1006, 30)), versus the 8.5–12 meter diameter fans of EPRI and Schulenberg discussed above. Dr. Jacobi does not dispute Dr. Tanbour’s estimation of the size of Kröger’s fans.

We agree with Dr. Tanbour’s testimony that these differences between EPRI and Schulenberg on the one hand, and Kröger on the other hand, represent “distinctly different” systems. Ex. 2007 ¶¶ 26–27. Dr. Jacobi’s original testimony in support of the asserted obviousness of using a single fan to blow air over two heat exchanger deltas in EPRI and Schulenberg does not account persuasively for the distinct differences in the cooling capacity requirements of the air flows in the respective references, or the respective sizes of the fans being used. *See, e.g.*, Ex. 1003 ¶¶ 41–44, 62–64 (combining EPRI and Kröger); *id.* ¶¶ 136–139, 153–155 (combining Schulenberg and Kröger). Dr. Jacobi’s reply testimony then, in a hindsight fashion, points out various similarities among the three systems because they all perform air cooling, but does not persuasively grapple with the differences between them. *See* Ex. 1030 ¶¶ 1–6, 8–17.

Thus, at best, the evidence of record supporting Petitioner’s arguments that it would have been obvious to make the fans of EPRI and Schulenberg larger with a reasonable expectation of success is in equipoise with the evidence of record supporting Patent Owner’s arguments that such modifications would not have been obvious. We accordingly determine that Petitioner has not met its burden to prove unpatentability of claim 1, or its dependent claims 2–11, by a preponderance of the evidence.

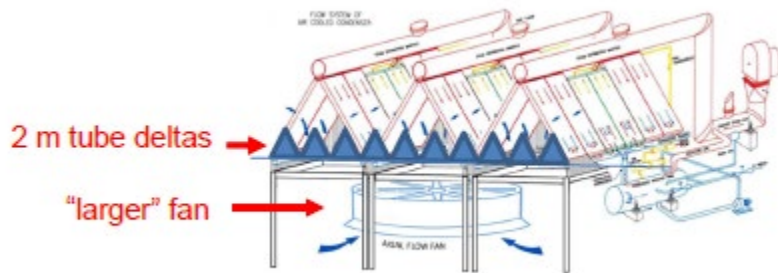
Independent claim 12 recites an air-cooled condenser that is similar to that of claim 1. Ex. 1001, 8:45–9:29. With claim 12, however, the top ends of the condenser bundles of each condenser pair converge toward each other (rather than the bottom ends, as in claim 1). *Id.* In challenging claim 12, Petitioner largely cites to and relies on its assertions made regarding claim 1, but maps the two bundles of a single one of EPRI’s and Schulenberg’s deltas to each recited pair of condenser bundles. *See* Pet. 34–46, 92–103. For the reasons discussed above regarding claim 1, we determine that Petitioner has not met its burden to prove unpatentability of claim 12, or its dependent claims 13–19, by a preponderance of the evidence.

Independent claim 20 recites an air-cooled condenser that is similar to that of claims 1 and 12. Ex. 1001, 10:12–11:2. Claim 20, however, does not recite any converging of tube bundles, but does recite that the second and third condenser bundles are symmetrically angled approximately 20°–30° from vertical. *Id.* In challenging claim 20, Petitioner largely cites to and relies on its assertions made regarding claim 1, and relies on EPRI and Schulenberg to disclose the recited bundle angles. *See* Pet. 50–56, 106–13. For the reasons discussed above regarding claim 1, we determine that Petitioner has not met its burden to prove unpatentability of claim 20 by a preponderance of the evidence.

We note that dependent claims 5, 6, and 15 recite that the tubes “have a length equal to approximately two meters.” Ex. 1001, 8:7–14, 9:55–59. Petitioner argues that it would have been an obvious design choice to make the tubes of EPRI and Schulenberg of this length. Pet. 27–28, 85–86.

In addition to contesting Petitioner’s assertions, Patent Owner argues that the Petition does not link using shorter tubes, as required by dependent

claims 5, 6, and 15, to using a smaller fan; according to Patent Owner, “[t]he fan stayed ‘larger.’” PO Sur-reply 3. Patent Owner presents an annotated version of EPRI Figure 2-6 as modified by Petitioner (*see* Pet. 9) illustrating how it interprets the Petition’s mapping of the EPRI-Kröger combination to dependent claims 5, 6, and 15:



PO Sur-reply 3. Petitioner’s modification to EPRI Figure 2-6 adds two heat exchanger deltas and a single fan underneath the three deltas. Pet. 9. Patent Owner’s additional modification adds ten small blue triangles it purports to represent deltas of tubes having a length of two meters. PO Sur-reply 3. Patent Owner argues that reducing the fan size, thus, is not necessarily a consequence of using shorter tubes, as Petitioner would have it. *Id.* at 3; *see also* Pet. Reply 11 (arguing, without specific reference to claims 5, 6, and 15, that fan size would be reduced “as a consequence” of reducing tube length).⁸

We agree with Patent Owner. Even if we were to agree with Petitioner that it would have been obvious to alter the modified systems of EPRI and Schulenberg to include tubes having a length equal to approximately two meters, we nonetheless agree with Patent Owner that this

⁸ The corollary to Petitioner’s assertion—that increasing tube length would be a consequence of increasing fan size—cuts against Petitioner’s arguments to increase only the size of the fan but not the length of the tubes.

change would not necessitate a reduction in the original size of EPRI's or Schulenberg's fans. Accordingly, Petitioner's arguments regarding the tubes having a length of approximately two meters fail to overcome the shortcomings noted above regarding independent claims 1 and 12, from which claims 5, 6, and 15 depend.

Petitioner also relies on Schabosky and O'Kane to challenge dependent claims 5, 6, and 15. Pet. 57–62, 113–16. Petitioner relies on Schabosky to teach using pre-assembled pipe bundles for ease of assembly at a job site and on O'Kane to teach the size of a standard freight container. *Id.* Petitioner asserts that this would result in tube bundles having a length of two meters and a width of 12 meters. *Id.* at 60–61, 115–16. Patent Owner opposes Petitioner's contentions. *See* PO Resp. 36–40.

Petitioner's reliance on the teachings of Schabosky and O'Kane fails to overcome the shortcomings noted above regarding independent claims 1 and 12, from which claims 5, 6, and 15 depend. Although Petitioner does not argue that altering EPRI's and Schulenberg's tubes to have a length of two meters would result in an ordinarily skilled artisan also altering the original size of EPRI's or Schulenberg's fans, even if we were to agree that altering the tube length would have been obvious, for the reasons explained above we agree with Patent Owner that this change would not necessitate a reduction in the original size of EPRI's or Schulenberg's fans.

For at least the foregoing reasons, Petitioner has failed to demonstrate sufficiently how the asserted references render obvious any of the challenged claims. Notably, Petitioner's contentions to make EPRI's and Schulenberg's fans "large," without specifying how large the resulting fans would be or the size of the fans that are to be enlarged, renders Petitioner's

contentions unclear. If Petitioner were relying on an ordinarily skilled artisan selecting a fan having a size other than what is typical in the industry, as Petitioner asserts in its Reply, it was incumbent on Petitioner to explain in the Petition why an ordinarily skilled artisan would have chosen an atypical system and then modified such a system to result in a condenser as claimed in the '126 patent. This, Petitioner did not do. Thus, Petitioner has failed to set forth, with requisite particularity, how the asserted references and evidence of record support its assertions. *See* 35 U.S.C. § 312(a)(3).

III. CONCLUSION

Based on the evidence presented with the Petition, the evidence introduced during the trial, and the parties' respective arguments, Petitioner has failed to show, by a preponderance of the evidence, that claims 1–20 of the '126 patent are unpatentable. In summary,

Claim(s)	35 U.S.C. §	Reference(s)/ Basis	Claims Shown Unpatentable	Claims Not Shown Unpatentable
1–20	103(a)	EPRI, Kröger		1–20
5, 6, 15	103(a)	EPRI, Kröger, Schabosky, O'Kane		5, 6, 15
1–20	103(a)	Schulenberg, Kröger		1–20
5, 6, 15	103(a)	Schulenberg, Kröger, Schabosky, O'Kane		5, 6, 15
Overall Outcome				1–20

IV. ORDER

Accordingly, it is:

ORDERED that claims 1–20 of the '126 patent have not been shown to be unpatentable; 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.

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Patent 10,551,126 B2

For PETITIONER:

Hyun Jin In
Timothy W. Riffe
Ralph Phillips
Sun Park
FISH & RICHARDSON P.C.
IPR48153-0002IP1@fr.com
PTABInbound@fr.com
in@fr.com
riffe@fr.com
rphillips@fr.com
apark@fr.com

For PATENT OWNER:

Timothy J. May
Houtan K. Esfahani
Joshua L. Goldberg
FINNEGAN, HENDERSON, FARABOW, GARRETT & DUNNER, LLP
timothy.may@finnegan.com
houtan.esfahani@finnegan.com
joshua.goldberg@finnegan.com