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Paper 36
Date: September 8, 2022

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

R.J. REYNOLDS VAPOR COMPANY,
Petitioner,

v.

PHILIP MORRIS PRODUCTS S.A.,
Patent Owner.

IPR2021-00585
Patent 10,555,556 B2

Before, JAMES J. MAYBERRY, ELIZABETH M. ROESEL, and SHEILA F. McSHANE, *Administrative Patent Judges.*

MAYBERRY, *Administrative Patent Judge*.

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

I. INTRODUCTION

R.J. Reynolds Vapor Company, ("Petitioner"), filed a Petition (Paper 2, "Pet.") requesting *inter partes* review of claims 1, 3–9, 15, 18, 20, 21, 25, and 26 (the "Challenged Claims") of U.S. Patent No. 10,555,556 B2 (Ex. 1001, the "'556 patent"). The '556 patent is owned by Philip Morris

Products S.A. ("Patent Owner"). Patent Owner disclaimed claims 25 and 26 after the Petition was filed. PO Resp. 1 n.1; *see* Ex. 2024 (providing the disclaimer).

For the reasons provided below, we conclude that Petitioner has proven, by a preponderance of the evidence, that claims 1, 3–9, 15, 18, 20, 21 of the '556 patent are unpatentable.

A. Procedural History

Upon review of the arguments and supporting evidence in the Petition and in Patent Owner's Preliminary Response (Paper 7), we instituted an *inter partes* review of all claims and grounds asserted in the Petition. Paper 10 ("Institution Decision" or "Inst. Dec."). Patent Owner filed a Patent Owner Response to the Petition. Paper 20 ("PO Resp."). Petitioner filed a Reply to the Patent Owner Response. Paper 25 ("Pet. Reply"). Patent Owner filed a Sur-reply to Petitioner's Reply. Paper 28 ("PO Sur-reply").

An oral hearing for this proceeding was held on July 7, 2022, and the transcript for that hearing is entered in the record. Paper 35 ("Tr.").

B. Real Parties-in-Interest

Petitioner identifies itself and RAI Innovations Company, R.J. Reynolds Tobacco Company, and Reynolds Asia-Pacific Limited as the real parties-in-interest. Pet. 74.

Patent Owner identifies itself as the sole real party-in-interest. Paper 5, 1.

C. Related Matters

The parties identify, as a matter related to the '556 patent, ongoing litigation in the U.S. District Court for the Eastern District of Virginia, in a case styled *RAI Strategic Holdings, Inc. v. Altria Client Services LLC*, No.

1:20-cv-00393-LO-TCB, filed on May 28, 2020. Pet. 75, Paper 5, 1. Patent Owner's claims directed to the '556 patent were dismissed from the litigation prior to trial in the district court. Ex. 3001, 1.

D. '556 Patent

The '556 patent, titled "Cartridge for an Aerosol-Generating System," issued February 11, 2020, from a Patent Cooperation Treaty (PCT) application filed December 15, 2014. Ex. 1001, codes (54), (45), (22). The '556 patent ultimately claims priority to foreign applications filed February 10, 2014. *Id.* at code (30). The '556 patent is directed to "a cartridge for aerosol-generating systems, in particular electrically operated smoking systems." *Id.* at 1:7–9. We reproduce Figures 2 and 3 from the '556 patent below.

Figure 2

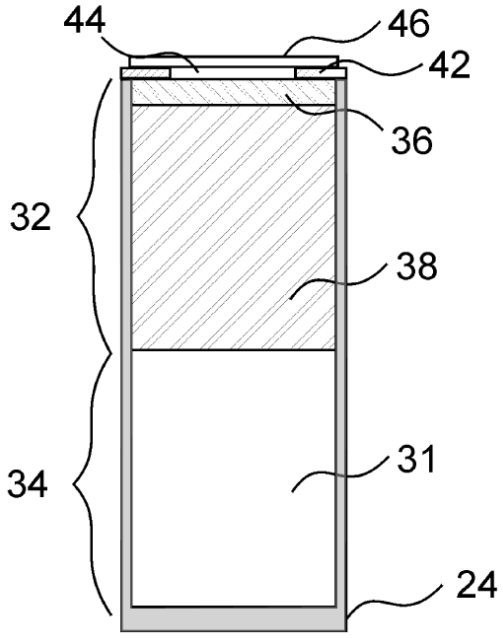


Figure 3

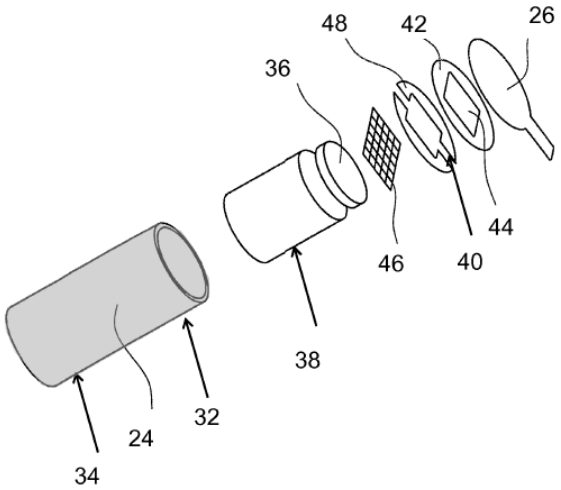


Figure 2 depicts "a cartridge with porous medium" and Figure 3 depicts "an exploded view of a similar cartridge." Ex. 1001, 10:29–32. The cartridge of Figures 2 and 3 includes housing 24, with liquid storage portions 32, 34. Ex. 1001, 11:64–66, 12:33–34.

First part 32 of the cartridge includes first and second capillary materials 36, 38. Ex. 1001, 11:66–12:1. First and second capillary material 36, 38 "are soaked in a liquid aerosol-forming substrate." *Id.* at 12:36–38. Resistive heater element 46 is located at an open end of housing 24, adjacent to first capillary material 36. *Id.* at 12:36–52. In this way, first capillary material 36 serves as a spacer separating heater element 46 from second capillary material 38. *Id.* at 12:16–20, 46–47. The '556 patent states that "[a] capillary material here is a material that actively conveys liquid from one end [of the material] to another." *Id.* at 12:42–44. The first and second capillary materials may be the same or different materials and, preferably, at least the first capillary material is compressed. *Id.* at 5:23–26, 5:39–42.

"The first capillary material may have a fiber size/pore size of between 0.1 to 50 μm, preferably of between 0.5 to 10 μm and most preferably of about 4 μm. The first capillary material has a density of below 2 g/ml, and preferably of about 0.5 g/ml." Ex. 1001, 4:66–5:3. "The second capillary material may have a fiber size/pore size of between 1 to 100 μm, preferably of between 15 to 40 μm and most preferably of about 25 μm. The second capillary material may have a density of below 1 g/ml, and preferably of between 0.1 and 0.3 g/ml." *Id.* at 5:12–16. "The capillary material may have any suitable capillarity and porosity so as to be used with different liquid physical properties." *Id.* at 4:5–7.

"[S]econd part 34 . . . is an empty tank that can be filled or partly filled with liquid aerosol-generating substrate." Ex. 1001, 12:1–3.

E. Challenged Claims

The Petition challenges claims 1, 3–9, 15, 18, 20, 21, 25, and 26. Pet. 10. Patent Owner disclaimed claims 25 and 26. PO Resp. 1 n.1; *see*

also Ex. 2024 (providing the disclaimer).[1] Accordingly, we consider claims 1, 3–9, 15, 18, 20, and 21 in this Final Written Decision.

Of the remaining Challenged Claims, claim 1 is the sole independent claim, which we reproduce below.

> 1. A cartridge for use in an aerosol-generating system, comprising:
>
> a liquid storage portion, comprising a housing configured to hold a liquid aerosol-forming substrate, the housing having an opening,
>
> wherein the liquid storage portion comprises at least two parts in fluid communication with each other,
>
> a first part of the liquid storage portion comprising a first capillary material, provided in a vicinity of the opening of the housing, and a second capillary material in fluid contact with the first capillary material and spaced apart from the opening by the first capillary material, and
>
> a second part of the liquid storage portion comprising a container configured to hold the liquid aerosol-forming substrate and to supply the liquid to the second capillary material.

Ex. 1001, 14:30–46.

[1] A review of the public file for the ’556 patent indicates that the form provided as Exhibit 2024 was filed with the Office, along with the required fee.

F. Prior Art and Asserted Grounds

Petitioner asserts that the Challenged Claims are unpatentable based on three grounds.[2]

Claims Challenged	35 U.S.C. §	References/Basis
1, 3–9, 15, 18, 20, 21	103[3]	Hearn,[4] Rabin[5]
1, 4–8, 15, 18, 21	103	Terry,[6] Thorens[7]
3, 9, 26	103	Terry, Thorens, Rabin

Petitioner relies on the declaration testimony of Mr. Kelly R. Kodama (Ex. 1002) in support of these grounds. Patent Owner deposed Mr. Kodama. Ex. 2029. Patent Owner relies on the declaration testimony of Dr. John Abraham (Ex. 2030) in support of its counter arguments to Petitioner's grounds. Petitioner deposed Dr. Abraham. Ex. 1037.

The following subsections provide brief descriptions of Hearn and Rabin. For purposes of this Decision, we do not need to summarize Terry or Thorens.

[2] We omit disclaimed claims 25 and 26 from the chart. Petitioner characterizes the second and third grounds as "Ground 2a" and "Ground 2b." Pet. 11.
[3] The Leahy-Smith America Invents Act ("AIA"), Pub. L. No. 112-29, 125 Stat. 284, 287–88 (2011), amended 35 U.S.C. § 103, effective March 16, 2013. Because the '556 patent issued from an application that ultimately claims priority to foreign applications filed after this effective date, the AIA version of § 103 applies. Ex. 1001, codes (22), (30).
[4] Hearn et al., US 2013/0056012 A1, published March 7, 2013 (Ex. 1004, "Hearn").
[5] Rabin et al., US 7,920,777 B2, issued April 5, 2011 (Ex. 1005, "Rabin").
[6] Terry et al., US 8,314,591 B2, issued November 20, 2012 (Ex. 1006, "Terry").
[7] Thorens et al., US 8,794,231 B2, issued August 5, 2014 (Ex. 1007, "Thorens").

1. Hearn

Hearn, titled "Simulated Cigarette," published March 7, 2013. Ex. 1004, codes (54), (43). We reproduce Hearn's Figure 2, below.

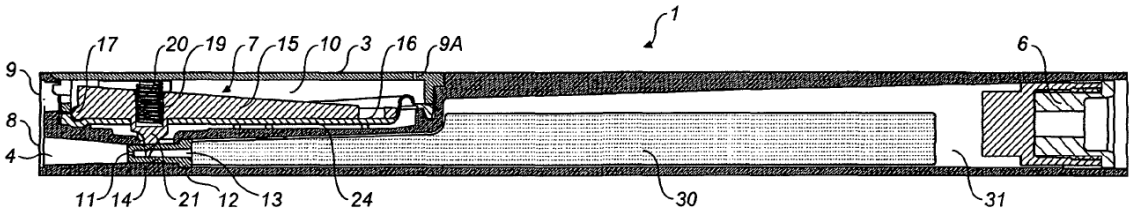


FIG. 2

Figure 2 depicts a cross section of an embodiment of Hearn's simulated cigarette device. *Id.* ¶¶ 27, 28. Hearn's device includes housing 1, which surrounds capillary rod 30 and reservoir 5 (no reference numeral shown). *Id.* ¶¶ 31, 38. Filling valve 6 is located at the end opposite from outlet end 8. When a user sucks on outlet end 8, breath-activated valve 7 opens to allow the user to inhale the composition contained within reservoir 5 and transported to outlet path 13 through capillary plug 30. *Id.* ¶¶ 16, 32, 40. In an alternative embodiment, reservoir 5 can be a replaceable component. *Id.* ¶ 31.

Capillary plug 30 is compressed in the region adjacent to valve 7, which reduces the effective pore size of the plug in that region and increases its capillary force. Ex. 1004 ¶ 39. Capillary plug 30 may be formed of a single material, with varying pore size though the length of the material, or two or more different materials with different pore sizes. *Id.* ¶ 17. In a preferred embodiment, the capillary plug does not occupy the full cross-section of the reservoir to allow a liquid flow path within the reservoir alongside the plug. *Id.* ¶ 15.

2. Rabin

Rabin, titled "Capillary Force Vaporizers," issued April 5, 2011. Ex. 1005, codes (54), (45). We reproduce Rabin's Figure 6, below.

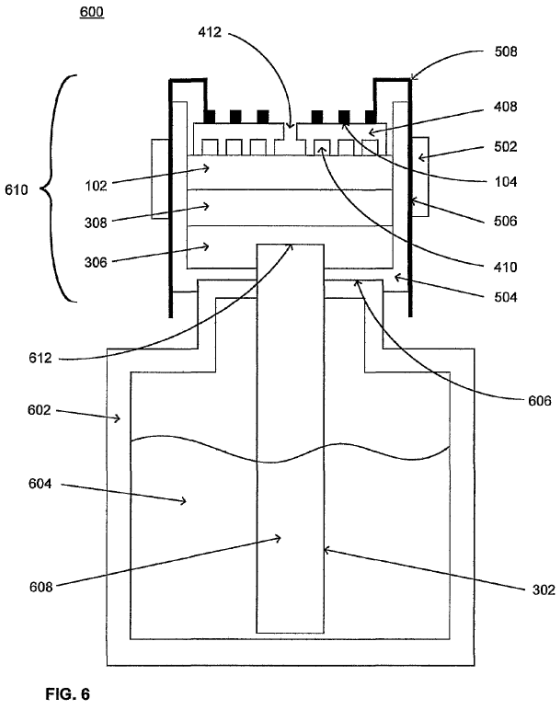


FIG. 6

Figure 6 depicts a "schematic cross sectional view of a capillary force vaporizer in accordance with" an embodiment of Rabin. *Id.* at 2:46–47. System 600 includes upper assembly 610 in liquid supply contact with removable liquid reservoir 602, which contains liquid to be vaporized. *Id.* at 12:28–37. Upper assembly 610 includes porous member 102, heater 104, liquid supply component 306, and inner housing 504. *See id.*, Fig. 6.

Heat generated by heater 104 vaporizes liquid in porous member 102. Ex. 1005, 6:26–28. Liquid supply component 306 is an additional wicking material that directly contacts the liquid supply source. *Id.* at 6:5–7. In the embodiment of Figure 6, an additional wick component 608 ensures liquid contact between upper assembly 610 and reservoir 602. *Id.* at 12:47–54.

II. ANALYSIS OF PETITIONER'S CHALLENGES

A. Applicable Law

In *inter partes* reviews, a petitioner bears the burden of proving unpatentability of the challenged claims, and the burden of persuasion never shifts to the patent owner. *Dynamic Drinkware, LLC v. Nat'l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015). To prevail in this proceeding, Petitioner must support its challenge by a preponderance of the evidence. 35 U.S.C. § 316(e) (2018); 37 C.F.R. § 42.1(d) (2022). Accordingly, all of our findings and conclusions are based on a preponderance of the evidence standard.

Petitioner's asserted grounds of unpatentability are based on obviousness under 35 U.S.C. § 103.

> A patent for a claimed invention may not be obtained, notwithstanding that the claimed invention is not identically disclosed as set forth in section 102, if the differences between the claimed invention and the prior art are such that the claimed invention as a whole would have been obvious before the effective filing date of the claimed invention to a person having ordinary skill in the art to which the claimed invention pertains. Patentability shall not be negated by the manner in which the invention was made.

35 U.S.C. § 103. 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) when available, objective evidence, such as commercial success, long felt but unsolved

needs, and failure of others.[8] *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).

What prior art references teach or suggest, and whether a skilled artisan would have been motivated to combine the references are questions of fact. *In re Kahn*, 441 F.3d 977, 985 (Fed. Cir. 2006). "[O]bviousness must be determined in light of all the facts, and . . . a given course of action often has simultaneous advantages and disadvantages, and this does not necessarily obviate motivation to combine" teachings from multiple references. *Medichem, S.A. v. Rolabo, S.L.*, 437 F.3d 1157, 1165 (Fed. Cir. 2006).

B. Level of Ordinary Skill in the Art

The level of 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 who is 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). Factors that may be considered in determining the level of ordinary skill in the art include, but are not limited to, the types of problems encountered in the art, the sophistication of the technology, and educational level of active workers in the field. *Id.* In a given case, one or more factors may predominate. *Id.*

Petitioner contends that a person having ordinary skill in the art "would have had a Bachelor's degree in mechanical engineering, electrical engineering, industrial design or product design or product design

[8] Neither party directs us to any objective evidence in the record for our consideration.

engineering, chemistry, or physics, or a related field, and three to four years of industry experience." Pet. 9. Petitioner further asserts that only one to two years of experience would be needed if the person had a Master's degree in one of the listed disciplines. *Id.* at 9–10. Petitioner adds that the hypothetical person of ordinary skill "might also have been familiar with electrically powered smoking articles and their components and underlying technologies or similar components and technologies." *Id.* at 10. Finally, Petitioner asserts, generally, that "[a] higher level of education may substitute for a lesser amount of experience, and vice versa." *Id.* Petitioner bases these contentions on declaration testimony from Mr. Kodama. *Id.* (referencing Ex. 1002 ¶¶ 18–20).

Patent Owner does not dispute Petitioner's characterization of the level of ordinary skill. PO Resp. 7.

On the complete trial record, we adopt Petitioner's undisputed characterization of the level of ordinary skill in the art. We find, based on our review of the '556 patent Specification and the prior art of record, that Petitioner's characterization is reflected in these references.

C. Claim Construction

In *inter partes* reviews, we interpret a claim "using 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. § 42.100(b). Under this standard, we construe the claim "in accordance with the ordinary and customary meaning of such claim as understood by one of ordinary skill in the art and the prosecution history pertaining to the patent." *Id.*

Petitioner does not propose any express constructions. Pet. 11. Petitioner adds that, in the parallel litigation, the district court considered the terms "the housing having an opening"; "provided in a vicinity of the

opening of the housing"; "a second capillary material . . . spaced apart from the opening by the first capillary material"; and "compressed;" and concluded that these terms "are well known common English words given their common meaning." *Id.* at 12 (quoting Ex. 1008, 1).

Patent Owner states that it "does not believe that any terms need to be expressly construed for the Board to confirm the patentability of the asserted claims." PO Resp. 7.

Based on the parties' arguments during trial, including arguments directed to the proper scope and meaning of the claim term "pore size," we believe the term "pore size" needs to be expressly construed.

1. "pore size"

Dependent claims 4, 8, 18, and 21 recite the term "pore size," and specify certain ranges for the pore size. For example, claim 4 recites "[t]he cartridge according to claim 1, wherein the first capillary material has a fiber size or pore size of between 0.1 to 50 μm." Ex. 1001, 14:54–56. The other three claims recite pore size ranges for either the first or the second capillary material. *See id.* at 14:63–65, 15:40–42, 15:47–49.

Patent Owner argues that "[i]t is undisputed that 'pore size' refers to the diameter of the pore." PO Resp. 24 (citing testimony from Mr. Kodama's deposition, Ex. 2029, 38:14–19; Dr. Abraham's Declaration, Ex. 2030 ¶¶ 34–40). In Mr. Kodama's testimony, he was asked, "Is pore size referring to an area or a circumference or something else?" Ex. 2029, 38:14–15. He answered, "Pore size should be the diameter, I would assume, of the actual -- assuming it's a round pore or a round bubble, I would assume it's the diameter of that particular pore size." *Id.* at 38:16–19. Patent Owner argues that this testimony is consistent with the plain and ordinary meaning

if the term "pore size." PO Resp. 24 (referencing Ex. 2030 ¶¶ 34–40; Ex. 2031, 1; Ex. 2033, 1742; Ex. 2034, 1).

Patent Owner recognizes that Hearn uses the term "pore size," and refers to specific values for "pore radii." PO Resp. 24–25. Patent Owner argues that Hearn uses the term "pore size" in connection with two of its formulas, one concerning "R_{pore}" and one concerning "R^2(pore)." *Id.* at 25; *see* Ex. 1004 ¶¶ 21 ("R_{pore}=foam pore-size"), 23 ("R^2(pore) equates to pore size"). Patent Owner argues that a person having ordinary skill in the art "reading these conflicting disclosures would understand that Hearn's use of the term 'pore size' is specifically with reference to its disclosed equations—not 'pore size' in accordance to its plain meaning, which refers to the pore diameter." PO Resp. 25.

Petitioner argues that Patent Owner's "overly-narrow interpretation [of the term 'pore size'], which relies exclusively on expert testimony and other extrinsic evidence, is not supported by the intrinsic evidence." Petitioner argues that the Specification of the '556 patent "is entirely silent as to any required unit of measurement for pore size." Pet. Reply 19. Petitioner adds that the Specification does use "diameter" when discussing other aspects of the disclosed device. *Id.*

Petitioner also argues that Hearn uses "pore radii" to describe capillary plug pore size. Pet. Reply 19–20. Petitioner adds that Dr. Abraham testified that, although a person having ordinary skill in the art "might 'typically' refer to pore size in terms of diameter or width, a [person having ordinary skill in the art] would not always do so." *Id.* at 20 (referencing Ex. 1037, 18:8–19:12).

In response, Patent Owner argues that "all experts (including Petitioner's) agree that 'pore size' refers to the diameter/width of the pore,

not its radius . . . [and t]his is dispositive as to the plain meaning of 'pore size.'" PO Sur-reply 6. As to Hearn, Patent Owner argues that Hearn uses two special definitions for pore size, one with the pore radius as the "foam pore-size," and the other as the pore radius squared as the "pore size." *Id.* Patent Owner adds that these special uses of the term do not change the plain meaning of the term "pore size." *Id.* at 6–7. Patent Owner also argues that Petitioner's reliance on Dr. Abraham's deposition testimony is misplaced, as it "merely recognized that while the plain meaning of 'pore size' refers to the diameter, it can be explicitly defined otherwise, as 'with Hearn.'" *Id.* at 7 (referencing Ex. 1037, 18:14–25).

In construing a claim term, we start with the language of the claims. *See, e.g.*, *Phillips v. AWH Corp.*, 415 F.3d 1303, 1314 (Fed. Cir. 2005) (en banc) ("[T]he context in which a term is used in the [claim at issue] can be highly instructive."). The language of the claims is instructive here—the recited "pore size" is amenable to a physical measurement, as the claim language limits the pore size to a numerical range. *See, e.g.*, Ex. 1001, 14:54–56 (limiting the pore size to between 0.1 μm and 50 μm). Beyond this insight, however, the express language of the claims does not otherwise clarify the construction of the term.

"[T]he specification 'is always highly relevant to the claim construction analysis. Usually, it is dispositive; it is the single best guide to the meaning of a disputed term.'" *Phillips*, 415 F.3d at 1315. Here, the Specification provides little information about the meaning of "pore size." The Specification states that "[t]he structure of the capillary material forms a plurality of small bores or tubes, through which the liquid can be transported by capillary action." Ex. 1001, 3:62–64. The Specification adds that "[t]he pore size may be for example measured as being an average pore size for a

region of the capillary material." *Id.* at 4:53–55. The Specification also provides preferred ranges of values for the pore size, without further explanation of what these values mean. *See id.* at 4:66–5:3, 5:12–16. The Specification also indicates that the pore size can vary between the first and second capillary materials and radially in the housing, such as by compressing the material. *See id.* at 5:23–38, 6:7–37, 9:38–41, 13:55–14:12. Although these discussions shed some light on the meaning of "pore size," they are not helpful in resolving the parties' dispute about whether the term is limited to a diameter.

Petitioner argues that the term "pore size" is entitled to a broad construction because the Specification fails to provide disclosure on how the pore size is determined. Pet. Reply 19. We find, however, that the evidence in the Specification is ambiguous as to what constitutes the pore size.

We do not discern, nor do the parties direct us to, anything in the prosecution history that would provide any insight as to what constitutes the pore size. *Cf. Phillips*, 415 F.3d at 1317 ("In addition to consulting the specification, we have held that a court 'should also consider the patent's prosecution history, if it is in evidence.'").

"[E]xtrinsic evidence 'can shed useful light on the relevant art,' . . . [but] it is 'less significant than the intrinsic record in determining "the legally operative meaning of claim language."'" *Phillips*, 415 F.3d at 1317. Indeed, Petitioner criticizes Patent Owner's reliance on extrinsic evidence in interpreting "pore size." Pet. Reply 19. And, "where the public record *unambiguously* describes the scope of the patented invention, reliance on any extrinsic evidence is improper." *Vitronics Corp. v. Conceptronic, Inc.*, 90 F.3d 1576, 1583 (Fed. Cir. 1996) (emphasis added); *see, e.g.*, *Genuine Enabling Tech. LLC v. Nintendo Co.*, 29 F.4th 1365, 1373 (Fed. Cir. 2022)

("In other words, '[e]xtrinsic evidence is to be used for the court's understanding of the patent, not for the purpose of varying or contradicting the terms of the claims.'" (quoting *Markman v. Westview Instruments, Inc.*, 52 F.3d 967, 981 (Fed. Cir. 1995)).

Here, however, the intrinsic record does not resolve the parties' dispute about whether the term "pore size" is limited to a diameter, and extrinsic evidence provides us with insights on how that technical term would be understood by a person having ordinary skill in the art. Dr. Abraham testifies that a person having ordinary skill in the art would have understood "pore size" to mean "pore width." Ex. 2030 ¶ 34. Dr. Abraham bases his opinion on his specific experience, and technical papers, including a paper recognizing that the National Institute of Standards and Technology applies this definition to "pore size." *See id.* at ¶¶ 35–39; *see, e.g.*, Ex. 2031, 1 ("As a simplified measure, pore size (or width) is referred to the smallest dimension within a given pore shape, that is, the width between two opposite walls for a slit-shaped pore and the diameter for a cylindrical pore (Rouquerol et al., 1999)."); Ex. 2033, 1742 ("**Pore size** (generally, pore width): the distance between two opposite walls of the pore (diameter of cylindrical pores, width of slit-shaped pores)."); Ex. 2034, 1 (discussing porous membranes and providing pore diameters). Also, prior art of record is consistent with this understanding. *See* Ex. 1015 ¶ 25 ("Generally, wick materials, in accordance with various aspects of the present invention, have pores with substantially the same spherical geometry and the pore size is the diameter of the largest cross-section for any particular pore space."); Ex. 1017, 8:24–26 (providing porosity measurements in terms of a pore diameter).

Based on the complete record, we construe the term "pore size" to mean "pore width." As such, for pores with generally circular cross-sections, the pore size would be the pore diameter. We credit Dr. Abraham's testimony, which is supported by other credible evidence. Petitioner's expert testified in a manner consistent with Dr. Abraham's opinion in his deposition. *See* Ex. 2029, 38:16–18 ("Pore size should be the diameter . . . assuming it's a round pore."). Also, technical papers define or use the term "pore size" to mean "pore width." *See* Ex. 2031, 1; Ex. 2033, 1742; Ex. 2034, 1. We find that these papers are the type a person having ordinary skill in the art would be familiar with and relied on as authoritative. *See, e.g.*, Ex. 2031, 1 ("Porosity is one of the factors that influences the physical interactions and chemical reactivity of solids with gases and liquids for many industrial applications."); Ex. 2033, 1741 ("It is well known that . . . the control of porosity is of great industrial importance for example in the design of catalysts, industrial adsorbents, membranes and ceramics. Furthermore, porosity is one of the factors which influence the chemical reactivity of solids and the physical interaction of solids with gases and liquids."); Ex. 2030 ¶ 35 ("[T]he International Union of Pure and Applied Chemistry (IUPAC) provides a system for classifying porous materials based on their pore sizes."). Accordingly, we find that a person having ordinary skill in the art would have understood the plain and ordinary meaning of the term "pore size" to be "pore width."

Also, our construction is not inconsistent with the intrinsic record. As we have already said, the intrinsic record does not provide any specifics on how pore size is to be measured. The Specification, however, does disclose that "[t]he structure of the capillary material forms a plurality of small bores or tubes, through which the liquid can be transported by capillary action."

Ex. 1001, 3:62–64. "Bores" and "tubes" connote structures with generally circular cross-sections, lending themselves to measuring their width or diameter.

Petitioner's reliance on Dr. Abraham's deposition testimony to support a broader construction of the term "pore size" is unpersuasive. We find Dr. Abraham's deposition testimony to be consistent with his declaration testimony and our construction. Dr. Abraham stated that "the accepted definition of a pore size[] is a diameter or a width." Ex. 1037, 19:7–9.

With respect to Petitioner's reliance on Hearn's use of the term "pore size," we agree with Patent Owner that Hearn uses the term in a "conflicting" manner and, as such, we find does not reflect the plain and ordinary meaning of the term. *See* PO Resp. 25. For example, at one point, Hearn uses "pore radii" and "pore size" to mean the same thing, stating that "it is envisaged that the compression of foam at the outlet valve should entertain pore radii most preferably around 100 microns, whereas the base of the wicking apparatus should constitute pore sizes of around 150 microns to provide an optimum capillary gradient." Ex. 1004 ¶ 19. In discussing an equation calculating rise height of liquid through a capillary rod, Hearn indicates that pore radius (R_{pore}) equals the foam pore size. *Id.* ¶¶ 20, 21. In discussing an equation for foam permeability, Hearn "equates to pore size" to the value of the pore radius squared, which would be more akin to a pore area. *Id.* ¶ 23; *see id.* ¶ 18 (stating that permeability is proportional to pore area). Dr. Abraham characterizes Hearn's use of the term "pore size" as "a special use" "appl[ied] . . . to very specific equations that require a specific pore size definition" and "atypical." Ex. 1037, 19:2–6. We agree with Dr. Abraham's characterization, based on our reading of Hearn.

In conclusion, based on the complete record, we construe the term "pore size" to mean "pore width," which would be the pore diameter for pores with a generally circular cross-section.

2. Additional claim terms

We determine that we need not expressly construe any other claim terms to resolve the parties' disputes on the current record. *See Realtime Data, LLC v. Iancu*, 912 F.3d 1368, 1375 (Fed. Cir. 2019) ("The Board is required to construe 'only those terms . . . that are in controversy, and only 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)). To the extent that the scope of any particular claim term requires discussion, however, we provide it in our assessment of the challenges, which we turn to next.

D. Ground 1: Claims 1, 3–9, 15, 18, 20, and 21 as unpatentable over Hearn or Hearn and Rabin

Petitioner contends that claims 1, 3–9, 15, 18, 20, and 21 are unpatentable over Hearn alone or in combination with Rabin. Pet. 11, 19–45. Below, we discuss the scope and content of the prior art and any differences between the prior art and claimed subject matter, on a limitation-by-limitation basis.

1. Independent claim 1

With respect to claim 1, Patent Owner disputes only whether Petitioner has demonstrated that Hearn, or Hearn as modified by Rabin, teaches or suggests "a second part of the liquid storage portion comprising a container configured to hold the liquid aerosol-forming substrate and to supply the liquid to the second capillary material" (Ex. 1001, 14:43–46, the "container" limitation of claim 1). *See* PO Resp. 11–17 (disputing

Petitioner's position that Hearn discloses the "container" limitation of claim 1); *id.* at 17–23 (arguing that a person having ordinary skill in the art would not have combined teachings from Rabin with Hearn, both generally and to arrive at the subject matter of the "container" limitation).

"The Board . . . [is] not required to address undisputed matters." *In re NuVasive, Inc.*, 841 F.3d 966, 974 (Fed. Cir. 2016). Because Petitioner's contentions with respect to undisputed terms inform its position with respect to the "container" limitation of claim 1, however, we turn to the undisputed limitations of claim 1 before addressing the parties' dispute.

a) Undisputed limitations

(1) Preamble

The preamble of claim 1 recites "[a] cartridge for use in an aerosol-generating system." Ex. 1001, 14:30–31. Petitioner contends that Hearn discloses a cartridge that is used in an aerosol-generating system—a simulated cigarette. Pet. 19–20 (referencing Ex. 1004 ¶¶ 3, 22, 31; Ex. 1002 ¶¶ 77–80). Petitioner contends that "Hearn discloses a simulated cigarette device 1 having a cartridge in the form of reservoir 5 containing a liquid inhalable composition and a capillary plug 30" and that "[t]he cartridge may be replaceable." *Id.* at 19 (referencing Ex. 1004 ¶¶ 3, 31).

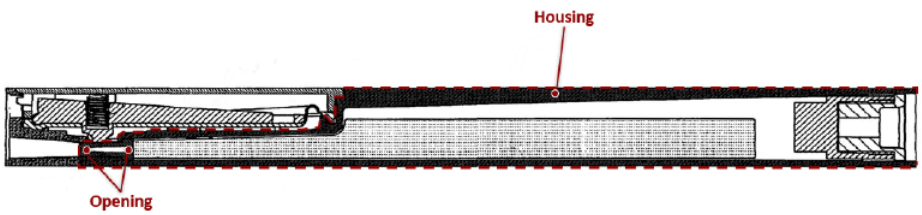
Upon review of the information in the Petition and corresponding evidence, we find that Hearn discloses the subject matter of the preamble of claim 1. *See* Ex. 1004 ¶¶ 3, 22, 31, Fig. 2; Ex. 1002 ¶¶ 77–80.

(2) Housing limitation

Claim 1 also recites "a liquid storage portion, comprising a housing configured to hold a liquid aerosol-forming substrate, the housing having an opening." Ex. 1001, 14:32–34 (the "housing limitation" of claim 1). In support of its position with respect to the housing limitation, Petitioner

provides an annotated version of Hearn's Figure 2, which we reproduce below.

FIG. 2
(Annotated)



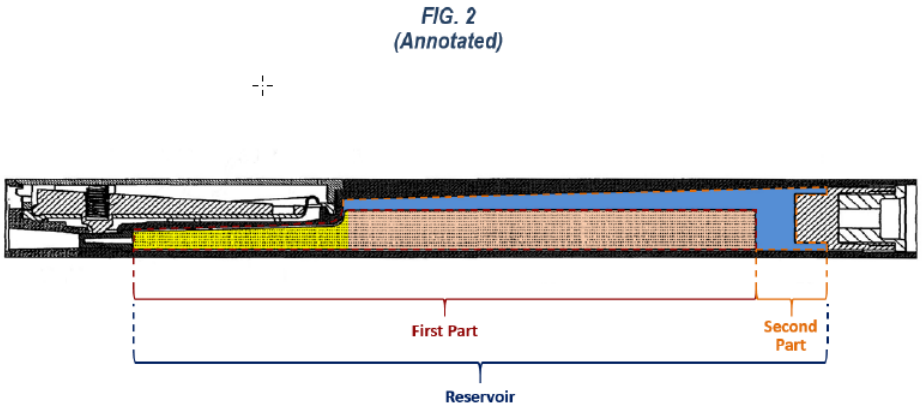
Pet. 21. Figure 2 depicts a cross section of an embodiment of Hearn's simulated cigarette device, with annotations for the housing and its opening shown in red. Ex. 1004 ¶¶ 27, 28; Pet. 21. Petitioner contends that Hearn's pressurized reservoir, outlined with red dashed lines in the annotated figure, corresponds to the recited housing and that outlet path 13 and outlet orifice 11 correspond to the opening. Pet. 20–21 (referencing Ex. 1004 ¶¶ 15, 17, 31, 34; Ex. 1002 ¶¶ 81–82). Petitioner contends that the pressurized reservoir "contains the inhalable composition," that is, the liquid aerosol-forming substrate. *Id.* at 21.

Upon review of the information in the Petition and corresponding evidence, we find that Hearn discloses the subject matter of the housing limitation of claim 1. *See* Ex. 1004 ¶¶ 15, 17, 31, 34, Fig. 2; Ex. 1002 ¶¶ 81–82.

(3) Fluid communication limitation

Claim 1 also recites "wherein the liquid storage portion comprises at least two parts in fluid communication with each other." Ex. 1001, 14:34–36 (the "fluid communication" limitation of claim 1). Petitioner contends that Hearn's reservoir includes two parts in fluid communication, with the first part containing capillary plug 30 and the second part containing the refill liquid. Pet. 21 (referencing Ex. 1004 ¶ 38). In support

of this contention, Petitioner provides another annotated version of Hearn's Figure 2, which we reproduce below.



Pet. 22. Figure 2 depicts a cross section of an embodiment of Hearn's simulated cigarette device, with annotations identifying the first part of the reservoir (including capillary plug 30, in yellow and peach), and second part (including the remaining volume within the reservoir for holding liquid, in blue). Ex. 1004 ¶¶ 27, 28; Pet. 22; *see also* Pet. at 20 (contending that the structure defining the reservoir forms a housing and corresponds to the liquid storage portion). Petitioner contends that the first and second parts have no barrier between them, so that these two parts are in fluid communications with each other. Pet. 22. Petitioner adds that Hearn discloses that the capillary plug does not occupy the entire reservoir. *Id.* (referencing Ex. 1004 ¶ 14; Ex. 1002 ¶¶ 83–84).

Upon review of the information in the Petition and corresponding evidence, we find that Hearn discloses that the liquid storage portion comprises at least two parts in fluid communication with each other. Ex. 1004 ¶¶ 14, 27, 28, 38; Ex. 1002 ¶¶ 83–84. Consistent with Petitioner's position, we find that the structure defining Hearn's reservoir includes two parts. The first part is defined by the portion of the housing that contains capillary plug 30, and the second part is defined by the portion of the

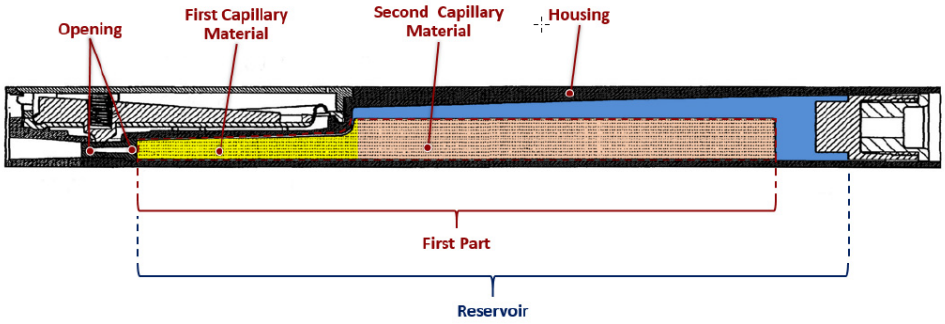
housing that contains the refill liquid. *See, e.g.*, Pet. 21 (providing an annotated version of Hearn's Figure 2, showing the outline of the housing defining the reservoir), 22 (providing an annotated version of Hearn's Figure 2, showing the first and second parts of the reservoir).

(4) Capillary material limitation

Claim 1 also recites "a first part of the liquid storage portion comprising a first capillary material, provided in a vicinity of the opening of the housing, and a second capillary material in fluid contact with the first capillary material and spaced apart from the opening by the first capillary material." Ex. 1001, 14:37–42 (the "capillary material limitation" of claim 1). Petitioner contends that Hearn discloses the recited first and second capillary materials within the first part of Hearn's reservoir, with the compressed region of capillary plug 30 adjacent the opening corresponding to the first material, and the remaining portion of capillary plug 30 corresponding to the second material. Pet. 22–24 (referencing Ex. 1004 ¶¶ 16, 17, 24, 25, 38, 39; Ex. 1002 ¶¶ 85, 86, 89, 91).

Petitioner relies, in part, on Hearn's disclosure that the capillary plug "may be 'a single phase material formed with varying pore size, or may be two or more materials each having different pore sizes, the relative proportions of which are varied along the length of the plug.'" Pet. 23 (quoting Ex. 1004 ¶ 17); *see e.g.*, *id.* at 24 (providing an annotated version of Hearn's Figure 2, showing the housing, opening, reservoir, and first part, with first and second capillary materials shown in yellow and peach, respectively). Petitioner explains that Hearn's first and second capillary materials are adjacent to and in fluid communication with one another. *Id.* at 24. We reproduce another of Petitioner's annotated versions of Hearn's Figure 2, below.

FIG. 2
(Annotated)



Id. Figure 2 depicts a cross section of an embodiment of Hearn's simulated cigarette device, with annotations identifying the reservoir (including the first part with capillary plug 30, in yellow and peach, and the remaining volume within the reservoir for holding liquid, in blue), the housing, the opening, and specifically identifying the first capillary material (in yellow) and second capillary material (in peach). As seen in the annotated figure, the first and second capillary materials are adjacent to one another, allowing fluid to flow from the second to the first capillary material.

Upon review of the information in the Petition and corresponding evidence, we find that Hearn discloses the subject matter of the capillary material limitation of claim 1. Ex. 1004 ¶¶ 16, 17, 24, 25, 38, 39, Fig. 2; Ex. 1002 ¶¶ 85, 86, 89, 91.

Petitioner offers an alternative position with respect to the capillary material limitation—that the subject matter would have been obvious over the combination of Hearn and Rabin. Pet. 25–28. The Petition asserts that Rabin discloses the subject matter of the capillary material limitation of claim 1. *See id.* We do not need to address this alternative position because we agree with Petitioner's primary position that Hearn alone discloses this subject matter. Similarly, we need not address Patent Owner's arguments

that a person having ordinary skill in the art would not have combined teachings from Rabin and Hearn. *See* PO Resp. 17–18.

b) Disputed limitation – the Container limitation

Claim 1 recites "a second part of the liquid storage portion comprising a container configured to hold the liquid aerosol-forming substrate and to supply the liquid to the second capillary material." Ex. 1001, 14:43–46. We turn first to Petitioner's contentions, then Patent Owner's counter arguments, Petitioner's reply to those arguments, and finally Patent Owner's response to the reply arguments, before turning to our analysis.

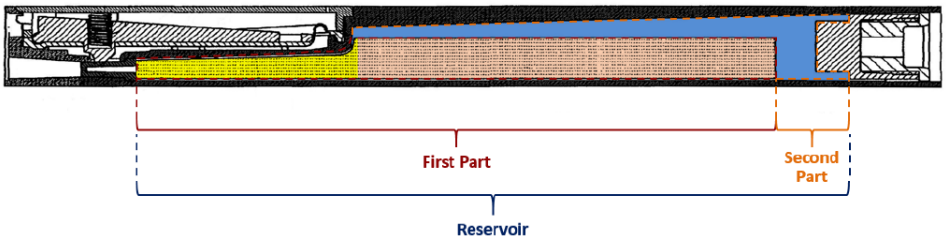
(1) Petitioner's contention

Petitioner references its analysis of the "fluid communication" limitation of claim 1 (which we discuss above) and contends that Hearn discloses a liquid storage portion comprising two parts. Pet. 29; *see also id.* at 21–22 (providing Petitioner's contentions with respect to the "fluid communication" limitation of claim 1)[9]. Petitioner explains that "[t]he first part comprises the capillary plug and the second part is the remaining space within the reservoir where liquid or refill liquid is received." *Id.* at 29.

We reproduce Petitioner's annotated version of Hearn's Figure 2, below.

[9] As we find in our analysis of the "fluid communication" limitation of claim 1, Hearn discloses that the liquid storage portion comprises at least two parts in fluid communication with each other. Specifically, we find that Hearn's reservoir is defined by the portion of the housing that contains capillary plug 30 (first part of the liquid storage portion) and the portion that contains the refill liquid (second part of the liquid storage portion). *See* Section II.D.1.a.3, *supra*.

FIG. 2
(Annotated)



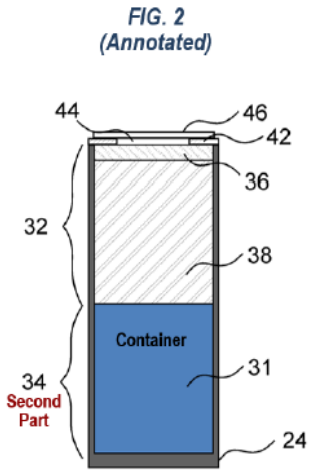
Id. Figure 2 depicts a cross section of an embodiment of Hearn's simulated cigarette device, with annotations identifying the reservoir, the first part of the liquid storage portion with capillary plug 30, in yellow and peach, and the second part of the liquid storage portion for holding liquid, in blue. Figure 2 also depicts filing valve 6 (not labeled in the figure), which is located at the right end of Hearn's simulated cigarette device and allows the device to be refilled with liquid. *See* Ex. 1004 ¶ 31. As Petitioner notes, reservoir 5 may be a replaceable component. Pet. 13; *see* Ex. 1004 ¶ 31.

Petitioner explains that "[t]he function of the second part [of Hearn's liquid storage portion] is to supply liquid to the second capillary material in the capillary plug." Pet. 29. As depicted in Hearn's Figure 2 and explained in Hearn, "capillary plug 30 . . . extends for substantially the entire length of the reservoir, although there is a gap 51 between the end of the rod and the refill valve 6." Ex. 1004 ¶ 38; *see also* Pet. 13 ("Within the reservoir is a capillary plug (30), which extends for substantially the entire length of the reservoir with the exception of a gap where liquid can be received."). Petitioner asserts that "Hearn discloses: 'the plug does not occupy the full cross-section of the reservoir for a substantial proportion of the length of the reservoir to allow a liquid flow path within the reservoir alongside the porous plug.'" Pet. 29 (quoting Ex. 1004 ¶ 15, and also referencing

Ex. 1004 ¶¶ 14, 38); *see, e.g.*, Ex. 1004 ¶ 38 (stating that capillary "plug 30 does not fill the entire cross-section of the reservoir, . . . [which] allows refill material to pass along this gap and be absorbed along the length of the rod, rather than all of the refill liquid having to enter through the end of the" plug).

Petitioner concludes that "Hearn thus discloses a second part of the liquid storage portion comprising a container (the space within the reservoir, including gap 31) configured to hold the liquid aerosol-forming substrate (inhalable composition, refill liquid) and to supply the liquid to the second capillary material." Pet. 29–30 (referencing Ex. 1002 ¶ 103).

Petitioner argues that "[t]o the extent the '556 [p]atent discloses any kind of 'container,' Hearn does also." *Id.* at 30 (providing an annotated version of the '556 patent's Figure 2, which illustrates second part 34 as housing 24 surrounding an empty space). Petitioner also directs us to the disclosure in the '556 patent stating that "second part 34 of the liquid storage portion is an empty tank." *Id.* We reproduce Petitioner's annotated version of Figure 2 from the '556 patent.



Pet. 30. Figure 2 from the '556 patent depicts "a cartridge with porous medium." Ex. 1001, 10:29. Petitioner provides annotations that identify the

second part of the liquid storage portion 34, and an area colored blue and labeled "container." The region labeled as "container," is located below second capillary material 38, which is below first capillary material 36, with both materials positioned in the first part of the liquid storage portion 32. *See id.* at 11:64–12:32 (describing Figure 2).

(2) Patent Owner's counter arguments

Patent Owner argues that Petitioner identifies empty space in Hearn as corresponding to the recited container, and a container must be "an 'object' or a 'thing.'" PO Resp. 11–12. Patent Owner argues that interpreting the recited "container" to be "empty 'space'" would eliminate the requirement that the second part of the liquid storage portion comprise a container. *Id.* at 12.

Patent Owner states that "claim 25 recited 'the **second part** of the liquid storage portion **is substantially empty** and is configured to hold a liquid aerosol-forming substrate.'" PO Resp. 13 (emphasis in original). Patent Owner argues that this recitation differentiates a recitation of empty space from claim 1's recitation of a container. *Id.* at 12–13.

Patent Owner also argues that our understanding of Petitioner's position as stated in the Institution Decision is incorrect. PO Resp. 14. In that Decision, we stated that "[w]e understand Petitioner to contend that the identified housing satisfies the housing limitation of claim 1 and also serves as the recited container, as it contains the liquid aerosol-forming substrate." Inst. Dec. 21 (citing Pet. 29–30). Patent Owner argues that "[t]he Petition identifies only 'the space within the reservoir, including gap 31' as the 'container,' [and that] "Petitioner never identified the 'housing' as the claimed 'container.'" PO Resp. 14.

Patent Owner argues that Petitioner identifies Hearn's reservoir as corresponding to the recited housing in claim 1. PO Resp. 14. Patent Owner argues that neither the Board in its Institution Decision nor Petitioner can identify Hearn's reservoir as the "container," "because the claims require the 'container' to be part of the '**second part** of the liquid storage portion.'" *Id.* at 14–15. Patent Owner argues that the second part of the liquid storage portion cannot comprise the reservoir because Petitioner contends that the reservoir is the housing, which comprises the first and second parts of the liquid storage portion, as alleged by Petitioner. *Id.* at 15.

Patent Owner also argues that Petitioner's comparison of Hearn's disclosure to Figure 2 of the '556 patent "is irrelevant." PO Resp. 15. Patent Owner argues that Figure 2 of the '556 patent need not show the claimed container. *Id.* at 15–16. Also, Patent Owner argues that Petitioner's comparison of Hearn's disclosure to the '556 patent's Specification identifying an "empty tank" fails, as Petitioner does not identify an empty tank in Hearn. *Id.* at 16–17.

(3) Petitioner's reply to Patent Owner's counter arguments and Patent Owner's response to the reply arguments

Petitioner argues that claim 1 does not require the first part of the liquid storage portion, which comprises the capillary materials, to be physically separate from the second part, which comprises the container. Pet. Reply 4. Petitioner argues that the only requirement in claim 1 is that the two parts be in fluid communications with one another. *Id.*

Petitioner argues that its mapping of Hearn to the "container" limitation of claim 1 does not eliminate the requirement for a container, as the structure is the portion of the housing that does not include the capillary

material. Pet. Reply 4–5. Petitioner also argues that Patent Owner's reliance on the language of claim 25 does not differentiate it from claim 1, as a container or tank may be substantially empty as recited in claim 25. *Id.* at 5.

Petitioner argues that the Specification of the '556 patent does not identify a standalone container that is physically separate from the housing. Pet. Reply 5. Petitioner argues that, as we determined in our Institution Decision, the Specification's detailed description identifies housing 24 as containing the liquid aerosol-forming substrate, rather than a separate, standalone structure. *Id.* at 6. Petitioner adds that, in describing Figures 4 and 5, the Specification of the '556 patent identifies the inside of the housing as forming the tank reservoir. *Id.* at 7.

With respect to Patent Owner's contentions concerning Hearn, Petitioner argues that "[t]he Petition . . . identified a second part of Hearn's reservoir structure 5 as comprising the claimed 'container' that is 'configured to hold the liquid aerosol-forming substrate.'" Pet. Reply 8 (citing Pet. 29–30); *see also id.* (providing an annotated version of Hearn's Figure 2, showing how the reservoir is parsed into a first part and a second part). Petitioner argues that, in our Institution Decision, we "readily understood that the Petition does not rely on 'empty space' (alone) as being the 'container,' and determined that Hearn's housing '**encloses a reservoir** including capillary plug 30 and the liquid aerosol-forming substrate.'" *Id.* at 9 (emphasis in original).

Petitioner argues that Hearn also discloses a standalone container, as Hearn discloses an alternative embodiment where reservoir 5 is a replaceable component. Pet. Reply 9 (citing Pet. 13, 19, and referencing Ex. 1004 ¶ 31). Petitioner explains that, "[i]n this alternative embodiment,

in order for Hearn's reservoir 5 to be replaceable, it would necessarily be physically separate and removable from outer housing 1." *Id.* at 10 (citing Pet. 20–21).

Patent Owner states that it does not dispute that a single prior art structure can serve as both the housing and the container, as we determined in our Institution Decision. PO Sur-reply 2 (citing Inst. Dec. 25). That is, Patent Owner argues that Petitioner mischaracterizes the dispute as Patent Owner requiring a standalone container. *Id.* Patent Owner argues that the issue is that Petitioner identifies "'**space** within the reservoir' of Hearn as the claimed 'container,'" rather than a structure. *Id.* (emphasis in original). Patent Owner argues that, because a container is an object, it cannot correspond to the remaining space in Hearn, as Petitioner contends.

Patent Owner argues that Petitioner's "new theory" that "'a second part of Hearn's reservoir structure 5' corresponds to the claimed 'container,'" is not in the Petition, as the Petition does not identify a "reservoir structure." PO Sur-reply 3. Patent Owner adds that "Petitioner's new assertion that 'a second part of Hearn's reservoir structure 5' is the claimed 'container' fails on the merits," because, again, this assertion relies on empty space not occupied by the capillary material. *Id.*

Patent Owner also argues that, to the extent that Petitioner contends that the structure of reservoir 5 is the recited container, that cannot be correct, as this structure includes both the first and the second parts of the alleged liquid storage portion, which is contrary to the language of the claims. PO Sur-reply 4.

Patent Owner also argues that Petitioner's reliance on Hearn's alternative embodiment was not identified in the Petition as satisfying the

"container" limitation, and also the contention fails on the merits for the same reason as Petitioner's reliance on reservoir 5. PO Sur-reply 4.

(4) Analysis

We find, on the complete trial record, that Petitioner demonstrates, by a preponderance of the evidence, that Hearn discloses the subject matter of the "container limitation" of claim 1. We have considered Patent Owner's arguments, but find that Petitioner's arguments and evidence are persuasive to show that the claim limitation is taught by the prior art.

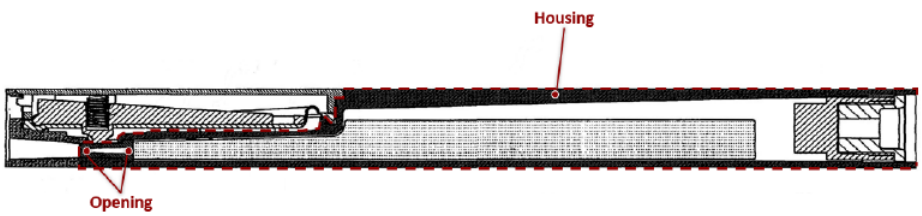
As an initial matter, both parties address, in differing degree, our preliminary analysis in the Institution Decision of whether a single structure, the structure defining Hearn's reservoir 5, can satisfy two distinct claim limitations of claim 1—the housing limitation and the container limitation. *See* PO Resp. 14; Pet. Reply 2–8; PO Sur-reply 2. In our Institution Decision, we looked to the claim language and Specification to determine whether a single structure can satisfy two distinct claim limitations. *See* Inst. Dec. 23–25; *see also Powell v. Home Depot U.S.A., Inc.*, 663 F.3d 1221, 1231–32 (Fed. Cir. 2011) (evaluating the issue in an infringement context); *cf. Applied Med. Res. Corp. v. U.S. Surgical Corp.*, 448 F.3d 1324, 1333 n.3 (Fed. Cir. 2006) ("[T]he use of two terms in a claim requires that they connote different *meanings*, not that they necessarily refer to two different *structures*.") (emphasis in original)).

We determined, in light of the claim language and Specification, that a single prior art structure may correspond to the recited housing and container of claim 1. Inst. Dec. 23–25. Based on the parties' briefing, it appears that this determination is not in dispute, and we maintain that determination without further addressing it here. *See* PO Sur-reply 2 ("Patent Owner does not dispute the Institution Decision's finding that 'a

single prior art structure may correspond to the recited housing and container.'" (emphasis omitted)); Tr. 9:4–6 ("[Patent Owner] say[s] in the [S]ur-reply that they no longer contest the finding in the institution decision that a single prior art structure can be both the housing and the container.").

We do not agree with Patent Owner's characterization that Petitioner does not identify structure in Hearn as corresponding to the recited container. We recognize that the Petition uses the phrases "remaining space" and "space within the reservoir" in describing how Hearn teaches or suggests the subject matter of the "container" limitation of claim 1. *See* Pet. 29. These phrases, read in context, refer to structure formed by the housing of Hearn's simulated cigarette device. *See, e.g.*, *id.* at 19 ("Hearn discloses a simulated cigarette device 1 having a cartridge in the form of reservoir 5 containing a liquid inhalable composition and a capillary plug 30, as illustrated in [Hearn's Figure 2]." (referencing Ex.1004 ¶ 3)); 20 ("In one embodiment, as shown in annotated F[igure] 2 below, Hearn discloses a pressurized reservoir that forms a housing (dashed red lines) containing the inhalable composition."); 21 ("Hearn thus discloses a liquid storage portion including a housing (the reservoir that contains the inhalable composition) configured to hold a liquid aerosol-forming substrate (the inhalable composition)"). We reproduce one of Petitioner's annotated version of Hearn's Figure 2, below.

FIG. 2
(Annotated)



Pet. 21. Figure 2 depicts a cross section of an embodiment of Hearn's simulated cigarette device, with annotations for the housing and its opening shown in red. Ex. 1004 ¶¶ 27, 28; Pet. 21. We find that Petitioner relies on the physical structure of Hearn's housing as corresponding to the recited container, with this container defining a volume. And, Petitioner directs us to the volume of this structure not occupied by capillary plug 30 as performing the recited function for the container, that is, being "configured to hold the liquid aerosol-forming substrate . . . and to supply the liquid to the second capillary material." *See* Pet. 29–30 (contending that the second part of the liquid storage portion—that structure defining a volume of the reservoir not occupied by the capillary plug—as being configured to hold the liquid aerosol-forming substrate, that is, "where liquid or refill liquid is received"). Patent Owner's argument ignores that physical structures of Hearn's device define the volume or space that *contains* Hearn's liquid.

We do not agree with Patent Owner that Petitioner offers a "new theory" in its Petitioner Reply that the corresponding structure is the "reservoir structure." PO Sur-reply 3. In our view, this characterization is not a new theory, but instead, reflects Petitioner's position in the Petition that the structure of Hearn's simulated cigarette that forms the reservoir volume corresponds to the recited container, as that structure contains the liquid aerosol-forming substrate. *See* Pet. 29–30.

We have also considered Patent Owner's argument that Hearn's housing cannot form the structure for the container because claim 1 requires the *second* part of the liquid storage portion to comprise the container, and Petitioner contends that Hearn's housing corresponds to both the first and second parts of the liquid storage portion. PO Resp. 14–15. We find that Petitioner correctly parses the housing structure forming Hearn's reservoir

and shows persuasively that it meets the functional language recited in claim 1. More particularly, Petitioner shows persuasively that Hearn's housing is configured to hold a liquid aerosol-forming substrate in the reservoir formed by the housing. *See* Pet. 20–21; Ex. 1004 ¶¶ 31, 38, Fig. 2. One part of the reservoir formed by the housing structure includes first and second capillary materials, configured as recited in claim 1. Pet. 22–25; Ex. 1004 ¶¶ 17, 38, 39, Fig. 2. The other part of the reservoir formed by the housing structure is configured to hold a liquid aerosol-forming substrate. Pet. 29–30; Ex. 1004 ¶¶ 15, 38, Fig. 2. The two parts are in fluid communication with each other. Pet. 21–22; Ex. 1004 ¶¶ 15, 38.

We agree with Petitioner that its position as to Hearn is consistent with the '556 patent's disclosure. The detailed description in the '556 patent is directed to an embodiment where the second part of the liquid storage portion is defined by housing 24 containing the liquid aerosol-forming substrate. *See* Ex. 1001, 11:64–12:32, Fig. 2 (depicting housing 24 surrounding second part 34 and not depicting a container), Fig. 3 (showing an exploded image of the described cartridge and depicting housing 24 with no other container); *see e.g., id.* at 6:32–35 ("The capillary material is in fluid connection with a liquid reservoir, wherein the liquid reservoir is provided in the part of the housing that is not occupied by the capillary material."); 12:1–3 ("The second part 34 of the liquid storage portion is an empty tank that can be filled or partly filled with liquid aerosol-generating substrate.").

The term "container" is used three times in the '556 patent, including once in claim 1. In one instance, in summarizing "a first aspect of the invention," the Specification states that "[t]he second part of the liquid storage portion comprises a container for holding aerosol-forming substrate

in liquid form and preferably arranged for supplying the liquid to the second capillary material." Ex. 1001, 1:58–2:5. The very next line, which is still describing the "first aspect of the invention," states "[t]he second part of the liquid storage portion may comprise a tank that is substantially empty and is suitable for holding aerosol-forming substrate in liquid form." *Id.* at 2:5–8. This summary indicates that the container may be the "empty tank." The Specification expressly identifies second part 34, depicted in Figures 2 and 3 of the '556 patent, as "an empty tank." *See* Ex. 1001, 12:1–3; *see also* 13:17–21 ("The open end of the cylindrical housing at the right hand side in F[igure] 4 is provided with a closure, such that the inside of the cylindrical housing forms a tank reservoir for holding liquid aerosol-generating substrate."), 13:40–53 ("Again, the open end of the cylindrical housing at the right hand side in F[igure] 5 is provided with a closure, such that the inside of the cylindrical housing forms a tank reservoir for holding liquid aerosol-generating substrate."). As such, we agree with Petitioner that Hearn's housing, which houses the capillary material and liquid aerosol-forming substrate, is comparable to the embodiments depicted in Figures 2–5 of the '556 patent, and described in the detailed description. *See* Pet. 30; Pet. Reply 6–7. The Specification does not include any written description of a "container," or how the container would be separate from the housing, other than the reference to a "tank."

For the reasons above, we find, on the complete record, that Petitioner demonstrates, by a preponderance of the evidence, that Hearn teaches or suggests the subject matter of the "container" limitation of claim 1.

Because we find that Hearn alone satisfies this limitation, we need not address Petitioner's alternative argument concerning modifying Hearn with Rabin's teachings of a container. *See* Pet. 30–31. Also, we need not address

Patent Owner's counter arguments directed to this alternative position. *See* PO Resp. 19–23.

c) Conclusion – claim 1

Upon review of the complete trial record, we determine Petitioner has demonstrated, by a preponderance of the evidence, that claim 1 is unpatentable under 35 U.S.C. § 103 over Hearn alone.

2. Dependent claims 3–9, 15, 18, 20, and 21

Petitioner contends that dependent claims 3–9, 15, 18, 20, and 21 are unpatentable as obvious over Hearn alone or Hearn in combination with Rabin. Pet. 11. We address each of these claims below. Patent Owner does not dispute Petitioner's contentions with respect to any of the dependent claims except claims 4, 18, and 21. *See* PO Resp. 24–31.

a) Disputed dependent claims – the pore size claims

Four of the challenged dependent claims recite specific fiber size or pore size ranges. *See, e.g.*, Ex. 1001, 14:54–56 (providing claim 4, which requires the first capillary material to have a fiber size or pore size of between 0.1 to 50 μm); *id.* at 14:63–65 (claim 8), 15:39–41 (claim 18), 15:46–48 (claim 21). The parties dispute whether Petitioner has shown, for Ground 1, that the subject matter of claims 4, 18, and 21[10] are rendered obvious over the prior art.

(1) Claims 4 and 18

Claim 4 depends from claim 1 and recites "wherein the first capillary material has a fiber size or pore size of between 0.1 to 50 μm." Ex. 1001, 14:54–56. Claim 18 depends from claim 1 and recites "wherein the first capillary material has a fiber size or pore size of between 0.5 to 10 μm." *Id.*

[10] We address claim 8, which is not in dispute, later in this Decision.

at 15:39–41. Petitioner groups its contentions for these two claims together. We turn first to Petitioner's contentions, then Patent Owner's counter arguments, Petitioner's reply to those arguments, and finally Patent Owner's response to the reply arguments, before turning to our analysis.

(a) Petitioner's contentions

Petitioner contends that "Hearn discloses a range of potential pore sizes for the capillary plug, stating, '[w]hen detailing the precise characteristics, the pore radii are between 50 and 500 microns, preferably 100-300 and most preferably 100-150 microns." Pet. 33 (referencing Ex. 1004 ¶ 19). Petitioner argues that "Hearn's disclosed range includes a pore size of 50 microns, meeting the claim 4 recitation of 'pore size of between 0.1 to 50 μm.'" *Id.* Petitioner adds that "Hearn teaches that it would be routine and obvious for a [person having ordinary skill in the art] to use materials with differing pore sizes in order to 'fit the optimum performance of the flow of aerosol' in the device." *Id.* (referencing Ex. 1004 ¶ 22).

Petitioner also contends that "Rabin discloses a first capillary material (porous component 102) with 'a mean pore size of about 1 micron (μm),' falling within claim 4." Pet. 33.[11] Petitioner concludes that

> Given the wide range of materials disclosed in Hearn and Rabin as suitable for the first and second capillary materials, it would

[11] At oral argument, Petitioner was asked "For the dependent claims that recite specific ranges for pore size and density for either the first or second capillary materials, does Petitioner rely on a combination of Hearn and Rabin?" Tr. 15:17–19. Petitioner answered, "I don't think anywhere that we suggested that the materials specifically given in Rabin should be substituted into the Hearn device, but we do look to Rabin for demonstrating state of the art and the fact that materials with the pore sizes claimed were known in the art." *Id.* at 16:8–11.

> have been obvious to a [person having ordinary skill in the art] to use pore sizes in the range of between 0.1 to 50 μm (including the subset range of 0.5 to 10 μm) for the first capillary material.

Id. (referencing Ex. 1002 ¶ 115). Mr. Kodama's testimony is nearly the same as quoted above, and he does not provide any additional bases for his opinion. *See* Ex. 1002 ¶ 115.

(b) Patent Owner's counter arguments

Patent Owner argues, with respect to claim 4, that Hearn's disclosed range does not fall with the recited range, as Hearn discloses pore radii, and the claimed "pore size" would be the pore diameter. PO Resp. 24–25. Patent Owner explains that Hearn discloses ranges for pore size, as that term is properly construed, of between 100 and 1,000 microns—that is, twice the pore radius. *Id.* at 25. Patent Owner asserts that this range is "plainly outside the claimed ranges" for claims 4 and 18. *Id.*

As to Petitioner's reliance on Rabin's teachings, Patent Owner argues that Petitioner fails to explain why a person having ordinary skill in the art would modify Hearn's capillary plug, with a smallest pore size of 100 microns, to a pore size of 1 or 20 microns, as disclosed in Rabin. PO Resp. 27 (referencing Ex. 2030 ¶¶ 28, 30–33). Patent Owner argues that "Hearn warns against decreasing the pore size." *Id.* at 27–28 (quoting Ex. 1004 ¶ 21). Patent Owner argues that "decreasing the Hearn pore size would significantly decrease the permeability of Hearn's capillary plug . . ., which is contrary to Hearn's teachings of using an 'open cell, reticulated structure' to **increase** foam permeability and allow vaporization to be achieved with the liquid/liquid propellant mixture and without a heater." *Id.* at 28 (referencing Ex. 1004 ¶¶ 19, 23; Ex. 2030 ¶¶ 28, 30–33) (emphasis in original).

Patent Owner concludes that a person having ordinary skill in the art "reading Hearn . . .would also be discouraged by Hearn's aforementioned warnings and teachings from decreasing the pore size to the claimed ranges or Rabin's pore size of 1 or 20 microns—again, all of which are far smaller than the smallest pore size taught by Hearn (100 microns)." PO Resp. 28 (referencing Ex. 1004 ¶ 21; Ex. 2030 ¶¶ 28, 30–33). Patent Owner also argues that a person having ordinary skill in the art would not have looked to Rabin, as its device functions differently from Hearn's device, including using a heater to vaporize the liquid. *Id.* at 29. Patent Owner adds that Hearn's capillary plug is optimized for generating vapor without a heater, "which requires a very porous 'open cell, reticulated structure' and flow rate of between 60 and 80 mm^3 per second—these factors are not accounted for with respect to the capillary materials used by Rabin for wicking the liquid to be vaporized . . . at [Rabin's] heater." *Id.* (referencing Ex. 1004 ¶ 19).

Patent Owner also argues that a person having ordinary skill in the art would not have been motivated to use Rabin's pore size, as Rabin uses a different liquid, and that the appropriate capillary material would differ between Hearn and Rabin for this reason as well. PO Resp. 29–30 (relying, in part, on Ex. 2029 (Kodama Deposition testimony), 27:9–14, 64:10–17).

With respect to Petitioner's reliance on Hearn's teachings to "fit the optimum performance of the flow or aerosol," Patent Owner argues that Petitioner takes this teaching out of context. PO Resp. 30 (referencing Ex. 1004 22; Ex. 2030 ¶ 29). Patent Owner argues that "Hearn states that the 'pore size and density level' can be '**graduated across the device**, to fit the optimum performance of the flow of aerosol for the user.'" *Id.* (quoting Ex. 1004 ¶ 22) (emphasis in original). Patent Owner argues that Petitioner fails to explain how Hearn's teaching of optimizing the graduation of pore

size along the length and width of the capillary plug would motivate a person having ordinary skill in the art to modify Hearn's plug to have a pore size far less than that disclosed in Hearn and, instead, provides only conclusory assertions of obviousness. *Id.* at 31 (referencing Ex. 1004 ¶ 21; Ex. 2030 ¶ 29; *see also id.* ¶ 28, 30–32).

(c) Petitioner's reply arguments and Patent Owner's sur-reply arguments

Petitioner replies that Hearn's disclosed pore radii (50 to 500 microns) overlaps the claimed range in claim 4 and is "close" to the top of the recited range for claim 18. Pet. Reply 20. Petitioner bases this assertion on its construction of the term "pore size," which is broad enough to encompass pore radii. *See* Pet. Reply 19–20.

Petitioner also argues that, even under Patent Owner's construction, which we adopt here, the recited ranges in claims 4 and 18 "would still have been obvious in view of Hearn, Rabin, and the knowledge of a" person having ordinary skill in the art." Pet. Reply 20. Petitioner argues that an artisan of ordinary skill would have known that pore sizes other than those taught in Hearn could have been used. Petitioner argues that Hearn teaches that pore radii and density of the capillary material "should be kept in equilibrium as to provide the maximum amount of performance for the device." *Id.* at 21 (quoting Ex. 1004 ¶ 21). Petitioner adds that Hearn teaches selecting "appropriate foam wicking characteristics," considering maximum rise-height and permeability. *Id.* (referencing Ex. 1004 ¶ 18).

Petitioner argues that "Hearn discloses that, depending upon the fluid, 'the capillary plug can have a pore size and density level . . . to fit the optimum performance of the flow of aerosol for the user." Pet. Reply 21 (referencing Ex. 1004 ¶ 22). Petitioner adds that Hearn teaches enhancing

the capillary action of the plug by graduating the pore size, such as by compressing the material or using two different materials with different pore sizes, and that the material can be "tuned for pore radii." *Id.* (referencing Ex. 1004 ¶¶ 17, 25). Petitioner argues that, these broad teachings would have led a person having ordinary skill in the art to understand that Hearn was not limited to is disclosed pore size ranges. *Id.*

Petitioner also argues that, "where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation." Pet. Reply 22 (quoting *E.I. DuPont de Nemours & Co. v. Synvina*, 904 F.3d 996, 1006 (Fed. Cir. 2018)). Petitioner explains that "discovery of an optimum value of a result effective variable in a known process is ordinarily within the skill of the art" (quoting *In re Boesch*, 617 F.2d 272, 276 (C.C.P.A. 1980)), and "[a] recognition in the prior art that a property is affected by the variable is sufficient to find the variable result-effective" (quoting *In re Applied Materials*, 692 F.3d 1289, 1297 (Fed. Cir. 2012)). *Id.*

Petitioner argues that Hearn and other prior art references recognize that pore size is a result effective variable. Pet. Reply 22 (referencing Ex. 1004 ¶¶ 17, 18, 20, 22; Ex. 1005, 6:14–18; Ex. 1015 ¶¶ 20–21; Ex. 1017, 6:27–39; Ex. 1020, 22:4–8, 24:50–65). Petitioner also argues that the parties' declarants also agree that pore size is a result effective variable. *Id.* (referencing Ex. 1002 ¶ 45; Ex. 2030 ¶¶ 27, 59).

Petitioner argues that Hearn expressly instructs a person having ordinary skill in the art to select pore size and density level for the capillary material "to 'fit the optimum performance of the flow of aerosol for the user.'" Pet. Reply 23 (referencing Ex. 1004 ¶ 22). Petitioner adds that Mr. Kodama testifies that "it would be routine for a [person having ordinary

skill in the art] to try various densities and pore sizes of [capillary] materials to optimize liquid flow." *Id.* (quoting Ex. 1002 ¶ 46). Petitioner concludes that it would have been obvious to experiment with pore sizes of known materials to optimize flow rate, including materials having pore sizes in the recited ranges. *Id.* at 24 (citing *Ohio Willow Wood v. Alps South*, 735 F.3d 1333, 1343–44 (Fed. Cir. 2013); *In re Huang*, 100 F.3d 135, 139 (Fed. Cir. 1996)).

Next, Petitioner argues that the pore sizes disclosed in Hearn, Rabin, Young,[12] He,[13] and Ward[14] ("contemporaneous prior art") demonstrate that a person having ordinary skill in the art would have had a reasonable expectation of success in selecting pore sizes from materials known as of the priority date of the '556 patent. Pet. Reply 24 (referencing Ex. 1002 ¶¶ 35–36, 45–46, 178–193, 206–212; citing *Randall Mfg. v. Rea*, 733 F.3d 1355, 1362–63 (Fed. Cir. 2013)).

Petitioner argues that Patent Owner's reliance on Hearn's statement about cells of the capillary plug that, if too small might limit flow rate, is misplaced. Pet. Reply 25 (citing PO Resp. 27–31; referencing Ex. 1004 ¶ 21). Petitioner argues that Hearn does not identify what size would be too small. *Id.* Petitioner adds that this statement in Hearn follows a discloses that the pore radii and foam density must be kept in equilibrium to maximize performance. *Id.* Petitioner argues that, in light of Hearn's complete teachings, this "isolated statement about 'cells' that are 'too small' and 'might' limit flow rate for certain fluids would not have discouraged a [person having ordinary skill in the art] from selecting pore sizes within the

[12] US 6,585,509 B2, issued July 1, 2003 (Ex. 1017, "Young").
[13] US 2005/0191481 A1, published Sept. 1, 2005 (Ex. 1015, "He").
[14] US 7,888,275 B2, issued February 15, 2011 (Ex. 1019, "Ward").

claimed ranges for all potential fluids." *Id.* (citing *Fleming v. Cirrus Design*, 28 F.4th 1214, 1224 (Fed. Cir. 2022);[15] *In re Geisler*, 116 F.3d 1465, 1471 (Fed. Cir. 1997)).

In its Sur-reply, Patent Owner reiterates that Hearn discloses pore sizes that are at least twice and, preferably from twelve to twenty times the recited pore size ranges of claims 4 and 18. PO Sur-reply 5, 7.

Next, Patent Owner argues that Petitioner fails to establish that a person having ordinary skill in the art would have been motivated to modify Hearn to arrive at the recited pore size range—instead, Petitioner merely argued that pore sizes in the claimed range could have been used. PO Sur-reply 7–8. Patent Owner adds that Petitioner fails to explain why Hearn's statements about selecting appropriate wicking characteristics with useful parameters and recognizing the pore radii and foam density are to be kept in equilibrium would motivate a person having ordinary skill in the art to modify Hearn to arrive at the claimed ranges, which represent pore sizes that are much smaller than those disclosed in Hearn. *Id.* at 8.

Next, Patent Owner again criticizes Petitioner's reliance on the "fit the optimum performance of the flow of aerosol" language in Hearn as a teaching to modify the pore size. PO Sur-reply 9. Patent Owner argues that this teaching is directed at graduating the pore size across the capillary plug. *Id.* (referencing Ex. 1004 ¶ 22). Patent Owner directs us to testimony from Dr. Abraham, who declares that a person having ordinary skill in the art would understand this teaching "to simply mean that Hearn's pore sizes can be 'graduated' (or varied) 'across the device' to 'fit the optimum

[15] Cited as "2022 WL 710549, at *7 (Fed. Cir. Mar. 10, 2022)" in the Petitioner Reply.

performance of the flow of aerosol.'" *Id.* (referencing Ex. 2030 ¶ 29). Patent Owner adds that Hearn discloses the pore sizes that are appropriate for its device (100 to 1,000 microns, with a preferred range of 200 to 600 microns). *Id.* at 9–10.

Patent Owner characterizes Petitioner's argument concerning "result-effective variables" as "new" and, as such, waived by Petitioner. PO Sur-reply 10. Patent Owner also argues that "Petitioner . . . ignores that obviousness requires more than merely establishing that a variable is 'result-effective.' . . . Petitioner must also prove that 'the general conditions of a claim are disclosed' in the prior art (such as Hearn) by demonstrating, for example, that the prior art discloses 'values overlapping the ranges claimed.'" *Id.* (citing *In re Applied Materials, Inc.*, 692 F.3d at 1295). Petitioner argues that each of the cases upon with Petitioner relies in support of its position directed to a result effective variable include overlapping ranges. *Id.* at 10–11. Patent Owner adds that, "[r]egardless, Petitioner failed, and still fails, to explain (i) ***why*** it would have been routine optimization to arrive at the claimed invention, and (ii) ***why*** a person of ordinary skill in the art would have had a reasonable expectation of success in achieving the claimed range." *Id.* at 11 (citing *In re Stepan Co.*, 868 F.3d 1342, 1346–48 (Fed. Cir. 2017)) (emphasis in original).

As for Petitioner's reliance on state of the art evidence from Rabin, Young, He, and Ward, Patent Owner argues that merely demonstrating that the pore sizes were disclosed in the prior art does not demonstrate that modifying Hearn to arrive at the recited ranges would have been obvious. PO Sur-reply 12–13.

Finally, Patent Owner argues that "Hearn provides a clear and unmistakable warning to a [person having ordinary skill in the art] seeking

'to provide the maximum amount of performance for [its] device' to avoid pores that are too small." PO Sur-reply 13 (referencing Ex. 1004 ¶ 21). Patent Owner adds that Hearn discloses preferred pore sizes, which puts the phrase "too small" into perspective." *Id.* at 13–14. Patent Owner concludes that a person having ordinary skill in the art "reading Hearn's warnings against making pores 'too small' would have thus been discouraged from drastically reducing the pore sizes as Petitioner proposes." *Id.* at 14.

(d) Analysis – claims 4 and 18

For the reasons discussed below, we determine, on the complete trial record, that Petitioner demonstrates, by a preponderance of the evidence, that the subject matter of dependent claims 4 and 18 are obvious over Hearn.

We start our analysis with an understanding of the claimed pore size ranges for the first capillary material as disclosed in the '556 patent. The Specification describes that "[t]he first capillary material may have a fiber size/pore size of between 0.1 to 50 μm, preferably of between 0.5 to 10 μm and most preferably of about 4 μm." Ex. 1001, 4:66–5:1. The description adds that this "material has a density of below 2 g/ml, and preferably of about 0.5 g/ml." *Id.* at 5:2–3. The Specification describes that this "material can be selected from the group of kevlar felt, ceramic paper, ceramic felt, carbon felt, cellulose acetate, hemp felt, PET/PBT sheet, cotton pad, porous ceramic disc or porous metal disc." *Id.* at 4:41–44.

The Specification does not describe that the disclosed ranges for the first capillary material are "critical" or "produce a new and unexpected result which is different in kind and not merely in degree from the results of the prior art." *Cf. In re Aller*, 220 F.2d 454, 456 (1955). Although the Specification discusses a preferred liquid capacity for the capillary material of the disclosed device, the Specification does not tie the disclosed pore

sizes to this capacity. *See* Ex. 1001, 2:33–34, 4:66–5:1. Nor does the Specification tie the disclosed pore sizes to any preferred materials. *See id.* at 4:41–49, 4:66–5:1, Tr. 49:9–10 (Patent Owner's counsel stating "The patent doesn't tie these pore sizes to material."). As such, we find that the recited porosity values represent workable ranges of values for the first capillary material for the disclosed cartridge.

"[W]here the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation." *In re Aller*, 220 F.2d at 456. The Federal Circuit

> and its predecessors have long held, however, that even though applicant's modification results in great improvement and utility over the prior art, it may still not be patentable if the modification was within the capabilities of one skilled in the art, unless the claimed ranges 'produce a new and unexpected result which is different in kind and not merely in degree from the results of the prior art.'

In re Huang, 100 F.3d 135, 139 (Fed. Cir. 1996) (citing *In re Aller*, 220 F.2d at 456).

The "rule" in *Aller* "is limited to cases in which the optimized variable is a 'result-effective variable.'" *In re Applied Materials, Inc.*, 692 F.3d 1289, 1295 (Fed. Cir. 2012); *see, e.g.*, *In re Boesch*, 617 F.2d 272, 276 (CCPA 1980) ("[D]iscovery of an optimum value of a result effective variable . . . is ordinarily within the skill of the art."). "[T]he prior art need not provide the exact method of optimization for the variable to be result-effective. A recognition in the prior art that a property is affected by the variable is sufficient to find the variable result-effective." *In re Applied Materials*, 692 F.3d at 1297.

We do not agree with Patent Owner's argument that Petitioner has not demonstrated that the general conditions of claims 4 and 18 are met because

Hearn does not disclose ranges for pore size that overlap the recited ranges. PO Resp. 10–11.[16] Our review of the prevailing law does not seem to be so limited. For example, in *Huang*, the claim at issue recited a range for a thickness ratio of "equal to or larger than approximately 0.18." *In re Huang*, 100 F.3d at 137. The prior art disclosed ratio ranges from 0.111 to 0.142—values all outside of *Huang*'s claimed range. *Id.* at 136. The Court concluded that the claim was obvious because "one of ordinary skill would have experimented with various thicknesses to obtain an optimum range[, and] . . . Huang does not contend that he has achieved unexpected results by increasing the thickness of the polyurethane layer." *Id.* at 139.

We find that Petitioner has demonstrated that the general conditions of claims 4 and 18 are met. As we discussed above in connection with our analysis of claim 1, we conclude that Hearn renders obvious claim 1, finding that Hearn alone teaches or suggests each limitation of claim 1. Claims 4 and 18 each depends from claim 1 and adds only the recited pore size ranges for the first capillary material. So, outside of these pore size ranges, the *general* conditions of claim 1 are satisfied by Hearn.

[16] At one point during oral argument, Patent Owner's counsel seemed to say that, should we determine that Petitioner has demonstrated that Hearn teaches or suggests the subject matter of claim 1, then the "general conditions" of claims 4 and 18 are met (ignoring, in the hypothetical, Patent Owner's teaching away argument). *See* Tr. 61:11–21; *but see id.* at 61:7–10 ("I think the overlapping ranges is one aspect of the general conditions. So if Your Honors found that Hearn discloses everything else, we would agree that Hearn discloses the general conditions of the claim, setting aside the teaching away issue."); PO Sur-reply 10–11 (arguing that Petitioner must demonstrate that the general conditions of the claim are met by demonstrating that Hearn discloses ranges that overlap the recited ranges).

The parties do not dispute that pore size is a result effective variable. *See, e.g.*, Tr. 57:17–22 (Patent Owner's counsel agrees that "a person of ordinary skill in the art at the time of the invention would have understood that pore size is a result-effective variable for how well the liquid moves through the porous material"); Ex. 2030 ¶¶ 27 ("pore size strongly influences the ability of a porous material to transport and to hold liquid within the pores"), 59 ("pore size . . . is something [persons having ordinary skill in the art] consider when optimizing liquid flow"). And Hearn supports this finding. Hearn teaches that maximum rise height and foam permeability are "two useful parameters describing foam wicking performance," with maximum rise-height being inversely proportional to pore size and foam permeability being proportional to pore size. Ex. 1004 ¶ 18; *see* Pet. Reply 22 (identifying disclosures in Hearn supporting a finding that pore size is a result effective variable).

We do not agree that Petitioner's reliance on pore size as a result effective variable represents a new argument. Although we recognize that Petitioner does not use the words "result effective variable" in the Petition, Petitioner does argue the underlying concept—that the recited range of values are the product of optimization, within the level of ordinary skill. For example, Petitioner contends, in analyzing claim 4, that "Hearn teaches that it would be routine and obvious for a [person having ordinary skill in the art] to use materials with differing pore sizes in order to 'fit the optimum performance of the flow of aerosol' in the device." Pet. 33 (referencing Ex. 1004 ¶ 22); *see also id.* at 32 ("A [person having ordinary skill in the art] would have selected 'average pore size' or 'mean pore size' consistent with Hearn's teaching that pore size and porosity should be calibrated 'to fit the optimum performance of the flow of aerosol for the user.'"); Ex. 1002 ¶ 45

("Prior to the alleged invention date of at least the '556 [p]atent, a [person having ordinary skill in the art] would also have understood that characteristics including pore size, fiber size, porosity, and density for materials used as wicking or capillary materials would impact the flow of liquid in an aerosol-forming device." (referencing Ex. 1004 ¶¶ 21–25)).

Independent of these arguments in the Petition, we find Petitioner's reply arguments responsive to Patent Owner's claim construction from the Patent Owner Response. *See, e.g.*, Pet. Reply 20 ("Even if 'pore size' were limited to the diameter/width of a pore as [Patent Owner] urges, the particular numerical pore size ranges recited in claims 4, 18, and 21 would still have been obvious in view of Hearn, Rabin, and the knowledge of a [person having ordinary skill in the art]").

This is not a case where Petitioner changes its theory midstream. As we discuss above, Petitioner relies on optimization in arguing that the subject matter of claims 4 and 18 would have been obvious. *See, e.g.*, Pet. 33 ("Hearn teaches that it would be routine and obvious for a [person having ordinary skill in the art] to use materials with differing pore sizes in order to 'fit the optimum performance of the flow of aerosol' in the device."). Responsive to Patent Owner's claim construction position, Petitioner frames its arguments from the Petition within the framework of Patent Owner's construction. *Cf. Intell. Ventures I LLC v. EMC Corp.*, 786 F. App'x 1021, 1032 (Fed. Cir. 2019) ("EMC did not abandon its previous theory of prima facie obviousness in favor of a new one, nor did it advance a new theory of invalidity using entirely different references.") (non-precedential); *Infineum USA L.P. v. Chevron Oronite Co.*, 2022 WL 3147683, at *4 (Fed. Cir. Aug. 8, 2022) ("The theory of unpatentability advanced in Oronite's petition remained the same throughout the

proceedings. . . . And the Board's decision held each of the challenged claims obvious on those same grounds.") (non-precedential).

Accordingly, we conclude that the subject matter of claims 4 and 18 represent workable ranges and achieving these range values were well within the level of ordinary skill.

We also find, as discussed above, that the claimed ranges do not "produce a new and unexpected result which is different in kind and not merely in degree from the results of the prior art." *Cf. In re Aller*, 220 F.2d at 456. During oral argument, Patent Owner's counsel was asked if "the '556 patent anywhere describe the recited pore sizes and densities as being critical or delivering certain unexpected results in its application?" Tr. 47:20–22. Counsel responded that the '556 patent describes that "you want to tune the pore sizes between the first and second capillary materials, which will help with the liquid transport," and directed us to Exhibit 1001, 4:50–57. Tr. 48:9–12. Counsel added that "[t]he patent tells . . . you why you need to use different pore sizes, why you need the first capillary material to have smaller pore sizes than the second capillary material. And it tells you the preferred pore sizes, which are then what are claimed." *Id.* at 48:18–49:2.

We do not agree with counsel's characterization of what is claimed. Most importantly, neither claim 4 nor claim 18 requires the first capillary material to have smaller pore sizes than the second capillary material—that requirement is recited in claim 3. *See* Ex. 1001, 14:50–53. Patent Owner does not dispute that Hearn discloses a first capillary material having a smaller pore size than the second capillary material. *See* PO Resp. 24–31 (not disputing dependent claim 3, which requires "an average pore size or porosity of the first capillary material [be] less than an average pore size or

porosity of the second capillary material"(Ex. 1001, 14:50–53). Also, neither claim 4 nor claim 18 provides any limitations on the pore size of the second capillary material. Indeed, as we discussed above, the '556 patent merely discloses ranges of values for the pore sizes for the capillary materials, devoid of any relationship between these ranges of values and the materials used, the specific use of the cartridge, or the specific liquid aerosol-generating medium employed. *See, e.g., id.* at 4:41–49 (providing a list of materials from which "[t]he first capillary material can be selected"), 4:67–5:1 (providing pore size for the first capillary material), 7:8–20 (discussing the nature of the aerosol-forming substrate in broad terms), 11:55–58 ("Furthermore, a capillary assembly in accordance with the disclosure may be used in systems of other types to those already described, such as humidifiers, air fresheners, and other aerosol-generating systems."). We do not agree with Patent Owner that the '556 patent shows unexpected results for the recited ranges of pore size. Even if the recited pore sizes help with liquid transport, the record does not show that this result was unexpected.

We also do not agree with Patent Owner that Hearn discourages a person having ordinary skill in the art from reducing the pore size to within the claimed range. *See* PO Resp. 27–28; PO Sur-reply 13–14. Hearn includes the following disclosure at issue here:

> The pore radii and the density of the foam should be kept in equilibrium as to provide the maximum amount of performance for the device. A capillary plug which has cells that are too small might ultimately limit the flow-rate of formulation from the device and so the performance of the foam must ensure that the delivery of the flow from any angle of orientation is between 60 and 80 mm^3 per second, in order to ensure accuracy and consistency in the emitted dose.

Ex. 1004 ¶ 21. The paragraph concludes with a formula for rise height. *See id.* The previous paragraph provides examples of rise height for medium and high-density Capu-Cell foam materials, and teaches that the greater the foam density, the greater the rise height. *Id.* ¶ 20. The statement about cells being "too small" is a recognition that increasing foam density (which reduces pore size) may increase rise height, the increase is not without limitation, as it could limit flow rate of the liquid. *See id.*; *see also id.* at ¶ 23 (providing the relationship of permeability and pore radius); Ex. 1002 ¶ 124 ("pore size is related to density (i.e. the higher the porosity in a material, the lower the density)"); Ex. 2030 ¶¶ 27 ("[P]ore size strongly influences the ability of a porous material to transport and to hold liquid within the pores, such as by affecting the "rise-height" and permeability as noted by Hearn."), 59 ("[P]ore size (which is related to density) is something [persons having ordinary skill in the art] consider when optimizing liquid flow."). As such, the pore size and foam density values "should be kept in equilibrium as to provide the maximum amount of performance for the device." Ex. 1004 ¶ 21; *see* Pet. Reply 25. Indeed, as Petitioner argues, Hearn recognizes that certain materials would adequately perform even with different liquids, provided the pore size and density are appropriately "tuned." *See* Pet. Reply 25; Ex. 1004 ¶ 25. Accordingly, we find that the statement about pore size being "too small" does not discourage pore sizes within the claim range, but rather teaches that pore size and material density are variables that impact flow performance and must be considered when choosing a porous material and liquid aerosol-forming substrate.

We also do not agree with Patent Owner that Petitioner takes Hearn's directions for optimizing the capillary plug out of context. *See* PO Resp. 30. We reproduce Hearn's paragraph 22, in its entirety, below.

> For solutions where the fluid density and surface tension are different-i.e. by changing the combinations of propellant (for example the more dense HFA227), excipient or active ingredient, the capillary plug can have a pore size and density level, *which can be graduated across the device*, to fit the optimum performance of the flow of aerosol for the user. With this in mind, not only can pore size be graduated upwards towards the distal end, pore size can be graduated across the device, so that smaller pore sizes can form the core of the wicking area, and surround the outlet valve. In practical terms, this is achieved by layering smaller pore sized foam sheet onto larger sheets so that there is a graduation in pore size over the cross sectional area. This means than pore size can graduate across the device as well as along the device to increase performance. In the present case, the plug has been calibrated with the use of a nicotine containing solution.

Ex. 1004 ¶ 22 (emphasis added). This paragraph addresses modifying Hearn's capillary plug if the aerosol-generating solution is different from a solution containing HFA134b. *See id.* at ¶ 20 (discussing examples of rise height using HFA134b). The express direction in Hearn is that "the capillary plug can have a pore size and density level . . . to fit the optimum performance of the flow of aerosol for the user." *Id.* at ¶ 22. That is to say, if a different solution is used, then the pore size and density level of the capillary plug are adjusted to achieve "optimum performance." *Id.*

The omitted language from the sentence (the clause we emphasized in the reproduced paragraph above) is an offset clause that adds "which can be graduated across the device." Ex. 1004 ¶ 22. That is, this additional clause teaches that the pore size and density level *can be* graduated across the device as part of the overall optimization process. The teaching does not limit the optimization of pore size and density level to graduating these properties across the device, as Patent Owner and its declarant argues. Instead, graduating the pore size and density level across the capillary plug

(as well as graduating the pore size along the length of the plug) is one tool that may be used to optimize performance. The teaching, however, is more broadly directed to optimizing the pore size and density level of the material to arrive at an optimal or workable capillary plug.

We credit Mr. Kodama's testimony concerning the teaching of Hearn's paragraph 22, as it correctly parses the language to highlight the broad teaching of adjusting pore size and density level of the capillary plug to arrive to achieve optimum performance of the plug. *See* Ex. 1002 ¶¶ 109–110; *see also* Pet. 32 (relying on Mr. Kodama's testimony concerning Hearn's teaching in paragraph 22); Pet. Reply 21 (same). We do not credit Dr. Abraham's reading of Hearn's paragraph 22, which is contrary to the plain meaning of the paragraph, limiting the teaching to graduating the pore size and density level across the capillary plug. *See* Ex. 2030 ¶ 29; *see also* PO Resp. 31 (relying on Ex. 2030 ¶ 29); PO Sur-reply 9 (same).

We also find, contrary to Patent Owner's argument, that Petitioner provides a reason for modifying Hearn's pore size, taken directly from Hearn—"to 'fit the optimum performance of the flow of aerosol.'" Pet. 33 (referencing Ex. 1004 ¶ 22). As Petitioner argues, "[g]iven the wide range of materials disclosed in Hearn and Rabin as suitable for the first and second capillary materials, it would have been obvious to a [person having ordinary skill in the art] to use pore sizes in the range of between 0.1 to 50 μm (including the subset range of 0.5 to 10 μm) for the first capillary material." *Id.* (referencing Ex. 1002 ¶ 115). Similarly, Hearn discloses that other solutions may be used to generate its vapor, and also discloses that different solution properties may require different material properties to ensure the device works optimally, and that other wicking material may be used. *See* Ex. 1004 ¶¶ 21 (disclosing that rise height is proportional to fluid surface

tension and inversely proportional to fluid density), 22 (discussing modifying the capillary plug for a solution with different fluid density and surface tension); 24 (discussing polyolefin wick material and an exemplary material), 25 (identifying alternative materials), including "polyurethane, Capu-Cell, a polyether/polyester hybrid, neoprene, Basotect and PVA). And as we discussed above, the pore size ranges of claims 4 and 18 represent workable ranges, and it was within the level of ordinary skill to arrive at these values.

Petitioner's citations to state-of-the-art evidence also supports a finding that a person having ordinary skill in the art would have had a reasonable expectation of success in modifying Hearn to arrive at a device with a first capillary material having the recited pore range. *See* Pet. Reply 24 (identifying Hearn, Rabin, Young, He, and Ward); *Ariosa Diagnostics v. Verinata Health, Inc.*, 805 F.3d 1359, 1365 (Fed. Cir. 2015) ("Art can legitimately serve to document the knowledge that skilled artisans would bring to bear in reading the prior art identified as producing obviousness."); *Randall Mfg. v. Rea*, 733 F.3d 1355, 1362–63 (Fed. Cir. 2013) (cited by Petitioner at Pet. Reply 24); *see, e.g.*, Ex. 1015 ¶ 37 (showing examples of porous polymer wicks with pore sizes of between 4.7 and 28.6 microns). As one example, the pore sizes cited in He (Ex. 1015) for a wicking material comparable to that disclosed in Hearn provides evidence in support of a reasonable expectation of success. *See* Ex. 1015 ¶ 37 (identifying three sample pore sizes: 4.7, 10.2, and 28.6 microns).

Patent Owner's reliance on *In re Stepan* is misplaced, as the facts of that case are distinguishable from the facts of the present proceeding. *See* PO Sur-reply 11, 19 (citing *In re Stepan Co.*, 868 F.3d 1342 (Fed. Cir. 2017)). In *Stepan*, the Federal Circuit held that "[t]he Board failed to

explain why it would have been 'routine optimization' to select and adjust the claimed surfactants and achieve a cloud point above at least 70°C" or why a skilled artisan "would have had a reasonable expectation of success to formulate the claimed surfactant system with a cloud point above at least 70°C." *In re Stepan Co.*, 868 F.3d at 1346–47. The Federal Circuit further explained that, for there to be a reasonable expectation of success, "one must be motivated to do more than merely to vary all parameters or try each of numerous possible choices until one possibly arrived at a successful result." *Id.* at 1347. As explained above, however, in this case Hearn identifies the *important parameters* for capillary plug performance—pore size and density. *See* Ex. 1004 ¶¶ 18–25. A person having ordinary skill in the art would not have been left to attempt to optimize every possible combination of variables. And Petitioner directs us to disclosures in Hearn and other state-of-the-art evidence to support its reasons to modify Hearn and the likelihood of succeeding in arriving at a capillary plug with a porosity in the claimed ranges.

The present case is more closely like *In re Huang*. As we discussed briefly above, in *Huang*, the claim at issue recited a range for a thickness ratio of polyurethane to textile "equal to or larger than approximately 0.18," and the prior art disclosed ratio ranges from 0.111 to 0.142—values all less than *Huang*'s claimed range, similar to the express disclosure in Hearn. *In re Huang*, 100 F.3d at 136–137. In *Huang*, the Federal Circuit noted that the applicant argued aspects of the alleged invention that were not part of the claims at issue. *See id.* at 138 ("While this may accurately describe Huang's grips, our obviousness analysis focuses on the invention *as claimed.* Claims 24 and 25 contain no limitation relating to a decrease in the textile layer so as to maintain an overall thickness of the grip."(emphasis in original)).

Similarly, here, Patent Owner argues that the claimed ranges for the pore size of the first capillary material are critical, as "[t]he ['556] patent tells . . . you why you need to use different pore sizes, why you need the first capillary material to have smaller pore sizes than the second capillary material. And it tells you the preferred pore sizes, which are then what are claimed." Tr. 48:18–49:2. Claims 4 and 18, however, do not claim the first capillary material as having smaller pore sizes than the second capillary material or, indeed, any pore size for the second capillary material.

In *Huang*, the Federal Circuit concluded that "one of ordinary skill would have experimented with various thicknesses to obtain an optimum range. Because Huang does not contend that he has achieved unexpected results by increasing the thickness of the polyurethane layer, the Board properly concluded that the prior art grips in combination with Lau created a *prima facie* case of obviousness." *In re Huang*, 100 F.3d at 139. Here, there is no evidence of unexpected results stemming from the recited pore sizes, and Petitioner shows persuasively that one of ordinary skill would have experimented with different pore sizes to achieve a workable range, particularly given Hearn's specific teachings of optimization and the choice of a variety of wicking materials and vaporizing solutions.

For the reasons discussed above, we find that Petitioner has demonstrated, by a preponderance of the evidence, that the subject matter of claims 4 and 18 are unpatentable under 35 U.S.C. § 103 over Hearn alone.

(2) Claim 21

Claim 21 depends from claim 1 and recites "wherein the second capillary material has a fiber size or pore size of between 15 to 40 μm." Ex. 1001, 15:46–48. The parties provide similar arguments for claim 21 as for claims 4 and 18, or otherwise group claim 21 in with arguments for

claims 4 and 18. *See* Pet. 34–35; PO Resp. 24 (including claim 21 with claims 4 and 18); Pet. Reply 20 (same); PO Sur-reply 14 n.2 ("Petitioner's challenges to claim 21, which requires the 'second capillary material' to have a 'pore size of between 15 to 40 μm,' fail for the same reasons.").

For the reasons discussed above in connection with our analysis of claims 4 and 18, we find that Petitioner has demonstrated, by a preponderance of the evidence, that the subject matter of claim 21 is unpatentable under 35 U.S.C. § 103 over Hearn alone.

b) Undisputed dependent claims

(1) Claim 3

Claim 3 depends from claim 1 and recites "wherein an average pore size or porosity of the first capillary material is less than an average pore size or porosity of the second capillary material." Ex. 1001, 14:50–53. Petitioner contends that "pore size in Hearn decreases from the non-compressed second capillary material, further from the outlet valve, to the compressed first capillary material, closer to the opening in the housing." Pet. 32 (referencing Ex. 1004 ¶ 17). Hearn expressly discloses that "[i]n order to enhance the capillary action, the plug preferably has a pore size which decreases towards the outlet valve," that is, for the first capillary material relative to the second capillary material. Ex. 1004 ¶ 17.

Based on our review of the complete trial record, including the identified evidence, we find that Hearn, alone, teaches or suggests the subject matter of claim 3.

(2) Claims 5 and 20

Claim 5 depends from claim 1 and recites "wherein the first capillary material has a density of below 2 g/ml." Ex. 1001, 14:57–58. Claim 20 depends from claim 1 and recites "wherein the first capillary material has a

density of about 0.5 g/ml." *Id.* at 15:44–45. Petitioner contends that Hearn expressly discloses two exemplary capillary materials with densities of 0.06 g/ml and 0.12 g/ml. Pet. 37. Petitioner adds that Hearn discloses other possible materials, "[s]everal [of which] have a density below 2 g/ml, and porous wicks having a density of 0.2 to 1 g/ml were known in the art as suitable for fluid transmission and vaporization by February 2014." *Id.* at 37–38; *see* Ex. 1002 ¶ 127. Petitioner also contends that "[b]ecause pore size is related to density . . ., it would be routine and obvious for a [a person having ordinary skill in the art] to use materials with differing densities in order to 'fit the optimum performance of the flow of aerosol' in the device as taught by Hearn." Pet. 37 (referencing Ex. 1004 ¶ 22; Ex. 1002 ¶ 124).

Petitioner concludes that "[i]t would have been obvious for a [person having ordinary skill in the art] to select as Hearn's first capillary material a material having a density below 2 g/ml as recited in claim 5 or having a density of about 0.5 g/ml[] as recited in claim 20." Pet. 38 (referencing Ex. 1002 ¶¶ 124–127).

Based on our review of the complete trial record, including the identified evidence, we find that Hearn, alone, teaches or suggests the subject matter of claims 5 and 20.

(3) Claims 6 and 7

Claim 6 depends from claim 5 and recites "wherein the second capillary material has a density of below 1 g/ml." Ex. 1001, 14:59–60. Claim 7 depends from claim 5 and recites "wherein the second capillary material has a density of between 0.1 and 0.3 g/ml." *Id.* at 14:61–62. Petitioner makes similar contentions with respect to claims 6 and 7 as made for claims 5 and 20. *Compare* Pet. 37–38 *with* Pet. 38–39.

Based on our review of the complete trial record, including the identified evidence, we find that Hearn, alone, teaches or suggests the subject matter of claims 6 and 7.

(4) Claim 8

Claim 8 depends from claim 1 and recites "wherein the second capillary material has a fiber size or pore size of between 1 to 100 μm." Ex. 1001, 14:63–65. Petitioner contends that Hearn discloses a capillary plug with pore radii "between 50 and 500 microns," and "preferably 100–300 and most preferably 100–150 microns." Pet. 34 (referencing Ex. 1004 ¶ 19). Petitioner concludes that "[a] pore size or fiber size between 1 and 100 μm . . . for the second capillary material was thus disclosed or would have been obvious to a [person having ordinary skill in the art] in light of Hearn's recited range of 50–300 microns." *Id.* (referencing Ex. 1002 ¶ 117).

As we discussed in our claim construction section and analysis of claim 1, above, Petitioner premises its contentions with respect to Hearn and pore size based on a construction of the term "pore size" to encompass pore radius. We rejected that construction. Regardless, when we convert pore radius to pore diameter for Hearn's disclosed material, the disclosed range overlaps the claimed range. *See, e.g.*, Tr. 42:15–17 (asking Patent Owner's counsel: Q: "Would it be proper for us . . . to translate [Hearn's range of 50 to 500 microns for pore radius] . . . to 100 to 1,000 microns as far as pore diameter." A: "Yes."). Accordingly, based on our review of the complete trial record, including the identified evidence, we find that Hearn, alone, teaches or suggests the subject matter of claim 8.

(5) Claim 9

Claim 9 depends from claim 1 and recites "wherein the first capillary material or the second capillary material is compressed in the housing such that an effective pore size of the first capillary material or the second capillary material is reduced." Ex. 1001, 14:66–15:3. Petitioner contends that Hearn expressly discloses compressing its capillary plug 30 in the vicinity of the outlet valve of the device. Pet. 35 (referencing Ex. 1004 ¶ 17). Petitioner adds that Hearn discloses that capillary plug 30 "is compressed thereby reducing the pore size to provide increased capillary force in this region." *Id.* (referencing Ex. 1004 ¶ 39); *see also id.* at 36 (providing an annotated version of Hearn's Figure 2 showing the first capillary material compressed relative to the second capillary material).

Based on our review of the complete trial record, including the identified evidence, we find that Hearn, alone, teaches or suggests the subject matter of claim 9.

(6) Claim 15

Claim 15 recites "[a]n aerosol-generating system comprising a cartridge according to claim 1." Ex. 1001, 15:29–30. Petitioner contends that "Hearn alone . . . discloses this limitation for the reasons discussed in claim 1." Pet. 39 (referencing Ex. 1002 ¶¶ 130–131).

Based on our review of the complete trial record, including the identified evidence, we find that Hearn, alone, teaches or suggests the subject matter of claim 15.

E. Grounds 2a and 2b – the Terry grounds: Claims 1, 3–9, 15, 18, 20, and 21 as unpatentable over Terry and Thorens or Terry, Thorens, and Rabin

Petitioner contends that claims 1, 3–9, 15, 18, 20, and 21 are unpatentable over Terry and Thorens or Terry, Thorens, and Rabin. Pet. 11, 46–70.[17] Specifically, Petitioner contends that claims 1, 4–8, 15, 18, 20, and 21 are obvious over Terry and Thorens (Ground 2a) and claims 3, 9, and 26 are obvious over Terry, Thorens, and Rabin. Because we determine that all challenged claims are unpatentable under Ground 1, we need not reach the Terry-based grounds. *See SAS Inst. Inc. v. Iancu*, 138 S. Ct. 1348, 1359 (2018) (holding that a petitioner "is entitled to a final written decision addressing all of the claims it has challenged"); *see also Boston Sci. Scimed, Inc. v. Cook Grp. Inc.*, 809 F. App'x 984, 990 (Fed. Cir. 2020) (nonprecedential) (stating that the "Board need not address issues that are not necessary to the resolution of the proceeding," such as "alternative arguments with respect to claims [the Board] found unpatentable on other grounds").

[17] The claim listing for Grounds 2a and 2b do not include claim 20. Pet. 11, 46, 65. The Petition, however, addresses claim 20 as part of Ground 2a. *Id.* at 60–62.

III. CONCLUSION

After considering all the evidence and arguments presently before us, we determine Petitioner has proven, by a preponderance of the evidence, that all of the Challenged Claims are unpatentable. [18]

In summary:

Claims	35 U.S.C. §	Reference(s)/ Basis	Claims Shown Unpatentable	Claims Not Shown Unpatentable
1, 3–9, 15, 18, 20, 21	103	Hearn or Hearn, Rabin	1, 3–9, 15, 18, 20, 21	
1, 4–8, 15, 18, 21	103	Terry, Thorens[19]		
3, 9	103	Terry, Thorens, Rabin		
Overall Outcome			1, 3–9, 15, 18, 20, 21	

[18] Should Patent Owner wish to pursue amendment of the Challenged Claims in a reissue or reexamination proceeding subsequent to the issuance of this decision, we draw Patent Owner's attention to the April 2019 Notice Regarding Options for Amendments by Patent Owner Through Reissue or Reexamination During a Pending AIA Trial Proceeding, 84 Fed. Reg. 16,654 (Apr. 22, 2019). If Patent Owner chooses to file a reissue application or a request for reexamination of the challenged patent, we remind Patent Owner of its continuing obligation to notify the Board of any such related matters in updated mandatory notices. *See* 37 C.F.R. §§ 42.8(a)(3), (b)(2).

[19] As explained above, because we determine the challenged claims are rendered obvious by Hearn, we do not reach the two Terry-based grounds.

IV. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that claims 1, 3–9, 15, 18, 20, and 21 of U.S. Patent No. 10,555,556 B2 are determined to be unpatentable;

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

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