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Paper 44
Date: August 18, 2025

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

AIR PRODUCTS AND CHEMICALS, INC.,
Petitioner,

v.

EVONIK OPERATIONS GMBH and
EVONIK CORPORATION,
Patent Owner.

IPR2024-00611
Patent 10,471,380 B2

Before JO-ANNE M. KOKOSKI, AVELYN M. ROSS, and ALYSSA A. FINAMORE, *Administrative Patent Judges.*

KOKOSKI, *Administrative Patent Judge*.

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

I. INTRODUCTION

We have jurisdiction to conduct this *inter partes* review under 35 U.S.C. § 6, and issue this Final Written Decision pursuant to 35 U.S.C. § 318(a). For the reasons that follow, we determine that Air Products and Chemicals Inc. ("Petitioner") does not show by a preponderance of the evidence that claims 1–23 (the "challenged claims") of U.S. Patent No. 10,471,380 B2 ("the '380 patent," Ex. 1001) are unpatentable.

A. Procedural Background

Petitioner filed a Corrected Petition[1] to institute an *inter partes* review of claims 1–23 of the '380 patent. Paper 6 ("Corrected Pet."). Evonik Operations GmbH and Evonik Corporation (collectively, "Patent Owner") filed a Preliminary Response. Paper 11. Pursuant to 35 U.S.C. § 314(a), we instituted an *inter partes* review of claims 1–23 on the grounds advanced in the Corrected Petition. Paper 12 ("Institution Decision" or "Dec."). After institution of trial, Patent Owner filed a Patent Owner Response ("PO Resp.," Paper 26), Petitioner filed a Reply ("Pet. Reply," Paper 35), and Patent Owner filed a Sur-reply ("PO Sur-reply," Paper 40).

We held an oral hearing on May 23, 2025, and a transcript is included in the record. Paper 43 ("Tr.").

B. Real Parties in Interest

Petitioner and Patent Owner each identifies itself as the real party in interest. Corrected Pet. 69; Paper 4, 2 (Mandatory Notice).

[1] Petitioner filed its initial Petition for *Inter Partes* Review ("Initial Petition," Paper 2) on February 23, 2024, and, with leave of the Board (Ex. 3001), filed a Corrected Petition for *Inter Partes Review* (Paper 6) on May 1, 2024.

C. Related Matters

The parties indicate that the ’380 patent is at issue in *Evonik Operations GmbH v. Air Products and Chemicals, Inc.*, 1:22-cv-01543-MN (D. Del). Corrected Pet. 69; Paper 4, 2.

D. The ’380 Patent

The ’380 patent, titled “Process for Separation of Gases with Reduced Maintenance Costs,” is directed “to a specific process and apparatus for separation of gas mixtures with reduced maintenance costs.” Ex. 1001, codes (54), (57). The ’380 patent explains that “[i]t has now surprisingly been found that the inventive process . . . and the inventive apparatus described herein can afford pure stream of permeate and retentate without requiring more than one compressor respectively without further purification of the permeate or retentate stream by other methods.” *Id.* at 2:13–18.

Figure 1 is reproduced below.

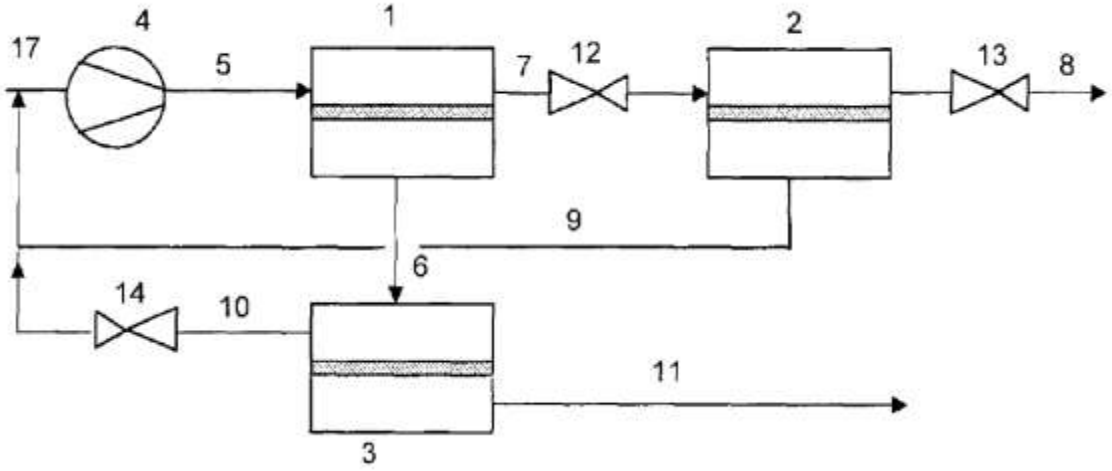

Figure 1 is an “[i]llustrative connection arrangement of several membrane modules” described in the ’380 patent. *Id.* at 29:35–36. Crude gas stream 17 (comprising a gas mixture of two or more gases to be separated) is compressed by compressor 4 to form feed stream 5 that is fed to feed stream

separation stage 1. *Id.* at 3:46–50, 3:52–57. Feed stream separation stage 1 is a membrane separation stage that separates feed stream 5 into first permeate stream 6 and first retentate stream 7. *Id.* at 4:15–17. Retentate separation stage 2 is a membrane separation stage that separates first retentate stream 7 into second permeate stream 9 and second retentate stream 8. *Id.* at 4:18–22. Permeate separation stage 3 is a membrane separation stage that separates first permeate stream 6 into third permeate stream 11 and third retentate stream 10. *Id.* at 4:23–28. Pressure reducing valves 12, 13, and 14 are in first retentate stream 7, second retentate stream 8, and third retentate stream 10, respectively. *Id.* at 29:51–56. After recycling second permeate stream 9 and/or third retentate stream 10, feed stream 5 is composed of crude gas stream 17, second permeate stream 9, and third permeate stream 10. *Id.* at 4:1–5. The apparatus is configured such that second retentate stream 8 may be removed as a first product or may be further processed; similarly, third permeate stream 11 may be removed as a second product or may be further processed. *Id.* at 5:18–25.

The '380 patent explains that "a maintenance cost optimum for three-stage membrane separation" can be obtained by

> increasing the total gas volume recycled in sum with the second permeate stream (9) and the third retentate stream (10), in combination with
>
> an increase of the total membrane capacity of the retentate separation stage (2) compared to the total membrane capacities of separation stage (1) and preferably also of separation stage (3), and
>
> a specific quotient of the pressure ratios of the permeate separation stage (3) over the feed stream separations stage (1).

Id. at 2:27–40. "Membrane capacity" is "defined as the product of the membrane surface and the permeance of the membrane at operating

temperature that is determined for nitrogen (Grade 4.8) under standard conditions." *Id.* at 2:53–57. "Permeance is defined as material flow per time unit, area and differential pressure through a membrane." *Id.* at 3:18–19. As a result, when "membranes of identical materials are operated in different separation stages" at the same operating temperature, "their permeance is identical" and "the ratio of membrane capacities used in two separation stages correlates to the ratio of the membrane surfaces." *Id.* at 3:1–5.

The '380 patent teaches that the described process can simultaneously produce retentate and permeate gas streams with high purity, and "also provides the flexibility to isolate only one gas stream with high purity, if desired." *Id.* at 5:61–65. Because the process "allows to reduce the membrane capacities, required in sum for all separation stages in the process . . . the investment costs and in particular the maintenance costs can be reduced significantly." *Id.* at 5:66–6:3. According to the '380 patent, "the achieved reduction of total membrane capacities is encompassed by an increased volume of the gas in streams (9) and (10), which increases the operating costs," so the process is particularly designed for plant sites where energy "is very cheap and where the invest costs and the maintenance costs are the critical issue." *Id.* at 6:4–11.

E. Illustrative Claim

Petitioner challenges claims 1–23 of the '380 patent. Corrected Pet. 1. Claim 1, the only independent challenged claim, is illustrative of the claimed subject matter, and is reproduced below.

> 1. A method for separating gases from a crude gas stream comprising at least two components, wherein in an apparatus comprising a feed stream separation stage, a retentate separation

stage and a permeate separation stage, each stage being a membrane separation stage with gas separation membranes,

a) a feed stream is separated in the feed stream separation stage into a first permeate stream and a first retentate stream,

b) the first retentate stream is separated in the retentate separation stage into a second permeate stream and a second retentate stream,

c) the first permeate stream is separated in the permeate separation stage into a third retentate stream and third permeate stream,

d) the second retentate stream is removed as a first product,

e) the third permeate stream is removed as a second product, and

f) the second permeate stream and the third retentate stream are combined with the crude gas stream to give the feed stream,

and wherein

i) the combined gas volume of the second permeate stream and the third retentate stream is from 60 to 100% of the volume of the crude gas stream,

ii) the total capacity of the gas separation membranes in the retentate separation stage is higher than the total capacity of the gas separation membranes in the feed stream separation stage, the total capacity being measured for nitrogen Grade 4.8 under standard conditions as defined in the description, and

iii) the quotient of the pressure ratio over the permeate separation stage to the pressure ratio over the feed stream separation stage is in a range of from 0.5 to 8.

Ex. 1001, 29:62–30:55.

F. Asserted Grounds

Petitioner asserts that claims 1–23 would have been unpatentable on the following grounds:

Claim(s) Challenged	35 U.S.C. §	Reference(s)/Basis
1–5, 7, 9, 11–23	103	Ungerank Patent,[2] Scholz[3]
1–13, 16, 17, 21, 23	103	Scholz

Corrected Pet. 2. Petitioner relies on the Declaration of Dr. Richard W. Baker ("Baker Declaration," Ex. 1003) and the Supplemental Declaration of Dr. Richard W. Baker (Ex. 1041). Patent Owner relies on the Declaration of Geoffrey Geise (Ex. 2008).

II. ANALYSIS

A. Level of Ordinary Skill in the Art

Petitioner asserts that a person of ordinary skill in the art ("POSITA") "would have had a Master of Science degree in physical chemistry, chemistry, chemical engineering, or a related field, and at least three years of work experience in membrane gas-separation systems, including but not limited to biogas membrane separations." Corrected Pet. 12 (citing Ex. 1003 ¶¶ 56–60). Patent Owner states that it "utilizes Petitioner's proposed level of skill in the art" in the Patent Owner Response. PO Resp. 26.

In the Institution Decision, we adopted the assessment offered by Petitioner. Dec. 6. Because Petitioner's definition of the level of skill in the art is consistent with the '380 patent and the asserted prior art, we maintain it for purposes of this Final Written Decision. *See Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir 2001).

[2] Ungerank et al., US 8,999,038 B2, issued Apr. 7, 2015 (Ex. 1006).
[3] M. Scholz et al., *Structural optimization of membrane-based biogas upgrading processes*, J. of Membrane Sci. 474, 1–10 (2015) (Ex. 1007).

B. Dr. Geise

Petitioner argues that Patent Owner does not have an expert that qualifies as a POSITA because Patent Owner's declarant, Dr. Geise, "has no experience in biogas separations." Pet. Reply 2. In particular, Petitioner argues that Dr. Geise "never designed or worked on any multi-stage gas membrane separation apparatuses" and "never simulated a three-stage separation process." *Id.* at 3. Petitioner argues that Dr. Geise's "opinions should be given little weight." *Id.*

Patent Owner responds that "[n]either Petitioner nor Dr. Baker asserts any error in any opinion Dr. Geise offered, much less contends that Dr. Geiss was incorrect regarding any aspect of the science of gas permeability." PO Sur-reply 23 (citing Ex. 2018, 12:12–17). Patent Owner asserts that Dr. Geise has a Master's degree and a Ph.D. in chemical engineering and therefore meets the educational requirement of the definition of a POSITA, and also has "more than three years of work experience in gas and liquid membrane separation systems and has taught these topics for years." *Id.* at 24 (citing Ex. 2008 ¶ 17; Ex. 1039, 80:9–15, 218:13–219:20).

We generally permit testimony where a declarant's scientific, technical, or other specialized knowledge will help the Board understand the evidence or determine a fact in issue. PTAB Consolidated Trial Practice Guide, 34 (Nov. 2019) ("CTPG") (citing Fed. R. Evid. 702(a)). Given his doctorate degree in chemical engineering and over ten years of experience working with membranes for separation applications, including work related to membrane-based separations, we find Dr. Giese's testimony helpful in deciding factual issues in this proceeding. Ex. 2008 ¶¶ 3–9, App. A. Moreover, when assigning weight to a declarant's testimony, we consider

the underlying facts or data upon which the testimony is based. CTPG 40–41. In our analysis of the asserted grounds of unpatentability, we weigh Dr. Geise's testimony accordingly.

C. Claim Construction

We construe each 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." 37 C.F.R. § 42.100(b). Under this standard, claim terms are generally given their plain and ordinary meaning as would have been understood by a person of ordinary skill in the art at the time of the invention and in the context of the entire patent disclosure. *Phillips v. AWH Corp.*, 415 F.3d 1303, 1313 (Fed. Cir. 2005) (en banc). Only those terms in controversy need to be construed, and only to the extent necessary to resolve the controversy. *Realtime Data LLC v. Iancu*, 912 F.3d 1368, 1375 (Fed. Cir. 2019).

The parties address the construction of the claim terms "capacity" and "standard conditions as defined in the description." PO Resp. 27–28; Pet. Reply 6–9. Based on our review of the complete trial record and the claim construction arguments raised by the parties, we determine that it is not necessary to expressly construe any claim terms to resolve the parties' dispute. *Realtime Data*, 912 F.3d at 1375.

D. Asserted Obviousness over the Ungerank Patent and Scholz

Petitioner contends that claims 1–5, 7, 9, and 11–23 would have been obvious over the combined teachings of the Ungerank Patent and Scholz. Corrected Pet. 18–43.

1. Ungerank Patent

The Ungerank Patent, titled "Process for Separation of Gases," relates to "a chain of gas separation membrane modules, for separation of gas

mixtures into two fractions each of increased purity." Ex. 1006, code (54), 1:3–6. In addition to Markus Ungerank, three other individuals are named as inventors, including Markus Priske, who is the sole named inventor on the '380 patent. *Id.* at code (75); Ex. 1001, code (72). Figure 11 of the Ungerank Patent is identical to Figure 1 of the '380 patent. *Compare* Ex. 1006, Fig. 11, *with* Ex. 1001, Fig. 1.

The Ungerank Patent describes an apparatus that "can afford pure streams of permeate and retentate without requiring more than one compressor or any need to purify the permeate or retentate streams further by other methods." Ex. 1006, 3:31–35. In particular, the Ungerank Patent addresses three-stage gas separation systems with selective membranes. In this context, "selectivity" describes the degree to which a membrane will preferentially allow one gas to permeate relative to another.[4] The Ungerank Patent teaches that "[m]embranes of higher selectivity have the advantage that the separation becomes more effective and less permeate has to be recycled" thus "it is necessary to compress less gas twice, which entails economic advantages in the operation of the plant." *Id.* at 9:14–20. The Ungerank Patent further teaches that "the inventive operation can be conducted in a much more economically viable manner with more selective membranes, and the necessary size of the compressor and the energy required can be reduced." *Id.* at 9:31–34.

The Ungerank Patent teaches that the amount of recycled gas should be less than 60% by volume of the crude gas stream. Specifically, the Ungerank Patent states:

[4] The Ungerank Patent states that "[t]he quotient of the permeances of the individual gases gives the selectivity of the membrane for separation with regard to the two gases." Ex. 1006, 3:47–49.

> The process according to the invention or the inventive apparatus is notable particularly in that it is configured such that the gas volume recycled in the second permeate stream (9) and in the third retentate stream (10) totals less than 60% by volume, preferably to 50% by volume, most preferably 20 to 40% by volume, of the volume of the crude gas stream (17).

Id. at 7:19–24.

The Ungerank Patent includes one comparative example ("Comparative Example 1") as well as four inventive examples. *Id.* at 10:17–14:43. Comparative Example 1 describes a system having the connection arrangement of Ungerank's Figure 11, where "[t]he sum of recycled gas streams (9) and (10) is . . . 86.7%." *Id.* at 10:62–63. Comparative Example 1 further describes certain pressure values at various points in the system. *Id.* at 10:36–39, 10:53–56.

2. Scholz

Scholz reports on a study "to design a membrane based biogas upgrading process"[5] in which "(i) the optimal process configuration, (ii) the required membrane areas in the various stages and (iii) the pressure to drive the gas permeation process for a commercial membrane material are determined simultaneously." Ex. 1007, 1. Scholz states that, "[i]n general, feed gas conditions, product gas requirements and economic parameters such as product gas pressure and energy costs considerably determine the optimal process configurations." *Id.* at 2. Although Scholz's study focuses on the separation of methane (CH_4) and carbon dioxide (CO_2), Scholz states that "[t]he process model can easily be adapted to other gas separation

[5] Scholz explains that "[b]iogas upgrading refers to the separation of CH_4 and CO_2, where a CH_4 rich gas is polished so that it can be used as a natural gas substitute." Ex. 1007, 1.

problems such as helium production from natural gas, natural gas upgrading or air separation to determine the most profitable process configurations." *Id.*

In its study, Scholz considers gas permeation modules that "are equipped with polymeric membrane materials to separate CO_2 and CH_4." Ex. 1007, 2. The membranes preferentially allow the permeation of carbon dioxide such that "CO_2 will permeate faster through the membrane so that the permeate is enriched in CO_2" and "CH_4 is enriched on the retentate side of the membrane." *Id.*

Scholz's Figure 7 is reproduced below.

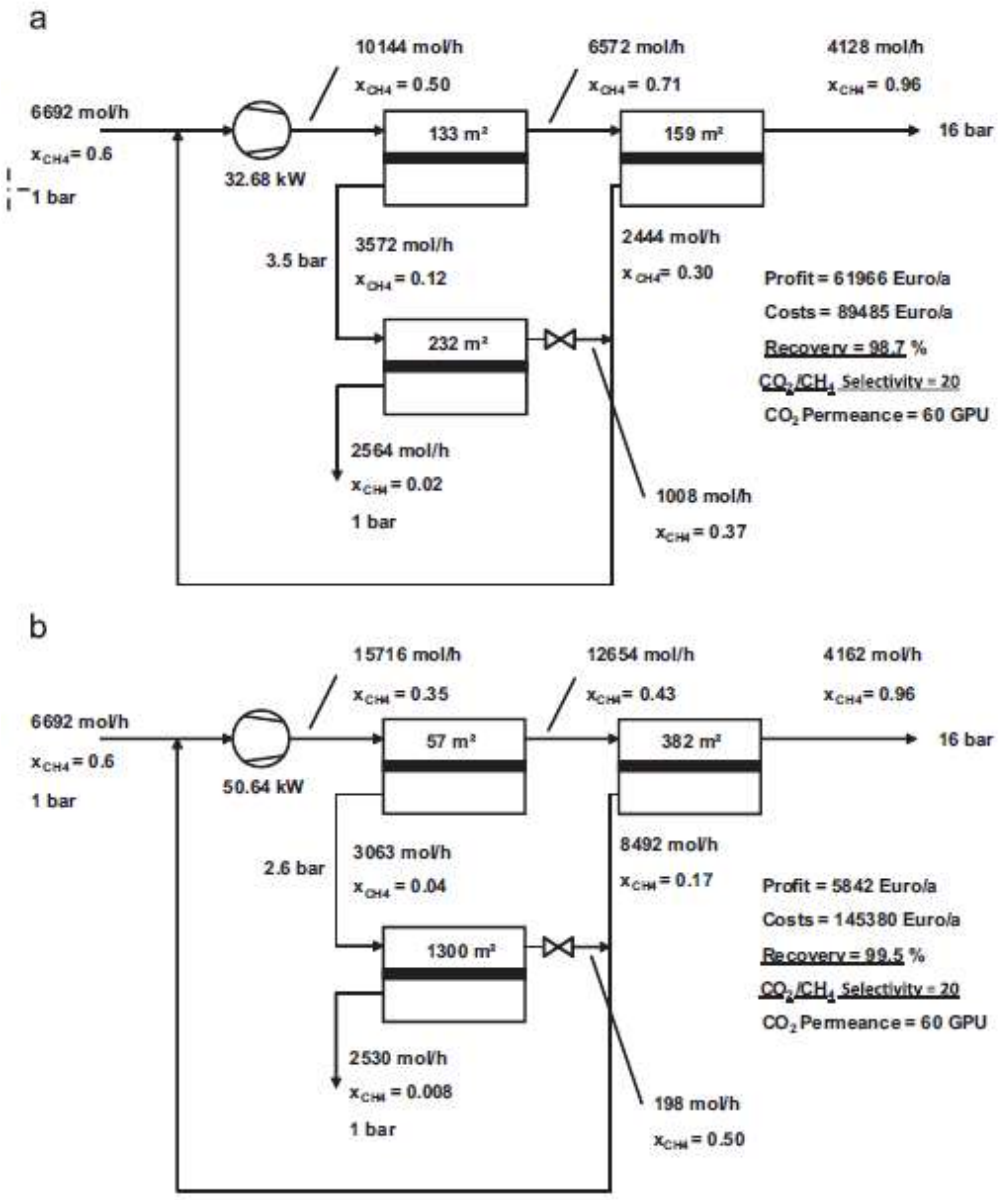

Figure 7 depicts the "[o]ptimal design process and conditions for gas permeation membranes with a CO_2/ CH_4 selectivity of 20 and a CO_2 permeance of 60 GPU." The process depicted in Figure 7a (top) has a required CH_4 recovery rate higher than 95%, and the process depicted in Figure 7b (bottom) has a required CH_4 recovery rate of higher than 99.5%. *Id.* at 7. In both Figures 7(a) and 7(b) the membrane surface area of the

retentate stage membranes (159 m^2 in Figure 7(a) and 382 m^2 in Figure 7(b)) is greater than that of the feed stage membranes (133 m^2 in Figure 7(a) and 57 m^2 in Figure 7(b)). *Id.*

3. Whether the Ungerank Patent Qualifies as Prior Art

Petitioner contends that the portions of the Ungerank Patent that are "cited by column and line numbers" in the Corrected Petition and the Baker Declaration "are prior art under § 102(a)(1), as they were published on April 25, 2013 in U.S. Patent App. Pub. No. 2013/0098242[6] (AP-1038)." Corrected Pet. 3; *see* Pet. Reply 9–10. Patent Owner disagrees. PO Resp. 29–30; PO Sur-reply 2–4.

a) Background

In its Initial Petition filed on February 23, 2024, Petitioner stated that "U.S. Patent No. 8,999,038 ('Ungerank') is prior art under § 102(a)(2). Ungerank issued under §151, names another inventor than the '380 patent's named inventor, and was filed May 26, 2011, effectively before the earliest effective filing date of the '380 patent." Initial Pet. 3 (citing Ex. 1006, 1). Five days later, on February 29, 2024, Petitioner notified the Board by email that "Petitioner's counsel noticed an error in the petition," and identified the error as "the petition cites to U.S. Patent No. 8,999,038 (Ungerank) (AP-1006) as prior art instead of the earlier application publication for that patent (U.S. Publ. No. 2013/0098242A1)." Ex. 3001, 1. Petitioner also represented that "Patent Owner's counsel does not oppose Petitioner's request." *Id.* at 2. On April 30, 2024, the Board responded to Petitioner's

[6] Ungerank et al., US 2013/0098242 A1, published Apr. 25, 2013 ("Ungerank Application," Ex. 1038).

request, stating that, "[i]n view of the absence of opposition from Patent Owner, Petitioner's request to file a corrected Petition is granted." *Id.* at 1.

Petitioner subsequently filed the Corrected Petition on May 1, 2024. The Corrected Petition states, in relevant part:

> The portions of U.S. Patent No. 8,999,038 (AP-1006), cited by column and line numbers herein and in AP-1003, are prior art under § 102(a)(1), as they were published on April 25, 2013 in U.S. Patent App. Pub. No. 2013/0098242 (AP-1038) ("Ungerank"). The publication's specification and figures are identical to the patent. *Compare* AP-1006 to AP-1038. Ungerank issued under § 151, names another inventor than the '380 patent's named inventor, and was filed May 26, 2011, effectively before the earliest effective filing date of the '380 patent." AP-1006, 1.

Corrected Pet. 3. Petitioner submitted the Ungerank Application as Exhibit 1038 with the Corrected Petition.

b) Analysis

Patent Owner argues that the Ungerank Patent is not prior art to the '380 patent because the effective date of the Ungerank Patent is April 7, 2015 (the day the Ungerank Patent issued), which is after the application for the '380 patent was filed on December 29, 2014. PO Resp. 29–30 (citing 35 U.S.C. § 102(a)(1); MPEP § 2152.02(a)). Patent Owner argues that § 102(a) and the MPEP are clear that there is no statutory or other basis to conclude that referencing the content of a different document (the Ungerank Application) changes the effective date of the Ungerank Patent. *Id.* at 30 (citing 35 U.S.C. § 102(d); MPEP § 2152.02(a)). Patent Owner also argues that the Corrected Petition cites to, and relies on, the Ungerank Patent instead of the Ungerank Application, and that Petitioner's declarant, Dr. Baker, never considered the Ungerank Application. PO Sur-reply 3 (citing Ex. 2009, 44:13–45:18; Ex. 2018, 12:18–23). Patent Owner further

notes that "the Board instituted this IPR on [the Ungerank Patent], not [the Ungerank Application], and never cited the latter." *Id.* (citing Dec. 7).

Petitioner responds that the Corrected Petition identifies the Ungerank Application "as 'Ungerank' and made clear Petitioner relied on [the Ungerank Application] as prior art, which it undisputably is." Pet. Reply 9 (citing Corrected Pet. 3). Petitioner contends that "[t]he specific purpose of the correction was to rely on [the Ungerank Application] as prior art," and that, by citing the Ungerank Patent's "column and line numbers instead of [the Ungerank Application's] paragraph numbers, Petitioner provided much more specific citations in support of its arguments." *Id.* at 9–10 (citing Ex. 3001). Petitioner further contends that if Patent Owner believed Petitioner was relying on the Ungerank Patent as prior art, it could and should have raised the issue at the time of the correction or in its Preliminary Response, and Patent Owner's failure to do so is a waiver of this argument. *Id.* at 10.

"In an *inter partes* review, the burden of persuasion is on the petitioner to prove 'unpatentability by a preponderance of the evidence,' . . . and that burden never shifts to the patentee." *Dynamic Drinkware, LLC v. Nat'l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015) (quoting 35 U.S.C. § 316(e)). Here, Petitioner asserts that (1) the combined teachings of the Ungerank Patent and Scholz disclose or suggest all of the limitations of claims 1–5, 7, 9, and 11–23 of the '380 patent, and (2) the Ungerank Patent qualifies as prior art because the portions cited in the Corrected Petition and the Baker Declaration were published in the Ungerank Application.[7]

[7] There is no dispute that Scholz qualifies as prior art. *See* Corrected Pet. 3–4; PO Resp.

Petitioner ultimately has the burden of persuasion, based on all the evidence, on both these assertions. *See Dynamic Drinkware*, 800 F.3d at 1378. After reviewing the parties' arguments and the evidence of record, we are not persuaded that Petitioner establishes, by a preponderance of the evidence, that the portions of the Ungerank Patent relied on in the Corrected Petition and the Baker Declaration qualify as prior art.

There is nothing in the Initial Petition or the exhibits filed in support thereof that indicates Petitioner's intention to rely on the Ungerank Application as prior art in this proceeding. The Initial Petition defines "Ungerank" as the Ungerank Patent, and all citations to "Ungerank" in support of Petitioner's allegations are to the Ungerank Patent. Initial Pet. 3, 12–14, 17–42. The Initial Petition does not refer to the Ungerank Application, and the Ungerank Application was not submitted as an exhibit with the Initial Petition. *Id.* at iii–v (Exhibit List). And Petitioner's expert declarant, Dr. Baker, did not consider the Ungerank Application when formulating his opinions in support of the Initial Petition. Ex. 1003 ¶ 51 (identifying materials considered).

Although the Corrected Petition redefines "Ungerank" as the Ungerank Application, the Corrected Petition retains its citations to the Ungerank Patent.[8] Corrected Pet. 3, 12–15, 18–43. In that regard, Petitioner generally asserts that the Ungerank Application's "specification and figures

[8] At the hearing, Petitioner's counsel stated that they left the citations to the Ungerank Patent in the Corrected Petition because they "didn't want to make tons and tons of changes," and the Ungerank Patent citations "are much more specific." Tr. 12:10–13; *see also* Pet. Reply 10 ("Moreover, by citing AP-1006's column and line numbers instead of AP-1038's paragraph numbers, Petitioner provided more specific citations in support of its arguments.").

are identical to the" Ungerank Patent, but does not direct us to where the specific portions of the Ungerank Patent that it asserts to be prior art can be found in the Ungerank Application. *See id.* at 3. We are also not directed to any evidence in the record that indicates that Dr. Baker compared the portions of the Ungerank Patent on which he relies to the disclosures in the Ungerank Application, or even considered the Ungerank Application at all. *See* Ex. 1003 ¶ 51; Ex. 1041 ¶ 4; Ex. 2009, 44:10–45:18; Ex. 2018, 12:18–23. We decline to perform an analysis that is missing from the Corrected Petition and Dr. Baker's testimony. *See United States v. Dunkel*, 927 F.2d 955, 956 (7th Cir. 1991) ("Judges are not like pigs, hunting for truffles buried in briefs."); *DeSilva v. DiLeonardi*, 181 F.3d 865, 866–67 (7th Cir. 1999) ("A brief must make all arguments accessible to the judges, rather than ask them to play archaeologist with the record."). Accordingly, Petitioner does not establish, by a preponderance of the evidence, that the cited portions of the Ungerank Patent were published in the Ungerank Application.

We are also not persuaded that Patent Owner waived its argument that Petitioner relies on the Ungerank Patent (not the Ungerank Application) as prior art by not raising it "at the time of the correction or even in its Preliminary Response," as Petitioner contends. *See* Pet. Reply 10. As an initial matter, a patent owner is not required to file a preliminary response. *See* 37 C.F.R. § 42.107(a) ("The patent owner *may* file a preliminary response to the petition." (emphasis added)); *id.* § 42.107(b) ("A patent owner may expedite the proceeding by filing an election to waive the patent owner preliminary response."). And, although a patent owner can waive arguments made in the preliminary response by not raising them in the patent owner response, a patent owner does not waive an argument made in

the patent owner response because it was not raised in its preliminary response. *See* 37 C.F.R. § 42.120; *see also* Paper 13, 9 (Scheduling Order) ("Patent Owner is cautioned that any arguments not raised in the response may be deemed waived."); *In re NuVasive, Inc.*, 842 F.3d 1376, 1381 (Fed. Cir. 2016) (explaining that a patent owner waives an issue presented in its preliminary response if it fails to renew the issue in its response after trial is instituted).

Petitioner further argues that Patent Owner agreed to the correction in the Corrected Petition, and "has never claimed any prejudice" as a result of the correction. Pet. Reply 10. Although Patent Owner did not oppose Petitioner's request *to submit* the Corrected Petition, we disagree that by doing so, Patent Owner agreed to the correction being made therein. Ex. 3001. Furthermore, we are not persuaded that whether or not Patent Owner was prejudiced by the submission of the Corrected Petition is relevant to the question of whether or not the Ungerank Patent qualifies as prior art.

c) Conclusion

For the reasons discussed above, we find that Petitioner does not meet its burden to show that the portions of the Ungerank Patent cited in the Corrected Petition and the Baker Declaration are prior art because they were previously published in the Ungerank Application. Accordingly, we determine that the Ungerank Patent does not qualify as prior art.

4. Analysis of Claims 1–5, 7, 9, and 11–23

For the reasons set forth above, we are not persuaded that Petitioner adequately establishes that the portions of the Ungerank Patent cited in the Corrected Petition and the Baker Declaration qualify as prior art to the '380 patent. Therefore, we determine that Petitioner has not demonstrated, by a

preponderance of the evidence, that claims 1–5, 7, 9, and 11–23 would have been obvious over the combined teachings of the Ungerank Patent and Scholz.

However, even if the portions of the Ungerank Patent cited in the Corrected Petition and the Baker Declaration qualify as prior art to the '380 patent, we determine that Petitioner does not sufficiently establish that a POSITA would have been motivated to combine the teachings of the Ungerank Patent and Scholz as proposed by Petitioner.

a) Motivation to Combine the Ungerank Patent and Scholz

Petitioner contends that Comparative Example 1 in the Ungerank Patent discloses all of the elements of claim 1 except for limitation [1.f.ii], which recites that "the total capacity of the gas separation membranes in the retentate separation stage is higher than the total capacity of the gas separation membranes in the feed stream separation stage, the total capacity being measured for nitrogen Grade 4.8 under standard conditions as defined in the description." Corrected Pet. 18 (citing Ex. 1003 ¶¶ 119–195); Ex. 1001, 30:47–52. Petitioner contends that the three-stage systems depicted in Scholz's Figure 7 "use lower-selectivity membranes that meet the capacity ratio limitation [1f.ii] by virtue of the simple fact that the membrane areas in their retentate separation stages are larger than the membrane areas in their feed separation stages." Corrected Pet. 18–19 (citing Ex. 1007, Abstract, 6). Petitioner contends that because "Comparative Example 1 does not provide details on the membranes' areas (or their ratios), a POSITA would have found it obvious to combine Ungerank's teachings on three-stage systems with lower-selectivity membranes with Scholz's teachings in Figure 7 on optimized surface area

ratios (proportional to the capacity ratios)." *Id.* at 19 (citing Ex. 1003 ¶¶ 119–142).

Patent Owner responds that "Comparative Example 1 provides specific make and model information, and states that a module was used in each of its separation stages and, therefore, that the area ratios are 1:1." PO Resp. 41. In particular, Patent Owner asserts that "each stage consisted of a hollow fiber membrane module consisting of hollow polyimide fibers from UBE (NM B01 A type)." *Id.* (quoting Ex. 1006, 10:24–27). Patent Owner argues that because the Ungerank Patent "expressly states that the same membrane module was used in each stage, a POSITA would have known exactly what the membrane area ratios were, and would not need to turn to Scholz." *Id.* at 42 (citing Ex. 2008 ¶¶ 84–85). Patent Owner also argues that a POSITA "could readily determine membrane capacity, permeance, and areas of the modules used" by physically inspecting and/or testing the identified UBE module. *Id.* (citing Ex. 2008 ¶ 86). Patent Owner further argues that the Ungerank Patent's Comparative Example 1 is functionally complete, and Petitioner's rationale for combining Scholz's Figure 7 with the Ungerank Patent's Comparative Example 1 relies on impermissible hindsight. *Id.* at 42–44.

Having considered the complete trial record, we determine that Petitioner fails to sufficiently demonstrate that the combination of the Ungerank Patent and Scholz teaches limitation [1.f.ii] because Petitioner fails to establish by a preponderance of the evidence that a POSITA would have been motivated to look to the relative sizes of the membranes in the stages of Scholz's Figure 7 to determine the relative sizes of the membranes in the stages of Comparative Example 1.

The Ungerank Patent states that Comparative Example 1 uses the three-stage module connection arrangement shown in Figure 11, which is reproduced below:

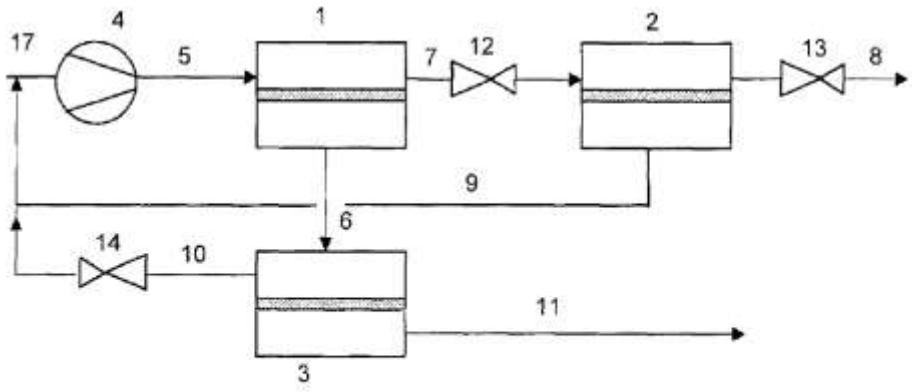

Fig. 11: Illustrative connection arrangement of several membrane modules according to invention

Ex. 1006, 10:24, Fig. 11. Figure 11 includes feed separation stage 1 that separates feed stream 5 into first permeate stream 6 and first retentate stream 7, retentate separation stage 2 that separates first retentate stream 7 into second permeate stream 8 and second retentate stream 9, and permeate separation stage 3 that separates first permeate stream 6 into third permeate stream 11 and third retentate stream 10. *Id.* at 4:19–32. The Ungerank Patent explains that, in Comparative Example 1, "[e]ach stage consisted of a hollow fiber membrane module consisting of hollow polyimide fibers from UBE (NM B01 A type)." *Id.* at 10:25–27. The Ungerank Patent also teaches that "[t]he membranes used exhibit a moderate mixed gas selectivity for carbon dioxide over methane of 20." *Id.* at 10:66–67.

Accordingly, by its express disclosures, the Ungerank Patent teaches that Comparative Example 1 has three stages, each of which uses a membrane module identified as being "UBE (NM B01 A type)," wherein the membranes exhibit a moderate mixed gas selectivity for carbon dioxide over

methane of 20. Patent Owner's declarant Dr. Geise explains a POSITA would recognize that the Ungerank Patent's description of "a hollow fiber membrane module consisting of hollow polyimide fibers from UBE (NM B01 A type)" (Ex. 1006, 10:25–27) "refers to a specific UBE membrane module." Ex. 2008 ¶ 85. Dr. Geise also explains:

> A "module" refers to a membrane unit, which has a common size to other modules of the same type. *See* EX2009-Baker Dep., 77:11–81:4; *see also* AP1007-Scholz, 6 ("assuming a gas permeation module size of 25 m^2 per module, 24 modules have to be installed."). This is a common use of the term 'module' that a person of ordinary skill in the art would understand. Since [Comparative Example 1] says each stage had "a . . . module," then, a person of ordinary skill in the art would understand each stage had the same area, and the area ratio between all stages would be 1:1.

Id. (second alteration in original). The properties of the specific UBE module used[9] in Comparative Example 1 are information a POSITA would expect to receive from UBE. *Id.* ¶ 86. In any event, because the Ungerank Patent teaches that each stage uses the properties of the same UBE module, it follows that the membrane in each stage has the same area. For these reasons, we are not persuaded that Petitioner establishes that the Ungerank Patent does not provide relative membrane sizes.

Petitioner further contends that "POSITAs 'might have figured out' that in [Comparative Example 1], stage 2's surface was larger than stage 1's

[9] We recognize that Comparative Example 1 is a simulation that did not employ physical UBE membrane modules. *See* PO Resp. 56 ("Comparative Example 1 and the Figures 7(a) and 7(b) embodiments in Scholz are based on the results of simulation software . . . ."); Pet. Reply 21 (Comparative Example 1 "is a simulation, like Scholz.").

area." Pet. Reply 19 (citing Ex. 2009, 111:3–113:6). According to Petitioner,

> [t]he fact that Scholz's Figure 7 has larger stage 2 membrane areas than stage 1, and that was consistent with a POSITA's likely intuition about [Comparative Example 1's] stage 2 and stage 1 areas, was an additional reason POSITAs would have found it appropriate to look to Scholz's Figure 7 to better understand [Comparative Example 1's] relative surface areas.

Id. (citing Ex. 1041 ¶¶ 31–32). Patent Owner argues that this is a new theory raised for the first time in Petitioner's Reply, and "[b]ecause the Reply asserts 'an entirely new rationale to explain why one of ordinary skill in the art would have been motivated to combine' the asserted prior art, it is impermissible and should be disregarded in its entirety." PO Sur-reply 7 (citing *Intelligent Bio-Systems, Inc. v. Illumina Cambridge Ltd.*, 821 F.3d 1359, 1370 (Fed. Cir. 2016)). We agree with Patent Owner.

Our rules provide that a petitioner must include "[a] full statement of the reasons for the relief requested, including a detailed explanation of the significance of the evidence including material facts, and the governing laws, rules, and precedent." 37 C.F.R. § 42.22(a). Our rules also state that "[a] reply may only respond to arguments raised in the corresponding . . . patent owner response." *Id.* § 42.23(b). "'Respond,' in the context of 37 C.F.R. § 42.23(b), does not mean proceed in a new direction with a new approach as compared to the positions taken in a prior filing." CTPG 74. Our Trial Practice Guide explains that "Petitioner may not submit new evidence or argument in reply that it could have presented earlier, e.g., to make out a *prima facie* case of unpatentability." *Id.* at 73; *see also id.* at 74 ("Examples of indications that a new issue has been raised in a reply include new evidence necessary to make out a *prima facie* case for the patentability

or unpatentability of an original or proposed substitute claim, such as newly raised rationale to combine the prior art references that was not expressed in the petition.").

In the Reply, Petitioner argues that "POSITAs 'might have already figured out'" that, in Comparative Example 1, the surface area of the membrane in stage 2 was larger than that of the membrane is stage 1, and Scholz's Figure 7 systems with larger stage 2 membrane areas than stage 1 were "consistent with POSITAs' likely intuition about [Comparative Example 1's] stage 2 and stage 1 areas." Pet. Reply 19. As Petitioner concedes, this "*an additional reason* POSITAs would have found it appropriate to look to Scholz's Figure 7 to better understand [Comparative Example 1's] relative surface areas." *Id.* (citing Ex. 1041 ¶¶ 31–32) (emphasis added). The case presented in the Corrected Petition is that a POSITA would have looked to Scholz because Comparative Example 1 does not provide details on the area of the membranes or their ratios. Corrected Pet. 18–19. Petitioner's admitted "additional reason" to combine the Ungerank Patent and Scholz in the Reply is a newly raised rationale to combine the prior art references necessary to make out a *prima facie* case of unpatentability. *See* CTPG 74. Accordingly, Petitioner's untimely new argument is waived, and we do not consider it here.

b) Conclusion

For the reasons set forth above, we determine that Petitioner does not establish, by a preponderance of the evidence, that a POSITA would have been motivated to combine the teachings of the Ungerank Patent and Scholz as proposed. Consequently, we determine that Petitioner does not establish, by a preponderance of the evidence, that independent claim 1, and claims 2–

5, 7, 9, and 11–23 that depend therefrom, would have been obvious over the combined teachings of the Ungerank Patent and Scholz.

E. Asserted Obviousness over Scholz

Petitioner contends that claims 1–13, 16, 17, 21, and 23 would have been obvious over the teachings in Scholz. Corrected Pet. 43–61.

1. Claim 1

Petitioner contends that Scholz discloses or suggests all of the limitations of independent claim 1. Corrected Pet. 43–52. Patent Owner disagrees. PO Resp. 59–64. We focus our analysis on limitation [1.f.i], which is dispositive of the controversy between the parties.

Limitation [1.f.i] recites "the combined gas volume of the second permeate stream and the third retentate stream is from 60 to 100% of the volume of the crude gas stream." Ex. 1001, 30:44–46. Petitioner contends that "[i]n Scholz's Figure 7(a) system 'the combined gas volume of the second permeate stream and the third retentate stream' as a percentage 'of the volume of the crude gas stream' (i.e. 'recycle percentage' or 'recycle volume') is 51%." Corrected Pet. 48 (citing Ex. 1007, 7). Petitioner contends that the recycle percentage in Scholz's Figure 7(b) system is 135%. *Id.* (citing Ex. 1007, 7; Ex. 1003 ¶ 205). Relying on *Titanium Metals Corp. of America v. Banner*, 778 F.2d 775, 783 (Fed. Cir. 1985), Petitioner contends that "[t]he claimed '60 to 100%' range falls within the two single recycle percentages (51% and 135%) disclosed in Scholz, and thus would have been *prima facie* obvious." *Id.* (citing Ex. 1003 ¶¶ 205–210). Petitioner further contends that a POSITA would have understood that "varying the recycle percentage within and around the range between the Figure 7 systems (a) and (b) would have a predictable effect on product recovery and operating costs." *Id.* at 49 (citing Ex. 1003 ¶ 206). Petitioner

additionally contends that the high purity permeate stream of Scholz's Figure 7(b) (X_{CH4} = 0.008) would be unnecessary in most applications and, thus, a POSITA would have had reason to modify the system to achieve a lesser purity and thereby reduce the volume of gas recycled. *Id.* at 49–50 (citing Ex. 1003 ¶ 209).

Patent Owner responds that the two recycle percentage values reported in Figures 7(a) and 7(b), "neither one of which is close to the claimed range," do not create a range. PO Resp. 60. Patent Owner argues that "[t]here are enormous differences between Figures 7(a) and 7(b) in terms of profits, costs, and optimal process conditions, illustrating the differences in properties between a recycle rate of 51% and 135% are significant." *Id.* at 61 (citing Ex. 1003 ¶ 206; Ex. 2008 ¶¶ 116–117). Patent Owner further argues that Dr. Baker "did not perform any ChemCad or other type of simulation to show the ramifications of seeking a different recycle percentage" and "did not 'offer any opinions as to what the specific membrane area sizes would be for a system that would achieve any different recycle percentages' using the system depicted in either Scholz Figure 7(a) or 7(b)." *Id.* at 63 (internal footnote omitted) (citing Ex. 2009, 129:12–24). Therefore, according to Patent Owner, Petitioner has not presented any evidence "that even if a POSITA did elect to modify Scholz Figure 7(a) or Figure 7(b) to achieve a recycle percentage" between 60 and 100%, "either the membrane capacity or the pressure ratio quotient limitations of claim 1 would still be met." *Id.*

After considering the complete trial record, we are not persuaded that Petitioner sufficiently shows that Scholz discloses "the combined gas volume of the second permeate stream and the third retentate stream is

from 60 to 100% of the volume of the crude gas stream" as recited in limitation [1.f.i].

In *Titanium Metals*, the claimed alloy required 0.3% Mo and 0.8% Ni, and the asserted prior art disclosed one alloy having 0.25% Mo and 0.75% Ni and a second allow having 0.31% Mo and 0.94% Ni. *Titanium Metals*, 778 F.2d at 783. The Federal Circuit determined that "[t]he proportions are so close that prima facie one skilled in the art would have expected them to have the same properties," no evidence was provided to rebut that *prima facie* case, and the claimed alloy "must therefore be considered to have been obvious from known alloys." *Id.*; *see also In re Patel*, 566 F. App. 1005, 1009–10 (Fed. Cir. 2014) (explaining that, in *Titanium Metals*, "the prior art establishes two measures—which were themselves not far apart—and the claim simply adopted a measure between those end points").

In contrast, Petitioner here does not allege, let alone establish, that 51% and 135% "are so close" to the claimed range of 60–100% that a POSITA "would have expected them to have the same properties" as those recited in claim 1. Corrected Pet. 48. Specifically, neither Petitioner nor Dr. Baker adequately addresses whether a POSITA would consider the systems in Scholz's Figures 7(a) and 7(b) to have the same properties, or that those properties would be the same as those recited in claim 1. *Id.*; Ex. 1003 ¶ 205. Scholz's Figures 7(a) and 7(b) show that the systems differ with respect to the size of the membranes in each stage, flow rates between the stages, recovery percentage, profits, and costs. Ex. 1007, 7. Dr. Geise explains that the systems in Figures 7(a) and 7(b) each "incorporates specific conditions that the Scholz optimization approach used for the desired design criteria, including recycle volume as well as other parameters such as pressure and membrane area, among others" and a POSITA "would not

understand from Scholz that simply any value between the two values taught, 51% and 135%, is desirable." Ex. 2008 ¶ 116. Accordingly, the facts here are distinguishable from those in *Titanium Metals*, and we are not persuaded that Petitioner establishes that the claimed range would have been *prima facie* obvious based on the reported recycle volumes for the systems in Scholz's Figures 7(a) and 7(b).

We are also not persuaded that Petitioner sufficiently shows that a POSITA would have been motivated to vary the recycle percentages in the Scholz Figures 7(a) and 7(b) systems "to achieve a recycle percentage within the claimed range with a reasonable expectation of success." Corrected Pet. 48. In that regard, Dr. Baker testifies that a POSITA would "have understood that varying the recycle percentage within and around the range between the Figure 7 systems (a) and (b) (51–135%) would have a predictable effect on product recovery and operating costs," but does not adequately explain why a POSITA would have been motivated to vary the recycle percentage within the claimed range of 60–100%. Ex. 1003 ¶ 206. Dr. Baker states that "a POSITA would have been guided by Scholz to test within the range encompassed by the systems is Scholz's Figures 7 systems (a) and (b) (51–135%) and 60–100% lies within that range" (*id.* ¶ 208), but, as set forth above, we are not persuaded that a POSITA would have understood the recycle percentages in Figures 7(a) and 7(b) to be the end points of range of desirable recycle percentages. Dr. Baker also testifies that if a POSITA is told to make a system with a recycle percentage between 60 and 100%, "he can do it. He's got all the info he needs" (Ex. 2009, 133:4–134:12), which, at best, shows that a POSITA *could* have varied the recycle percentages in the Scholz Figures 7(a) and 7(b) systems. However, "[t]he obviousness inquiry does not merely ask whether a skilled artisan could

combine the references, but instead asks whether 'they would have been motivated to do so.'" *Adidas AG v. Nike, Inc.*, 963 F.3d 1355, 1359 (Fed. Cir. 2020) (quoting *InTouch Techs., Inc. v. VGO Commc'ns, Inc.*, 751 F.3d 1327, 1352 (Fed. Cir. 2014)).

Moreover, neither Petitioner nor Dr. Baker adequately addresses whether other system modifications would be required because of the modified recycle percentage, and if so, whether the modified systems would also meet the other elements of claim 1. *See* Corrected Pet. 47–50; Ex. 1003 ¶¶ 205–210. In contrast, Dr. Geise testifies:

> A change to the recycle volume would result in other changes to the system, such as different membrane areas, different pressure ratios, different methane recovery or some combination of these factors. This is particularly true if the changes are relatively large, such as going from 51% to the low end of the range, 60% (a 17.5% increase), or from 135% to the high end of the range, 100% (a 25.9% reduction).

Ex. 2008 ¶ 117. Dr. Geise also testifies that a POSITA "would understand that the values of 51% and 135% in Scholz are significantly different from the claimed range of 60–100%." *Id.* For example, Scholz teaches that, for the system shown in Figure 7(a) (with a recycle percentage of 51%), when the methane recovery rate is at least 95%, the total membrane area is 554 m^2. Ex. 1007, 7. For the system shown in Figure 7(b) (with a recycle percentage of 135%), the methane recovery rate is increased to at least 99.5%, the total membrane area more than triples to 1,739 m^2, and the profit drops "significantly." *Id.*; *see also id.* (showing that, for Figure 7(a), the methane recovery rate is 98.7%, profit is 61,966 Euro/a, and costs are 89,485 Euro/a, and for Figure 7(b), the methane recovery rate is 99.5%, profit is 5,842 Euro/a, and costs are 145,380 Euro/a).

For these reasons, we determine that Petitioner does not establish, by a preponderance of the evidence, that Scholz teaches or suggests limitation [1.f.i] of claim 1.

2. Claims 2–13, 16, 17, 21, and 23

Petitioner contends that Scholz teaches or suggests all of the limitations of dependent claims 2–13, 16, 17, 21, and 23. Corrected Pet. 52–61. Claims 2–13, 16, 17, 21, and 23 depend from claim 1, and therefore also include limitation [1.f.i] of claim 1. Ex. 1001, 30:56–31:42, 32:34–40, 32:51–54, 32:59–33:4. Petitioner's arguments with respect to dependent claims 2–13, 16, 17, 21, and 23 do not remedy the deficiencies set forth above with respect to claim 1. Corrected Pet. 52–61. Accordingly, for the reasons set forth above with respect to claim 1, we determine that Petitioner does not establish, by a preponderance of the evidence, that Scholz teaches or suggests all of the limitations of dependent claims 2–13, 16, 17, 21, and 23.

3. Conclusion

Based on our consideration of the entire record, and for the reasons set forth above, we determine that Petitioner does not show, by a preponderance of the evidence, that claims 1–13, 16, 17, 21, and 23 would have been obvious over the teachings in Scholz.

III. CONCLUSION

After reviewing the parties' arguments and weighing the evidence offered by both parties, we determine that Petitioner has not shown, by a preponderance of the evidence, that claims 1–5, 7, 9, and 11–23 would have been obvious over the combined teachings of the Ungerank Patent and Scholz, or that claims 1–13, 16, 17, 21, and 23 would have been obvious over the teachings of Scholz.

In summary:

Claim(s)	35 U.S.C. §	Reference(s)/Basis	Claim(s) Shown Unpatentable	Claim(s) Not Shown Unpatentable
1–5, 7, 9, 11–23	103	Ungerank Patent, Scholz		1–5, 7, 9, 11–23
1–13, 16, 17, 21, 23	103	Scholz		1–13, 16, 17, 21, 23
Overall Outcome				1–23

IV. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that Petitioner has not shown by a preponderance of the evidence that claims 1–23 of the ’380 patent are unpatentable; and

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

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