

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

GENERAL ELECTRIC COMPANY,
Petitioner,

v.

RAYTHEON TECHNOLOGIES CORPORATION,
Patent Owner.

IPR2020-00405
Patent 10,066,548 B2

Before HYUN J. JUNG, GEORGE R. HOSKINS, and
PAUL J. KORNICZKY, *Administrative Patent Judges*.

KORNICZKY, *Administrative Patent Judge*.

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

I. INTRODUCTION

We have jurisdiction to hear this *inter partes* review under 35 U.S.C. § 6. This decision is a Final Written Decision under 35 U.S.C. § 318(a) and 37 C.F.R. § 42.73. For the reasons below, we determine that General Electric Company (“Petitioner”) has demonstrated by a preponderance of the evidence that claims 9 and 28 of U.S. Patent No. 10,066,548 B2 (Ex. 1001, “the ’548 patent”) are unpatentable. *See* 35 U.S.C. § 316(e) (2018); 37 C.F.R. § 42.1(d) (2020).

II. BACKGROUND

A. Procedural History

Petitioner filed a Petition for an *inter partes* review of claims 1–36 of the ’548 patent. Paper 1 (“Pet.”). Raytheon Technologies Corporation (“Patent Owner”) filed a Preliminary Response. Paper 9 (“Prelim. Resp.”). Because Patent Owner disclaimed claims 1–8, 10–27, and 29–36 (Ex. 2005; Prelim. Resp. 2 n.2; *see* Patent Owner’s Response to Petition (“PO Resp.”) 1 n.1), the only remaining challenged claims are claims 9 and 28. We instituted *inter partes* review on claims 9 and 28 on the grounds presented in the Petition. Paper 10 (“Institution Decision” or “Dec.”).

After institution, Patent Owner filed a Response to the Petition. Paper 16 (“PO Resp.”). Petitioner thereafter filed a Reply to Patent Owner’s Response. Paper 20 (“Pet. Reply”). Patent Owner filed a Sur-reply to Petitioner’s Reply. Paper 21 (“PO Sur-reply”). An oral hearing was held on May 5, 2021. A transcript of the hearing is included in the record. Paper 27 (“Tr.”).

B. Real Parties-in-Interest

Under 37 C.F.R. § 42.8(b)(1), each party must identify the real party-in-interest. Petitioner identifies Safran Aircraft Engines, CFM International S.A., CFM International, Inc., Safran S.A., and itself as the real parties-in-interest. Pet. 1. Patent Owner identifies itself as the real party-in-interest. Paper 4, 2; Paper 7, 2.

C. Related Matters

Under 37 C.F.R. § 42.8(b)(2), each party must identify judicial or administrative matters that would affect or be affected by a decision in this proceeding. According to Petitioner and Patent Owner, the '548 patent is not involved in any district court litigations or other *inter partes* reviews. Pet. 1; Paper 4, 2.

D. The '548 Patent (Ex. 1001)

The title of the '548 patent is “Acoustic Liner with Varied Properties.” Ex. 1001, code (54). The '548 patent relates to gas turbine engines and, in particular, to an acoustic liner assembly for reducing emitted noise propagating through a duct. *Id.* at 1:18–20. Figure 1 of the '548 patent, as annotated by Patent Owner, is reproduced below:

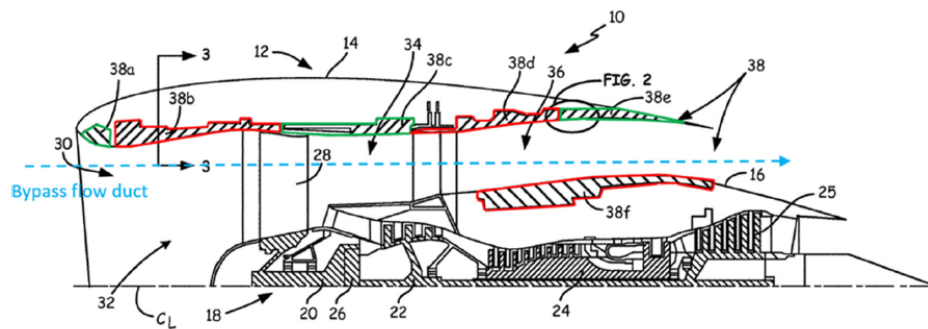


FIG. 1

GE-1001.003, Fig. 1 (annotated)

PO Resp. 13. Figure 1 above is a cross-sectional side view of geared turbofan engine 10 with acoustic liner 38 (shown in alternating red and green). Ex. 1001, 2:16–17, 2:37–38; PO Resp. 12–13 (discussing annotated Fig. 1). Geared turbofan engine 10 includes nacelle 12, first rotor 20, fan drive gear train system 26, fan 28, and a plurality of discrete acoustic liner segments 38a–38f. Ex. 1001, 2:65–3:26. Bypass flow duct 30 (marked with a blue arrow) “extends axially along engine 10 centerline axis C_L .” *Id.* at 3:8–9.

The ’548 patent states that the noise-attenuation acoustic liner ideally will reduce or eliminate noise of all frequencies generated within the propulsion system, but practical limitations reduce the efficient attenuation of noise at some frequencies in favor of other noise frequencies. Ex. 1001, 1:27–36. The patent explains that, for these reasons, noise-attenuation acoustic liners are only tuned or tailored to attenuate the most undesirable frequencies with the greatest efficiency, and the compromises required to efficiently attenuate the most undesirable frequencies limit the effective attenuation of other noise frequencies. *Id.*

To address this purported problem, the ’548 patent seeks to place a plurality of discrete acoustic liner segments with varied geometric properties along the bypass flow duct. Ex. 1001, code (57). Figure 2 of the ’548 patent, as annotated by Patent Owner, is reproduced below:

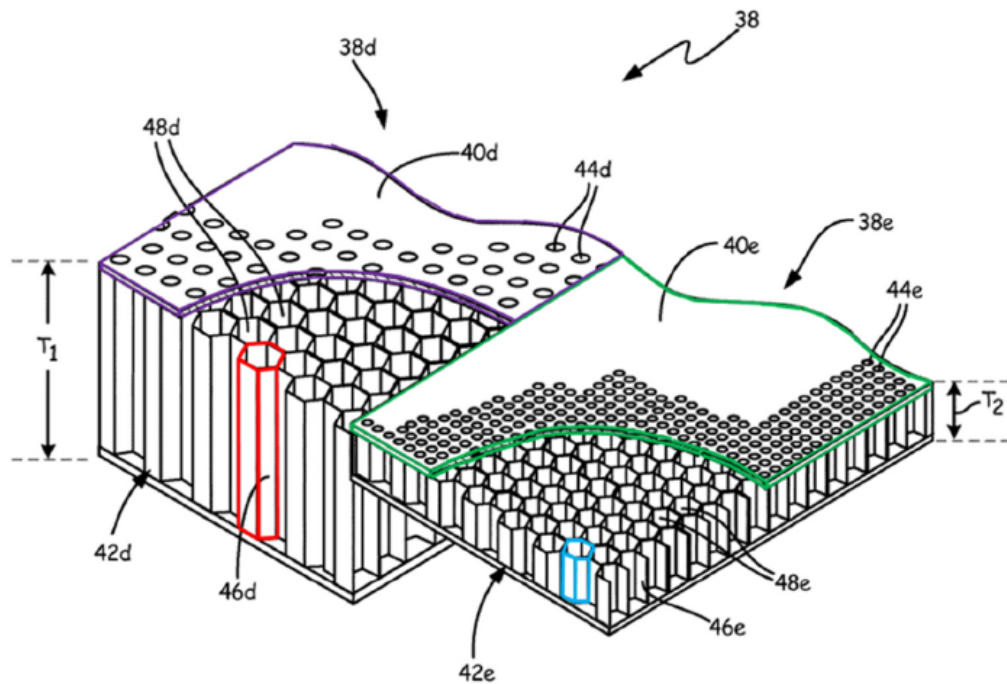


FIG. 2

GE-1001.004, Fig. 2 (annotated)

PO Resp. 17. Figure 2 is a perspective view of the acoustic liner from Figure 1 with portions cut away to reveal interior portions of the liner. Ex. 1001, 2:19–20. The acoustic liner shown in Figure 2 includes two segments: segment 38d and segment 38e. *Id.* at 4:62–5:2. These two segments each have cellular cores 42d, 42e with cells 46d, 46e (representative cells outlined in red and blue, respectively) that define cavities 48d, 48e. *Id.* Each segment also includes face sheets 40d, 40e (outlined in purple and green, respectively) disposed on the cellular core. *Id.* Holes 44d, 44e are formed in the face sheets. *Id.* The segments differ in thickness of the cellular core: the core 42d has a thickness T_1 while the core 42e has a smaller thickness T_2 . *Id.* at 5:15–20. The thickness of face sheets 40d, 40e can also differ between segments. *Id.* at 5:13–14. Varying the

geometric properties of each segment (such as cell width, the face sheet thickness, and the diameter of the face sheet holes) affects the frequencies of noise attenuated by the liner, and thus, segmentation allows for focused attenuation of different target frequency ranges at particular locations. *Id.* at 2:37–57, 3:20–26.

E. Illustrative Claim

As mentioned above, the challenged claims are claims 9 and 28. Claim 9 and independent claim 1 and claim 7, from which claim 9 depends, are reproduced below:

1. A geared turbofan engine, comprising:
 - a first rotor;
 - a fan connected to the first rotor, wherein the fan is capable of rotation at frequencies between 200 and 6000 Hz and has a fan pressure ratio of between 1.25 and 1.60;
 - a second rotor;
 - a gear train that connects the first rotor to the second rotor;
 - a fan casing and a nacelle arranged circumferentially about a centerline and defining a bypass flow duct in which the fan is disposed; and
 - a plurality of discrete acoustic liner segments having varied geometric properties disposed along the bypass flow duct; wherein the plurality of discrete acoustic liner segments comprises a first acoustic liner segment, and a second acoustic liner segment spaced apart from the first acoustic liner segment;
 - wherein each [of] the first and second acoustic liner segments includes a cellular core structure, the cellular core structure comprising one or more resonator chambers having a width; and

wherein the width of the one or more resonator chambers of the first acoustic liner[] differs from the width of the one or more resonator chambers of the second acoustic liner.

Ex. 1001, 9:1–26.

7. The geared turbofan engine of claim 1,

wherein each of the plurality of discrete acoustic liner segments includes a face sheet with holes and the holes communicate with the resonator chambers in the cellular core structure,

wherein a diameter of the holes in the face sheet of one of the plurality of discrete acoustic liner segments differs from a diameter of holes in the face sheet of another of the plurality [of] discrete acoustic liner segments.

Id. at 9:53–60.

9. The geared turbofan engine of claim 7,

wherein a thickness of the face sheet of one of the plurality of discrete acoustic liner segments differs from a thickness of the face sheet of another of the plurality of discrete acoustic liner segments.

Id. at 9:66–10:3.

F. References and Other Evidence

Petitioner relies on the following references:

Reference	Description	Date	Exhibit
Heldenbrand	R. Heldenbrand and W.M. Norgren, “AiResearch QCGAT Program Final Report,” NASA Report CR-159758	1979	Ex. 1032

Kisner	L.S. Kisner, “AiResearch QCGAT Engine - Acoustic Test Results,” NASA Doc. ID 19800013843, General Aviation Propulsion, NASA Conference Publication 2126, pp. 65–100	March 1, 1980	Ex. 1015
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Petitioner also relies on a declaration from Dr. Wing Ng (Ex. 1003 or “Ng Decl.”).

Patent Owner has submitted a declaration from Dr. Thomas Corke (Ex. 2015 or “Corke Decl.”).

Both parties have submitted deposition transcripts for these two declarants. Exs. 1056 (“Corke Dep.”), 2007 (“Ng Dep.”).

G. Asserted Ground

Petitioner challenges the patentability of the ’548 patent claims on the following ground:¹

Claims Challenged	35 U.S.C. § ²	References
9, 28	103	Heldenbrand, Kisner

Pet. 14–15.

¹ As mentioned above, Petitioner initially challenged claims 1–36 of the ’548 patent. Pet. 14. Because Patent Owner filed a disclaimer of claims 1–8, 10–27, and 29–36 (Ex. 2005; Prelim. Resp. 2 n.2), the only remaining challenged claims are claims 9 and 28.

² The Leahy-Smith America Invents Act (“AIA”) included revisions to 35 U.S.C. § 103 that became effective on March 16, 2013. Because the ’548 patent has an effective filing date before March 16, 2013, we apply the pre-AIA version of the statutory basis for unpatentability. Our decision is the same regardless of which version of § 103 applies.

III. ANALYSIS

A. Petitioner's Burden

Petitioner bears the burden of persuasion to prove unpatentability of the challenged claims by a preponderance of the evidence. 35 U.S.C. § 316(e) (2018); 37 C.F.R. § 42.1(d). This 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). Here, Petitioner asserts that the challenged claims are unpatentable under 35 U.S.C. § 103. Pet. 19.

B. Obviousness

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

When evaluating a combination of teachings, we must also “determine whether there was an apparent reason to combine the known elements in the fashion claimed by the patent at issue.” *KSR*, 550 U.S. at 418 (citing *In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006) (“[R]ejections on obviousness

³ Patent Owner does not rely on objective indicia of nonobviousness.

grounds cannot be sustained by mere conclusory statements; instead, there must be some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness.”)). In this regard, an obviousness analysis “need not seek out precise teachings directed to the specific subject matter of the challenged claim, for a court can take account of the inferences and creative steps that a person of ordinary skill in the art would employ.” *KSR*, 550 U.S. at 418; see *In re Translogic Tech, Inc.*, 504 F.3d 1249, 1259 (Fed. Cir. 2007). In *KSR*, the Supreme Court also stated that an invention may be found obvious if trying a course of conduct would have been obvious to a person of ordinary skill in the art:

When there is a design need or market pressure to solve a problem and there are a finite number of identified, predictable solutions, a person of ordinary skill has good reason to pursue the known options within his or her technical grasp. If this leads to the anticipated success, it is likely the product not of innovation but of ordinary skill and common sense. In that instance the fact that a combination was obvious to try might show that it was obvious under § 103.

550 U.S. at 421.

“Whether an ordinarily skilled artisan would have been motivated to modify the teachings of a reference is a question of fact.” *WBIP, LLC v. Kohler Co.*, 829 F.3d 1317, 1327 (Fed. Cir. 2016) (citations omitted).

“[W]here a party argues a skilled artisan would have been motivated to combine references, it must show the artisan ‘would have had a reasonable expectation of success from doing so.’” *Arctic Cat Inc. v. Bombardier Recreational Prods. Inc.*, 876 F.3d 1350, 1360–61 (Fed. Cir. 2017) (citations omitted).

C. Level of Ordinary Skill in the Art

We consider the asserted grounds of unpatentability in view of the understanding of a person of ordinary skill in the art. In assessing the level of ordinary skill in the art, various factors may be considered, including the “type of problems encountered in the art; prior art solutions to those problems; rapidity with which innovations are made; sophistication of the technology; and educational level of active workers in the field.” *In re GPAC Inc.*, 57 F.3d 1573, 1579 (Fed. Cir. 1995) (quoting *Custom Accessories, Inc. v. Jeffrey-Allan Indus., Inc.*, 807 F.2d 955, 962 (Fed. Cir. 1986)). “[O]ne or more factors may predominate.” *Id.*

Here, Petitioner asserts that a person of ordinary skill in the art would have had “a M.S. degree in Mechanical or Aerospace Engineering, as well as at least 3–5 years of experience in the field of gas turbine engine design and analysis, including experience with acoustics and noise generated by turbine engines.” Pet. 14; Ex. 1003 ¶ 6. Patent Owner does not address the level of education and experience of a person of ordinary skill in the art.

We regard Petitioner’s definition as consistent with the prior art before us and the disclosure in the ’548 patent. *See Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001) (prior art itself may reflect an appropriate level of skill). Thus, for the purpose of our decision, we adopt Petitioner’s proposal.

D. Claim Construction

In an *inter partes* review, the claims are construed 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). *See* 37 C.F.R. § 42.100(b) (2019).

This claim construction standard includes construing the claim in accordance with the ordinary and customary meaning of such claims as understood by one of ordinary skill in the art. *Id.*; see *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312–13 (Fed. Cir. 2005). In construing claims in accordance with their ordinary and customary meaning, we take into account the specification and the prosecution history of the patent. *Phillips*, 415 F.3d at 1315–17. Extrinsic evidence, including expert and inventor testimony, dictionaries, and treatises, may also be used but is less significant than the intrinsic record. *Id.* at 1315. Usually, the specification is dispositive, and it is the single best guide to the meaning of a disputed term. *Id.* at 1315. Any special definitions for claim terms must be set forth in the specification with reasonable clarity, deliberateness, and precision. See *In re Paulsen*, 30 F.3d 1475, 1480 (Fed. Cir. 1994).

Additionally, only terms that are in controversy need to be construed, and these need be construed only to the extent necessary to resolve the controversy. See *Vivid Techs., Inc. v. Am. Sci. & Eng'g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999) (“[O]nly those terms need be construed that are in controversy, and only to the extent necessary to resolve the controversy.”); *Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co. Matal*, 868 F.3d 1013, 1017 (Fed. Cir. 2017) (applying *Vivid Techs.* in the context of an *inter partes* review).

Petitioner asserts that a person of ordinary skill in the art would construe the claim term “bypass flow duct” as “those sections of the duct that are forward of the fan, surround the fan, and are aft of the fan.” Pet. 19 (citing Ex. 1003 ¶ 94); see Pet. 17–19. Patent Owner does not address the meaning of “bypass flow duct.”

We determine that no claim term requires express construction for purposes of this Decision.

E. Obviousness over Heldenbrand and Kisner

Petitioner asserts that claims 9 and 28 are unpatentable under 35 U.S.C. § 103 as obvious over the combined teachings of Heldenbrand and Kisner. Pet. 64–67, 71. We first address the two references and then address the merits of the challenge.

1. Overview of Heldenbrand and Kisner (Exs. 1032, 1015)

In 1975, NASA began the Quiet, Clean, General Aviation Turbofan (QCGAT) Engine program to improve environmental characteristics of civil aircraft near suburban airports. Ex. 1036, 11. Heldenbrand and Kisner are reports describing the QCGAT engine designed, built, and tested by AiResearch. Ex. 1032, 17; Ex. 1015, 2. Heldenbrand is a report titled “AiResearch QCGAT Program Final Report.” Ex. 1032, 2. Kisner is a report titled “AiResearch QCGAT Engine — Acoustic Test Results.” Ex. 1015, 2.

The QCGAT program sought “to obtain significant reductions in noise and pollutant emissions while reducing or maintaining fuel consumption levels” by developing and testing “new-technology designs for rotating parts and all items in the engine and nacelle” of smaller engines using the “AiResearch Model TFE731-3 Engine” as a “base-line engine.” Ex. 1032, 17. The acoustic liner used in Heldenbrand had “a perforated-plate, broadband-resonator.” Ex. 1032, 112. Heldenbrand lists certain parameters, including “Average Duct Height,” “Treatment Length,” “Cavity Depth,” and “Percent Open Area,” for multiple sections of its acoustic liner.

Ex. 1032, 114, Table 7–10. The “Percent Open Area” is the amount of open area in the face sheet, *i.e.*, occupied by holes. PO Resp. 21.

According to one of the goals of Heldenbrand, the acoustic liner design sought to “balance the noise suppression” and “provide[] the broadest possible attenuation bandwidth without sacrificing significant attenuation from optimum.” Ex. 1032, 111. Testing confirmed that Heldenbrand’s acoustic liners satisfied this objective. *See* Ex. 1032, 175 (“The QCGAT engine/nacelle system met or bettered the contract noise goals based on the jet noise dominated correlation analysis of measured static acoustic data.”).

Kisner is another report on the same QCGAT program, focusing on “the acoustic design . . . for the AiResearch QCGAT engine.” Ex. 1015, 2. Kisner also provides information about design parameters for the acoustic liner, including “Liner Length,” “Face Sheet Open Area,” “Cavity Depth,” and “Honeycomb Cell Size.” Ex. 1015, 20, Table 1. Much of Kisner’s information about the acoustic liner design is identical to Heldenbrand’s because they both describe the same project. *Compare* Ex. 1032, 111–112 *with* Ex. 1015, 4–5.

2. Analysis of Asserted Obviousness of Claims 9 and 28

Claim 9 depends from claims 1 and 7 and claim 28 depends from claims 20, 24, and 26. Ex. 1001, 9:2–10:3, 10:53–12:3. In support of Petitioner’s contention that claims 9 and 28 would have been obvious over the combined teachings of Heldenbrand and Kisner, Petitioner provides an element-by-element analysis showing where each limitation of claims 1, 7, and 9 and claims 20, 24, 26, and 28 is disclosed in Heldenbrand or Kisner. Pet. 20–40 (claim 1), 60–63 (claim 7), 64–67 (claim 9), and 67–71

(claims 20, 24, 26, and 28). Petitioner supports its analysis with testimony from Dr. Wing Ng. *See* Ex. 1003 ¶¶ 60–176.

Patent Owner does not dispute that Heldenbrand and Kisner disclose each limitation of claims 1, 20, and 24. *See* PO Resp. As to claims 7 and 9 and claims 26 and 28, Patent Owner disputes that Heldenbrand and Kisner disclose the two limitations which require individually varying the hole diameter (claims 7 and 26) and face sheet thickness (claims 9 and 28) in different liner segments or varying both the hole diameter and the face sheet thickness. *See, e.g.,* PO Resp. 2.

We have reviewed the evidence and arguments provided by Petitioner and Patent Owner including the supporting declarations of Drs. Ng and Corke. For reasons set forth below, Petitioner has demonstrated by a preponderance of the evidence that claims 9 and 28 are unpatentable.

a) Claims 1, 20, and 24

In support of Petitioner's contention that claims 1, 20, and 24 would have been obvious over the combined teachings of Heldenbrand and Kisner, Petitioner provides an element-by-element analysis showing where each element of claims 1, 20, and 24 is disclosed in Heldenbrand or Kisner. Pet. 20–40 (claim 1), 67–69 (claims 20 and 24). Petitioner supports its analysis with testimony from Dr. Ng. *See* Ex. 1003 ¶¶ 60–176. In particular, Petitioner asserts that Kisner discloses that the resonator chamber widths of first and second acoustic liners are different, as recited in claims 1 and 20. Pet. 38–40. Patent Owner does not contest that Heldenbrand and Kisner disclose the limitations in claims 1, 20, and 24. *See* PO Resp.

After reviewing Petitioner’s evidence and arguments,⁴ we find that Petitioner has demonstrated by a preponderance of the evidence that claims 1, 20, and 24 are unpatentable over Heldenbrand and Kisner.

b) Claims 7 and 26 – the “hole diameter” limitation

Claims 7 and 26 require that (1) “each of the plurality of discrete acoustic liner segments includes a face sheet with holes and the holes communicate with the resonator chambers in the cellular core structure” and (2) “a diameter of the holes in the face sheet of one of the plurality of discrete acoustic liner segments differs from a diameter of holes in the face sheet of another of the plurality [of] discrete acoustic liner segments.” Ex. 1001, 9:53–60 (claim 7) and 11:31–38 (claim 26).

(i) Petitioner’s Arguments

As to the first limitation, Petitioner asserts that both Heldenbrand and Kisner disclose sandwich-style acoustic liners that include a perforated face sheet and because “the face sheet in conjunction with the cellular core and backing sheet act as Helmholtz resonators, the holes in the face sheet communicate with the resonator chambers in the cellular core.” Pet. 60–61 (citing Ex. 1003 ¶¶ 146–147; Ex. 1032, 112 (“a perforated-plate, broadband-

⁴ In its Reply, Petitioner argues that because Patent Owner disclaimed claims 1–8, 10–27, and 29–36, Patent Owner is precluded from using these disclaimed claims to argue the patentability of challenged claims 9 and 28. Pet. Reply 2–3. Petitioner’s argument is unpersuasive because “[d]isclaimed claims are treated as if they never existed, and disclaimer does not legally constitute ‘an admission that the subject of the disclaimer appears in the prior art.’” *Raytheon Techs. Corp. v. General Electric Co.*, 993 F.3d 1374, 1379 n.4 (Fed. Cir. 2021) (citations omitted); *see also* Tr. 60:25–61:21 (Petitioner’s counsel stating Petitioner “do[es] not have a . . . clear response that what the Federal Circuit said in that footnote is not controlling here”).

resonator was constructed from aluminum perforated sheet, bonded to 3/8-inch cell aluminum honeycomb backing”); Ex. 1032, 63 (disclosing a “perforated-face sheet”); Ex. 1015, 4 (“A broadband resonator was constructed from aluminum perforated sheet . . .”). Patent Owner does not contest that a person of ordinary skill in the art would have understood that Heldenbrand and Kisner disclose this first limitation.

As to the second “hole diameter” limitation, Petitioner asserts that Heldenbrand and Kisner teach varying hole diameter between different sections of the acoustic liner by disclosing varying “percent open area” (also called “porosity”) between different sections of the acoustic liner. Pet. 61–62 (citing Ex. 1003 ¶¶ 148–150; Ex. 1032, 114 (Table 7-10 (reproduced below)), 112 (“The cavity depths and face sheet open areas required to achieve optimum attenuation were computed.”); Ex. 1015, 20 (Table 1 (reproduced below))). For example, Heldenbrand’s Table 7–10, as annotated by Petitioner, is reproduced below.

TABLE 7-10. QUART WACELLE ATTENUATION DESIGN PARAMETERS.

Parameter	Inlet Duct				Fan Exhaust					
	Section A		Section B		Section 1		Section 2		Section 3	
	Pre-liminary	Final	Pre-liminary	Final	Pre-liminary	Final	Pre-liminary	Final	Pre-liminary	Final
Average Duct Height, h - cm	35.05	35.05	38.00	38.35	14.48	14.48	14.22	14.22	17.82	17.82
- (in.) ¹	(13.8)	(13.8)	(15.3)	(15.1)	(5.7)	(5.7)	(5.6)	(5.6)	(6.7)	(6.7)
Treatment (A ₁ & A ₂) Length - cm	46.48	44.78	16.51	15.24	32.00	32.00	38.00	38.06	52.83	52.83
- (in.)	(18.3)	(17.6)	(6.5)	(6.0)	(12.6)	(12.6)	(15.3)	(15.3)	(20.8)	(20.8)
Tuned Center Frequency, Hz	2500	1000	5000	2500	2500	2500	5000	4000	2000	2000
Cavity Depth - cm	1.52	2.79	0.76	1.32	1.42	1.42	0.69	0.91	1.91	1.96
- (in.)	(0.6)	(1.1)	(0.3)	(0.52)	(0.56)	(0.56)	(0.27)	(0.36)	(0.75)	(0.77)
- cm	3.43	1.83								
- (in.)	(1.35)	(0.72)								
Percent Open Area - %	7.1	8.6	18.2	14.2	8.8	7.8	18.3	8.6	7.1	6.8
	18.1	5.8								
Frequency Parameter ² , fm/c	5.19	2.131	5.71	5.644	2.05	2.05	1.93	1.59	1.92	1.92
	2.07	1.99								
Condition Tuned For:	Sideline	Sideline	Sideline	Sideline	Approach	Approach	Takeoff	Approach	Approach	Approach

¹For Inlet h = D/2

²For one wall treated, h = 2h

Pet. 62. Table 7–10 describes the QCGAT nacelle attenuator design parameters, including variation in percent open area/porosity (in yellow) between different acoustic liner segments. Ex. 1003 ¶ 148.

Kisner’s Table 1, as annotated by Petitioner, is reproduced below.

TABLE 1. QCGAT NACELLE ATTENUATOR DESIGN CHARACTERISTICS.

Liner Section	Tuned Freq, Hz	Operating Condition Tuned for	Liner Length, cm (in.)	Face Sheet Open Area, %	Cavity Depth, cm (in.)	Honeycomb Cell Size,  cm (in.)
A ₁	1000	Sideline	17.5 (6.9)	5.8	18.83 (0.72)	1.905 (0.75)
A ₂	1000	Sideline	27.2 (10.7)	8.6	2.79 (1.10)	1.905 (0.75)
B	2500	Sideline	15.2 (6.0)	14.2	1.32 (0.52)	0.953 (0.375)
1	2500	Approach	32.0 (12.6)	7.0	1.42 (0.56)	0.953 (0.375)
2	4000	Approach	38.9 (15.3)	8.6	0.91 (0.36)	0.953 (0.375)
3	2000	Approach	52.8 (20.8)	6.8	1.96 (0.77)	1.905 (0.75)

Pet. 62. Table 1 describes the QCGAT nacelle attenuator design characteristics, including the percent open area/porosity (in yellow) between different acoustic liner sections. Ex. 1003 ¶¶ 149–150. Petitioner and Patent Owner agree that porosity is dependent on two variables: pore size (i.e., hole diameter) and the number of holes per unit area. *Id.* at ¶ 148; Ex. 2015 ¶ 100 (“the percent open area of each section, which is described in Heldenbrand and Kisner, relates to both the size of the holes and the number of holes per unit area (e.g., the spacing of the holes)”).

According to Petitioner, by disclosing differing porosities for different segments, Heldenbrand and Kisner teach variation in both the pore size and pore number, thus, disclosing the “hole diameter” limitation. Pet. 61 (citing Ex. 1003 ¶ 148). Petitioner states that a person of ordinary skill in the art “would understand the role the face sheet porosity plays, in relation to cell size, in determining the resonant frequency of the acoustic liner.” *Id.* at 63

(citing Ex. 1003 ¶¶ 41–43). Petitioner further states that “[b]ecause Heldenbrand and Kisner teach that the face sheets of different segments have different porosities (i.e., different percentages of open area), a [person of ordinary skill in the art] would be clearly motivated to design the face sheets in a manner that best accomplishes the correct percentage of open areas.” *Id.* (citing Ex. 1003 ¶ 150; Pet. 9–13). Along those lines, Petitioner contends that there “are a finite number of ways to accomplish this—by varying hole size and/or hole numbers across each segment—which would be immediately and readily apparent to a [person of ordinary skill in the art].” *Id.* (citing Ex. 1003 ¶ 150; Pet. 9–13). According to Petitioner, because “Heldenbrand and Kisner disclose segments with varying porosities, the segments must either have varied hole size or number” and, thus, “varying hole diameter is disclosed in Heldenbrand and Kisner, or at minimum would have been obvious to a [person of ordinary skill in the art] based on Heldenbrand and Kisner.” *Id.* (citing Ex. 1003 ¶ 150).

(ii) Patent Owner’s Arguments

Patent Owner presents several reasons why Petitioner’s assertion that Heldenbrand and Kisner disclose the “hole diameter” limitation is erroneous. PO Resp. 20–39. First, Patent Owner argues that Heldenbrand and Kisner do not disclose the “hole diameter” limitation because they “say nothing at all about hole diameter,” and Petitioner “does not assert any ground combining Heldenbrand and Kisner with another reference that discloses varying hole diameter.” *Id.* at 20. According to Patent Owner, Petitioner wrongly argues that “varying hole diameter between liner segments is actually **disclosed** because Heldenbrand discloses a separate parameter—percent open area (or porosity).” *Id.* Patent Owner argues that “these are

two independent parameters: a disclosure of percent open area is not a disclosure of hole diameter.” *Id.* (citing Ex. 2015 ¶¶ 96–99). Patent Owner argues that Petitioner wrongly “conflates two different parameters” and “[p]orosity, which is also referred to as ‘percent open area,’ that is, the amount of open area in the sheet, is distinct from the hole diameter and is a function of both the number of holes in the sheet and the area of each hole.” *Id.* at 21 (citing Ex. 2015 ¶¶ 96–99).

Second, Patent Owner argues that “hole diameter is not among the ‘major design characteristics’ for the QCGAT acoustic liner that Heldenbrand and Kisner identify and about which they provide detailed information.” PO Resp. 22 (citing Ex. 1015, 5; Ex. 2015 ¶¶ 82–83, 95–96). According to Patent Owner, Heldenbrand’s Table 7–10 and Kisner’s Table 1 describe varying percent open area, not hole diameter. *Id.* at 23–24 (citing Ex. 2015 ¶¶ 83, 95). Patent Owner also argues that “percent open area is not a proxy or substitute for hole diameter” (*id.* at 24), and “Heldenbrand and Kisner inform a [person of ordinary skill in the art] only about the porosity of each liner section, and with that limited information, the [person of ordinary skill in the art] can do nothing more than speculate as to the hole diameter for each of those sections” (*id.* at 27 (citing Ex. 2015 ¶ 100)).

Third, Patent Owner argues that Petitioner fails to provide a sufficient motivation to modify Heldenbrand and Kisner. PO Resp. 29–35. Patent Owner argues that Dr. Ng’s testimony that a person of ordinary skill in the art would vary hole diameters to achieve a given percent open area “lacks any evidentiary support.” *Id.* at 33. According to Patent Owner, a skilled artisan “seeking to apply the teachings of Heldenbrand and Kisner would not look to ‘accomplish[] the correct percentage of open areas,’ as [Petitioner]

suggests (Petition 63), but rather [would look] to how to accomplish Heldenbrand and Kisner’s goal: ***noise attenuation of a target attenuation spectrum***.” *Id.* at 34 (citing Ex. 1032, 111; Ex. 1015, 4; Ex. 2007, 35:23–25 (Dr. Ng agreeing that “the overall goal of an acoustic liner [is] to attenuate noise”); Ex. 2015 ¶¶ 101–106).

Finally, Patent Owner argues that Petitioner does not present evidence that a person of ordinary skill in the art would have been motivated to pursue a variation in hole diameter between sections in Heldenbrand’s and Kisner’s acoustic liner with a reasonable expectation of success. PO Resp. 20–21 (citing Ex. 2015 ¶¶ 101–107), 36–39.

(iii) Analysis

Petitioner has the better arguments. A person of ordinary skill is “a person of ordinary creativity, not an automaton.” *KSR*, 550 US at 421. “When there is a design need or market pressure to solve a problem and there are a finite number of identified, predictable solutions, a person of ordinary skill has good reason to pursue the known options within his or her technical grasp.” *Id.* Here, Petitioner’s witness, Dr. Ng, and Patent Owner’s witness, Dr. Corke, agree that varying face sheet porosity was a binary choice—either vary the diameter of the holes or vary the number of holes. *See* Ex. 1003 ¶¶ 148–150; Ex. 2015 ¶ 100 (“the percent open area of each section, which is described in Heldenbrand and Kisner, relates to both the size of the holes and the number of holes per unit area (e.g., the spacing of the holes)”; Ex. 1056, 23:2–24:11, 28:8–30:16.

Dr. Ng’s testimony that varying hole size in different liner segments was an obvious design choice is supported by the prior art references. For example, Heldenbrand references the 1976 Minner and Rice report

(Ex. 2004). Ex. 1032, 112, 194. Minner and Rice discloses different hole diameters for different liner segments. Table V of Minner and Rice, as annotated by Petitioner, is reproduced below.

TABLE V. - LINER MECHANICAL DESIGN, EXAMPLE LINER
OF TABLE IV, FOR QF-9 DUCT

Section	Sheet thickness, t		Hole diameter, d		Open area ratio, σ , percent	Back cavity depth, b	
	cm	in.	cm	in.		cm	in.
1	3.8	1.5	0.64	0.25	23.7	7.06	2.779
2	.051	.020	.127	.050	12.0	1.37	0.541

RTX-2004.027, Table V (annotated)

Pet. Reply 13 (citing Ex. 2004, 27 (Table V)). Table V discloses varying hole diameters for different sections 1–2 (i.e., liner segments). Dr. Corke confirmed that Tables 5 and 22 of Minner and Rice disclose an acoustic liner with two segments with different face sheet hole diameters. Ex. 1056, 71:7–10 (“Q. Table 5 of Minner and Rice, Exhibit . . . 2004, lists different face sheet hole diameters for sections 1 and 2 of the acoustic liner, correct? A. . . . [T]hat’s correct.”), 74:5–22 (discussing Table 22 of Minner and Rice).

Like Minner and Rice, the 1983 Wilkinson report (Exhibit 1055) discloses honeycomb-style acoustic liner segments with varying hole diameters. Wilkinson’s Table 1, as annotated by Petitioner, is reproduced below.

Table 1. - Model construction data.

	MODEL					
PARAMETER	1	2	3	4	5	6
CONFIG.	A	A	B	B	A	A
d_1 , mm	0.28	0.46	1.48	1.45	0.28	0.46
d_2 , mm	0.18	0.36	-	-	0.18	0.36
s , mm	9.51	0.76	5.49	3.40	0.61	0.76
t , mm	0.18	0.30	0.81	0.81	0.18	0.30
PCA, %	6.1	17.6	6.8	12.0	4.7	13.9
H, holes/cm ²	261	172	3.8	10.0	269	172
A_1 , m ²	0.255	0.255	0.255	0.255	0.165	0.165
γ , %	56.8	56.8	96.0	96.0	85.6	85.6
L , mm	0.711	0.711	0.914	0.914	0.813	0.813
PLENUM	P1	P3	P2	P2	P1	P1

P1: HONEYCOMB, HEX CELL, 4.8 mm/SIDE, 19.1 mm DEEP, CLOSED ON BOTTOM
P2: HONEYCOMB, HEX CELL, 4.8 mm/SIDE, 12.7 mm DEEP, CLOSED ON BOTTOM
P3: SINGLE, EMPTY CAVITY; VARIABLE DEPTH

GE-1055.006, Table 1 (annotated)

Pet. Reply 17 (citing Ex. 1055, 6 (Table 1)). Table 1 discloses six different “model” liners, four of which were honeycomb-style liners (annotated in yellow). *Id.* at 16 (citing Ex. 1055, 3, 6 (Table 1), 7 (Fig. 1B)). All four honeycomb models include hole diameters that differ from the other models. *Id.* (citing Ex. 1055, 2 (listing “d” as the “diameter of perforation”)); *id.* at 6 (Table 1)). Dr. Corke confirmed that Wilkinson discloses face sheets with different hole diameters. Ex. 1056, 60:1–3 (“Q. Do you also recall that in Wilkinson, that the perforation hole sizes differed? A. I do recall that.”).

Minner and Rice’s and Wilkinson’s teachings of different acoustic liner segments with varied hole diameters provide further support for Dr. Ng’s testimony that it would have been obvious to a person of ordinary skill in the art, viewing Heldenbrand and Kisner, to vary the hole diameter among the acoustic liner segments given that the face sheets of the segments had different porosities. Ex. 1003 ¶¶ 148–150. Thus, we agree with Petitioner that varying face sheet hole diameter is disclosed in Heldenbrand

and Kisner or, at minimum, would have been obvious to a person of ordinary skill in the art based on Heldenbrand and Kisner.

Finally, we do not agree with Patent Owner's arguments that Petitioner does not present evidence that a person of ordinary skill in the art would have been motivated to pursue a variation in hole diameter between sections in Heldenbrand's and Kisner's acoustic liner with a reasonable expectation of success. PO Resp. 20–21 (citing Ex. 2015 ¶¶ 101–107), 36–39. Petitioner argues that a person of ordinary skill in the art would have understood

the role the face sheet porosity plays, in relation to cell size, in determining the resonant frequency of the acoustic liner. GE-1003, ¶¶ 41–43. Because Heldenbrand and Kisner teach that the face sheets of different segments have different porosities (i.e., different percentages of open area), a [person of ordinary skill in the art] would be clearly motivated to design the face sheets in a manner that best accomplishes the correct percentage of open areas. There are a finite number of ways to accomplish this—by varying hole size and/or hole numbers across each segment—which would be immediately and readily apparent to a [person of ordinary skill in the art]. *See* GE-1003, ¶ 150; *see also* [Pet. 9–13].

Pet. 63; *see also* Pet. Reply 10 n.5. Given that there are only two ways to modify the face sheet porosity, a person of ordinary skill in the art would have been fully aware of and motivated to vary the hole diameter among segments to achieve the disclosed porosities with a reasonable expectation of success. *KSR*, 550 U.S. at 421 (“When there is a design need ... to solve a problem and there are a finite number of identified, predictable solutions, a person of ordinary skill in the art has good reason to pursue the known options within his or her technical grasp.”). We note, further, that the claims pertinently require only different hole diameters in different segment face

sheets, which we conclude a person of ordinary skill in the art could readily carry out. The claims do not specify any particular noise attenuation goals that must be achieved by having different hole diameters.

(iv) Determination for Claims 7 and 24

We determine that Petitioner has shown by a preponderance of the evidence that claims 7 and 24 are unpatentable as being obvious over Heldenbrand and Kisner.

c) Claims 9 and 28 – the “face sheet thickness” limitation

Claims 9 and 28 recite that “a thickness of the face sheet of one of the plurality of discrete acoustic liner segments differs from a thickness of the face sheet of another of the plurality of discrete acoustic liner segments.” Ex. 1001, 9:66–10:3 (claim 9), 11:44–12:3 (claim 28).

(i) Petitioner’s Arguments

Petitioner, relying on the testimony of Dr. Ng, contends that a person of ordinary skill in the art would have found it obvious “to vary the thickness of the face sheets disclosed in Heldenbrand and Kisner for different acoustic liner segments” because “it has been long known to vary face sheet thickness for different acoustic liner segments.” Pet. 64 (citing Ex. 1003 ¶¶ 153–154). In support of this position, Dr. Ng, for example, testifies that GE’s 1964 QCSEE engine used “acoustic liner segments in different parts of the disclosed geared engine having different face sheet thicknesses.” *Id.* at 65 (citing Ex. 1003 ¶¶ 154, 199–200 (comparing Ex. 1006, 38, Figure 19 (listing face sheet thicknesses of 0.081 cm for acoustic liner segments in the section of the bypass flow duct shown in Ex. 1006, 37, Figure 18) with Ex. 1006, 40, Figure 21 (listing face sheet thickness of 0.102 cm and 0.203 cm for acoustic liner segments in the

section of the bypass flow duct shown in Ex. 1006, 39, Figure 20))). Dr. Ng also testifies that U.S. Pat. No. 5,923,003 (issued in 1999) teaches variation in the face sheet thickness: “‘The dimensions of the extended reaction acoustic liner . . . may be varied, as desired. For example, the outer layer 12 and the inner layer 14 may have a thickness of 1/32 inch to 1/8 inch, as desired . . .’ (where inner layer 14 is the perforated face sheet).” *Id.* at 64–65 (citing Ex. 1034, 4:26–29; Ex. 1003 ¶ 154).

Petitioner, again relying on the testimony of Dr. Ng, contends that a person of ordinary skill in the art would have been motivated “to alter the face sheet thickness.” Pet. 65 (citing Ex. 1003 ¶ 155). Petitioner explains that “Heldenbrand and Kisner already disclose the variation of the geometric properties of the acoustic liner for different acoustic liner segments” including, for example, the “QCGAT engine utilizes variation in cell width and depth and faceplate porosity among its acoustic liner segments” in order to attenuate different frequencies. *Id.* at 65–66 (citing Pet. 20–41 (Section VII.A.2); Ex. 1015, 5 (“To achieve optimum attenuation, the required cavity depths and face sheet open areas were computed.”); Ex. 1015, 20, Table 1; Ex. 1032, 112 (“The cavity depths and face sheet open areas required to achieve optimum attenuation were computed.”))). Petitioner also contends that it “was known in the art that varying the face sheet thickness was another way to affect the frequencies attenuated by the acoustic liner” (Pet. 66 (citing Ex. 1003 ¶ 156)) and the “face sheet thickness corresponds to the neck length in a Helmholtz resonator, a value known to affect the resonant frequency of the cavity” (*id.* (citing Pet. 9–13 (Section III.A.3); Ex. 1003 ¶¶ 40–43; Ex. 1033, 3; Ex. 1014, 144)).

Relying on Dr. Ng’s testimony, Petitioner reasons that, because “alterations to face sheet thickness were known in the art, as well as the straight-forward benefits of changing face sheet thickness, it would have been an obvious design choice to a [person of ordinary skill in the art] to alter the face sheet thickness among acoustic liner segments to attenuate different frequencies.” *Id.* at 66 (citing Ex. 1003 ¶ 157). Petitioner also reasons that, because “the QCGAT engine was already fitted for acoustic liner segments with varied geometric properties, there would have not been any expected barriers to a [person of ordinary skill in the art’s] success in altering the face sheet thicknesses.” *Id.* at 67 (citing Ex. 1003 ¶ 157).

(ii) Patent Owner’s Arguments

Patent Owner argues that Petitioner’s challenge is deficient because there are several reasons that a person of ordinary skill in the art would not have been motivated to modify Heldenbrand and Kisner by varying face sheet thickness between sections. PO Resp. 39–47. First, Patent Owner argues that a person of ordinary skill in the art would not have been motivated to vary face sheet thickness in the acoustic liner because Heldenbrand and Kisner are silent regarding face sheet thickness. *Id.* at 39 (citing Ex. 2015 ¶ 83).

Second, Patent Owner argues that Petitioner’s rationale that a person of ordinary skill in the art would have been motivated to vary face sheet thickness in different segments “to attenuate different frequencies” is “a generic rationale entirely divorced from the prior art elements and from the face sheet thickness parameter.” *Id.* at 40. Patent Owner argues that Petitioner’s “motivation is entirely divorced from the prior art references—Heldenbrand and Kisner—in that [Petitioner] identifies no flaw in

Heldenbrand[’s] and Kisner’s already-optimized liner which would have motivated a [person of ordinary skill in the art] to attenuate different frequencies.” *Id.* at 42. Patent Owner further argues that Petitioner’s “generic objective of attenuating different frequencies” “provides no reason why a [person of ordinary skill in the art] would select face sheet thickness, in particular, out of all the possible variables, to modify in order to do so.” *Id.* at 42–43.

Third, Patent Owner argues that Petitioner’s alleged motivation is “redundant of objectives already achieved by [Petitioner’s] cited references, and thus insufficient to demonstrate obviousness.” PO Resp. 40. According to Patent Owner, “Heldenbrand and Kisner’s acoustic liner already is designed for the specific environment of the QCGAT engine, *e.g.*, to effectively attenuate the target frequencies at issue in that engine” (*id.* at 43–44 (citing Ex. 2015 ¶¶ 84–86)), and “their acoustic liner ‘achieve[d] ***optimum attenuation***’” (*id.* at 44 (citing Ex. 1015, 5; Ex. 1032, 112)). As part of its argument, Patent Owner asserts that Petitioner’s position that a person of ordinary skill in the art “would have seen room for improvement of the acoustic liner [of Heldenbrand and Kisner] at least with respect to noise attenuation at takeoff” is newly proposed in the Reply. PO Sur-Reply 13 (citing Pet. Reply 19).

Finally, Patent Owner argues that Petitioner’s challenge is legally deficient because it does not address the claims as a whole. PO Resp. 48–50. Patent Owner asserts that the challenged claims 9 and 28, through their dependencies on various parent claims, “require the concurrent variation of multiple distinct acoustic liner parameters: the width of the resonator chambers, the diameter of the holes in the face sheet, and the thickness of

the face sheet (claim 9); and these three parameters in addition to the depth of the cellular core structure (claim 28).” *Id.* at 48. Patent Owner argues that Petitioner “only treats each element of the challenged claims in isolation” and does not address “this combination of parameters, instead dealing only with each parameter individually,” or “the claimed parameter variations in the specific context of the geared turbofan engine of the challenged claims.” *Id.* Because “the acoustic liner design process is unpredictable and grounded in a complex interrelationship among the various geometric parameters” (*id.* at 49 (citing Ex. 1015, 5; Ex. 1032, 112; Ex. 2015 ¶¶ 39–72, 107, 111)), Patent Owner explains that a “change in the value of just one of these parameters can necessitate a redesign of the entirety of the acoustic liner” and “[c]hanges in multiple distinct parameters obviously introduces even more complexity and variability” (*id.* (citing Ex. 2015 ¶ 93)). Petitioner’s challenge is deficient, according to Patent Owner, because Petitioner “never addresses whether a [person of ordinary skill in the art] would have modified Heldenbrand and Kisner’s liner to have concurrent variations in all three claimed parameters.” *Id.*

(iii) Analysis

Petitioner has the better arguments. Petitioner need only articulate a reason to combine the references with some rational underpinning to support the legal conclusion of obviousness. *KSR*, 550 U.S. at 418. An express teaching or motivation in the Heldenbrand and Kisner references is not required. *Id.* A precise teaching directed to the specific subject matter of a challenged claim is not necessary to establish obviousness. *Id.* Rather, “any need or problem known in the field of endeavor at the time of invention and

addressed by the patent can provide a reason for combining the elements in the manner claimed.” *Id.* at 420.

As an initial matter, we note that Petitioner does not argue that Heldenbrand and Kisner teach varying the face sheet thickness of different acoustic liner segments. We determine that a preponderance of the evidence supports Dr. Ng’s articulated reasoning that it “was well known in the art that varying the face sheet thickness would also affect the frequencies attenuated by the acoustic liner” (Ex. 1003 ¶ 156; *see id.* at ¶¶ 153–157, 40–43, 176, 199–200) and that, because “alterations to face sheet thickness were known in the art, as well as the straight-forward benefits of changing face sheet thickness, it would have been an obvious design choice to a [person of ordinary skill in the art] to alter the face sheet thickness among acoustic liner segments to attenuate different frequencies.” Pet. 66 (citing Ex. 1003 ¶ 157).

We agree with Petitioner that it was well known to those skilled in the art that jet engines produce a broad spectrum of frequencies, and altering face sheet thickness of the acoustic liner allows different frequencies to be attenuated. Ex. 1003 ¶ 157; *id.* ¶¶ 40–44 (Because an acoustic liner acts like a Helmholtz resonator, varying the face sheet thickness affects the frequency); Ex. 2004, 27 (“The tuning frequency, if very low may require a very thick facing plate”), 16 (“Such items as facing sheet thickness . . . do have an influence on acoustic performance”). Dr. Ng’s testimony that a person of ordinary skill in the art would have found it obvious to vary face sheet thickness for different acoustic liner segments is supported by several decades-old prior art references. *See, e.g.*, Ex. 1006 (a 1976 NASA report for the “Quiet Clean Short-Haul Experimental Engine (QCSEE)”) at

37–38 (liner sections 1–3 in fan inlet of UTW Boiler Plate design have faceplate thickness of 0.081 cm), 39–40 (liner sections 1–5 in fan exhaust of UTW Boiler Plate design have faceplate thicknesses of 0.102 cm or 0.040 cm); Ex. 1055 (a 1983 American Institute of Aeronautics and Astronautics report) at 6 (Table 1 disclosing different thicknesses “t” for models 1–6); Ex. 2004 (a 1976 NASA report for a “Computer Method for Design of Acoustic Liners for Turbofan Engines”) at 27 (Table V disclosing different face sheet thicknesses “t” for liner sections 1–2), 78 (Table XXII disclosing two different face sheet thicknesses “TH”); Ex. 1034 (a 1999 patent) at 4:26–29 (“The dimensions of the extended reaction acoustic liner of the present invention may be varied, as desired. For example, the outer layer 12 and the inner layer 14 may have a thickness of 1/32 inch to 1/8 inch, as desired . . .”). Dr. Corke confirmed that Minner and Rice (Ex. 2004) discloses an acoustic liner with varied face sheet thicknesses between different acoustic liner segments. Ex. 1056, 70:12–15 (“Q. So table 5 of Minner and Rice . . . lists different face sheet thicknesses for sections 1 and 2 of the acoustic liner, correct? A. It does.”).

We do not agree with Patent Owner’s position that Petitioner’s motivation is redundant of objectives already achieved by Heldenbrand and Kisner. While Dr. Ng acknowledges that Kisner attenuated certain frequencies (Ex. 1003 ¶¶ 155–156), he also testifies that a person of ordinary skill in the art “would have been motivated to alter the face sheet thickness among liner segments in order to attenuate *different* frequencies.” *Id.* ¶ 157 (emphasis added); *see KSR*, 550 U.S. at 417 (“[I]f a technique has been used to improve one device, and a person of ordinary skill in the art would recognize that it would improve similar devices in the same way, using the

technique is obvious unless its actual application is beyond his or her skill.”). Dr. Ng’s testimony is buttressed by Dr. Corke’s testimony. When asked whether there was room for improving the noise attenuation achieved by the acoustic liners in Heldenbrand and Kisner, Dr. Corke testified that “as a designer, you’re always looking for improvement.” Ex. 1056, 18:10–18; *see id.* at 19:1–8 (stating that he was not sure whether Heldenbrand and Kisner had reached the best possible design). We also agree with Petitioner that Kisner discloses that while the acoustic liners met many of the program’s noise goals, the noise attenuation results at takeoff ranged from just slightly below the noise goal to 1.4 EPNdB “*above* the takeoff noise goal.” Ex. 1015, 16 (emphasis added); *id.* at 18 (stating the results were “slightly above the take-off noise goal”). Therefore, a person of ordinary skill in the art reading Kisner would have seen room for improvement of the acoustic liner at least with respect to noise attenuation at takeoff. Ex. 1056, 18:10–18.

Dr. Corke also agrees that turbofan engines produce a “wide spectrum” of noise frequencies, and that there “have been advancements” in acoustic liner performance between the time Kisner was published in 1980 and the time the ’548 patent was filed in 2013. Ex. 1056, 20:9–15, 65:20–66:5. Therefore, given the advances and known issues with noise attenuation in the industry, the wide spectrum of noise frequencies generated by an engine, and the well-known method of varying face sheet thickness as a means to accomplish attenuation, the evidence supports Dr. Ng’s testimony that a person of ordinary skill in the art would have been motivated to vary the face sheet thickness in order to achieve wider or improved noise attenuation. Ex. 1003 ¶¶ 155–157.

Finally, we do not agree with Patent Owner’s arguments that Petitioner’s challenge is legally deficient because it does not address the claims as a whole. PO Resp. 48–50. Similar arguments were recently rejected by the Federal Circuit as “misunderstand[ing] the requirement to show obviousness of the claim as a whole.” *General Electric Co. v. Raytheon Techs. Corp.*, 983 F.3d 1334, 1351–52 (Fed. Cir. 2020). The obviousness analysis does not require a motivation to combine the three claim elements when the three elements are present together in a reference because such an “analysis unduly dissects prior art references into collections of individual elements, requiring a party showing obviousness to re-do the work already done in the prior art reference.” *Id.* at 1352. “This does not change when combining prior art references would require some alteration of the apparatuses disclosed in the prior art.” *Id.* A person of ordinary skill in the art is “‘not an automaton,’ so the fact that it would take some creativity to carry out the combination does not defeat a finding of obviousness.” *Id.* (quoting *KSR*, 550 U.S. at 421).

Here, Petitioner has shown that the combined teachings of the references and the knowledge of a person of ordinary skill in the art renders the claims obvious, necessarily addressing the claims “as a whole.” First, Petitioner asserts and the evidence establishes that because the acoustic liner acts like a Helmholtz resonator, the skilled artisan would have understood that varying the three parameters—cell width, hole diameter, and face sheet thickness—affects frequency attenuation and noise suppression. *See, e.g.*, Tr. 59–60; Ex. 1003 ¶¶ 29–55; *id.* ¶ 55 (“To summarize, varying the physical properties of sandwich-style acoustic liner has been well-known in the art for decades, and a [person of ordinary skill in the art] would

understand how to weigh these considerations when selecting acoustic liner segments for different portions of a jet engine, and apply liners with different properties in different areas. For example, Ely discloses an acoustic liner that may potentially have: cells of varying widths, cells of varying depths, cells of varying shapes, face sheets of varying thicknesses, face sheets of varying hole size, and face sheets of varying number of holes per cell.” (citations omitted)). Second, the evidence also supports Petitioner’s assertions that, for the reasons discussed above, Heldenbrand and Kisner disclose or render obvious the varying of cell width and hole diameter in different acoustic liner segments, and a person of ordinary skill in the art would have known to vary face sheet thickness between different liner segments. *See* Tr. 60; Pet. Reply 27 (citing Ex. 2004, 27 (Table V), 78 (Table XXII); Ex. 1056, 70:12–15, 71:7–10, 59:12–15; Ex. 1055, 6 (Table 1)). Third, Petitioner also asserts and the evidence establishes that Heldenbrand and Kisner reference Minner and Rice (Ex. 2004) which disclose varying face sheet thickness and hole diameter in different acoustic liner segments. Tr. 60; Pet. Reply (citing (citing Ex. 2004, 27 (Table V), 78 (Table XXII); Ex. 1056, 70:12–15, 71:7–10, 59:12–15; Ex. 1055, 6 (Table 1)).

Minner and Rice’s Table V, as annotated by Petitioner, is reproduced below.

TABLE V. - LINER MECHANICAL DESIGN, EXAMPLE LINER
OF TABLE IV, FOR QF-9 DUCT

Section	Sheet thickness, t		Hole diameter, d		Open area ratio, σ , percent	Back cavity depth, b	
	cm	in.	cm	in.		cm	in.
1	3.8	1.5	0.64	0.25	23.7	7.06	2.779
2	.051	.020	.127	.050	12.0	1.37	0.541

RTX-2004.027, Table V (annotated)

Pet. Reply 28 (citing Ex. 2004, 27, Table V). Table V describes concurrently varying sheet thickness and hole diameter in different liner sections 1–2.

Wilkinson's Table 1, as annotated by Petitioner, is reproduced below.

Table 1. - Model construction data.

PARAMETER	MODEL					
	1	2	3	4	5	6
CONFIG.	A	A	B	B	A	A
d_1 , mm	0.28	0.45	1.68	1.45	0.28	0.46
d_2 , mm	0.18	0.36	-	-	0.18	0.36
s, mm	0.61	0.76	5.49	3.40	0.61	0.76
t, mm	0.18	0.30	0.81	0.81	0.18	0.30
POA, %	6.8	17.6	6.0	12.0	4.7	13.9
H, holes/cm ²	269	172	3.8	10.0	269	172
A_T , m ²	0.255	0.255	0.255	0.255	0.165	0.165
γ , %	56.8	56.8	96.0	96.0	85.6	85.6
L, mm	0.711	0.711	0.914	0.914	0.813	0.810
PLENUM	P3	P3	P2	P2	P1	P1

P1: HONEYCOMB, HEX CELL, 4.8 mm/SIDE, 19.1 mm DEEP, CLOSED ON BOTTOM
P2: HONEYCOMB, HEX CELL, 4.8 mm/SIDE, 12.7 mm DEEP, CLOSED ON BOTTOM
P3: SINGLE, EMPTY CAVITY; VARIABLE DEPTH

GE-1055.006, Table 1 (annotated)

Pet. Reply 28 (citing Ex. 1055, 6, Table 1). Table 1 describes model construction data and concurrently varying sheet thickness and hole diameter in different models (i.e., liner sections) 3–6.

Thus, we determine that Petitioner has shown that a person of ordinary skill in the art would have understood that the three claimed Helmholtz resonator parameters would be successfully simultaneously varied for the types of acoustic liners disclosed in Heldenbrand and Kisner, and we reject Patent Owner’s “as a whole” argument.

(iv) Determination for Claims 9 and 28

We determine that Petitioner has shown by a preponderance of the evidence that claims 9 and 28 are unpatentable as being obvious over Heldenbrand and Kisner.

IV. CONCLUSION⁵

For the reasons expressed above, Petitioner has demonstrated by a preponderance of the evidence that claims 9 and 28 of the ’548 patent are unpatentable as being obvious over Heldenbrand and Kisner.

A summary of our conclusion is set forth in the table below.

⁵ 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*. See 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).

Claims	35 U.S.C. §	References/ Basis	Claims Shown Unpatentable	Claims Not shown Unpatentable
9, 28	103	Heldenbrand, Kisner	9, 28	

V. ORDER

It is, therefore,

ORDERED that claims 9 and 28 of U.S. Patent No. 10,066,548 B2 are unpatentable; and

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

IPR2020-00405
Patent 10,066,548 B2

PETITIONER:

Brian Ferguson
Anish Desai
Christopher Pepe
WEIL, GOTSHAL & MANGES LLP
brian.ferguson@weil.com
anish.desai@weil.com
christopher.pepe@weil.com

PATENT OWNER:

W. Karl Renner
David L. Holt
Gretchen DeVrie
FISH & RICHARDSON P.C.
axf-ptab@fr.com
holt2@fr.com
devries@fr.com