UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

APPLE INC.
Petitioner,

v.

COREPHOTONICS, LTD.,
Patent Owner.

IPR2020-00878
U.S. Patent No. 10,330,897 B2

PETITIONER APPLE INC.'S NOTICE OF APPEAL

via E2E
Patent Trial and Appeal Board

via Hand Delivery
Director of the United States Patent and Trademark Office
c/o Office of the General Counsel, 10B20
Madison Building East
600 Dulany Street
Alexandria, VA 22314

via CM/ECF
United States Court of Appeals for the Federal Circuit

Pursuant to 28 U.S.C. § 1295(a)(4)(A), 35 U.S.C. §§ 141(c), 142, and 319, and 37 C.F.R. §§ 90.2(a), 90.3, and Federal Circuit Rule 15(a)(1), Petitioner Apple Inc. ("Petitioner") provides notice that it appeals to the United States Court of Appeals for the Federal Circuit from the Final Written Decision of the Patent Trial and Appeal Board ("Board") entered November 2, 2021 (Paper 29), and from all underlying and related orders, decisions, rulings, and opinions regarding U.S. Patent No. 10,330,897 B2 ("the '897 patent") in *Inter Partes* Review IPR2020-00878.

In accordance with 37 C.F.R. § 90.2(a)(3)(ii), the expected issues on appeal include, but are not limited to: the Board's error(s) in determining that claims 3, 8, 16, 19, 24 and 30 are not unpatentable, and all other issues decided adversely to Petitioner in any orders, decisions, rulings, or opinions.

Pursuant to 35 U.S.C. § 142 and 37 C.F.R. § 90.2(a), a copy of this Notice is being filed with the Director of the United States Patent and Trademark Office and with the Patent Trial and Appeal Board. In addition, a copy of this Notice and the required docketing fees are being filed with the Clerk's Office for the United States Court of Appeals for the Federal Circuit via CM/ECF.

Respectfully submitted,

Dated: January 4, 2022

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CERTIFICATE OF FILING

The undersigned hereby certifies that, in addition to being electronically filed through PTAB E2E, a true and correct copy of the above-captioned PETITIONER APPLE INC.'S NOTICE OF APPEAL is being filed by hand with the Director on January 4, 2022, at the following address:

Director of the United States Patent and Trademark Office
c/o Office of the General Counsel, 10B20
Madison Building East
600 Dulany Street
Alexandria, VA 22314

The undersigned also hereby certifies that a true and correct copy of the above-captioned PETITIONER APPLE INC.'S NOTICE OF APPEAL and the filing fee is being filed via CM/ECF with the Clerk's Office of the United States Court of Appeals for the Federal Circuit on January 4, 2022.

Respectfully submitted,

Dated: January 4, 2022

/Michael S. Parsons/
Michael S. Parsons
Reg. No. 58,767
Attorney for Petitioner Apple Inc.

CERTIFICATE OF SERVICE

Pursuant to 37 C.F.R. § 42.6, this is to certify that a true and correct copy of the foregoing "Petitioner Apple Inc.'s Notice of Appeal" was served on the Patent Owner Corephotonics, Ltd. as detailed below:

Date of service	January 4, 2022
Manner of service	Electronic Service by E-mail: - nrubin@raklaw.com - jchung@raklaw.com - mfenster@raklaw.com - jtsuei@raklaw.com
Documents served	**Petitioner Apple Inc.'s Notice of Appeal**
Persons served	Neil A. Rubin (nrubin@raklaw.com) C. Jay Chung (jchung@raklaw.com) Marc A. Fenster (mfenster@raklaw.com) James S. Tsuei (jtsuei@raklaw.com) Russ August & Kabat 12424 Wilshire Blvd., 12th Floor Los Angeles, CA 90025

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Paper 29
Date: November 2, 2021

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

APPLE INC.,
Petitioner,

v.

COREPHOTONICS, LTD.,
Patent Owner.

IPR2020-00878
Patent 10,330,897 B2

Before BRYAN F. MOORE, MONICA S. ULLAGADDI, and JOHN R. KENNY, *Administrative Patent Judges.*

MOORE, *Administrative Patent Judge*.

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

I. INTRODUCTION

Apple, Inc. ("Petitioner") requested an *inter partes* review ("IPR") of claims 1–6 and 8–30 (the "challenged claims") of U.S. Patent No.

10,330,897 B1 (Ex. 1001, "the '897 patent"). Paper 1 ("Petition" or "Pet."). Corephotonics, Ltd. ("Patent Owner") did not file a Preliminary Response.

On November 3, 2020, we instituted trial. Paper 7 ("Inst. Dec." or "Decision to Institute"). Patent Owner filed a Response. Paper 12 ("PO Resp."). Petitioner filed a Reply. Paper 14 ("Pet. Reply"). Patent Owner filed a Sur-Reply. Paper 19 ("Sur-Reply"). An oral argument was held on June 9, 2021, and a transcript was entered into the record. Paper 28 ("Tr.").

We have jurisdiction to conduct this *inter partes* review under 35 U.S.C. § 6. This Final Written Decision is issued pursuant to 35 U.S.C. § 318(a) and 37 C.F.R. § 42.73. For the reasons discussed herein, we determine that Petitioner has shown, by a preponderance of the evidence, that claims 1, 2, 4–6, 9–15, 17, 18, 20–23, and 25–29 of the '897 patent are unpatentable and that Petitioner has not shown, by a preponderance of the evidence, that claims 3, 8, 16, 19, 24, and 30 of the '897 patent are unpatentable.

II. BACKGROUND

A. The Challenged Patent (Ex. 1001)

The '897 patent issued on June 25, 2019, based on an application filed May 10, 2018, which claimed priority back to a provisional application filed Nov. 19, 2017. Ex. 1001, codes (22), (45), (63). The '897 patent concerns an optical lens assembly with five lens elements. *Id.* at code (57). Figure 1A of the '897 patent is reproduced below.

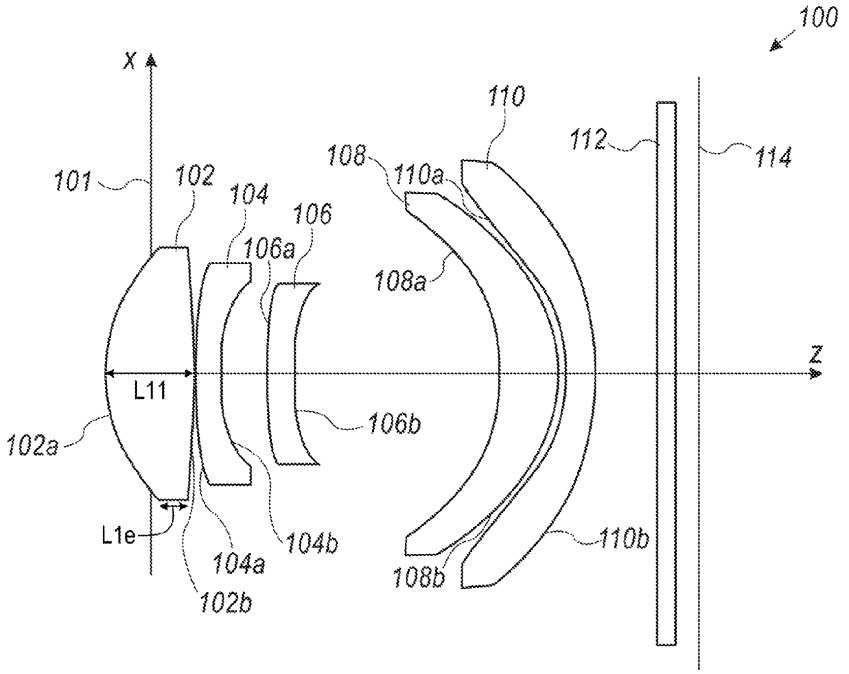

FIG. 1A

Figure 1A of the ’897 patent illustrates an arrangement of lens elements in a first embodiment of an optical lens system.

In order from an object side to an image side, optical lens assembly 100 comprises: optional stop 101; first plastic lens element 102 with positive refractive power having a convex, object-side surface 102*a*; second plastic lens element 104 with negative refractive power having a meniscus, convex, object-side surface 104a, with an image side surface marked 104b; third plastic lens element 106 with negative refractive power having a concave, object-side surface 106a, with an inflection point and a concave image-side surface 106b; fourth plastic lens element 108 with positive refractive power having a positive meniscus with a concave, object-side surface 108a and an image-side surface marked 108b; fifth plastic lens element 110 with negative refractive power having a negative meniscus with a concave, object-side surface 110a and an image-side surface marked 110b. *Id.* at 3:24–41.

In Table 1, reproduced below, the '897 patent discloses radii of curvature, *R*, for the lens elements, lens element thicknesses and/or distances between each of the lens elements, and a refractive index, *Nd*, for each lens element.

TABLE 1

#	Comment	Radius R [mm]	Distances [mm]	Nd/Vd	Diameter [mm]
1	Stop	Infinite	−0.466		2.4
2	L11	1.5800	0.894	1.5345/57.095	2.5
3	L12	−11.2003	0.020		2.4
4	L21	33.8670	0.246	1.63549/23.91	2.2
5	L22	3.2281	0.449		1.9
6	L31	−12.2843	0.290	1.5345/57.095	1.9
7	L32	7.7138	2.020		1.8
8	L41	−2.3755	0.597	1.63549/23.91	3.3
9	L42	−1.8801	0.068		3.6
10	L51	−1.8100	0.293	1.5345/57.095	3.9
11	L52	−5.2768	0.617		4.3
12	Window	Infinite	0.210	1.5168/64.17	3.0
13		Infinite	0.200		3.0

Table 1 of the '897 patent sets forth optical parameters for the optical lens assembly.

Id. at 4:35–50. The '897 patent discloses that, in Table 1, reproduced above

> [T]he distances between various elements (and/or surfaces) are marked "Lmn" (where m refers to the lens element number, n=1 refers to the element thickness and n=2 refers to the air gap to the next element) and are measured on the optical axis z, wherein the stop is at z=0. Each number is measured from the previous surface. Thus, the first distance -0.466 mm is measured from the stop to surface 102*a*, **the distance L11 from surface 102*a* to surface 102*b* (i.e. the thickness of first lens element 102)** is 0.894 mm, the gap L12 between surfaces 102*b* and 104*a* is 0.020 mm, the distance L21 between surfaces 104*a* and 104*b* (i.e. thickness d2 of second lens element 104) is 0.246 mm, etc. Also, L21=d_2 and L51=d_5.

Id. at 4:14–50.

Challenged claims 1 and 17 are independent. Challenged claims 2–6 and 8–16 depend directly or indirectly from claim 1 and challenged claims 18–30 depend directly or indirectly from claim 17. Independent claim 1 is reproduced below.

> 1. A lens assembly, comprising:
>
> a plurality of lens elements arranged along an optical axis and spaced apart by respective spaces,
>
> wherein the lens assembly has an effective focal length (EFL), a total track length (TTL) of 6.5 millimeters or less and a ratio TTL/EFL<1.0,
>
> wherein the plurality of lens elements includes, in order from an object side to an image side, a first group comprising lens elements L_{1_1}, L_{1_2} and L_{1_3} with respective focal lengths f_{1_1}, f_{1_2} and f_{1_3} and a second group comprising lens elements L_{2_1} and L_{2_2},
>
> wherein the first and second groups of lens elements are separated by a gap that is larger than twice any other gap between lens elements,
>
> wherein lens element L1_1 has positive refractive power and lens element L_{1_2} has negative refractive power and
>
> wherein lens elements L_{2_1} and L_{2_2} have opposite refractive powers.

Id. at 8:21–36.

B. Asserted Grounds of Unpatentability

Petitioner advances the following challenges supported by the declaration of Dr. José Sasián (Ex. 1003).

Claim(s) Challenged	35 U.S.C. §[1]	Reference(s)/Basis
1, 4, 9–15, 17, 20, 25–29	102	U.S. Patent No. 9,128,267 to Ogino et al. ("Ogino," Ex. 1005)

[1] The Leahy-Smith America Invents Act, Pub. L. No. 112-29, 125 Stat. 284 (September 16, 2011) ("AIA"), included revisions to 35 U.S.C. §§ 102 and 103 that became effective on March 16, 2013. Because the '897 patent issued from an application filed after March 16, 2013, we apply the AIA

Claim(s) Challenged	35 U.S.C. §[1]	Reference(s)/Basis
2, 5, 6, 18, 21–23	103	Ogino and *The Optics of Miniature Digital Cameras* by Jane Bareau et al., SPIE Proceedings Volume 6342, *International Optical Design Conference 2006*; 63421F (2006) ("Bareau", Ex. 1012).
3, 8, 19, 24	103	Ogino, Bareau, and U.S. Patent No. 9,128,267 to Kingslake, *Optics in Photography*, 1992 ("Kingslake," Ex. 1013)
16, 30	103	U.S. Patent No. 10,324,273 to Chen et al. ("Chen," Ex. 1020), and U.S. Patent No. 9,678,310 to Iwasaki et al. ("Iwasaki," Ex. 1009), and *Polymer Optics: A Manufacturer's Perspective on the Factors that Contribute to Successful Programs* by Beich et al. ("Beich," Ex. 1007)

Pet. 8–10.

Patent Owner submits the Declaration of Tom D. Milster, Ph.D. (Ex. 2001) in support of its arguments.

C. Related Matters

The '897 patent is asserted in *Corephotonics Ltd. v. Apple Inc.*, 5-19-cv-04809 (N.D. Cal.) filed August 14, 2019. Pet. 1; Paper 6, 1.

U.S. Patent No. 9,897,712 ("the '712 patent"), 9,402,032 ("the '032 patent"), 9,857,568 ("the '568 patent"), and 10,324,277 ("the '277 patent") are part of a chain of continuity that includes PCT/IB2014/062465, from which the '897 patent also claims priority. This proceeding is related to

versions of the statutory bases for unpatentability. *See* Ex. 1001, codes (22), (60), (63).

IPR2018-01146 ("the '1146IPR"), an *inter partes* review proceeding instituted based on Petitioner's challenge to the '712 patent. The '1146IPR Final Written Decision was affirmed-in-part and remanded by the Federal Circuit. This proceeding is also related to IPR2018-01140 ("the '1140IPR"), an *inter partes* review proceeding instituted based on Petitioner's challenge to the '032 patent. This proceeding is also related to IPR2019-00030 ("the '0030IPR"), an *inter partes* review proceeding instituted based on Petitioner's challenge the '568 patent. Each of those IPRs resulted in a Final Written Decision and were affirmed by the Federal Circuit on October 25, 2021. Presently pending is IPR2020-00897, an *inter partes* review proceeding based on Petitioner's challenge to the '277 patent.

D. Real Parties-in-Interest

Petitioner identifies Apple Inc. as the real party-in-interest. Pet. 1. Patent Owner identifies Corephotonics, Ltd. as the real parties-in-interest. Paper 6, 1.

III. ANALYSIS

A. Principles of Law

Petitioner bears the burden of proving unpatentability of the challenged claims, and the burden of persuasion never shifts to Patent Owner, except in limited circumstances not present here. *Dynamic Drinkware, LLC v. Nat'l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015).

A claim is anticipated if a single prior art reference either expressly or inherently discloses every limitation of the claim. *Orion IP, LLC v. Hyundai Motor Am.*, 605 F.3d 967, 975 (Fed. Cir. 2010). Although the elements must be arranged or combined in the same way as in the claim, "the reference

need not satisfy an *ipsissimis verbis* test," i.e., identity of terminology is not required. *In re Gleave*, 560 F.3d 1331, 1334 (Fed. Cir. 2009) (citing *In re Bond*, 910 F.2d 831, 832–33 (Fed. Cir. 1990)).

A claim is unpatentable under 35 U.S.C. § 103 if the differences between the claimed subject matter and the prior art are such that the subject matter as a whole would have been obvious before the effective filing date of the claimed invention to a person having ordinary skill in the art. *KSR Int'l Co. v. Teleflex, Inc.*, 550 U.S. 398, 406 (2007). The question of obviousness is resolved on the basis of underlying factual determinations, including: (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of skill in the art; and (4) when in evidence, objective evidence of non-obviousness, i.e., so-called secondary considerations such as commercial success, long felt but unsolved needs, and failure of others.[2] *Graham v. John Deere Co*., 383 U.S. 1, 17–18 (1966). The obviousness inquiry further requires an analysis of "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) (requiring "articulated reasoning with some rational underpinning to support the legal conclusion of obviousness")).

Thus, to prevail in an *inter partes* review, Petitioner must explain sufficiently how the proposed combinations of prior art would have rendered the challenged claims unpatentable. We analyze the challenges presented in the Petition in accordance with the above-stated principles.

[2] Neither party has argued that secondary considerations or objective evidence of nonobviousness exists. Thus, we do not address secondary considerations or objective evidence of nonobviousness.

B. Claim Construction

Because the Petition was filed after November 13, 2018, we construe the challenged claims using the same claim construction standard that would be used to construe the claims in a civil action under 35 U.S.C. § 282(b). 37 C.F.R. § 42.100(b) (2020).[3] This rule adopts the same claim construction standard used by Article III federal courts, which follow *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005) (en banc), and its progeny. Under this standard, the words of a claim are generally given their "ordinary and customary meaning," which is the meaning the term would have to a person of ordinary skill at the time of the invention, in the context of the entire patent, including the specification. *See Phillips*, 415 F.3d at 1312–13.

Independent claim 1 recites "wherein the lens assembly has an effective focal length (EFL)." Ex. 1001, 8:24–25. Petitioner contends that the term "effective focal length" should be construed as "the focal length of a lens assembly." Pet. 7. This construction coincides with the construction of the same term in the '1140IPR (Paper 10, 10), the '1146IPR (Paper 8, 7–8), and '0030IPR (Paper 32, 8). The '897 specification supports this construction because it is the essentially the same as the specification on which the '1140IPR based the construction of EFL.

Independent claim 1 also recites "wherein the lens assembly has a total track length (TTL) of 6.5 millimeters or less." Ex. 1001, 8:25–26. Petitioner contends that the '897 patent discloses that TTL is the "the length of the optical axis spacing between the object-side surface of the first lens element and one of: an electronic sensor, a film sensor, and an image plane

[3] *See* Changes to the Claim Construction Standard for Interpreting Claims in Trial Proceedings Before the Patent Trial and Appeal Board, 83 Fed. Reg. 51,340 (Oct. 11, 2018) (final rule).

corresponding to either the electronic sensor or [the] film sensor." Pet. 8. This construction coincides with the construction of the same term in the '1140IPR (Paper 10, 10–11), the '1146IPR (Paper 8, 8), and '0030IPR (Paper 32, 14–15). The '897 specification supports this construction because it is the essentially the same as the specification on which the '1140IPR based the construction of TTL.

Patent Owner argues that no "dispute between the parties in this IPR depends on the construction of EFL, TTL, or of any other claim term [and] submits that the Board should refrain from construing any terms in the patent for the purposes of this proceeding." PO Resp. 17. Petitioner does not respond to this argument. *See generally* Pet. Reply. We agree with Patent Owner. If we were to adopt either construction, it would not change the determination made in this Decision.

Thus, we decline to construe any claim terms for purposes of this Final Written Decision. *See Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017) (quoting *Vivid Techs., Inc. v. Am. Sci. & Eng'g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999)) ("[W]e need only construe terms 'that are in controversy, and only to the extent necessary to resolve the controversy.'").

C. Level of Ordinary Skill in the Art

The level of skill in the art is a factual determination that provides a primary guarantee of objectivity in an obviousness analysis. *Al-Site Corp. v. VSI Int'l Inc.*, 174 F.3d 1308, 1324 (Fed. Cir. 1999) (citing *Graham*, 383 U.S. at 17–18; *Ryko Mfg. Co. v. Nu-Star, Inc.*, 950 F.2d 714, 718 (Fed. Cir. 1991)).

Petitioner argues that one of ordinary skill in the art at the time of the invention of the '897 patent

> would include someone who had, at the priority date of the '897 Patent, (i) a Bachelor's degree in Physics, Optical Sciences, or equivalent training, as well as (ii) approximately three years of experience in designing multi-lens optical systems. Such a person would have had experience in analyzing, tolerancing, adjusting, and optimizing multi-lens systems for manufacturing, and would have been familiar with the specifications of lens systems and their fabrication. In addition, a POSITA [person of ordinary skill in the art] would have known how to use lens design software such as Code V, Oslo, or Zemax, and would have taken a lens design course.

Pet. 6–7 (citing Ex. 1003 ¶¶ 19–20). Patent Owner applied the same level of skill for the purposes of this IPR. PO Resp. 14–15 (citing Ex. 2001 ¶ 19).

We regard Petitioner's formulation of the level of skill as consistent with the prior art before us. *See Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001) (prior art itself may reflect an appropriate level of skill). Therefore, for purposes of this Final Written Decision, we adopt Petitioner's assessment of the level of skill in the art because it is consistent with the '897 patent and the asserted prior art, and we apply it in our analysis below.

D. Overview of the Asserted Prior Art

1. Ogino (Ex. 1005)

Ogino concerns an imaging lens. Ex. 1005, code (54). Figure 5 of Ogino is reproduced below.

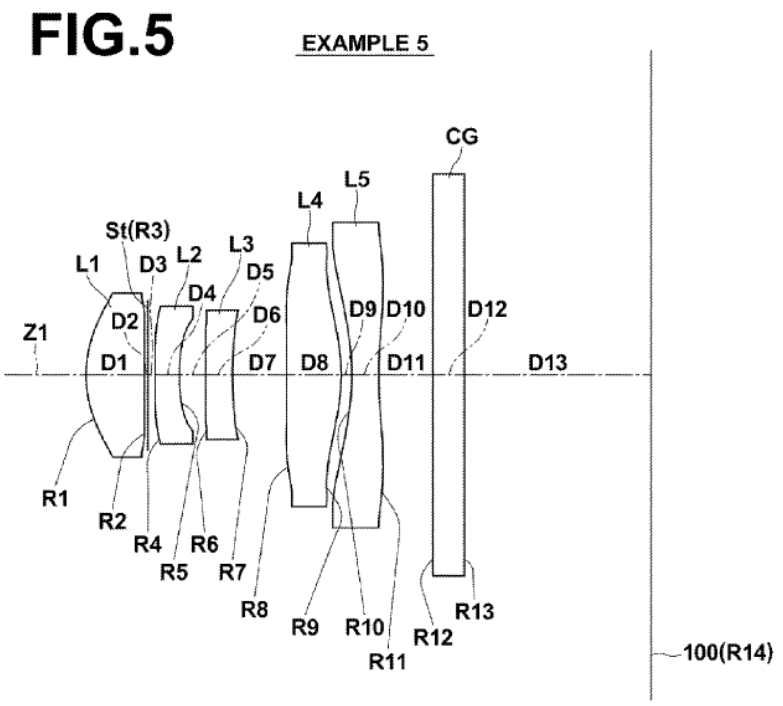

Figure 5 is a lens cross-sectional view illustrating a configuration example of an imaging lens of Ogino

Id. at Fig. 5, 4:5–9. Figure 5, above, shows and embodiment of Ogino including, in order from an object side, five lenses: a first lens L1 that has a positive refractive power and a meniscus shape which is convex toward the object side; a second lens L2 that has a biconcave shape; a third lens L3 that has a meniscus shape which is convex toward the object side; a fourth lens L4 that has a meniscus shape which is convex toward an object side; and a fifth lens L5 that has a negative refractive power and at least one inflection point on an image side surface. *Id.* at 2:4–12.

2. Bareau (Ex. 1012)

Bareau concerns "the design and manufacturing of consumer and commercial imaging systems using lens elements" that have millimeter-scale

diameters. Ex. 1012, 1. Bareau lists an f-number of 2.8 in its "typical lens specifications for a ¼″ sensor format." *Id.* at 3, 4.

3. Kingslake (Ex. 1013)

Kingslake is titled "Optics in Photography." Ex. 1013, Cover. In Chapter 11, titled "The Brightness of Images," Kingslake indicates that "[t]he relation between the aperture of a lens and the brightness of the image produced by it . . . is often misunderstood, yet it is of the greatest importance to the photographer who wishes to make the best use of the equipment." *Id.* at 104. Kingslake then states that "[t]he tremendous efforts of lens designers and manufacturers that have been devoted to the production of lenses of extremely high relative aperture are an indication of the need that exists for brighter images and 'faster' lenses." *Id.*

4. Chen (Ex. 1020)

Chen is directed to "an optical imaging lens set of five lens elements for use in mobile phones, in cameras, in tablet personal computers, or in personal digital assistants (PDA)." Ex. 1020, 1:16–19. Chen's Example 1 is reproduced below:

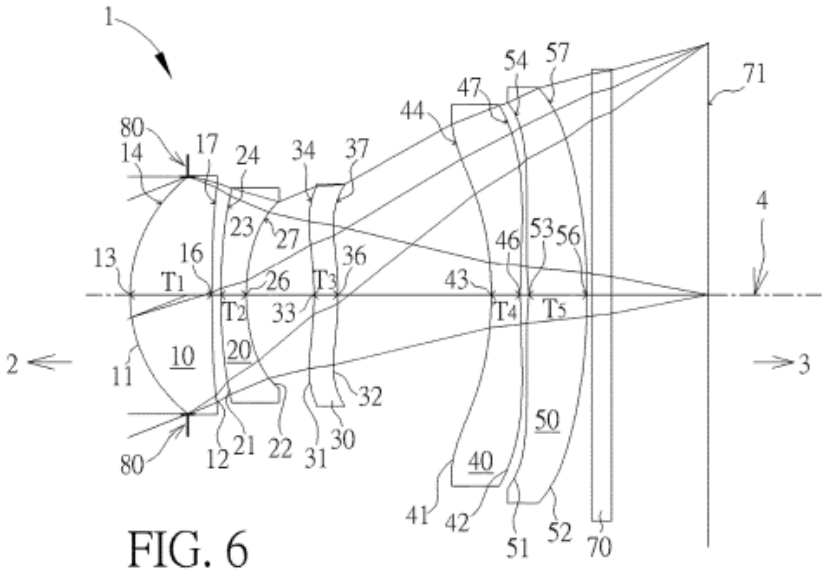

FIG. 6

Figure 6 illustrates an example [Example 1] of the optical imaging lens set

Figure 6, above, shows an "optical imaging lens set 1 of the first example has five lens elements 10 to 50 with refractive power. The optical imaging lens set 1 also has a filter 70, an aperture stop 80, and an image plane 71." *Id.* at 8:55–58. The prescription table describing Example 1 providing the thickness and spacing of each element along the optical axis and the focal length of each lens is provided in Figure 24, reproduced below:

First Example							
No.		Curvature Radius	Ape. Stop Distance Lens Thickness Air Gap		Refractive Index	Abbe No.	Focal Length
	Object	INFINITY	INFINITY				
		INFINITY	0.628				
80	Ape. Stop	INFINITY	-0.602				
11	First Lens	1.565	0.855	T_1	1.545	55.987	2.975
		34.464	0.088	G_{12}			
21	Second Lens	6.079	0.264	T_2	1.642	22.409	-4.568
22		1.955	0.704	G_{23}			
31	Third Lens	-3.412	0.249	T_3	1.545	55.987	122.164
32		-3.330	1.598	G_{34}			
41	Fourth Lens	-4.283	0.310	T_4	1.545	55.987	-6.178
42		16.327	0.064	G_{45}			
51	Fifth Lens	-61.049	0.619	T_5	1.642	22.409	15.559
52		-8.680	0.050	G_{56}			
70	IR Filter	INFINITY	0.210		1.517	64.167	
		INFINITY	1.007				
71	Image Plane	INFINITY					

FIG. 24

Figure 24 shows the optical data of the first example of Chen's optical lens set

Figure 24, above, is a table listing the Curvature radius, Aperture Stop Distance Lens Thickness Air Gap, Refractive Index, Abbe Number, and Focal length for the following objects: Aperture Stop, First through Fifth Lens, IR Filter, and Image Plane. According to Chen, Example 1 has a focal length (f) of 6.582 mm, a total track length (TTL) of 6.0187 mm, and an f-number of 2.6614. *See id.* at 10:9–11, Fig. 42 (col. 1). Chen also provides

the sag equation and aspheric coefficients for Example 1. *Id.*, 9:49–67, Fig. 41.

5. Iwasaki (Ex. 1009)

Iwasaki discloses "a fixed focus imaging lens for forming optical images of subjects" that is designed for use in portable devices such as "a digital still camera, a cellular telephone with a built in camera, a PDA (Personal Digital Assistant), a smart phone, a tablet type terminal, and a portable gaming device." Ex. 1009, 1:18–26. Iwasaki's lens system is designed to meet a "demand for miniaturization of the entirety of the photography devices as well as imaging lenses to be mounted thereon" and to meet a "demand for high resolution and high performance of imaging lenses." *Id.* at 1:36–41.

Examples 1 and 2 of Iwasaki maintain this ratio by using a thinner cover glass element of 0.145 mm rather than using 0.210 mm or 0.300 mm thick cover glass used in Examples 3 and 4. *See id.* at Tables 1, 3, 5, 7.

6. Beich (Ex. 1007)

Beich concerns "the process of creating state-of-the-art polymer optics and a review of the cost tradeoffs between design tolerances, production volumes, and mold cavitation." Ex. 1007, 2. Beich discloses design considerations, or "[r]ules of thumb," with respect to shape and tolerances of polymer-based optical devices that drive cost and manufacturability. *Id.* at 7. These considerations include such knowledge as "thicker parts take longer to mold than thinner parts" and "[o]ptics with extremely thick centers and thin edges are very challenging to mold." *Id*.

E. Asserted Anticipation of Claims 1, 4, 9–15, 17, 20, and 25–29 by Ogino

Petitioner contends that claims 1, 4, 9–15, 17, 20, and 25–29 are unpatentable under 35 U.S.C. § 102 as anticipated by Ogino. Pet. 10–40. Patent Owner does not present arguments related to this ground. *See generally* PO Resp. For the reasons that follow, we are persuaded that the evidence supports Petitioner's arguments and thus, Petitioner establishes by a preponderance of the evidence that claims 1, 4, 9–15, 17, 20, and 25–29 are unpatentable under 35 U.S.C. § 102 as anticipated by Ogino.

1. Independent Claim 1

"A lens assembly, comprising: a plurality of lens elements arranged along an optical axis and spaced apart by respective spaces"

Petitioner contends that Ogino discloses this limitation in Ogino's Example 5, shown in Figure 5 reproduced above, which includes lenses L1 to L5 arranged along optical axis Z1, in order from an object side. Pet. 14–15 (citing Ex. 1005, Fig. 5, 5:13–15). Based on the complete record, Petitioner has demonstrated sufficiently that Ogino teaches this limitation, which Patent Owner does not dispute.

"wherein the lens assembly has an effective focal length (EFL)"

Petitioner contends that Ogino teaches for each of its embodiments, that "f is a focal length of a whole system." Pet. 15. (quoting Ex. 1005, 3:16) (citing Ex. 1003, 29). In Table 9, Ogino discloses that the focal length *f* of the entire lens system of Example 5 is provided in Table 9 as *f* = 5.956 mm. *Id.* (quoting Ex. 1005, Table 9) (citing Ex. 1005, 14:47–53). Table 9 of Ogino is reproduced below.

TABLE 9

EXAMPLE 5
f = 5.956, Bf = 2.438, TL = 5.171

Si	Ri	Di	ndj	vdj
*1	1.12444	0.546	1.54488	54.87
*2	252.97534	0.030		
3 (APERTURE STOP)	∞	0.069		
*4	−18.78836	0.227	1.63351	23.63
*5	2.25616	0.243		
*6	506.45581	0.253	1.63351	23.63
*7	4.36560	0.506		
*8	−99.83715	0.506	1.63351	23.63
*9	−1.70702	0.100		
*10	−2.17464	0.253	1.54488	54.87
*11	3.61429	0.500		
12	∞	0.300	1.51633	64.14
13	∞	1.740		
14	∞			

*ASPHERIC SURFACE

Figure 24 shows the optical data of the first example of Ogino's optical lens set

Id. at 21:10–35. Table 9 of Ogino discloses optical parameters for the lens assembly of Example 5, which is depicted in Figure 5. Based on the complete record, Petitioner has demonstrated sufficiently that Ogino teaches this limitation, which Patent Owner does not dispute.

"a total track length (TTL) of 6.5 millimeters or less and a ratio TTL/EFL of less than 1.0"

Petitioner contends that a person of ordinary skill in the art "would have identified the total track length of Example 5 lens apparatus to be the distance between the object-side surface of the first lens L1 and the image plane 100 (R14)." Pet. 16–17 (citing Ex. 1005, Fig. 5; Ex. 1003, 30).

As noted by Petitioner, Ogino explicitly discloses that "the TTL with the cover glass element can be calculated by summing the widths above

labeled D1 to D13" which results in a TTL of 5.273, using the values depicted in Table 9 of Ogino. Ex. 1005, Table 9; *see* Pet. 17–18 (citing in part Ex. 1003, 30–31). Ogino discloses an EFL of 5.956 as depicted in Table 9. Ex. 1005, Table 9; *see* Pet. 17–19 (citing in part Ex. 1003, 30–32).

With Ogino disclosing a TTL of 5.273 and an EFL of 5.956, Ogino also discloses a ratio of TTL/EFL of 0.8853, which is less than 1.0. *See* Pet. 18–19. Based on the complete record, Petitioner has demonstrated sufficiently that Ogino teaches this limitation, which Patent Owner does not dispute.

"wherein the plurality of lens elements includes, in order from an object side to an image side, a first group comprising lens elements L_{1_1}, L_{1_2} and L_{1_3} with respective focal lengths f_{1_1}, f_{1_2} and f_{1_3} and a second group comprising lens elements L_{2_1} and L_{2_2},"

According to Petitioner, Figure 13 of Ogino depicts "Example 5 lens assembly includes a first lens group with three lens elements L1-L3 in order (i.e., L_{1_1}, L_{1_2}, and L_{1_3}) and a second lens group with two lens elements L4-L5 in order (i.e., L_{2_1} and L_{2_2})." Pet. 19–20 (citing Ex. 1003, 33; Ex. 1005, Figs. 5, 13). Petitioner calculates the focal lengths of L_{1_1}, L_{1_2}, and L_{1_3} respectively as 2.068, -3.168, -6.926. *Id.* at 20–21 (citing Ex. 1005, 15:44–48). Based on the complete record, Petitioner has demonstrated sufficiently that Ogino teaches this limitation, which Patent Owner does not dispute.

"wherein the first and second groups of lens elements are separated by a gap that is larger than twice any other gap between lens elements"

Petitioner asserts Figure 5 shows the "gap between the other lens elements are identified as D2+D3 (between L1 and L2), D5 (between L2 and L3), and D9 (between L4 and L5) [and t]he widths of each gap D2+D3 (with

the aperture stop in the middle, which is not a lens element), D5, D7, and D9 are provided in Table 9." Pet. 22–24 (Ex. 1005, Fig. 5, Table 11).

Petitioner further presents, based on this data, calculations that show Ogino's D7 is more than twice as large than the other gaps between lens elements, i.e. D7 (0.506) is more than two times the length of the gaps D2, D3 (0.099), D5 (0.243), and D9 (0.100). *Id.* Based on the complete record, Petitioner has demonstrated sufficiently that Ogino teaches this limitation, which Patent Owner does not dispute.

"wherein lens element L_{1_1} has positive refractive power and lens element L_{1_2} has negative refractive power"

Petitioner contends Ogino discloses this limitation because the optical data for the Example 5 lens assembly shows that the L1 lens element (i.e., L_{1_1}) has positive refractive power and the L2 lens element (i.e., L_{1_2}) has negative refractive power. Pet. 24 (citing Ex. 1003, 37).

Petitioner asserts

> [a person of ordinary skill at the time of the invention] would have recognized that the refractive power of a lens is equal to the inverse of the focal length of the lens: '[t]he practical unit of power is a *dioptre*; **it is the reciprocal of the focal length**, when the focal length is expressed in meters.'

Pet. 24 (quoting Ex. 1010, 159) (alteration in original). Thus, as established above, the L1 lens has a positive focal length of 2.068 mm thereby indicating a positive refractive power and the L2 lens has a negative focal length of -3.168 mm thereby indicating a negative refractive power. *Id.* (citing Ex. 1003, 37). Based on the complete record, Petitioner has demonstrated sufficiently that Ogino teaches this limitation, which Patent Owner does not dispute.

"and wherein lens elements L_{2_1} and L_{2_2} have opposite refractive powers"

> Petitioner asserts
>
> while not given in Ogino, the focal length f4 of the L4 lens can be calculated by inputting the optical data for the lens into the commonly known 'lens maker's equation' for lenses separated by a gap, as stated in Born
>
> $$f = -\frac{n\, r_1\, r_2}{(n-1)[n(r_1 - r_2) - (n-1)t]}$$
>
> where *f* is the focal length of the lens, *n* is the index of refraction, *r*1 and *r*2 are the curvature of the lens's two surfaces, and *t* is the axial thickness of the lens.

Pet. 25.

Petitioner further presents, based on the data in Table 9, calculations that show the L4 lens has a focal length f_4 = 2.7359 mm and the L5 lens has a focal length f_5 = -2.451 mm. *Id.* at 25–27 (citing Ex. 1005, Table 9, 13; Ex. 1003, 40). Thus, because L4 is positive and L5 is negative, they have opposite refractive powers. *Id.* Based on the complete record, Petitioner has demonstrated sufficiently that Ogino teaches this limitation, which Patent Owner does not dispute.

Conclusion

Based on the complete record, and for the reasons explained by Petitioner, we are persuaded that Petitioner has shown by a preponderance of the evidence that Ogino discloses the limitations of claim 1.

2. Dependent Claims 4, 9–15, 17, 20, 25–29

Patent Owner does not raise arguments for claims 4, 9–15, 17, 20, and 25–29. We have reviewed Petitioner's arguments and evidence concerning claims 1, 4, 9–15, 17, 20, 25–29, and we adopt them as our own. Pet. 28–40. Thus, based on the complete record, and for the reasons explained by

Petitioner, we are persuaded that Petitioner has also shown by a preponderance of the evidence that these claims are anticipated by Ogino. *See id*.

F. Asserted Obviousness of Claims 2, 5, 6, 18, and 21–23 over Ogino in view of Bareau

Petitioner asserts that the combination of Ogino and Bareau teaches or suggest all the limitations of claims 2, 5, 6, 18, and 21–23, and provides reasoning as to why one of ordinary skill in the art would have been prompted to combine the teachings of these references. Pet. 40–51. For the reasons that follow, we determine that Petitioner has shown persuasively that the combination of Ogino and Bareau would have rendered claims 2, 5, 6, 18, and 21–23 of the '897 patent obvious.

1. Analysis of Motivation to Combine Ogino and Bareau and the Limitation of "a f-number F#<2.9" and/or "a f-number F#=2.8"

Petitioner's analysis, as supported by the Sasián Declaration, demonstrates where Petitioner contends each element in claims 2, 5, 6, 18, and 21–23 is disclosed in Ogino and Bareau. Pet. 40–51. In particular, Petitioner relies on its anticipation contentions regarding Ogino, discussed above, and adds Bareau to teach the limitation of an f-number less than 2.9, recited in claim 2, and an f-number equal to 2.8, recited in claim 23. *Id.* at 41–49, 51. Our discussion above addresses Petitioner's contentions as to Ogino. *See supra* Section III.E. Accordingly, our discussion here focuses on whether the combination of Ogino and Bareau accounts for the limitations of an f-number less than 2.9 and/or an f-number equal to 2.8.

As to the motivation to combine Ogino and Bareau, Petitioner states

> A POSITA would have found it obvious to modify Ogino's Example 5 lens assembly in view of Bareau's specifications for cell phone camera lenses with an F#=2.8 or less

> for ¼" and smaller image sensors. Such a combination would have been simpl[ly] . . . applying Bareau's specification for a brighter lens system for smaller image sensors, according to known lens design and modification methods (as taught in [Fischer (Ex. 1017)]), to yield a predictable result of Ogino's Example 5 lens assembly likewise supporting an f-number of 2.8 or lower for a small sensor format.

Id. at 41–42 (citing Ex. 1003 ¶ 51; Ex. 1017, 172; Ex. 1024, 1:23–53; Ex. 1012, 3–4). Petitioner relies on Bareau to show that: cell phones having cameras with f-number 2.8 for one quarter inch and smaller sensors were common in 2006; the desire to achieve lower f-numbers was well known because of the need for faster lenses; and "a POSITA therefore would have sought to modify existing lens designs to achieve faster f-numbers like 2.8 while still maintaining a short total track length appropriate for thin cell phone designs." *Id.* at 42 (citing Ex. 1003 ¶ 52; Ex. 1012, 3; Ex. 1013, 104). Petitioner asserts Ogino has examples with an f-number "down to 2.45" and thus "modifying Ogino's Example 5 to have an f-number of 2.8, as taught in Bareau, would have been nothing more than applying Bareau's specification of an F#=2.8 for a ¼" image sensor format according to known lens design methods (as taught in Fischer [Ex. 1017]) to allow Example 5 to likewise better support a ¼" sensor format in a thin cell phone." *Id.* at 43 (citing Ex. 1003 ¶ 53).

Petitioner acknowledges that Bareau has a field of view (FOV) of 60 degrees, associated with a wide lens rather than a telephoto lens, but contends that "that Bareau's specifications for f-number and short TTL would still be highly relevant to incorporating a telephoto lens like Example 5 since TTL dictates the thickness of the cell phone and the f-number indicates how much light reaches the image sensor regardless of a lens's

focal length or FOV." *Id.* (citing Ex. 1003 ¶ 54; Ex. 1005, Figs. 14, 15; Ex. 1012, 3–4; Ex. 1014, Fig. 16, Ex. 1015). Thus, according to Petitioner a person of ordinary skill in the art seeking to create a telephoto lens with a low f-number would have looked to modify Ogino's Example 5. *Id.* (citing Ex. 1003 ¶ 54).

Petitioner, supported by Dr. Sasián, contends one way to modify Example 5 to lower the f-number would be to increase the diameter of one or more lens element surfaces such as the first lens in Example 5 which is the entrance aperture due to the relationship between "f-number, focal length (EFL), and the diameter of the entrance aperture (i.e. the entrance pupil diameter EPD) which controls the amount of light that enters the assembly." *Id.* at 44 (citing Ex. 1003 ¶ 55, Ex. 1016, 59).

According to Petitioner, the lens design arrived at by Dr. Sasián has the following specifications: "EFL=5.648 mm, TTL=5.271 mm, and radii of curvature, spacing, and focal lengths of lens elements L2, L3, L4, and L5 are unchanged and the focal length of L1 is f1=2.0711 similar to f1 unmodified." *Id.* at 45 (citing Ex. 1003 ¶ 56). Petitioner presents Zemax data sheets supporting its contention that its proposed design has "the same structural design (i.e., focal lengths and spacing) and similar performance characteristics when compared to the original Example 5 design." *Id.* (citing Ex. 1003 ¶ 57). Additionally, according to Petitioner, "Example 5 modified for F#=2.8 continues to meet all of the limitations of claim 1 since f1-f5, EFL, TTL, and thicknesses and spacing all still satisfy the respective conditional expressions" of independent claim 1. *Id.* at 46–47 (citing Ex. 1003 ¶ 58). Finally, Petitioner asserts that the declarant for Patent Owner in two related IPRs, IPR2018-01140 and -1146, testified that a person of

ordinary skill in the art would know how to lower the f-number. *Id.* at 47 (citing Ex. 1023, 119:4–22, 121:5–122:13).[4]

Analysis of Patent Owner's Arguments

Patent Owner argues that

> [i]f a POSITA looking at Ogino felt that an f-number of 3.94 was not suitable for their particular application and wanted an f-number of 2.8 instead, that person would naturally look to one of Ogino's other designs, with f-number closer to 2.8, or to one of the hundreds of other miniature lens designs available in the patent literature or in the market. Dr. Sasian provides no explanation for why a POSITA would pick Ogino Example 5, the Ogino lens that is farthest from this desired f-number and modify it dramatically as Dr. Sasian proposes.

PO Resp. 31 (citing Ex. 2001 ¶ 81). This argument does not undermine Petitioner's showing. As explained above, Petitioner cites to Bareau as suggesting lowering the f-number to 2.8. Pet. 41–42. That is, Petitioner has shown an artisan seeking to improve upon or otherwise modify Ogino would have tried to lower the f-number because of the known advantages provided by such a lower f-number. *See id.*

As to the motivation to choose Example 5 versus the other examples in Ogino, the Federal Circuit has found that a person of ordinary skill is not limited to pursuing only the one best option. *PAR Pharm., Inc. v. TWI Pharm., Inc.*, 773 F.3d 1186, 1197–98 (Fed. Cir. 2014) ("Our precedent . . . does not require that the motivation be the best option, only that it be a suitable option from which the prior art did not teach away."); *In re Fulton*, 391 F.3d 1195, 1200 (Fed. Cir. 2004) (holding that "a particular

[4] For example, when asked "[would] a person of ordinary skill in the art be able to reduce an f-number to under 2.9," Dr. Moore testified "Yes." Ex. 1023, 119:19–22.

combination" need not "be the preferred, or the most desirable, combination described in the prior art in order to provide motivation"). Additionally, in response to Patent Owner's argument, Petitioner, in its Reply, contends that Dr. Milster's claim that there were "hundreds" of miniature lens designs did not limit that estimate to telephoto lenses. Pet. Reply 3 (citing Ex. 1025, 78:12–17,[5] Ex. 1037 ¶ 4 (Saisán reply declaration)).

Petitioner also responds, in its Reply, that a person of ordinary skill in the art would have chosen Example 5 because

> Example 5 offers the best telephoto ratio of the Ogino's examples (0.868) which, when considered alone, would have motivated a POSITA to consider it ripe for improvement given its less desirable features, like a higher F-number relative to Ogino's other examples. *See id*., 16:29-22:35 (Tables 1-11). The low telephoto ratio of Example 5 would also have given a POSITA more flexibility to experiment with the lens design while still maintaining its telephoto character. APPL-1037, ¶ 6.

Id. at 4. To the extent that Petitioner is required to show that a person of ordinary skill in the art would have chosen Example 5 over the other examples in Ogino, we are persuaded that Petitioner has shown this by Petitioner's contention that Example 5 offers the best telephoto ratio above.[6]

Patent Owner also argues "Dr. Sasián's modification to Ogino Example 5 does not satisfy all of the 'typical lens specifications' from

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[5] There a appears to be a typographical error and Ex. 1028, 159:25–160:15 (Milster Dep.) appears to be the correct citation.

[6] Petitioner also asserts "The relevance of Ogino to the lenses of the '897 patent is also evidenced by not only their similarities in track length and optical characteristics, but also the fact that Ogino's Example 5 anticipates most of the claims of the '897 patent, which Patent Owner does not dispute." We do not rely on this assertion.

Bareau" because it reduces the full field of view of 40°. PO Resp. 31 (citing Ex. 2001 ¶ 82). Patent Owner asserts that Petitioner needs to explain why the combination "move[s] [] further away" from a specification of Bareau. *Id.* at 31–32. Thus, according to Patent Owner, "nothing cited by Dr. Sasián suggests that an f-number of 2.8 was desirable in the context of a narrower-angle lens." *Id.* We find Petitioner's contentions that the f-number indicates how much light reaches the image sensor regardless of a lens's focal length or FOV (Pet. 43) persuasive, and we find that Patent Owner has not presented sufficient rebuttal why the selection of f-number would be different in narrower-angle lenses; thus, this conclusory argument does not undermine Petitioner's showing. PO Resp. 31; *See generally* Sur-Reply (Patent Owner does not address the field of view of Ogino).

Patent Owner also argues Petitioner has not shown that a person of ordinary skill in the art would have followed Dr. Sasián's approach and made the modification he made. PO Resp. 32–34. Specifically, Patent Owner argues that

> [i]n modifying Ogino Example 5, Dr. Sasian kept the number of lens elements, the powers of the lens elements, their thicknesses, and their spacings unchanged, except for a small change to the thickness of the first lens element. (Ex. 1003, Sasian Decl. at 104; Ex. 2001, Milster Decl., ¶ 84.) He made the small change in thickness of the first lens element, from 0.546 mm (Ex. 1005, Ogino Table 9) to 0.600 mm (Ex. 1003, Sasian Decl. at 107) by hand. (Ex. 2003, Sasian Depo. at 24:14–25:10.) By keeping these parameters (nearly) unchanged, Dr. Sasian ensured that the values of EFL, TTL, lens powers, and lens gaps needed to satisfy other claim elements remained unchanged. (Ex. 2001, Milster Decl., ¶ 84.)

Id. at 32–33. Patent Owner argues that this approach was guided by hindsight rather than the knowledge and motivation of one of ordinary skill

in the art at the time of the invention. *Id.* at 33. Patent Owner points to "vast number of ways" the lens parameters could be varied including 20 different approaches suggested in Dr. Sasián's own design textbook on the subject. *Id.* at 33–34. Patent Owner also suggests a person of ordinary skill would have started with Ogino's Example 6 which has an f-number of 2.64 and a field of view of 59.6° which are more in line with Bareau. *Id.* at 34.

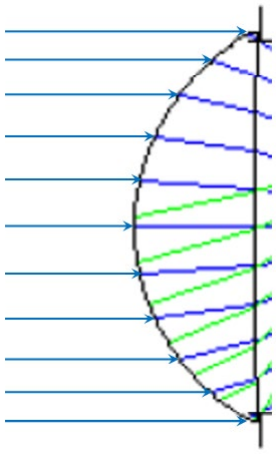
Petitioner argues the approach of making small changes is "precisely" the approach one of ordinary skill would have taken. Pet. Reply 6–7. Petitioner relies on Fischer (Ex. 1017), Kinglake (Ex. 1013) and the opening and reply testimony of Dr. Sasián to support this contention. Pet. Reply 6–7 (citing Ex. 1003, 55, 104; Ex. 1013; Ex. 1017, 168; Ex. 1037 ¶ 11; Ex. 1028, 21:6–18; Ex. 1023, 99:6–18). We credit the testimony of Dr. Sasián on this point. Additionally, Petitioner contends, as discussed above, that "the f-number indicates how much light reaches the image sensor *regardless* of a lens's focal length or FOV." Pet. 43 (citing Ex. 1003 ¶ 54; Ex. 1005, Figs. 14, 15; Ex. 1012, 3–4; Ex. 1014, Fig. 16; Ex. 1015). Patent Owner does not respond to this argument in its Sur-Reply. *See generally* Sur-Reply (Patent Owner does not address this field of view argument).[7] We find that Petitioner has the better position. Petitioner has persuasively explained why one of ordinary skill in the art guided by Bareau would have looked to

[7] Patent Owner's counsel at the hearing asserts that "[t]he F number, the field of view, and the telephoto ratio all depend on the focal length of the lens." Tr. 36. Patent Owner's counsel also argues "because the longer focal length of the narrow-angle lens requires a larger lens element, a larger aperture in order to support the small F number." *Id.* at 362–37. However, these arguments by counsel were not briefed by Patent Owner and are not supported by expert testimony. Therefore, we do not rely on this unsupported attorney argument.

Ogino in order to reduce the f-number below 2.9 and begin with Example 5, then reduce the f-number with a minimum of other changes to the design.

Despite the discussion above, we clarify that we do agree with Patent Owner that a person of ordinary skill in the art would have known that the lenses in Ogino would most likely be made of injection molded plastic. PO Resp. 34–37 (citing Ex. 2001 ¶ 91). We agree with Patent Owner that a person of ordinary skill in the art at the time of the invention would have considered issues of manufacturability in determining the edge thickness and consider oversizing the edges of the lens to deal with this potential problem. *Id.* at 37–46. Finally, we agree a person of ordinary skill in the art at the time of the invention would also have recognized that when designing lens elements for crafting via injection molding, a number of manufacturing realities apply that all promote maximizing the thickness of the lens element at the edge. In particular, the Handbook of Optics (Ex. 1019) states that "Surface-tension effects may play a significant role in the accuracy to which a precision optical surface may be molded. Particularly in areas of the part where the ratio of surface area/volume is locally high (corners, edges) . . . ." PO Resp. 46. Nevertheless, we disagree with Patent Owner regarding the import of one of ordinary skill being aware of manufacturability concerns.

Based on the alleged knowledge of one of ordinary skill discussed above, Patent Owner argues that one of ordinary skill would have believed the edges of the first lens element of Petitioner's proposed lens design would be too thin to be manufacturable. *Id.* at 34. Specifically, Patent Owner, through its declarant Dr. Milster, shows that in order to achieve that f-number in Petitioner's proposed lens design the first lens element would need to be the shape shown below in a drawing reproduced from Dr. Milster's declaration.



In the drawing, reproduced above from Dr. Milster's declaration, representing Dr. Sasián's proposed lens design with an f-number of 2.8, there is a rounded lens surface with blue rays entering from the right and being bent inward as the pass through the lens – the blue rays of this drawing are the rays of the bundle that defines the entrance pupil. *Id.* at 38–39 (citing Ex. 2001 ¶ 96). Based on Dr. Milster's calculations, Patent Owner argues "[t]he resulting shape has a very narrow edge and a large slope at that edge. According to Dr. Milster's calculations, the edge thickness is only 0.0394 mm (or 39.4 microns), and the slope is 58.86°." PO Resp. 40 (citing Ex. 2001 ¶ 98, Appx. § XI.A).

Patent Owner also argues that not only does Dr. Sasián's proposed lens design have thin edges but a commercial lens would be oversized at the edges to accommodate mounting. *Id.* at 41–48. Patent Owner also presents X-Ray CT images of a commercial lens showing that the curved potions of the lens are oversized creating flanges at the edge to accommodate the mounting of the lenses. *Id.* at 41–43. Patent Owner argues that oversizing is necessary because a lens cannot be made with perfectly sharp corners and edges. *Id.* at 43 (citing Ex. 2001 ¶ 103). According to Patent Owner, "[i]n molded lenses, one reason for this is surface tension of the lens material. If

one attempted to inject plastic or glass into a mold with sharp corners such as shown in the Zemax drawing, the liquid would not fill the corners, but would rather form a rounded surface, which would bend light differently than the ideal shape in Zemax." *Id.* Thus, according to Patent Owner, "[a] practical lens design would use an edge shape that permitted oversizing and rounded corners." *Id.* at 46 (citing Ex. 1019, 34.16; Ex. 2001 ¶ 108).

Petitioner points out that claims 2, 5, 6, 18, and 21–23 do not include any manufacturing requirements such as center-to-edge thickness ratio. Pet. Reply 9. Petitioner also points out that "the inclusion of the center-to-edge thickness ratio in claims 16 and 30 and not in any other claims makes it clear that they are additional limitations not required of the other claims of the '897 patent under the doctrine of claim differentiation." *Id.* at 10 (citing *SRI Int'l v. Matsushita Elec. Corp.*, 775 F.2d 1107, 1122 (Fed. Cir. 1985) ("It is settled law that when a patent claim does not contain a certain limitation and another claim does, that limitation cannot be read into the former claim in determining either validity or infringement.").

Petitioner also contends that Example 1 of the '897 patent would not meet the manufacturability requirements suggested by Dr. Milster. *Id.* at 17–18 (citing Ex. 1037 ¶ 22; Ex. 1028, 98:24–99:4 (Dr. Milster testified he did not determine whether the lenses in the '897 Specification were manufacturable)); *EPOS Techs. Ltd. v. Pegasus Techs. Ltd.*, 766 F.3d 1338, 1347 (Fed. Cir. 2014) ("[A] claim construction that excludes a preferred embodiment . . . is rarely, if ever correct and would require highly persuasive evidentiary support." (alteration in original)).

We agree that claims 2, 5, 6, 18, and 21–23 do not include any manufacturing requirements such as center-to-edge thickness ratio; therefore

we decline to read a limitation of a manufacturability and/or edge thickness limitation into the claims that do not recite such a requirement.

As to motivation to combine, it is unclear upon which one of the following Patent Owner's argument regarding manufacturability is based: the design proposed by Petitioner being inoperable for its intended purpose, or that there is no reasonable likelihood of success in creating a manufacturable version of the lens design offered by Petitioner, or that a person of ordinary skill in the art simply would not have been motivated to pursue designs that do not meet Beich's rules of thumb for manufacturability. *See* Tr. 55–56. Below, we address each of these possible bases for Patent Owner's arguments.

"The reasonable expectation of success requirement refers to the likelihood of success in combining references to meet the limitations of the *claimed* invention." *See Intelligent Bio-Systems, Inc. v. Illumina Cambridge Ltd.*, 821 F.3d 1359, 1367 (Fed. Cir. 2016) ("[F]ailure to consider the appropriate scope of the . . . patent's claimed invention in evaluating the reasonable expectation of success . . . constitutes a legal error") (emphasis omitted, alteration in original). Because manufacturability concerns regarding edge thickness are not claimed, a person of ordinary skill can have success in making the lens design claimed in claims 2, 5, 6, 18, and 21–23 without regard to manufacturability. Thus, Patent Owner's argument does not undermine Petitioner's showing of reasonable expectation of success.

As to inoperability for its intended purpose, "[i]f references taken in combination would produce a 'seemingly inoperative device,' . . . such references teach away from the combination and thus cannot serve as predicates for a prima facie case of obviousness." *McGinley v. Franklin*

Sports, Inc., 262 F.3d 1339, 1354 (Fed. Cir. 2001). However, a modification to a prior art reference that results in the loss of key functionality can be overcome by evidence that a person of ordinary skill would nevertheless have been motivated to combine references. *In re Urbanski*, 809 F.3d 1237, 1244 (Fed. Cir. 2016). Here, Petitioner presents evidence, including testimony by its declarant, that a person of ordinary skill in the art would have been motivated to make lenses for experimental or research purposes that to do require manufacturing tolerances for edge thickness. Pet. Reply 13–14 (citing Ex. 1037 ¶¶ 16, 17; Ex. 1028, 173:9–11, 25).[8,9]

Petitioner also contends a person of ordinary skill in the art "would have understood these patented lens designs to have usefulness and purpose, and to be physically producible, even if they do not meet the strict large-scale manufacturing considerations argued by Patent Owner. *Id.* at 15 (citing Ex. 1037 ¶ 19). Petitioner contends that Beich suggests that one of ordinary skill would have balanced the manufacturing difficulty of the allegedly thin edges of Petitioner's proposed lens design with the performance achieved by those lenses. *Id.* at 16 (citing Ex. 1007, 1, 7, 9; Ex. 1012, 11).

But it is a commonplace fact that design decisions entail making tradeoffs among multiple objectives. *Allied Erecting and Dismantling Co. v. Genesis Attachments, LLC*, 825 F.3d 1373, 1381 (Fed. Cir. 2016) ("A given

[8] There appears to be a typographical error and the correct citation appears to be Ex. 1028, 182:17–20, 182:9.
[9] Petitioner also asserts that other patents disclose lenses with similar edge thickness. Pet. Reply 14 (citing Exs. 1035, 1036). We do not rely on this evidence.

course of action often has simultaneous advantages and disadvantages, and this does not necessarily obviate motivation to combine.").

Additionally, Petitioner presents an alternative lens design to show that one of ordinary skill would have been able to create a device that was operable. Pet. Reply 19–21 (citing Ex. 1037 ¶¶ 24–26). Petitioner's proposed design shows that a design with acceptable edge thickness while still meeting the limitations of claims 2, 5, 6, 18, and 21–23 was within the knowledge of one of ordinary skill in the art. *Id.*

Patent Owner argues that this is a new combination that is untimely and should be disregarded. Sur-Reply 11–12. Specifically, Patent Owner complains "[i]n creating this new lens, Dr. Sasián manually changed the thickness of the first lens element and performed steps in Zemax that turned off vignetting and that caused the location of the image plane to change, along with the conic constant of the first lens surface and 32 higher-order aspheric terms describing the lens surfaces," all of which would be new purported combinations to which Patent Owner would need to respond. *Id.* at 11. We note that none of the changes Patent Owner discusses, other than the thickness of the first lens, is a limitation of the claims at issue or any other claims of the '897 patent, nor is the new combination presented as a new ground but rather, as stated above, to show that changing the lens design to meet Patent Owner's alleged manufacturability concerns was within the knowledge of one of ordinary skill in the art. Pet. Reply 19–21.

Additionally, as to Patent Owner's assertion that this argument is an improper new argument never before presented by Petitioner, we determine that Petitioner's additional proposed lens design properly responds to Patent Owner's arguments that Petitioner's modification would have rendered Ogino unsatisfactory for its intended purpose or would have frustrated

Petitioner's asserted motivation to combine. *See* 37 C.F.R. § 42.23(b) ("A reply may only respond to arguments raised in the corresponding . . . patent owner response."); *Idemitsu Kosan Co., Ltd. v. SFC Co. Ltd.*, 870 F.3d 1376, 1380–81 (Fed. Cir. 2017) (permitting rebuttal argument from a petitioner in response to a patent owner's argument that a reference taught away from a particular combination, as such argument was "simply the by-product of one party necessarily getting the last word"). Additionally, Patent Owner was given the opportunity to address this alleged new theory in its Sur-Reply.

Therefore, for the reasons above, Petitioner has shown sufficient motivation to combine that is not undermined by Patent Owner's assertions regarding the lack of manufacturability of Petitioner's proposed lens design. That is, Patent Owner's arguments do not undermine Petitioner's showing that the combination of Ogino and Bareau would have taught a person of ordinary skill in the art to create a lens design with an f-number less than 2.9 and/or an f-number equal to 2.8. Additionally, we find that Petitioner has made a sufficient showing that one of ordinary skill in the art would have been motivated to combine Ogino and Bareau in the manner described by Petitioner with a reasonable expectation of success, and that the motivation has sufficient rational underpinning. Pet. 41–47. Below we discuss the remaining limitations of claims 2, 5, 6, 18, and 21–23.

2. Claim 2

"The lens assembly of claim 1, wherein the TTL is equal or smaller than 6.0 mm and the lens assembly has a f-number F#<2.9"

Petitioner relies on its contentions as to how Ogino discloses the limitations of claim 1 discussed above. Pet. 47–48. Petitioner also contends the combination of Ogino and Bareau discloses this limitation in the

modification of Ogino's Example 5 which supports an f-number is 2.8, the TTL is maintained to 5.271 mm as compared to the original TTL of 5.273 mm. *Id.* at 48 (citing Ex. 1003, 62). As explained above, Petitioner has shown sufficiently a motivation to combine Ogino and Bareau so as to modify Ogino's Example 5 to support an f-number is 2.8. Based on the complete record, Petitioner has demonstrated sufficiently that the combination of Ogino and Bareau teaches the limitations of claim 2, which Patent Owner does not dispute except as noted above.

3. Claims 5, 18, and 21–23

Claims 5, 18, and 21–23 depend directly or indirectly from claims 2 and/or 17 and further recite substantially the same limitations as dependent claims 2 and 6. Petitioner refers back to its analysis for claims 1, 2, 6, and 17 (Pet. 49–51), and Patent Owner does not present arguments beyond those discussed above with respect to claim 2. We have reviewed Petitioner's arguments and evidence concerning claims 5, 18, and 21–23 and we adopt them as our own. *Id.* at 49–51. Based on the complete record, and for the reasons explained by Petitioner, we are persuaded that Petitioner has shown by a preponderance of the evidence that the combination of Ogino and Bareau teaches or suggests the limitations of claims 5, 18, and 21–23. *See id.*

4. Claim 6

"The lens assembly of claim 5, wherein lens element L1_1 has a concave image-side surface"

Petitioner relies on Ogino's disclosure of the "L1 lens (i.e., L1_1) in Example 5 which has a meniscus shape which is convex toward the object side." Pet. 50 (Ex. 1005, 13:5–11). Petitioner contends a person of ordinary skill in the art "would have recognized that the description of L1 being

meniscus means that the first lens has a convex object-side surface and a concave image-side surface." *Id.* (citing Ex. 1003, 64). Petitioner contends that this is because meniscus lenses are commonly known to include one convex side and one concave side. *Id.* (citing Ex. 1010, Fig. 4.15). Based on the complete record, Petitioner has demonstrated sufficiently that the combination of Ogino and Bareau teaches the limitations of claim 6, which Patent Owner does not dispute.

G. Asserted Obviousness of Claims 3, 8, 19, and 24 over Ogino, Bareau, and Kingslake

Petitioner asserts that the combination of Ogino, Bareau, and Kingslake teaches or suggests all the limitations of claims 3, 8, 19, 24 and provides reasoning as to why one of ordinary skill in the art would have been prompted to combine the teachings of these references. Pet. 51–61. For the reasons that follow, we determine that Petitioner has not shown persuasively that the combination of Ogino, Bareau, and Kingslake would have rendered claims 3, 8, 19, 24 of the '897 patent obvious.

These claims add two limitations that are not satisfied by the first modification to Ogino used in the ground based on anticipation by Ogino or the ground based obviousness only over Ogino and Bareau: an image-side surface diameter between 2.3 mm and 2.5 mm for the first lens element (claims 3 and 19) and a convex image-side surface (claims 8 and 24). The image-side surface diameter of the first lens element in Petitioner's first modification of Ogino is 2×0.98943 = 1.97886 mm, outside the range required by claims 3 and 19. Ex. 2001 ¶ 126. This image-side surface is also concave, as shown by the positive value of the radius of curvature (252.97534) in Dr. Sasián's lens prescription. Ex. 1003, 107; Ex. 2001 ¶ 126. Dr. Sasián explains how the meniscus lens convex toward the object

side in each of Ogino's examples has a concave image-side surface in his analysis of claim 6. Ex. 1003, 63–66; Ex. 2001 ¶ 128.

Patent Owner asserts "[t]he fact that the first lens element has a concave image-side surface is a feature of every example in Ogino and is described by Ogino as a defining feature of its invention." PO Resp. 56 (citing Ex. 2001 ¶ 126). For example, Ogino explains that its invention uses a first lens that "has a positive refractive power and has a meniscus shape which is convex toward the object side." Ex. 1005, code (57), 13:5–10. Ogino explains its reason for including this feature:

> by making the first lens L1, which is a lens closest to the object, have a positive refractive power and have a meniscus shape which is convex toward the object side in the vicinity of the optical axis, the position of the rear side principal point of the first lens L1 can be set to be close to the object, and thus it is possible to appropriately reduce the total length.

PO Resp. 57 (quoting Ex. 1005, 7:31–37) (emphasis omitted). Petitioner suggests this disclosure would not have discouraged one of ordinary skill from changing the shape of the lens (Pet. Reply 23), however, Patent Owner is not arguing teaching away but rather that Petitioner has failed to present sufficient motivation for the change.

Petitioner also asserts its proposed lens design for this ground changes "[t]he radius of curvature for the image-side surface of L1 [] from concave to convex to allow the L1 lens to better focus incoming light, to provide a thicker edge for easier manufacturing (*see* [Ex. 1007, 7]) while maintaining its original focal length as much as possible." Pet. 60 (citing Ex. 1003, 74–75); Pet. Reply 23. In explaining his method for modifying the lens, Dr. Sasián testifies he "Re-optimize[d the] lens with only lens L1 radii (due to location of the aperture), airspaces, and aspheric coefficients." Ex. 1003,

Appx., 108, Fig. 3D. Petitioner does not explain sufficiently its rationale for modifying Ogino to change the shape of the lens.

Petitioner's cursory reference to better focusing incoming light, providing a thicker edge, or location of the aperture is not sufficient to change the shape of a lens.[10] Petitioner needed to explain sufficiently why the change in shape was required to achieve these benefits as opposed to other possible changes. In its Reply, Petitioner repeats these cursory statements with a slight variation (a "POSITA would have been motivated to change the shape of Ogino's Example 5 first lens to increase the lens diameter to allow more light to pass through the system while maintaining a focal length similar to the original Ogino Example 5 lens assembly"). Pet. Reply 23–24. However, Petitioner still does not explain sufficiently why changing the shape of the lens would have been the method chosen by one of ordinary skill in the art to allow more light in or focus more light. Additionally, Petitioner does not explain sufficiently how the location of the aperture informed this choice.

Petitioner also argues that "the steps Dr. Sasián used to produce the second modified Example 5 lens design . . . are gradual and within the level of a skill of a POSITA." Pet. Reply 24. To the extent that Petitioner wishes to fill a missing limitation with the general knowledge of one of ordinary skill, "the use of common sense [requires] a reasoned explanation that avoids conclusory generalizations." *Arendi S.A.R.L. v. Apple Inc.*, 832 F.3d

[10] Petitioner asserts that in IPR2018-01140 we accepted Dr. Sasián's modification of Ogino's Example 6 lens assembly with the second lens changed from meniscus to biconcave. Pet. Reply 22 (citing Ex. 1032, 44). However, in that case Dr. Sasián relied on a prior art reference and explained the motivation to make the modification. Ex. 1032, 39. He does not do so here.

1355, 1366 (Fed. Cir. 2016). Petitioner's conclusory reference to changes being "gradual" or within the level of skill do not explain sufficiently what about Dr. Sasián's process indicates that one of ordinary skill would be able to take the steps that he did.

Petitioner also asserts, "a POSITA would have been motivated to experiment . . . to see if a smaller f-number would also have been attainable for Example 5. [Ex. 1003], pp.68-69. A *natural* target for further reduction would have been f=2.45, which is the lowest F-number offered in Ogino's examples. *Id.*, p.69." Pet. Reply 24 (emphasis added); *see also id.* at 27–28 ("f=2.45 being a *natural* design goal as provided in Ogino's other embodiment" (emphasis added)). Again, Petitioner does not explain sufficiently why using an f-number of 2.45 would require changing the shape of the first lens. [11]

[11] At the Oral Hearing, Petitioner tried to explain that Dr. Sasián simply ran an optimization and the computer chose to change the shape of the lens. Specifically, Petitioner's counsel argued that

> when Dr. Sasián says that he was starting with Ogino Example 5 at F equals 2.8, he opened the aperture and then he re-optimized the lens only using the L1 radii. So he used the radius -- the radii values on both sides of the first lens and then he allowed the software to optimize it and what that did is that created the convex surface on the image side. The convex surface on the image side is a natural result that the software derived of applying this particular change to this embodiment.
>
> So because it's a natural result of it there's nothing wrong and there's no motivation that needs to be provided specifically for this change. Again, when the change is a natural result of the modification there's no specific argument that needs to be provided -- or reason or motivation that needs to be provided to make that specific change because it's the result of applying the modifications that Dr. Sasián did.

Additionally, at the hearing Petitioner suggested that its reference to "natural" was an inherency argument by citing to *PAR Pharmaceuticals v. TWI Pharmaceuticals*, 773 F.3d at 1195–96. Tr. 53. *PAR* states that "[a] party must[] meet a high standard in order to rely on inherency to establish the existence of a claim limitation in the prior art in an obviousness analysis—the limitation at issue necessarily must be present, or the natural result of the combination of elements explicitly disclosed by the prior art." *PAR Pharms.*, 773 F.3d at 1195–96. We do not determine that Petitioner's passing reference to "natural" raised an inherency argument. However, even if we accepted such an argument, Petitioner has not shown in the Petition that reducing the f-number of Example 1 to 2.45 would "naturally" result in changing the shape of the lens. The Petition states that changing the shape was a choice based on letting more light in the lens. Pet. 60.

Patent Owner also asserts Dr. Sasián made several errors in this calculations concerning this modification to Ogino. PO Resp. 16–17. Petitioner presents evidence that purportedly shows that despite alleged clerical errors in Dr. Sasián's declaration, a person of ordinary skill in the art "would be successful" in making Petitioner's proposed lens design, but this does not explain sufficiently the motivation to make the modification. *See* Pet. Reply 24–28. However, even if we accept that these errors were harmless to Dr. Sasián's overall analysis, the mere fact that the prior art *could* be so modified would not have made the modification obvious unless the prior art suggested the desirability of the modification. *In re Gordon*, 733 F.2d 900, 902 (Fed. Cir. 1984).

Tr. 23. We find no testimony from Dr. Sasián or other evidence in the record to support this attorney argument, therefore we do not rely on it.

Petitioner needed to provide a sufficient rationale for changing a feature of Ogino. Petitioner also argues that "changing the curvature of surfaces within a lens system is a well-known improvement technique that POSITAs regularly consider," and cites Ogino itself as stating that the curvature values can be varied. Pet. Reply 23. Petitioner misses the point. Petitioner must show that one of ordinary skill would have been motivated to make the change it suggests, not just that the art would have allowed that such a change could be made. *See Gordon*, 733 F.2d at 901.

Patent Owner argues

> Dr. Sasian does not explain why ***he*** did it or how he did it in 2020, let alone why a ***POSITA*** would have been motivated to make these changes years earlier. (Ex. 2001, Milster Decl., ¶ 139.) For example, he does not cite to any example of a system with a bi-convex lens that would have motivated the POSITA to try this approach, and he doesn't explain any benefits that flow from this change. (*Id.*) Indeed, the only reason he gives for changing the radii of curvature of the first lens at all (let alone flipping one from a concave positive radius to a convex negative radius) is a vague statement that he did it "due to the location of the aperture." (Ex. 1003, Sasian Decl. at 108; Ex. 2001, Milster Decl., ¶ 139).

PO Resp. 62–63. We agree with Patent Owner. Petitioner does not explain sufficiently why it changed the shape of the lens. Petitioner does not assert that it was because of some suggestion in the art, rather Petitioner relies on unsupported conclusory statements by its declarant.

We have reviewed Petitioner's explanations and supporting evidence regarding dependent claims 3, 8, 19, and 24, and because Petitioner's proposed design with the changed lens shape is used to support its contentions as to claims 3, 8, 19, and 24, we do not find them persuasive in accordance with our above findings. *See* Pet. 51–61. Petitioner, therefore,

has not demonstrated by a preponderance of the evidence that the combined teachings of Ogino, Bareau, and Kingslake would have rendered claims 3, 8, 19, and 24 obvious.

H. Asserted Obviousness of Claims 16 and 30 over Chen, Iwasaki, and Beich

Petitioner asserts that the combination of Chen, Iwasaki, and Beich teaches or suggests all the limitations of claims 16 and 30, and provides reasoning as to why one of ordinary skill in the art would have been prompted to combine the teachings of these references. Pet. 61–84. For the reasons that follow, we determine that Petitioner has not shown persuasively that the combination of Chen, Iwasaki, and Beich would have rendered claims 16 and 30 of the '897 patent obvious.

Claim 16 - "The lens assembly of claim 18, wherein the lens assembly further includes a ratio between a largest optical axis thickness L11 and a circumferential edge thickness L1e of lens element L1_1 of L11/L1e<3"

Claim 30 - "The lens assembly of claim 18, wherein the lens assembly further includes a ratio between a largest optical axis thickness L11 and a circumferential edge thickness L1e of lens element L1_1 of L11/L1e<3"

Petitioner contends "Chen's Example 1 with a thinner cover glass as taught in Iwasaki shows a TTL of 5.985 mm." Pet. 79. Petitioner also contends Chen's Example 1 has an f-number (F#) of 2.661. *Id.* Petitioner asserts that the Zemax model of Example 1 of Chen shows that "the L1 lens has a center thickness of 0.855 mm (*see* Fig. 24), an edge thickness of 0.293 mm, and a center-to-edge thickness ratio of 2.92. *Id.* at 79 (Ex. 1020, Fig. 24; Ex. 1003, 94–95, Appx., Fig. 4E).

Petitioner notes that Chen does not provide a diameter for its first lens. *Id.* at 80. Because of that fact, Petitioner asserts that "[b]ased on the teaching of Beich, a POSITA would have sought to limit the diameter of the

first lens so that this would be maintained for easier plastic injection molding." *Id.* at 79 (citing Ex. 1007, 7; Ex. 1003, 94). Specifically, according to Petitioner, "a POSITA considering the manufacturability of Chen would have determined the diameter of the first lens such that the lens would cover the aperture (to allow light passing through the aperture to enter the lens system) but would also be easy to manufacture." *Id.* at 80. Thus, according to Petitioner, as "shown in the Zemax calculated model in Dr. Sasián's Appendix, a POSITA would have determined the thickness of the edge of the L1 lens to be 0.293 mm (*see* [Ex. 1003], Appx., Fig. 4E) yielding a center-to-edge thickness ratio of the L1 lens in Chen's Example 1 to be 2.92 (i.e., 0.855/0.293) which is less than the claimed ratio of three and consistent with Beich's teaching. *Id.*, p.95." *Id.* at 80–81.

Patent Owner agrees that Petitioner's choice of a diameter for the first lens results in a center-to-edge thickness of 0.292 mm:

> Dr. Sasian suggests that a POSITA would choose a semi-diameter for this first lens (or at least for its object-side surface) of 1.2375 mm, barely 0.004 mm larger than the semi-diameter of the stop, 1.2333 mm. (Ex. 1003, Sasian Decl. at 115; Ex. 2001, Milster Decl., ¶ 142.) He finds that this lens would have a center-to-edge thickness ratio of 2.92, just under the value of 3 required by claims 16 and 30. (Ex. 2001, Milster Decl., ¶ 142.)
>
> This diameter is essentially the smallest that it could be without disrupting other characteristics of Chen that Dr. Sasian relies upon, such as its f-number. (Ex. 2001, Milster Decl., ¶ 143.)

PO Resp. 64. However, Patent Owner asserts that the diameter chosen could not be much larger or smaller "without reducing the entrance pupil diameter and increasing the f-number" and cannot be made larger than "1.249 mm, approximately 0.012 mm larger (less than 1% larger) than Dr. Sasian

proposes." *Id.* at 64–66 (citing Ex. 2001 ¶¶ 143–145; Ex. 1003, 112). Thus, according to Patent Owner, this violates manufacturing tolerances:

> The Beich paper also says that the tolerance for the diameter of the lens is "± 0.020 mm," and that the displacement between the front surface of the lens and the back surface is "< 0.020 mm." (Ex. 2001, Milster Decl., ¶ 146.) . . . the semi-diameter of the first lens is only 0.004 mm larger than the stop. (Ex. 2001, Milster Decl., ¶ 147.) If the lens is too small by 0.020 mm in diameter (0.010 mm in semi-diameter), this will make the semi-diameter of the first lens ***smaller*** than the semi-diameter of the stop by 6 μm.

Id. at 66. Additionally, according to Patent Owner, having the "first lens smaller than the stop will mean that light will leak and scatter around the lens and cause a haze in the image that is highly undesirable [thus] a POSITA would make the first lens from Chen larger in diameter than Dr. Sasian proposes." *Id.*

Patent Owner asserts "[o]versizing the 1.2374 mm semi-diameter surface by even 1% (far less than is required in practice) would make it 1.2499 mm in semi-diameter and would make the center-to-edge thickness ratio greater than 3. (Ex. 2001, Milster Decl., ¶ 17, Appx. § XI.B.)." *Id.* at 67. We do not rely on oversizing in this Decision. We find the choice to oversize is tradeoff that can be made without undermining the motivation to combine. The mere existence of disadvantages resulting from a modification does not refute the obviousness of the modification, especially when the prior art indicates that the modification also offers an advantage. Tradeoffs regarding features, costs, manufacturability, or the like, do not necessarily prevent the combination. *See Medichem, S.A. v. Rolabo, S.L.*, 437 F.3d 1157, 1165 (Fed. Cir. 2006) ("[A] given course of action often has simultaneous advantages and disadvantages, and this does not

necessarily obviate motivation to combine."); *Winner Int'l Royalty Corp. v. Wang*, 202 F.3d 1340, 1349 n.8 (Fed. Cir. 2000) ("The fact that the motivating benefit comes at the expense of another benefit, however, should not nullify its use as a basis to modify the disclosure of one reference with the teachings of another. Instead, the benefits, both lost and gained, should be weighed against one another."); *Allied*, 825 F.3d at 1381 ("A given course of action often has simultaneous advantages and disadvantages, and this does not necessarily obviate motivation to combine.").

We note that the Federal Circuit specifically found in a context similar to this that oversizing as suggested in the Optic Handbook relied on by Patent Owner does not teach away from using other rules of thumb in Beich. *Corephotonics, Ltd., v. Apple Inc.,* No. 2020-1961, 2021 WL 4944471, at *1 (Fed. Cir. Oct. 25, 2021) ("the *Corephotonics Appeal"*).

As explained with regard to the ground based on Ogino and Bareau, we agree with Patent Owner that a person of ordinary skill in the art at the time of the invention would have considered issues of manufacturability in determining the edge thickness and would have *considered* oversizing the edges of the lens to deal with this potential problem. *See* PO Resp. at 37–46. A person of ordinary skill in the art at the time of the invention would also have recognized that when designing lens elements for crafting via injection molding, a number of manufacturing realities apply that all promote maximizing the thickness of the lens element at the edge. In particular, the Handbook of Optics (Ex. 1019) states that "Surface-tension effects may play a significant role in the accuracy to which a precision optical surface may be molded. Particularly in areas of the part where the ratio of surface area/volume is locally high (corners, edges) . . . ." *Id.* at 46. As we found in

regard to the ground based on Ogino and Bareau, these considerations would not necessarily undermine the motivation to combine.

However, this ground is different from the ground based on Ogino and Bareau in a significant and dispositive way. As to claims 16 and 30 in this ground, Petitioner relies on the same reference Beich–that suggests the design tolerances at issue–to change the diameter of Chen:

> a POSITA looking to manufacture Chen's Example 1 lens system would have understood the benefit of applying the teachings of Beich, thereby resulting in an L1 lens in Chen's Example 1 with a diameter set for manufacturing so that the center-to-edge thickness ratio is maintained at less than 3, as provided for in Chen's original design.

Pet. 70 (emphasis omitted). But Petitioner then contends one of ordinary skill would ignore the design tolerance rule that applies to a change of diameter of the L1 lens, i.e. "[t]he Beich paper also says that the tolerance for the diameter of the lens is '± 0.020 mm,' and that the displacement between the front surface of the lens and the back surface is '< 0.020 mm.'" PO Resp. 66. Although the diameter is not claimed, as discussed above, Patent Owner explains that it is related to the claimed dimensions of the claimed lens such that a change to the diameter affects claim limitations and, in fact, Petitioner changes the diameter for the purpose of meeting other claim limitations. Sur Reply 19–21. We agree with this argument. That is, we determine that a person of ordinary skill in the art would not have been motivated to choose the diameter for Chen that Petitioner suggests upon considering the tolerance rule of Beich.

In response, Petitioner argues that a "lens designer would not have been bound by these specific manufacturing considerations regardless of the purpose of the lens design, especially with the only change being using a

thinner cover glass." Pet. Reply 28. However, Petitioner changes (or sets) the diameter of Chen as well as using a thinner cover glass. Thus, we are not persuaded by this argument. Additionally, Petitioner suggests "Patent Owner complains that the lens design cannot be oversized to meet various alleged manufacturing tolerances for injection molded lenses." *Id.* While Patent Owner does argue that the lens could not be oversized, it also argues that the lens as suggested by Petitioner is unacceptable without oversizing. PO Resp. 67. Specifically, Patent Owner argues "[t]he lens is unacceptable even without taking into account the need to oversize 'considerably beyond the clear apertures.'" *Id.* As noted above, we do not rely on oversizing but rather specifically the tolerance rule of Beich.

Petitioner also argues, in conclusory fashion, that "it would have been obvious for a POSITA to design for different purposes besides ease of manufacturing that still meet the limitations of claims 16 and 30." Pet. Reply 29. We are not persuaded by this late argument. Petitioner relies on manufacturability explicitly as the motivation to combine Chen, Iwasaki, and Beich. Pet. 69 ("[A] POSITA would have set a lens diameter . . . [to] be easier to manufacture."). Petitioner also makes the conclusory assumption that a "POSITA would have had the requisite skill to design a lens system based on Chen's Example 1 that would meet the manufacturing tolerances cited by Patent Owner, if required." Pet. Reply 29.[12] Unlike ground 2 above, Petitioner does not explain sufficiently how its proposed lens design would be changed to take into account the manufacturing tolerance suggested by Beich. Dr. Sasián, in his reply declaration, suggests that "the

[12] We note that Petitioner does not point to other specific rules in Beich or elsewhere that conflict with or undermine Beich's discussion of lens tolerance.

modified Chen Example 1 lens design represents one possible design that meets the limitations of claims 16 and 30" and cites his original declaration at pages 85–99. Ex. 1037 ¶ 37. To the contrary, we do not find at those pages disclosure of any alternative lens design.

Finally, Petitioner suggests, but does not explicitly argue, that the manufacturing tolerances in Beich are not relevant here because the '897 patent does not meet the manufacturing tolerances required by Beich. Pet. Reply 29–30; Ex. 1037 ¶¶ 38–42. Petitioner asserts that the first lens of Example 1 of Chen is the only lens that satisfies the limitation of claims 16 and 30 of L11/L1e<3 with a L11/L1e ratio of 2.99238. Pet. Reply 30. Thus, according to Petitioner, "this lens is not sufficient to meet the claims because it can only be oversized by 0.000759 mm (far less than the 1% larger tolerance allegedly required, Response, p.67) and still be below the claimed ratio because there is no room for 'rounded corners' or 'oversizing considerably beyond the clear apertures.'" *Id.* at 30.

We note that Patent Owner is not arguing that the claims are limited to the tolerances in Beich but rather that a person of ordinary skill in the art "would not have been motivated to make the combination proposed by Dr. Sasián for ground 4." PO Resp. 63. Even if the '897 patent does not take into account Beich's manufacturability considerations, Petitioner itself argues that one of ordinary skill in the art would have taken into account Beich's manufacturability considerations at least as to the center-to-edge thickness ratio. *See* Pet. 69 ("lens manufactures rely on 'rules of thumb,' . . . in manufacturing lens elements to maintain the ratio of center thickness to edge thickness to a value less than three ("< 3:1").") (citing Ex. 1007, 7).

Additionally, Patent Owner's declarant points out several errors in Dr. Sasián's analysis as to whether the examples in the '897 specification meet

the Beich tolerances. Sur-Reply 22–30. We do not need to decide if Dr. Sasián's analysis is sufficiently reliable, because, as explained above, even if we accept Dr. Sasián's analysis as being correct, we are not persuaded that Petitioner's argument that the '897 specification's examples do not meet the manufacturing tolerances would overcome the failure of Petitioner to provide a sufficient rationale to combine Chen with Beich.

Finally, we acknowledge that the Federal Circuit recently upheld our final written decision in IPR2019-00030 finding that the petitioner in that case had shown that Ogino alone and a combination of Ogino and Beich taught a limitation to "a ratio between a largest optical axis thickness L11 and a circumferential edge thickness L1e of the first lens element of L11/L1e<3, as to challenged claim 5 [of the '568 patent]." *Corephotonics Appeal*, at *1. We first note that the *Corephotonics Appeal* had Ogino as a main reference and did not involve Chen or Iwasaki. *Id.* at *1. The *Corephotonics Appeal* did involve Beich's rules of thumb such as Beich's teaching of "center thickness to edge thickness ratio" of <3:1. *Id.* at *3. In fact Patent Owner argued that the "Board did not explain why a relevant artisan would have applied only the center-to-edge thickness ratio rule from Beich (to reduce costs and improve manufacturability), ignoring Beich's diameter-to-thickness ratio rule." *Id.* at *5. However, in the *Corephotonics Appeal* "the L11/L1e ratio that is at issue is solely about the *first* lens element (L1), not the fifth lens element (L5)." *Id.* Here, on the other hand, Patent Owner asserts the same lens to which the center-to-edge thickness ratio rule is being applied is the one that violates the lens tolerance rule at issue in this IPR.

Additionally, the *Corephotonics Appeal* also found that "Nothing in Ogino or Beich 'criticize[s], discredit[s], or otherwise discourage[s]

investigation into, so as to teach away from, selecting the center-to-edge thickness ratio rule of thumb for L1 without modifying other lens elements.'" *Id.* Here, teaching away was not raised or argued but a tolerance directed at the same lens and dimension at issue could be argued to teach away for the modification to Chen.

Finally, in the *Corephotonics Appeal* the Court found patent owner had not shown a "blanket assertion that any willingness to incur higher costs or reduced manufacturability . . . would have undermined (rather than enhanced) the motivation to save costs or improve manufacturability in other ways, such as by following Beich's rule of thumb for the center-to-edge thickness ratio." *Id.* at *6. Here we acknowledge that manufacturability can be a tradeoff but base our decision on the fact that the rule relied on by Patent Owner in this case is closely tied to the rule Petitioner cites for its motivation to modify Chen.

Based on the complete record, Petitioner has not demonstrated sufficiently that the combination of Chen, Iwasaki, and Beich teaches the limitations of claims 16 and 30. As discussed above, we have reviewed Petitioner's explanations and supporting evidence regarding these claims, and we do not find them persuasive in accordance with our above findings. *See* Pet. 61–82. Petitioner, therefore, has not demonstrated by a preponderance of the evidence that the combined teachings of Chen, Iwasaki, and Beich would have rendered claims 16 and 30 obvious.

IV. CONCLUSION

For the foregoing reasons, we determine Petitioner has established by a preponderance of the evidence the unpatentability of claims 1, 2, 4–6 and 9–15, 17, 18, 20–23, 25–29 of the '897 patent and Petitioner has not

established by a preponderance of the evidence the unpatentability of claims 3, 8, 16, 19, 24, 30 of the '897 patent.[13]

In summary:

Claims	**35 U.S.C. §**	**Reference(s)/ Basis**	**Claim(s) Shown Unpatentable**	**Claim(s) Not Shown Unpatentable**
1, 4, 9–15, 17, 20, 25–29	102(a)	Ogino	1, 4, 9–15, 17, 20, 25–29	
2, 5, 6, 18, 21–23	103(a)	Ogino, Bareau	2, 5, 6, 18, 21–23	
3, 8, 19, 24	103(a)	Ogino, Bareau, Kingslake		3, 8, 19, 24
16, 30	103(a)	Chen, Iwasaki, Beich		16, 30
Overall Outcome			1, 2, 4–6, 9–15, 17, 18, 20–23, 25–29	3, 8, 16, 19, 24, 30

V. ORDER

Accordingly, it is

ORDERED that claims 1, 2, 4–6, 9–15, 17, 18, 20–23, and 25–29 of U.S. Patent No. 10,330,897 B2 are unpatentable and claims 3, 8, 16, 19, 24, and 30 of U.S. Patent No. 10,330,897 B2 are not unpatentable;

[13] 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).

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

FOR PETITIONER:

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