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Paper 54
Entered: January 24, 2024

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

MOTOROLA MOBILITY LLC,
Petitioner,

v.

LARGAN PRECISION CO., LTD.,
Patent Owner.

IPR2022-01210
Patent 9,969,519 B1

Before JON M. JURGOVAN, NORMAN H. BEAMER, and NABEEL U. KHAN, *Administrative Patent Judges.*

JURGOVAN, *Administrative Patent Judge*.

DECISION
Final Written Decision
Determining No Challenged Claims Unpatentable
35 U.S.C. § 318(a)
Dismissing Patent Owner's Motion to Amend and Revised Motion to Amend
35 U.S.C. § 316(d)
Dismissing Patent Owner's Motion to Exclude
37 C.F.R. 42.64(c)
Granting Patent Owner's Motion to Seal
37 C.F.R. §§ 42.14, 42.54

I. INTRODUCTION

A. Background and Summary

Motorola Mobility LLC ("Petitioner") filed a Petition (Paper 2, "Pet.") requesting an *inter partes* review of all claims 1–27 ("the challenged claims") of U.S. Patent No. 9,696,519 B1 ("the '519 patent," Ex. 1001). Largan Precision Co. Ltd. ("Patent Owner") filed a Preliminary Response (Paper 6). Petitioner filed a Preliminary Reply (Paper 7) and Patent Owner filed a Preliminary Sur-Reply (Paper 8) addressing the issue of real parties-in-interest. After reviewing these submissions, we instituted *inter partes* review (Paper 10).

Following institution, Patent Owner filed a Response (Paper 18 (board and parties only), Paper 19 (public), "PO Resp."), Petitioner filed a Reply (Paper 27), and Patent Owner filed a Sur-Reply (Paper 38). Patent Owner also filed a contingent Motion to Amend (Paper 20, "MTA"), and Petitioner filed Petitioner filed an Opposition to the Motion to Amend (Paper 28, "Opp. to MTA"). We entered Preliminary Guidance (Paper 35, "Prelim. Guid.") for the contingent Motion to Amend.

Following the Preliminary Guidance, Patent Owner filed a contingent Revised Motion to Amend (Paper 37, "Revised MTA"). Petitioner filed an Opposition (Paper 40) to the Revised Motion to Amend, Patent Owner filed a Reply (Paper 43) to Petitioner's Opposition to the Revised Motion to Amend, and Petitioner filed a Sur-Reply (Paper 50) in Opposition to the Revised Motion to Amend.

Patent Owner filed a Motion to Exclude (Paper 45) portions of expert testimony in Exhibits 1003, 2038, and 1045. Petitioner filed an Opposition

(Paper 47) to the Motion to Exclude, and Patent Owner filed a Reply (Paper 49) to Petitioner's Opposition to the Motion to Exclude.

Patent Owner filed a Motion to Seal portions of its Patent Owner Response and Exhibit 2044. Paper 17.

Petitioner and Patent Owner requested oral argument (Papers 41, 42). A hearing was held on November 28, 2023 and the transcript (Paper 53, "Tr.") has been entered in the record.

We have jurisdiction under 35 U.S.C. § 6. This Final Written Decision is entered pursuant to 35 U.S.C. § 318(a). Having reviewed the complete trial record, we determine that Petitioner has not shown, by a preponderance of the evidence, that the challenged claims are unpatentable.

B. Related Matters

The parties identify the following pending matters as involving the '519 patent:

- *Largan Precision Co., Ltd. v. Motorola Mobility LLC*, Case No. 4:21-cv-09138 (N.D. Cal.).
- *Motorola Mobility LLC v. Largan Precision Co., Ltd.,* IPR2022-01022, regarding U.S. Pat. No. 8,514,499
- *Motorola Mobility LLC v. Largan Precision Co., Ltd.*, IPR2022-01023, regarding U.S. Pat. No. 8,310,767
- *Motorola Mobility LLC v. Largan Precision Co., Ltd.*, IPR2022-01156, regarding U.S. Pat. No. 9,784,948
- *Motorola Mobility LLC v. Largan Precision Co., Ltd.*, IPR2022-01170, regarding U.S. Pat. No. 10,209,487 (parent of U.S. Pat. No. 10,564,397)

- *Motorola Mobility LLC v. Largan Precision Co., Ltd.*, IPR2022-01172, regarding U.S. Pat. No. 10,564,397 (continuation of U.S. Pat. No. 10,209,487)
- U.S. Patent Application No. 17/511,732
- U.S. Patent No. 10,247,911
- U.S. Patent No. 10,705,316
- U.S. Patent No. 11,187,873

Pet. ix; Paper 3, 2; Paper 15, 1–2.

C. Real Parties-in-Interest

Petitioner identifies itself as the sole real party-in-interest, and notes that Motorola Mobility Holdings, LLC owns 100% of Petitioner's stock and is, indirectly, a wholly-owned subsidiary of Lenovo Group Limited. Pet. ix. Patent Owner identifies itself as the sole real party-in-interest. Paper 3, 2.

D. Overview of the '519 Patent (Ex. 1001)

The '519 patent, titled "Imaging Optical Lens Assembly, Image Capturing Apparatus and Electronic Device," relates to an imaging optical lens assembly having a total of five lens elements. Ex. 1001, code (54), code (57). As background, the '519 patent states that there is a trend in using "photographing modules" in various intelligent products, including mobile phones, tablet computers, optical recognition devices, rear view cameras, and other devices, and that there is an increasing demand for lens systems with high image quality and specifications. *Id.* at 1:19–30. The '519 patent further explains "there is a trend in the market towards miniaturized photographing modules featuring wide angles of view" that would be applicable to the mentioned devices. *Id.* at 1:31–36. The '519 patent further explains that conventional lens assemblies usually require lens

elements of large size to capture an image of a larger area, but this increases total track length of the assembly and makes it difficult to reduce the device's size. *Id.* at 1:36–42. Viewed conversely, the strict size requirement of the lens module limits its field of view. *Id.* at 1:42–44.

To address this need, the '519 patent describes an imaging optical lens assembly with five lens elements having specific characteristics and properties. *Id.* at 1:51–2:9. Figure 1A of the '519 patent, reproduced below, illustrates one embodiment of the '519 patent's optical lens assembly.

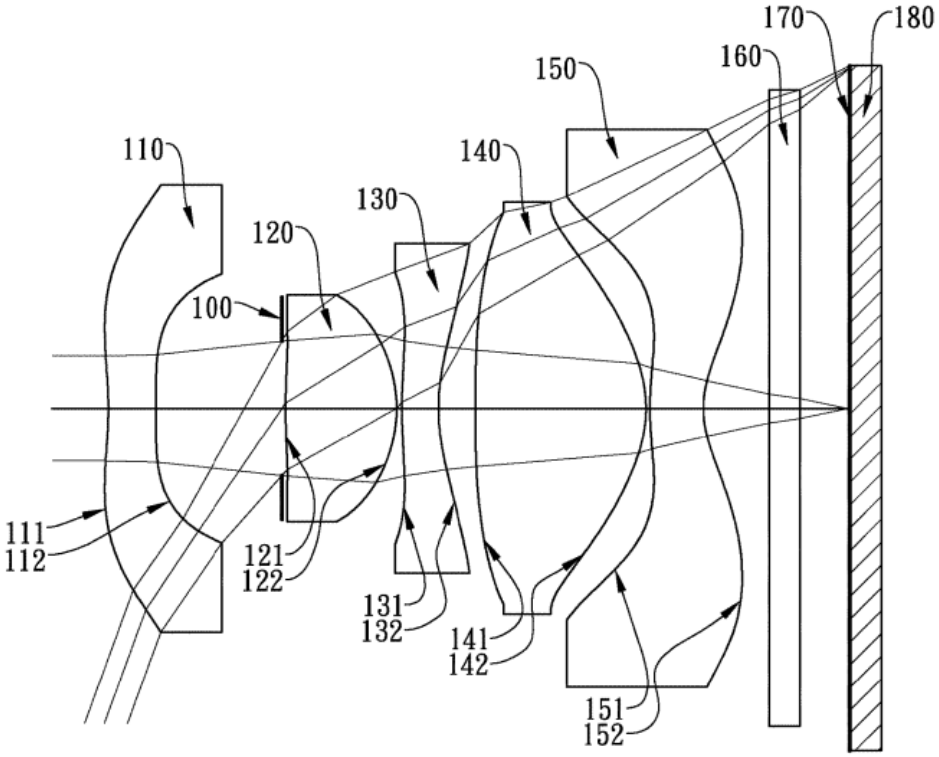

Fig. 1A

Figure 1A shows an image capturing apparatus. *Id.* at 8:27–29. The apparatus includes, from object side to image side, a first (110), second

(120), third (130), fourth (140), and fifth (150) lens elements with object side and image side surfaces. *Id.* at 8:33–39. The apparatus further comprises a stop 100 and an image sensor 180 where image plane 170 is located. *Id.*

The first lens element 110 has negative refractive power and an object-side surface 111 that is concave in a paraxial region thereof, and an image-side surface 112 that is concave in a paraxial region thereof, which are both aspheric. *Id.* at 8:40–43. At least one convex shape is in an off-axial region on the object-side surface 111. *Id.* at 8:43–46. The first lens element 111 is made of plastic material.

The second lens element 120 with positive refractive power with an object-side surface 121 that is convex in a paraxial region thereof and an image-side surface 122 that is convex in a paraxial region thereof, which are both aspheric. *Id.* at 8:47–50. The second lens element 120 is made of plastic material. *Id.* at 8:51.

The third lens element 130 has a negative refractive power and has an object-side surface 131 that is convex in a paraxial region thereof and an image-side surface 132 that is concave in a paraxial region thereof, which are both aspheric. *Id.* at 8:52–55. The third lens element 130 is made of plastic material. *Id.* at 8:55–56.

The fourth lens element 140 has a positive refractive power with an object-side surface 141 that is convex in a paraxial region thereof and an image-side surface 142 that is convex in a paraxial region. *Id.* at 8:57–60. The surfaces 141, 142 are both aspheric. *Id.* at 8:59. The fourth lens element 140 is made of plastic material. *Id.* at 8:60.

The fifth lens element 150 has a negative refractive power and has an object-side surface 151 that is convex in a paraxial region thereof and an image-side surface 152 that is concave in a paraxial region thereof. *Id.* at 8:61–64. Both surfaces 151 and 152 are aspheric, and the image-side surface 11 has at least one convex shape in an off-axial region. *Id.* at 8:64–66. The fifth lens element 150 is made of plastic material. *Id.* at 8:66–67.

The '519 patent also places certain conditions on the apparatus's elements. For example, claim 1 provides the following conditions:

$|R4/R3|<1.0$;

$f5/f3<1.0$;

$-10.0<R1/f<0$

where R1 is a curvature radius of the object-side surface of the first lens element, R3 is a curvature radius of an object-side surface of the second lens element, R4 is a curvature radius of an image-side surface of the second lens element, f is a focal length of the imaging optical lens assembly, $f3$ is a focal length of the third lens element, $f5$ is a focal length of the fifth lens element. *Id.* at 33:16–28, 1:63–2:9.

The '519 patent includes another embodiment (claim 14) with the following conditions.

$|R4/R3|<2.0$;

$f1/f3<2.0$;

$0.15<Yc11/Yc52<1.20$

where $f1$ is a focal length of the first lens element, Yc11 is a vertical distance between an off-axial critical point on the object-side surface of the first lens

element and an optical axis, Yc52 is a vertical distance between an off-axial critical point on the image-side surface of the fifth lens element and the optical axis. *Id.* at 34:49–65, 2:23–37.

The '519 patent includes a further embodiment (claim 23) with the following conditions:

$|R4/R3|<4.0$;

$f1/f3<5.0$.

Id. at 36:6–15, 2:54–63.

E. Illustrative Claim

Of the challenged claims, only claims 1, 14, and 23 are independent. Claim 1 is representative and is reproduced below with limitation identifiers in brackets corresponding to claim analysis headings in the Petition. *See, e.g.*, Pet. 23–31.

> [1.1] An imaging optical lens assembly, comprising, in order from an object side to an image side:
>
> [1.2] a first lens element with negative refractive power having an object-side surface being concave in a paraxial region thereof;
>
> [1.3] a second lens element having positive refractive power;
>
> [1.4] a third lens element having negative refractive power;
>
> [1.5] a fourth lens element having positive refractive power; and
>
> [1.6] a fifth lens element with negative refractive power having an image-side surface being concave in a paraxial region thereof, and at least one convex shape in an off-axial region on the image-side surface;
>
> [1.7] wherein the imaging optical lens assembly has a total of five lens elements;

> [1.8] and wherein a curvature radius of the object-side surface of the first lens element is Rl, a curvature radius of an object-side surface of the second lens element is R3, a curvature radius of an image-side surface of the second lens element is R4, a focal length of the imaging optical lens assembly is f, a focal length of the third lens element is f3, a focal length of the fifth lens element is f5, and the following conditions are satisfied:
>
> $|R4/R3|<1.0$;
>
> $f5/f3<1.0$;
>
> $-10.0<R1/f<0$.

Ex. 1001, 33:2–28.

F. Evidence

The Petition relies on the following references:

Reference	**Exhibit No.**
US 2015/0098137 Al; filed August 15, 2014; published April 9, 2015; ("Chung").	1004
US 2013/0182339 A1; filed January 9, 2013; published July 18, 2013; ("Sekine")	1005

Petitioner also relies on the Declarations of David Aikens (Ex. 1003; Ex. 1045; Ex. 2047; Ex. 1050) and Dr. Tom Milster (Ex. 2053) in support of its Petition. Patent Owner relies on the Declarations of Julie L. Bentley, Ph.D. (Ex. 2001; Ex. 2046) in support of its Response. The parties rely on other exhibits as noted below.

G. Asserted Grounds of Unpatentability

Petitioner asserts that the challenged claims would have been unpatentable on the following grounds:

Claim(s) Challenged	35 U.S.C. §[1]	Reference(s)/Basis
1–18, 20–27	103	Chung (Embodiment 11), Sekine
1–7, 9–27	103	Chung (Embodiment 12), Sekine

Pet. 2.

II. ANALYSIS OF ASSERTED GROUNDS

A. Principles of Law

Petitioner bears the burden of persuasion to prove unpatentability of the claims challenged in the Petition, and that burden never shifts to Patent Owner. *Dynamic Drinkware, LLC v. Nat'l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015).

A patent claim is unpatentable under 35 U.S.C. § 103(a) if the differences between the claimed subject matter and the prior art are such that the subject matter, as a whole, would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). The question of obviousness is resolved on the basis of underlying factual determinations including: (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of skill in the art; and (4) any objective evidence of obviousness or non-obviousness. *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).

[1] The Leahy-Smith America Invents Act ("AIA"), Pub. L. No. 112-29, 125 Stat. 284, 287–88 (2011), amended 35 U.S.C. §§ 102 and 103 and became effective March 16, 2013. Because the '519 patent was filed after this date, the AIA versions of 35 U.S.C. §§ 102 and 103 apply.

B. Level of Ordinary Skill in the Art

In determining the level of ordinary skill in the art, various factors may be considered, including the "type of problems encountered in the art; prior art solutions to those problems; rapidity with which innovations are made; sophistication of the technology; and educational level of active workers in the field." *In re GPAC Inc.*, 57 F.3d 1573, 1579 (Fed. Cir. 1995) (internal quotation marks and citation omitted).

Petitioner contends that a person of ordinary skill in the art ("POSITA") "would include someone who had . . . (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." Pet. 7. "Lack of work experience could have been offset by additional education, and vice versa." *Id.* In addition, Petitioner argues that a POSITA 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. *Id.*. According to Petitioner, a "POSITA would have understood the fundamentals of optical aberration theory, and understood and used standard techniques for making lenses cheaper and more effective, especially for lens systems used in mobile devices." *Id.*. In addition, Petitioner argues, "a POSITA would have known how to use lens design software such as Code V, Oslo, and ZEMAX, and would have taken a lens design course or had equivalent training." *Id.* at 7–8. "A POSITA would have regularly used such software to create new lens designs, including through optimizing pre-existing lens designs to reach a desired design." *Id.* at 8. Petitioner argues a "POSITA would have followed and regularly consulted books, articles, and

other publications by the Society of Photo-Optical Instrumentation Engineers ("SPIE")." *Id.* (citing Ex. 1003 ¶¶ 33–37). "The knowledge and skill of a POSITA is reflected in numerous prior art textbooks and publications discussed herein." *Id.* (citing Ex. 1003 ¶¶ 39–45).

Patent Owner's declarant, Dr. Bentley, testifies that "a [POSITA] around the time of the invention would have had a bachelor's degree in physics or optics, and at least three years of experience in the field of optical design, or its equivalent experience." Ex. 2001 ¶ 28.

For purposes of this Decision, we adopt Petitioner's proposed level of ordinary skill. We note, however, that the two proposed levels of ordinary skill are similar and our analysis and conclusions would not change under Patent Owner's proposed level of ordinary skill.

C. Claim Construction

We apply the same claim construction standard used in district court actions under 35 U.S.C. § 282(b), namely that articulated in *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005) (en banc). *See* 37 C.F.R. § 42.100(b) (2020).

In applying that standard, claim terms generally are given their ordinary and customary meaning as would have been understood by a POSITA at the time of the invention and in the context of the entire patent disclosure. *Phillips*, 415 F.3d at 1312–13. "In determining the meaning of the disputed claim limitation, we look principally to the intrinsic evidence of record, examining the claim language itself, the written description, and the prosecution history, if in evidence." *DePuy Spine, Inc. v. Medtronic Sofamor Danek, Inc.*, 469 F.3d 1005, 1014 (Fed. Cir. 2006) (citing *Phillips*, 415 F.3d at 1312–17). Only claim terms in controversy require express

construction, "and only to the extent necessary to resolve the controversy." *Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017); *see also Vivid Techs., Inc. v. Am. Sci. & Eng'g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999).

Petitioner does not propose a specific construction for any terms and instead argues that "no claim terms require specific construction to resolve the unpatentability issues presented" in their Petition. Pet. 12. Patent Owner also does not propose any specific constructions in their Response, nor does their declarant, Dr. Bentley.

We determine that no explicit constructions are required to resolve the dispute between the parties.

D. Obviousness over Chung Embodiment 11 and Sekine

Petitioner contends that claims 1–18 and 20–27 would have been obvious over Chung Embodiment 11 and Sekine. Pet. 13–71. Below we provide a brief overview of Chung Embodiment 11 and Sekine and then analyze Petitioner's contentions in light of Patent Owner's arguments.

1. Overview of Chung Embodiment 11

Chung is titled "Wide-Angle Image Taking Lens System," and it discloses several embodiments of five-lens systems satisfying various conditions. Ex. 1004, codes (54), (57). Chung's Embodiment 11 is depicted below in Figure 11A.

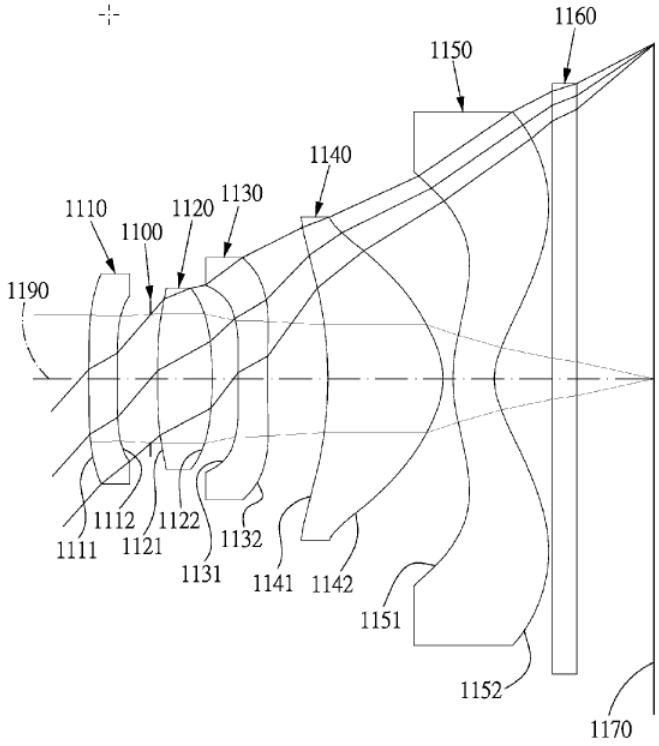

FIG.11A

Chung's Figure 11A shows, from object side to image side, first lens element 1110, second lens element 1120, third lens element 1130, fourth lens element 1140, fifth lens element 1150, an IR cut filter 1160, and an image plane 1170. *Id.* ¶ 179. Aperture stop 1100 is between the first and second lens elements. *Id.*

The first lens element 1110 with a negative refractive power has an object-side surface 1111 that is concave near the optical axis 1190 and an image-side surface 1112 that is convex near the optical axis 1190. *Id.* ¶ 180.

The second lens element 1120 with a positive refractive power has an object-side surface 1121 that is convex near optical axis 1190 and an image-side surface 1122 that is convex near the optical axis. *Id.* ¶ 181.

The third lens element 1130 with a negative refractive power has an object-side surface 1131 that is convex near the optical axis 1190 and an image-side surface 1132 that is concave near optical axis 1190. *Id.* ¶ 182.

The fourth lens element 1140 with a positive refractive power has an object-side surface 1141 that is concave near optical axis 1190 and an image-side surface 1142 that is convex near the optical axis 1190. *Id.* ¶ 183.

The fifth lens element 1150 has a negative refractive power and an object-side surface 1151 that is convex near the optical axis 1190 and an imade-side surface 1152 that is concave near the optical axis 1190. The fifth lens element 1150 has more than one inflection point formed on the surfaces 1151, 1152. *Id.* ¶ 184.

The first through fifth lens elements are made of plastic material, and all surfaces of the lens elements are aspheric. *Id.* ¶¶ 180–184.

Further properties and characteristics of Chung's Embodiment 11 are shown below in Table 21:

TABLE 21

(Embodiment 11)
f(focal length) = 2.574 mm, Fno = 2.4, HFOV = 47.97 deg.

Surface		Curvature Radius	Thickness	Material	index	Abbe #	Focal length
0	Object	Plane	Infinity				
1	Lens 1	−39.1130(ASP)	0.24	Plastic	1.515	57.0	−133.92
2		−90.6338(ASP)	0.29				
3	Aperture stop	Plane	0.06				
4	Lens 2	7.6644(ASP)	0.47	Plastic	1.544	56.5	3.97
5		−2.9441(ASP)	0.22				
6	Lens 3	90.0000(ASP)	0.25	Plastic	1.650	21.4	−12.55
7		7.4734(ASP)	0.52				
8	Lens 4	−2.8942(ASP)	0.98	Plastic	1.533	55.7	1.39
9		−0.6603(ASP)	0.09				
10	Lens 5	1.3075(ASP)	0.35	Plastic	1.650	21.4	−1.62
11		0.5204(ASP)	0.49				
12	IR-filter	Plane	0.21	Glass	1.517	64.2	
13		Plane	0.66				
14	Image	Plane					

For example, Table 1 above shows values for curvature radii of the lens elements' surfaces, focal lengths for the lens elements and overall system, lens material, refractive index, Abbe number, and half field of view (HFOV) for the system. *Id.* ¶ 186.

2. *Overview of Sekine*

Sekine is titled "Image Pickup Lens" and describes a wide-angle pickup lens having small F-value, high resolution, and small distortion. Ex. 1005, codes (54), (57). The image pickup lens has, in order from object side to image side, a first lens having a positive refractive power with a concave surface facing the object side; an aperture stop; a second lens having a negative refractive power with a concave surface facing the image side; a third lens having a positive refractive power; a fourth lens having a positive refractive power with a concave surface facing the object side; and a

fifth lens having a negative refractive power with a concave surface facing the image side. *Id.* ¶ 9.

Sekine sets forth various conditions to be satisfied in the design of its wide-angle pickup lens. These conditions include R3/R4 and R1/*f* criteria. *Id.* ¶¶ 11–14, 16–18, 49, 55, 61, 79, 85 (Tables 1, 2, 5, 6).

3. Combination of Chung Embodiment 11 and Sekine

We now address Petitioner's reasons for combining Chung with Sekine, and Patent Owner's arguments against the combination.

a) Petitioner's Contentions

Petitioner contends that a POSITA implementing Chung would have been motivated to incorporate Sekine's teachings on maintaining image quality at wider fields of view. Pet. 15–22. Specifically, Petitioner notes that the references have various similarities, including that both are directed to wide-angle systems that provide high-quality images, have small five-lens assemblies with aspheric plastic lenses, for use in mobile devices. *Id.* at 15–16 (citing Ex. 1004 ¶¶ 3, 5, 8, 201; Ex. 1005 ¶¶ 3–8, 53, 91, 94).

Petitioner contends that Chung and Sekine teach systems with a first lens having an object-side surface that is concave in the paraxial region. *Id.* at 16 (citing Ex. 1004 ¶¶ 180, 190; Ex. 1005 ¶ 10). Chung explains that its first lens causes aberrations to be corrected with the second lens. *Id.* (citing Ex. 1004 ¶¶ 15, 32). According to Petitioner, Sekine explains how to correct aberrations with its second lens, and further teaches reducing aberrations by balancing the concavity of the first lens against the system focal length, i.e.,

R1/f.[2] *Id.* (citing Ex. 1005 ¶¶ 13, 18). Petitioner contends that Chung and Sekine thus complement each other. *Id.* (citing Ex. 1003 ¶¶ 104–105).

Petitioner contends that Chung and other references recognize the need for high image quality at wide angles (i.e., higher FOV). *Id.* (citing Ex. 1004 ¶¶ 3, 5, 7; Ex. 1019, 20; Ex. 1007 ¶¶ 55, 63; Ex. 1003 ¶ 106). Chung identifies the popularity of self-portraits or "selfies" as a reason for increased demand. *Id.* (citing Ex. 1004 ¶ 5). Petitioner contends that "[o]ther background prior art publications reflect the known benefits of lenses with wider angles—including for cell-phone selfies and video chart applications—thus confirming that a POSITA would have been motivated to implement the Chung designs at the higher end of the disclosed FOV, i.e., FOV=115 degrees." *Id.* at 17 (citing Ex. 1008, 5–6 (noting that wider angle lenses "capture more people and background than a regular narrow angle module" and that "benefits include additional background information," then providing examples of selfie and video as areas where wide angle lenses provide these benefits); Ex. 1003 ¶ 106).

Petitioner contends that Chung gives a preferred FOV of "86<FOV<115." *Id.* (citing Ex. 1004 ¶¶ 20, 33; Ex. 1003 ¶ 106). Petitioner argues that, given the demands for camera systems with a higher FOV, a POSITA would have been motivated to push Chung's embodiments to its higher end FOV of 115 degrees, and would have sought out teachings on maintaining image quality while increasing FOV. *Id.*

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[2] The papers and exhibits in the record variously refer to this ratio using different combinations of capital and small case letters and italics. We refer to this ratio consistently in the remainder of this decision as "R1/f."

Petitioner contends that "[i]n doing so, a POSITA would have naturally encountered Sekine, which teaches improving image quality at wide viewing angles." *Id.* (citing Ex. 1005 ¶¶ 3–8, 13–14, 49; Ex. 1003 ¶ 107). Petitioner argues that Sekine reinforces the importance of wider angles, and explains how to reduce aberrations in wide-angle systems using the ratio "R1/f" which is the ratio of curvature of the "curvature radius of the object side surface of first lens" to the "focal length of overall optical system." *Id.* (citing Ex. 1005 ¶¶ 6–13, 49). Petitioner contends that a POSITA would have been motivated to apply Sekine's teachings on R1/f to Chung Embodiment 11, in order to reduce aberrations. *Id.* at 17–18 (citing Ex. 1003 ¶ 107).

Petitioner argues that "Sekine discloses that [R1/f] within $-70.0<[R1/f]<0$ allows for a wide angle while maintaining image quality." *Id.* at 18 (citing Ex. 1005 ¶¶ 11–13). Petitioner contends that Sekine gives an upper limit of zero because otherwise "the object side of the first lens becomes a convex surface, so that it is disadvantageous in widening of the angle." *Id.* Petitioner asserts that "Sekine correlates a lower (i.e., more negative) [R1/f] with a wider angle—but warns that going too negative causes aberrations." *Id.* (citing Ex. 1005 ¶ 13 ("if the [R1/f] value is below the lower limit [-70.0], it is advantageous in widening of the angle, however, the chromatic aberration at high image height deteriorates"); Ex. 1003 ¶ 108). Petitioner contends "a POSITA would have thus understood that Sekine describes a tradeoff with [R1/f]: a value closer to -70.0 widens the angle but undesirably affects aberrations, compared to an [R1/f] closer to zero." *Id.* Petitioner contends that a POSITA would know that a very small R1/f of -0.1 or -0.2 would result in a first lens that was too fast to be used

with a wide field. *Id.* (citing Ex. 1003 ¶ 108; Ex. 1010, 402). According to Petitioner, Sekine explains that an upper limit of -3.0 such that -70<R1/f<-3.0 would permit shortening the total track length of the system. *Id.* (citing Ex. 1005 ¶ 15). Petitioner contends a POSITA would have been motivated to start with an R1/f at or near -3.0, and then reduce that value if possible to balance between aberration correction with shorter track length. *Id.* at 18–19 (citing Ex. 1003 ¶ 108).

Petitioner contends that a "POSITA would have appreciated that two simple design techniques were available for reaching R1/f near -3.0: (1) set the radius of curvature to a smaller value; or (2) bend the lens so its R1 nears -3*f. *Id.* at 19 (citing Ex. 1010, 50 ("useful to first vary only the curvatures"), 47 ("Bend an element. Change its shape but maintain its power."), 607 (bending definition); Ex. 1019, 1 ("The lens parameters available to the designer for change . . . include the radii of curvature of the surfaces."), 21, 80 ("One of the most powerful tools available to the lens designer is bending" (emphasis omitted)), 182; Ex. 1003 ¶ 109).

Petitioner contends "a POSITA would also be mindful of the need to minimize the power of the first lens while obtaining the wider field. *Id.* (citing Ex. 1003 ¶ 110). According to Petitioner, Smith explains that, in a wide-angle retrofocus system with a negative first lens and positive second lens, increasing the spacing between the negative and positive lenses improves performance by decreasing the required power of especially the front negative lens. *Id.* (citing Ex. 1010, 397 ("a large airspace will reduce the power of the components, especially of the front component"); Ex. 1003 ¶ 110). Petitioner contends that "increasing the field of view requires both decreasing the magnitude of [R1] while balancing this by increasing the

spacing between lenses 1 and 2." *Id.* Petitioner further asserts that a "POSITA would implement an [R1/f] ratio of -3 (as taught by Sekine), increase the spacing between lenses 1 and 2, and then reoptimize the lens with a wider field of view." *Id.* Petitioner contends, in order to recover the lost track length, the POSITA would perform routine optimizations to reduce the other lens spacings as needed to maintain total track length. *Id.* at 19–20. Petitioner then contends that a "POSITA would then turn to the lens design program to find the balance between these competing objectives—a short TTL, a wide field of view, and improved image quality—and optimize [R1/f] to an appropriate value." *Id.* at 20. In doing so, Petitioner contends that "a POSITA would have had a reasonable expectation of success in achieving an FOV of roughly 115 degrees for wide viewing angle, with an [R1/f] near -3 or below for reduced aberrations and better performance." *Id.* Petitioner contends that ZEMAX modeling confirms that "a POSITA would have had a reasonable expectation of success and required no undue experimentation in applying Sekine's teachings to optimize Chung Embodiment 11." *Id.* (citing Ex. 1003 ¶ 111).

b) Patent Owner's Contentions

Patent Owner argues that the similarities that Petitioner notes between Chung and Sekine (both are wide-angle systems with a first lens having an object-side surface that is concave in the paraxial region, which concavity can cause aberrations) "suggests at best that the two references are *analogous* art, not that a POSITA would have been motivated to combine them." PO Resp. 24–25 (emphasis Patent Owner's).

Patent Owner further argues that the evidence does not support a finding that a POSITA would have used Sekine to maintain Chung's image

quality while increasing field of view. *Id.* at 25–28. Specifically, in response to Petitioner's contention that a POSITA would have been motivated to push Chung's embodiments toward the higher end FOV of 115, Patent Owner argues that Chung already taught how to obtain an FOV of 115, discloses and claims the range 86<FOV<115, discusses the desirability of that range, and teaches three different ways to widen FOV. *Id.* (citing Ex. 1004, claims 8 and 18, ¶¶ 11, 18–20, 33). Patent Owner argues that a "fourth way would have been a superfluity that a POSITA would not have sought." *Id.* (citing *In re NTP*, 654 F.3d 1279, 1298–99 (Fed. Cir. 2011) (improper hindsight demonstrated by choice to add a feature that would render existing feature superfluous); Ex. 2046 ¶ 30).

Patent Owner next argues that Chung criticizes Sekine's disclosed FOVs as too small. *Id.* at 25. Patent Owner asserts that Sekine's six embodiments range from 72.02° to 85.66°. *See* Ex. 1005 ¶ 92. Patent Owner argues that "Chung expressly criticizes prior art lens systems 'with a maximal field of view (FOV) that is smaller than 85 degrees' as presenting 'problems' that '[t]he present invention has been made to solve.'" PO Resp. 26 (citing Ex. 1004 ¶¶ 5–6). Patent Owner asserts that this would have dissuaded a POSITA from looking to Sekine if the motivation was to achieve FOV of 115. *Id.* (citing Ex. 2046 ¶ 31).

Patent Owner also argues that Sekine seeks to widen FOV but lacks any suggestion of achieving a FOV beyond the 85.66° ceiling disclosed in Sekine. *Id.* (citing § II.B.1). Patent Owner asserts that this stands in contrast to Chung, which teaches the desirability of a range that exceeds Sekine's embodiments, claims that range, and provides instruction in how to achieve widened FOV. *Id.*

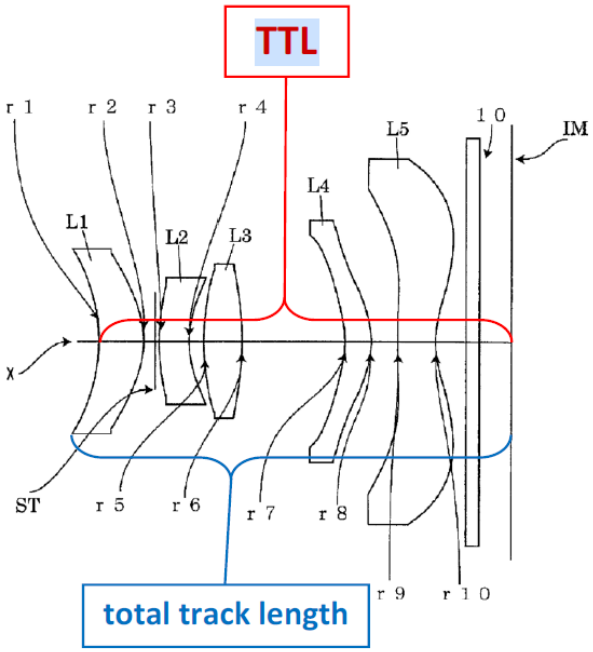
Patent Owner next argues that "Sekine does not actually teach any kind of predictable relationship between [Rr1/f] and FOV." *Id.* (citing § II.B.5). Patent Owner states that Sekine discusses manipulating R1/f between -70 and 0, but states that it is advantageous to widening the angle of view if the value is below the lower limit of -70. *Id.* (citing Ex. 1005 ¶ 13). Patent Owner argues that Sekine's teachings would have led a POSITA to make R1/f more negative, not less, to increase the FOV, and a POSITA would not have tried R1/f close to -3.0 but closer to -70.0 without going beyond that point where Sekine indicates that aberrations lie. *Id.* (citing Ex. 2046 ¶ 33). Patent Owner contends that while Mr. Aikens interprets Sekine as teaching "a value closer to -70.0 widens the angle," he implements an R1/f close to -3 in his optimized designs despite his alleged motivation of widening the angle, which is against Sekine's teaching. *Id.* at 27 (citing Ex. 1003 ¶ 108).

Patent Owner further argues that "Sekine's refinement of the [R1/f] range from -70<[R1/f]<0 to -70<[R1/f]<-3.0 is not for correcting aberration" but for "shortening the total (mechanical) track length by reducing the amount of space the object side surface requires." *Id.* (citing § II.B.4). Patent Owner asserts that Sekine teaches that "if the value is below the lower limit [of -70] . . . the chromatic aberration at high image heights deteriorates." *Id.* (citing Ex. 1005 ¶ 13). According to Patent Owner, Mr. Aikens noted that Chung's Embodiment 11 and Embodiment 12 already have R1/f values of -15.195 and -25.641, that are not beyond -70.0, and since Chung's image quality is acceptable, there is no need for further correction of aberrations. *Id.* (citing Ex. 2046 ¶ 34).

Patent Owner further argues that "there is no evidence that images from the combined Chung and Sekine systems would have been of a quality equal to or higher than those of either system standing alone." *Id.* at 28 (citing Ex. 2046 ¶ 35). According to Patent Owner, "Mr. Aikens testified emphatically that he did not evaluate any aberration data either before or after 'optimizing' Chung's [Embodiment 11] and [Embodiment 12], because he was not interested in achieving a finished product, only a preliminary design." *Id.* (citing Ex. 2040, 89:8–92:4, 208:14–210:3). Patent Owner asserts that "there is, in other words, no evidence to suggest that a POSITA would have been motivated to use Sekine to maintain or improve Chung's image quality." *Id.*

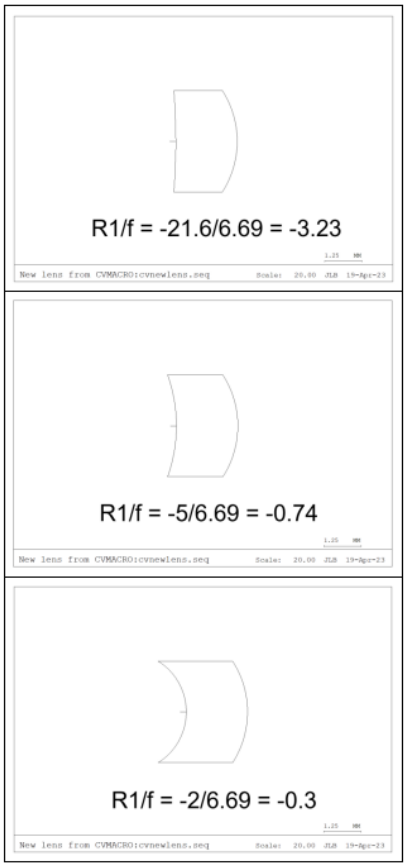
Patent Owner argues that the evidence does not support a finding that a POSITA would have used Sekine to correct aberrations or shorten track length that is found in Chung. *Id.* at 28–32. Patent Owner argues that Petitioner's expert testified that "a POSITA would have been motivated to apply Sekine's teachings on Rl/f to Chung Embodiment 11, in order to reduce aberrations" but there was "nothing to suggest that Chung was suffering from significant aberrations." *Id.* at 28–29 (citing § II.A.3; Ex. 1004, Figs. 1B–12B; Ex. 1003 ¶ 107). Patent Owner argues that the aberration diagrams in Chung show that the lenses are well corrected (which Mr. Aikens allegedly does not refute); that Chung teaches five ways to reduce aberrations (which Mr. Aikens allegedly ignored and did not try); and that a sixth way of reducing aberrations taken from Sekine would have been superfluous and not something a POSITA would have been motivated to do. *Id.* at 29 (citing Ex. 2046 ¶ 38; *In re NTP*, 654 F.3d at 1299).

According to Patent Owner, Mr. Aikens testified that "a POSITA would thus have been motivated to use an [R1/f] at or near -3.0 for a balance between aberration correction and shorter track length." *Id.* (citing Ex. 1003 ¶ 109). Patent Owner asserts that Sekine attempted to shorten the "total track length," not the "TTL," by reducing the amount of space required to house the object-side surface of the first lens. *Id.* (citing §II.B.4). Patent Owner presents the following figure to explain the difference between "total track length" and "TTL."



Id. at 19 (citing Ex. 1005 ¶ 57; Ex. 2046 ¶ 23). In the figure above, Patent Owner states that "TTL" is used in its traditional sense, i.e., to refer the distance on the optical axis X from the object side surface of the first lens Ll to the image plane IM," which is highlighted in red in the figure above. Patent Owner asserts that Sekine uses "total track length" to refer to the distance highlighted in blue in the figure above. *Id.* at 20. According to Patent Owner, Sekine shortens total track length in order to "decrease the

SAG amount" of r1 and "shortens the total track length, in the case of including the circumferential edge portion of an effective diameter of the first lens." *Id.* at 29. "SAG" is a measure of the length of a lens, as shown in the figure below. Ex. 2046 ¶¶ 39–40.



The above figure from Dr. Bentley's supplemental declaration (PO Resp. 31; Ex. 2046 ¶ 40) shows that as R1/f increases from -3.23 for the top lens, to -0.74 for the middle lens, and -0.3 for the bottom lens, the SAG increases due to extension of the circumferential edges of the lenses relative to their central points at which the object-side surfaces meet their optical axes. Thus, the higher the SAG, the greater the length and the space occupied by

the lens, and conversely, the lower the SAG, the lesser the length and space occupied by the lens.

Patent Owner argues that the Sekine teaches that if R1/f is below -3.0, then this shortens total track length. PO Resp. 29–30. However, Patent Owner argues, Chung has no need for this improvement because the circumferential region of its first lens bends away from the object. According to Patent Owner, a "POSITA would have had no reason to combine Sekine with Chung to obtain the SAG benefits Sekine describes" and "Sekine provides a solution for a problem that does not exist in Chung." *Id.* at 31 (citing Ex. 2046 ¶ 41).

Patent Owner further argues that "Sekine has a central TTL that is more than two times that of Chung," and that "POSITA would not have been inspired by Sekine's extremely long 10mm TTL if the goal was to shorten or maintain Chung's sub-5mm TTL." *Id.* at 32 (citing Ex. 2046 ¶ 42).

Patent Owner further argues that a POSITA would have considered Sekine for all that it discloses, including that a negative R1 on the concave object-side surface of the first lens makes it "possible to shorten the length from the first lens to the stop." *Id.* (citing § II.B.4; Ex. 1005 ¶ 10; *Henny Penny Corp. v. Frymaster LLC*, 938 F.3d 1324, 1332 (Fed. Cir. 2019)). According to Patent Owner, Mr. Aikens did the opposite and increased the distance T12 between the first and second lenses in his optimizations, and increased the power of the first lens element despite testifying that increasing the spacing between the negative and positive lenses improves performance by decreasing the required power of especially the front negative lens. *Id.* (citing Ex. 1003 ¶ 111; Ex. 2040, 136:2–16, 157:18–

158:8, 225:4–13; Ex. 2046 ¶ 43). Patent Owner asserts that the only explanation for Mr. Aikens's decisions is hindsight. *Id.*

Patent Owner further argues that Mr. Aikens's testimony is not proof of what a POSITA would have done, but merely what Mr. Aikens actually did, and that his explanations indicate hindsight bias. *Id.* at 33–37. Specifically, Patent Owner argues that "there is the clear divergence between Chung and Sekine, especially given the alleged motivations of widening Chung's FOV while maintaining image quality, and balancing aberration reduction with short TTL." *Id.* at 33. Compared to Sekine, Patent Owner asserts, "Chung has a much wider FOV, much shorter TTL, and a much faster f-number." *Id.* Patent Owner argues that there is "no rational explanation for using Sekine to widen Chung, other than the '519 patent's recitation of a negative [R1/f] value in each of its claims" which "can only be found in Sekine, which is why Mr. Aikens was focused on it." *Id.*

Patent Owner argues that Mr. Aikens' fixated "on narrow parts of both Chung and Sekine, to the exclusion of the other parts that would have discouraged a POSITA from pursuing the combination, such as Chung's criticism of Sekine's FOV range as too small and Sekine's TTL as too long." *Id.* Specifically, Patent Owner asserts that Mr. Aikens's "focused singularly on Chung's [Embodiment 11] and [Embodiment 12], and ignored Chung's teachings on widening FOV and correcting aberration." *Id.* (citing Ex. 2040, 46:25–48:21, 49:11–51:6, 52:25–53:15). Patent Owner argues that Mr. Aikens could only characterize his motivation to widen FOV to a value that Chung already disclosed as an "academic exercise." *Id.* at 33–34 (citing Ex. 2040, 79:3–23).

Patent Owner further criticizes Mr. Aikens's "odd choice" to increase the T12 distance between the first two lenses when Sekine contradicts this change. *Id.* at 34 (citing Ex. 1003 ¶ 111; Ex. 1005 ¶ 10). Patent Owner asserts that Sekine teaches to shorten the distance between the first lens and the stop on the object side of the second lens, but Mr. Aikens increased T12 without explanation other than hindsight. *Id.* (citing Ex. 2040, 146:6–147:7).

Patent Owner asserts that Mr. Aikens testified that he elected to increase the optical power for the first lenses in the Chung Embodiment 11 and Embodiment 12 optimizations. *Id.* According to Patent Owner, this conflicts with Mr. Aikens declaration concerning Smith's teaching to bend an element to change its shape but maintain its power. *Id.* at 34 n.9 (citing Ex. 1003 ¶ 135). In addition, Patent Owner notes that Mr. Aikens stated "increasing the spacing between the negative and positive lenses improves performance by decreasing the required power of especially the front negative lens." *Id.* at 35 (emphasis omitted); Ex. 1003 ¶ 111. Patent Owner argues that Mr. Aikens increased both T12 and the power of the first lens, and the only explanation is hindsight. PO Resp. 35.

Patent Owner further argues that Mr. Aikens used hindsight in his optimization of Chung Embodiment 12 resulting in R1/f of -2.56 when Sekine discourages a value between 0 and -3.0 as increasing the SAG thickness of R1, thus causing thickening at the circumferential edge of the first lens. *Id.* (citing Ex. 1003 ¶¶ 109, 233; Ex. 1005 ¶ 15).

Patent Owner also criticizes Mr. Aikens's terminating "both optimizations in the middle, once he reached a point where at least some of the rays converged at the image plane, without regard to the presence of

aberrations, or an unacceptably large f-number." *Id.* at 35–36 (citing Ex. 2040, 90:10–13, 90:22–91:22, 187:14–25, 202:20–203:7, 208:18–209:14, 229:3–230:8, 233:13–20). Patent Owner states that the f-numbers for these intermediate designs are 4.6 and 5.4, and Sekine criticizes prior art designs have f-numbers over 4.5 as "large" and "not suitable for obtaining bright image." *Id.* at 36 (citing Ex. 2038 ¶¶ 9, 10; Ex. 1005 ¶ 7). Patent Owner argues, "[w]ith the benefit of hindsight, it is easy to stop the optimization process at a point where the 'intermediate' 'preliminary' design meets the requirements of the [c]hallenged [c]laims, even if those designs feature f-numbers Sekine itself rejected as not 'a suitable option.'" *Id.* at 36–37 (citing *Intel Corp. v. Qualcomm Inc.*, 21 F.4th 784, 800 (Fed. Cir. 2021)).

Patent Owner argues that "both 'optimizations' perform substantially worse than Chung alone." *Id.* at 37. Patent Owner asserts that "[t]here is no conceivable reason why a POSITA would have been motivated to make Mr. Aikens' proposed optimizations, absent a hindsight desire to create a "non-final" design reading on the [c]hallenged [c]laims." *Id.* Patent Owner further argues that "these 'preliminary' designs cannot support a finding of obviousness as both are unsatisfactory for Chung's intended purpose." *Id.* (citing *In re Gordon*, 733 F.2d 900, 902 (Fed. Cir. 1984)).

c) Analysis

Dr. Bentley states that five-lens optical systems are defined by many different interdependent parameters, and the design of optical systems is highly complex. *Id.* ¶ 34. According to Dr. Bentley, the POSITA first obtains a set of specifications, for example, supplied by a customer, which are targets for the lens design process. These specifications include the

f-number, the maximum image height or the related parameter FOV (defined by the image sensor to be used), total track length (TTL) or maximum length of the opto-mechanical assembly, and performance metrics such as modulation transfer function (MTF) (to evaluate resolution), and distortion. *Id.* (citing Ex. 1029, 171).

Dr. Bentley explains that the f-number is set or selected to provide resolution matching the image sensor. *Id.* ¶ 35. A smaller f-number means the optical system is faster, and a larger f-number means the optical system is slower. *Id.* (citing Ex. 1012, 71). If the f-number is too high (i.e., too slow), then the resolution of the optical system is limited by the lens rather than the sensor, a circumstance which the designer seeks to avoid. *Id.*

To meet the specifications issued by the customer (e.g., f-number, FOV, total track length), the designer chooses parameters including the properties of the lens materials (index of refraction, Abbe number (dispersion)), the shape of the optical lenses, the thicknesses of the lens elements, the precise contours of the front (object-facing) and back (image-facing) surfaces of the lenses, the size and location of the aperture stop, and the air spaces between lenses. *Id.* ¶¶ 36–38 (citing Ex. 1029, 173). These parameters define the "prescription" of the optical system. *Id.* ¶ 38 (citing Ex. 1010, 87).

Dr. Bentley further explains that the parameters that can be varied during a computer-aided optimization of a lens system include the following:

(i) radius of curvature, r, for each lens surface;

(ii) conic coefficient, k, for each aspheric lens surface;

(iii) aspheric coefficients for each aspheric lens surface (typically at

least four coefficients per surface);

(iv) air spaces between each of these components, including the distance to the image sensor;

(v) thickness of each lens element;

(vi) refractive index for each lens element; and

(vii) Abbe number for each lens element.

Id. ¶ 39 (citing Ex. 1029, 173–174). Dr. Bentley notes that this leads to a nearly infinite variety of possible combinations of the lens parameters. *Id.* ¶ 40 (citing Ex. 1029, 178). Optimization software such as Code V, Oslo, and Zemax is used to manipulate these parameters to derive a prescription meeting the design specifications. *See, e.g.*, Pet. 7–8. The Petition similarly sets forth the lens design process and it accords with Dr. Bentley's description. *Id.* at 8–11.

Against this background, on the full record, we now consider Petitioner's reasons why a POSITA would combine Chung and Sekine. *Id.* at 15–22; Reply 2–17. Petitioner contends that Chung and Sekine are both small wide-angle lens systems that provide high-quality images with aspheric plastic lenses for use in a mobile device. Pet. 15–16 (citing Ex. 1004 ¶¶ 3, 5, 8, 201; Ex. 1005 ¶¶ 3–8, 53, 91, 94); Reply 2 (citing Ex. 1045 ¶¶ 4–5). Petitioner further argues that Chung and Sekine both have first lenses with an object-side concave in their paraxial regions. Pet. 16 (citing Ex. 1004 ¶¶ 180, 190; Ex. 1005 ¶ 10); Reply 2. Petitioner contends that these similarities were one factor that would have led a POSITA to combine Chung with Sekine. Reply 4–5.

Patent Owner argues that these alleged similarities at best establish that the two references are analogous, and that this is insufficient to establish

that one of ordinary skill in the art would have combined their teachings in the manner set forth in the claims. PO Resp. 24–25 (citing *Johns Manville Corp. v. Knauf Insulation, Inc.*, IPR2018-00827, Paper 9 at 10 (PTAB Oct. 16, 2018) (informative) (citing *Securus Techs., Inc. v. Global Tel*Link Corp.*, 701 F. App'x 971, 977 (Fed. Cir. 2017)). Patent Owner argues that it is not enough to show that "a skilled artisan, once presented with the two references, would have understood that they *could* be combined." *Personal Web Techs., LLC v. Apple, Inc.*, 848 F.3d 987, 993 (Fed. Cir. 2017) (emphasis altered). According to Patent Owner, "[n]either analogousness nor compatibility can alone supply the 'rational underpinning to support the legal conclusion of obviousness' that the law requires." PO Resp. 24–25 (citing *KSR*, 550 U.S. at 418).

Although Petitioner points to the similarities between Chung and Sekine as supporting the combination, there are significant differences in the systems as well, as Patent Owner explains. Pet. 15–16; PO Resp. 24–25; Reply 2–4; Sur-Reply 1–3. Chung Embodiment 11 and Embodiment 12 each have a negative first lens and a positive second lens. Ex. 2001 ¶¶ 79, 82–83. Conversely, Sekine has a positive first lens and negative second lens. *Id.* ¶ 79. Patent Owner states that Petitioner's expert in another case, Dr. Milster, testified that positive and negative lenses have the opposite effect, and that the use of a negative first lens instead of a positive first lens results in a considerably different system with considerably different performance. *Id.* ¶ 82 (citing Ex. 2053 ¶ 88). Patent Owner argues that, if Dr. Milster's testimony is true, then a POSITA would not have combined Chung Embodiment 11 or Chung Embodiment 12 with Sekine. *Id.* ¶ 83.

Petitioner does not sufficiently address in this proceeding that Chung Embodiment 11 and Embodiment 12 have negative first lens and positive second lens while Sekine has a positive first lens and a negative second lens, and how this would impact the Sekine teachings that Petitioner proposes to use in Chung. *See* Pet. 15–22. The differences in these systems' performance would have led a POSITA to doubt or at least question that Sekine's teachings would have been useful in Chung even considering their alleged similarities. In any case, Petitioner bears the burden of showing that Sekine's teachings are applicable to Chung's despite their different systems, which Petitioner did not show sufficiently on this record. *Dynamic Drinkware*, 800 F.3d at 1378.

While assuming that Sekine's teachings would apply to Chung despite their different systems, Petitioner contends that Chung has a first lens with a concave object-side surface R1 that generates aberrations and suggests correcting the aberrations with a second lens. Pet. 16 (citing Ex. 1004 ¶¶ 15, 32). Petitioner contends that Sekine teaches how to correct aberrations with a second lens by balancing the concavity of the first lens against the system focal length. *Id.* (citing Ex. 1005 ¶¶ 13, 18).

We agree with Patent Owner that there is insufficient evidence to support that a POSITA would consider Sekine's teachings to improve Chung's image quality, as Petitioner contends. PO Resp. 38 (citing Ex. 2046 ¶ 35); Pet. 15–19; Reply 2–17. Dr. Bentley explains that "Chung has a faster f-number, at 2.4, than Sekine's f-number of 3.0." Ex. 2046 ¶ 35 (citing Ex. 1004 ¶ 73; Ex. 1005 ¶ 92). According to Dr. Bentley, "Chung's faster system lets in more light and produces higher resolution images than Sekine's system." *Id.* Dr. Bentley further stated that she saw no evidence

that images from combined Chung and Sekine systems would have been of equal or higher quality than either system standing alone. *Id.* ¶ 36. She further testified that in her opinion a POSITA would not have used Sekine to correct aberrations or shorten the track length found in Chung. *Id.* ¶ 37. In addition, Dr. Bentley states that there was no evidence that Chung suffered from significant aberrations, that Chung shows that all lenses are well corrected, and that Mr. Aikens does not testify otherwise. *Id.* ¶ 38. Dr. Bentley further indicates that Chung teaches five ways to reduce aberrations, so a POSITA would not have looked to Sekine for yet another way to correct aberrations, particularly not one that would appear to produce inferior results. PO Resp. 29 (citing *In re NTP, Inc.*, 654 F.3d at 1299; Ex. 2046 ¶ 38). We agree with Patent Owner that a POSITA would not have been motivated to combine Chung with Sekine for the reasons that Dr. Bentley provides.

Sekine discloses a range of $-70<R1/f<0$ and states that it is a condition for correcting field curvature while seeking widening of the angle (FOV). Ex. 1005 ¶¶ 11–13. Patent Owner provides the following table to explain why a POSITA would not have recognized Sekine to be helpful in widening Chung's FOV:

	EM1	EM2	EM3	EM4	EM5	EM6
HFOV	38.09°	42.83°	39.04°	36.01°	36.49°	37.51°
FOV	76.18°	85.66°	78.08°	72.02°	72.98°	75.02°

PO Resp. 14 (citing Ex. 1005 ¶¶ 55, 61, 67, 73, 79, 85, 92); Ex. 2046, ¶ 18. The table above shows the HFOV and FOV (=2*HFOV[3]) for each of Sekine's six embodiments.

In its background, Chung criticizes various patents as having a FOV that is "smaller than 85 degrees," and states that "[t]he present invention [has] been made in order to solve the above-mentioned problems." Ex. 1004 ¶¶ 5–6. Only Sekine's second embodiment meets this criterion, and just barely, at 85.66 degrees (see "FOV" data for "EM2" in table above). The other Sekine embodiments have FOVs that are considerably below 85 degrees.

Furthermore, Chung discloses and claims (and thus regards as its invention) the range from 86<FOV<115. Ex. 1004, ¶¶ 20, 33, claim 8, claim 18. This range excludes all Sekine embodiments (i.e., the FOV values for all six of Sekine embodiments are below 86 degrees).

Dr. Bentley provides the following table derived from Chung's FOV data.

[3] "HFOV" means "half field of view." *See, e.g.*, Ex. 2001 ¶ 46.

Embodiment of Chung	Curvature of object side of first lens element	FOV
EM1	convex	103.4
EM2	convex	105.7
EM3	convex	99.9
EM4	convex	100.4
EM5	convex	106.7
EM6	convex	105.8
EM7	convex	108.5
EM8	convex	103.8
EM9	convex	106.9
EM10	convex	99.7
EM11	concave	95.9
EM12	concave	96.4

Ex. 2001 ¶ 85. The above table indicates Chung's twelve embodiments and the FOV associated with each embodiment. As shown in red, the smallest FOV is 95.9 for Chung Embodiment 11, and the next smallest FOV is 96.4 for Chung Embodiment 12, which are the only two Chung embodiments with a concave (negative) R1.

According to the Chung FOV data in the table above, a POSITA seeking to widen the FOV would not have selected Chung Embodiment 11 and Chung Embodiment 12, the two embodiments with the smallest FOVs, as starting points to design a wide FOV system. To the contrary, a POSITA would have selected the embodiment with the highest (or at least higher) FOV as the starting point, which would lead one to choose a first lens with an object-side surface R1 that is convex (positive), not concave (negative), as the above table shows. This is a strong indication that impermissible hindsight is being used in the proposed combination of Chung and Sekine.

In addition, as Patent Owner notes, Chung teaches three ways to increase FOV, to attain angles much wider than Sekine's. PO Resp. 25;

Ex. 1004 ¶¶ 11, 18, 19; Ex. 1005 ¶ 92. Thus, we disagree with Petitioner's contention that a POSITA would look to Sekine's R1/f teaching when the FOVs that Sekine obtains from that teaching are inferior to Chung's. Pet. 16–22; Reply 5–10.

Petitioner further relies on Sekine's teaching that a "better effect" can be obtained with an FOV in the range from -70.0<R1/f<-3.0 because the SAG amount on the object side of the first lens can be reduced, which permits shortening the total track length. Pet. 18–22; Reply 10–13; Ex. 1005 ¶¶ 14–15. Chung similarly has as its objective to shorten the total track length. Ex. 1004 ¶¶ 4–5. However, as Patent Owner noted, the first lenses of Chung's Embodiment 11 and Embodiment 12 are complex surfaces that have circumferential regions that bend away from the object. Ex. 1004, Figs. 11A, 12A. Accordingly, Sekine's teaching of how to reduce SAG amount of the first lens and total track length is inapplicable to Chung's Embodiment 11 and Embodiment 12, notwithstanding Petitioner's arguments to the contrary. Reply 13–14. As Patent Owner puts it, Sekine teaches a solution to a problem that does not exist in Chung. PO Resp. 32 (citing Ex. 2046 ¶ 41).

As discussed in Sections II.D.3.a and II.D.3.b, many of the parties' contentions relate to Mr. Aikens's optimizations (Ex. 1003 ¶¶ 112, 233) of the combination of Chung's Embodiment 11 or Embodiment 12 with Sekine. Pet. 19–22; Reply 11, 14–17; PO Resp. 3–4, 37–56; Sur-Reply 5–7, 12–14. Patent Owner and Petitioner have argued over the role that Mr. Aikens's optimizations should play in this proceeding, if any. Petitioner has not shown them to be "patents and publications" under 35 U.S.C. § 311(b), and they have not been shown to be prior art for, as Patent Owner

notes, they were created by Mr. Aikens many years after the priority date of the '519 patent. *See, e.g.*, PO Resp. 55. Petitioner initially relies on these optimizations as demonstrating a reasonable expectation of success for the proposed combination of Chung Embodiment 11 or Embodiment 12 with Sekine. *See, e.g.*, Pet. 20. Although Patent Owner argues in its Reply that these optimizations also provide motivation to apply Sekine's teachings to increase Chung's FOV, Petitioner seems to have retreated from this position. Reply 1–2; Tr. 16:21–17:13. In any event, the use of Mr. Aikens' optimizations to show motivation would amount to a new argument that was not in the Petition, and one that goes beyond the scope of a proper reply because it is not responsive to any argument Patent Owner raised in the Response and is not a fair extension of any previously raised argument in the Petition. 37 C.F.R. § 42.23(b); *Rembrandt Diagnostics, LP v. Alere, Inc.*, 76 F.4th 1376, 1385 (Fed. Cir. 2023) (reply argument not new if responsive to argument raised in response and is a fair extension of previously raised argument).

As we need only address the motivation to combine for the proposed combination to resolve this proceeding, we do not reach the separate issue of expectation of success. *Intelligent Bio-Systems, Inc. v. Illumina Cambridge Ltd.*, 821 F.3d 1359, 1365 (Fed. Cir. 2016) (discussing reasonable expectation of success as a separate requirement for a conclusion of obviousness); *Elekta Ltd. v. ZAP Surgical Systems, Inc.*, 81 F.4th 1368, 1375 (Fed. Cir. 2023) (similar). Thus, we do not consider Mr. Aikens's optimizations further in this decision, which were relied on in the Petition only for the purpose of showing a reasonable expectation of success.

Petitioner contends that Patent Owner's arguments attempt to distinguish the art based on unclaimed features such as image quality. Reply 1. We do not agree. Petitioner's stated motivation to combine was to improve image quality, and Patent Owner's arguments were responsive to this assertion. *See, e.g.*, Pet. 16; PO Resp. 38–50.

Petitioner further argues that Patent Owner ignores that lens design involves tradeoffs, for example, sacrificing image quality for a wider FOV. Reply 1–3, 14–15. Chung teaches, however, that its objectives are to increase FOV, reduce total track length, and increase image quality. Ex. 1004 ¶¶ 5–7. A proposed combination that sacrifices these objectives through tradeoffs is not what Chung contemplates.

Patent Owner further argues that Petitioner is considering Sekine's teachings selectively and is not considering other teachings such as the disclosed ranges for the ratios R1/R2 and the lenses' focal lengths compared to the system focal length. Sur-Reply 4–7 (quoting *Henny Penny Corp. v. Frymaster LLC*, 938 F.3d 1324, 1332 (Fed. Cir. 2019) ("the prior art must be considered for all its teachings, not selectively.")). We agree that Petitioner did not explain sufficiently why a POSITA would have isolated Sekine's R1/f teaching from the other Sekine teachings. Nor did Petitioner adequately explain how the proposed combination meets the other ranges, to the extent applicable, described in Sekine's other teachings.

On the full record, we determine that the Petition does not show by a preponderance of the evidence that a POSITA would have had reason to combine Sekine and Chung.

E. Obviousness over Chung Embodiment 12 and Sekine

Petitioner argues that claims 1–7 and 9–27 would have been obvious over Chung Embodiment 12 and Sekine. Pet. 71–125. Below we provide a brief overview of Chung Embodiment 12 and address the motivation to combine Chung Embodiment 12 with Sekine.

1. Chung Embodiment 12

Chung's Embodiment 12 is depicted below in Figure 12A.

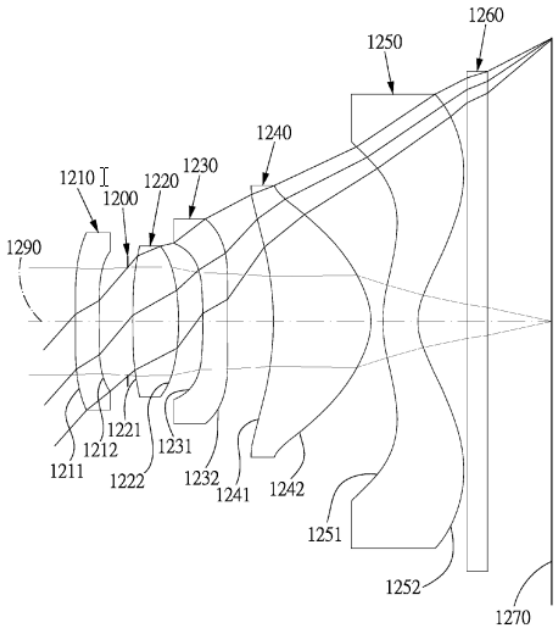


FIG.12A

Chung's Figure 12A shows, from object side to image side, first lens element 1210, second lens element 1220, third lens element 1230, fourth lens element 1240, fifth lens element 1250, an IR cut filter 1260, and an image plane 1270. Ex. 1004 ¶ 189. Aperture stop 1200 is between the first and second lens elements. *Id.*

The first lens element 1210 with a negative refractive power has an object-side surface 1211 that is concave near the optical axis 1290 and an image-side surface 1212 that is convex near the optical axis 1290. *Id.* ¶ 190.

The second lens element 1220 with a positive refractive power has an object-side surface 1221 that is convex near optical axis 1290 and an image-side surface 1222 that is convex near the optical axis. *Id.* ¶ 191.

The third lens element 1230 with a negative refractive power has an object-side surface 1231 that is concave near the optical axis 1290 and an image-side surface 1232 that is concave near optical axis 1190. *Id.* ¶ 192.

The fourth lens element 1240 with a positive refractive power has an object-side surface 1241 that is concave near optical axis 1290 and an image-side surface 1242 that is convex near the optical axis 1290. *Id.* ¶ 193.

The fifth lens element 1250 has a negative refractive power and an object-side surface 1251 that is convex near the optical axis 1290 and an image-side surface 1252 that is concave near the optical axis 1290. *Id.* ¶ 194. The fifth lens element 1250 has more than one inflection point formed on the surfaces 1251, 1252. *Id.*

The first through fifth lens elements are made of plastic material, and all surfaces of the lens elements are aspheric. *Id.* ¶¶ 190–194.

Further properties and characteristics of Chung's Embodiment 12 are shown below in Table 23:

TABLE 23

(Embodiment 12)
f(focal length) = 2.555 mm, Fno = 2.4, HFOV = 48.18 deg.

Surface		Curvature Radius	Thickness	Material	index	Abbe #	Focal length
0	Object	Plane	Infinity				
1	Lens 1	−65.5134(ASP)	0.24	Plastic	1.515	57.0	−491.75
2		−88.5093(ASP)	0.29				
3	Aperture stop	Plane	0.05				
4	Lens 2	8.9984(ASP)	0.46	Plastic	1.544	56.5	3.68
5		−2.5262(ASP)	0.25				
6	Lens 3	−9.6224(ASP)	0.25	Plastic	1.650	21.4	−8.94
7		14.8291(ASP)	0.46				
8	Lens 4	−2.7750(ASP)	0.99	Plastic	1.533	55.7	1.46
9		−0.6818(ASP)	0.12				
10	Lens 5	1.3228(ASP)	0.35	Plastic	1.650	21.4	−1.76
11		0.5481(ASP)	0.50				
12	IR-filter	Plane	0.21	Glass	1.517	64.2	
13		Plane	0.65				
14	Image	Plane					

For example, Table 23 above shows values for curvature radii of the lens elements' surfaces, focal lengths for the lens elements and overall system, lens material, refractive index, Abbe number, and half field of view (HFOV) for the system. *Id.* ¶ 196.

2. Combination of Chung Embodiment 12 and Sekine

Petitioner contends that a POSITA would have combined Chung Embodiment 12 and Sekine for the same reasons already discussed in Section III.D.3. Pet. 15–22. For the reasons explained in Section III.D.3.c, on the full record, we determine that the Petition does not show by a preponderance of the evidence that a POSITA would have had a reason to combine Sekine and Chung.

F. Motion to Amend and Revised Motion to Amend

As we determine that motivation to combine has not been shown by a preponderance of the evidence, we dismiss the Motion to Amend and Revised Motion to Amend pursuant to 35 U.S.C. § 316(d) because they were contingent upon our finding a claim of the '519 patent to be unpatentable. MTA 1; Revised MTA 1.

G. Motion to Exclude

Patent Owner filed a Motion to Exclude the portions of Mr. Aikens declaration testimony present in Exhibit 1003 and Exhibit 1045 relating to or arising from "lens design studies, simulations, or optimizations using Zemax lens design software, or otherwise rely[ing] on undisclosed facts and data." Paper 45, 1.

Because we do not rely on any of this evidence in this decision in a manner adverse to Patent Owner, we dismiss Patent Owner's Motion to Exclude.

H. Motion to Seal

Pursuant to 37 C.F.R. §§ 42.14 and 42.54, Patent Owner filed a Motion to Seal portions of Patent Owner's Response and Exhibit 2044.[4] Paper 17, 1. Patent Owner contends this paper and the exhibits contain sales data regarding lens product units sold and market share, and customer information, which constitutes confidential research development or commercial information. *Id.* at 3–4. Patent Owner asserts that good cause to seal exists because revealing this sensitive, competitive information could

[4] Patent Owner's reference to Exhibit 2037 appears to be an error because there is no exhibit in the record with that number.

put Patent Owner at a disadvantage in the marketplace. *Id.* Petitioner does not oppose Patent Owner's Motion to Seal.

After review, and based on Patent Owner's representations, we determine that the information sought to be sealed constitutes confidential research, development or commercial information, and that good cause has been shown to seal the identified portions of the paper and exhibits, and grant Patent Owner's Motion to Seal. 37 C.F.R. § 42.54. Patent Owner's Response (Paper 18) and the sealed version of Exhibit 2044 shall remain sealed and only the redacted versions thereof will be publicly available.

III. CONCLUSION

After consideration of the full record, the Petition does not demonstrate by a preponderance of the evidence that any claim of the '519 patent is unpatentable due to lack of a reason to combine the prior art references asserted in the challenge grounds.

IV. ORDER

For the foregoing reasons, it is

ORDERED that, pursuant to 35 U.S.C. § 318(a), claims 1–27 of the '519 patent have not been shown to be unpatentable; and

FURTHER ORDERED that Patent Owner's contingent Motion to Amend and Revised Motion to Amend are dismissed;

FURTHER ORDERED that Patent Owner's Motion to Exclude is dismissed; and

FURTHER ORDERED that Patent Owner's Motion to Seal is granted and Paper 18 and the sealed version of Exhibit 2044 shall remain sealed.

In summary:

Claim(s)	35 U.S.C. §	Reference(s)/Basis	Claim(s) Shown Unpatentable	Claim(s) Not shown Unpatentable
1–18, 20–27	103	Chung (Embodiment 11), Sekine		1–18, 20–27
1–7, 9–27	103	Chung (Embodiment 12), Sekine		1–7, 9–27
Overall Outcome				1–27

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