

Petition for *Inter Partes* Review of U.S. Patent No. 7,618,162 (IPR2025-00331)
Claims 1, 4-6, 8, 9, 31, 39, and 43

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SAMSUNG ELECTRONICS CO., LTD., AND
SAMSUNG ELECTRONICS AMERICA, INC.
Petitioner

v.

SINOTECHNIX LLC.
Patent Owner

Case No. IPR2025-00331
U.S. PATENT No. 7,618,162

PETITION FOR *INTER PARTES* REVIEW OF U.S. PATENT NO. 7,618,162

CHALLENGING CLAIMS 1, 4-6, 8, 9, 31, 39, and 43
UNDER 35 U.S.C. §312 AND 37 C.F.R. §42.104

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PETITIONER’S EXHIBIT LIST

Exhibit No.	DESCRIPTION
1001	U.S. Patent No. 7,618,162 (’162 Patent)
1002	Declaration of Dr. Tom Milster
1003	File History of U.S. Patent No. 7,618,162
1004	U.S. Patent No. 6,356,395 (“Tawa”)
1005	U.S. Patent No. 5,384,659 (“Shikama”)
1006	U.S. Patent No. 6,105,869 (“Scharf”)
1007	Robert D. Guenther, “Modern Optics,” John Wiley & Sons, Inc. (1990)
1008	The Royal Swedish Academy of Sciences. “The Nobel Prize in Physics 2014: Press Release.” October 7, 2014. https://www.nobelprize.org
1009	Parkyn, William A. and David G. Pelka. “Uniformly illuminating dual-lens system for LED collimation.” SPIE Optics + Photonics (2001).
1010	Reserved
1011	U.S. Patent No. 3,754,814 (“Leith”)
1012	U.S. Patent No. 4,655,539 (“Caufield”)
1013	Reserved
1014	U.S. Patent No. 5,600,487 (“Kiyomoto”)
1015	U.S. Patent No. 5,607,492 (“Doric”)
1016	U.S. Patent No. 5,924,788 (“Parkyn”)
1017	U.S. Patent No. 6,433,936 (“Carpenter”)
1018	U.S. Patent Publication No. 2004/0228131 (“Minano”)
1019	U.S. Patent Publication No. 2007/0109615 (“Wunderer”)
1020	Docket Control Order in <i>Sinotechnix LLC v. Samsung Electronics et al.</i> , 2:24-cv-544-JRG-RSP
1021	Judicial Caseload For Eastern District of Texas
1022	Judge Gilstrap’s Case Schedule (May 4, 2026)
1023	U.S. Patent No. 4,864,216
1024	Love, Clyde, <i>Differential and Integral Calculus</i> (sixth ed.). New York, MacMillan. (1916)
1025	Kingslake, R., & Johnson, R. B, “Lens Design Fundamentals,” Academic Press, (2009)
1026	LinkedIn page of William (“Bill”) A. Parkyn

Petition for *Inter Partes* Review of U.S. Patent No. 7,618,162 (IPR2025-00331)
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Exhibit No.	DESCRIPTION
1027	“InteLED Corp promotes Caterina Hall to CEO” at https://www.ledsmagazine.com/company-newsfeed/article/16682414/inteled-corp-promotes-caterina-hall-to-ceo
1028	RocketReach page of David Pelka

All annotations, coloring, and emphases have been added unless indicated otherwise.

I. Introduction

U.S. Patent No. 7,168,162 (“’162 Patent”) is directed to a lens that converts light having a nonuniform distribution of light (*e.g.*, brighter at the center of the light beam) into a beam that has a uniform distribution of light (*e.g.*, similar brightness throughout the beam). But such a lens was known long before the ’162 Patent. Petitioner respectfully requests cancellation of the challenged claims.

II. Mandatory Notices

A. Real Party-In-Interest (37 C.F.R. §42.8(b)(1))

Petitioner identifies itself as a real party-in-interest (“RPI”).

B. Related Matters (37 C.F.R. §42.8(b)(2))

The ’162 Patent is currently asserted against Petitioner by Patent Owner in *Sinotechnix LLC v. Samsung Electronics Co., Ltd. et al.*, No. 2:24-cv-00544 (EDTX) (“Litigation”). Petitioner has filed petitions for *inter partes* review of U.S. Patent Nos. 8,132,952 (IPR2025-00335), 7,748,873 (IPR2025-00333), 7,901,113 (IPR2025-00336) and will file petitions for *inter partes* review of U.S. Patent Nos. 7,951,626, and 9,412,913, each of which is being asserted against Petitioner in the Litigation.

C. Lead And Back-Up Counsel (37 C.F.R. §42.8(b)(3))

Petitioner is filing a Power of Attorney appointing the practitioners associated with Customer Number 132,593. Petitioner designates the following lead and back-up counsels:

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Please address all correspondence to counsels identified above and email Samsung-Sinotechnix-IPR@desmaraisllp.com. Petitioner consents to electronic service by email.

III. Fees

Petitioner is concurrently electronically submitting the required fees for this Petition. The Board is authorized to charge Desmarais LLP's deposit account, No. 50-6822, for any fee deficiency.

IV. Certification Of Grounds For Standing

Petitioner certifies that the '162 Patent is available for *inter partes* review and that Petitioner is not barred or estopped from requesting this *inter partes* review.

V. Identification Of Challenge And Relief Requested

Under 37 C.F.R. §§42.22(a)(1) and 42.104(b)(1)-(2), Petitioner requests cancellation of claims 1, 4-6, 8, 9, 31, 39, and 43 ("Challenged Claims") of the '162 Patent.

A. Identification Of Prior Art

The following references are pertinent to the grounds of unpatentability explained below:

1. U.S. Patent No. 6,356,395 (Tawa) (EX1004), issued on March 12, 2002, is prior art under 35 U.S.C. §102(b).¹

¹ The '162 Patent claims a priority date of November 12, 2004. This Petition applies the pre-AIA provisions of 35 U.S.C. §§102 and 103.

2. U.S. Patent No. 5,384,659 (Shikama) (EX1005), issued on January 24, 1995, is prior art under 35 U.S.C. §102(b).

3. U.S. Patent No. 6,105,869 (Scharf) (EX1006), issued on August 22, 2000, is prior art under 35 U.S.C. §102(b).

B. Statutory Grounds Of Unpatentability

Petitioner requests cancellation of claims 1, 4-6, 8, 9, 31, 39, and 43 of the '162 Patent under 35 U.S.C. §102 and §103 based on the following Grounds.

Ground	35 U.S.C.	Claims	Prior Art Reference(s)
I	§103	1, 4-6, 8, 31, 39, 43	Tawa, Shikama
II	§103	9	Tawa, Shikama, Scharf
III	§102	1, 4-6, 8, 31, 39, 43	Tawa
IV	§103	1, 4-6, 8, 31, 39, 43	Tawa
V	§103	9	Tawa, Scharf

This Petition demonstrates that there is a reasonable likelihood that Petitioner would prevail with respect to at least one of the challenged claims. *See* 35 U.S.C. §314(a).

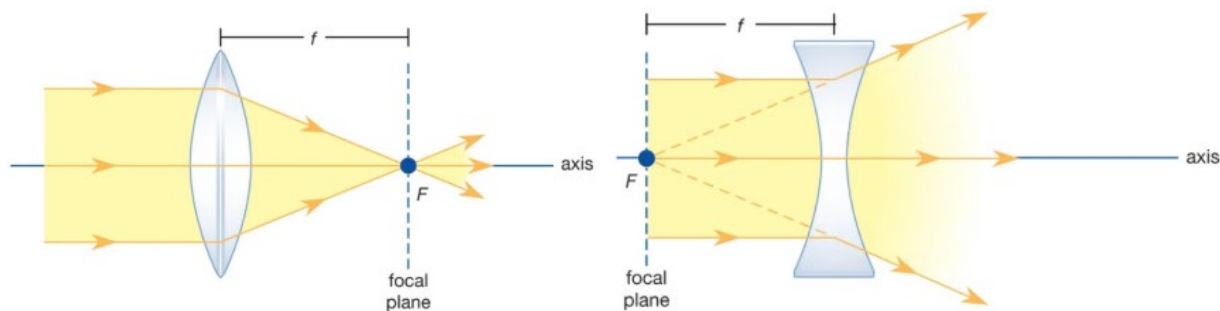
VI. Technology Background

A. General Overview

Light emitting diodes (LEDs) are “energy-efficient, environmentally-friendly light source[s],” (EX1008), that typically generate a beam of light that is brighter near the center. *See, e.g.*, EX1023, 2:55-58 (*e.g.*, “light output from the LEDs ... have a more or less Gaussian distribution.”). EX1002, ¶30.

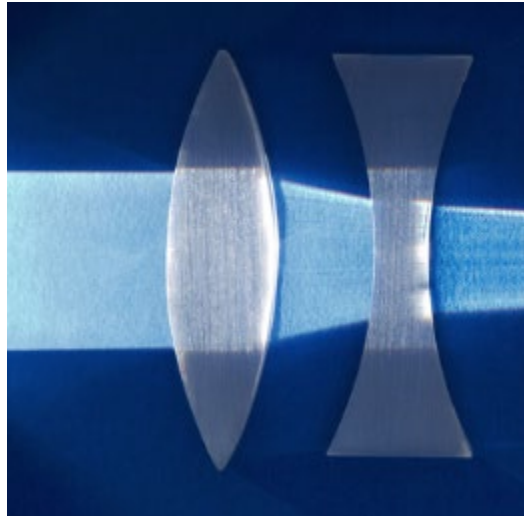
In many applications, uniformly illuminating the target area is desirable. EX1009, 237 (*e.g.*, explaining “an RGB collimating backlight ... requires tight control of beam uniformity”). As such, optical engineers often use lenses to convert the non-uniform light into a uniform light.² *See, e.g.*, EX1009, 232 (“We present ... lens that produces uniform illumination at its output plane.”). EX1002, ¶32.

Numerous different lens designs exist. For example, a convex-convex lens (left below) has two convex surfaces (as viewed from the left and right sides of the lens, respectively) and can converge the light rays. In contrast, a concave-concave lens (right below) has two concave surfaces (as viewed from the left and right sides of the lens, respectively) can diverge the light rays.



² In optics, the intensity of the light reaching a given area of the target surface is often called “flux density.” Unfortunately, “[t]he units used for the flux density are a confusing mess in optics”—sometimes called “irradiance” or “illuminance” depending on the specific branch of optics that the term originated from. *See* EX1007, 34. The ’162 Patent also uses these terms loosely. EX1002, ¶31.

Oftentimes, these lenses can be combined to form lenses where the light behaves in a manner that the optical designer desires, such as the array of convex-convex and concave-concave lenses shown below.



In some instances, these shapes can be collapsed into a single lens, such as a convex-concave lens below (*i.e.*, convex relative to the left side of the lens and concave relative to the right side of the lens).

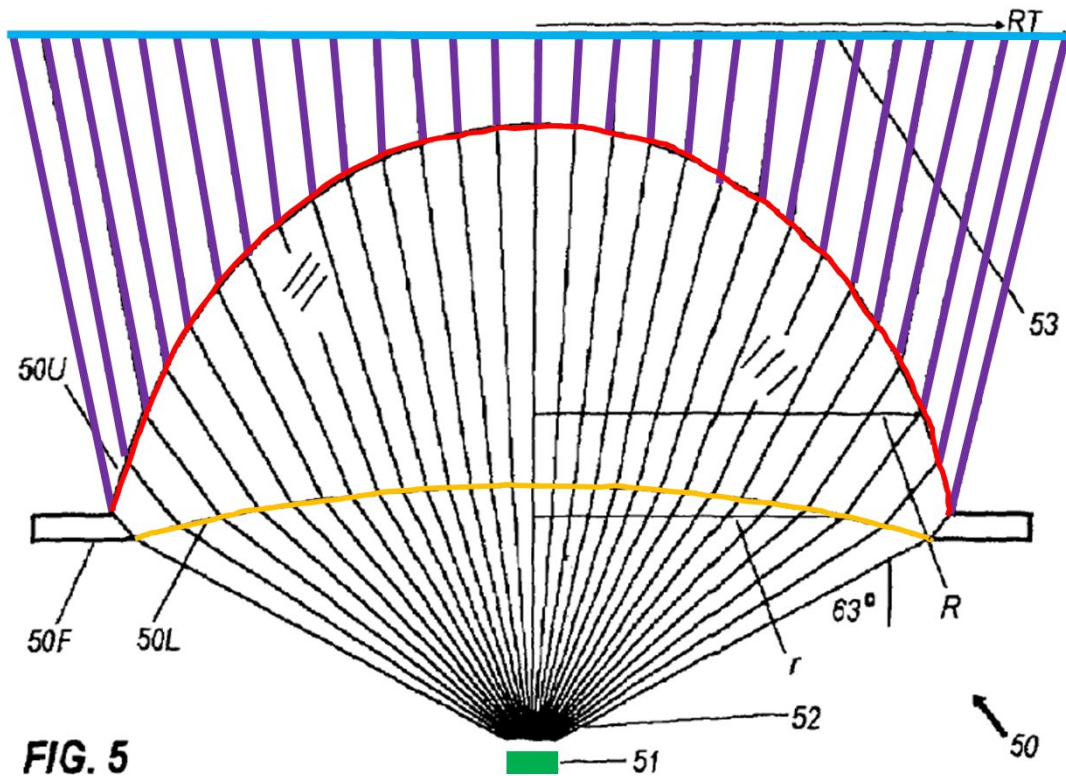


Many different lens shapes were available to optical engineers to produce a beam of light having desired characteristics. EX1002, ¶¶32-38.

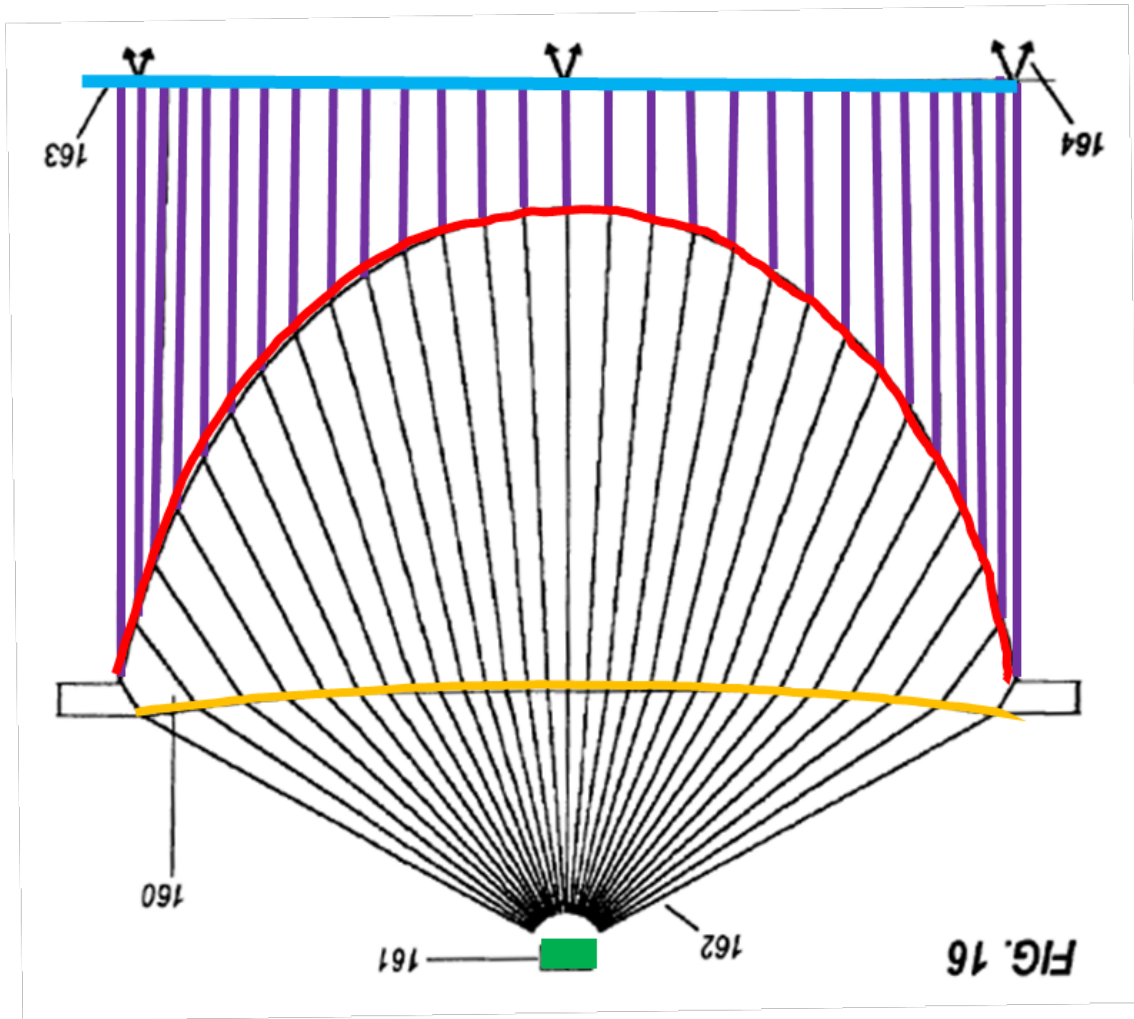
VII. Overview Of The '162 Patent

A. Purported Invention

The '162 Patent is directed to a lens that can uniformly illuminate a surface using a small light source, such as an LED. *See* EX1001, 1:52-54 (“The present invention relates generally to illumination lenses, especially for LEDs, that produce uniform output-irradiance from highly nonuniform inputs.”). As shown below in Figure 5, the lens has an **entry surface 50L** that receives light from **LED 51**, and an **exit surface 50U** through which the **light leaves** the lens onto a **target surface 53**. *See* EX1001, 3:60-64 (“Figure 5 shows a ... circularly symmetric illumination-redistribution lens formed of polycarbonate and comprising concave **lower surface 50L**, **upper exit-surface 50U**, and optically inactive flange 50F.”).



EX1001, Figure 5. Specifically, the **lower surface 50L** “refract[s light] in such a way that it has a uniform distribution by the time it has intercepted the **front surface.**” EX1001, 1:60-65. The rays are then “refractively deflected therefrom toward **radius RT on target surface 53**” to achieve a “uniform illuminance.” EX1001, 4:4-10. As shown below, “[o]ne preferred embodiment ... produces a very tightly **collimated beam** [*i.e.*, light rays that are parallel to each other] with uniform irradiance.” EX1001, 1:66-2:3.



EX1001, Figure 16. EX1002, ¶¶39-42.

B. Prosecution History Of The '162 Patent

The '162 Patent, filed on November 9, 2005, claims priority to a provisional application filed on November 12, 2004. *See* EX1001, Cover. EX1002, ¶43.

Claims 1-13 were rejected under 35 U.S.C §112 (as indefinite) and §103 over U.S. 5,607,492 (“Doric”) and U.S. 6,433,936 (“Carpenter”) (claims 1-3, 8), Doric, Carpenter and U.S. 3,754,814 (“Leith”) (claims 4-7), Doric, Carpenter and U.S.

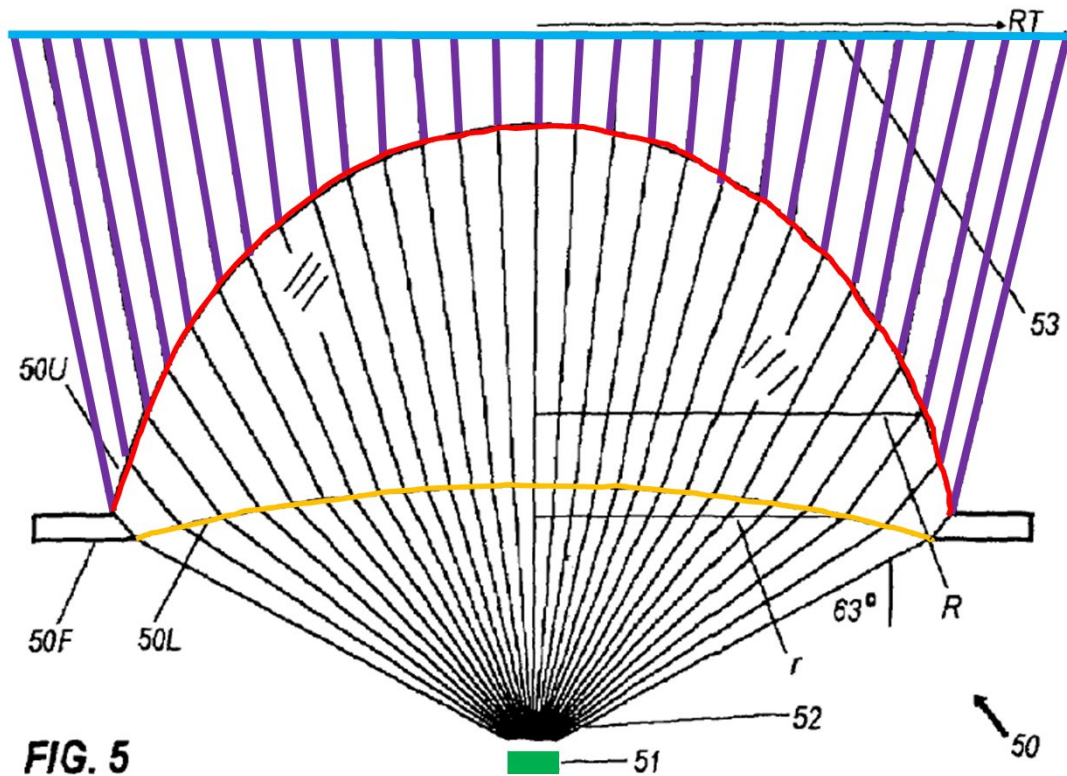
2007/0109615 (“Wunderer”) (claim 9), and Doric, Carpenter and U.S. 4,655,539 (“Caufield”) (claims 11-13). EX1003, 106-116. EX1002, ¶44.

After amendments and arguments, the claims were again rejected under 35 U.S.C §112 (as indefinite), §102, and §103 over U.S. 2004/0228131 (“Minano”), U.S. 5,924,788 (“Parkyn”), and U.S. 5,600,487 (“Kiyomoto”). EX1003, 146-151. EX1003, 142-152. EX1002, ¶¶45-47.

In Response, the Applicant amended the independent claims to recite:

said **entry surface** having first concavity facing toward said **light source**, and second concavity facing toward the **entry surface**, said second concavity being substantially greater than said first concavity.

EX1003, 169-170, 181-182. The amendments were accompanied by an explanation that “the **entry** and **exit** concave surfaces are ... **50L** and **50U** in Fig. 5, the **light source being at 51**.” EX1003, 186-187.



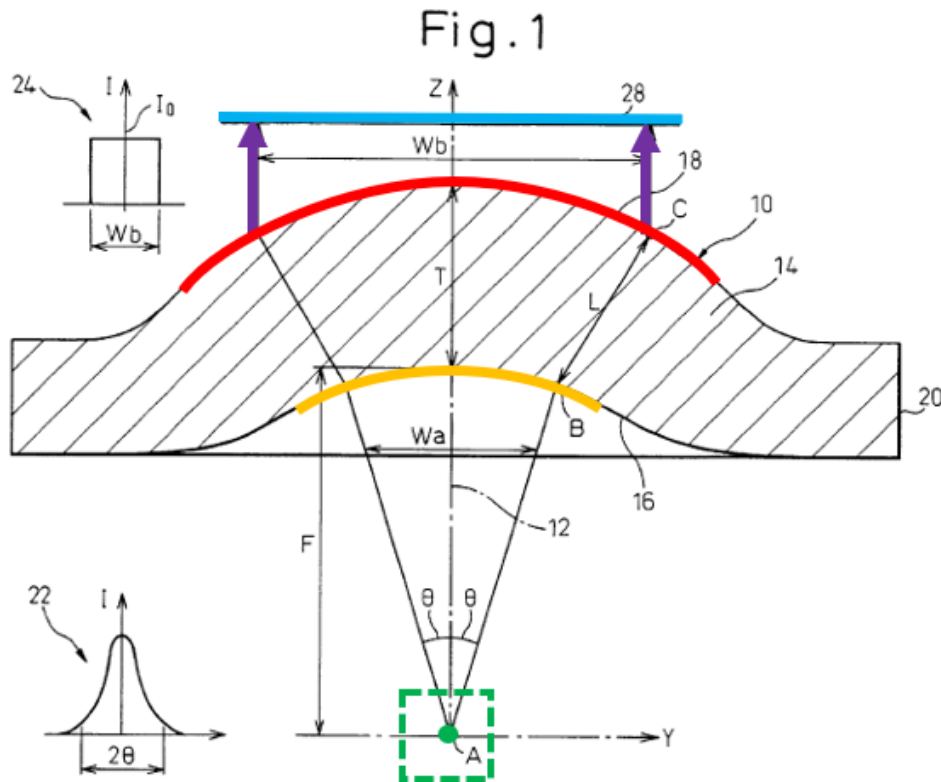
EX1003, 37. EX1002, ¶¶48-51.

VIII. Overview Of Tawa And Shikama

A. Tawa

Tawa is directed to a “light intensity distribution converting device” that “can be used as a collimator lens” to convert light having a nonuniform “Gaussian” intensity to light having a uniform intensity distribution. EX1004, 2:41-44 (“Using this light intensity distribution converting device, emerging light having a uniform intensity distribution can be obtained from incident light having a Gaussian intensity distribution.”), 7:6-14. EX1002, ¶¶56-57.

As shown below, the device has a “**first curved surface 16**” that receives the light from a **light source (point A)**, and a “**second curved surface 18**,” through which the light emerges. See EX1004, 3:66-4:2 (“In FIGS. 1 and 2, **point A** represents a **radiation point**, **point B** represents an incident point of light onto the **first curved surface 16**, and **point C** represents a light emerging on the **second curved surface 18**.”). “**Point A** can be, for example, a laser,” (EX1004, 4:9-12), or an LED. See EX1004, 10:33-37 (“[T]his lighting apparatus can be used when an LED array or the like is used ...”).

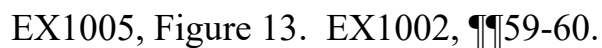


EX1004, Figure 1. The **first curved surface 16** receives light having a non-uniform

“Gaussian” light distribution (as shown in 22) from **point A**. See EX1004, 4:35-38 (“[D]iverging light having a Gaussian light intensity distribution 22 is made incident to the body 14 at the **first curved surface 16**, and passes through the body 14.”). “The light emerges the body 14 from the **second curved surface 18** as **parallel light** having a uniform light intensity distribution 24.” EX1004, 4:38-41. EX1002, ¶58.

B. Shikama

Shikama is also directed to a “lens.” EX1005, Title. As shown below, lens 143 has a **first surface S1** and **second surface S2** with a **flange 133**. See EX1005, 14:58-68 (“FIG. 13 shows the construction of a light source apparatus ..., wherein the reference numeral 131 is a condenser lens, 143 is a first plane face formed around the periphery of the effective diameter of the **first surface S1** of the condenser lens 131, 132 is a second plane face formed around the periphery of the **second surface S2** of the condenser lens 131, and **133 is a flange** ... formed integrally with the condenser lens 131.”), 15:22-24. “The **lamp 120** is mounted facing the **second surface S2** of the condenser lens 131” EX1005, 15:12-19.



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zone thereof.”), 17:3-4. “[T]he beam of light ... emerges as a **parallel beam of light 2.**” EX1005, 15:41-45. EX1002, ¶¶61-62.

IX. Level Of Ordinary Skill In The Art

“Factors that may be considered in determining level of ordinary skill in the art include: (1) the educational level of the inventor; (2) type of problems encountered in the art; (3) prior art solutions to those problems; (4) rapidity with which innovations are made; (5) sophistication of the technology; and (6) educational level of active workers in the field.” *Env’t Designs, Ltd. v. Union Oil Co. of California*, 713 F.2d 693, 696 (Fed. Cir. 1983). “Not all such factors may be present in every case, and one or more of these or other factors may predominate.” *Id.*

The ’162 Patent is directed to an “illumination-redistribution lens.” *See* EX1001, Title, Abstract. The prior art references considered during prosecution generally relate to lenses. *See* EX1001, Cover. The named inventors had at least a Bachelor of Science degree coupled with at least several years in the field of optics by November 12, 2004. *See* EX1026-EX1028. EX1002, ¶¶53.

Accordingly, a person of ordinary skill in the relevant field or art (“POSITA”) as of November 12, 2004, would have been someone with at least a bachelor’s degree in engineering (*e.g.*, optical engineering), physics, or a related field. Additionally, a POSITA would have had at least a minimum of two years of

experience in designing optical systems. Less work experience may be compensated by a higher level of education and vice versa. EX1002, ¶¶52-54.

X. Claim Construction

The claims should be construed “in accordance with the ordinary and customary meaning of such claims as understood by one of ordinary skill in the art and the prosecution history pertaining to the patent.” 37 C.F.R. §42.100(b); *see also Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005) (*en banc*). The Board “need[s] only construe terms ‘that are in controversy, 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). Petitioner submits no terms require construction for the purposes of this IPR.³ EX1002, ¶¶67-68.

³ Petitioner reserves all rights to raise claim construction arguments in other forums, including challenges under 35 U.S.C. §112 (*e.g.*, “predominantly,” “sufficiently compact,” “substantially greater,” and limitations [1i]-[1j]).

XI. Specific Grounds For Challenge

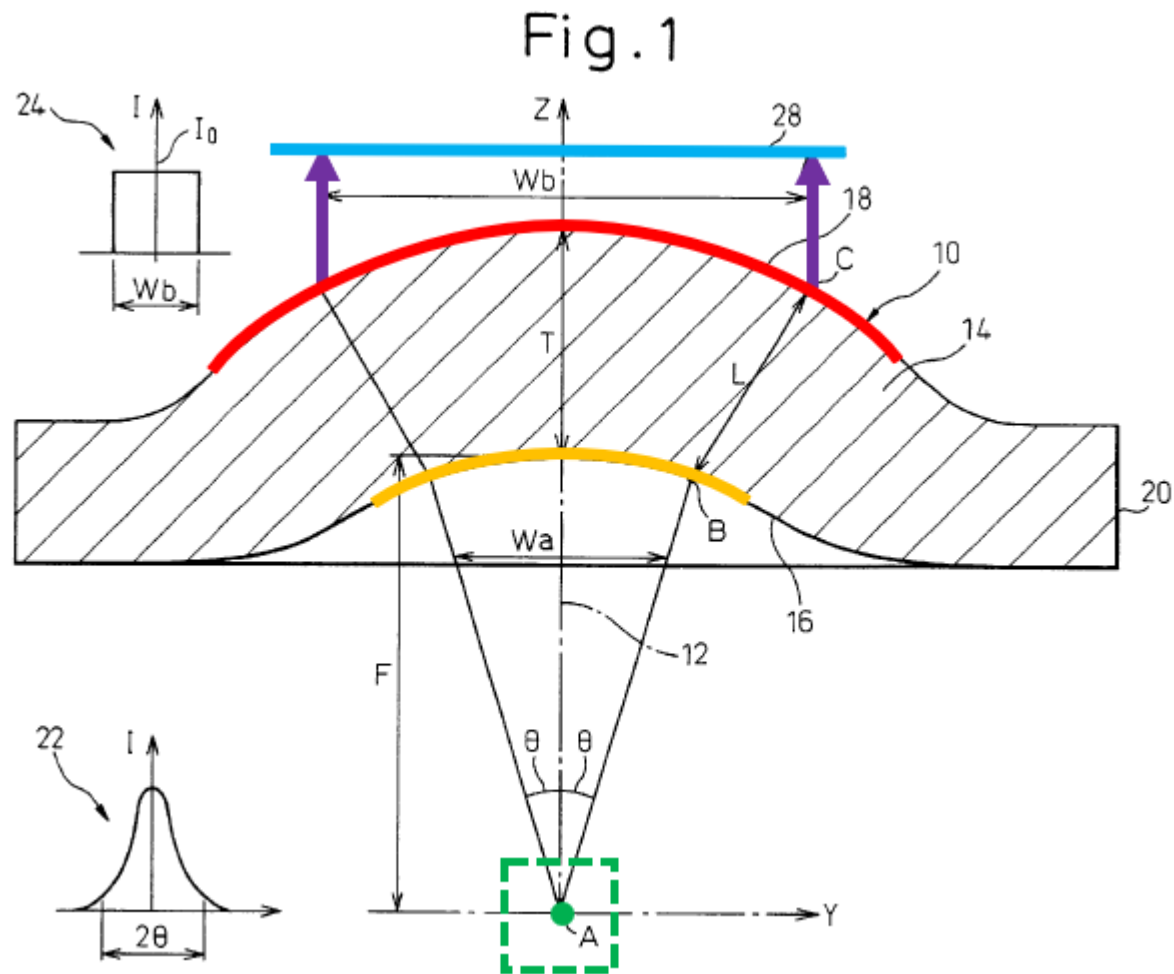
A. Ground I: Tawa In Combination With Shikama Renders Obvious Claims 1, 4-6, 8, 31, 39, And 43

1. Independent Claim 1

i. [1pre]: An irradiance-redistribution illumination lens⁴ comprising

Tawa teaches [1pre]. Tawa teaches a “**lens.**” For example, Figure 1 of Tawa, shows a “**light intensity distribution converting device 10** [that] not only converts the light intensity distribution at the point A, but also serves as a collimator **lens.**” EX1004, 4:47-50; *see also id.*, 3:55-58 (describing that the “device 10 comprises a transparent body 14 ... made of a transparent material, such as glass, having an isotropic refractive index).

⁴ During prosecution, Applicant noted that “[i]lluminating a target is the function of an illumination lens...” EX1003, 134-137.



EX1004, Figure 1. EX1002, ¶¶67-68.

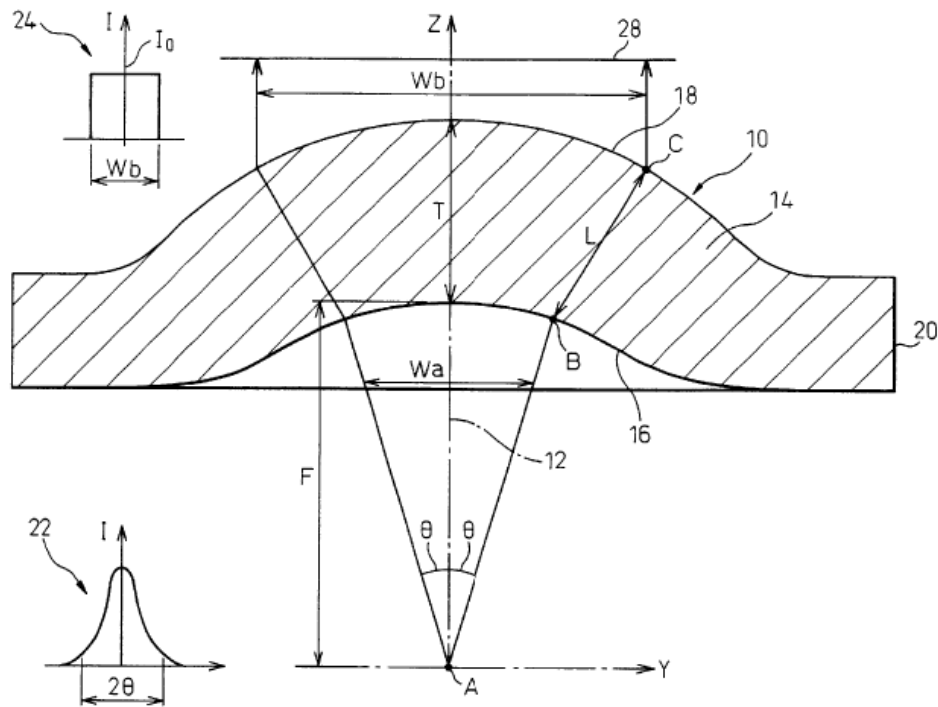
Tawa teaches “**irradiance-redistribution [for] illumination**” because device 10 receives non-uniform light (as shown in light intensity distribution 22) from a **light source (at point A)**, redistributes the light using a **first curved surface 16** towards a **second curved surface 18**, to **output a light beam** of uniform illumination (as shown in the light intensity distribution 24) on **surface 28**. See EX1004, 3:66-4:2 (“In FIGS. 1 and 2, **point A** represents a **radiation point**, point

B represents an incident point of light onto the **first curved surface 16**, and point C represents a light emerging point on the **second curved surface 18**.”), 4:20-22 (“The **first curved surface 16** is defined by a generally shallow rounded concave surface and the **second curved surface 18** is defined by a generally rounded convex surface.”), 4:38-47 (“The **light emerges** the body 14 from the **second curved surface 18** as parallel light having a uniform light intensity distribution 24.”). Indeed, the ’162 Patent notes that “such a configuration, of **redistributive lower surface** and **beam-forming convex upper surface**, encompasses all preferred embodiments of the present invention.” EX1001, 3:50-53. EX1002, ¶¶69-70.

ii. [1a] a transparent dielectric solid of revolution with external surface area predominantly comprised of

Tawa teaches [1a]. Tawa teaches a “*transparent dielectric*.” See EX1004, 3:55-58 (“In FIGS. 1 and 2, the light intensity distribution converting device 10 comprises a transparent body 14 having a central axis 12. The body 14 is *made of a transparent material, such as glass....*”).

Fig. 1

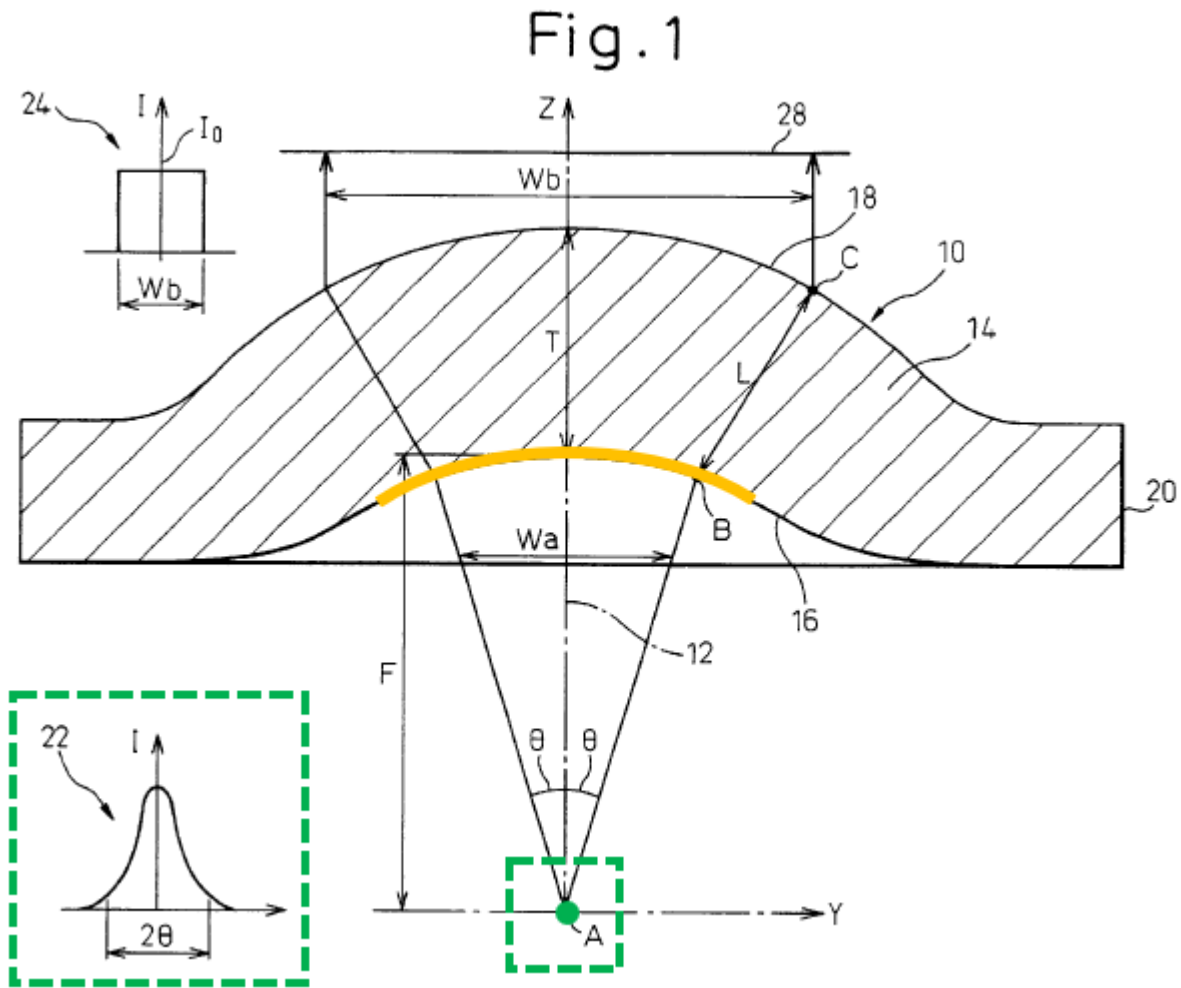


EX1004, Figure 1. EX1002, ¶¶71-72.

The transparent body 14 meets the claimed “solid of revolution with external surface area” because the body 14 has external curved surfaces 16 and 18 that extend “transversely ... with respect to the central axis 12” and that has a “rotation-symmetry with respect to the Z-axis.” EX1004, 3:59-65; *see also id.*, 4:12-15. EX1002, ¶73.

iii. [1b] **an entry surface** that receives light of nonuniform irradiance from **a nearby compact light source** and

Tawa teaches and/or renders obvious [1b]. Tawa teaches “**an entry surface**,” as evidenced by Tawa’s “**first curved surface 16**,” shown in Figure 1 below.



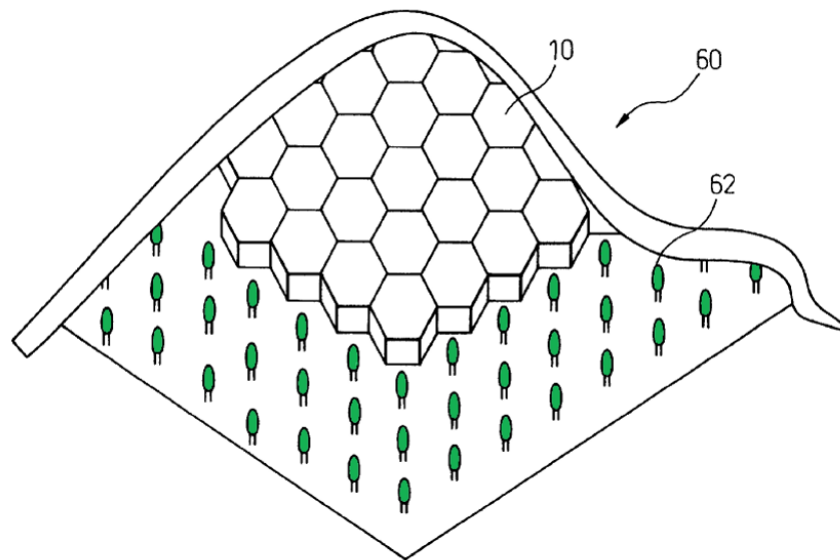
curved surface 16, and passes through the body 14.”). Specifically, as shown above, the intensity is highest near the Z-axis and falls off rapidly with increasing angles, meeting the claimed “nonuniform irradiance.” Indeed, Tawa distinguishes the non-uniform Gaussian light intensity distribution 22 from that of a uniform light intensity distribution 24, which as shown above is constant across the entire aperture Wb. EX1002, ¶¶76-77.

The **light source at point A** also meets the claimed “**compact light source**.” For example, Tawa teaches that “[p]oint A can be, for example, a laser.” EX1004, 4:9-10. The **light source at point A** is significantly smaller than the light intensity distribution converting device 10 because “point A represents a *radiation point*.” EX1004, 3:66-67. *See also* EX1003, 189-190 (“The present invention teaches a separate lens that is much larger than its light source, whereas Minano teaches at attached body about the same size as the light source, which therefore is the opposite of ‘compact’.”); EX1001, 3:53-59 (“The ratio shown in FIG. 4 of the width of emitter 41 to that of receiving surface 44 is ... less than $\frac{1}{5}$.”). EX1002, ¶¶78-79.

Alternatively, or additionally, Tawa teaches that the **light source 62** can be “composed of light emitters, such as light emitting diodes.” EX1004, 10:18-37. Figure 20 shows the relative size of each of these “**light source 62**” to be much smaller than the light intensity distribution converting device 10. *See* EX1004, 10:20-27 (“In this embodiment, the light source 62 composed of light emitters, such

as light emitting diodes, is a two-dimensional arrangement, and the light intensity distribution converting devices 10 of a honeycomb shape are arranged corresponding to the light emitters.”).

Fig. 20



EX1004, Figure 20. *See also* Section XI.A.1.xii [Ground I, Reasons To Combine] below. EX1002, ¶78.

Moreover, the **light source at point A** is “nearby” because it is typically millimeters away from the light intensity distribution converting device 10. *See, e.g.,* EX1004, Figures 3, 9A-9C, and 10A-10C (showing the distance between **point A** and the **first curved surface 16** (F) to be between 3.0 mm to 8.0 mm), 5:14-29 (explaining that “the distance F [is measured] between the **radiation point A** and

10”), 7:47-8:18.

Fig. 3

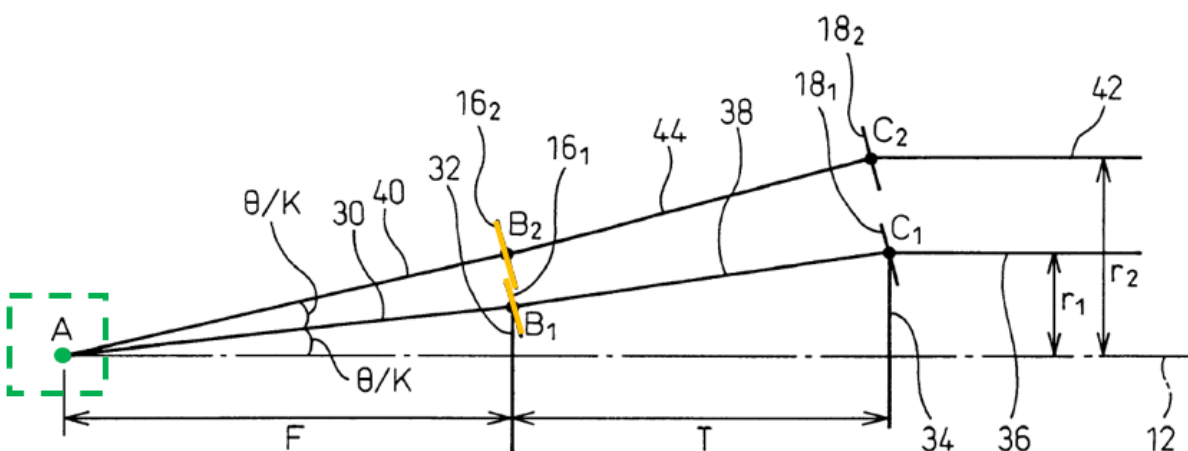
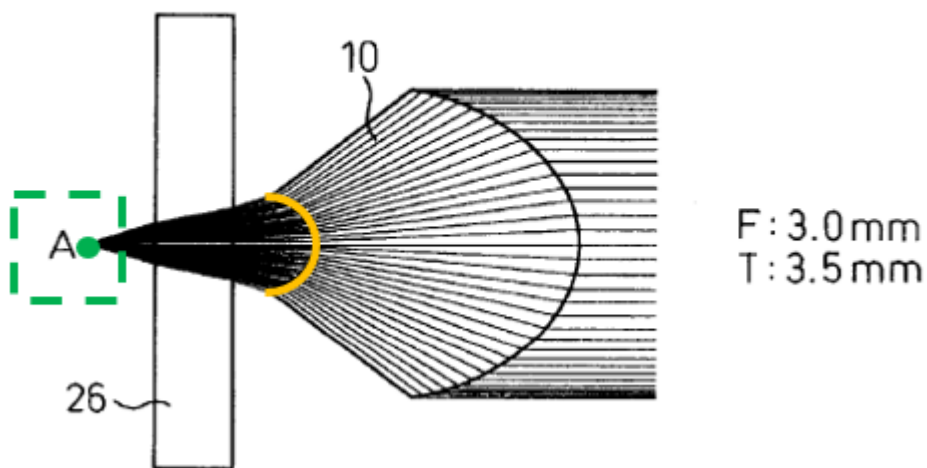


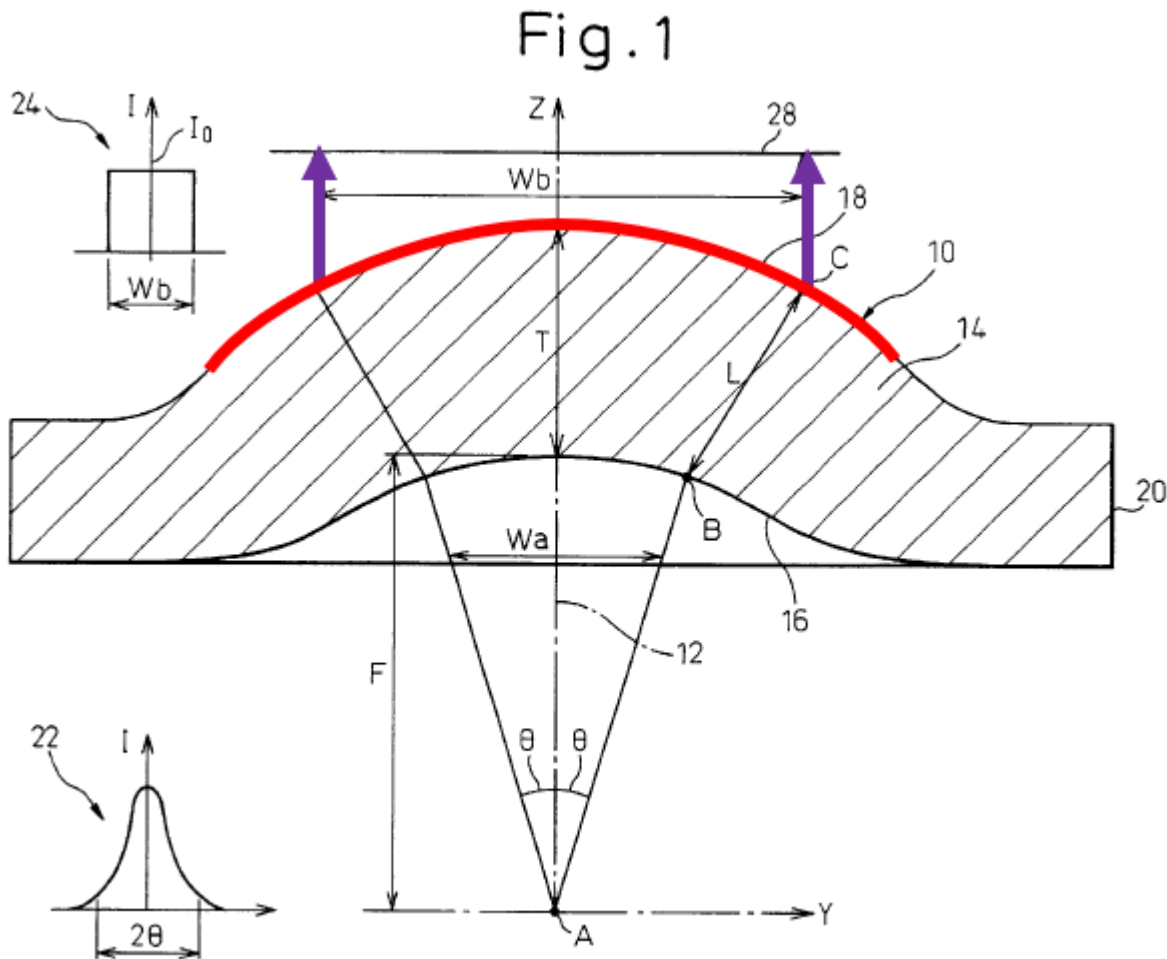
Fig. 9A



EX1004, Figures 3 and 9A. EX1002, ¶80.

- iv. [1c] of **an opposing exit surface** that forms from said received light a pre-specified diverging **output beam**;

Tawa teaches and/or renders obvious [1c]. Tawa teaches “**an opposing exit surface**,” as evidenced by Tawa’s “**second curved surface 18**” shown in Figure 1 below. See EX1004, 3:59-65.



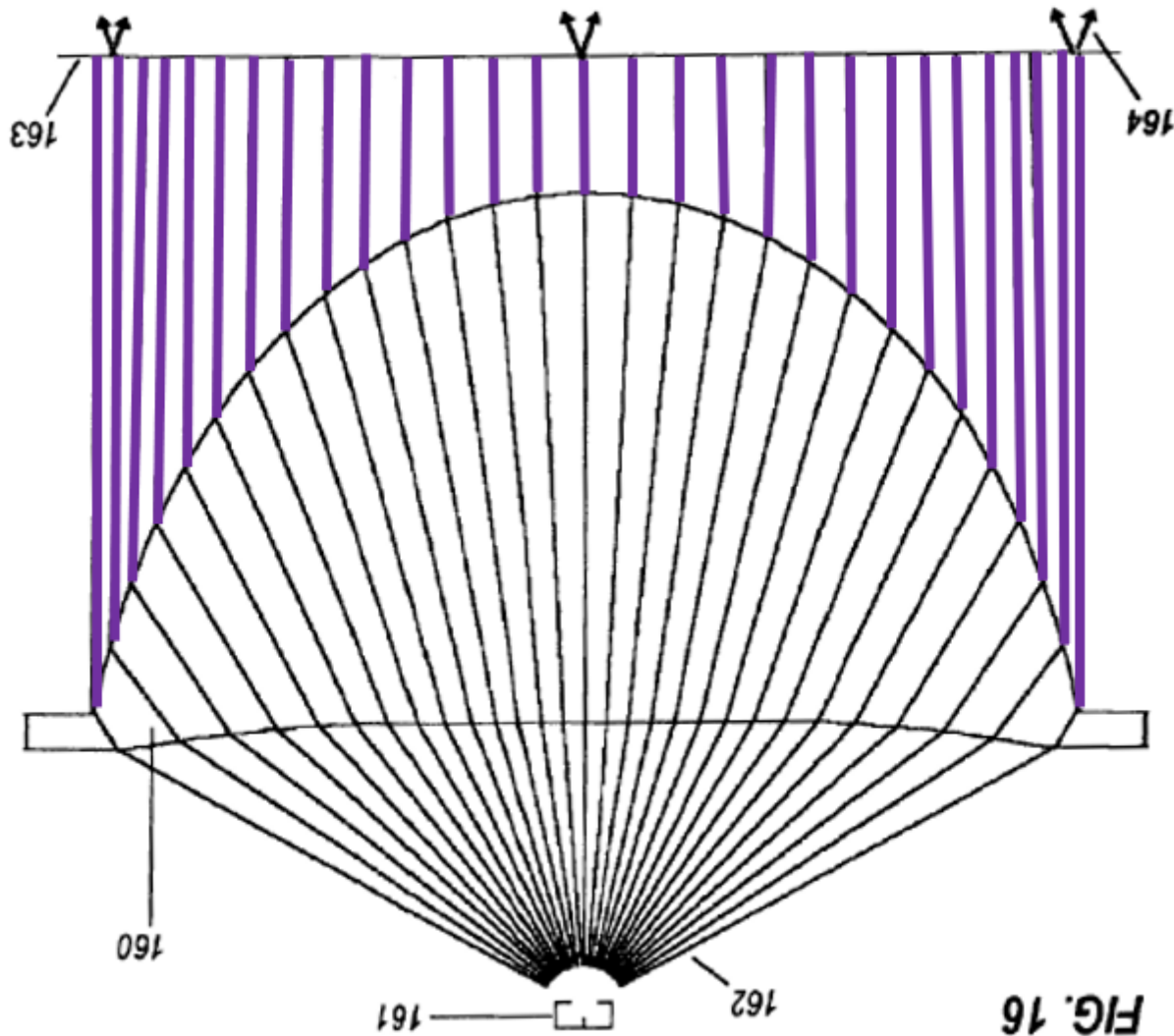
EX1004, Figure 1. EX1002, ¶¶81-82.

The **second curved surface 18** “forms[,] from the received light[,] a[n] ... **output beam**.” As shown above in Figure 1, the light from point A is received at

the first curved surface 16, passes through the body 14, and “emerges the body 14 from the **second curved surface 18**.” EX1004, 4:31-40. EX1002, ¶83.

The **output beam** is “pre-specified.” The **second curved surface 18** is shaped so that **the light rays emerging from the body** are parallel to each other. EX1004, 4:41-43 (“The inclination of the **second curved surface 18** is determined such that the **light emerging the body from the point C** travels in parallel with the Z-axis.”). The effect of this **second curved surface 18** in the light intensity distribution device is that it “not only converts the light intensity distribution at the point A, but also serves as a collimator lens.” EX1004, 4:47-50. In other words, the emerging light is pre-specified to be collimated. EX1002, ¶83.

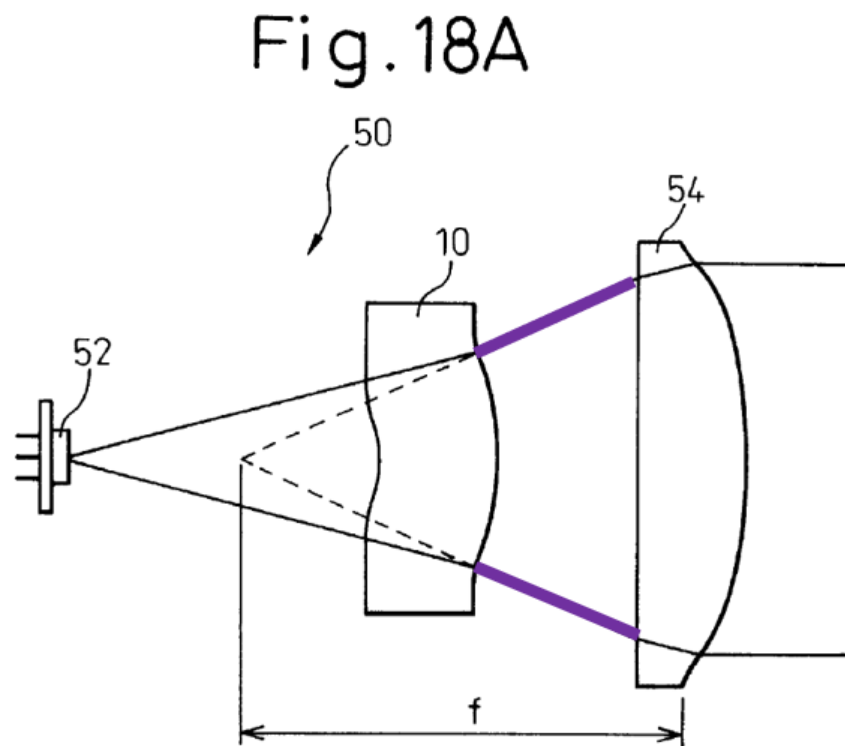
Moreover, the collimated output beam is “diverging.” For example, dependent claim 11 specifies that a collimated beam is one example of a diverging output beam. EX1001, claim 11 (“The lens of claim 1, **wherein said** [diverging] **output beam** is **collimated**....”). Indeed, the ’162 Patent specifies that “[o]ne **preferred** embodiment of this new lens produces a very tightly **collimated beam** with uniform irradiance.” EX1001, 1:66-67; *see also* EX1001, 6:1-3. *See SynQor, Inc. v. Artesyn Tech., Inc.*, 709 F.3d 1365, 1378-79 (Fed. Cir. 2013) (“A claim construction that ‘excludes the preferred embodiment is rarely, if ever, correct and would require highly persuasive evidentiary support.’”).



EX1001, Figure 16. EX1002, ¶¶84-85.

To the extent Patent Owner argues that “diverging” requires non-collimated beams that spread out, Tawa renders obvious [1c]. Tawa teaches that **light emanating** from the light intensity distribution converting device 10 can **spread out**, which can then be subsequently collimated by an additional collimator lens 54. See EX1004, 9:39-55 (“In FIG. 18A, the light intensity distribution converting

device 10 is arranged so that the diverging light, which enters the light intensity distribution converting device 10, *is emitted therefrom at an increased divergent angle*. In FIG. 18B, the light intensity distribution converting device 10 is arranged so that the diverging light, which enters the light intensity distribution converting device 10, *is emitted therefrom at a reduced divergent angle*.”).



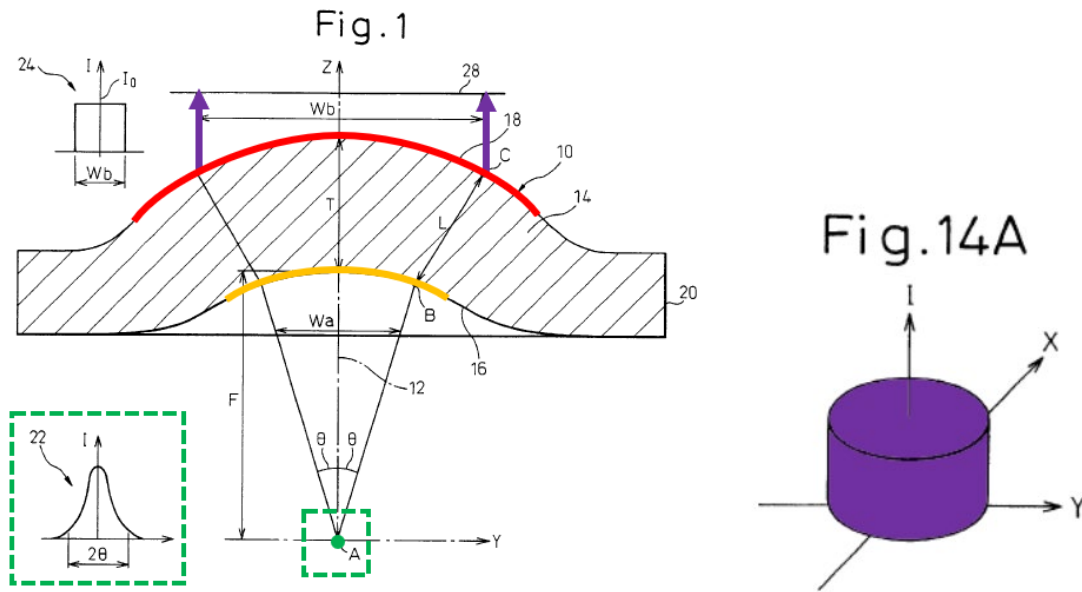
EX1004, Figure 18A. EX1002, ¶86.

- v. [1d] **said entry surface** given a specific profile that refractively deflects said received light into a different solid angle,

Tawa teaches [1d]. Tawa teaches “**said entry surface** [is] given a specific profile.” See EX1004, 5:4-5 (“The *design* of the **first ... curved surface**[] **16** will

be explained below.”). Specifically, Tawa explains that the **first curved surface 16** is designed such that it “refractively deflects said received light into a different solid angle.” EX1002, ¶¶87-88.

The light emitted at **point A** is symmetric with respect to the Z-axis. *See* EX1004, 4:9-12 (“**Point A** can be, for example, a laser, which radiates diverging light having Gaussian light intensity distribution 22 which is in rotation-symmetry with respect to the Z-axis.”). As shown by the ray traces in Figure 1, the light incident upon the **first curved surface 16** refracts to a different solid angle, such that the **light emitted** from the **second curved surface 18** has uniform light intensity I_0 across the aperture W_b (*see* item 24 in Figure 1 below). *See* EX1004, 4:29-40; *see also* EX1004, 8:44-46 (“A cylindrical uniform light intensity distribution is shown in FIG. 14A.”).

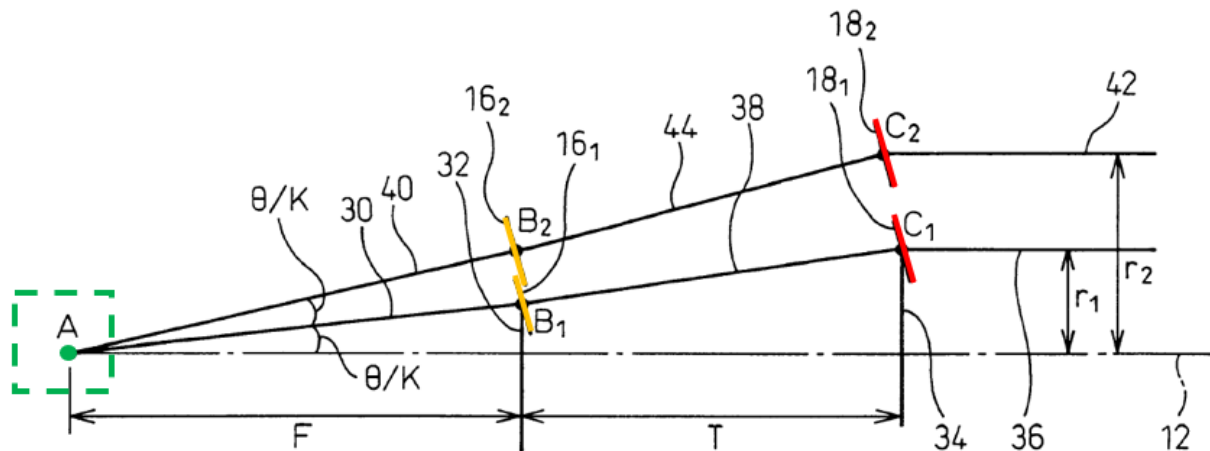


EX1004, Figures 1 and 14A. EX1002, ¶89.

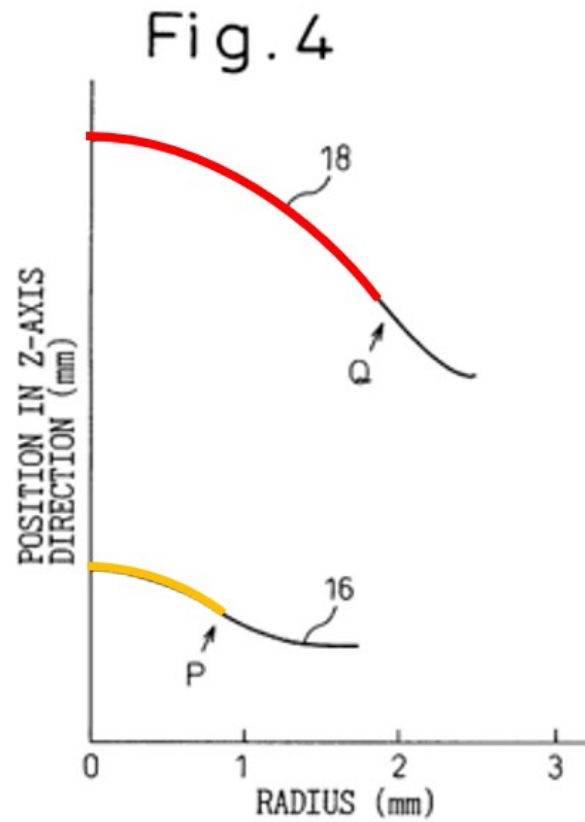
Tawa provides a detailed explanation of how the shapes of the **first curved surface 16** and the **second curved surface 18** are designed to achieve that uniform light intensity I_0 24 across the aperture W_b . As shown in Figure 3 below, Tawa first divides the angle θ of the incident light into small angular segments θ/k , and iteratively calculates, at these small intervals, how the light should be redistributed to ensure that: (1) the amount of light incident on small angular segments of the **first curved surface 16** is the same as the amount of light exiting the corresponding small angular segments of the **second curved surface 18**; (2) the amount of light per unit area exiting each of the small angular segments across the entirety of the **second curved surface 18** are the same (*i.e.*, uniform); and (3) the **first curved surface 16**

and the **second curved surface 18** each forms a smooth continuous shape. See generally EX1004, 5:5-56.

Fig. 3



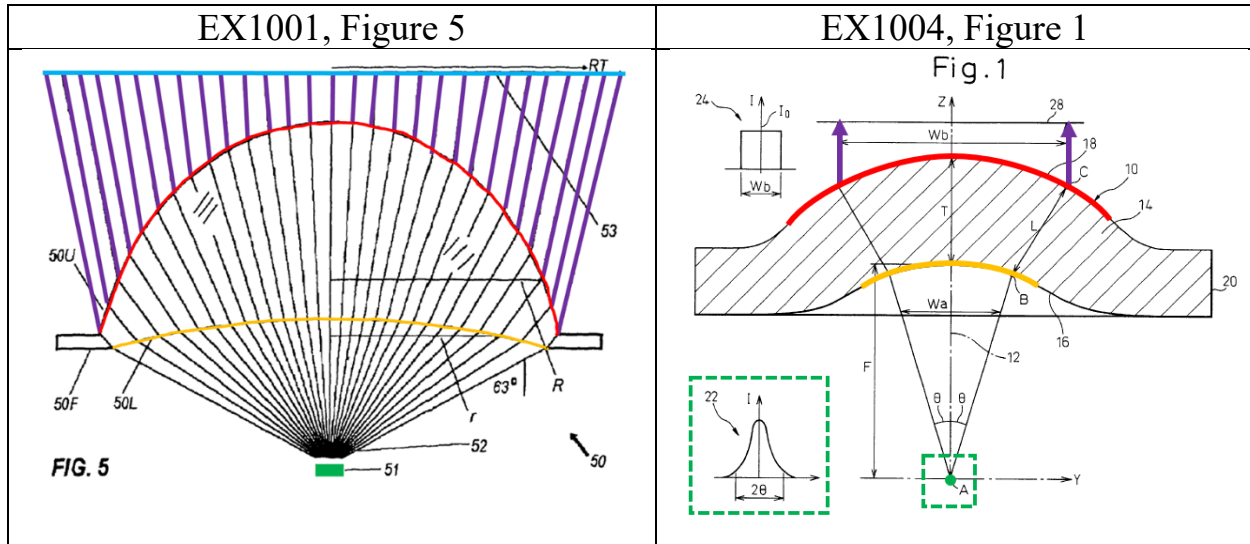
EX1004, Figure 3. “FIG. 4 shows the shape of the [resulting] **first** and **second** curved surface **16** and **18** of the light intensity distribution converting device 10 shown in FIG. 2.” EX1004, 6:12-31.



EX1004, Figure 4. EX1002, ¶¶91-92.

Figure 1 of Tawa shows refraction further away from the optical axis at the **first curved surface 16** to cause the formation of a “different solid angle.” To the extent Patent Owner argues that Figure 5 of the ’162 Patent shows refraction towards the optical axis (despite the fact that [1d] does not require refraction towards any particular direction), a POSITA would have at a minimum found it obvious that the direction of refraction can be altered as desired depending on the specific configuration of the system, such as the thickness of the lens, distance between the light source to the entry surface, the refractive index of the lens, the type of

nonuniform light source utilized (e.g., Tawa’s Gaussian vs. ’162 Patent’s Lambertian light sources), the local radius of curvature of the lens surface, and the like.

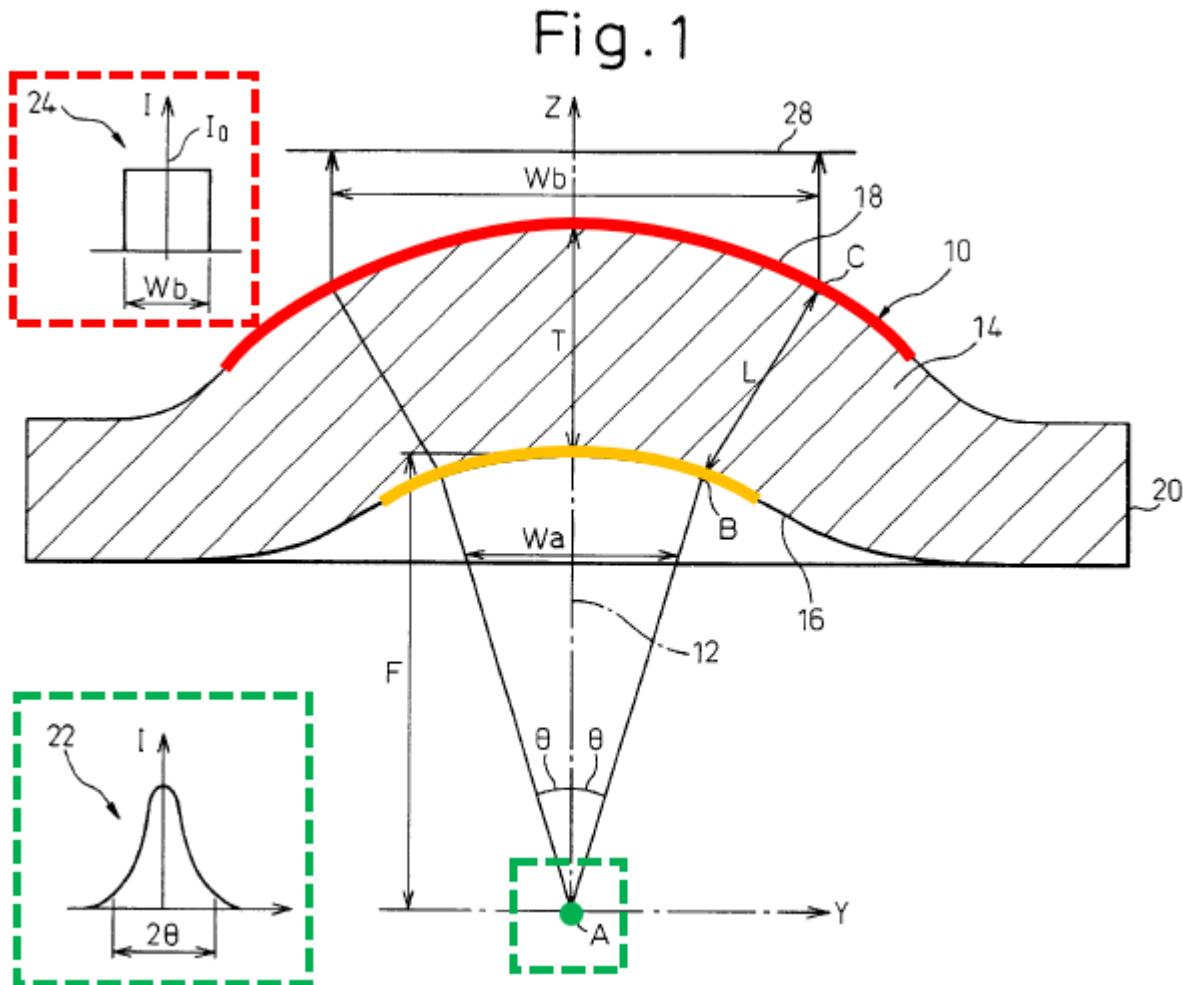


There is nothing inventive or critical about the direction of refraction as light hits the **entry surface**. See, e.g., EX1004, Figures 2, 9A-11B, and 18A-18B. EX1002, ¶90.

- vi. [1e] **said entry surface** spatially distributed such that **said exit surface** receives said deflected light with predominantly uniform irradiance,

Tawa alone teaches and/or renders obvious or Tawa in combination with Shikama renders obvious [1e]. As explained above in Section XI.A.1.v [Ground I, 1d], Tawa teaches “**said entry surface** [that is] spatially distributed” because the **first curved surface 16** has the shape shown in Figure 1 that “transversely extend[s]

with respect to the central axis” and has a “rotation-symmetric shape” about the Z-axis. EX1004, 3:37-65, 4:12-15.



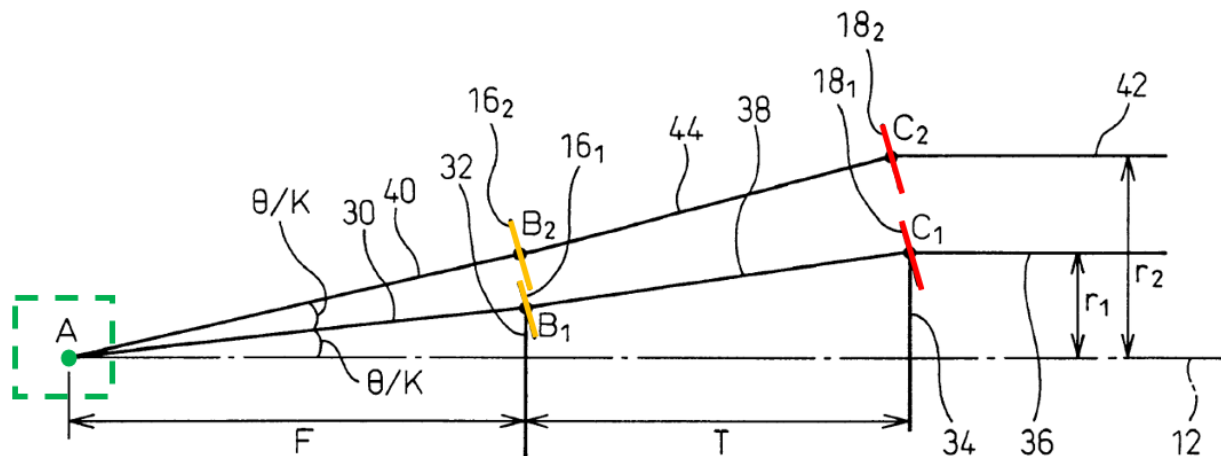
EX1004, Figure. 1. EX1002, ¶¶93-94.

Tawa further teaches that “**said exit surface** receives said deflected light with predominantly uniform irradiance” because the **first curved surface 16** refracts the light towards the **second curved surface 18**. As Dr. Milster explains, Tawa’s calculations ensure that the amount of light per unit area exiting each of the

small angular segments across the entirety of the **second curved surface 18** are the same (*i.e.*, uniform) because each of the successive concentric areas (*e.g.*, k , and $k-1$) on the **second curved surface 18** has the same constant light intensity I_0 and the light arriving at the **second curved surface 18** is nearly perpendicular to the local surface at C_1 and C_2 ,

$$\frac{Q_k}{\pi(r_k^2 - r_{k-1}^2)} = I_0$$

Fig. 3



EX1003, Figure 3. Indeed, the calculations to ensure that the **output beam** (that refracts out of the **exit surface**) has uniform irradiance on the **target surface** are nearly identical to each other in both Tawa and the '162 Patent. *See also* Section XI.A.1.viii [Ground I, 1g] (explaining the similarities between the iterative calculations carried out by Tawa and the '162 Patent to determine the shape of the entry and exit surfaces). EX1002, ¶¶95-96.

As a result, “[t]he light emerges the body 14 from the **second curved surface 18** as parallel light having a uniform light intensity distribution 24.” EX1004, 4:38-40; *see also id.*, 4:59-65 (explaining that “the emission light has a uniform light intensity distribution”), 5:14-65 (explaining how to spatially distribute the **first curved surface 16** such that the **second curved surface 18** receives the light deflected by the **first curved surface 16** to emit a beam of light with uniform intensity distribution), 10:66-11:4 (“wherein said body is constructed such that the incident light with a Gaussian light intensity distribution is converted into the emerging light with an approximately uniform light intensity distribution, due to refraction of light caused while the light passed from the **first curved surface** to the **second curved surface**”), 10:23-30, Figure 2. EX1002, ¶97.

Indeed, Shikama also teaches that its lens produces a uniformly bright distribution of light. *See* EX1005, 6:2-7 (discussing the components are arranged “to attain a uniform distribution of the projected image brightness”); *see also id.*, 6:39-48, 18:51-54, 19:7-12, 26:45-50, 27:18-26. Specifically, Shikama teaches that its construction of the **second surface S2** “serves to improve the uniformity of the transmittance characteristic.” EX1005, 16:60-67. EX1002, ¶97.

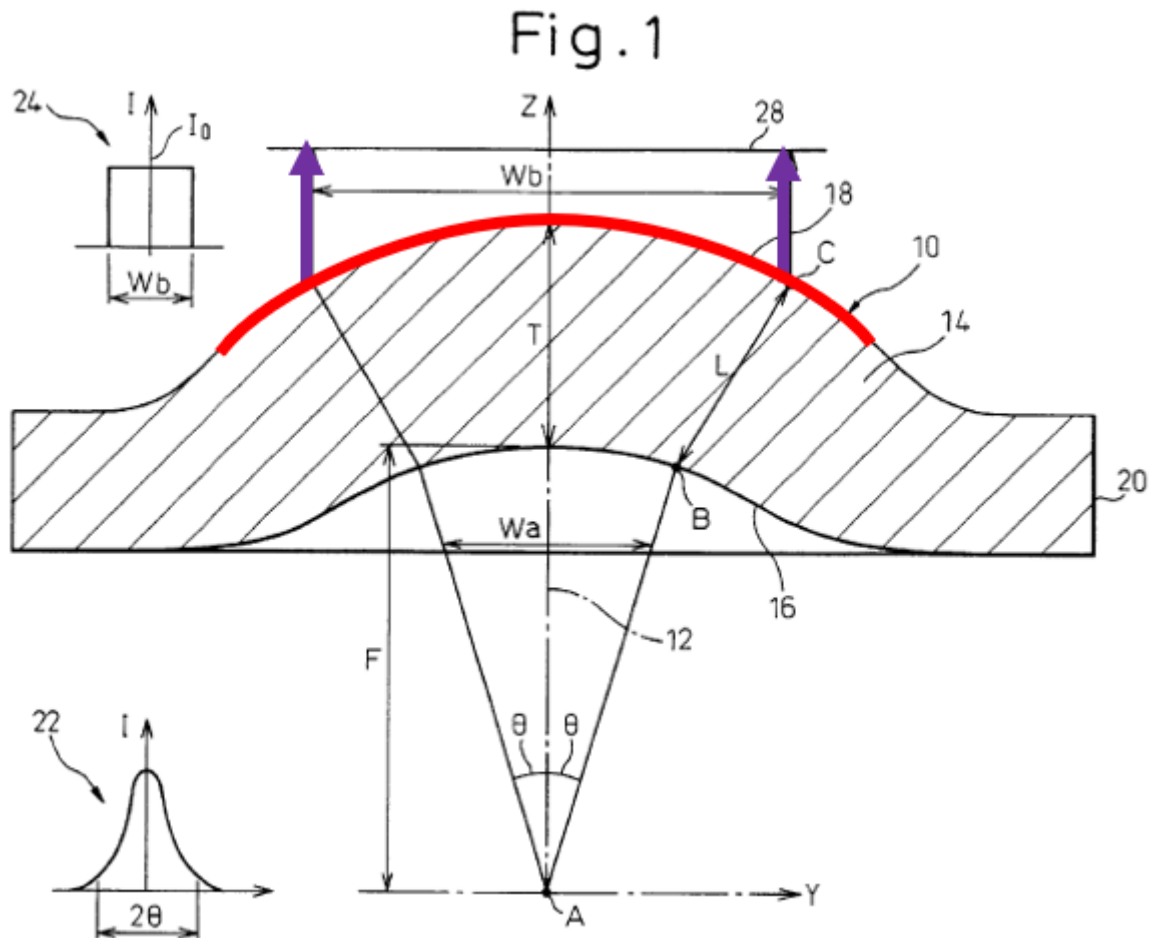
At a minimum, based on the teachings of Tawa alone and/or Tawa in combination of Shikama, a POSITA would have recognized that in order to produce light having uniform intensity distribution 24, a POSITA would have spatially

distributed the **first curved surface 16** such that the **second curved surface 18** receives the deflected light with a predominantly uniform irradiance such that the light can simply bend as it exits the **second curved surface 18** to more readily produce a collimated beam that has a uniform intensity. Such a design would have more readily facilitated outputting beam having uniform intensity distribution onto target. EX1002, ¶98.

- vii. [1f] **said exit surface** given a specific shape that refractively deflects said uniform irradiance into **said output beam**;

Tawa teaches [1f]. As explained in Section XI.A.1.v [Ground I, 1d], Tawa also teaches how “**said exit surface** [is] given a specific shape.” See EX1004, 5:4-5 (“The design of ... the **second curved surface[] ... 18** will be explained below.”). Particularly, the **second curved surface 18** is designed to have a specific shape that refracts light redistributed by the first curved surface 16. EX1004, 4:20-40. Tawa teaches that the shape of the **second curved surface 18** is calculated by iteratively determining inclinations at multiple points, ensuring the refracted light emerges parallel to the central axis and with a uniform intensity. See generally EX1004, 5:5-56. “FIG. 4 shows the shape of the first and **second curved surface** 16 and **18** of the light intensity distribution converting device 10 shown in FIG. 2.” EX1004, 6:12-31. Tawa further teaches that “**said exit surface** ... refractively deflects said

the **second curved surface 18** is deflected by refraction as light exits device 10.



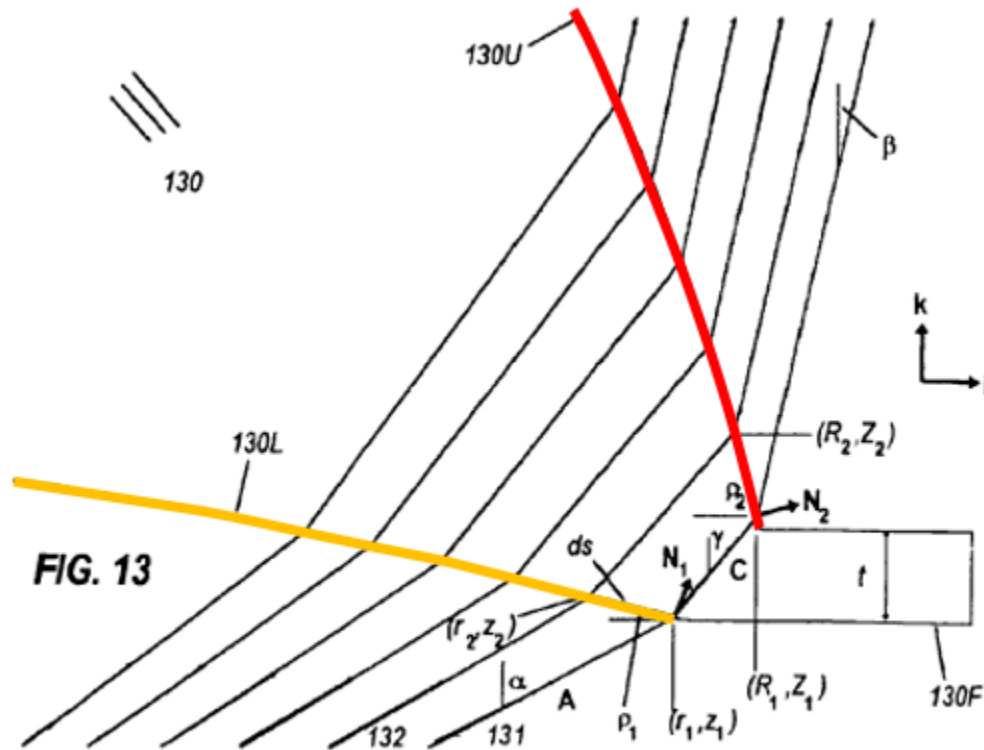
EX1004, Figure 1. “The light emerges the body 14 from the **second curved surface 18** as parallel light having a uniform light intensity distribution 24.” EX1004, 4:38-40; *see also id.*, 4:59-65 (explaining that “the **emission light** has a uniform light intensity distribution”), 10:23-30. EX1002, ¶¶99-100.

- viii. [1g] **said light source** being sufficiently compact for said specific shapes to be calculated by mathematical integration of the slope distributions required by said refractive deflections,

Tawa teaches and/or renders obvious [1g]. As explained in Section XI.A.1.iii [Ground I, 1b], Tawa's "**light source**" is "compact." EX1002, ¶¶101-102.

Moreover, as discussed below, Tawa's **light source at point A** is also "sufficiently compact for said specific shapes to be calculated by mathematical integration of the slope distributions required by the said refractive deflections." First, the '162 Patent does not explicitly define what "*mathematical integration of the slope distributions*" is or how the "specific shape [of **the exit surface** can] be calculated by mathematical integration of the slope distributions." But the '162 Patent explains, in conjunction with Figure 13, how small intervals (ds) can be iteratively used to refine the lens profile. As shown below, discrete steps are added up (or "integrated"), starting from the periphery of the lens and moving towards the center (or the optical axis), to produce smooth lens surfaces **130L** and **130U** resulting in a lens that emits a uniform intensity of light. EX1001, 5:9-54 ("The mathematical generation of lower surface 130L begins with its outer edge, at defined point (r,z) ... By using small intervals ds , smooth surfaces **130L** and **130U** can thus be mathematically iterated from the periphery to the center, with different resultant shapes dependent upon the size and distance of the illumination target, such as target

63 of FIG. 6.”) ; *see also* Sections XI.A.1.v [Ground I, 1d] and XI.A.1.vii [Ground I, 1f].

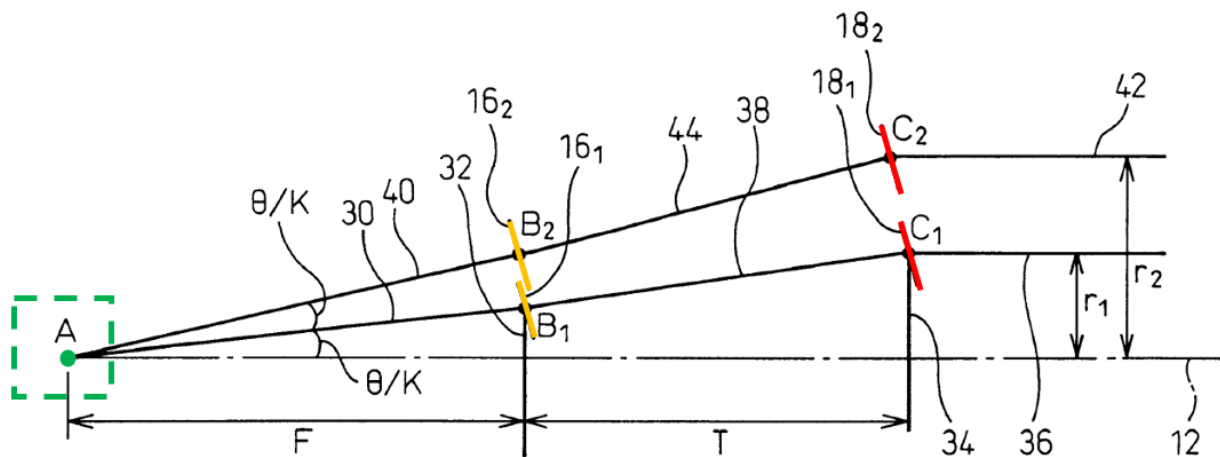


EX1001, Figure 13 (showing iterative calculations of the shapes of the entry and exit surface by calculating points (r_1, z_1) , (r_2, z_2) on the **entry surface** and (R_1, Z_1) , (R_2, Z_2) on the **exit surface**). EX1002, ¶¶103-104.

Just like the '162 Patent, Tawa iteratively calculates, albeit starting from the center (or optical axis) and moving towards the periphery of the lens, the refractive deflections occurring at the **first** and **second curved surfaces** to determine surface inclinations that output a uniform intensity of light. EX1004, 5:30-39 (“The

inclination 16_1 of a micro part of the **first curved surface 16**, which passes through the point B_1 is determined so that the optical path of the incident light corresponds to the line 30, and the optical path of the refracted light corresponds to the line 38. Thereafter, the inclination 18_1 of a micro part of the **second curved surface 18**, which passes through the point C_1 is determined so that the optical path of the incident light corresponds to the line 38, and the optical path of the refracted light corresponds to the line 36 and is parallel with the central axis line 12.”), 4:41-43 (“The inclination of the **second curved surface 18** is determined such that the light emerging the body from the point C travels in parallel with the Z-axis.”).

Fig. 3



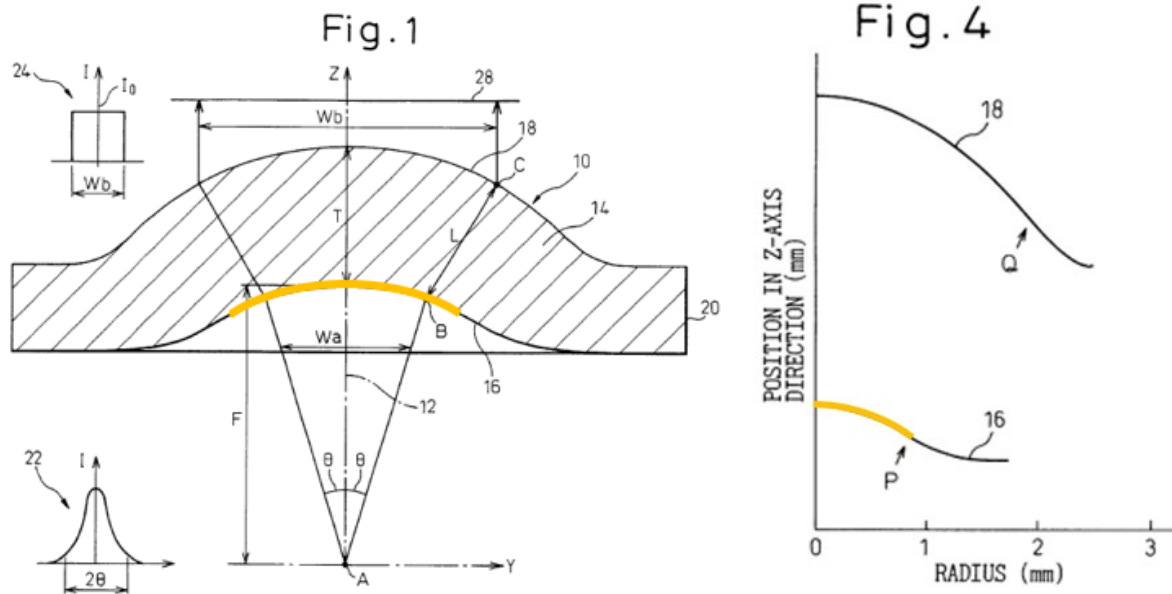
EX1004, Figure 3 (showing iterative calculations to obtain the shapes of the **first** and **second curved surfaces** by calculating points $B_1, B_2 \dots B_k$ of the **first curved**

surface 16 and $C_1, C_2 \dots C_k$ of the **second curved surface 18**). EX1002, ¶¶104-105.

In other words, both the '162 Patent and Tawa describe designing the surfaces of the lens by iteratively calculating local inclinations to output a uniform intensity of light based on nonuniform light that was generated by a compact light source, such as an LED (or laser in the case of Tawa). *See, e.g.*, EX1001, 5:5-49; EX1004, 5:14-56. Hence, a POSITA would have recognized that Tawa teaches or at least renders obvious [1g]. EX1002, ¶105.

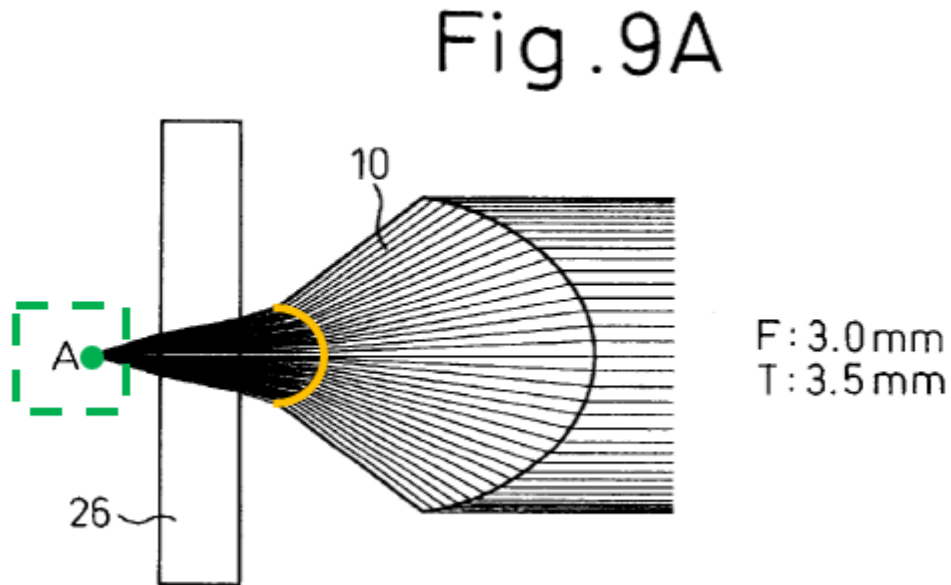
ix. [1h] said entry surface having first concavity facing toward said light source,

Tawa in combination with Shikama renders obvious [1h]. As shown below in Figures 1 and 4, Tawa teaches a portion of the **first curved surface 16** having a concavity that faces toward the **light source at point A**.



EX1004, Figures 1, 4; *see also id.*, 4:20-21 (“The **first curved surface 16** is defined by a generally shallow rounded concave surface...”). EX1002, ¶¶106-108, 206-207.

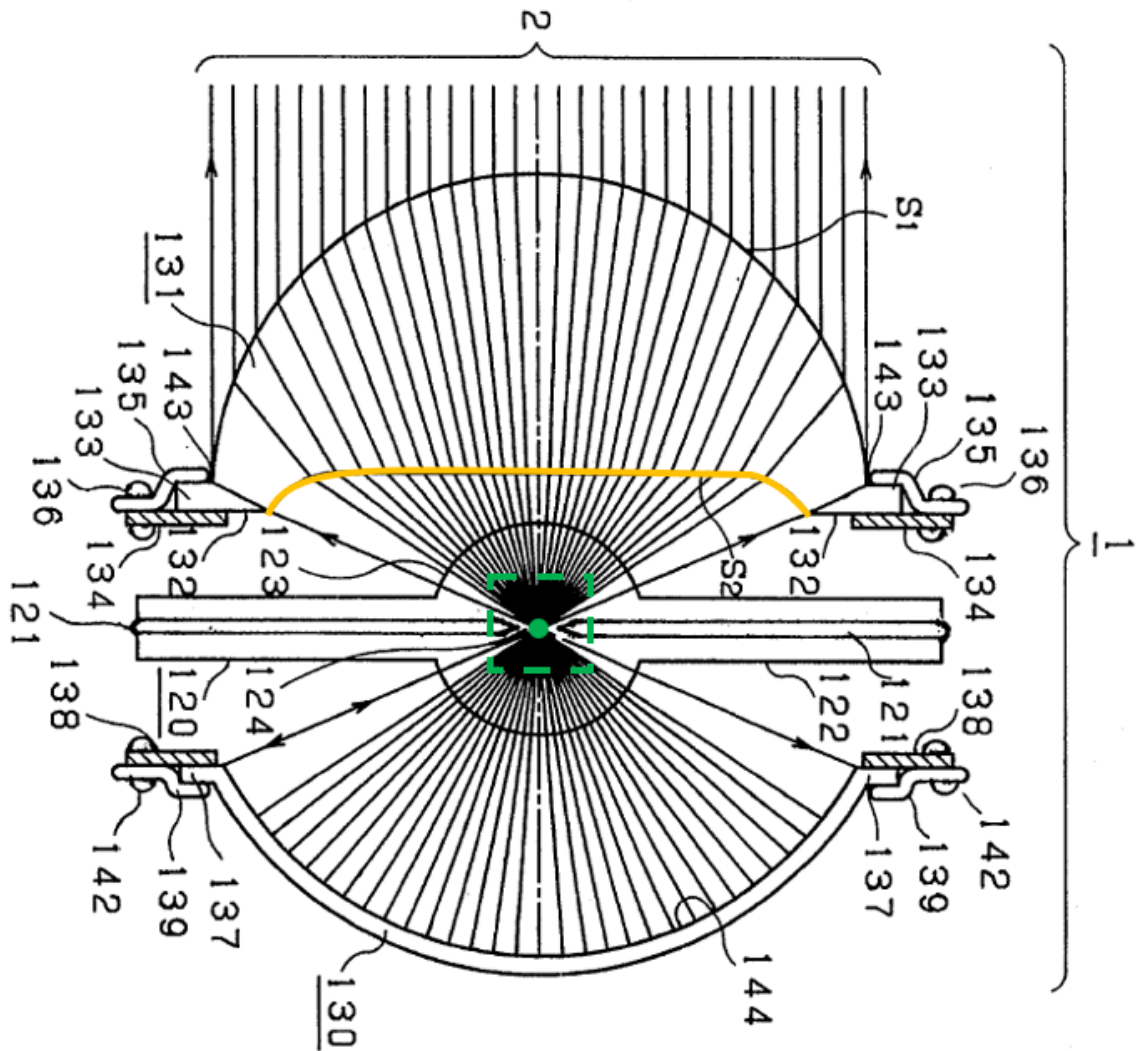
However, to the extent [1h] requires the entirety of **the entry surface** to be concave (*i.e.*, without changing from a concave region to a convex region), Tawa in combination with Shikama renders obvious [1h]. At the outset, Tawa itself teaches such a structure in Figure 9A.



EX1004, Figure 9A. EX1002, ¶109.

Similarly, as shown in Figure 13 of Shikama, condenser lens 131 has a **second surface S2** having a concavity that faces toward the **lamp 120**. See EX1005, 14:58-68 (“FIG. 13 shows the construction of a light source apparatus ... wherein the reference numeral 131 is a condenser lens, ... 132 is a second plane face formed around the periphery of the **second surface S2** of the condenser lens 131,...”), 15:12-19 (“The **lamp 120** is mounted facing the **second surface S2** of the condenser lens 131 ... placed perpendicularly to the optical axis (indicated by a dashed line) of the condenser lens 131.”).

Fig. 13

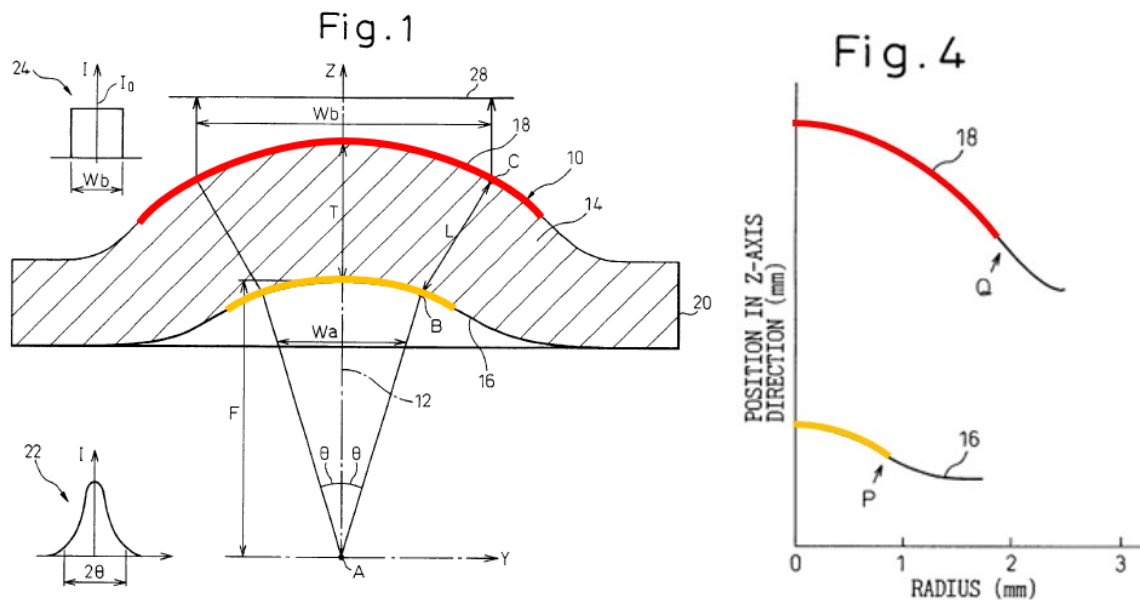


EX1005, Figure 13. EX1002, ¶110.

A POSITA would have had numerous reasons to modify the shape of Tawa's particular embodiment with that of Shikama's lens shape with a reasonable expectation of success as more fully explained in Section XI.A.1.xii [Ground I, Reasons To Combine] below. EX1002, ¶111.

x. [1i] and [said **exit surface** having] second concavity facing toward the **entry surface**,⁵

Tawa in combination with Shikama renders obvious [11]. As shown below in Figures 1 and 4, Tawa teaches a portion of the **second curved surface 18** having a concavity that faces toward the **first curved surface 16**.



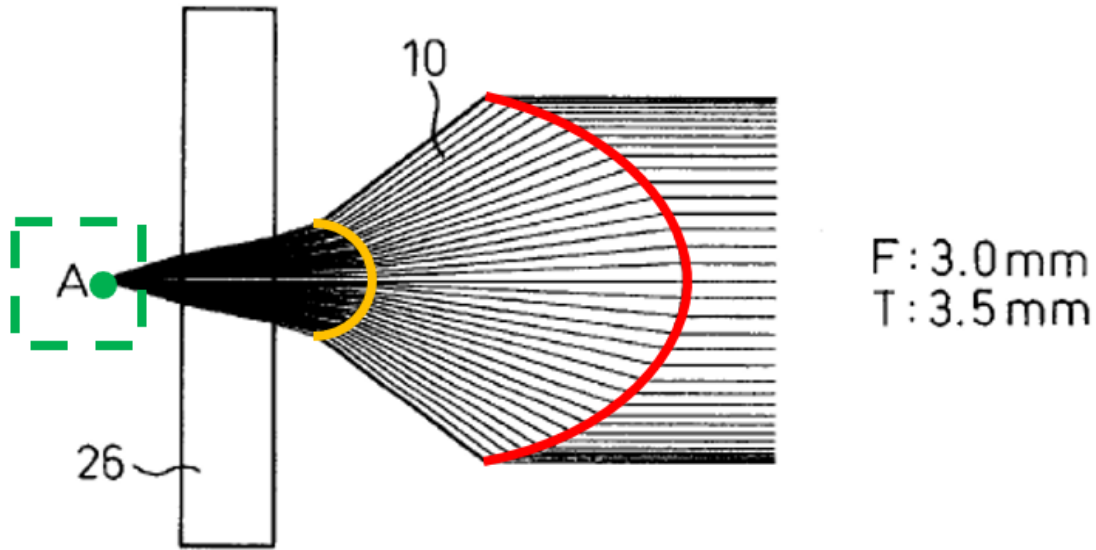
⁵ [1i],[1j], [39k], and [39l] are amenable to multiple possible interpretations. The various Grounds throughout the Petition includes added language in square brackets and the footnotes in [1i], [1j], [39k], and [39l] that provide further clarification as to the possible interpretation being applied in that instance.

EX1004, Figures. 1, 4; *see also id.*, 4:21-22 (“[T]he **second curved surface 18** is defined by a generally rounded convex⁶ surface.”). EX1002, ¶¶112, 127-130.

However, to the extent [1i] requires the entirety of **the exit surface** to be concave (*e.g.*, without changing from a concave region to a convex region), Tawa in combination with Shikama renders obvious [1i]. At the outset, Tawa itself teaches such a structure in Figure 9A.

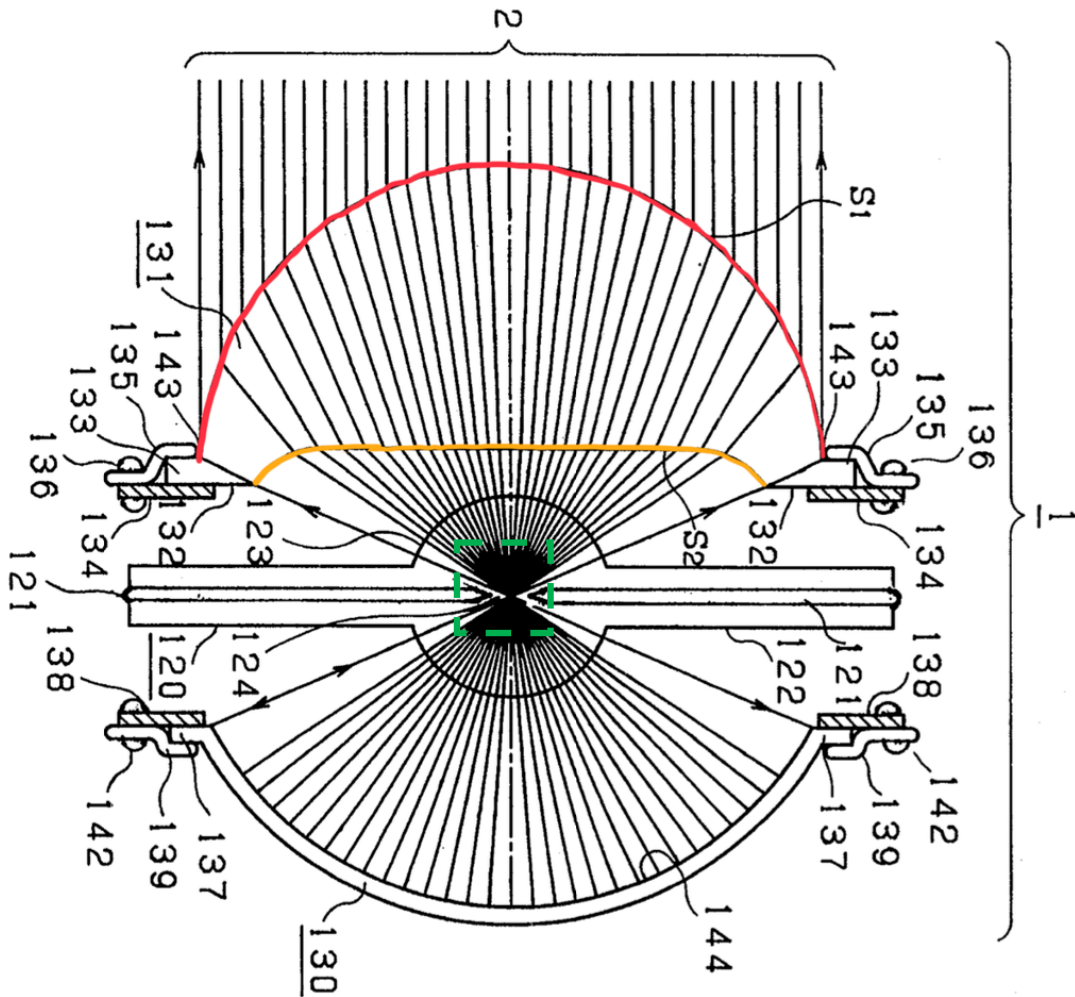
⁶ As Dr. Milster explained, the term “convex” is used in Tawa because the curvature is typically determined from the vantage point that is external to the surface it is being measured against. That is, the curvature for the **second curved surface 18** is determined from the vantage point near target surface 28 whereas the curvature for the **first curved surface 16** is determined from the vantage point near **point A**. EX1002, ¶¶34-36.

Fig. 9A



EX1004, Figure 9A. EX1002, ¶¶113-116

Similarly, as shown in Figure 13 of Shikama, lens 131 has a **first surface S1** having a concavity that faces toward the **second surface S2**, which in turn faces toward the **lamp 120**. See EX1005, 14:58-68 (“FIG. 13 shows the construction of a light source apparatus ... wherein the reference numeral 131 is a condenser lens, 143 is a first plane face formed around the periphery of the effective diameter of the **first surface S1** of the condenser lens 131, 132 is a second plane face formed around the periphery of the **second surface S2** of the condenser lens 131, ...”).



EX1005, Figure 13. *See also* Section XI.A.1.xii [Ground I, Reasons To Combine]

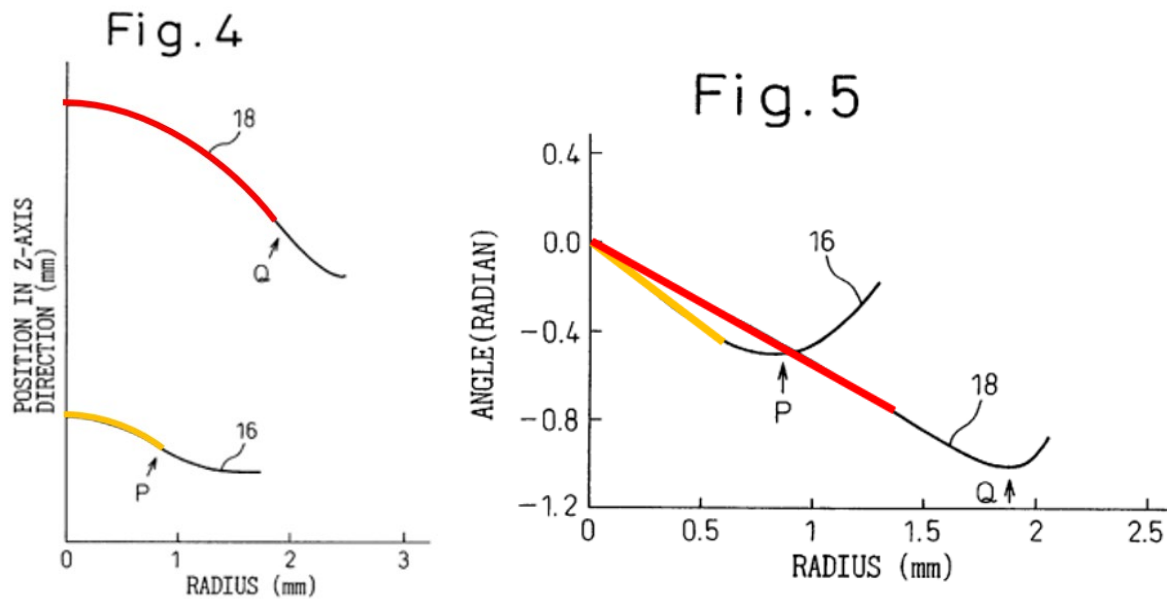
below. EX1002, ¶¶117-118.

- xi. [1j] said second concavity⁷ [of the **exit surface**] being substantially greater than said first concavity [of the **entry surface**].

Tawa in combination with Shikama renders obvious [1j]. As further explained below, although Tawa shows an embodiment where the **second curved surface 18** has a smaller concavity than that of the **first curved surface 16**, it would have been obvious to make the concavity of the **second curved surface 18** to be substantially greater than the concavity of the **first curved surface 16** in light of the teachings of Tawa and Shikama. EX1002, ¶¶119, 128-130.

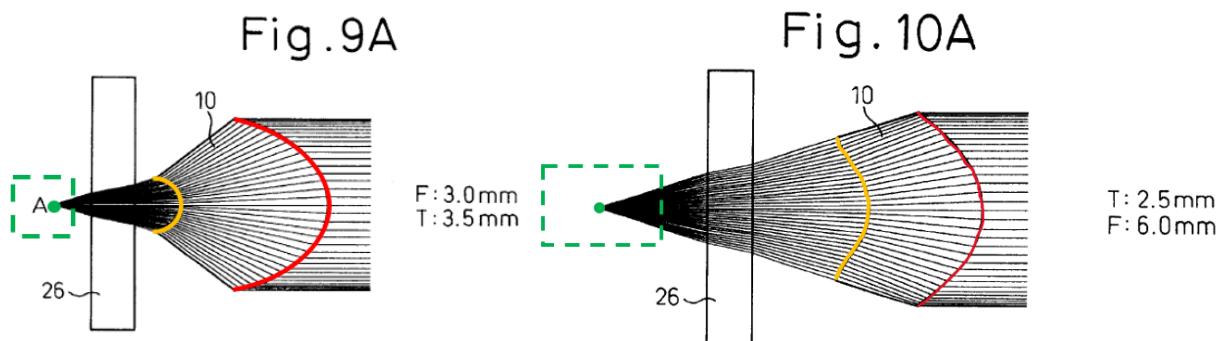
As for Tawa, Figure 4 shows the shape of the **first curved surface 16** and the **second curved surface 18**. EX1004, 6:12-14 (“FIG. 4 shows the shape of the first and second curved surface **16** and **18** of the light intensity distribution converting device 10 shown in FIG. 2.”).

⁷ “Concavity” based on the degree of curvature.



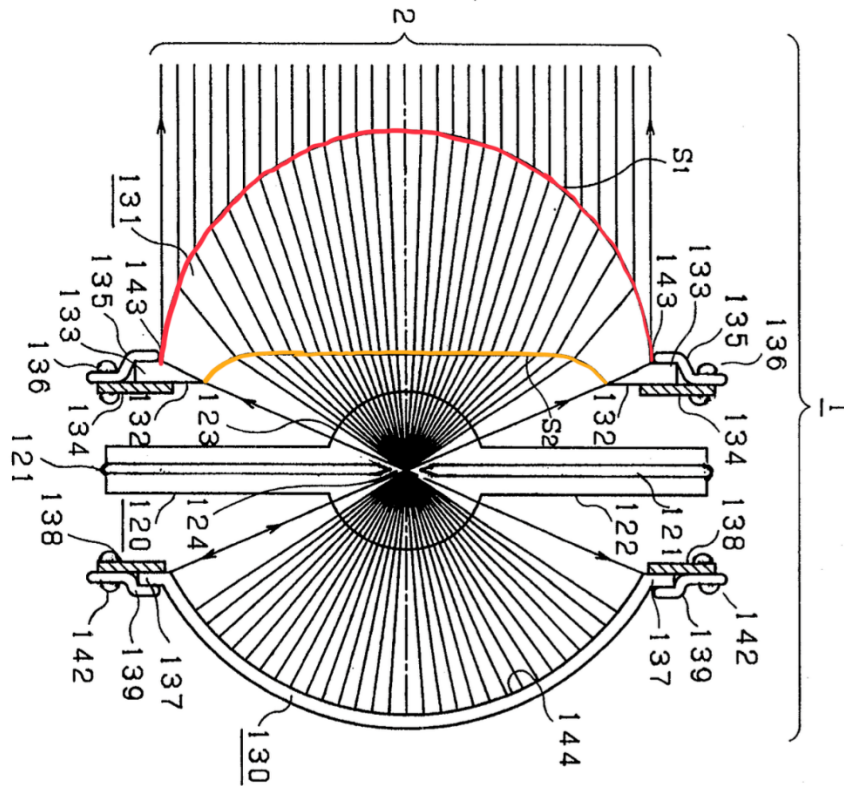
EX1004, Figures 4 and 5. Figure 5 shows the slopes (*i.e.*, the first derivatives) of the **first curved surface 16** and **the second curved surface 18** from Figure 4. As Dr. Milster explains, the degree of concavity may be determined by taking the slope of the curves shown in Figure 5 (*i.e.*, the second derivative of the curves shown in Figure 4). *See* EX1024, 33 (“Concavity. The second derivative is the rate of change of the first derivative.”). As shown, in Figure 5, up to the respective inflection points P and Q, the slope corresponding to the **first curved surface 16** is slightly larger than the slope corresponding to **the second curved surface 18**. Hence, this particular embodiment shows the concavity of the **first curved surface 16** to be slightly larger than the concavity of **the second curved surface 18**. EX1002, ¶¶120-121.

Nevertheless, Tawa discloses that precise shapes of the **first curved surface 16** and **the second curved surface 18** can vary, depending on “distance F between the radiation point A and the light intensity distribution converting device 10” as well as “the thickness T” of the lens. EX1004, 7:49-55. For instance, “FIGS. 9A to 9C show ... [t]he shape of the light intensity distribution converting device differs depending on the distance F between the radiation point A and the device 10. The shorter the distance F, the larger the curvatures of the first and second curved surfaces 16 and 18.” EX1004, 7:47-60. In other words, a POSITA would have readily recognized that any desired curvature of the **first curved surface 16** and the **second curved surface 18** may be formulated (keeping the condition of producing a uniform distribution of light), and “the second concavity being substantially greater than the first concavity” is merely one design choice that would have led to expected results of uniform distribution of emitted light.



EX1004, Figures 9A-10C. EX1002, 122.

Indeed, lenses having “the second concavity being substantially greater than the first concavity” were well-known in the art. For example, as shown in Figure 13 of Shikama below, Shikama’s **first surface S1** has a concavity that is substantially greater than the concavity of the **second surface S2**. See EX1005, 10:62-65 (“The **first surface S1** is of aspherical form having a convex curvature, while the **second surface S2** is also of aspherical form having a strongly concave curvature on the outermost circular zone thereof.”), 17:3-4 (“In the case of the first surface S1, the angle of incidence tends to increase toward its periphery;...”), 11:3-8 (further explaining that “since the absolute value of the radius of curvature at the center of the **second surface S2** is extremely large compared with that of the **first surface S1**, the *center zone* [of the **second surface S2**] *appears almost flat* [*i.e.*, has a small concavity].”).



EX1005, Figure 13. EX1002, ¶123.

Specifically, Shikama teaches that its lens system “satisfies the following conditional expressions:

$$0.42 < r_{1/nf} < 0.45 \quad (2)$$

$$18 < |r_2/nf| \quad (3)$$

$$-0.39 < K_1 < -0.25 \quad (4)$$

$$0.11 < \Delta 2/f < 0.14 \quad (5)$$

where

f: focal length of the whole lens system

n: refractive index of the lens

r1: radius of center curvature of the **first surface S1**

r2: radius of center curvature of the **second surface S2**...” EX1005, 11:9-

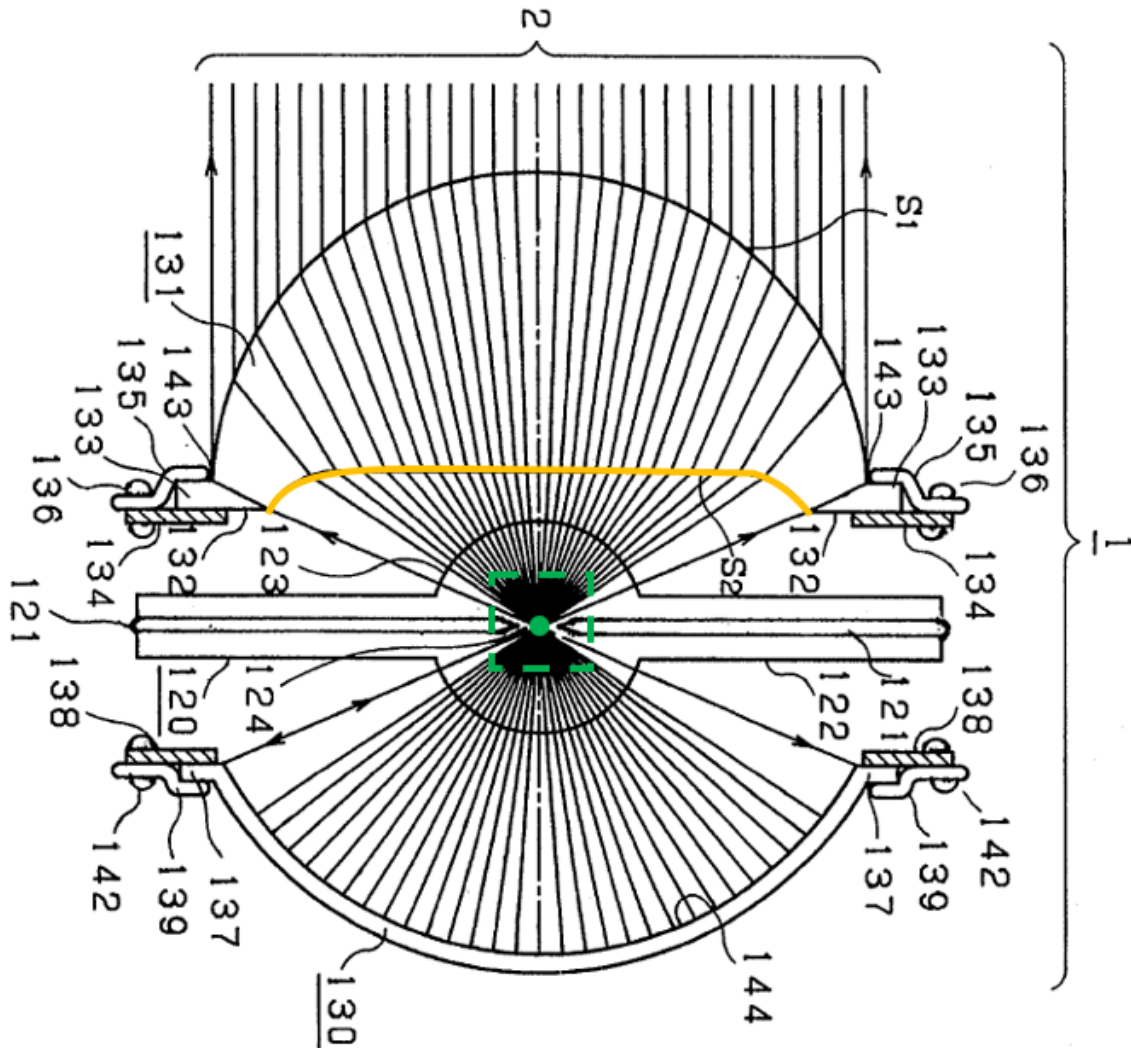
34. Analyzing these conditions further, for a given lens, the refractive index of the lens (n) and the focal length of the whole lens system (f) is the same in equations (2) and (3). Moreover, “[t]he reciprocal of the curvature is called the radius of curvature.” EX1024, 78. Therefore, the curvature associated with the **first surface S1** (*i.e.*, between 1/0.42 and 1/0.45 or between ~2.2 to ~2.4) is significantly greater than the curvature associated with the **second surface S2** (*i.e.*, less than 1/18 or less than ~0.056). Accordingly, Shikama explicitly teaches that a lens having the second concavity associated with **exit surface** being substantially greater than the concavity associated with the **entry surface** was well-known in the art. *See also* Section XI.A.1.xii [Ground I, Reasons To Combine] below. EX1002, ¶¶124-126.

- xii. [1h]-[1j] **said entry surface** having first concavity facing toward **said light source**, and [said entry surface having] second concavity facing toward the **entry surface**, said second concavity⁸ [of the **entry surface**] being substantially greater than said first concavity [of the **entry surface**].

To the extent Patent Owner argues that [1i] requires the **entry surface** (and *not* the **exit surface**) to have a second concavity facing toward itself, Shikama's **second surface S2** satisfies [1h]-[1j]. For example, as shown in Figure 13 of Shikama, "the **second surface S2** is ... of aspherical form having a *strongly concave curvature on the outermost circular zone thereof*," (EX1005, 10:62-65), whereas "the radius of curvature at the center of the **second surface S2** is extremely large ... [because] the *center zone appears almost flat* [*i.e.*, has a small concavity]." EX1005, 11:3-8. Hence, Shikama teaches the **second surface S2** has two different concavities at different regions of the **second surface S2** that face toward the **light source** and/or the central portion of the **second surface S2**.

⁸ "Concavity" based on the degree of curvature.

Fig. 13



EX1005, Figure 13. *See also* Section XI.A.1.xii [Ground I, Reasons To Combine] below. EX1002, ¶¶127-130.

2. Reasons To Combine

A POSITA would have been able to readily modify the **first curved surface 16** and the **second curved surface 18** of Tawa. A POSITA would have been able to make numerous modifications while maintaining Tawa's intended goal of

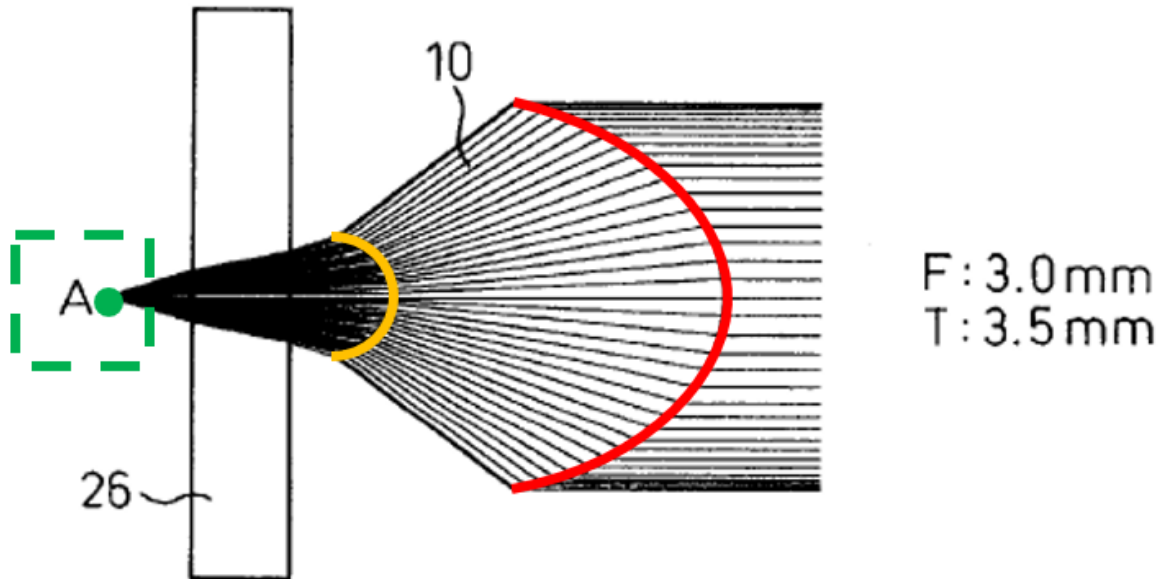
converting the nonuniform light received from a point light source and redistributing the light to achieve a uniform distribution of light that exits the lens surface to project them onto a target surface. A POSITA would have also readily recognized that any types of **point light sources**, whether it be a laser or an LED, can be utilized. EX1002, ¶131.

First, a POSITA would have recognized that any one of the embodiments of Tawa can be combined with each other. Tawa teaches that numerous other shapes of the **first curved surface 16** and the **second curved surface 18** are possible. See EX1004, 8:13-18 (“[S]ince the light intensity distribution converting device 10 has a freedom in shape to some extent, an optimum shape light intensity distribution converting device 10 according to the requirements of dimensional precision or an optical system to be used together therewith can be obtained.”). Indeed, Tawa explicitly shows many different exemplary shapes and curvatures that can output a uniform distribution of light intensity depending on the specific geometry of the system, utilizing the same method to calculate the exact lens shape profile taught by Tawa. For example, Figures 9A-12C of Tawa show several possible shapes of the **first curved surface 16** and the **second curved surface 18**—all of which lead to a uniform beam of light that exits the **second curved surface 18**. In some cases, the light rays exiting the light distribution converting device 10 may be collimated (*e.g.*, as shown in Figures 1, 2, 9A-10C, 14A) or they may further spread out (*e.g.*, as

shown in Figures 18A-18B). All of these variations would have been readily possible to a POSITA based on application of Tawa's teachings. EX1002, ¶132.

Second, a POSITA would have recognized that any one of the embodiments of Tawa can be further modified according to the teachings of Shikama. For example, Tawa shows that the concavity of the **first curved surface 16** can decrease or increase depending on the distance between the light source and the lens. *See, e.g.*, EX1004, 7:47-60, Figures 9A-10C; *see also* Section XI.A.1.xi [Ground I, 1j]. In some cases, such as shown in Figure 9A, both the **first curved surface 16** and the **second curved surface 18** have a single type of concavity (*i.e.*, without changing from concave to convex) throughout each of the two surfaces just like that of Shikama.

Fig. 9A



EX1004, Figure 9A. Similarly, a POSITA would have readily recognized that other exemplary curvatures and shape of the lens, such as those taught by Shikama, are just other obvious variants that would have been readily obtained based on the specific goals and dimensions (*e.g.*, focal length, refractive index, radius of curvatures of the **first surface S1** and the **second surface S2**, and the like) desired by the POSITA. *See* EX1005, 11:9-34. Indeed, making such a modification would have entailed nothing more than routine calculations that a POSITA would have been able to carry out based on the iterative calculation methods taught by Tawa. *See* EX1004, 4:41-43, 5:30-39. In other words, a POSITA would have found the teachings of Tawa and Shikama to readily lead a POSITA to at least try to utilize the

specific lens shape taught by Shikama to achieve a uniform distribution of light taught by Tawa. The modification is nothing more than a simple application of known lens shapes taught by Shikama using known calculation methods taught by Tawa to obtain the predictable result of a lens that can convert a nonuniform distribution of light intensity from a point light source into a uniform distribution of light intensity by the time it reaches the target surface. EX1002, ¶133.

Third, at a minimum, the modification amounts to nothing more than applying a known technique to a known device ready for improvement to yield predictable results. As explained in Sections XI.A.1.v [Ground I, 1d] and XI.A.1.vii and [Ground I, 1f], Tawa teaches how the shapes of the **first curved surface 16** and the **second curved surface 18** can be designed according to a desired system configuration. By applying the same technique—albeit with some of the system constraints of Shikama such as a different distance between the light source and the lens and/or the target surface—a POSITA would have been able to readily calculate the shape of the lens that resemble the shape of the lens described by Shikama, while achieving the desired goal of outputting a uniform distribution of light. *See, e.g.*, EX1004, 7:47-60 (explaining that “[t]he shape of the light intensity distribution converting device differs depending on the distance F between the radiation point A and the device 10.”). Indeed, a POSITA would have recognized that additional improvements, such as an “apparatus that achieves high image brightness with good

color uniformity ... that prevents breakage of a condenser lens due to heat,” (EX1005, 4:35-39), may have been possible. Shikama teaches that by satisfying (among others) the conditions expressed in Shikama’s Equations 2 and 3, a condenser lens having a number of advantages (*e.g.*, “reduced spherical aberration,” “long back focal length,” etc.) can be obtained. *See* EX1005, 4:57-5:45. A POSITA would have recognized that the modification would have led to the predictable result of a condenser lens that emits collimated light having a uniform intensity distribution. *See* EX1004, 2:40-47; EX1005, 24:46-62. EX1002, ¶134.

Fourth, a POSITA would have readily recognized that any small **light source** can be utilized. For example, certain embodiments, such as embodiment associated with Figure 20, may be combinable with any of the other embodiments, such as embodiment associated with Figures 1-5 in which any of the light sources can be utilized. Both lasers and LEDs are compact sized light sources that can be placed near a lens. The embodiment associated with Figure 20 (that utilizes LEDs) merely implements the embodiment associated with Figures 1-5 (that utilizes lasers) in a lighting apparatus. And a POSITA would have readily recognized that the same principles would have been equally applicable in either embodiment. EX1002, ¶135.

Finally, a POSITA would have been able to make the modification with a reasonable expectation of success because the modification merely entails carrying out simple optical calculations that were well known in the art, as explained in Tawa

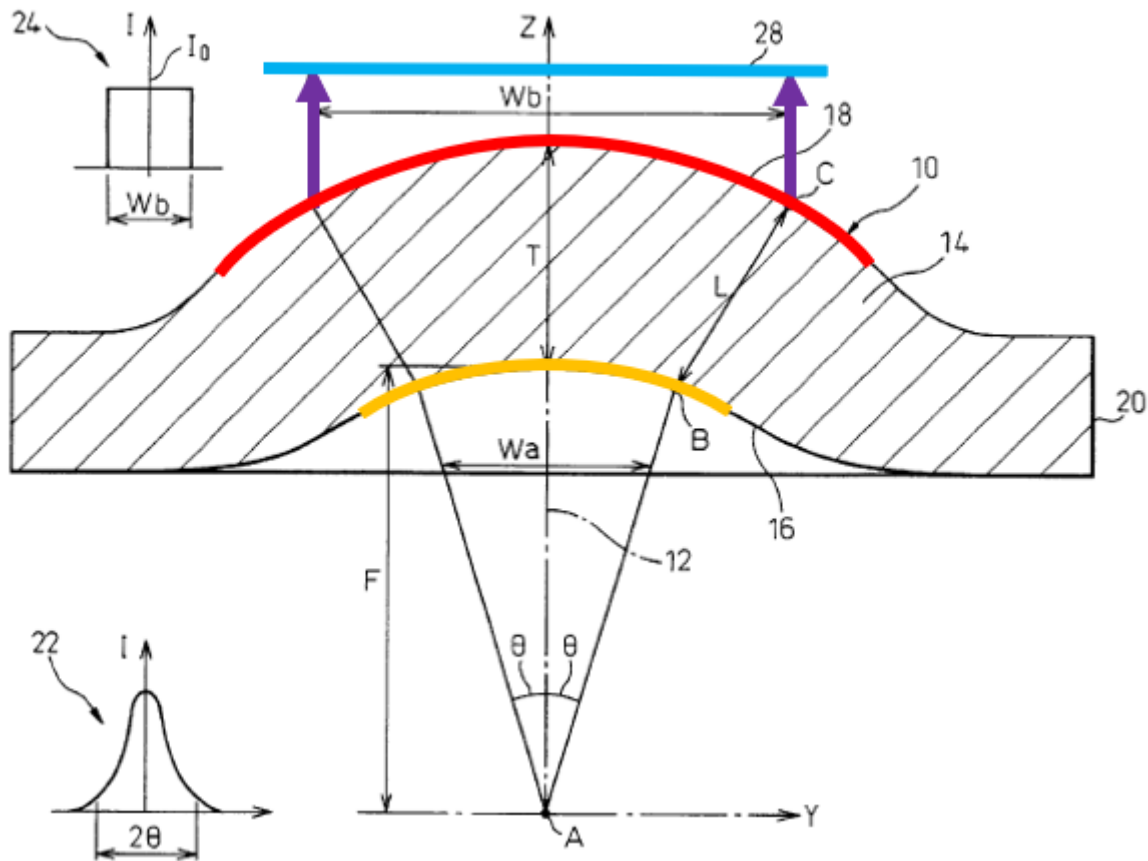
itself, to obtain a slightly different lens shape with similar point light sources, such as explained in various embodiments of Tawa and Shikama. *See* EX1004, 4:41-6:31. The modification would have led to the same predictable result of a lens that emits light having a uniform intensity distribution. *See* EX1004, 2:40-47; EX1005, 24:46-62. EX1002, ¶136.

3. Dependent Claim 4

- i. [4] The lens of claim 1 wherein **said output beam** has **predominantly uniform intensity within a predetermined angular limit**.

Tawa teaches the added limitation of [4]. As explained in Section XI.A.1.vii [Ground I, 1f], Tawa teaches that “[t]he light emerges the body 14 from the **second curved surface 18** as parallel light having a uniform light intensity distribution 24.” EX1004, 4:38-40; *see also id.*, 4:59-65 (explaining that “**the emission light** has a uniform light intensity distribution”), 10:23-30.

Fig. 1



EX1004, Figure 1. EX1002, ¶¶137-138.

Moreover, as shown in Figure 1 above, the **emitted light** is within a predetermined angular limit, as demarcated by Wb. EX1004, 4:51-54 (“Wa represents the aperture diameter of incident light upon the light intensity distribution converting device 10, and Wb represents the aperture diameter of the light emerging therefrom.”), 6:6-10 (explaining the shape of the lens can vary depending on, among other factors, “the emission aperture diameter Wb.”). EX1002, ¶139.

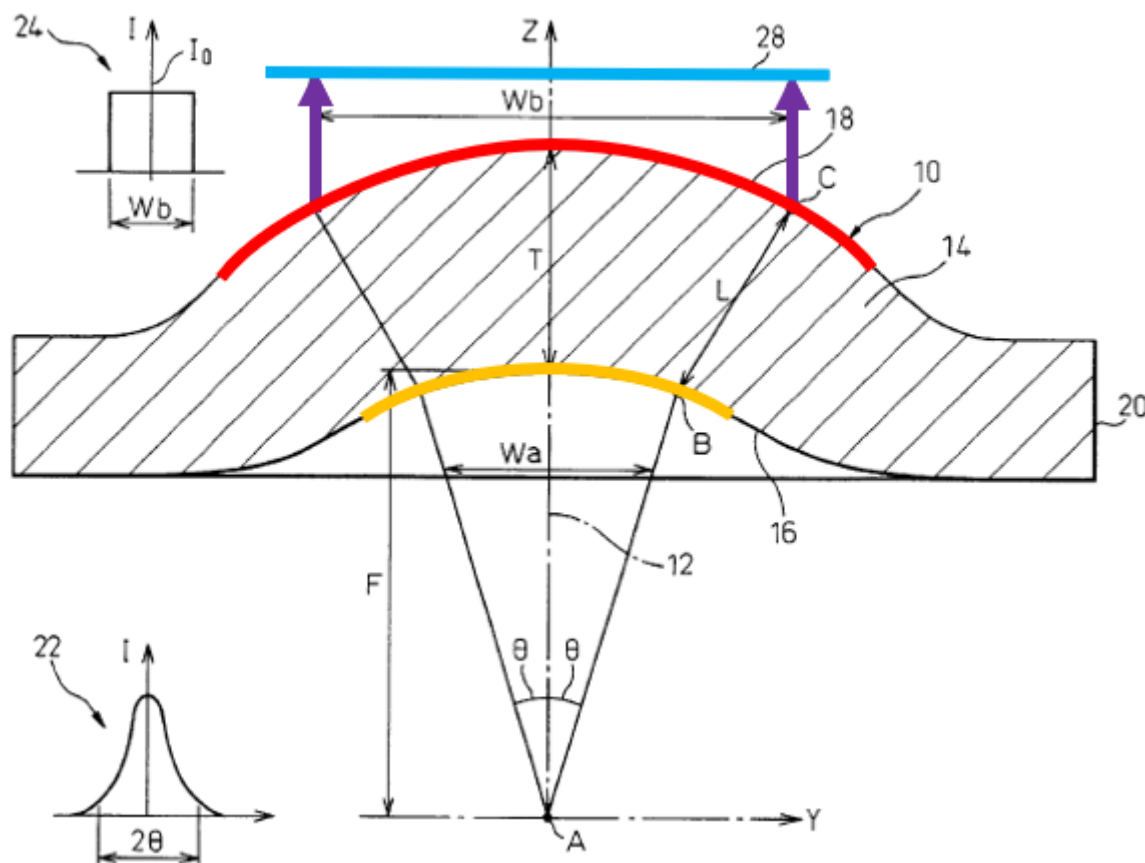
4. Dependent Claims 5-6

i. [5] The lens of claim 1 wherein said output beam uniformly illuminates a **target zone**.

[6] The lens of claim 5 wherein said **target zone** is on a plane facing said lens.

Tawa teaches the added limitation of [5]. As explained in Section XI.A.1.vii [Ground I, 1f], Tawa teaches that “[t]he light emerges the body 14 from the **second curved surface 18** as parallel light having a uniform light intensity distribution 24.” EX1004, 4:38-40; *see also id.*, 4:59-65 (explaining that “**the emission light** has a uniform light intensity distribution”), 10:23-30. And as shown in Figure 1 below, the light is illuminated onto “**surface 28**, which lies in a plane perpendicular to the Z-axis and which is located beyond the point C” and faces the lens. EX1004, 4:41-47; *see also id.*, 5:57-67.

Fig. 1



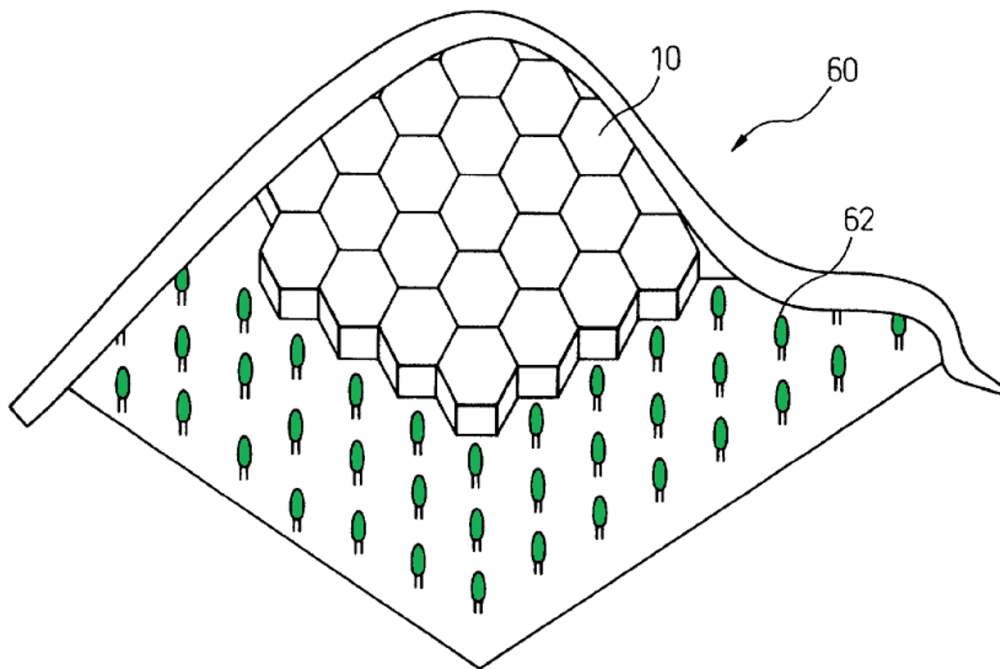
EX1004, Figure 1. EX1002, ¶¶140-142.

5. Dependent Claim 8

- i. [8] The lens of claim 1 wherein said **light source** is a **light emitting diode**.

Tawa teaches and/or renders obvious the added limitation of [8]. As explained in Section XI.A.1.iii [Ground I, 1b], Tawa teaches that “[p]oint A can be, for example, a laser.” EX1004, 4:9-10. Alternatively, or additionally, Tawa teaches that the light source can be “composed of light emitters, such as light emitting

Fig. 20



6. Dependent Claim 31

- Tawa teaches [31pre]. Tawa’s “FIG 20 shows an embodiment of a lighting apparatus 60 using a light source 62 and the **light intensity distribution converting**

device 10.” EX1004, 10:18-20; *see also* Section XI.A.1 [Ground I, Claim 1].
EX1002, ¶¶145-146.

ii. [31a] LED means,

Tawa teaches and/or renders obvious [31a]. At the outset, the term “LED means” recites no function corresponding to the claimed means and does not invoke means-plus-function treatment. *See Aristocrat Techs. Australia Pty Ltd. v. Multimedia Games, Inc.*, 266 F. App’x 942 (Fed. Cir. 2008) (“A presumption applies that a claim limitation that includes the word “means” is intended to invoke means-plus-function treatment. ... However, that presumption may be rebutted (1) if the claim limitation recites no function corresponding to the means...”) (*citing York Products, Inc. v. Cent. Tractor Farm & Family Ctr.*, 99 F.3d 1568, 1576 (Fed.Cir.1996) (“Without a ‘means’ sufficiently connected to a recited function, the presumption in use of the word ‘means’ does not operate.”)). As such, a construction under 37 C.F.R. §42.104(b)(3) is not required.⁹ EX1002, ¶147.

Tawa teaches and/or renders obvious the claimed “LED means” because Tawa teaches “light source 62 composed of light emitters, such as **light emitting diodes**.” EX1004, 10:20-23; *see also* 10:35-37 (explaining “this lighting apparatus

⁹ Even if a construction is required, “LED means” includes an LED and its equivalents. *See, e.g.*, EX1001, 2:53-64.

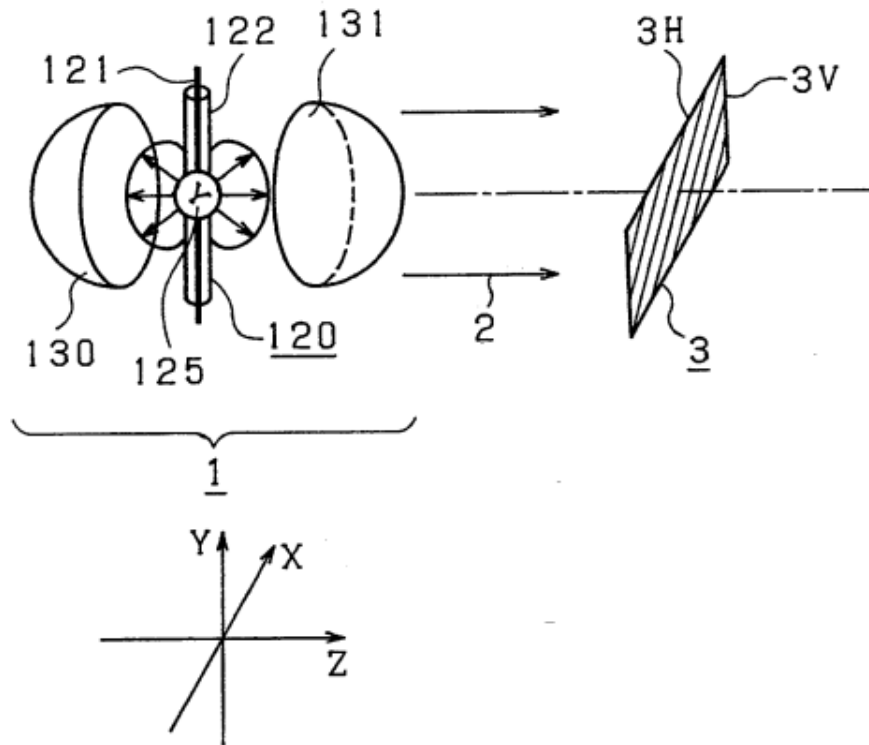
can be used when an **LED** array or the like is used for a lighting device...”). *See also* Section XI.A.5.i [Ground I, 8]. EX1002, ¶¶148-149.

iii. [31b] the lens having a concave lower refracting surface receiving rays from said LED means,

Assuming the claim term “a concave lower refracting surface” refers to the “entry surface” claimed in claim 1 (and not an additional surface in addition to the claimed “entry surface”), Tawa teaches, Tawa renders obvious, and/or Tawa in combination with Shikama renders obvious [31b]. *See* Sections XI.A.1.iii [Ground I, 1b], XI.A.1.ix [Ground I, 1h], XI.A.1.xii [Ground I, 1h-1j], and XI.A.5.i [Ground I, 8]. EX1002, ¶¶150-151.

iv. [31c] the lens having a dome-shaped refracting upper surface, the curvature of which is one of the following: i) exceeds the curvature of the lower surface, ii) is less than the curvature of the lower surface,

Assuming the claim term “a dome-shaped refracting upper surface” refers to the “exit surface” claimed in claim 1 (and not an additional surface in addition to the claimed “exit surface”), Tawa teaches, Tawa renders obvious, and/or Tawa in combination with Shikama renders obvious [31b]. *See* Sections XI.A.1.ii [Ground I, 1a], XI.A.1.iv [Ground I, 1c], XI.A.1.vi [Ground I, 1e], XI.A.1.vii [Ground I, 1f], and XI.A.1.ix [Ground I, 1h] through XI.A.1.xii [Ground I, 1h-1j]; *see also* EX1005, Figure 17 (showing a dome-shaped condenser lens 131).



EX1005, Figures 17, 13. EX1002, ¶¶152-153.

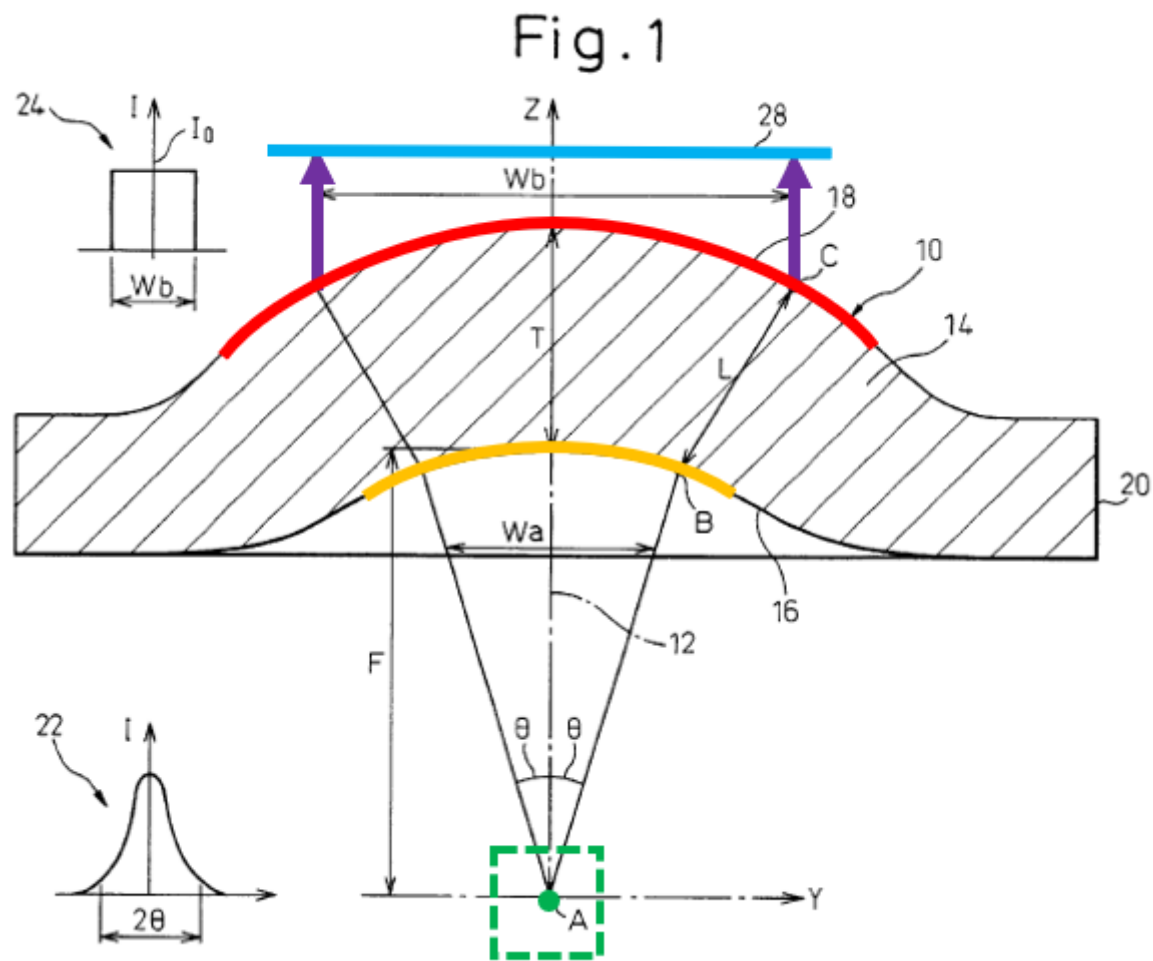
- v. [31d] a target surface receiving rays refracted by said upper surface,

Tawa teaches [31d]. See Sections XI.A.1.vii [Ground I, 1f] and XI.A.4 [Ground I, 5 and 6]. EX1002, ¶154.

- vi. [31e] said LED means and said upper and lower surfaces configured to produce a profile of bounded flux at said target surface that provides substantially uniform illuminance.

Tawa teaches, Tawa renders obvious, and/or Tawa in combination with Shikama renders obvious [31e]. See Sections XI.A.3.i [Ground I, 4], XI.A.4.i

[Ground I, 5 and 6], XI.A.5.i [Ground I, 8]. Specifically, **emitted light** having a uniform illuminance also has a **flux** that is bounded by W_b because the output rays are parallel to the Z-axis. EX1004, 4:41-43 (“The inclination of the second curved surface 18 is determined such that the light emerging the body from the point C travels in parallel with the Z-axis.”).



EX1004, Figure 1. EX1002, ¶¶155-156.

7. Independent Claim 39

i. [39pre] An irradiance-redistribution lens comprising

Tawa teaches [39pre]. *See* Section XI.A.1.i [Ground I, 1pre]. EX1002, ¶157.

ii. [39a] a transparent dielectric formed as a solid of revolution with an axis about which a planar curved profile-line is swept,

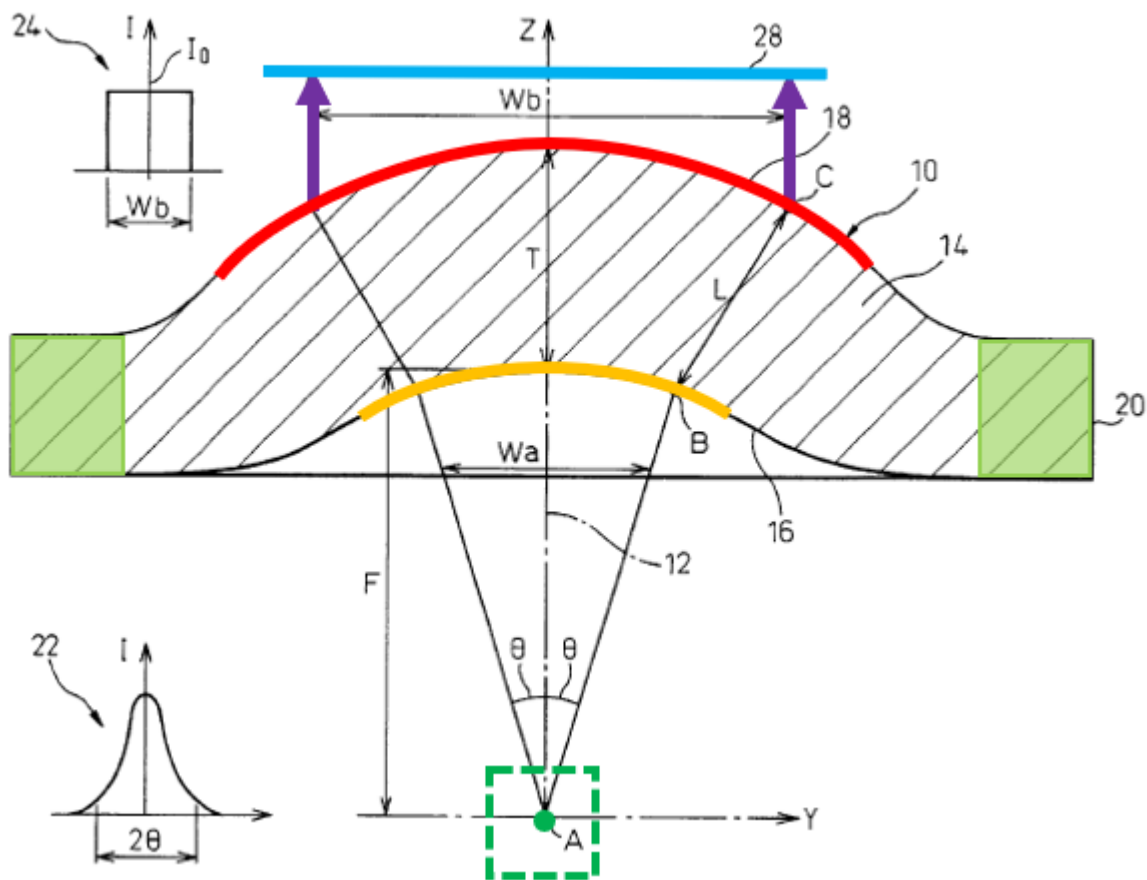
Tawa teaches [39a]. Tawa teaches “a transparent dielectric formed as a solid of revolution.” *See* Section XI.A.1.ii [Ground I, 1a]. Furthermore, Tawa teaches that the transparent dielectric is formed as a solid of revolution “with an axis about which a planar curved profile-line is swept.” Tawa explains that “the light intensity distribution converting device 10 is an optical device, having a rotation-symmetric shape regarding the Z-axis.” EX1004, 4:12-15; *see also* EX1004, 3:55-57. Tawa further explains that “[t]he body 14 has a first curved surface 16 transversely extending with respect to the central axis 12” and “a second curved surface 18 located on the side opposite to the first curved surface 16...” EX1004, 3:59-65. These curved surfaces meet the claimed “planar curved profile-line” that, when “swept” about the central axis 12, forms the solid of revolution. EX1002, ¶¶158-160.

- iii. [39b] with external surface area comprised of an optically active entry surface, an optically active exit surface, and an optically inactive mounting surface;

Tawa teaches, Tawa renders obvious, and/or Tawa in combination with Shikama renders obvious [39b]. Specifically, Tawa discloses an “external surface area comprised of an optically active entry surface[and] an optically active exit surface.” See Section XI.A.1.ii [Ground I, 1a], XI.A.1.iii [Ground I, 1b] and XI.A.1.iv [Ground I, 1c]. EX1002, ¶¶161-162.

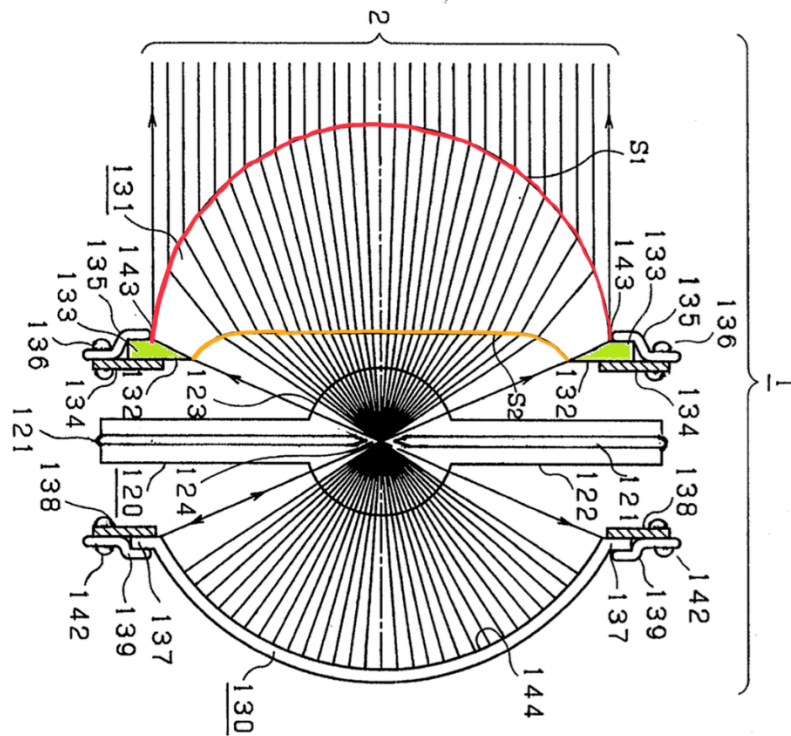
As for the claimed “optically inactive mounting surface,” as shown below, Figure 1 of Tawa shows flange portions (annotated below) that light rays from light source A do not reach and is optically inactive.

Fig. 1



EX1004, Figure 1. EX1002, ¶163.

Shikama similarly discloses “use of ... **flange 133** integrally formed around the peripheral of the effective diameter thereof.” EX1005, 16:10-12. As Shikama explains, the “**flange** for holding the lens in position can be formed from the plane faces on both surfaces, which facilitates the mounting of the lens.” EX1005, 14:28-32.



EX1005, Figure 13. EX1002, ¶164.

It would have been obvious to use Tawa's optically inactive portions as a mounting surface as taught by Shikama with a reasonable expectation of success as it would have merely amounted to nothing more than using the similarly shaped optically inactive regions of the lens for the same predictable purpose of mounting the lens onto a desired structure. EX1002, ¶165.

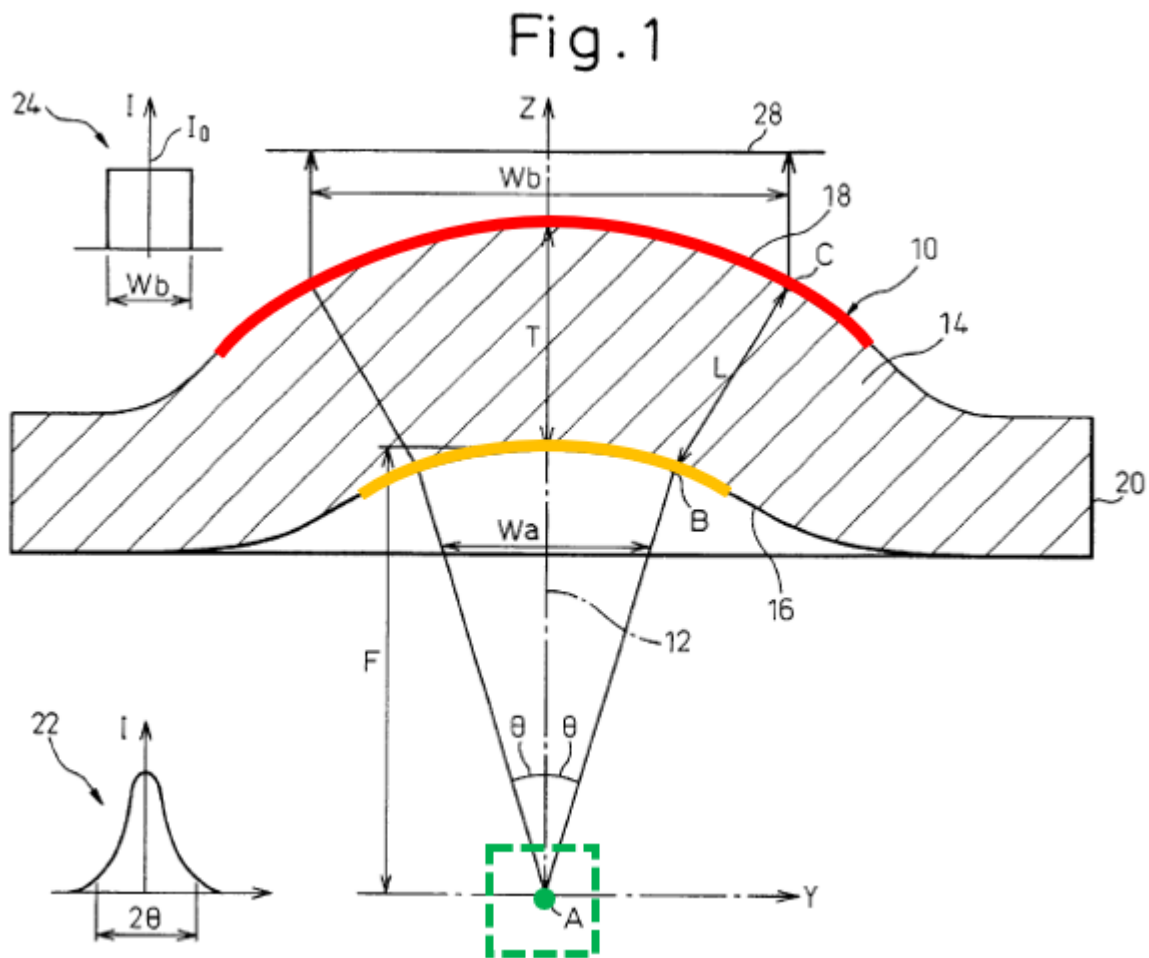
- iv. [39c] **said entry surface** receiving light of nonuniform irradiance from **a compact light source** situated on said axis in a nearby focal zone;

Tawa teaches and/or renders obvious [39c]. Tawa discloses “**said entry surface** receiving light of nonuniform irradiance from **a compact light source**.” See Section XI.A.1.iii [Ground I, 1b]. EX1002, ¶¶166-167.

Furthermore, Tawa teaches that the “**compact light source** is situated on said axis in a nearby focal zone.” Tawa describes that “**point A** is the object focal point” that passes through the optical axis. EX1004, 6:39-40; *see also* EX1004, Figures 18A-18B, 9:48-65 (explaining that the “focal length of the collimator lens 54 is represented by *f*” which is near “the light source 52”), 4:2-6 (“In these figures, the Z-axis passing through the point A defines the optical axis direction...”). EX1002, ¶158.

- v. [39d] **said entry surface** having a specific profile that produces refractive deflection of said received light into interiorly propagating light of a different solid angle;

Tawa teaches [39d]. See Section XI.A.1.v [Ground I, 1d]. Specifically, as shown in Figure 1, light from **point source A** refracts at the **first curved surface 16** towards the interior portion of the lens at a different solid angle and propagates through the interior portion of the lens. EX1004, 4:29-40.



EX1004, Figure 1. EX1002, ¶¶169-170.

- vi. [39e] **said exit surface** opposing **said entry surface** and receiving said internally propagating light therefrom;

Tawa teaches and/or renders obvious [39e]. *See* Sections XI.A.1.iv [Ground I, 1c] and XI.A.1.vi [Ground I, 1e]. EX1002, ¶171.

- vii. [39f] **said exit surface** forming a **pre-specified diverging output beam** from said internally propagating light;

Tawa teaches and/or renders obvious [39f]. *See* Section XI.A.1.iv [Ground I, 1c]. EX1002, ¶172.

- viii. [39g] **said entry-surface** deflection spatially distributed such that **said exit surface** receives said deflected light with predominantly uniform irradiance,

Tawa teaches and/or renders obvious [39g]. *See* Section XI.A.1.vi [Ground I, 1e]. EX1002, ¶173.

- ix. [39h] **said exit surface** given a specific shape that refractively deflects said uniform irradiance into **said output beam**;

Tawa teaches [39h]. *See* Section XI.A.1.vii [Ground I, 1f]. EX1002, ¶174.

- x. [39i] **said light source** being sufficiently compact for said specific shapes to be calculated by mathematical integration of the slope distributions required by said refractive deflections,

Tawa teaches and/or renders obvious [39i]. *See* Section XI.A.1.viii [Ground I, 1g]. EX1002, ¶175.

- xi. [39j] **said entry surface** having first concavity facing toward said **light source**,

Tawa in combination with Shikama renders obvious [39j]. *See* Sections XI.A.1.ix [Ground I, 1h]. EX1002, ¶176.

- xii. [39k] and [said **exit surface** having] second concavity facing toward **the entry surface**,

Tawa in combination with Shikama renders obvious [39k]. *See* Section XI.A.1.x [Ground I, 1i]. EX1002, ¶177.

- xiii. [39l] said second concavity [of the **exit surface**] being substantially greater than said first concavity [of the **entry surface**].

Tawa in combination with Shikama renders obvious [39l]. *See* Sections XI.A.1.xi [Ground I, 1j]. EX1002, ¶178.

- xiv. [39j]-[39l] **said entry surface** having first concavity facing toward **said light source**, and [said **entry surface** having] second concavity facing toward the **entry surface**, said second concavity [of the **entry surface**] being substantially greater than said first concavity [of the **entry surface**].

Shikama's **second surface S2** satisfies [39j]-[39l]. *See* Section XI.A.1.xii [Ground I, 1h-1j]. EX1002, ¶179.

8. Dependent Claim 43

- i. [43pre] A light redistribution system comprising, in combination with a lens as defined in claim 1,

Tawa teaches [43pre]. *See* Section XI.A.6.i [Ground I, 31pre]. EX1002, ¶180.

ii. [43a] **said light source comprising LED means,**

Tawa teaches and/or renders obvious [43a]. *See* Section XI.A.6.ii [Ground I, 31a]. EX1002, ¶181.

iii. [43b] **the lens concave lower refracting surface receiving rays from said LED means,**

Tawa teaches, Tawa renders obvious, and/or Tawa in combination with Shikama renders obvious [43b]. *See* Section XI.A.6.iii [Ground I, 31b]. EX1002, ¶182.

iv. [43c] **the lens having a dome-shaped refracting exit surface, the curvature of which is one of the following: i) exceeds the curvature of the lower surface, ii) is less than the curvature of the lower surface,**

Tawa teaches, Tawa renders obvious, and/or Tawa in combination with Shikama renders obvious [43c]. *See* Section XI.A.6.iv [Ground I, 31c]. EX1002, ¶183.

v. [43d] **there being a target surface receiving rays refracted by said exit surface,**

Tawa teaches [43d]. *See* Section XI.A.6.v [Ground I, 31d]. EX1002, ¶184.

- vi. [43e] **said LED means and said entry and exit surfaces configured to produce a profile of bounded flux at said target surface that provides substantially uniform illuminance.**

Tawa teaches, Tawa renders obvious, and/or Tawa in combination with Shikama renders obvious [43e]. *See* Section XI.A.6.vi [Ground I, 31e]. EX1002, ¶185.

B. Ground II: Tawa In Combination With Shikama And Scharf Renders Obvious Claim 9

1. Dependent Claim 9

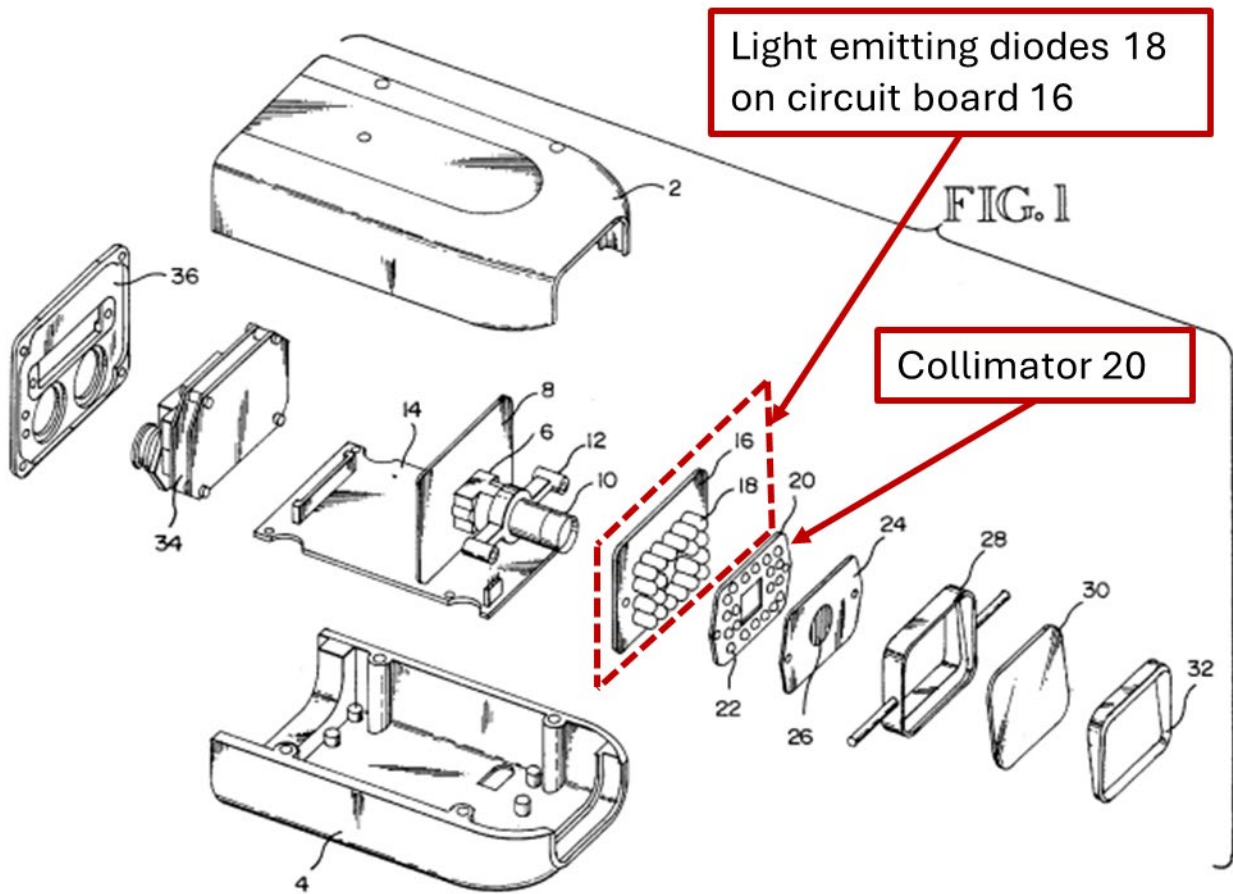
- i. [9a] **Multiple lenses as defined in claim 8 laterally arrayed in proximity, above multiple light sources,**

Tawa teaches and/or renders obvious [9a]. Tawa’s “FIG 20 shows an embodiment of a lighting apparatus 60 using a light source 62 and the **light intensity distribution converting device 10**. In this embodiment, the light source 62 composed of light emitters, such as **light emitting diodes**, is a two-dimensional arrangement, and the **light intensity distribution converting devices** of a honeycomb shape are arranged corresponding to the light emitters.” EX1004, 10:18-23; *see also* Sections XI.A.1 [claim 1] and XI.A.5.i [claim 8]. EX1002, ¶¶186-187.

- ii. [9b] **in association with a common circuit board, and**

Tawa in combination with Scharf renders obvious [9b]. While Tawa does not explicitly state that its **light emitting diodes (LEDs)** are associated with a common

circuit board, a POSITA would have found this to be obvious. For example, as shown below, Scharf teaches a two-dimensional array of **LEDs**, in which light emitted from **LEDs 18** passes through a collimator 20 to produce a uniform, high-intensity illumination on the target surface. EX1006, 2:58-60 (“The light emitted from the LEDs is passed through a collimator and an optical diffuser in order to provide a uniform high intensity illumination of the target symbol.”), 3:64-4:36 (“In the present invention collimator 20 is comprised of an array of collimating lenses arranged in the same pattern and in one-to-one alignment with the LEDs of array 18.”). Specifically, Scharf explains that “array of light-emitting diodes 18 are arranged in a generally rectangular pattern on LED printed *circuit board 16*.” EX1006, 4:2-4.



EX1006, Figure 1 (annotated). EX1002, ¶¶188-189.

iii. [9c] having their output beams illuminating the same target.

Tawa teaches and/or renders obvious [9c]. Tawa teaches that “the lighting apparatus can be used for, for example, a backlight of a display and can increase the illuminance in a given direction without light quantity loss.” EX1004, 10:30-33. Tawa further teaches that “this lighting apparatus can be used when an LED array or the like is used for a lighting device for a microscope.” EX1004, 10:35-37. In

other words, the same target, such as the display surface or the microscope sample, is illuminated by their output beams. EX1002, ¶¶190-191.

2. Reasons To Combine Tawa And Shikama With Scharf

A POSITA would have been motivated to arrange the light emitting diodes in Tawa's lighting apparatus on a common circuit board, as Scharf teaches, with a reasonable expectation of success for at least the following reasons. EX1002, ¶192.

First, both Tawa and Scharf disclose arrays of LEDs with lenses positioned on each LED. EX1004, 10:20-27 (“In this embodiment, the light source 62 composed of light emitters, such as light emitting diodes, is a two-dimensional arrangement, and the light intensity distribution converting devices of a honeycomb shape are arranged corresponding to the light emitters.”) Fig. 20; EX1006, 4:11-14 (“In the present invention collimator 20 is comprised of an array of collimating lenses arranged in the same pattern and in one-to-one alignment with the LEDs of array 18.”). A POSITA would have readily recognized that Tawa's LEDs also require providing electrical connection for them to function properly, and would have readily recognized that arranging the LEDs in Tawa's lighting device onto a circuit board, as taught by Scharf, involves a straightforward application of a known method. This arrangement represents one of a finite number of predictable solutions for arranging LEDs to yield the predictable results of an LED array that emits light. EX1002, ¶193.

Second, both Tawa and Scharf are directed to devices that produce uniform illumination on a target surface. EX1004 4:38-40 (“[t]he light emerges the body 14 from the second curved surface 18 as parallel light having a uniform light intensity distribution 24.”), 4:59-65 (explaining that “the emission light has a uniform light intensity distribution”), 10:23-30; EX1006, 2:58-60 (“The light emitted from the LEDs is passed through a collimator and an optical diffuser in order to provide a uniform high intensity illumination of the target symbol.”). It was well known that the LEDs may be arranged on a circuit board to produce illumination—and in particular uniform illumination. A POSITA would therefore have found it obvious to adopt this configuration in Tawa’s device as well, representing a simple combination that achieves the same predictable results of uniform illumination. EX1002, ¶¶194.

Third, arranging LEDs onto a circuit board, as disclosed in Scharf, represents one of a finite number of known and predictable solutions for integrating LED arrays in a lighting device. A POSITA would have had a reasonable expectation of success in making such a modification, as it involves standard and conventional methods for providing electrical connections and power to LEDs in a manner that was well-known in the field of LED-based lighting systems. EX1002, ¶197.

Finally, a POSITA would have combined Tawa with Shikama as explained in Section XI.A.2 [Ground I, Reasons To Combine]. And a POSITA would have

been able to similarly take the combined Tawa/Shikama system and further modify with Scharf as this merely involves placing the light source (*e.g.*, light emitting diodes) disclosed by Tawa onto a circuit board, as explained above. EX1002, ¶¶195-196.

C. Grounds III And IV: Tawa Anticipates And/Or Renders Obvious Claims 1, 4-6, 8, 31, 39, And 43

1. Independent Claim 1

- i. [1pre]: An irradiance-redistribution illumination lens comprising**

Tawa teaches [1pre]. *See* Section XI.A.1.i [Ground I, 1pre]. EX1002, ¶198.

- ii. [1a] a transparent dielectric solid of revolution with external surface area predominantly comprised of**

Tawa teaches [1a]. *See* Section XI.A.1.ii [Ground I, 1a]. EX1002, ¶199.

- iii. [1b] an entry surface that receives light of nonuniform irradiance from a nearby compact light source and**

Tawa teaches and/or renders obvious [1b]. *See* Section XI.A.1.iii [Ground I, 1b]. EX1002, ¶200.

- iv. [1c] of an opposing exit surface that forms from said received light a pre-specified diverging output beam;**

Tawa teaches and/or renders obvious [1c]. *See* Section XI.A.1.iv [Ground I, 1c]. EX1002, ¶201.

- v. [1d] **said entry surface** given a specific profile that refractively deflects said received light into a different solid angle,

Tawa teaches [1d]. See Section XI.A.1.v [Ground I, 1d]. EX1002, ¶202.

- vi. [1e] **said entry surface** spatially distributed such that **said exit surface** receives said deflected light with predominantly uniform irradiance,

Tawa teaches and/or renders obvious [1e]. See Section XI.A.1.vi [Ground I, 1e]. EX1002, ¶203.

- vii. [1f] **said exit surface** given a specific shape that refractively deflects said uniform irradiance into **said output beam**;

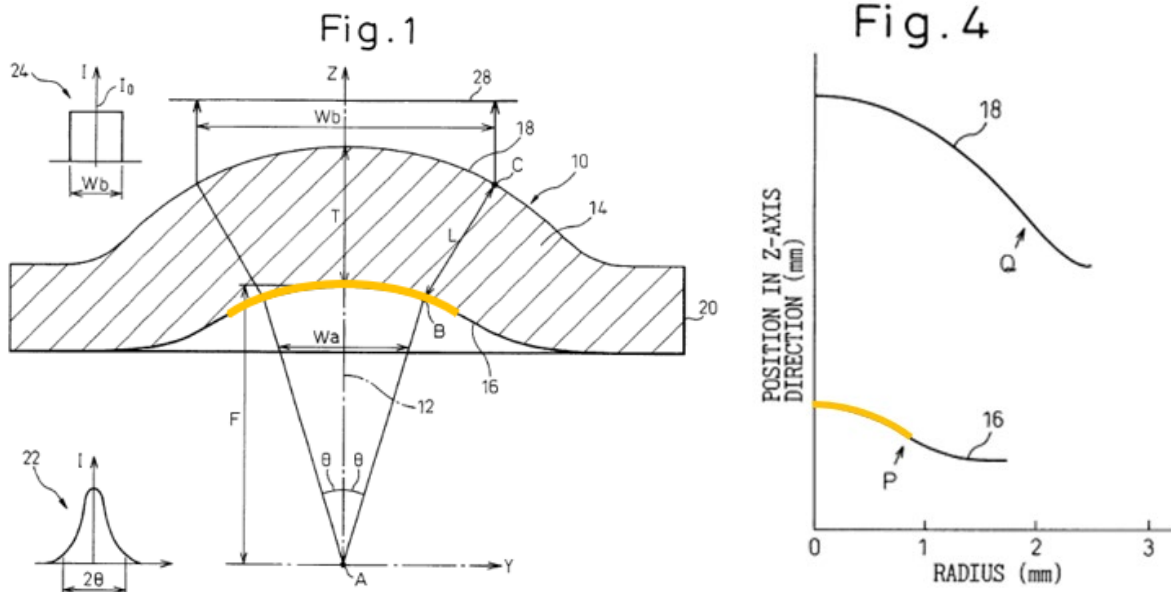
Tawa teaches [1f]. See Section XI.A.1.vii [Ground I, 1f]. EX1002, ¶204.

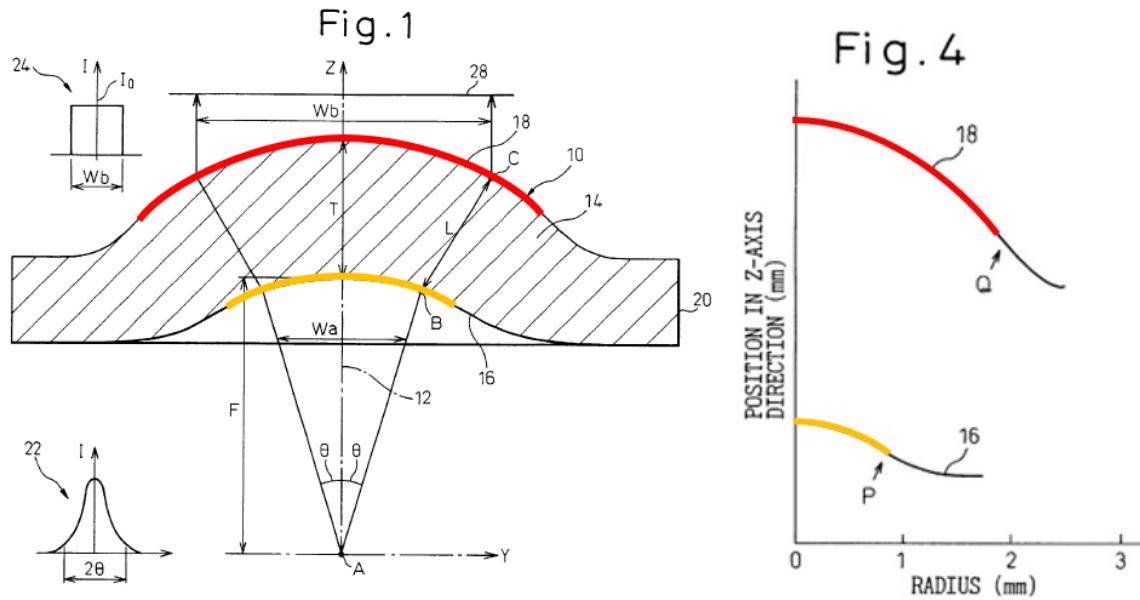
- viii. [1g] **said light source** being sufficiently compact for said specific shapes to be calculated by mathematical integration of the slope distributions required by said refractive deflections,

Tawa teaches [1g]. See Section XI.A.1.viii [Ground I, 1g]. EX1002, ¶205.

- ix. [1h] **said entry surface** having first concavity facing toward **said light source**,

To the extent Patent Owner argues that the “first concavity” can exist on any portion of the “**entry surface**,” Tawa teaches [1h] because as shown below in Figures 1 and 4, a portion of the **first curved surface 16** has a concavity that faces toward the **light source at point A**.





EX1004, Figures. 1, 4; *see also id.*, 4:21-22 (“[T]he **second curved surface 18** is defined by a generally rounded convex surface.”). EX1002, ¶¶208-209.

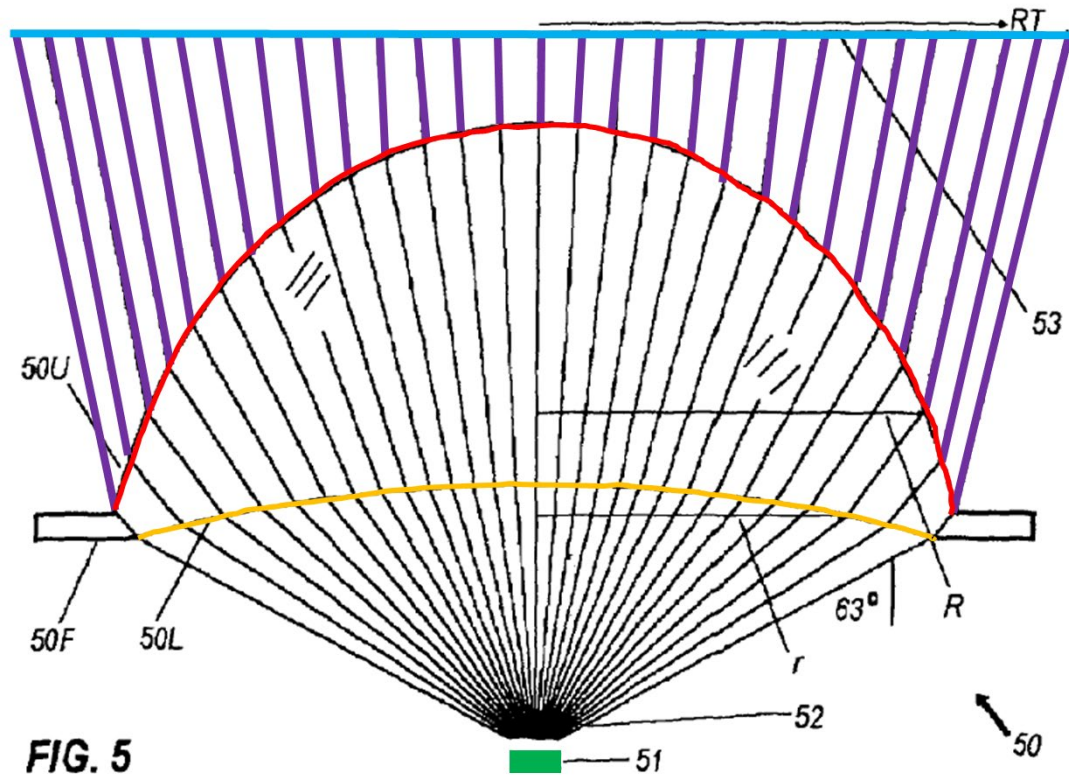
- xi. [1j] said second concavity¹⁰ [of the **exit surface**] being substantially greater than said first concavity [of the **entry surface**].

To the extent Patent Owner argues that the term “concavity” requires a special meaning that is different than something that can be measured by the curvature of the surfaces of the lens, Tawa teaches [1j]. EX1002, ¶210.

Regarding the special meaning, [1h]-[1i] were added by amendment during prosecution to overcome prior art. *See* EX1003, 169-170. And in making this

¹⁰ “Concavity” based on the concave portion spanning a greater portion of the lens.

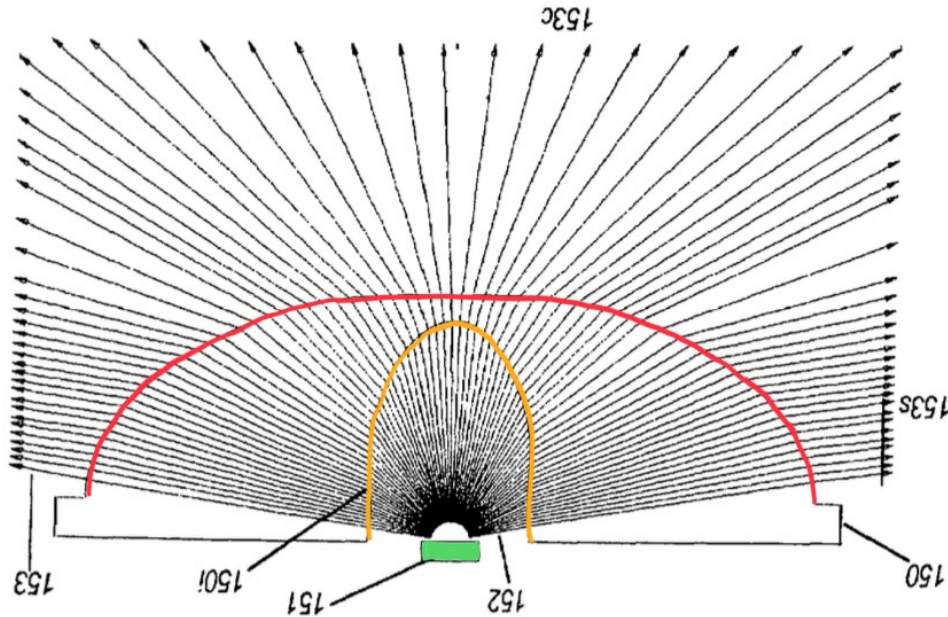
amendment, Applicant clarified that the added limitations are directed to the embodiment shown in Figure 5, reproduced below. *See* EX1003, 186 (“Base claim 1 now further defines over the art, including Minano.... In this regard, the entry and exit concave surfaces are for example see at 50L and 50U in Fig. 5, the light source being at 51. Note also beam refractions. Minano configurations lack suggestion of such lesser and greater concave surfaces, as claimed, ...”).



EX1001, Figure 5. EX1002, ¶211.

Applicant did not comment on whether claim 1 encompasses any other embodiment(s) described in the specification. However, the '162 Patent includes

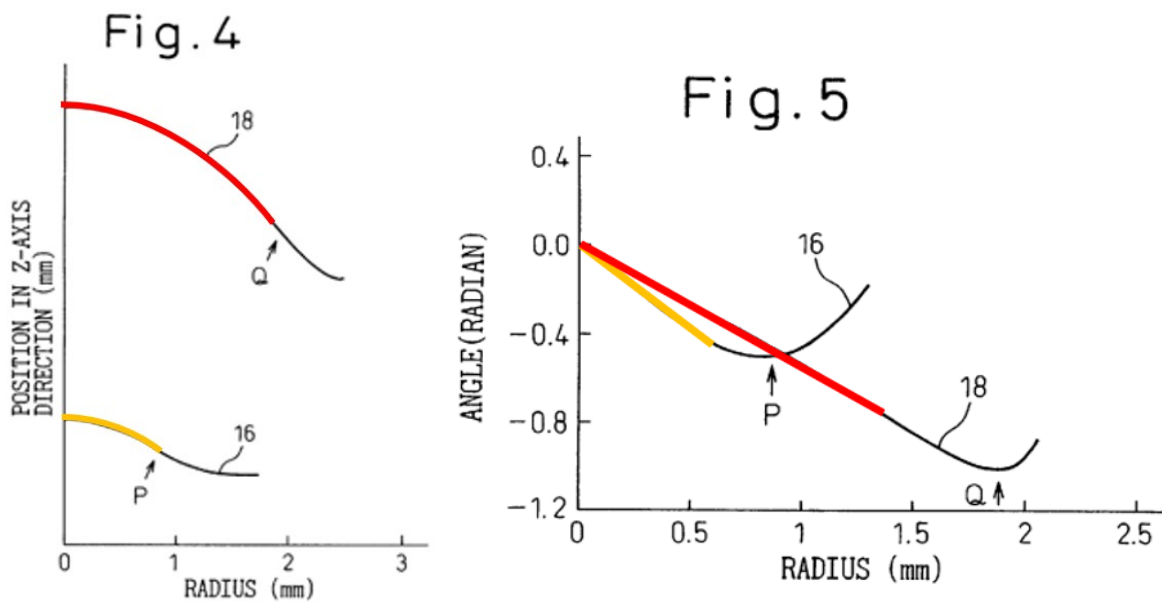
another embodiment shown in Figure 15A, in which the **second concavity** is smaller than the **first concavity** if the term “concavity” refers to the “curvature.” As such, the amendments made during prosecution carved out the embodiment shown in Figure 15A.



EX1001, Figure 15A. EX1002, ¶212.

To the extent that Patent Owner argues that Figure 15A is nevertheless encompassed by the claims, such as by arguing that the “second concavity” is greater than the “first concavity” merely because the concave portion spans a greater portion of the lens along the radial direction (and/or as measured by the circumference), Tawa discloses [1j]. EX1002, ¶213.

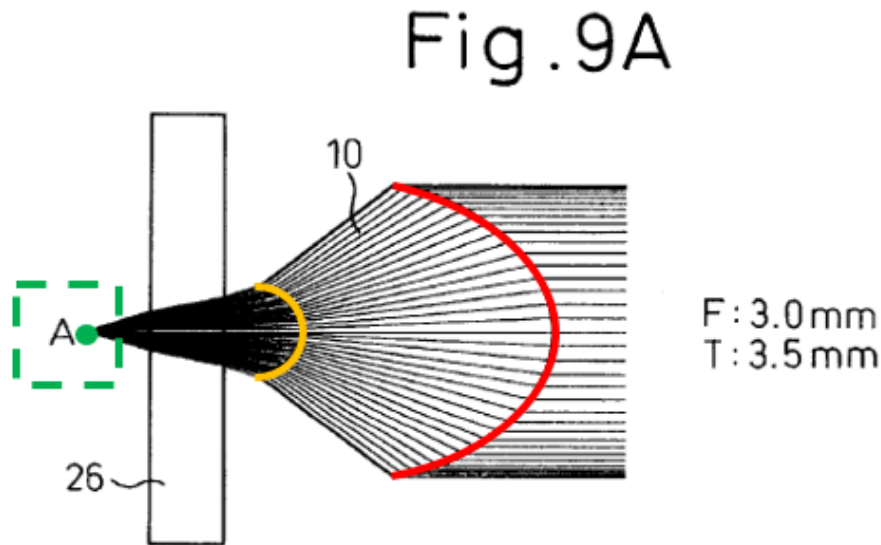
As explained above, Tawa shows the shape of the **first curved surface 16** and the **second curved surface 18** in Figure 4, with the inflection points denoted as P and Q, respectively. EX1004, 6:12-14 (“FIG. 4 shows the shape of the first and second curved surface **16** and **18** of the light intensity distribution converting device 10 shown in FIG. 2.”).



EX1004, Figures. 4 and 5. EX1002, ¶214.

As shown, the concave portion of the **second curved surface 18** spans a larger portion of the lens ($r \approx 1.8$ mm) than the concave portion of the **first curved surface 16** ($r \approx 0.8$ mm). Hence, Tawa discloses [1j] under this interpretation of the limitation. EX1002, ¶214.

Alternatively, even if Patent Owner argues that “concavity” must span the entirety of the **first curved surface 16** and the **second curved surface 18**, Tawa renders obvious claim 1 because Figure 9A of Tawa teaches such a configuration.¹¹



EX1004, Figure 9A. EX1002, 215.

2. Reasons To Combine

A POSITA would have recognized that any one of the embodiments of Tawa can be combined with each other with a reasonable expectation of success. *See* Section XI.A.1.xii [Ground I, Reasons To Combine]. EX1002, ¶216.

¹¹ To be clear, should Patent Owner make this argument, this obviousness argument applies to all other Grounds of the Petition as well.

3. Dependent Claim 4

- i. [4] The lens of claim 1 wherein **said output beam** has predominantly uniform intensity within a predetermined angular limit.

Tawa teaches the added limitation of [4]. *See* Section XI.A.3.i [Ground I, 4].
EX1002, ¶217.

4. Dependent Claims 5-6

- i. [5] The lens of claim 1 wherein said output beam uniformly illuminates a **target zone**.
- [6] The lens of claim 5 wherein said **target zone** is on a plane facing said lens.

Tawa teaches the added limitation of [5]. *See* Section XI.A.4.i [Ground I, 5 and 6]. EX1002, ¶218.

5. Dependent Claim 8

- i. [8] The lens of claim 1 wherein said **light source** is a **light emitting diode**.

Tawa teaches and/or renders obvious the added limitation of [8]. *See* Section XI.A.5.i [Ground I, 8]. EX1002, ¶219.

6. Dependent Claim 31

- i. [31pre] A light redistribution system comprising, in combination with a lens as defined in claim 1,

Tawa teaches [31pre]. *See* Section XI.A.6.i [Ground I, 31pre]. EX1002, ¶220.

ii. [31a] **LED means,**

Tawa teaches and/or renders obvious [31a]. *See* Section XI.A.6.ii [Ground I, 31a]. EX1002, ¶221.

iii. [31b] the lens having a concave lower refracting surface receiving rays from said LED means,

Tawa teaches and/or renders obvious [31b]. *See* Sections XI.A.6.iii [Ground I, 31b] and XI.C.1.ix [Grounds III/IV, 1h]. EX1002, ¶222.

iv. [31c] the lens having a dome-shaped refracting upper surface, the curvature of which is one of the following: i) exceeds the curvature of the lower surface, ii) is less than the curvature of the lower surface,

Tawa teaches and/or renders obvious [31c]. *See* Sections XI.A.6.iv [Ground I, 31c], and XI.C.1.ix [Grounds III/IV, 1h] through XI.C.1.xi [Grounds III/IV, 1j]. EX1002, ¶223.

v. [31d] a target surface receiving rays refracted by said upper surface,

Tawa teaches [31d]. *See* Section XI.A.6.v [Ground I, 31d]. EX1002, ¶224.

vi. [31e] said LED means and said upper and lower surfaces configured to produce a profile of bounded flux at said target surface that provides substantially uniform illuminance.

Tawa teaches and/or renders obvious [31e]. *See* Section XI.A.6.vi [Ground I, 31e]. EX1002, ¶225.

7. Independent Claim 39

i. [39pre] An irradiance-redistribution lens comprising

Tawa teaches [39pre]. *See* Section XI.A.7.i [Ground I, 39pre]. EX1002, ¶226.

ii. [39a] a transparent dielectric formed as a solid of revolution with an axis about which a planar curved profile-line is swept,

Tawa teaches [39a]. *See* Section XI.A.7.ii [Ground I, 39a]. EX1002, ¶227.

iii. [39b] with external surface area comprised of an optically active entry surface, an optically active exit surface, and an optically inactive mounting surface;

Tawa teaches and/or renders obvious [39b]. *See* Section XI.A.7.iii [Ground I, 39b]. EX1002, ¶228.

iv. [39c] said entry surface receiving light of nonuniform irradiance from a compact light source situated on said axis in a nearby focal zone;

Tawa teaches and/or renders obvious [39c]. *See* Section XI.A.7.iv [Ground I, 39c]. EX1002, ¶229.

v. [39d] said entry surface having a specific profile that produces refractive deflection of said received light into interiorly propagating light of a different solid angle;

Tawa teaches [39d]. *See* Section XI.A.7.v [Ground I, 39d]. EX1002, ¶230.

- vi. [39e] **said exit surface** opposing **said entry surface** and receiving said internally propagating light therefrom;

Tawa teaches and/or renders obvious [39e]. *See* Section XI.A.7.vi [Ground I, 39e]. EX1002, ¶231.

- vii. [39f] **said exit surface** forming a **pre-specified diverging output beam** from said internally propagating light;

Tawa teaches and/or renders obvious [39f]. *See* Section XI.A.7.vii [Ground I, 39f]. EX1002, ¶232.

- viii. [39g] **said entry-surface** deflection spatially distributed such that **said exit surface** receives said deflected light with predominantly uniform irradiance,

Tawa teaches and/or renders obvious [39g]. *See* Section XI.A.7.viii [Ground I, 39g]. EX1002, ¶233.

- ix. [39h] **said exit surface** given a specific shape that refractively deflects said uniform irradiance into **said output beam**;

Tawa teaches [39h]. *See* Section XI.A.7.ix [Ground I, 39h]. EX1002, ¶234.

- x. [39i] **said light source** being sufficiently compact for said specific shapes to be calculated by mathematical integration of the slope distributions required by said refractive deflections,

Tawa teaches and/or renders obvious [39i]. *See* Section XI.A.7.x [Ground I, 39i]. EX1002, ¶235.

- x. **[39j] said entry surface having first concavity facing toward said light source,**

Tawa teaches [39j]. *See* Section XI.C.1.ix [Grounds III/IV, 1h]. EX1002, ¶236.

- xii. **[39k] and [said exit surface having] second concavity facing toward the entry surface,**

Tawa teaches [39k]. *See* Section XI.C.1.x [Ground III/IV, 1i]. EX1002, ¶237.

- xiii. **[39l] said second concavity [of the exit surface] being substantially greater than said first concavity [of the entry surface].**

Tawa teaches [39l]. *See* Section XI.C.1.xi [Ground III/IV, 1j]. EX1002, ¶238.

8. Dependent Claim 43

- i. **[43pre] A light redistribution system comprising, in combination with a lens as defined in claim 1,**

Tawa teaches [43pre]. *See* Section XI.C.6.i [Ground III/IV, 31pre]. EX1002, ¶239.

- ii. **[43a] said light source comprising LED means,**

Tawa teaches and/or renders obvious [43a]. *See* Section XI.C.6.ii [Ground III/IV, 31a]. EX1002, ¶240.

- iii. [43b] the lens **concave lower refracting surface** receiving rays from **said LED means**,

Tawa teaches and/or renders obvious [43b]. *See* Section XI.C.6.iii [Ground III/IV, 31b]. EX1002, ¶241.

- iv. [43c] the lens having **a dome-shaped refracting exit surface**, the curvature of which is one of the following: i) exceeds the curvature of the lower surface, ii) is less than the curvature of **the lower surface**,

Tawa teaches and/or renders obvious [43c]. *See* Section XI.C.6.iv [Ground III/IV, 31c]. EX1002, ¶242.

- v. [43d] there being **a target surface** receiving rays refracted by **said exit surface**,

Tawa teaches [43d]. *See* Section XI.C.6.v [Ground III/IV, 31d]. EX1002, ¶243.

- vi. [43e] **said LED means** and **said entry** and **exit surfaces** configured to produce a profile of bounded flux at **said target surface** that provides substantially uniform illuminance.

Tawa teaches and/or renders obvious [43e]. *See* Section XI.C.6.vi [Ground III/IV, 31e]. EX1002, ¶244.

D. Ground V: Tawa In Combination With Scharf Renders Obvious Claim 9

1. Dependent Claim 9

- i. [9a] Multiple lenses as defined in claim 8 laterally arrayed in proximity, above multiple light sources,**

Tawa teaches and/or renders obvious [9a]. *See* Section XI.B.1.i [Ground II, 9a]. EX1002, ¶245.

- ii. [9b] in association with a common circuit board, and**

Tawa in combination with Scharf renders obvious [9b]. *See* Section XI.B.1.ii [Ground II, 9b]. EX1002, ¶246.

- iii. [9c] having their output beams illuminating the same target.**

Tawa teaches and/or renders obvious [9c]. *See* Section XI.B.1.iii [Ground II, 9c]. EX1002, ¶247.

2. Reasons To Combine Tawa With Scharf

A POSITA would have recognized that Tawa can be combined Scharf with a reasonable expectation of success. *See* Section XI.B.2 [Ground II, Reasons To Combine]. EX1002, ¶248.

XII. Discretionary Factors

A. Discretionary Denial Under *Advanced Bionics* Is Not Appropriate

The Board uses a two-pronged test to determine whether it will deny institution under 35 U.S.C. §325(d); (1) whether the same or substantially the same

art or arguments were previously presented to the Office; and (2) if so, whether the Office erred in a manner material to patentability. *See Advanced Bionics LLC v. MED-EL Elektromedizinische Geräte GmbH*, IPR2019-01469, Paper 6 (precedential).

Tawa, Shikama and Scharf do not meet the first prong of *Advanced Bionics*, because they were never considered during prosecution of the '162 Patent. As such, the second prong is moot.

B. Discretionary Denial Under *Fintiv* Is Not Appropriate

At the outset, Petitioner filed a motion to transfer the pending case from the current Eastern District of Texas to the District of New Jersey, where the headquarters of Samsung Electronics America Inc. resides. *See Sinotechnix LLC v. Samsung Electronics Co. Ltd et al.*, Case No. 2:24-cv-00544, Dkt. No. 53 (EDTX). While Petitioner will inform the Board of the latest developments related to the *Fintiv* factors as they become available, the following analysis is based on the *current* venue in the Eastern District of Texas for the parallel district court litigation.

Based on the current facts, the six *Fintiv* factors guide against discretionary denial. *See Apple Inc. v. Fintiv, Inc.*, IPR2020-00019, Paper 11 (precedential).

1. No Evidence Regarding A Stay

Factor 1 is neutral, because no motion to stay has been filed.

2. Parallel Proceeding Trial Date

Factor 2 is neutral. Trial in co-pending litigation is scheduled for May 4, 2026. EX1020 [Docket Control Order]. The expected trial date based on the court's median time-to-trial date statistics is also approximately May 2026. *See* EX1021 (showing the median time-to-trial date is approximately 21.9 months from the filing of the case (*i.e.*, July 17, 2024). Both of these dates are close to the expected final written decision date, which is around July 2026.

However, there is significant uncertainty over the trial date. Judge Gilstrap has scheduled trials for seven other patent cases for the same day. EX1022 [Judge Gilstrap Trial List]. It is at the very least uncertain that the '162 Patent will be tried on May 4, 2026. Hence, this factor is neutral.

As the interim guideline notes, “when other relevant factors weigh against exercising discretion to deny institution or are neutral, the proximity to trial should not alone outweigh all of those other factors.” Memorandum Regarding Interim Procedure for Discretionary Denials¹², 8 (*citing In re Genentech, Inc.*, 566 F.3d 1338, 1347 (Fed. Cir. 2009)).

¹² Available online at

https://www.uspto.gov/sites/default/files/documents/interim_proc_discretionary_denials_aia_parallel_district_court_litigation_memo_20220621_.pdf

3. Investment In Parallel Proceeding

Factor 3 favors institution. The co-pending litigation is in its early stages, and the investment in it has been minimal. *See* EX1020. The parties have not exchanged preliminary positions on claim construction, and discovery opened only recently on December 17, 2022. *See PEAG LLC v. Varta Microbattery GmbH*, IPR2020-01214, Paper 8, 17 (Jan. 6, 2021). Invalidity contentions will not be exchanged until February 14, 2025. *See* EX1020, 5. Moreover, the Markman hearing is not scheduled until November 7, 2025, and expert discovery is scheduled for completion on January 20, 2026—both of which are after the expected institution decision date of June-July 2025 for this instant IPR. *Id.*

4. Overlapping Issues With The Parallel Proceeding

Factor 4 favors institution. Petitioner stipulates that if the IPR is instituted, Petitioner will not pursue the same grounds in the district court litigation. *Sand Revolution II LLC v. Continental Intermodal Group – Trucking LLC*, IPR2019-01393, Paper 24 at 7 (June 16, 2020) (informative). As such, the Grounds presented in the instant IPR will be materially different from the grounds that will be presented in the district court. Petitioner may further update the stipulation in this instant proceeding after invalidity contentions have been exchanged with Patent Owner on February 14, 2025 in the parallel district court litigation.

5. Identity Of Parties

Factor 5 is neutral. Petitioner is the defendant in the litigation. This factor should not be a basis for denying institution.

6. Other Circumstances, Including The Merits

Factor 6 favors institution. “[W]here the PTAB determines that the information presented at the institution stage presents a compelling unpatentability challenge, that determination alone demonstrates that the PTAB should not discretionarily deny institution under *Fintiv*.” Memo, 4-5. Here, the evidence of unpatentability is compelling, as evidenced by Grounds laid out above.

C. General Plastic Factors Favor Institution

The ’162 Patent has not been challenged in any prior IPR petition. Thus, the *General Plastic* factors favor institution.

XIII. Conclusion

Petitioner respectfully requests that the Board institute *inter partes* review, hold the challenged claims unpatentable, and cancel the challenged claims.

Dated: January 27, 2025

Respectfully submitted,

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Counsel for Petitioner

CERTIFICATION UNDER 37 C.F.R. §42.24(d)

I hereby certify that this Petition for *Inter Partes* Review of U.S. Patent No. 7,618,162 has, excluding the portions exempted under 37 C.F.R. §42.24(a), 13,910 words as counted by the word-processing system used to prepare this document, in compliance with 37 C.F.R. §42.24(d).

Dated: January 27, 2025

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Counsel for Petitioner

CERTIFICATE OF SERVICE

Under 37 C.F.R. §§42.6(e) and 42.105, the undersigned certifies that on January 27, 2025, complete copies of the foregoing and any accompanying exhibits were caused to be served by sending them via Federal Express Priority Overnight shipping, which is at least as fast and reliable as U.S. Priority Mail Express, to the correspondence address of record for U.S. Patent No. 7,618,162 as indicated in Patent Center:

H.C. PARK & ASSOCIATES, PLC
1894 Preston White Drive
Reston, VA 20191

Petitioner is also serving courtesy copies to counsels of record in the Litigation via Federal Express Priority Overnight shipping at:

Nelson Bumgardner Conroy PC
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