UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

KOITO MANUFACTURING CO., LTD.

Petitioner

v.

LONGHORN AUTOMOTIVE GROUP LLC

Patent Owner

PETITION FOR *INTER PARTES* REVIEW OF U.S. PATENT 8,810,803

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I. INTRODUCTION

Koito Manufacturing Co., Ltd. ("Petitioner") requests *inter partes* review and cancelation of claims 1-17 of U.S. Patent No. 8,810,803 ("the '803 Patent"), which describes a lens system for creating a light pattern for use with computer vision systems. EX1001, Abstract. The '803 Patent describes that such a light pattern is created via a combination of a light emitting diode (LED) cluster, a condenser lens, and a lens cluster. EX1001, 5:64-6:17. The '803 Patent further describes that the lens system is intended to address a need for more accurate tracking and determination of object positions, which is purportedly not met by related art that provides a light pattern that is "too regular." EX1001, 1:20-35, 2:51-58.

The independent claims of the '803 Patent, however, do not require a non-regular light pattern. Moreover, the alleged solution from the '803 Patent, including an irregular light pattern and the combination of a LED cluster, a condenser lens, and a lens cluster, was not innovative by the time of its priority date of November 12, 2007. As explained below and in the accompanying testimony of Adam Phenis (EX1003), the prior art references cited in Grounds 1-8 were not considered during prosecution. If they had been, the '803 Patent never would have issued. Petitioner therefore requests the Board to institute IPR of claims 1-17.

II. MANDATORY NOTICES UNDER 37 C.F.R. § 42.8

A. Real Parties-in-Interest

Pursuant to 37 C.F.R. § 42.8(b)(1), Petitioner certifies that Petitioner, Koito Manufacturing Co., Ltd. and North American Lighting ("NAL") are the real parties-in-interest, and further certify that no other party exercised control or could exercise control over Petitioner's participation in this proceeding, the filing of this petition, or the conduct of any ensuing trial.

B. Related Matters

The '803 Patent is currently the subject of the following litigation:

Longhorn Automotive Group LLC v. Volkswagen AG, Case No. 2:24-cv-00933 (EDTX Nov. 15, 2024);

Longhorn Automotive Group LLC v. Mazda Motor Corp., Case No. 2:24-cv-00686 (EDTX August 20, 2024);

Longhorn Automotive Group LLC v. Mitsubishi Corp., Case No. 2:24-cv-00685 (EDTX August 20, 2024);

Longhorn Automotive Group LLC v. AB Volvo et al., Case No. 2:24-cv-00603 (EDTX July 30, 2024);

Longhorn Automotive Group LLC v. Kia Corp. et al., Case No. 2:24-cv-00554 (EDTX July 19, 2024); and

Longhorn Automotive Group LLC v. Nissan Motor Co. Ltd., Case No. 2:24-cv-00397 (EDTX May 31, 2024).

Neither Koito nor NAL is a party in any of these litigations.

C. Lead and Back-up Counsel and Service Information

Lead Counsel for Petitioner is: William Mandir, Registration No. 32,156. Back-Up Counsel for Petitioner are: John Rabena, Registration No. 38,584; Tyler Del Rosario, Registration No. 72,943, and Derek True, Registration No. 82,017.

Service Information: Petitioner consents to electronic service by email to the following addresses:

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- jrabena@sughrue.com
- tdelrosario@sughrue.com
- dtrue@sughrue.com
- koitoIPR@sughrue.com

A Power of Attorney accompanies this Petition.

III. CERTIFICATION OF GROUNDS FOR STANDING

Petitioner certifies, pursuant to Rule 42.104(a), that the patent for which review is sought is available for *inter partes* review and that Petitioner is not barred or estopped from requesting an *inter partes* review challenging the patent claims on the grounds identified in this Petition.

IV. OVERVIEW OF CHALLENGE AND RELIEF REQUESTED

Pursuant to Rules 42.22(a)(1) and 42.104(b)(1)–(2), Petitioner challenges claims 1-17 ("Challenged Claims") of the '803 Patent.

A. Prior Art Patents and Printed Publications

The '803 Patent has an effective filing date no earlier than November 12, 2007.

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

1. German Patent Application Publication No. 10129743C2 to Weidel (published May 8, 2003) (EX1004), which is prior art under at least 35 U.S.C. §102(a).
2. U.S. Patent No. 7,563,008B2 to Chinniah (filed March 28, 2006) (EX1005), which is prior art under at least 35 U.S.C. §102(e).

3. German Patent Application Publication No. 102006004587A1 to Brandenburg (published August 2, 2007) (EX1006), which is prior art under at least 35 U.S.C. §102(a).
4. U.S. Patent No. 7,736,036B2 to Tatsukawa (filed October 4, 2007) (EX1007), which is prior art under at least 35 U.S.C. §102(a).
5. U.S. Patent No. 7,733,574B2 to Mizusawa (PCT filing date of January 25, 2006) (EX 1008), which is prior art under at least 35 U.S.C. §102(e).
6. U.S. Patent Application Publication No. 2007/0263903A1 (Hilaire) (filed March 22, 2007) (EX1009), which is prior art under at least 35 U.S.C. §102(e).
7. Korean Patent Application Publication No. 100482557B1 to Cheon (published April 1, 2005) (EX1010), which is prior art under at least 35 U.S.C. §102(b).
8. Japanese Patent Application Publication No. 2004214144A to Osawa (published July 29, 2004) (EX1011), which is prior art under at least 35 U.S.C. §102(b).

B. Statutory Grounds for Challenges

This Petition, supported by the declaration of Adam Phenis (EX1003), requests cancellation of claims 1-17 under the Grounds listed below:

GROUND 1: Claims 15-16 are anticipated by Weidel (EX1004);

GROUND 2: Claims 1 and 8 are anticipated by Mizusawa (EX1008);

GROUND 3: Claim 15 is obvious by Tatsukawa (EX1007) in view of Brandenburg (EX1006).

GROUND 4: Claims 1-6, 8-13, and 15-16 are obvious by Weidel (EX1004) in view of Chinniah (EX1005).

GROUND 5: Claims 1-6, 8-13, and 15-16 are obvious by Chinniah (EX1005) in view of Brandenburg (EX1006) and Osawa (EX1011);

GROUND 6: Claims 7, 14, and 17 are obvious by Chinniah (EX1005) in view of Brandenburg (EX1006) and Osawa (EX1011), and in further view of Hilaire (EX1009) and/or Cheon (EX1010).

GROUND 7: Claims 3-4 and 10 are obvious by Weidel (EX1004) in view of Chinniah (EX1005), and in further view of Osawa (EX1011).

GROUND 8: Claims 7, 14, and 17 are obvious by Weidel (EX1004) in view of Chinniah (EX1005), and in further view of Hilaire (EX1009) and/or Cheon (EX1010).

V. U.S. PATENT NO. 8,810,803

A. Summary

The ’803 Patent (EX1001) is directed to a lens system for creating a light pattern for use with computer vision systems. EX1001, Abstract. The ’803 Patent specification contends that the lens system is intended to address a need for more accurate tracking and determination of object positions, which is purportedly not met by related art that provides a light pattern that is “too regular.” EX1001, 1:20-35, 2:51-58; EX1003, ¶15.

The ’803 Patent describes that its light pattern is created via a combination of a light emitting diode (LED) cluster 110, a condenser lens 120, and a lens cluster 130. EX1001, 5:64-6:17, FIG. 4 (reproduced below); EX1003, ¶16.

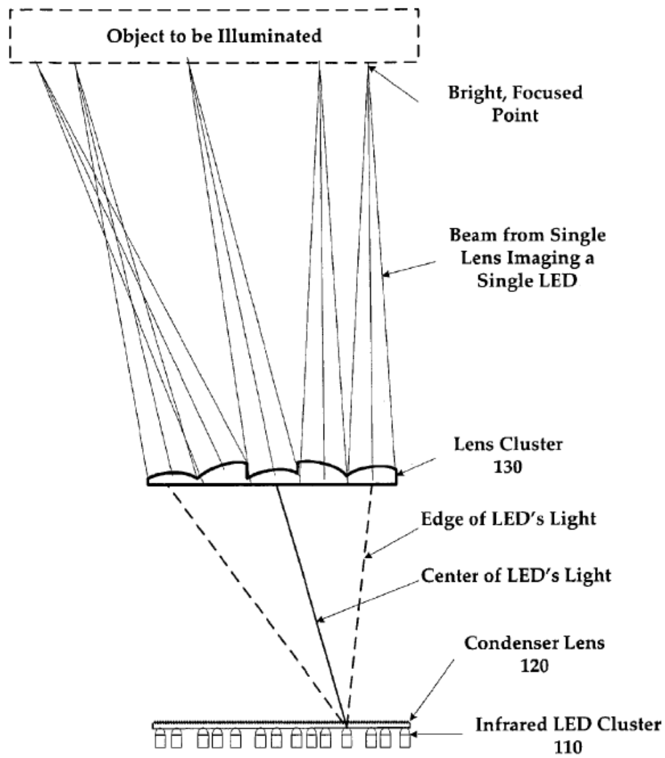

FIGURE 4

EX1001, FIG. 4.

The '803 Patent describes that the condenser lens 120 redirects light, from the LED cluster 110, towards the center of the lens cluster 130, and the lens cluster 130 focuses the light onto different locations on a distant plane, e.g., Object to be Illuminated. This creates a discernable light pattern that may be detected by a camera and processed by a computing device in order to track an object illuminated by the light pattern. EX1001, 6:4-27; EX1003, ¶17.

As detailed below, the use of an irregular light pattern and the combination of a LED cluster, a condenser lens, and a lens cluster was well known in the art prior to the ‘803 patent. EX1003, ¶18.

B. Prosecution History

The patent application (U.S. Application No. 13/448,321) (hereinafter, the “Application”) for the ’803 Patent was filed on April 16, 2012, and is a divisional application of U.S. Application No. 12/269,849, filed on November 12, 2008, which claims priority to Provisional Application No. 60/987,315, filed on November 12, 2007.

The Challenged Claims were allowed on April 16, 2014, after the Applicant amended independent claims 1, 8, and 21 of the Application (independent claims 1, 8, and 15 of the ’803 Patent, respectively), and an Examiner’s Amendment to claim 8, to describe an aspect of the function of a “cluster of lenses.” EX1002, pp. 385-392.

In an Amendment dated September 23, 2013, the Applicant amended independent claims 1 and 8 in response to an obviousness rejection based on U.S. Patent Application No. 2005/0110964 (“Bell”) in view of U.S. Patent Application

No. 2008/0245952 ("Troxell") and U.S. Patent Application No. 2006/0078015 ("Franck") as follows:

> a cluster of lenses located in front of the light source, wherein each lens of the cluster of lenses is configured to receive light from the plurality of emitters and the cluster of lenses is configured to concurrently focus and project light from each of the emitters in a plurality of directions~~, the focused and projected light forming the pattern of light~~; and

EX1002, p. 343 (amendment to claim 1).

> receiving light from the plurality of emitters at a plurality of points; and
>
> concurrently focusing the ~~emitted~~ light from each of the plurality of lights in a plurality of directions from the central location~~, the focused light forming a pattern of light~~.

EX1002, p. 344 (amendment to claim 8).

In a Final Office Action dated January 17, 2014, independent claims 1 and 8 were indicated to be allowable for the following reasons:

> As to **claim 1**, the prior art of record, taken alone or in combination, fails to disclose or render obvious in a system for projecting a pattern of light 'a cluster of lenses located in front of the light source, wherein each lens of the cluster of lenses is configured to receive light from the plurality of emitters and the cluster of lenses is configured to concurrently focus and project light from each of the emitters in a plurality of directions,' in combination with the rest of the limitations of **claim 1. Claims 2, 4-7, and 24** are allowable by virtue of their dependency from **claim 1.**

EX1002, p. 358 (reasons for allowance of claim 1).

As to **claim 21**, the prior art of record, taken alone or in combination, fails to disclose or render obvious in a system for projecting a pattern of light 'a cluster of lenses, each lens included in the cluster of lenses being configured to receive the emitted light from each of the plurality of emitters' in combination with the rest of the limitations of **claim 21. Claims 22 and 23** are allowable by virtue of their dependency from **claim 21.**

EX1002, p. 358 (reasons for allowance of claim 21).

In the Final Office Action, the rejection based on Bell, Troxell, and Franck was maintained for claims 8-9, 11-13, and 25. EX1002, p. 355.

Following an After-Final Amendment filed March 14, 2014, the Examiner entered an Examiner's Amendment for claim 8 (described below) and allowed the Challenged Claims on April 16, 2014. EX1002, p. 391.

Claim 8 lines 8-10 is amended from 'concurrently focusing, from the cluster of lenses, the received and concentrated light from the plurality of emitters in a plurality of directions.' to read -concurrently focusing, from each lens of the cluster of lenses, the received and concentrated light from each of the plurality of emitters in a plurality of directions.-

EX1002, p. 391 (Examiner's Amendment to claim 8).

On August 19, 2014, the Application issued as the ’803 Patent. EX1002, p. 416.

VI. PERSON OF ORDINARY SKILL IN THE ART

A person of ordinary skill in the art (“POSITA”) at the filing date for the ’803 Patent would have had an undergraduate bachelor’s degree in physics or optical science, or equivalent knowledge, training or experience, with at least 2 years of work experience in the design or analysis of optical systems. Additional education or industry experience may compensate for a deficit in one of the other aspects of the requirements stated above. EX1003, ¶37.

VII. CLAIM CONSTRUCTION

The claim terms should be given their ordinary and customary meaning as understood by a person of ordinary skill in the art (“POSITA”) in view of the specification. 37 C.F.R. § 42.100(b); *Phillips v. AWH Corp*., 415 F.3d 1303, 1312-13 (Fed. Cir. 2005) (*en banc*). Moreover, “claim terms need only be construed to the extent necessary to resolve the controversy.” *Wellman, Inc. v. Eastman Chem.*

Co., 642 F.3d 1355, 1361 (Fed. Cir. 2011).[1] Petitioner submits that, solely for purposes of this proceeding, no claim term requires construction beyond its plain and ordinary meaning.

VIII. GROUNDS CHALLENGING PATENTABILITY

The Grounds detailed below demonstrate a reasonable likelihood that claims 1-17 of the '803 Patent are unpatentable, and rely on references not previously considered during prosecution.

A. GROUND 1: Claims 15-16 are anticipated by Weidel

i. Overview of Weidel

Weidel (EX1004) is directed to a vehicle headlight system that projects a pattern of light. EX1004, ¶¶[0001] and [0009]-[0010]. The system includes a light

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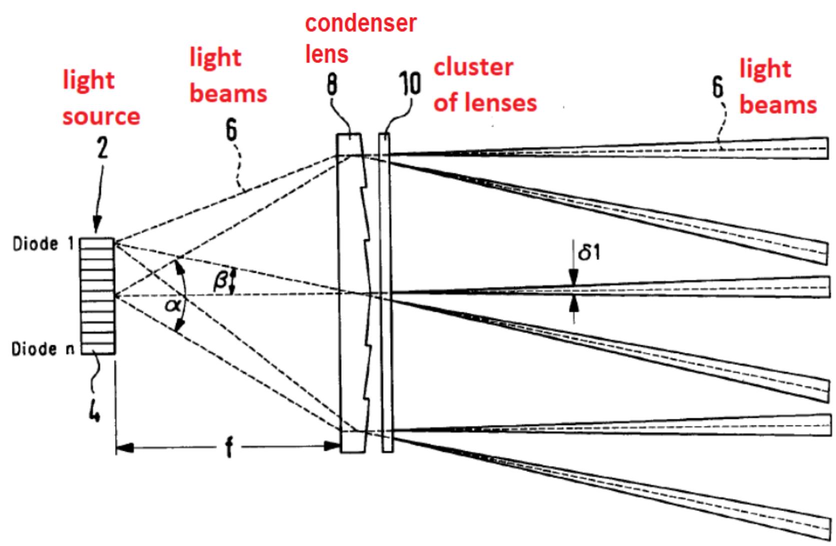
[1] For this Petition, Petitioner applies the claims to the prior art in the same manner as in Patent Owner's allegations of infringement before the district court. Petitioner does not concede that any claim satisfies all statutory requirements, such as §§101 and 112.

source (two-dimensional array 2), a cluster of lenses (diffuser 10), and a condenser lens (collecting lens 8) located between the light source and the cluster of lenses. FIG. 1. EX1003, ¶40.



EX1004, FIG. 1 (annotated)

Weidel describes that the light source (two-dimensional array 2) includes emitters (diodes 4) configured to emit light and arranged in a pattern, such as an irregular semi-elliptical pattern. EX1004, ¶[0024]. The emitters may include light emitting diodes 1-n configured to generate infrared light that is detectable by a camera, but not by an eye of a human observer interacting with an object illuminated by at least a portion of the light. EX1004, ¶¶[0005], [0012], [0018] and [0037]; EX1003, ¶41.

The converging lens 8 is configured to concentrate light from each of the plurality of emitters 1-n towards a center of the cluster of lenses 10. EX1004, ¶[0028]-[0029]; FIG. 1; EX1003, ¶42.

The cluster of lenses (diffuser 10) may include several micro-lenses that project light from each of the emitters in a plurality of overlapping directions. EX1004, ¶¶[0013], [0029], [0031], and claim 8; EX1003, ¶43.

Weidel explains that the vehicle headlight projection system may be incorporated into a night vision system that further includes a camera for capturing infrared light emitted from the plurality of emitters and reflected off of objects in front of the vehicle. EX1004, ¶¶[0005] and [0012]; EX1003, ¶44.

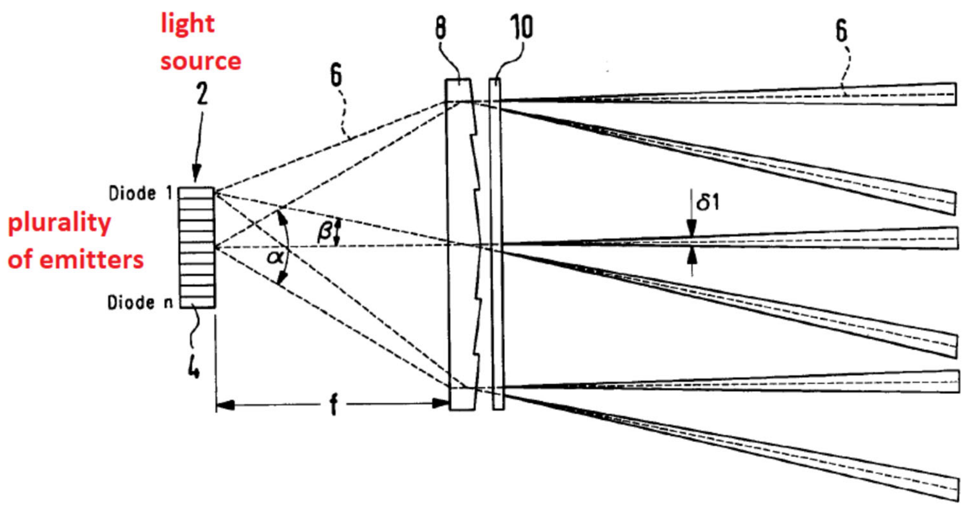
ii. Claim 15

a. 15[pre] "A system for projecting a pattern of light, the system comprising:"

Weidel discloses a system for projecting a pattern of light. EX1004, ¶¶[0009]-[0010]; EX1003, ¶47.

b. 15[a] "a light source including a plurality of emitters configured to emit light;"

Weidel teaches a light source (e.g., diode array 2) including a plurality of emitters (e.g., Fig. 1 shows the traced light rays of two diodes in array 2) configured to emit light. EX1003, ¶49.

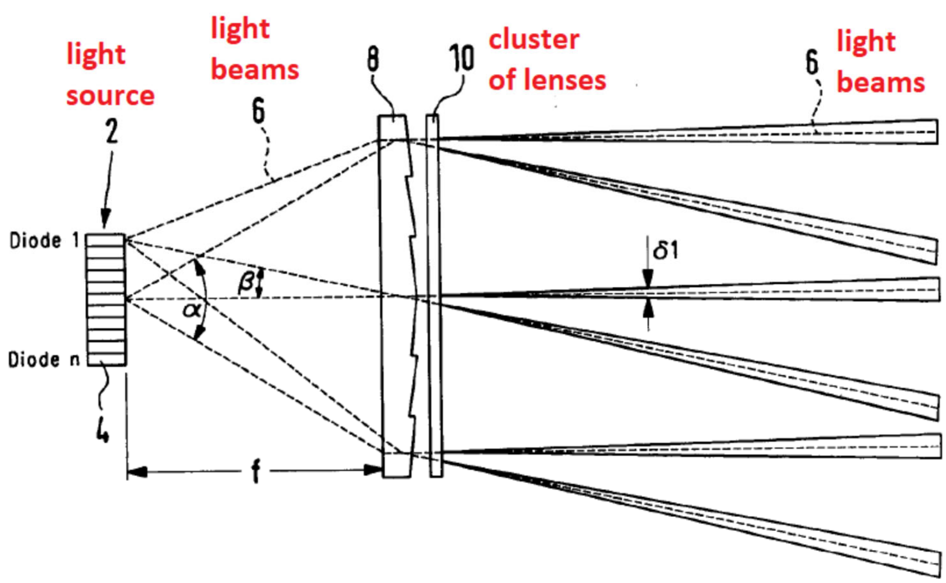


EX1004, FIG. 1 (annotated) *See also* [0023]-[0024];

FIG. 1 of Weidel shows the emitters (diodes of array 2) are arranged in a pattern for projecting light. EX1003, ¶50.

c. 15[b] "a cluster of lenses, each lens included in the cluster of lenses being configured to receive the emitted light from each of the plurality of emitters; and"

Weidel explains that diffuser 10 can be a collection of microlenses, i.e., "cluster of lenses." EX1004, ¶[0031] ("[M]icrolenses or microwedges can be used as the diffuser 10."); EX1003, ¶52.

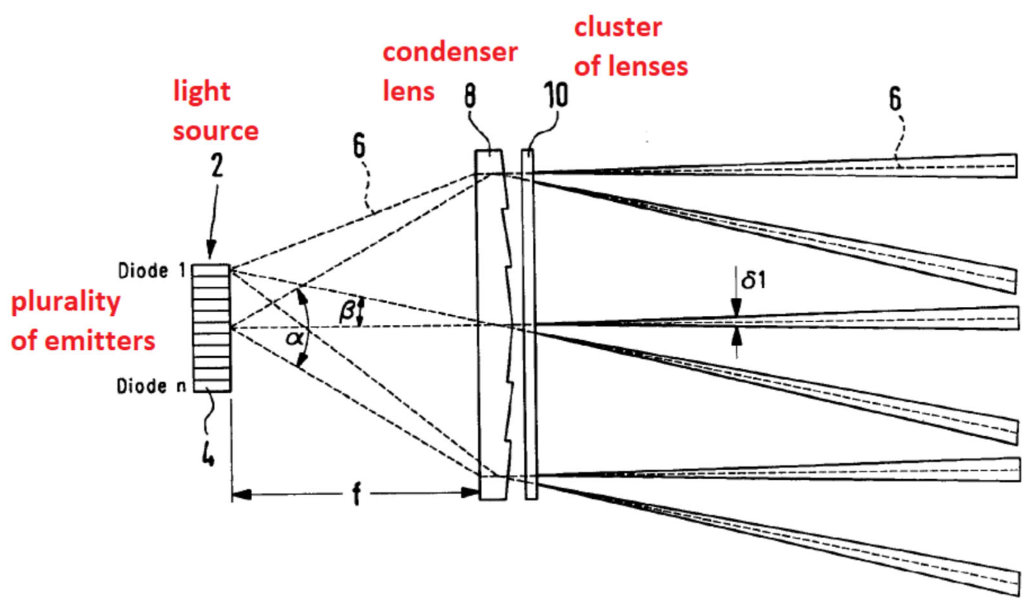


EX1004, FIG. 1 (annotated)

As shown in FIG. 1, Weidel also teaches that the entire cluster of lenses (e.g., diffuser 10 including microlenses) receives light from each of the emitters in the light source. EX1004, Claim 8 (describing a "diffuser (10) … in the light path of the light beams (6) of some or ***all of the luminous elements***") (emphasis added); EX1003, ¶¶53-55.

d. 15[c] "a condenser lens located between said light source and said cluster of lenses, the condenser lens concentrating light from each of the plurality of emitters towards a center of the cluster of lenses."

Weidel discloses a condenser lens (collecting lens 8) for collimating diverging light beams of each emitter (in diode array 2) that is located between the light source (diode array 2), and the cluster of lenses (microlenses of diffuser 10). *Id*., FIG. 1; ¶[0028]; ¶[0013] ("The diffuser is preferably arranged close to the converging lens on its light exit side[.]"); Claim 8; EX1003, ¶57:



EX1004, FIG. 1 (annotated)

Weidel further teaches the condenser lens (collecting lens 8) is configured to concentrate the light beams 6 from each of the plurality of emitters (diode array 2) towards a center of the cluster of lenses (microlenses of diffuser 10). *Id.*, at ¶[0028] ("The collecting lens 8 collimates the diverging light beam 6 of each diode 4."); *Id.*, at ¶¶[0031]-[0032] ("[M]icrolenses . . . can . . . form[] the desired headlight distribution from the incoming collimated light."); EX1003, ¶58.

Thus, Weidel discloses "a condenser lens located between said light source and said cluster of lenses, the condenser lens concentrating light from each of the plurality of emitters towards a center of the cluster of lenses." EX1003, ¶59

iii. Claim 16

a. "The system of claim 15, wherein the plurality of emitters includes light emitting diodes configured to generate infrared light that is not detectable by an eye of a human observer"

Weidel discloses that "one of the arrays can produce infrared light" which includes wavelengths that are "not detectable by an eye of a human observer." *Id.*, ¶¶[0018], [0016] ("one of the arrays can produce infrared light, and the remaining arrays can produce visible light."); EX1003, ¶61. Weidel teaches this so that "[t]he invention can be used in a night vision system[.]" *Id.*, at ¶[0012]; ¶¶[0005], [0038], and claim 1 ("[A] portion of the number of light elements (4) emits infrared light."); see also, EX1003, ¶65, (citing https://science.nasa.gov/ems/09_visiblelight/#:~:text=The%20visible%20light%20spectrum%20is,from%20380%20to%20700%20nanometers ("Typically, the human eye can detect wavelengths from 380 to 700 nanometers."), Sensitivity of the Human Eye, https://www.giangrandi.org/optics/eye/eye.shtml ("The human eye is sensible to light wave which wavelength is roughly between 400 nm (violet) and 700 nm (red). Wavelengths shorter than 400 nm (ultraviolet, UV) or longer than 700 nm (infrared, IR) are not visible.")).

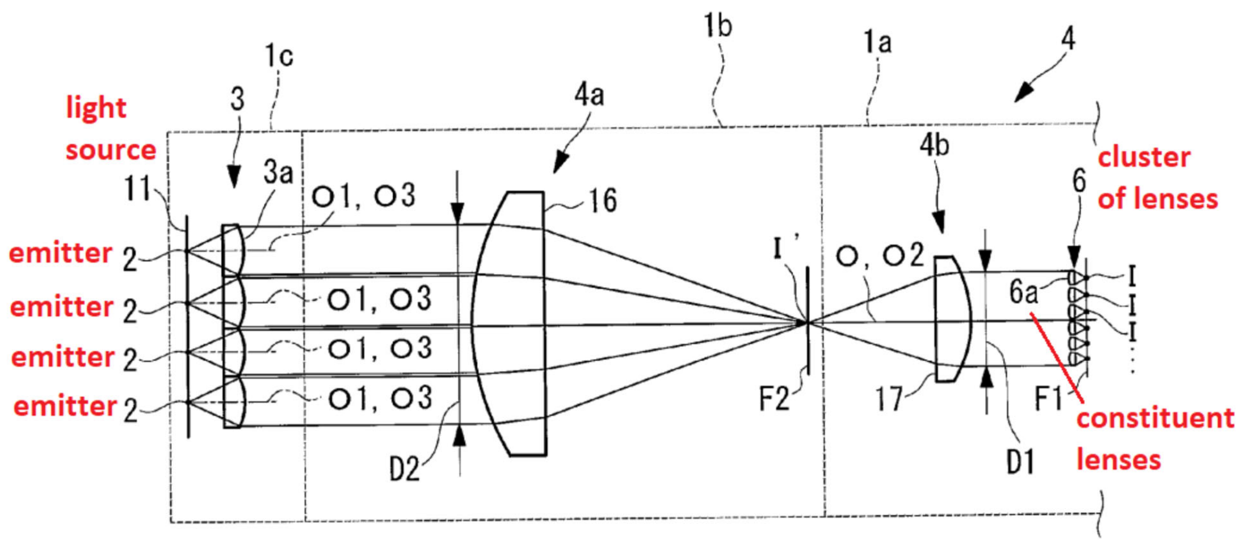
As set forth above, each and every limitation of claims 15-16 is taught by Weidel, and therefore Weidel anticipates these claims.

B. GROUND 2: Claims 1 and 8 are anticipated by Mizusawa

i. Overview of Mizusawa

Mizusawa (EX1008) discloses, *inter alia*, an optical system for projecting an image with a light source, and an observation optical system for examining a target object illuminated with the illumination optical apparatus. EX1008, 6:5-16. EX1003, ¶68.

Mizusawa describes, *inter alia*, an optical illumination system that collects light emitted from light source 11 that includes light-emitting sections 2, converts diverging beams emitted from the light source 11 into a beam of collimated light, which are then concentrated by lens 16 toward a center of a cluster of lenses (fly-eye lens 6). The system further projects the beams through the cluster of lenses (fly-eye lens 6) to form a plurality of light source images. EX1008, Abstract. The design of Mizusawa's illumination system facilitates brighter illumination, even with dim light sources. EX1008, 5:6-16; FIG. 1A. EX1003, ¶69.



EX1005, FIG. 1A (annotated)

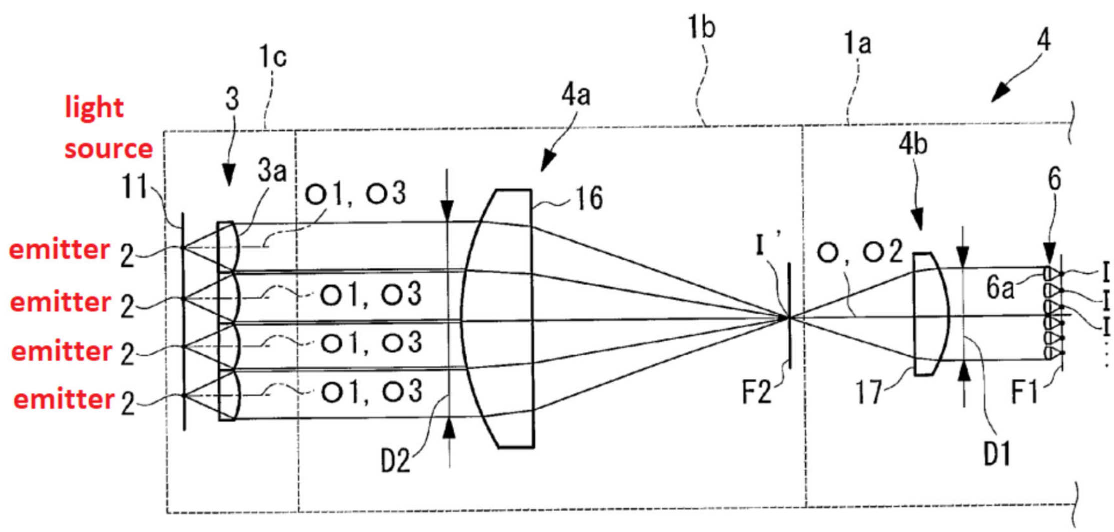
ii. Claim 1

a. 1[pre] "A system for projecting a pattern of light, the system comprising:"

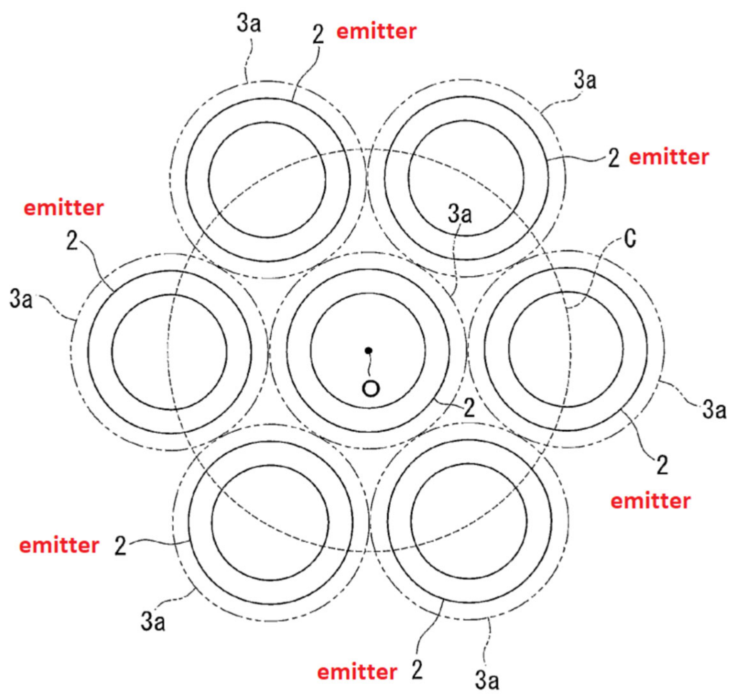
Mizusawa discloses a system for projecting a pattern of light. EX1008, 4:63-5:5 (describing "a projection apparatus having a projection optical system for projecting an image . . . [and] an exposure apparatus having a projection optical system for projecting a mask pattern"). EX1003, ¶72.

b. **1[a] "a light source including a plurality of emitters configured to emit light, the plurality of emitters arranged in a pattern;"**

Mizusawa discloses a light source including a plurality of emitters (e.g., LED-array light source 11) configured to emit light and arranged in a pattern. EX1008, 6:55-60 ("As shown in FIG. 1A[,] . . . this embodiment includes an LED-array light source 11 . . . [that] are used as the light-emitting sections 2."), FIG. 1A; EX1003, ¶74.

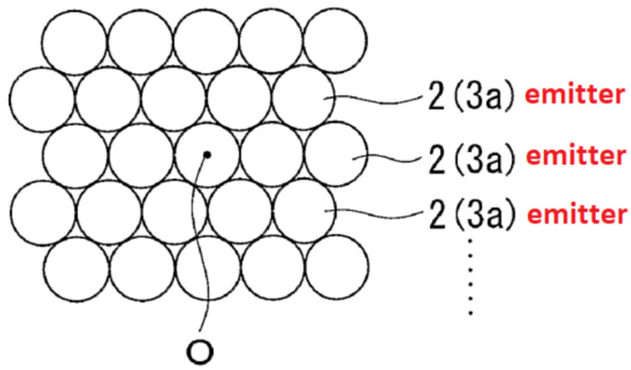


EX1008, FIG. 1A (annotated); *see also* 6:56-58, 5:35-37, 7:13-16. In FIG. 1A, the emitters are arranged in a linear array pattern; Mizusawa also teaches to use other patterns as needed, for example, in FIGs. 2 and 6A.



EX1008, FIG. 2 (annotated)

See also, 5:48-50 ("FIG. 6A is a diagram showing another exemplary layout of light-emitting sections, lens elements, and constituent lenses of the illumination optical apparatus shown in FIG. 1A."), FIG. 6A.

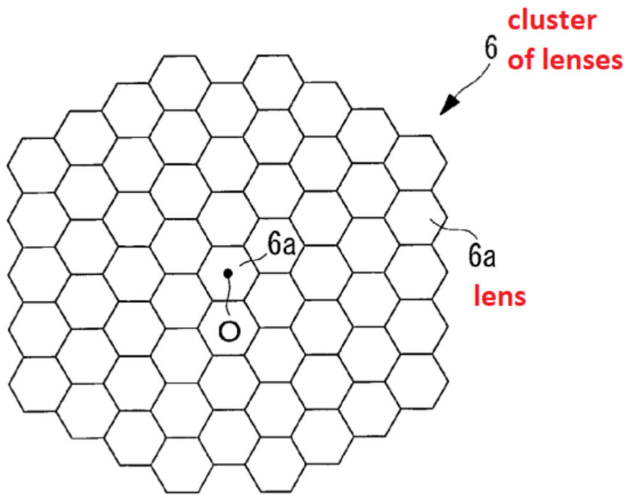


EX1008, FIG. 6A (annotated)

Accordingly, Mizusawa teaches to arrange the emitters in a pattern. EX1003, ¶75.

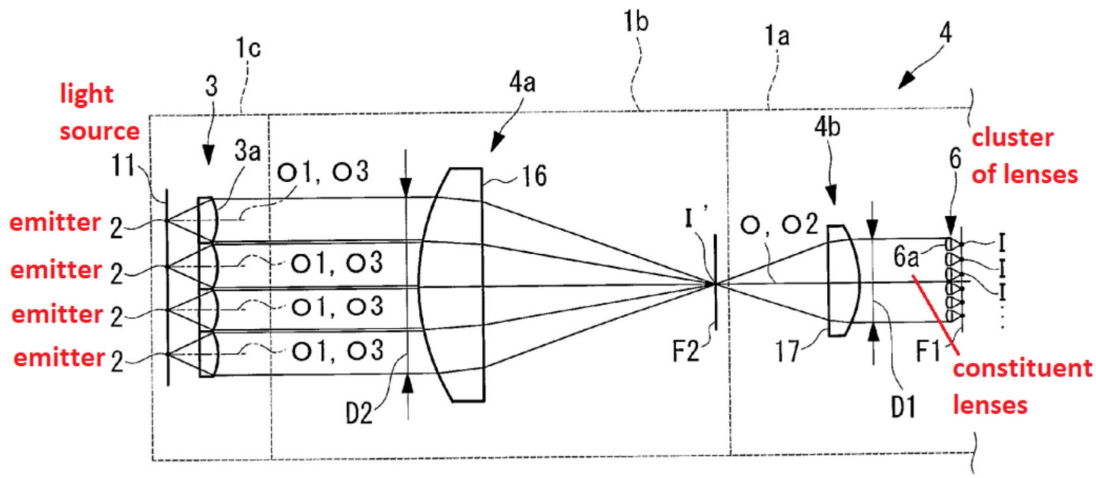
c. **1[b] "a cluster of lenses located in front of the light source, wherein each lens of the cluster of lenses is configured to receive light from the plurality of emitters and the cluster of lenses is configured to concurrently focus and project light from each of the emitters in a plurality of directions; and"**

Mizusawa teaches a cluster of lenses (e.g., constituent lenses 6a of fly-eye lens 6 in FIGS 1A and 3). EX1008, 4:16-21 ("In the illumination optical apparatus with this structure, the fly-eye lens can form four or more light-source images from one light-emitting section. As a result, the Koehler illumination optical system can illuminate the illumination surface from more directions than the number of light-emitting sections."). EX1003, ¶77. FIG. 3 of Mizusawa is reproduced below with annotation as an example. *See also*, 5:38-40.



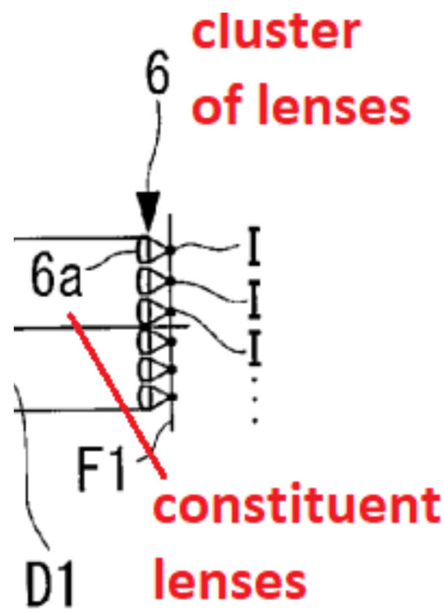
EX1008, FIG. 3 (annotated)

Mizusawa also teaches that the cluster of lenses is located in front of the light source and receives light from the light source. EX1008, FIG. 1A (constituent lenses 6a are in front of LED-array light source 11 and receive light from light source 11); EX1003, ¶78:



EX1008, FIG. 1A (annotated); *See, also*, 10:12-17 (describing how light-source images are produced from the constituent lenses 6a of the fly-eye lens 6 based on light received from the light-emitting sections 2). Accordingly, Mizusawa discloses "wherein each lens of the cluster of lenses is configured to receive light from the plurality of emitters."

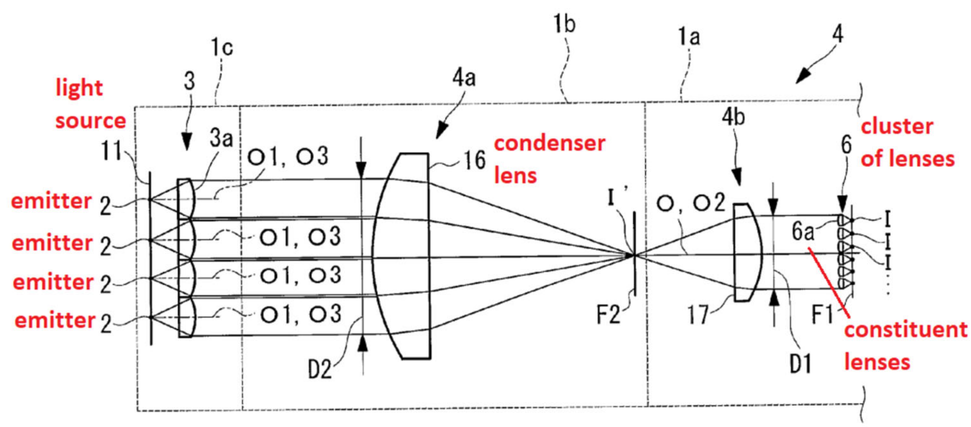
Mizusawa also teaches that the cluster of lenses (e.g., constituent lenses 6a of fly-eye lens 6) is configured to concurrently focus and project light from the light source in a plurality of directions. For example, as shown in FIG. 1A, the two representative light rays drawn as exiting from each constituent lens 6a are drawn in two directions ("a plurality of directions") to a focal point I along back focal plane F1 indicate the focusing of the exiting light, and one of ordinary skill would understand that additional light rays exist between the drawn rays that would also exit 6a in different directions from the two drawn rays in order to focus at the indicated focal point I:



EX1008, FIG. 1A, see also EX1003¶79; EX1008, 9:51-55 ("[t]he Koehler illumination optical system 7 . . . superimpose[es] beams from the light-source images I formed by the fly-eye lens 6 onto the illumination surface F1 from a plurality of directions."); EX1003, ¶79 Thus, Mizusawa discloses "the cluster of lenses is configured to concurrently focus and project light from each of the emitters in a plurality of directions." EX1003, ¶79.

d. 1[c] "a condenser lens located between the light source and the cluster of lenses, wherein the condenser lens is configured to concentrate light from each of the plurality of emitters towards a center of the cluster of lenses."

Mizusawa discloses a condenser lens (e.g., focusing lens 16), located between the light source (LED-array light source 11) and the cluster of lenses (constituent lenses 6a of fly-eye lens 6). EX1008, 7:64-8:5; EX1003, ¶81.



EX1008, FIG. 1A (annotated)

Mizusawa teaches that the "focusing lens 16 [is] for converging collimated beams obtained by the lens array 3 to focus images I from the plurality of light-emitting sections 2, . . . [and the] beams [are guided] onto the fly-eye lens 6." *Id.*, 7:64-8:5. Accordingly, Mizusawa discloses "a condenser lens located between the light source and the cluster of lenses, wherein the condenser lens is configured to concentrate light from each of the plurality of emitters towards a center of the cluster of lenses." EX1003, ¶82.

iii. Claim 8

a. 8[pre] "A method comprising"

See GROUND 2, Claim 1[pre], 1[a], 1[b], 1[c]; EX1003, ¶85.

b. 8[a] "emitting, from a plurality of emitters, a plurality of lights arranged in a pattern;"

See GROUND 2, Claim 1[a]; EX1003, ¶87.

c. 8[b] "concentrating, via a condenser lens, the plurality of lights towards a central location of a cluster of lenses;"

See GROUND 2, Claim 1[c]; EX1003, ¶89.

d. 8[c] "receiving the concentrated light at a plurality of points within the cluster of lenses; and"

See GROUND 2, Claim 1[b]; EX1003, ¶91.

e. 8[d] "concurrently focusing, from each lens of the cluster of lenses, the received and concentrated light from each of the plurality of emitters in a plurality of directions;"

See GROUND 2, Claim 1[b]; EX1003, ¶92.

C. GROUND 3: Claim 15 is obvious by Tatsukawa in view of Brandenburg

i. Overview of Tatsukawa

Tatsukawa teaches a vehicle headlamp system with a light source, a projector lens, and an array of lens elements that provide a light diverging function. EX1007, 2:35-61. The vehicle headlamp forms a light distribution pattern with an upper cutoff line, and controls projected light beams to avoid causing glare for oncoming traffic. EX1007, 2:2-7, 2:35-45. EX1003, ¶94.

ii. Overview of Brandenburg

Brandenburg (EX1006) is directed to an optical lens that enables an overall light intensity distribution to be influenced by locally shaping the light beams. EX1006, ¶4; EX1003, ¶96.

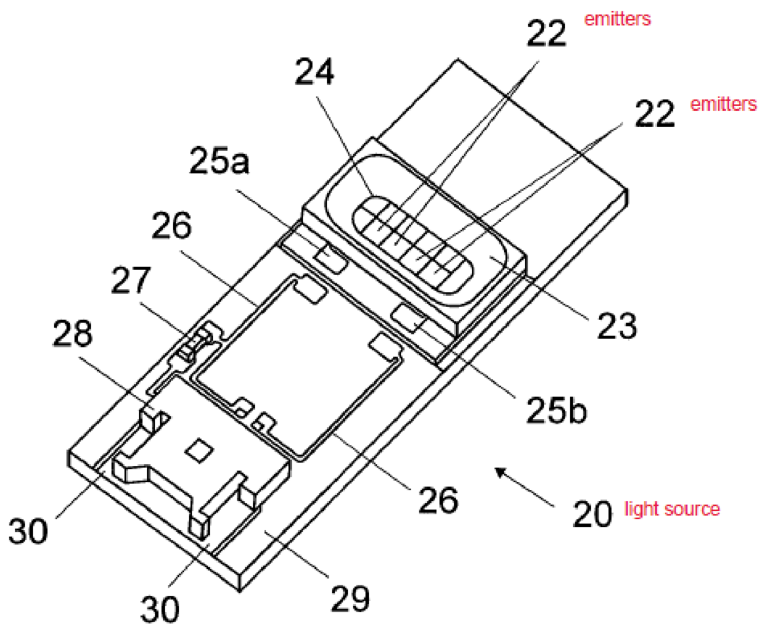
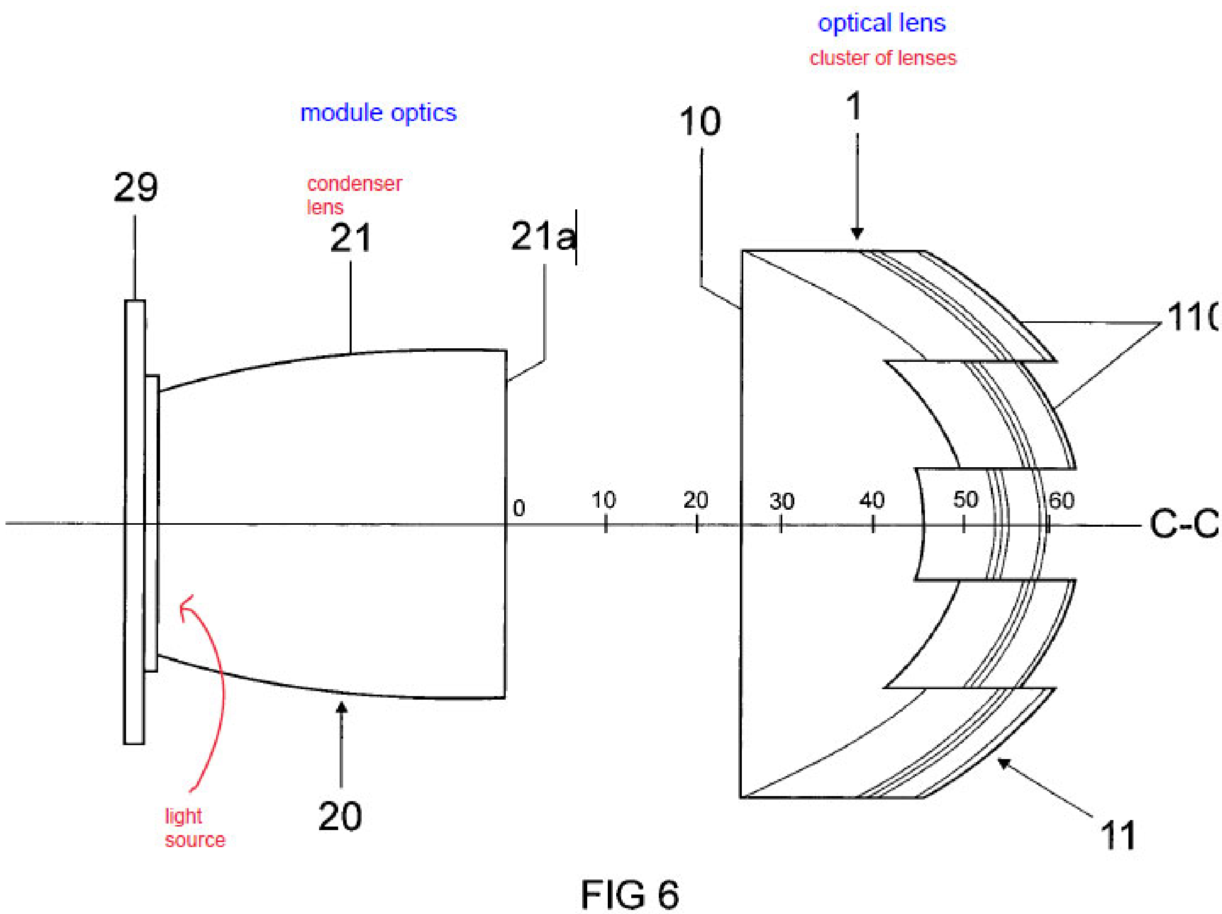


FIG 4

EX1006, FIG. 4 (annotated)



EX1006, FIG. 6 (annotated)

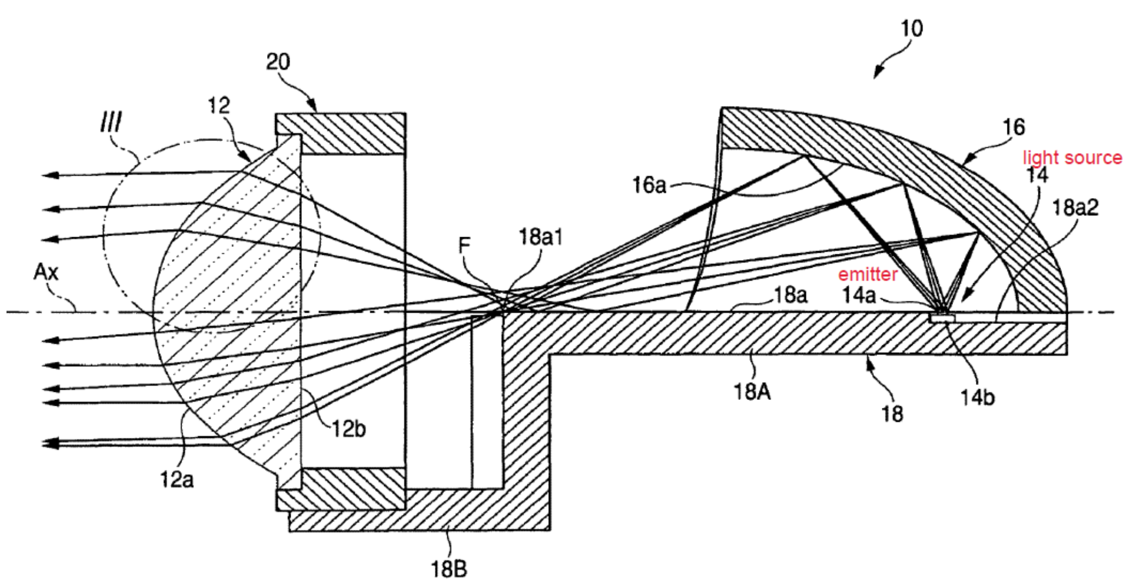
Brandenburg discloses a lighting system including a light source (light-emitting diode module 20) with emitters (light-emitting diode chips 22) and optical elements (e.g., an optical lens 10) to enable the overall light intensity distribution to be shaped. EX1006, [0004], [0009], and FIGS. 4-6, 7, and 12. The lighting system enables different light intensity distributions, different color temperatures and colors of light, and different lighting functions. EX1006, [0004], [0009], [0012], [0031], [0039]-[0040]; EX1003, ¶97.

Claim 15

a. 15[pre] "A system for projecting a pattern of light, the system comprising:"

Tatsukawa discloses a system for projecting a pattern of light. EX1007, 2:47-57 ("[A] vehicle headlamp is provided with a projector lens[,] . . . for forming a light distribution pattern."); FIG. 2 (pattern of light exiting lens 12); EX1003, ¶104.

FIG. 2



EX1007, FIG. 2 (annotated)

b. 15[a] "a light source including a plurality of emitters configured to emit light;"

Tatsukawa discloses a light source (e.g., light emitting element 14). EX1007, 6:47-52, FIG. 2. Tatsukawa does not describe a plurality of emitters, but Brandenburg expressly teaches to use multiple emitters and emitter modules in a vehicle headlight system to make the light brighter. EX1006, ¶[0040] ("So as to achieve, for example, the highest possible light intensity, the illumination device according to the invention, however, can alternatively also comprise multiple light-emitting diode modules 20…"); ¶[0031] ("In this embodiment, the light-emitting diode module 20 comprises five light-emitting diode chips 22. These light-emitting diode chips 22 are, for example, thin-film light-emitting diode chips 22 with a light output of at least 20 lumens per watt."), FIG. 4., ¶[0011], FIG. 5; EX1003, ¶106.

Brandenburg also teaches that using multiple light-emitting diode chips 22 or modules 20, can provide another benefit of enabling different (or particular) light intensity distributions and color temperature adjustments to be generated. EX1006,

¶¶[0009], [0012] [0040] (“the brightness can be varied by switching individual light-emitting diode modules 20 on or off or, in the case of differently designed light-emitting diode modules 20, the color temperature or the color of the light can be adjusted by activating or deactivating or dimming individual light-emitting diode modules 20”); EX1003, ¶107.

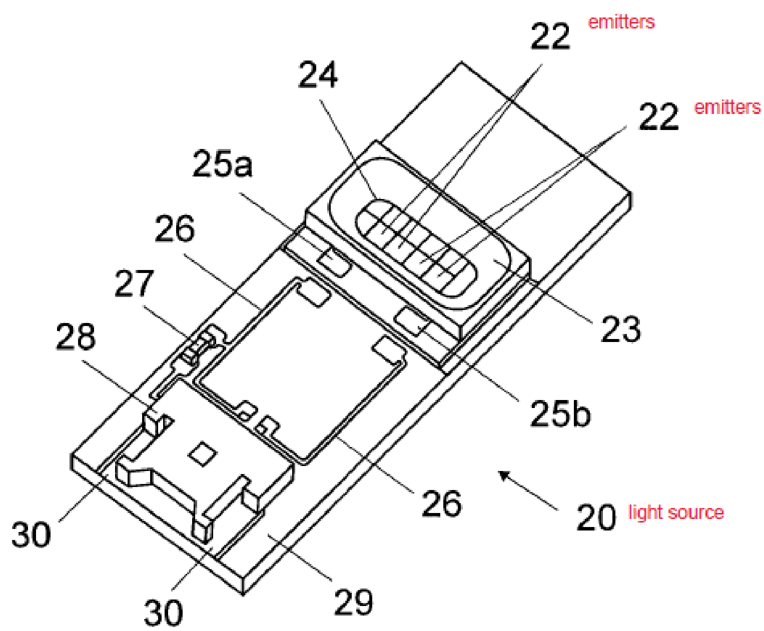


FIG 4

EX1006, FIG. 4 (annotated)

It would have been obvious to a POSITA to add emitters in the Tatsukawa system to increase light output and/or provide intensity control options as expressly taught by Brandenburg. EX1006, [0040]; EX1003, ¶108.

c. 15[b] "a cluster of lenses, each lens included in the cluster of lenses being configured to receive the emitted light from each of the plurality of emitters; and"

Tatsukawa teaches a cluster of lenses (e.g., lens elements 12As and 12Bs).[2] EX1007, 2:58-61 ("In the lamp unit, at least a portion of a surface of the projector lens is constituted as an up and down direction diverging portion comprising a plurality of lens elements."), 7:54-8:57, FIGS. 1-5; EX1003, ¶110.

FIG. 5 of Tatsukawa is reproduced below.

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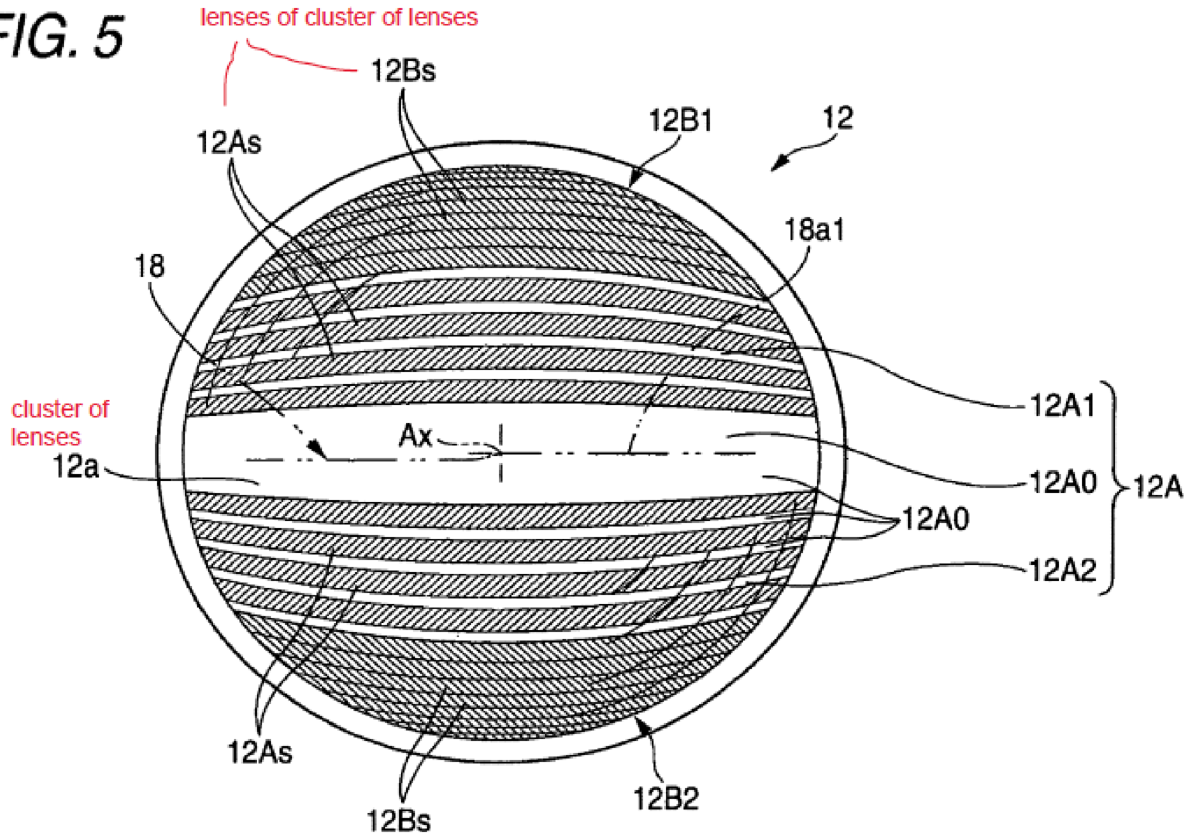
2 The Patent Owner has alleged that such lens elements in accused headlamps meets the claimed "cluster of lens"

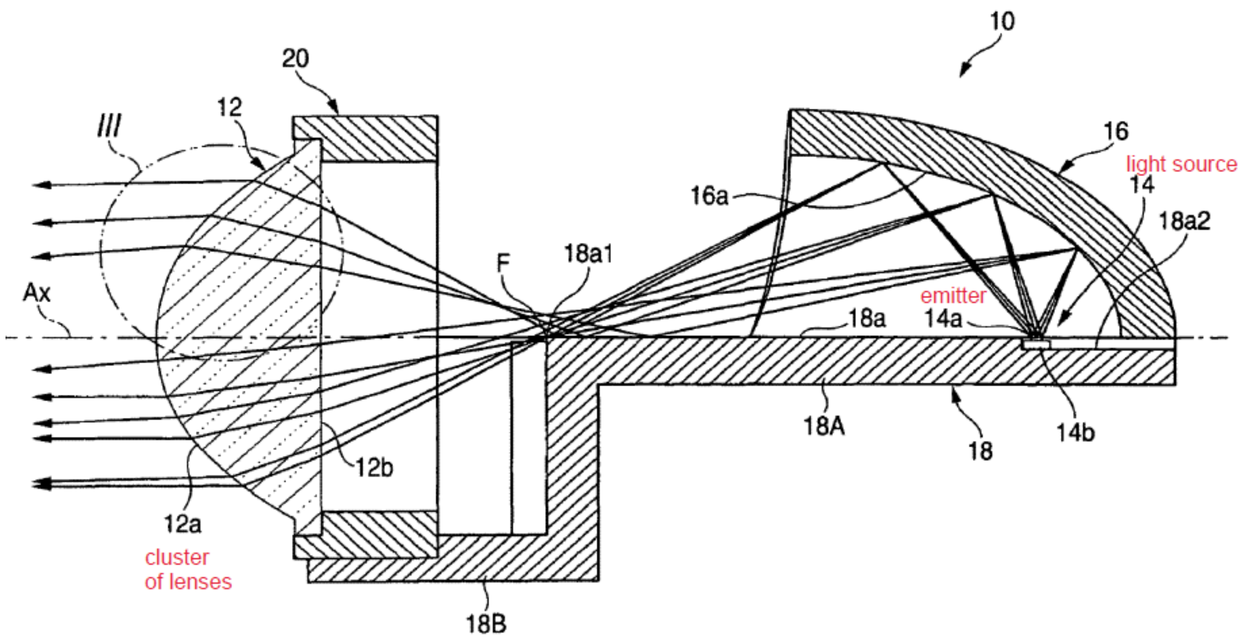
FIG. 5



EX1007, FIG. 5 (annotated)

Tatsukawa also teaches that the lens elements 12As and 12Bs are configured to receive light from the light source. EX1007, FIGS. 2-5. *See*, e.g., FIG. 2 of Tatsukawa below. EX1003, ¶112.

FIG. 2



EX1007, FIG. 2 (annotated)

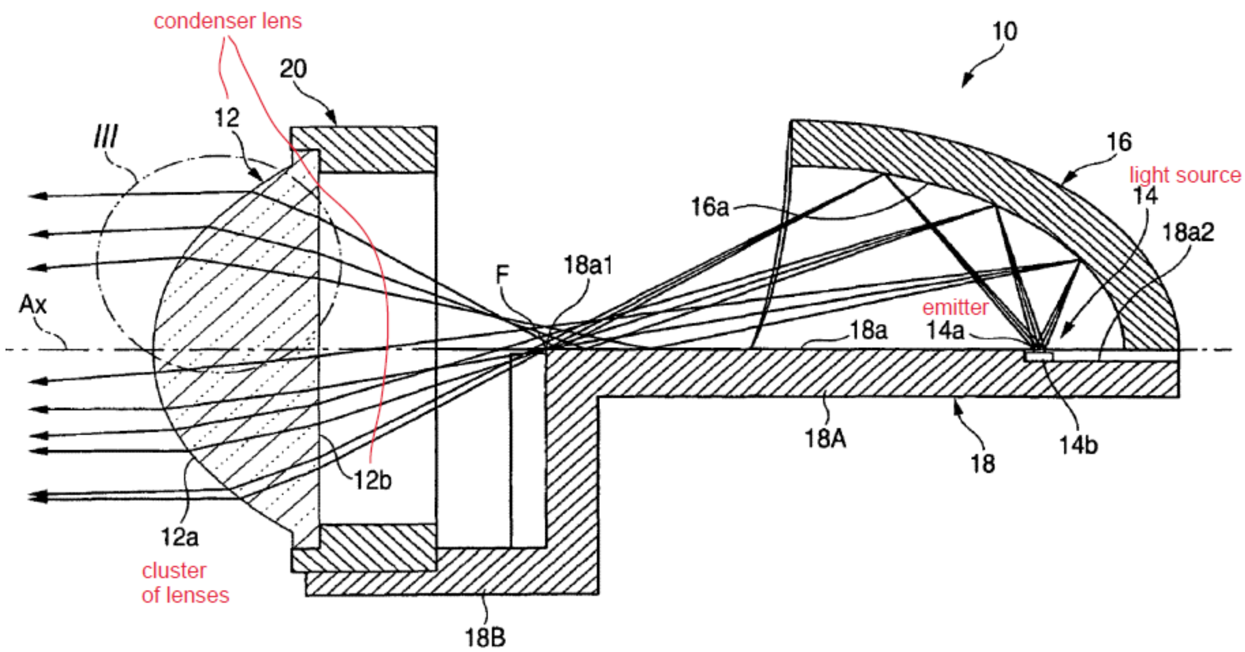
FIG. 2 of Tatsukawa shows light from light emitting element 14 reaches the cluster of lenses (lens elements 12As and 12Bs). EX1007, FIGS. 3-4. EX1003, ¶113.

Moreover, Tatsukawa discloses that the lens elements "are structured to form a plurality of dim light portions on an upper vicinity of the cutoff line, wherein the dim light portions are reduced in luminescence relative to the rest of the light distribution pattern," such that light from light emitting element 14 is received by each of the lens elements. EX1007, claim 1; EX1007, 8:40-44 (describing a function of lens elements 12As and 12Bs). Tatsukawa therefore discloses that each lens of the cluster of lenses (lens elements 12As and 12Bs) is configured to receive light from the light emitting element 14. The combination of Tatsukawa and Brandenburg provides a light source including a plurality of emitters, and "a cluster of lenses, each lens included in the cluster of lenses being configured to receive the emitted light from each of the plurality of emitters." See, also, EX1003, ¶114.

d. 15[c] "a condenser lens located between said light source and said cluster of lenses, the condenser lens concentrating light from each of the plurality of emitters towards a center of the cluster of lenses."

Tatsukawa discloses a condenser lens (e.g., projector lens 12) located between the light emitting element 14 and the cluster of lenses (front lens elements 12As and 12Bs). EX1007, 6:32-36 ("The projector lens 12 is a flat concave aspherical lens made of acrylic resin a front side surface 12 a of which is constituted by a concave face and a rear side surface 12 b is constituted by a flat face."); EX1003, ¶116.

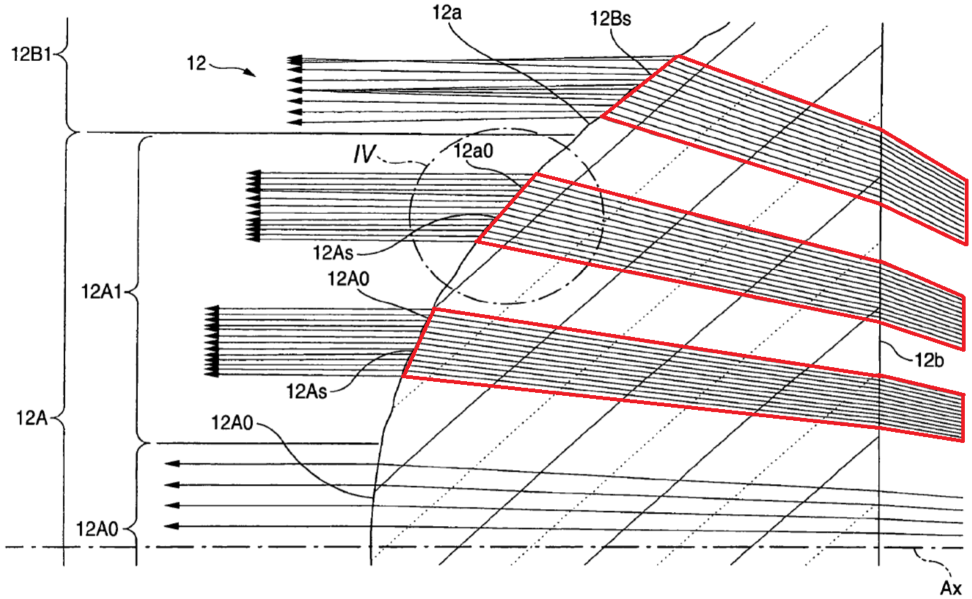
FIG. 2



EX1007, FIG. 2 (annotated)

FIG. 3 of Tatsukawa, reproduced below, shows that the condenser lens causes light to bend inwards at the transition of both the rear side surface 12b and the front side surface 12a; EX1003, ¶117.

FIG. 3



EX1007, FIG. 3 (annotated)

Tatsukawa discloses that the condenser lens is configured to concentrate light from the light emitting element 14 towards a center of the cluster of lenses on at least the front side surface 12a. The combination of Tatsukawa and Brandenburg discloses "a condenser lens located between said light source and said cluster of lenses, the condenser lens concentrating light from each of the plurality of emitters towards a center of the cluster of lenses."; EX1003, ¶118.[3]

D. GROUND 4: Claims 1-6, 8-13, and 15-16 are obvious by Weidel (EX1004) in view of Chinniah (EX1005).

i. Overview of Chinniah

Chinniah (EX1005) is directed to a headlamp assembly 20 including a light source 22 and a condenser lens 30 for improving control over the beam spread characteristics, while at the same time reducing the package size of the headlamp assembly. EX1005, 1:55-59; EX1003, ¶120.

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[3] The interpretation that the "cluster of lenses" element and the "condenser lens" element can be read on a single lens with a pattern on one side is based on Patent Owner's interpretation in accusing products of infringement. Tatsukawa teaches these elements. EX1003, n.2.

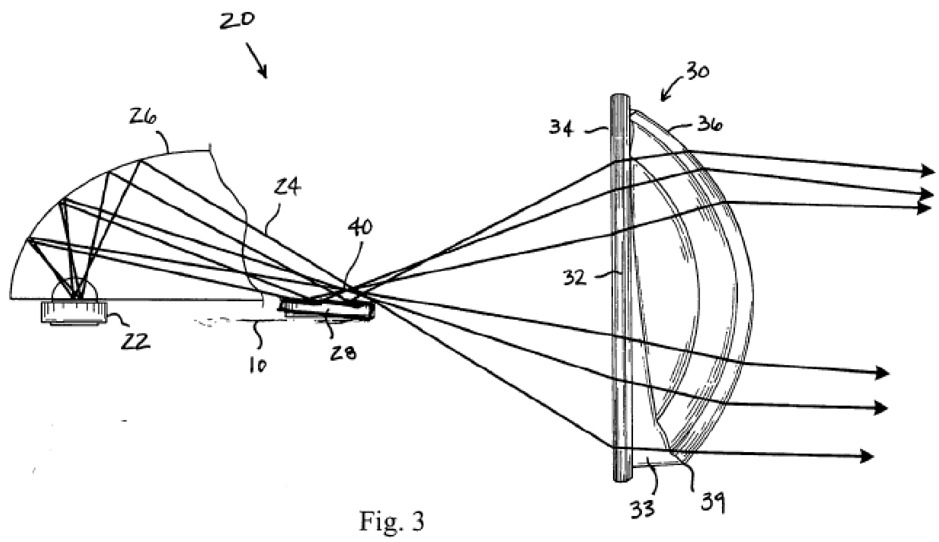


Fig. 3

EX1005, FIG.

The objective of the headlamp is "to provide a projector-type headlamp which exhibits improved control over the beam spread characteristics of the outputted light." *Id.*, 1:49-51. "[T]he beam pattern provided in road illumination should have a certain amount of vertical spread as well as a certain amount of horizontal spread. At the same time, a vertical cut-off should be provided to minimize glare to oncoming traffic." *Id.*, 1:17-21; EX1003, ¶121.

Chinniah further discloses:

> a condenser lens . . . for a projector-type headlamp assembly having a light source emitting light which is projected longitudinally downstream. . . . The condenser lens generally includes a main body of light transmitting material [and] . . . defines a first surface receiving

> light from the light source and a second surface emitting the light. The second surface has at least one facet structured to spread the light and provide a predetermined beam pattern.

Id., 1:59-67. Chinniah teaches a facet structure on the surface 36 of the condenser lens for focusing the light. Specifically, Chinniah teaches that the second surface of the condenser lens has "a plurality of facets structured to horizontally focus the light differently from the vertical focus of the light to provide a predetermined beam pattern" (*Id*., Claim 1), and that at least one facet "horizontally focuses the light differently [than how] the at least one facet vertically focuses the light" (*Id*., Claim 22); EX1003, ¶123.

i. Claim 1

a. 1[pre] "A system for projecting a pattern of light, the system comprising:"

Weidel discloses the preamble of claim 1 as discussed in GROUND 1, claim 15[pre]; EX1003, ¶126.

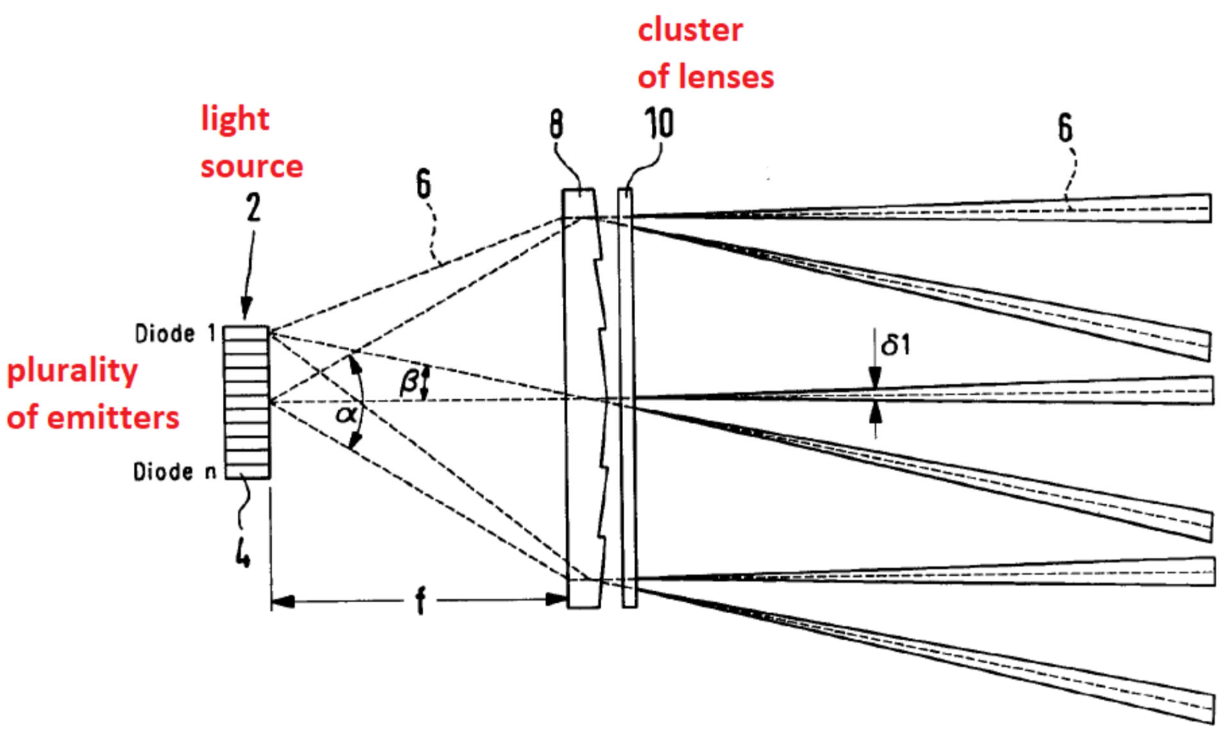
b. 1[a] "a light source including a plurality of emitters configured to emit light, the plurality of emitters arranged in a pattern;"

Weidel discloses this limitation as discussed in GROUND 1, claim 15[a]; EX1003, ¶128.

Additionally, Weidel discloses this limitation by teaching "a vehicle headlight comprising a two-dimensional array made up of a plurality of electronic luminous elements which are configured to emit a plurality of parallel light beams." *Id*. at ¶[0010]. The diode array 2 pattern can be arranged to be rectangular, elliptical or semi-elliptical. EX1004, ¶[0024]; EX1003, ¶129.

c. 1[b] "a cluster of lenses located in front of the light source, wherein each lens of the cluster of lenses is configured to receive light from the plurality of emitters and the cluster of lenses is configured to concurrently focus and project light from each of the emitters in a plurality of directions; and"

See GROUND 1 claim 15(b)



EX1004, FIG. 1 (annotated)

The representative rays in FIG. 1 of Weidel shows the entire cluster of lenses 10 receives light from the plurality of emitters and projects light from each of the emitters in a plurality of directions. *Id*., FIG. 1; EX1003, ¶131.

Chinniah teaches to project the light exiting from its cluster of lenses (facets 38, 138, 238) in different directions (EX1005, FIG. 3), and also expressly teaches to focus the light exiting from its cluster of lenses in a plurality of directions. Chinniah discloses that "the second surface [has] a plurality of facets structured to ***horizontally focus*** the light ***differently from the vertical focus*** of the light to provide a predetermined beam pattern having an increased horizontal beam spread relative to an aspheric condenser lens." EX1005, claim 1 (emphasis added); claim 16 ("[T]he second surface having a generally concave curvature to horizontally and vertically focus the light and provide a predetermined beam pattern, the second surface having at least one vertically elongated facet having one of a convex and a concave curvature that provides a horizontal beam spread component to the predetermined beam pattern."). Chinniah teaches that such focusing in a plurality of different directions is advantageous in vehicle headlight systems to "provide a predetermined beam pattern having an increased horizontal beam spread" so as to illuminate an area that is wider than it is tall. EX1005, 5:1-6. For vehicle headlights, Chinniah explains that this reduces the chance of blinding oncoming drivers. EX1005, 1:20-21; EX1003, ¶132.

It would have been obvious to a POSITA to modify Weidel such that the cluster of lenses concurrently focus and project light in different directions from the teachings of Chinniah. Both Weidel and Chinniah teach vehicle headlights that seek to address similar problems of improving visibility for the driver while minimizing glare to other vehicles. EX1004, ¶[0002] ("The headlights of oncoming vehicles and the reflections thereof, especially on wet roads, [may] cause the driver to be blinded."); EX1005, 1:20-21 ("[A] vertical cut-off should be provided to minimize glare to oncoming traffic."); EX1003, ¶133.

A POSITA implementing Weidel's vehicle headlight system would have been motivated to incorporate a lens with a plurality of facets structured to horizontally focus light differently from the vertical focus of the light, as taught by Chinniah, in order more precisely to illuminate the road and increase visibility by increasing a horizontal beam spread while minimizing glare to oncoming drivers. Indeed, Weidel seeks "[to illuminate traffic scenes as well as possible at night," and to avoid blinding drivers in oncoming vehicles EX1004, ¶¶[0002]-[0003]; EX1003, ¶134.

Thus, a POSITA implementing Weidel's lighting system would have been motivated to incorporate a focusing cluster of lenses, as explicitly taught by Chinniah, to improve visibility, to provide better control of the pattern projected by the lighting system, and to minimize glare to oncoming traffic; EX1003, ¶135.

A POSITA would have had a reasonable expectation of success in implementing Weidel's lighting system with a cluster of lenses that focused the light in different directions, as taught by Chinniah, as focusing lenses or facets were well known in the art. EX1005, FIGs. 1-4, 6-9; EX1003, ¶136. This would allow for better control of the light projected from Weidel's headlamp system such that "the desired angular distribution of the light beam 6" is achieved. EX1004, ¶[0029].

Thus, the combination of Weidel and Chinniah teaches a "cluster of lenses is configured to concurrently focus and project light from each of the emitters in a plurality of directions." EX1003, ¶137.

d. 1[c] "a condenser lens located between the light source and the cluster of lenses, wherein the condenser lens is configured to concentrate light from each of the plurality of emitters towards a center of the cluster of lenses."

See GROUND 1, claim 15[c]. EX1003, ¶139.

ii. Claim 2

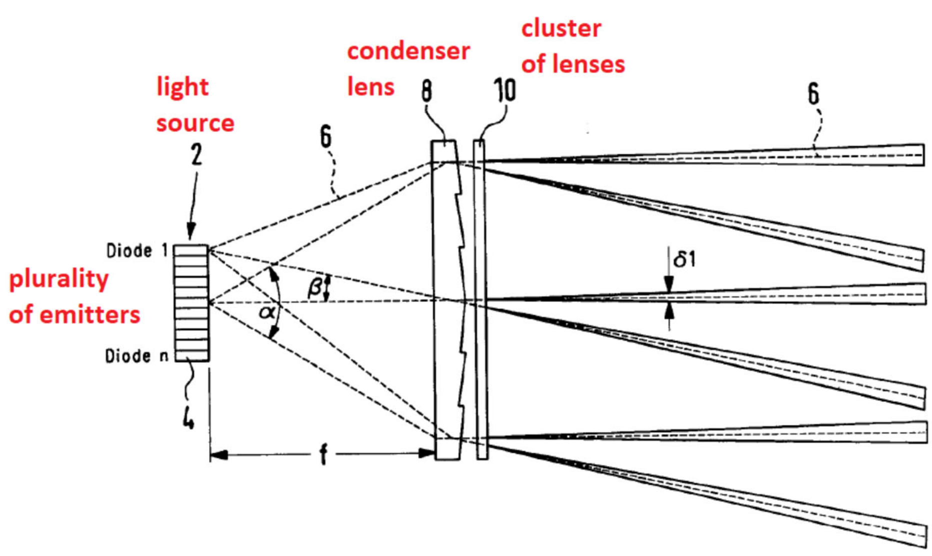
a. **"The system of claim 1, wherein the plurality of emitters includes light emitting diodes configured to generate infrared light that is detectable by a camera but not by an eye of a human observer interacting with an object illuminated by at least a portion of the light."**

See GROUND 1, claim 16. EX1003, ¶142.

iii. Claim 3

a. **"The system of claim 1, wherein the cluster of lenses includes a Fresnel lens."**

Weidel teaches that the collecting lens 8 may be a Fresnel lens, and that the diffuser 10 (cluster of lenses) can be integrated into the collecting lens 8. EX1004, ¶¶[0028], [0031]; FIG. 1; EX1003, ¶145.



EX1004, FIG. 1 (annotated)

iv. Claim 4

a. "The system of claim 1, wherein the emitters are arranged in an irregular pattern."

Weidel discloses emitters arranged in an irregular pattern. For example, Weidel teaches that "[i]n the example shown, [t]he diode array 2 . . . [is] arranged in a rectangular array with n rows and m columns. The arrangement, however, does not have to be rectangular, but can also be elliptical or semi-elliptical, depending on which areas . . . are to be illuminated." EX1004, ¶[0024]. Thus, Weidel teaches the emitters may be arranged in irregular patterns, such as semi-elliptical arrangements. EX1003, ¶¶148-149

v. Claim 5

a. "The system of claim 1, wherein a first pattern of light projected by one of the lenses from the cluster of lenses overlaps with a second pattern of light projected by another of the lenses from the cluster of lenses."

Weidel and Chinniah each teaches that a first pattern of light projected by one of the lenses from the cluster of lenses overlaps with a second pattern of light projected by another of the lenses from the cluster of lenses. Weidel teaches overlapping light beams for a desired angular distribution. EX1004, ¶[0029] ("…

the light beams 6 of adjacent diodes 4 ***overlap***[,] and . . . the desired angular distribution of the light beam 6 is created.") (emphasis added); EX1003, ¶152.

Similarly, Chinniah teaches that "each of the facets 38 may have their own unique curvature in either or both of the vertical and horizontal directions which can be structured to ***overlap*** or separate the light the lens 30 outputs, thereby creating a predetermined beam spread pattern." EX1005, 5:9-13 (emphasis added). The combined teachings of Weidel and Chinniah discussed above for claim 1 would result in the overlap of light patterns in claim 5. EX1003, ¶153.

Claim 6

a. "The system of claim 1, wherein a pattern of light projected by the cluster of lenses is aperiodic along at least one dimension."

Chinniah teaches:

> [E]ach of the facets 38 may have their own unique curvature in either or both of the vertical and horizontal directions which can . . . creat[e] a predetermined beam spread pattern. For example, assuming the facets 38 were numbered consecutively from left to right, facets 2 and 5 could be utilized to create a particular hot spot or hot spots while the remainder of the facets could be structured to provide a more uniformly spread beam pattern.

EX1005, 5:9-14. A POSITA would understand that the "hot spot(s)" described in Chinniah is the result of a pattern of aperiodic light from the cluster of lens. EX1003, ¶¶156-157. Furthermore, Chinniah teaches "an unlimited number of unique single facet and multi-facet embodiments can be readily envisioned by those skilled in the art and can be tailored to specific applications." EX1005, 6:33-36. Thus, a POSITA would understand that the combination of Weidel and Chinniah provides a system which creates a pattern of light projected by the lens array that is aperiodic. EX1003, ¶¶156-157.

vi. Claim 8

a. 8[pre] "A method comprising"

See GROUND 4, Claim 1[pre], 1[a], 1[b], 1[c]; EX1003, ¶160.

b. 8[a] "emitting, from a plurality of emitters, a plurality of lights arranged in a pattern;"

See GROUND 4, Claim 1[a]; EX1003, ¶162.

c. 8[b] "concentrating, via a condenser lens, the plurality of lights towards a central location of a cluster of lenses;"

See GROUND 4, Claim 1[c]; EX1003, ¶164.

d. 8[c] "receiving the concentrated light at a plurality of points within the cluster of lenses; and"

See GROUND 4, Claim 1[b]; EX1003, ¶166.

e. 8[d] "concurrently focusing, from each lens of the cluster of lenses, the received and concentrated light from each of the plurality of emitters in a plurality of directions;"

See GROUND 4, Claim 1[b] and Claim 5; EX1003, ¶168.

vii. Claim 9

a. "The method of claim 8, wherein said emitting includes generating infrared light that is not detectable by an eye of a human observer interacting with an object illuminated by at least a portion of the light."

See GROUND 4, Claim 2; EX1003, ¶171.

viii. Claim 10

a. "The method of claim 8, wherein said concentrating comprises concentrating the plurality of lights towards a center of a cluster of lenses including a Fresnel lens."

See GROUND 4, Claims 1[b]-[c] and 3; EX1003, ¶174.

ix. Claim 11

a. "The method of claim 8, wherein the focused light comprises an irregular pattern."

See GROUND 4, Claim 1[a] and 1[b] and Claims 4-6; EX1003, ¶177.

x. Claim 12

a. "The method of claim 8, wherein the focused light includes a first pattern of light overlapping with a second pattern of light."

See GROUND 4, Claim 1[b] and Claim 5; EX1003, ¶180.

xi. Claim 13

a. "The method of claim 8, wherein the focused light includes a pattern which is aperiodic along at least one dimension."

See GROUND 4, Claims 4, 6, and 11; EX1003, ¶183.

xii. Claim 15

a. 15[pre] "A system for projecting a pattern of light, the system comprising:"

See GROUND 4, Claim 1[pre], 1[a], 1[b], 1[c]; EX1003, ¶186.

b. 15[a] "a light source including a plurality of emitters configured to emit light;"

See GROUND 4, Claim 1[a]; EX1003, ¶ 188.

c. 15[b] "a cluster of lenses, each lens included in the cluster of lenses being configured to receive the emitted light from each of the plurality of emitters; and"

See GROUND 4, Claim 1[b]; EX1003, ¶190.

d. 15[c] "a condenser lens located between said light source and said cluster of lenses, the condenser lens concentrating light from each of the plurality of emitters towards a center of the cluster of lenses."

See GROUND 4, Claim 1[c]; EX1003, ¶192.

xiii. Claim 16

a. "The system of claim 15, wherein the plurality of emitters includes light emitting diodes configured to generate infrared light that is not detectable by an eye of a human observer"

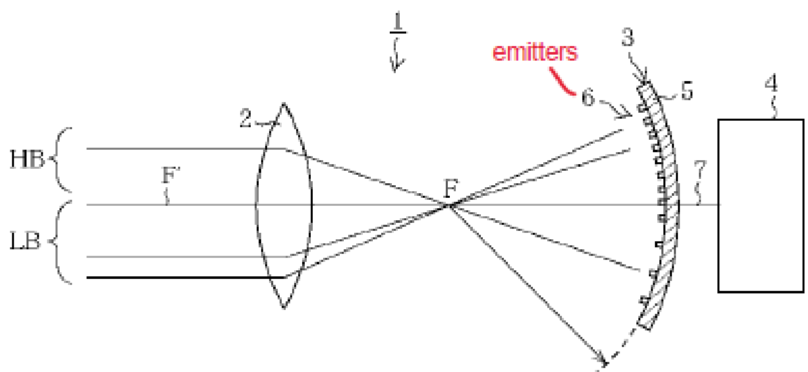
See GROUND 4, Claim 2; EX1003, ¶195.

E. GROUND 5: Claims 1-6, 8-13, and 15-16 are obvious by Chinniah in view of Brandenburg and Osawa

ii. Overview of Osawa

Osawa teaches a lighting device or system (e.g., a vehicle headlight or another optical light projection system) with a light source and optical elements. Osawa teaches a headlight with several emitters (LED chips 6) and a projecting convex lens 2. EX1011, [0009] and [0013], and FIGS. 1-2. Osawa teaches that the LED arrangement facilitates manufacturing compact headlamps with extended life and low power consumption. EX1011, [0008] and [0046]; EX1003, ¶197.

【図１】



EX1011, FIG. 1 (annotated)

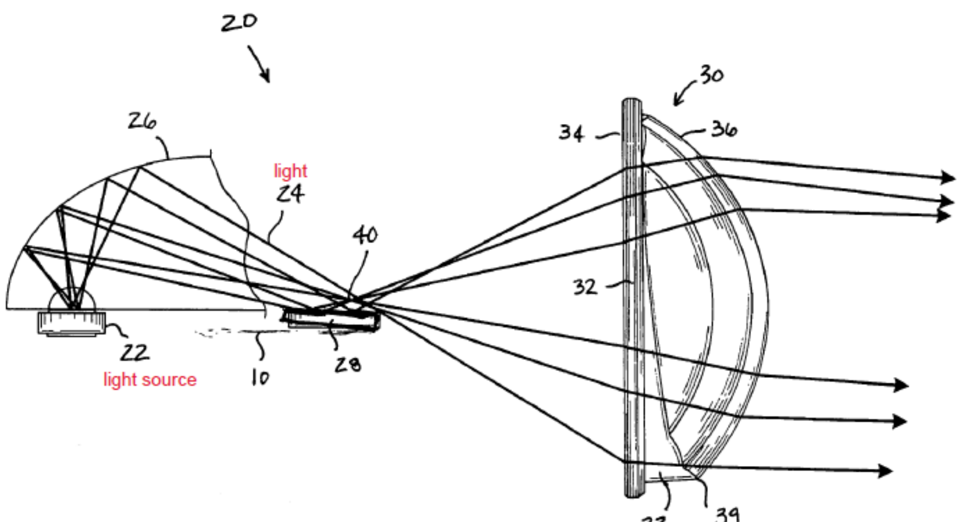
iii. Claim 1

a. 1[pre] "A system for projecting a pattern of light, the system comprising:"

Chinniah discloses a system for projecting a pattern of light. EX1005, Abstract ("The condenser lens is provided for a projector-type headlamp assembly having a light source emitting light which is projected longitudinally downstream in front of a motor vehicle."); 1:6-8; FIG. 3 (showing pattern of light rays); EX1003, ¶200.

b. 1[a] "a light source including a plurality of emitters configured to emit light, the plurality of emitters arranged in a pattern;"

Chinniah teaches a light source 22 configured to emit light 24. EX1005, 3:59-63 ("[T]he headlamp assembly 20 generally includes a light source 22 emitting light 24 … Preferably, the light source 22 is a LED which generally produces light from a surface area, as is known in the art."); FIG. 3; EX1003, ¶202.



EX1005, FIG. 3 (annotated)

Although Chinniah may not expressly describe a plurality of emitters in its light source, Chinniah recognizes that there is a light output requirement for automotive lighting applications, and that LEDs may be used in such applications to provide the required light output. EX1005, 1:12-15; EX1003, ¶203.

As discussed in Ground 3, 15[a], Brandenburg teaches a plurality of LEDs to increase the intensity of light and to enable the realization of more complex luminous intensity distributions. EX.1006, ¶[0040]; FIG. 4 (showing a plurality of emitters 22 arranged in a pattern in module 20), ¶¶[0031], [0011], FIG. 5; EX1003, ¶204.

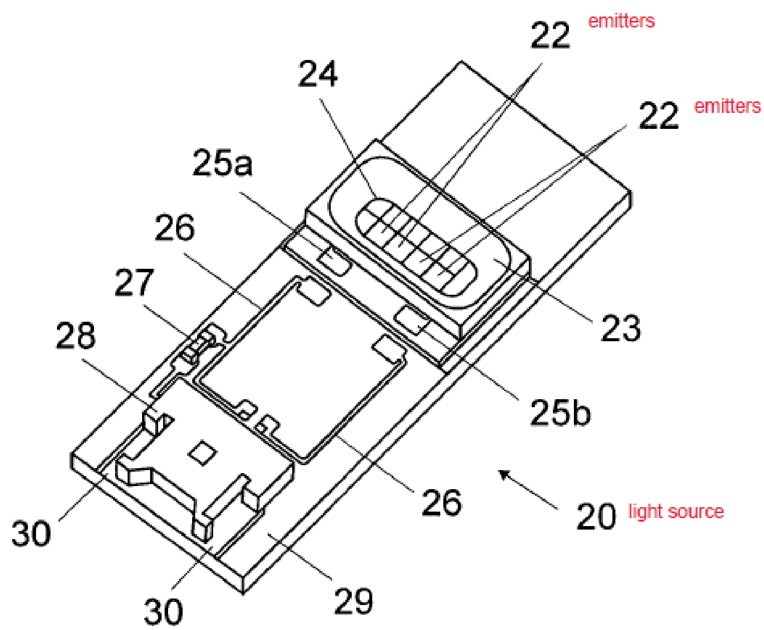


FIG 4

EX1006, FIG. 4 (annotated)

Brandenburg also shows in FIG. 5 the emitters (light-emitting diode chips 22) arranged in a pattern of a two-dimensional array. EX1003, ¶205.

It would have been obvious to a POSITA to modify Chinniah to include a plurality of emitters arranged in a pattern to improve light intensity from the teachings of Brandenburg. Brandenburg discloses a plurality of emitters 22 in each module 20, and expressly teaches to use a plurality of emitter modules 20 to increase light intensity. EX1006, ¶[0040], [0012], [0031]; and Chinniah EX1005, 3:26-31; EX1003, ¶206.

Both Brandenburg and Chinniah describe vehicle headlight optical systems, and seek to address similar problems relating to controlling illumination, beam distribution, and glare, and a POSITA would be motivated to apply known optimization techniques to improve Chinniah's system based on the disclosure of Brandenburg. EX1005, 1:6-8, 3:59-63; EX1006, ¶[0004]; EX1003, ¶207.

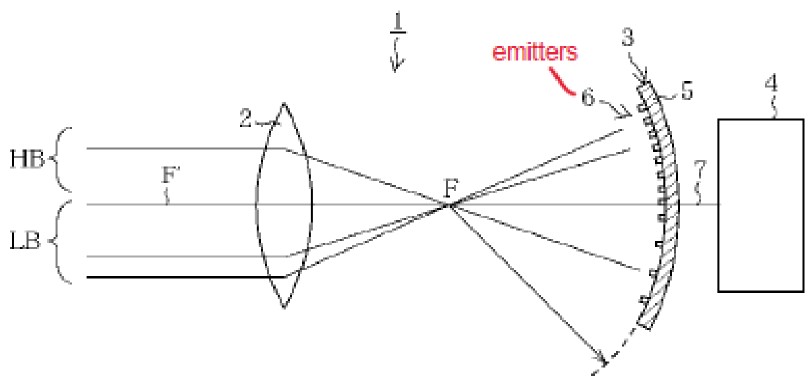
Brandenburg further describes that using multiple light-emitting diode chips 22 can provide another benefit of enabling different (or particular) light intensity distributions to be generated for the vehicle's high beam, low beam, daytime running light, and/or fog light. EX1006, ¶¶[0009], [0012]; EX1003, ¶208.

Accordingly, a POSITA would have been motivated to modify the system of Chinniah with the plurality of light-emitting diode chips 22 arranged in a pattern as shown in Brandenburg's FIG.4 and/or a plurality of patterned modules 20, in order to increase the light intensity and/or to achieve different (or particular) light intensity distributions. Further, there would be a reasonable expectation of success in making such a modification, because the modification based on Brandenburg involves simply adding an additional emitter(s) to emit light. EX1003, ¶209.

Alternatively or additionally, it would have been obvious to modify Chinniah based on Osawa to include a plurality of emitters arranged in a pattern. EX1003, ¶210.

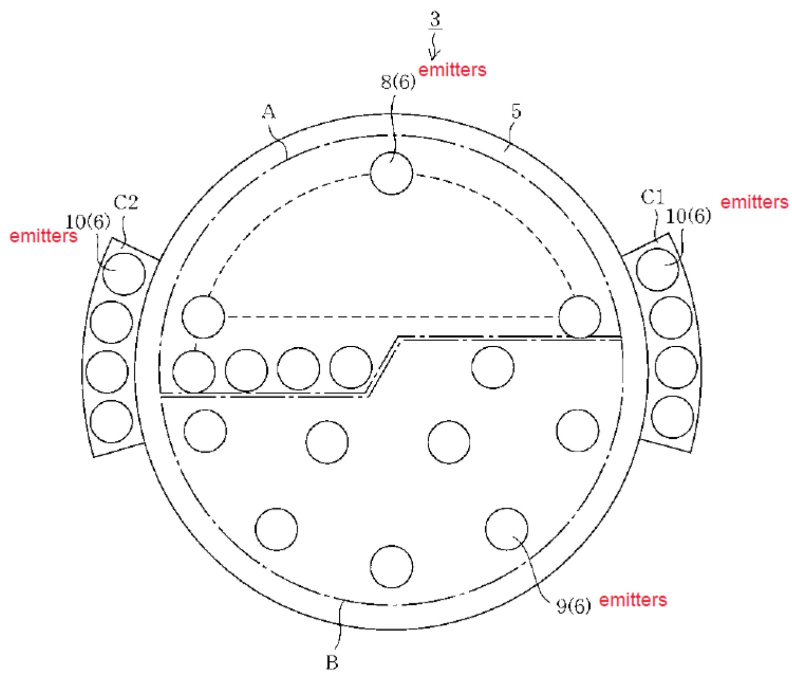
Osawa discloses a vehicle headlight with a projecting convex lens 2 and a light-emitting surface made of an arrangement of emitters (LED chips 6). EX1011, ¶¶[0009] and [0013], FIGS. 1-3; EX1003, ¶211. FIGS. 1 and 2 of Osawa are reproduced below with annotation.

【図 1】



EX1011, FIG. 1 (annotated)

【図 2】



EX1011, FIG. 2 (annotated)

The LED chips 6 shown above in Osawa's FIGS. 1-2 are arranged in an irregular pattern. Specifically, the LED chips 6 are arranged in a low beam LED chip group 8, a high beam LED chip group 9, and a cornering beam LED chip 10. EX1011, ¶¶[0018]-[0020]. By including the irregular pattern configuration of multiple LED chips 6, Osawa's headlight 1 can accomplish different light distribution patterns for various functions (e.g., low beam, high beam, cornering beam). EX1011, ¶¶[0018]-[0020], [0023] ("[T]here is an effect that the light distribution can be freely adjusted.”). By including the multiple LED chips 6 in this configuration, a reduction of parts can be realized, and vehicle safety can be improved by providing redundancy in case some LEDs fail. EX1011, ¶[0023] (“[E]ven if a part of the LED chips 6 falls into a function stop state, if the LED chips 6 of the other groups are turned on, it is possible to prevent the front from becoming dark…to secure very high safety during traveling …. Further … since it is not necessary to use a shade which is indispensable in the conventional headlamp…the light distribution can be freely adjusted in addition to the reduction in the number of components.”); EX1003, ¶212.

These teachings directly complement the headlamp designs in Chinniah and Brandenburg, which similarly seek to provide solutions for automotive headlight applications, including achieving appropriate beam characteristics for automotive headlight applications. EX1005, 3:26-31 (“[S]tandard elliptical reflectors may be employed in conjunction with LED light sources to provide a light output that is suitable for automotive headlight applications while also having the desired beam characteristics.”); EX1006, ¶¶[0009], [0012], [0040]; EX1003, ¶213. Also, like Brandenburg, Osawa teaches generating a low beam, a high beam, and a cornering beam via different (or particular) light intensity distributions. EX1006, ¶¶[0009], [0012].

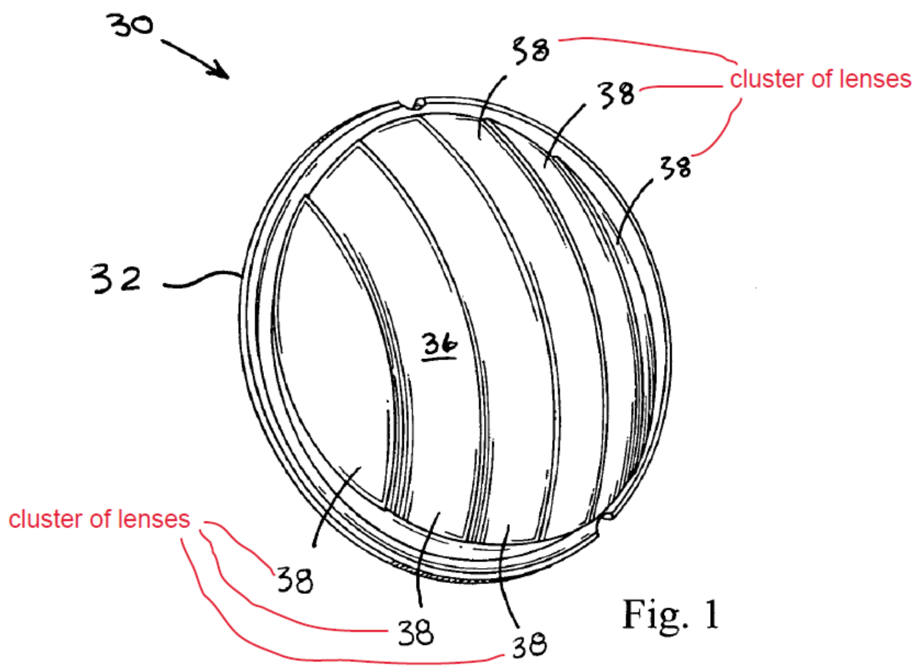
A POSITA would have been motivated to incorporate irregular patterns of emitters, as described in Osawa, in the lighting system of Chinniah to achieve a vehicle headlamp that is capable of producing various desired beam shapes and distributions, while also accomplishing a reduction in parts and improved vehicle safety; EX1003, ¶214.

Chinniah in view of Brandenburg and Osawa teaches "a light source including a plurality of emitters configured to emit light, the plurality of emitters arranged in a pattern." EX1003, ¶215.

c. 1[b] "a cluster of lenses located in front of the light source, wherein each lens of the cluster of lenses is configured to receive light from the plurality of emitters and the cluster of lenses is configured to concurrently focus and project light from each of the emitters in a plurality of directions; and"

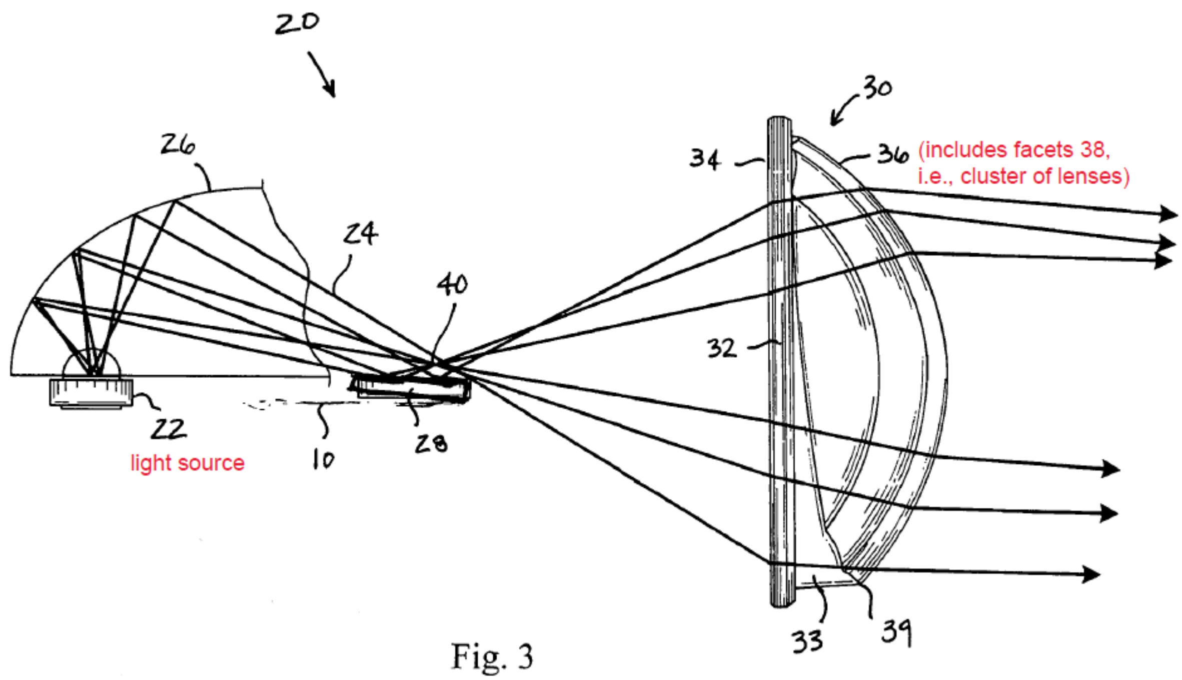
Chinniah teaches a cluster of lenses (e.g., facets 38 in FIGS. 1-4, facets 138 in FIGS. 6-7, facets 238 in FIG. 8). Chinniah describes that the second surface 36 is formed as a plurality of facets 38, and the embodiment of FIG. 2 includes six (6) facets although any number of facets may be readily employed. EX1005, 3:39-56; EX1003, ¶217.

FIG. 1 (annotated) of Chinniah is reproduced below.



EX1005, FIG. 1 (annotated)

Chinniah also teaches that the cluster of lenses (e.g., facets 38 in FIGS. 2-4, facets 138 in FIGS. 6-7, facets 238 in FIG. 8) is located in front of the light source (e.g., light source 22 including LED 22) to receive light from the light source. EX1005, FIG. 3, FIG. 4, 4:57-64 ("In either case, the condenser lens 30 receives light at its first surface 34, and through the construction of the second surface 36 having a plurality of facets 38, a predetermined beam pattern 44 is produced as shown in FIG. 5."); EX1003, ¶218. FIG. 3 (annotated) of Chinniah is reproduced below.



EX1005, FIG. 3 (annotated)

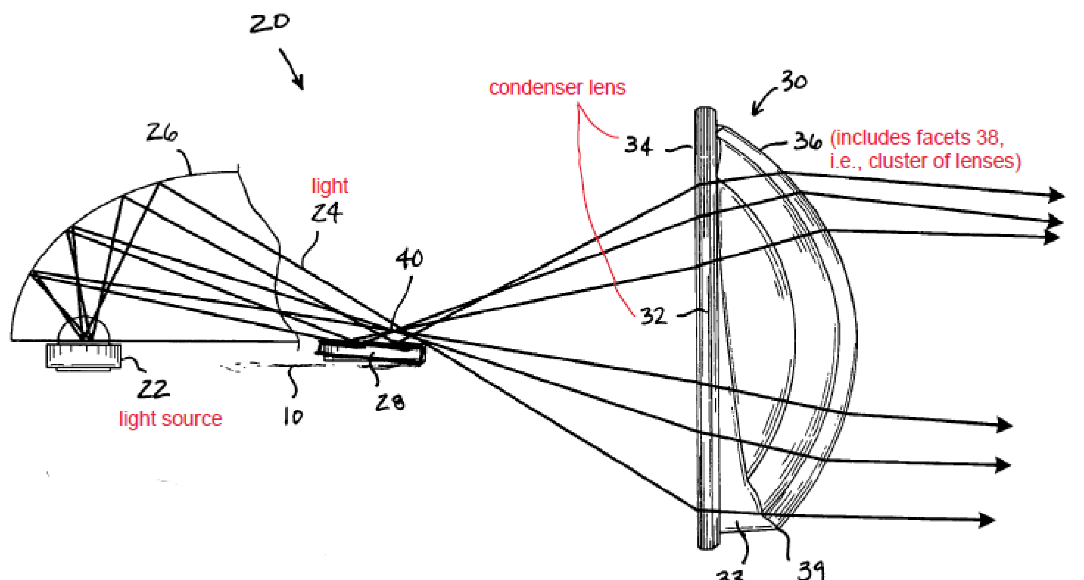
As shown above in FIG. 3, light from a light source 22 reaches the second surface 36, which includes the cluster of lenses (e.g., facets 38). EX1003, ¶219. Chinniah teaches that each of the facets 38 is used to provide a desired output beam, indicating that light from the light source 22 is received by each of the facets 38. EX1005, 3:46-56; EX1003, ¶219. The combination of Chinniah and Brandenburg teaches "wherein each lens of the cluster of lenses is configured to receive light from the plurality of emitters. "

Chinniah also discloses that the cluster of lenses (e.g., facets 38, facets 138, facets 238) is configured to concurrently focus and project light from the light source 22 in a plurality of directions. Chinniah discloses that "the second surface [has] a plurality of facets structured to horizontally ***focus the light differently*** from the vertical focus of the light to ***provide a predetermined beam pattern*** having an increased horizontal beam spread relative to an aspheric condenser lens." EX1005, Claim 1 (emphasis added); FIG. 1 (showing light being projected in a plurality of directions from facets 38), and Claim 16 ("[T]he second surface having a generally concave curvature to horizontally and vertically ***focus the light and provide a predetermined beam pattern***, the second surface having at least one vertically elongated facet having one of a convex and a concave curvature that provides a horizontal beam spread component to the predetermined beam pattern.") (emphasis added); EX1003, ¶220.

The combination of Chinniah and Brandenburg teaches "the cluster of lenses is configured to concurrently focus and project light from each of the emitters in a plurality of directions."

d. 1[c] "a condenser lens located between the light source and the cluster of lenses, wherein the condenser lens is configured to concentrate light from each of the plurality of emitters towards a center of the cluster of lenses."

Chinniah discloses a condenser lens (main body 32 and first surface 34) located between the light source 22 and the cluster of lenses (e.g., facets 38 in FIGS. 2-4, facets 138 in FIGS. 6-7, facets 238 in FIG. 8). EX1005, 3:32-37; EX1003, ¶222.



EX1005, FIG. 3 (annotated)

FIG. 3 of Chinniah discloses that the condenser lens (32, 34) is configured to concentrate light 24 from the light source 22 bend inwards towards a center of the cluster of lenses (e.g., facets 38). Thus, Chinniah in combination with Brandenburg discloses "a condenser lens located between the light source and the cluster of lenses, wherein the condenser lens is configured to concentrate light from each of the plurality of emitters towards a center of the cluster of lenses" as claimed. EX1003, ¶¶223-224

Alternatively or additionally, it would have been obvious for a POSITA to replace the reflector 26 and/or a shield 28 of Chinniah with a condenser lens. EX1003, ¶225.

Chinniah discloses that the reflector 26 collects and redirects light 24 emitted from the light source 22. EX1005, 3:57-4:13. The reflector 26 acts as a condenser lens and a POSITA would understand that the reflector 26 function can be accomplished using a condenser lens. EX1003, ¶226. Chinniah describes that the reflector 26 performs "focus[ing]" towards a focal point 40. EX1005, 3:65-4:2, FIG. 3. Thus, reflector 26 concentrates light from the light source 22 towards a center of the cluster of lenses (e.g., facets 38 in FIGS. 2-4, facets 138 in FIGS. 6-7, facets 238 in FIG. 8). EX1003, ¶226.

Chinniah also recognizes that a POSITA would have understood that the headlight assembly may be configured as a "direct projection headlamp" where "the LED 22 would be positioned generally as shown by numeral 22 in the FIG. 4.

EX1005, 4:57-61; EX1003, ¶227. Chinniah further explains that "[I]n a direct projector unit, no reflector is employed." EX1005, 1:32-35; EX1003, ¶227.

Brandenburg describes a direct projection headlamp that includes a light source (light-emitting diode module 20 including LED chips 22), a condenser lens (module optics 21), and a cluster of lenses (1). EX1006, ¶¶[0031]-[0032], FIGS. 4-6. Brandenburg describes that the condenser lens (concentrator 21) "bundles the light generated by the LED chips 22 so that it exits the front side 21a of the concentrator 21 facing away from the LED chips 22 with reduced divergence." EX1006, ¶[0031]. A POSITA would have recognized that this "bund[ling]" by the condenser lens (concentrator 21) improves light collection by the cluster of lenses (optical lens 1). EX1003, ¶228.

Given that Chinniah recognizes a benefit of improving light collection by a downstream optical element through the use of an upstream optical element(s) and that its headlight assembly may be configured as a direct projection headlamp without a reflector, and given that Brandenburg teaches using a condenser lens (concentrator 21) to improve light collection in a direct projection headlamp, it would have been obvious for a POSITA to include the concentrator 21 as an alternative to the reflector 26/shield 28 structure of Chinniah. There would have been a reasonable expectation of success in making such modification since the modification involves replacing equivalent optical components, i.e., replacing reflector 26 and shield 28 of Chinniah with a condenser lens (concentrator 21) of Brandenburg to perform the same function of light collection. EX1003, ¶229. In addition, a POSITA would have been motivated to modify Chinniah with the concentrator 21 of Brandenburg in order to implement a direct projection headlamp as suggested by Chinniah. EX1003, ¶229.

xiv. Claim 2

b. "The system of claim 1, wherein the plurality of emitters includes light emitting diodes configured to generate infrared light that is detectable by a camera but not by an eye of a human observer interacting with an object illuminated by at least a portion of the light."

Brandenburg discloses that the light-emitting diode chips 22 are configured to generate infrared light that is detectable by a camera, but not by an eye of a human observer interacting with an object illuminated by at least a portion of the light. EX1003, ¶232.

> The term light here should not only include the spectral range of visible electromagnetic radiation, but also **the near infrared range (wavelength**

> **range from approx. 800 nm to 1000 nm), which is usually used for night vision devices**. For example, the lighting device according to the invention can comprise light-emitting diode modules 20 which generate **infrared radiation from the near infrared range exclusively** or in addition to the visible electromagnetic radiation, which is coupled into one or more optical lenses according to the invention in order **to obtain an infrared long beam, for example together with a suitable infrared camera**.

EX1006, ¶[0042]l EX1003, ¶233.

It would have been obvious for a POSITA to have the plurality of emitters in the combination of Chinniah in view of Brandenburg and Osawa to include infrared light emitting diodes to improve safety in night driving as taught by Brandenburg. EX1006, ¶[0042]; EX1003, ¶234. There would also have been a reasonable expectation of success by a POSITA in making such modification since it involves simply adding infrared emitters. EX1003, ¶234.

xv. Claim 3

a. "The system of claim 1, wherein the cluster of lenses includes a Fresnel lens."

Brandenburg teaches that the cluster of lenses (optical lens 1, 1', or 1'') may be implemented as a Fresnel lens. Brandenburg explains "the surface segments [of lens 1, 1', or 1''] can also be arranged in concentric rings, for example, where each ring comprises several stepped surface segments …." EX1006, ¶[0039]. Brandenburg explains that such a structure was known in the art as a Fresnel lens. EX1006, ¶[0002] ("The Fresnel lens is an optical lens with a light-emitting surface that is divided into ring-shaped stepped surface segments, with the stepped surface segments forming concentric rings."); EX1003, ¶237.

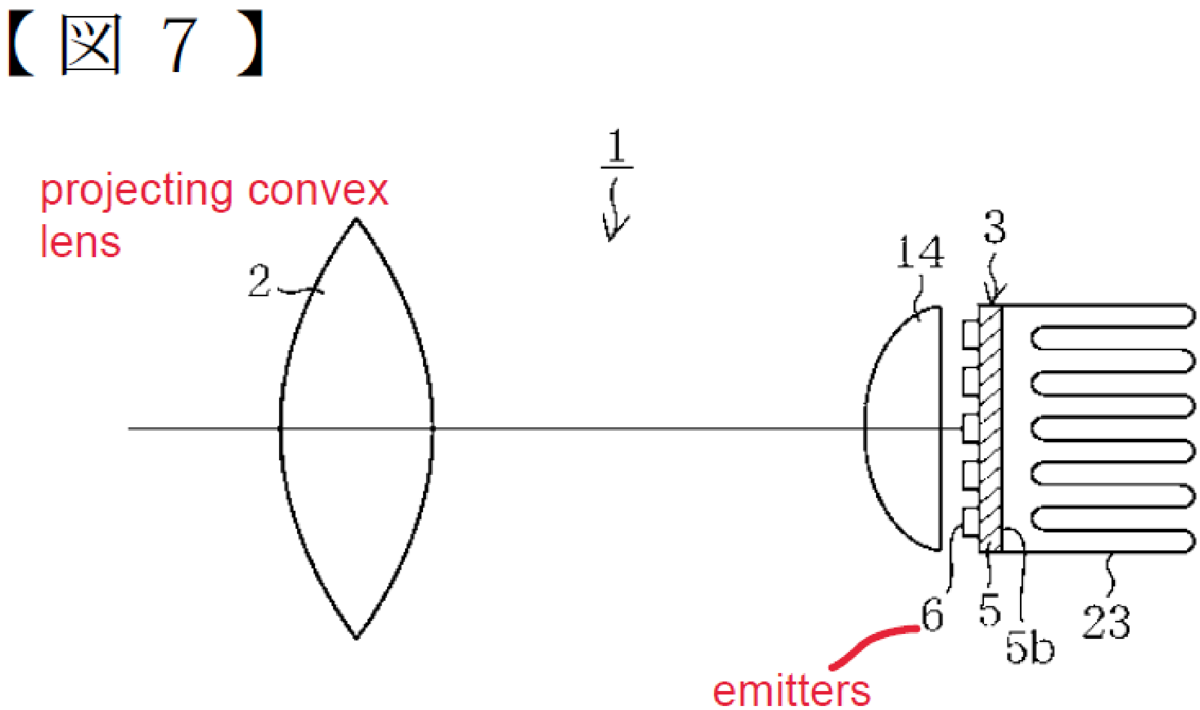
Brandenburg further describes that the cluster of lenses (optical lens 1 , 1', or 1''), and more particularly the surface segments thereof, may have particular shapes and arrangements to achieve a desired light intensity distribution such as, for example, for a high beam, low beam, daytime running light, or fog light. EX1006, ¶[0009], ¶¶[0030], [0034]-[0035], [0038], and FIGS. 2, 6, 10-11, and 14-15; EX1003, ¶238.

Chinniah recognizes that the condenser lens 230 may "take any shape, circular or non-circular, including rectangular, square, oval or other oblong shapes" which can provide a benefit in that "unused material of the condenser lens 230 can be [further] eliminated, reducing the weight of the lens 230 and headlamp assembly, thereby providing a headlamp assembly which is lighter and smaller." EX1005, 5:60-67. A POSITA would have known that a benefit of using a Fresnel lens is that has a reduced size and weight relative to a comparable condenser lens. EX1003, ¶239.

It would have been obvious for a POSITA to modify Chinniah, based on Brandenburg, so that the cluster of lenses includes a Fresnel lens, and there would have been a reasonable expectation of success in making such a modification since it involves replacing one known optical element for another known optical element. EX1003, ¶240. In addition, a POSITA would have been motivated to make the modification in order to achieve a desired light intensity distribution as described in Brandenburg and/or to provide a headlamp assembly that is lighter and smaller as described in Chinniah. EX1006, ¶[0009]; EX1005, 5:60-67; EX1003, ¶240.

This modification is further obvious when considering Chinniah in view of Brandenburg, and in further view of Osawa. EX1003, ¶241.

Osawa discloses a headlight with a projecting convex lens 2 and a light-emitting surface made of an arrangement of LED chips 6. EX1011, ¶¶[0009] and [0013], FIG. 7; EX1003, ¶242.



EX1011, FIG. 7 (annotated)

Osawa describes that the projecting convex lens (2) may be a Fresnel lens. EX1011, ¶[0044] ("The Fresnel lens is also effective as a convex lens for projection."), claim 14 ("wherein one or both of the projecting convex lens and the condensing convex lens are Fresnel lenses."); EX1003, ¶243.

Osawa teaches that, by incorporating a Fresnel lens in a headlamp, the headlamp may be thinner and lighter than other types of lenses, and it can be easily manufactured by using resin molding, making such lenses cost effective. EX1011, ¶¶[0044]-[0045]; EX1003, ¶244.

A POSITA would have been motivated to incorporate a Fresnel lens, as described in Osawa, in or as the condenser lens 30 of the lighting system in Chinniah to reduce the size and weight of Chinniah's headlamp. Moreover, there would have been a reasonable expectation of success in making such modification because the modification would have involved replacing a known element, a Fresnel lens, in or as the condenser lens. EX1003, ¶245.

The teachings of Chinniah, Brandenburg and Osawa render obvious the claim feature of "wherein the cluster of lenses includes a Fresnel lens." EX1003, ¶246

xvi. Claim 4

a. "The system of claim 1, wherein the emitters are arranged in an irregular pattern."

As discussed in GROUND 5, claim 1, Osawa describes LED chips 6 arranged in an irregular pattern. EX1011, Figs. 1-2. The LED chips 6 are arranged in a low beam LED chip group 8, a high beam LED chip group 9, and a cornering beam LED chip 10 group. EX1011, ¶¶[0018]-[0020]. By including the irregular pattern configuration of multiple LED chips 6, Osawa's headlight 1 can accomplish different light distribution patterns for various functions (e.g., low beam, high beam, cornering beam). EX1011, ¶¶[0018]-[0020], [0023]. Moreover, by including LED chips 6 in an irregular pattern configuration, a reduction of parts can be realized, and vehicle safety can be improved by providing redundancy in case some LEDs fail. EX1011, ¶[0023]. From the teachings of Osawa, it would have been obvious to modify Chinniah to include emitters configured in an irregular pattern. EX1011, ¶¶[0018]-[0020], FIGS. 1-2; EX1003, ¶249.

xvii. Claim 5

a. "The system of claim 1, wherein a first pattern of light projected by one of the lenses from the cluster of lenses overlaps with a second pattern of light projected by another of the lenses from the cluster of lenses."

As discussed for claim 5 of Ground 4, FIG. 3 of Chinniah shows light rays exiting from the cluster of lenses (facets 38) of surface 36 in different directions such that they will cross (i.e., overlap) downstream. EX1003, ¶252.

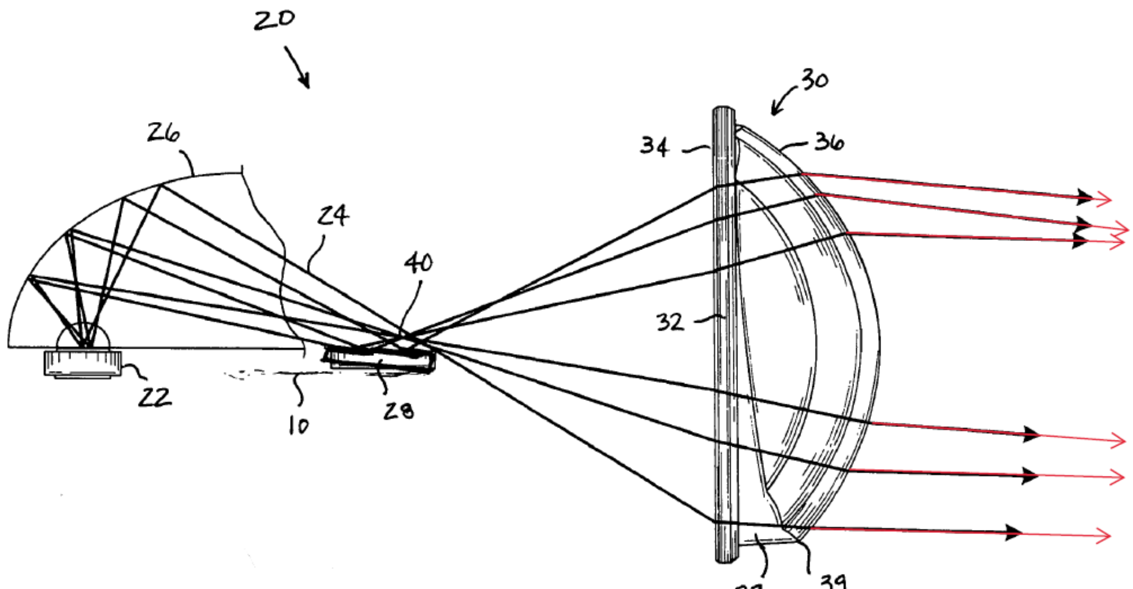


Fig. 3

EX1005, FIG. 3 (annotated)

EX1005, 5:9-13, 5:13-17. Thus, Chinniah teaches the claimed "wherein a first pattern of light projected by one of the lenses from the cluster of lenses overlaps with a second pattern of light projected by another of the lenses from the cluster of lenses". EX1003, ¶253

xviii. Claim 6

b. "The system of claim 1, wherein a pattern of light projected by the cluster of lenses is aperiodic along at least one dimension."

In FIG. 3 of Chinniah (shown above in GROUND 5, Claim 5), the upper light rays of the figure extending from the cluster of lenses (facets 38) of the second surface 36 have a different projection angle in comparison to the lower light rays of the figure. This is an irregular (i.e., aperiodic) light pattern along at least one dimension. EX1003, ¶256.

Chinniah discloses that the cluster of lenses (facets 38) may be configured to have a pattern of light with a horizontal focus that differs from a vertical focus thereof. EX1005, claim 1 ("[T]he second surface [has] a plurality of facets structured to horizontally focus the light differently from the vertical focus of the light to provide a predetermined beam pattern having an increased horizontal beam spread relative to an aspheric condenser lens."). The difference in horizontal and vertical focus of the light necessarily results in an irregular pattern of light and, more particularly, a pattern of light that is aperiodic along at least one dimension. EX1003, ¶257.

Accordingly, Chinniah discloses "wherein a pattern of light projected by the cluster of lenses is aperiodic along at least one dimension." EX1003, ¶258.

Additionally, Chinniah modified with the irregular pattern of emitters of Osawa would result in a pattern of light projected by the cluster of lenses to be irregular (i.e., aperiodic along at least one dimension) due to the irregular pattern of emitters. EX1003, ¶259.

xix. Claim 8

e. 8[pre] "A method comprising"

See GROUND 5, Claim 1[pre], 1[a], 1[b], 1[c]; EX1003, ¶262.

f. 8[a] "emitting, from a plurality of emitters, a plurality of lights arranged in a pattern;"

See GROUND 5, Claim 1[a]; EX1003, ¶264.

g. 8[b] "concentrating, via a condenser lens, the plurality of lights towards a central location of a cluster of lenses;"

See GROUND 5, Claim 1[c]; EX1003, ¶266.

h. 8[c] "receiving the concentrated light at a plurality of points within the cluster of lenses; and"

See GROUND 5, Claim 1[b]; EX1003, ¶268.

f. 8[d] "concurrently focusing, from each lens of the cluster of lenses, the received and concentrated light from each of the plurality of emitters in a plurality of directions;"

See GROUND 5, Claim 1[b] and Claim 5; EX1003, ¶270.

xx. Claim 9

b. "The method of claim 8, wherein said emitting includes generating infrared light that is not detectable by an eye of a human observer interacting with an object illuminated by at least a portion of the light."

See GROUND 5, Claim 2; EX1003, ¶273.

xxi. Claim 10

b. "The method of claim 8, wherein said concentrating comprises concentrating the plurality of lights towards a center of a cluster of lenses including a Fresnel lens."

See GROUND 5, Claims 1[b]-[c] and 3; EX1003, ¶276.

xxii. Claim 11

b. "The method of claim 8, wherein the focused light comprises an irregular pattern."

See GROUND 5, Claim 1[a]-[b] and Claims 4-6; EX1003, ¶279.

xxiii. Claim 12

b. "The method of claim 8, wherein the focused light includes a first pattern of light overlapping with a second pattern of light."

See GROUND 5, Claim 1[b] and Claim 5; EX1003, ¶282.

xxiv. Claim 13

b. "The method of claim 8, wherein the focused light includes a pattern which is aperiodic along at least one dimension."

See GROUND 5, Claims 4, 6, and 11; EX1003, ¶285.

xxv. Claim 15

e. 15[pre] "A system for projecting a pattern of light, the system comprising:"

See GROUND 5, Claim 1[pre], 1[a], 1[b], 1[c]; EX1003, ¶288.

f. 15[a] "a light source including a plurality of emitters configured to emit light;"

See GROUND 5, Claim 1[a]; EX1003, ¶290.

g. 15[b] "a cluster of lenses, each lens included in the cluster of lenses being configured to receive the emitted light from each of the plurality of emitters; and"

See GROUND 5, Claim 1[b]; EX1003, ¶292.

h. 15[c] "a condenser lens located between said light source and said cluster of lenses, the condenser lens concentrating light from each of the plurality of emitters towards a center of the cluster of lenses."

See GROUND 5, Claim 1[c]; EX1003, ¶294.

xxvi. Claim 16

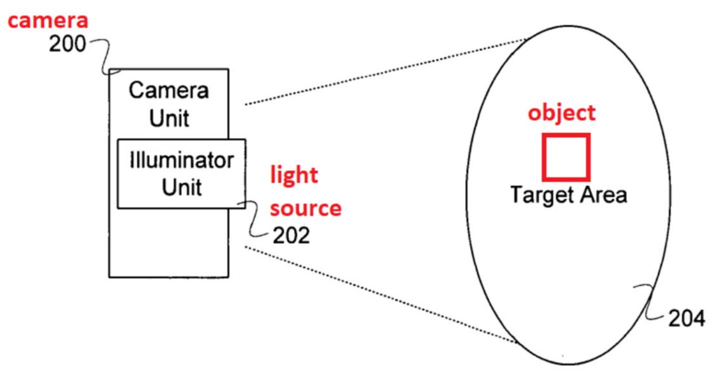
b. "The system of claim 15, wherein the plurality of emitters includes light emitting diodes configured to generate infrared light that is not detectable by an eye of a human observer"

See GROUND 5, Claim 2; EX1003, ¶297.

F. GROUND 6: Claims 7, 14, and 17 are obvious by Chinniah in view of Brandenburg and Osawa, and in further view of Hilaire and/or Cheon

i. Overview of Hilaire

Hilaire (EX1009) teaches a system for focusing and projecting patterns of light such that a location of an object illuminated by the pattern of light can be determined. EX1009, ¶¶[0002] and [0015]; FIG. 2A; EX1003, ¶299.



EX1009, FIG. 2A (annotated)

The system creates lighting patterns that are useful to computer vision systems and which allow for more accurate tracking and determination of object positions in space. EX1009, ¶¶[0002], [0015]-[0016], and [0019]; EX1003, ¶300.

Hilaire states that the LED light source may generate infrared light that interacts with an object and that is detectable by a camera but not by an eye of a human observer. EX1009, ¶¶[0015]-[0016], and [0021]. Additionally, multiple emitters can be used to generate more patterned features or to illuminate objects better. EX1009, ¶[0015]. The emitted light may be projected and focused into an irregular pattern. EX1009, ¶[0032]; FIGS. 7A-7B; EX1003, ¶301.

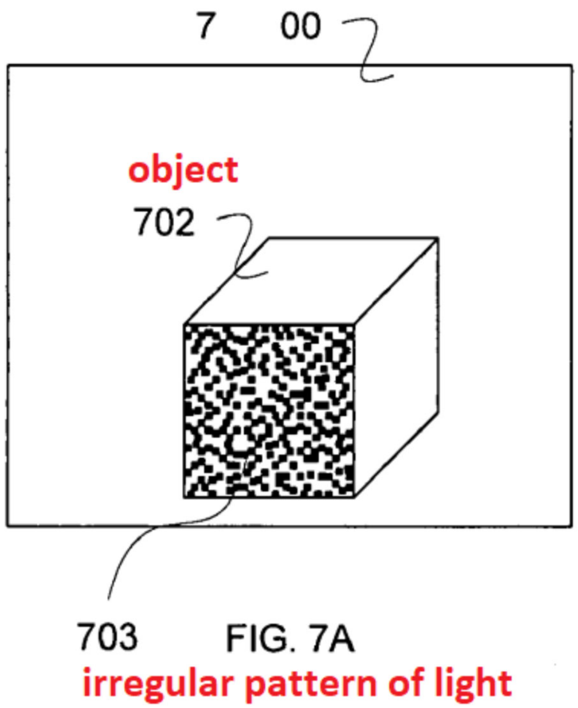
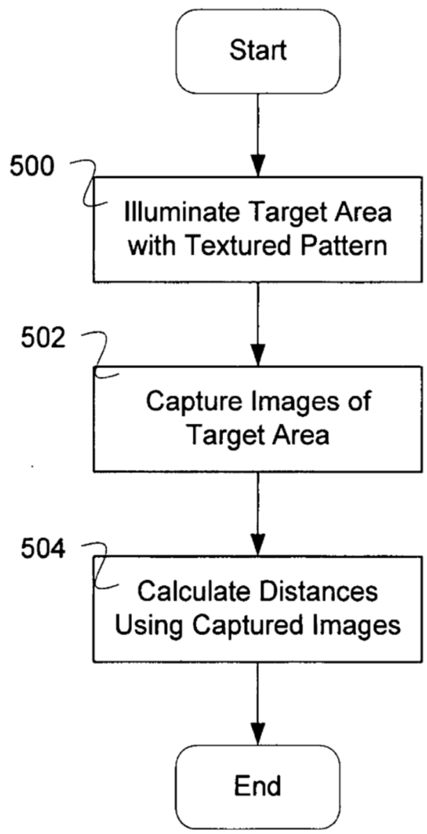


FIG. 7A

EX1009, FIG. 7A (annotated)

Hilaire further states that the use of the irregular pattern allows the system to more reliably detect objects that are at a different distances. EX1009, ¶¶[0015]-[0016]; EX1003, ¶302. The system utilizes its camera and computer to capture and process images of the patterned light reflected off of objects. EX1009, ¶¶[0009]-[0010], [0013], and [0015]-[0016]. Hilaire describes a stereopsis algorithm to match features between two or more camera images, and the system will attempt to find matches of corresponding points of the irregular pattern reflected off of an object in the different images. EX1009, ¶¶[0019], [0022]-[0023], and [0028]-[0029]. The disparity between these corresponding points allows depth calculations to be performed, providing the location of objects in space. *Id.*; FIG. 5. EX1003, ¶302.



EX1009, FIG. 5

ii. Overview of Cheon

Cheon (EX1010) teaches a vehicle lighting system that projects infrared light onto objects, such as pedestrians, to detect the objects. EX1010, p. 2, ¶¶1-6; p. 4, ¶1; FIG. 4; EX1003, ¶304.

EX1010, FIG. 4

Cheon teaches a vehicle lighting system that includes light sources (near-infrared lamps (40a) (40b)) to generate infrared light that interacts with an object and that is detected by a camera. *Id.*, p. 2, ¶¶1-6, 14; p. 4. The system is designed to aid a driver in conditions where visibility is low, while also avoiding glare to other vehicles. *Id.*, p. 2, ¶¶2-4. Cheon discloses that, through the object detection, the system may alert the driver as to the distance to the object. *Id*., p. 3, ¶¶9-12; EX1003, ¶305.

iii. Claim 7

a. "The system of claim 1, further comprising: a camera configured to detect a pattern of light on an object illuminated by at least a portion of the pattern of light; and a computing device configured to determine a location of the object in space based on at least the detected pattern of light on the object."

The teachings of Hilaire and/or Cheon render obvious the limitations of claim 7. Hilaire teaches a light source (illuminator unit 110, 202), a camera unit 100, 200, and a computing device (distance processor 130, 400), that are used to determine an object location in space based on at least the detected pattern of light on the object. EX1009, ¶¶[0002], [0015]-[0016], [0022]-[0023], [0028], [0031]. Hilaire teaches that, in order to calculate distances to an object, the illuminator unit illuminates the object in a target area with a textured pattern of light, the camera unit images the illuminated object, and the distance processor calculates the distance to the object based on the detected textured pattern of light. EX1009, ¶¶[0019]-][0023]. Hilaire also teaches that the illuminated light may be "non-visible" light (e.g., infrared).

EX1009, ¶[0016] ("Illumination source comprises … an infrared laser … light emitting diode ... A non-visible illumination source will enable the distance system to operate without being detectable by a human being who is in the target area."); EX1003, ¶308.

Similarly, Cheon discloses a light projection system that "us[es] near-infrared rays to monitor pedestrians or objects on the road ahead during night driving." EX1010, p. 4, ¶1. The system includes a light source (near-infrared lamps (40a) (40b)), a camera (image input unit (50)), and a computing device (image processing unit (60)). *Id.*, p. 2, ¶9. Cheon states the "image input unit (50) [that] is a near-infrared camera . . . detects [the] near-infrared rays reflected from objects or pedestrians." *Id.*, p. 2, ¶15. The system detects the location of the detected object in space and alerts the driver as to the distance to the object using a speaker. *Id.*, p. 2, ¶9, p. 3, ¶¶1, 11-12. Cheon thus describes determining a location of the object in space based on at least the detected pattern of infrared light. EX1003, ¶309.

It would have been obvious foto modify the vehicle lighting system taught by Chinniah, Brandenburg and Osawa to include a camera and a computing device as required by claim 7 (and similarly claims 14 and 17) from the teachings of Hilaire and/or Cheon. A POSITA would be motivated to make the modification in order to provide object detection in conditions where visibility is reduced (such as at night driving) and/or to avoid blinding other drivers with illumination. EX1006, ¶[0042]; EX1009, ¶[0016]; EX1010, p. 2, ¶3; EX1003, ¶310.

Chinniah, Brandenburg, Hilaire, and Cheon seek to address similar problems of controlling illumination to detect objects while avoiding negative impacts of the illumination on other individuals. EX1005, 1:17-21 ("[T]he beam pattern provided in road illumination should have a certain amount of vertical spread as well as a certain amount of horizontal spread. At the same time, a vertical cut-off should be provided to minimize glare to oncoming traffic."); EX1006, ¶[0009] ("By means of the lighting device according to the invention, asymmetrical light intensity distributions can therefore also be generated. The lighting device according to the invention can therefore advantageously be designed as a vehicle headlight in order to generate, for example, the high beam, **low beam,** daytime running light or fog light."); EX1009, ¶[0016] ("A non-visible illumination source will enable the distance system to operate without being detectable by a human being"); EX1010, p. 2, ¶¶4-6 ("[I]t is difficult to recognize [an] object[,] . . . so a high beam is used[.] . . . [H]owever, in the case of [a] high beam, glare is caused to the drivers of [other] vehicles[.] . . . The present invention was invented to solve the above-stated problems[.]"); EX1003, ¶311.

Brandenburg, Chinniah, and Cheon each describes an optical system for vehicle headlights and a POSITA would look to these references in designing a vehicle headlight. EX1006, ¶[0001]; EX1005, 1:6-8, 3:59-63; EX1010, Abstract. Brandenburg, Cheon and Hilaire all use infrared light to detect objects. EX1006, ¶[0042]; EX1010, Abstract, EX1009, ¶[0016]; EX1003, ¶312.

Chinniah and Cheon teach the ability to minimize glare onto oncoming traffic. EX1005, 1:20-21; Cheon at p. 2, ¶3. A POSITA would have recognized that the use of infrared light described in Hilaire and Cheon would enable object detection while avoiding glare. EX1006, ¶[0042]; EX1009, ¶[0016]; EX1003, ¶313.

Incorporating the computing device of Hilaire or Cheon (to determine a location of objects based on a detected pattern of light on the object), with Chinniah would provide predictable results of facilitating the improved detection of objects in conditions where visibility is reduced, such as during night driving. EX1004, ¶[0042]; EX1003, ¶314.

A POSITA would have had a reasonable expectation of success in making this modification, since it involves incorporating known elements i.e., emitters, cameras and computers n to achieve a known and predictable result of object detection using patterned illumination. EX1003, ¶315.

The combination of Chinniah, Brandenburg and Osawa, in further view of Hilaire and/or Cheon teach "a camera configured to detect a pattern of light on an object illuminated by at least a portion of the pattern of light; and a computing device configured to determine a location of the object in space based on at least the detected pattern of light on the object." EX1003, ¶316.

iv. Claim 14

a. "The method of claim 8, further comprising: detecting a pattern of light on an object illuminated by at least a portion of a pattern of light; and determining a location of the object in space based on at least the detected pattern of light on the object"

See GROUND 6, Claim 7; EX1003, ¶319.

v. Claim 17

a. "a computing device configured to analyze images of a pattern formed by light projected from each of the emitters on an object to determine a location of the object in space based on at least the pattern of light on the object"

See GROUND 6, Claim 7; EX1003, ¶322.

G. GROUND 7: Claims 3-4 and 10 are obvious by Weidel in view of Chinniah, and in further view of Osawa

i. Claim 3

a. "The system of claim 1, wherein the cluster of lenses includes a Fresnel lens."

As explained in GROUND 4, claim 3, Weidel in combination with Chinniah discloses this limitation. This limitation is further obvious in view of Osawa. EX1003, ¶325.

As discussed above for claim 3 in GROUND 4, by incorporating a Fresnel lens in a headlamp as described in Osawa, the headlamp may be produced to be thinner and lighter than other types of lenses, and it can be easily manufactured by using resin molding, making such lenses cost effective. EX1011, ¶¶[0044]-[0045]; EX1003, ¶326.

One of ordinary skill in the art would be motivated to incorporate a Fresnel lens as described in Osawa, in or as the surface 36 of the condenser lens 30 of the lighting system of the combination of Weidel and Chinniah, thereby configuring the cluster of lenses, to achieve Chinniah's objective of a vehicle headlamp that is lightweight, small, and cost effective. EX1005, Abstract and 5:63-67. There would also have been a reasonable expectation of success in making such modification since such modification involves replacing one optical element for another known optical element. EX1003, ¶327.

ii. Claim 4

a. "The system of claim 1, wherein the emitters are arranged in an irregular pattern."

Weidel in combination with Chinniah discloses this limitation, which is further obvious from Osawa. Osawa discloses LED chips 6 arranged in an irregular pattern. Similar to Weidel and Chinniah, Osawa provides solutions for automotive headlight applications. Also, similar to Osawa describing accomplishing a low beam, a high beam, and a cornering beam, Chinniah recognizes a benefit in controlling a light beam distribution. EX1005, Abstract, 1:49-51; EX1003, ¶330-331.

A POSITA would have been motivated to incorporate irregular emitter arrangements, as taught by Osawa, in the lighting system from the combination of Weidel and Chinniah to achieve a vehicle headlamp that is capable of producing various desired beam shapes and distributions, while also accomplishing a reduction in parts and improved vehicle safety. EX1005, 1:19-21; EX1011, ¶¶[0023]-[0024]; EX1003, ¶332.

The combination of Weidel, Chinniah and Osawa discloses "the emitters are arranged in an irregular pattern." EX1003, ¶333.

iii. Claim 10

a. "The method of claim 8, wherein said concentrating comprises concentrating the plurality of lights towards a center of a cluster of lenses including a Fresnel lens."

See GROUND 7, Claims 1[c] and 3; EX1003, ¶336.

H. GROUND 8: Claims 7, 14, and 17 are obvious by Weidel in view of Chinniah, and in further view of Hilaire and/or Cheon

i. Claim 7

a. "The system of claim 1, further comprising: a camera configured to detect a pattern of light on an object illuminated by at least a portion of the pattern of light; and a computing device configured to determine a location of the object in space based on at least the detected pattern of light on the object."

Weidel discloses "a camera configured to detect a pattern of light on an object illuminated by at least a portion of the pattern of light." Weidel states that "[t]he invention can be used in a night vision system[,] . . . preferably by equipping the headlight with LEDs or laser diodes which emit in the near infrared." EX1004, ¶[0012]. In describing an exemplary night vision system, Weidel states, "[a] CCD camera for recording the video image is located in the roof area of the vehicle. The CCD camera has an electronic shutter that is synchronized with the [infrared] laser diodes. . . . The video image is shown to the driver on an LCD display." EX1004, ¶[0005]. Weidel further states, "Since infrared light is almost invisible to the human eye, it can be illuminated permanently," and that [u]sing a video camera with a fast electronic shutter synchronized with the lasers can further reduce the light from oncoming vehicles [that would otherwise produce glare in the recorded video image]." *Id*., at ¶¶[0004]-[0005]; EX1003, ¶339.

Although Weidel may not expressly describe a computing device configured to determine a location of the object in space based on at least the detected pattern of light on the object, Weidel recognizes that its system for projecting light has an expanded functionality in addition to illumination, and, as discussed above, may be used for automobile night-vision systems. *Id*., ¶¶[0002], [0009], and [0012]. The express motivation for using the light projection system with a night vision system is to improve obstacle detection. *Id*., at ¶[0002] ("Poor visibility at night is a stressful and dangerous situation[,] . . . [which] leads to late detection of non-illuminated obstacles, pedestrians, bicyclists without lights and animals, and thus to accidents."); EX1003, ¶340.

Hilaire teaches a light source (illuminator unit 110, 202), a camera (camera unit 100, 200), and a computing device (distance processor 130, 400), that are used to determine a location of an object in space based on at least the detected pattern of light on the object. EX1009, ¶¶[0002], [0015]-[0016], [0022]-[0023], [0028], [0031]. Hilaire teaches to calculate distances to an object, the illuminator unit illuminates the object in a target area with a textured pattern of light, the camera unit images the illuminated object, and the distance processor calculates the distance to the object based on the detected textured pattern of light. EX1009, ¶¶[0019]-[0023]; EX1003, ¶¶341-342. Hilaire also teaches that the illuminated light may be "non-visible" light (e.g., infrared). EX1009, ¶[0016]. Similar to Weidel and Chinniah, Cheon discloses a light projection system that "us[es] near-infrared rays to monitor pedestrians or objects on the road ahead during night driving." EX1010, p. 4, ¶1. The system includes a light source (e.g., near-infrared lamps (40a) (40b)), a camera (e.g., image input unit (50)), and a computing device (e.g., image processing unit (60)). *Id*., p. 2, ¶9. Cheon further states the "image input unit (50) [that] is a near-infrared camera . . . detects [the] near-infrared rays reflected from objects or pedestrians." *Id*., p. 2, ¶15. The system detects the location of the detected object in space and alerts the driver as to the distance to the object. *Id*., p. 2, ¶9, p. 3, ¶¶1, 11-

12; EX1003, ¶343. It would have been obvious for a POSITA to modify the vehicle lighting system of Weidel and/or Chinniah based on Hilaire and/or Cheon to include a camera and a computing device to improve the ability to detect objects in conditions where visibility is reduced (such as at night) and/or to avoid blinding other drivers with illumination. EX1004, ¶[0002]; EX1009, ¶[0016]; EX1010, p. 2, ¶3; EX1003, ¶¶341-344.

Weidel, Chinniah, Hilaire and Cheon all address similar problems of controlling illumination to detect objects while avoiding negative impacts of the illumination on other individuals. EX1005, 1:17-21; EX1004, ¶[0005]; EX1009, ¶[0016]; and EX1010, p. 2, ¶¶4-6. Both Weidel and Cheon recognize using vehicle-based light projection systems to detect objects with infrared light. *e.g.,* EX1004, ¶¶[0012]; EX1010, Abstract. Hilaire also teaches projecting infrared light, which is not detectable by the naked eye, to detect objects. EX1009, ¶[0016]; EX1003, ¶345.

Chinniah and Cheon describe minimizing glare onto oncoming traffic. EX1005, 1:20-21; Cheon at p. 2, ¶3. A POSITA would have recognized and been motivated to use infrared light as described in Hilaire and Cheon, as opposed to visible light, to enable object detection while avoiding glare. EX1006, ¶[0042]; EX1009, ¶[0016]; EX1003, ¶¶346-347.

A POSITA would have found it obvious to incorporate the computing device of Hilaire or Cheon (that is used to determine a location of objects in space based on a detected pattern of light on the object), with Weidel and/or Chinniah in order to facilitate improved detection of objects in conditions where visibility is reduced, such as at night. EX1004, ¶¶[0002], [0004], and [0012]; EX1003, ¶348.

A POSITA would have had a reasonable expectation of success in making such a modification, because the modifications simply incorporate known elements, emitters, cameras, and computers, to achieve a known or predictable result of object detection using patterned illumination; EX1003, ¶349.

The combination of Weidel and Chinniah, in further view of Hilaire and/or Cheon teaches "a camera configured to detect a pattern of light on an object illuminated by at least a portion of the pattern of light; and a computing device configured to determine a location of the object in space based on at least the detected pattern of light on the object." EX1003, ¶350.

ii. Claim 14

a. "The method of claim 8, further comprising: detecting a pattern of light on an object illuminated by at least a portion of a pattern of light; and determining a location of the object in space based on at least the detected pattern of light on the object."

See GROUND 8, Claim 7; EX1003, ¶353.

iii. Claim 17

a. "a computing device configured to analyze images of a pattern formed by light projected from each of the emitters on an object to determine a location of the object in space based on at least the pattern of light on the object"

See GROUND 8, Claim 7; EX1003, ¶356.

IX. CONCLUSION

For at least the foregoing reasons, Petitioner requests that the Patent Office order institution of *inter partes* review for claims 1-17 and then cancel these claims as unpatentable.

Respectfully submitted,

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Pursuant to 37 C.F.R. § 42.24(d), Petitioner hereby certifies that the present paper contains 13,842 words (as counted by the "Word Count" feature of Microsoft Word^{TM}). This word count excludes the table of contents, table of authorities, table of exhibits, Mandatory Notices, certificate of word count, and certificate of service.

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CERTIFICATE OF SERVICE

The undersigned certifies that on April 30, 2025, in accordance with 37 C.F.R. §§ 42.105 and 42.6, a complete and entire copy of this Petition for *Inter Partes* Review and all supporting exhibits were provided via Priority Mail Express to the Patent Owner, by serving the correspondence address of record as follows:

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