

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

VOLKSWAGEN GROUP OF AMERICA, INC.,
Petitioner,

v.

YECHEZKAL EVAN SPERO,
Patent Owner.

U.S. Patent No. 10,894,503 to Spero

Case No.: IPR2023-00328

SECOND DECLARATION OF MATTHEW A. TURK PhD

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List of Exhibits

Exhibit No.	Description
2001	Declaration of Matthew A. Turk, PhD
2002	Curriculum Vitae of Matthew A. Turk, PhD
2003	Best Practices and FAQs for Filing Requests for Reexamination Compliant with 37 CFR 1.510 and 1.915, PTAB, May 2010
2004	Petition challenging U.S. Patent No. 10,894,503, <i>Volkswagen Group of America, Inc. v. Yechezkal Evan Spero</i> , IPR2023-00197, Paper 1, November 30, 2022
2005	Petition challenging U.S. Patent No. 10,894,503, <i>Volkswagen Group of America, Inc. v. Yechezkal Evan Spero</i> , IPR2023-00328, Paper 2, December 16, 2022
2006	Second Declaration of Matthew A. Turk, PhD
2007	Transcript of Deposition of Jianzhong Jiao, Ph.D. taken on August 2, 2023, <i>Volkswagen Group of America, Inc. v. Torchlight Technologies LLC</i> , IPR2023-01586
2008	Petition challenging U.S. Patent No. 9,995,551, <i>Volkswagen Group of America, Inc. v. Torchlight Technologies LLC</i> IPR2023-00318, Paper 2, December 22, 2022
2009	Declaration of Dr. Jiao, <i>Volkswagen Group of America, Inc. v. Torchlight Technologies LLC</i> IPR2023-00318, Exhibit 1003.
2010	Jianzhong Jiao and Ben Wang, “Etendue Concern for Automotive Headlamp Using LEDs,” SPIE Proceedings Vol. 5187, (January 2004) (Available at https://www.spiedigitallibrary.org/conference-proceedings-of-spie/5187/0000/Etendue-concerns-for-automotive-headlamps-using-white-LEDs/10.1117/12.504363.short)
2011	Michael Bass, <i>Handbook of Optics</i> 3 RD Edition Volume II, (McGraw-Hill, 2010) (Available at https://www.worldcat.org/title/555545456)
2012	Ben Wang and Jianzhong Jiao “Studies for Headlamp Optical Design Using LEDs,” SAE Technical Paper Series 2004-01-0434, (March 2004) (Available at https://www.sae.org/publications/technical-papers/content/2004-01-0434/)

Exhibit No.	Description
2013	Ben Wang and Jianzhong Jiao “Optical Transform Limitations in Headlamp Photometric Performance,” SAE Technical Paper Series 2005-01-0861, (April 2005) (Available at https://www.sae.org/publications/technical-papers/content/2005-01-0861/)
2014	Intentionally left blank
2015	Jianzhong Jiao and Ben Wang “High-Efficiency Reflector Optics for LED Forward Lighting,” SPIE Proceedings Vol. 6670, (September 2007) (Available at https://www.spiedigitallibrary.org/conference-proceedings-of-spie/6670/66700M/High-efficiency-reflector-optics-for-LED-automotive-forward-lighting/10.1117/12.730524.short)
2016	Navigant Consulting “Energy Saving Estimates of Light Emitting Diodes in Niche Lighting Applications” Building Technologies Program Office of Energy Efficiency and Renewable Energy U.S. Department of Energy (September 2008) (Available at Energy Savings Estimates of Light Emitting Diodes in Niche Lighting Applications (Technical Report) OSTI.GOV.)
2017	PCT Publication No. WO 86/05147 to Flaaten
2018	Transcript of Deposition of Jianzhong Jiao, Ph.D. taken on August 23, 2023, <i>Volkswagen Group of America, Inc. v. Torchlight Technologies LLC</i> , IPR2023-00315, IPR2023-00318.
2019	Alliance for Automotive Innovation website retrieved September 11, 2023 https://www.autosinnovate.org/about/our-members
2020	Michael Bass, <i>Handbook of Optics</i> 3 RD Edition Volume V, (McGraw-Hill, 2010) (Available at https://www.worldcat.org/title/557121959 .)
2021	Texas Instruments/Digikey “How DLP Technology Works,” (Available at https://www.digikey.com/en/product-highlight/t/texas-instruments/dlp-technology .) (Accessed September 12, 2023.)
2022	Texas Instruments “Introduction to +/- 12 Degree Orthogonal Digital Micromirror Devices (DMDs) (Available at https://www.ti.com/lit/an/dlpa008b/dlpa008b.pdf?HQS=dis-dk-

Exhibit No.	Description
	null-digikeymode-dsf-pf-null-ww&DCM=yes&distId=10) (Accessed September 12, 2023.)
2023	Intentionally left blank.
2024	Intentionally left blank.
2025	Transcript of Deposition of Jianzhong Jiao, PhD taken on October 3, 2023, <i>Volkswagen Group of America, Inc. v. Torchlight Technologies</i> , IPR2023-00197, -00328, -00335

1. I, Matthew A. Turk, hereby declare as follows:

2. I am making this declaration at the request of Yechezkal Evan Spero in the matter of *Inter Partes* Review of U.S. Patent No. 10,894,503 (“the ’503 Patent”) to Yechezkal Evan Spero.

3. I previously prepared a declaration in this proceeding dated April 19, 2023, submitted as an exhibit (Ex. 2001) with a Patent Owner Preliminary Response of the ’503 Patent to a Petition filed on December 16, 2022 by Petitioner *Volkswagen Group of America, Inc.* I understand that on July 17, 2023, the Board instituted the Petition.

4. For this second declaration, I have been asked to again provide opinions on the claims of the ’503 Patent in light of the prior art, Petitioner’s arguments in the Petition and the corresponding declaration and testimony of Dr. Jiao. If called upon to do so, I would testify competently thereto. I supplement my prior declaration (Ex. 2001) with this additional declaration to do so.

5. As I indicated in my prior declaration, although I am being compensated for the time spent reviewing materials and performing my analysis of the technical issues relevant to this matter, my compensation in no way depends on the outcome of this proceeding.

6. In preparation of this declaration, I have studied the exhibits as listed in the Exhibit List shown above.

7. In forming the opinions expressed below, I have considered:
- a. The documents listed above as well as additional patents and documents referenced herein;
 - b. The relevant legal standards, including the standard for obviousness provided in *KSR International Co. v. Teleflex, Inc.*, 550 U.S. 398 (2007), and any additional documents cited in the body of this declaration; and
 - c. My knowledge and experience based upon my work and study in this area as described below.

I. Qualifications and Professional Experience

8. I am a Professor and President of the Toyota Technological Institute at Chicago (TTIC) and an Emeritus Professor of the Department of Computer Science at the University of California, Santa Barbara. I have worked and studied in the field of computer vision since 1984, as well as related areas of image processing, pattern recognition, machine learning, and human-computer interaction. The field of computer vision is concerned with determining how computers can extract, analyze and understand information from images and video and has been applied to a wide variety of applications including automotive lighting and controls such as those used in automotive adaptive forward lighting systems.

9. I received my doctorate degree in Media Arts and Sciences from the Massachusetts Institute of Technology (MIT) in 1991. My doctoral work was in the area of computer vision, specifically concerning automatic face recognition. I received my Master of Science degree in Electrical and Computer Engineering from Carnegie Mellon University in 1984. My Master's work was in the area of robot fine motion planning. I received my Bachelor of Science degree in Electrical Engineering from Virginia Tech (VPI&SU) in Blacksburg, Virginia in 1982, where my senior honors thesis was on image processing.

10. In 1991, I published the paper "Eigenfaces for Recognition," which I co-authored with my Ph.D. advisor, Dr. Alex Pentland. The research reported in this paper helped lead to practical automated face recognition systems that are used in today's security and surveillance systems, as well as in consumer applications. My work on Eigenfaces has received several awards, including an IEEE Computer Society Outstanding Paper award at the IEEE Conference on Computer Vision and Pattern Recognition (CVPR) in 1991 and a "Most Influential Paper of the Decade" award from the International Association for Pattern Recognition (IAPR) Workshop on Machine Vision Applications (MVA 2000).

11. Along with my co-authors, I have received several other awards at professional conferences and workshops for my work in computer vision, image processing, and augmented reality, including several best paper awards and

winning the ACM Multimedia Open Source Competition in 2015.

12. My industry experience includes working for Martin Marietta Denver Aerospace from 1984 to 1987, where I worked primarily on computer vision for autonomous vehicle navigation as part of the Defense Advanced Research Projects Agency's Autonomous Land Vehicle program, the precursor to the later DARPA Grand Challenge events and subsequent advances in self-driving automobiles. In 1992, I was a visiting researcher at LIFIA/ENSIMAG in Grenoble, France and from 1993 to 1994, I worked for Teleos Research in Palo Alto, CA; in both of those positions, I worked on computer vision methods for recognizing human faces, gestures, and activity. From 1994 to 2000, I was a researcher for Microsoft Research, where I was a founding member of the Vision Technology Research Group and conducted research in vision-based human computer interaction and other related areas.

13. In 2000, I joined the faculty of the University of California, Santa Barbara, as an Associate Professor. In 2005, I was promoted to Full Professor and served as the Chair of the Media Arts and Technology Graduate Program from 2005 to 2010. In 2017, I was appointed as Chair of the Department of Computer Science. At UCSB, I taught graduate and undergraduate courses related to lighting, including automotive lighting, and lighting-control systems regarding computer vision, computer imaging, human computer interaction, probabilistic models and

methods, artificial intelligence, computer graphics, machine learning, and other areas. My Computer Imaging, Mobile Imaging, Computer Vision, Computer Graphics, and Computational Illumination courses covered the fundamentals of light and optics, camera sensors, imaging geometry, infrared imaging, optical filtering, image processing, 3D imaging, scene understanding, and structured lighting.

14. I co-founded (in 2003) and co-directed the Four Eyes Lab at UCSB, where the research focus is on the “four I’s” of Imaging, Interaction, and Innovative Interfaces. The Four Eyes Lab researches a variety of topics, including computer vision, pattern recognition, virtual and augmented reality, and face processing technologies such as face recognition and facial expression analysis. I worked on and supervised many research projects in these areas, including (1) visual recognition of automobiles and (2) multi-flash imaging, which used multiple image sources and special optics to infer 3D scene structure from images.

15. In 2014, I co-founded a startup company, Caugnate, to commercialize computer vision and augmented reality technology for remote collaboration. Caugnate was acquired by PTC Inc., in 2016, and now forms the core of the Vuforia Chalk augmented reality product.

16. In 2019, I became President of the Toyota Technological Institute at Chicago, an independent graduate research institute, where the research and

education focus of the faculty and Ph.D. students is on computer science theory, machine learning, artificial intelligence, and related areas such as computer vision, speech and language processing, robotics, and computational biology.

17. As a result of my work and research, I am a named inventor of U.S. Patent Number 5,164,992 entitled “Face Recognition System,” U.S. Patent Number 6,674,877 entitled “System and Method for Visually Tracking Occluded Objects in Real-time,” and U.S. Patent Number 9,495,761 entitled “Environment mapping with automatic motion model selection.”

18. I was a founding member of the Advisory Board for the International Conference on Multimodal Interfaces (ICMI), which provides a venue for disseminating recent advances in multimodal interaction research, systems, and methods, which includes combining visual modalities with audio, haptic, or other modalities. I served as the Chair of the ICMI Advisory Board from 2006 to 2009. I was also a founding member of the Advisory Board for the IEEE International Conference on Automatic Face and Gesture Recognition and served as the General Chair for the conference in 2011. I have been a primary organizer of several top research conferences, including serving as General Chair for the 2014 IEEE Conference on Computer Vision and Pattern Recognition, the primary annual conference in the field of computer vision, with over 2000 attendees, Program Chair for the 2017 IEEE Winter Conference on Applications of Computer Vision,

and General Chair of the 2019 International Conference on Multimodal Interfaces (ICMI).

19. I am currently an Associate Editor of the *ACM Transactions on Intelligent and Interactive Systems* and the *International Journal of Computer Vision and Signal Processing*, and was formerly an Associate Editor of *Image and Vision Computing*. I have also served as a guest editor of several other journals related to computer vision, machine learning, and facial recognition. I have published research on lighting and optics, including research focused on automobile-related imaging, including: “Car-Rec: A real-time car recognition system,” IEEE Workshop on Applications of Computer Vision (WACV 2011), January 2011; “VITS – a vision system for autonomous land vehicle navigation,” IEEE Trans. On Pattern Analysis and Machine Intelligence, Vol. 10, No. 3, pp. 342-361, May, 1988; “Video road-following for the Autonomous Land Vehicle,” Proc. IEEE International Conference on Robotics and Automation, Raleigh, N. C., April, 1987; “Color road segmentation and video obstacle detection,” Advances in Intelligent Robotic Systems: Mobile Robots, SPIE, Cambridge, MA, 1986.

20. In 2020, I was elected a Fellow of the Association for Computing Machinery (ACM), the main professional society in the field of computer science, for “contributions to face recognition, computer vision, and multimodal interaction.” In 2013, I was elected as a Fellow of the IEEE (the Institute of

Electrical and Electronics Engineers), an award conferred by the Board of Directors of the IEEE upon a person with an extraordinary record of accomplishments in any of the IEEE fields of interest. In 2014, I was elected as a Fellow of the International Association for Pattern Recognition (IAPR). In 2022, I was named as a Fellow of the Asia-Pacific Artificial Intelligence Association. I am also the recipient of the 2011-2012 Fulbright-Nokia Distinguished Chair in Information and Communications Technologies. I have given many keynote presentations at top conferences and workshops in my fields.

21. I have provided my full background in the curriculum vitae that is attached as Exhibit 2002.

II. Relevant Legal Standards

22. I have been asked to provide opinions on the claims of the '503 Patent in light of the prior art.

23. It is my understanding that a claimed invention is unpatentable under 35 USC § 102 if a prior art reference teaches every element of the claim. Further, it is my understanding that a claimed invention is unpatentable under 35 U.S.C. § 103 if the differences between the invention and the prior art are such that the subject matter as a whole would have been obvious at the time the alleged invention was made to a person having ordinary skill in the art to which the subject matter pertains. I also understand that an obviousness analysis takes into account

factual inquiries including the level of ordinary skill in the art, the scope and content of the prior art, and the differences between the prior art and the claimed subject matter.

24. It is my understanding that the Supreme Court has recognized several rationales for combining references or modifying a reference to show obviousness of the claimed subject matter. Some of these rationales include the following: combining prior art elements according to known methods to yield predictable results; simple substitution of one known element for another to obtain predictable results; a predictable use of prior art elements according to their established functions; applying a known technique to a known device to yield predictable results; choosing from a finite number of identified, predictable solutions, with a reasonable expectation of success; and some teaching, suggestion, or motivation in the prior art that would have led one of ordinary skill to modify the prior art reference or to combine prior art reference teachings to arrive at the claimed invention.

III. State of the Art as of 2002

A. POSA Considerations for LED Forward Lighting

25. While LEDs were being proposed for use in vehicle forward lighting applications to replace conventional light sources such as halogen and high-intensity discharge (HID) light sources, experts in vehicle lighting were uncertain,

even years later in 2004 and beyond, if or when the significant challenges associated with use of LEDs in these applications could be overcome to meet government regulations and industry standards while satisfying vehicle design aesthetics and operational demands.

B. Regulations and Standards

26. As generally referenced in numerous vehicle forward lighting patents and publications, vehicle forward lighting is subject to various government and industry regulations. Regulations such as the Federal Motor Vehicle Safety Standards (FMVSS) in the U.S. specify requirements with respect to minimum/maximum intensity, color, and beam pattern and shape for specific types of vehicle lights, such as low beam headlamp beams (also referred to as the dipped beam or passing beam) and high beam headlamp beams (also referred to as main beam or driving beam), cornering lamp beams, fog lamp beams, and signaling lamp beams, for example. Considering the differing requirements, functions, and positions for different types of lamp beams, a POSA would not have considered combining features from lamps having different functions (such as using amber color of fog lamp beams for low beam headlamps, or having high beam and low beam fog lamps, or cornering lamp beams having the intensity of low beam headlamps, etc.) or expect such combinations to meet regulatory requirements for a different type of lamp beam.

Any automotive headlamp beam pattern, either high-beam or low-beam, is a light luminous intensity (candela) angular distribution. The candela values are specified at different vertical and horizontal angles by using test points, lines, and zones. The specifications are governed by federal laws or industry recommendations. For a low-beam headlamp, for example, the beam pattern requirement is based on several factors: A) sufficient road illumination for driver visibility and safety; B) glare light control for the oncoming vehicle drivers; C) lamp aim-ability; and D) spread and foreground light for driver's comfort. Because of these requirements, the headlamp beam pattern must be a highly non-isotropic light distribution; and its light intensity varies in a range from a few hundreds to 20,000 or more candela.

(Ex. 2010¹ at 237.)

Based on the recent development of white LEDs, it becomes feasible to design automotive headlamps using LED light sources. While these LEDs are reaching high lumen output, the uniqueness of headlamp applications has not yet been sufficiently addressed. This paper discusses the optical features of an automotive headlamp, its optical

¹ Jianzhong Jiao and Ben Wang, "Etendue Concern for Automotive Headlamp Using LEDs", SPIE Proceedings Vol. 5187, published by the international society for optics and photonics (January 2004). Ex. 2010 is a true and accurate copy of a technical paper that I understand was published by SPIE in January 2004.

design principles, light intensity distribution and concentration requirements, and safety and customer pleasing needs.

(Ex. 2010 at 234.)

27. Regulations and standards define headlamp beam patterns so that light is provided to illuminate both near and far distances while avoiding glaring. The beam pattern includes invariable characteristics (such as a step, cutoff, and hotspot) that result from the optical system including the size, position, and intensity of the light source relative to reflectors and lenses to meet the photometric requirements at designated test points.

In certain angular area where high illumination is needed, the luminous intensity is very high and light is highly concentrated or collimated. This high light intensity area is called hotspot. At the top edge of the hotspot, light intensity is rapidly reduced to form a luminous intensity gradient or cutoff line, which serves two purposes: to control the glare light and to aim the lamp visually. Contrast to hotspot, the light that spreads to left and right or foreground has much less intensity and a large diverge or spread angle instead.

(Ex. 2010 at 237.)

Cutoff is designed into the luminaire through the optics (i.e., edge-ray designs) and/or the integration of baffles. While most applications do not require cutoff classification, except for those used on the exterior, such as automotive, roadway, and landscape lighting, most designers include such to make effective lighting systems by alleviating

potential glare, trespass, and pollution concerns. Often strict cutoff guidelines are mandated by governmental standards, such as for automotive, traffic signal, and roadway lighting. The goals are to provide the required lighting level to its users, while also alleviating light pollution and light trespass.

(Ex. 2011² at 40.43.)

A typical automotive headlamp is required to provide a specific output light distribution – beam pattern. For a low-beam headlamp, for example, the beam pattern requirement is based on several factors: (1) sufficient road illumination for driver visibility and safety; (2) glare light control for the oncoming vehicle drivers; (3) lamp aim-ability; and (4) spread and foreground light for driver's comfort. When the headlamp is constructed with multiple optical units or compartments with N LED light sources, each optical unit may have a different etendue value, or provide different luminous intensity and different spread angle.

* * *

However, because **both lamp aperture and number of LEDs that can be physically packaged into the lamp aperture are limited by vehicle level restriction**, the hotspot luminous intensity level, or

² Michael Bass, *Handbook of Optics* 3RD Edition Volume II, (McGraw Hill 2010.)

Ex. 2011 is a true and accurate copy of excerpts of a book that I understand was published by McGraw Hill in 2010.

performance is highly depending on the LED's luminance, rather than its total lumen output.

(Ex. 2012³ at 6-7, emphasis added.)

One major difficulty for forming a headlamp beam pattern is to obtain sufficient candela values in the hotspot while the lamp total aperture is limited. For high-beam design, it is more difficult to form the hotspot as its candela requirement can be as high as 40,000.

(Ex. 2010 at 237-238.)

The light intensity distribution or beam pattern from a forward lighting device is regulated by federal, state and international laws for safety. The optical system design to provide such beam patterns has been largely associated with the characteristics of the tungsten halogen or HID sources. White LEDs, on the other hand, have different optical characteristics, which in turn have impacted the headlamp optical system design.

(Ex. 2010 at 234.)

28. Regulations and standards require white light for vehicle forward lighting applications. As such, light sources emitting other colors are not available

³ Ben Wang and Jianzhong Jiao, "Studies for Headlamp Optical Design Using LEDs", SAE Technical Paper Series 2004-01-0434, published by Society of Automotive Engineers (March 2004). Ex. 2012 is a true and accurate copy of a technical paper that I understand was published by SAE in March 2004.

for use in increasing output light from vehicle headlamps.

Unless both covered and unlit, a vehicle operated on the highways of this state must not be equipped with a lamp or a part designed to be a reflector unless expressly required or permitted by this chapter or that meets the standards prescribed in 49 C.F.R. § 571.108. Except as otherwise provided, a lamp or a part designed to be a reflector, if visible from the front, must display or reflect a white or amber light; if visible from either side, must display or reflect an amber or red light; and if visible from the rear, must display or reflect a red light.

Michigan Vehicle Code Act 300 of 1949 § 257.698(4)⁴

Generating white light from HB-LEDs is typically accomplished by one of two methods as depicted in Fig. 4. The first method, shown in Figs. 4a and b, utilizes an AlInGaN-LED in conjunction with one or more phosphors. When a UV-LED is used, the UV light emission is absorbed and re-emitted by a mixture of red, green, and blue phosphors.

* * *

The second method for white light emission is preferred when color tuning is necessary, such as in outdoor displays. As indicated in Fig. 4c, by using red, green, and blue LEDs, one can create white light

⁴ Available at

[http://www.legislature.mi.gov/\(S\(3uenjar05mg4e4n3udxmh5on\)\)/mileg.aspx?page=GetObject&objectName=mcl-257-698](http://www.legislature.mi.gov/(S(3uenjar05mg4e4n3udxmh5on))/mileg.aspx?page=GetObject&objectName=mcl-257-698)

when the appropriate ratio of each is selected. This RGB approach has the added benefit of allowing the user to create any color within the associated color gamut by balancing the ratio of the individual LEDs. This method also allows for active adjustment of the color temperature of white light emission which is not possible using the LED/phosphor approach.

(Ex. 2011 at 18.5.)

C. Design Tradeoffs

29. Design tradeoffs imposed significant constraints on the use of LEDs in vehicle forward lighting applications, particularly with respect to meeting the required intensity, color, beam pattern, optical efficiency, packaging size, and thermal/heat management requirements.

As shown in Fig.1, if one wants to obtain smaller spread angle to form a beam pattern, especially the hotspot of the beam pattern, the size of optical unit needs to be enlarged, so that the reflection on the reflector can occur farther from the source to get smaller reflected light spread angle. However, the smaller focus length reflector leads to higher accuracy and tolerances, which is a big challenge for LED headlamp overall design.

(Ex. 2012 at 4.)

Besides the aperture, another limitation to form an adequate headlamp beam pattern is the overall size of the optical system and depth. Because of vehicle styling and packaging needs, the depth of a headlamp is also often restricted. As a consequence, the amount of

lumen being collected and projected into the beam pattern through the optical system may not be sufficient to meet all the desires.

(Ex. 2010 at 238.)

Because of the limitations of lamp aperture, the optical system focal length, and the dimensions of the LED emitter, the total system efficiency is assumed $\eta = 0.42$, which includes reflection loss, transmitting loss, refracting loss and collecting loss (equivalent to the above tungsten halogen case).

(Ex. 2010 at 240.)

30. Years after the patent application filed by Spero, experts in vehicle forward lighting acknowledged that implementing LEDs in headlamps presented “great concerns and challenges for the optical engineers.”

With desires of high performance and compact packaging size for both high and low beams, the issues of using LED light sources regarding light collection, efficiency, beam pattern compression and optical accuracy, are great concerns and challenges for the optical engineers.

(Ex. 2012 at 3, emphasis added.)

Besides the aperture, another limitation to form an adequate headlamp beam pattern is the overall size of the optical system and depth. Because of vehicle styling and packaging needs, the depth of a headlamp is also often restricted. As a consequence, the amount of lumen being collected and projected into the beam pattern through the optical system may not be sufficient to meet all the desires.

(Ex. 2010 at 238, emphasis added.)

31. In 2004 and beyond, multiple LEDs (more than 30) were required to generate lumen output similar to a typical tungsten filament halogen bulb as “currently available white LED’s lumen output [was] around 30 lm (maximum), which [was] about 3% of the typical tungsten halogen bulb’s light flux output (1000 lm for 9006 bulb).” (Ex. 2012 at 3.) Furthermore, “the luminance of LEDs must be comparable or higher than the existing tungsten halogen light sources.” (Ex. 2012 at 3.) The significant number of LEDs required to approximate a conventional halogen or HID light source would have prevented using those LEDs for purposes other than the designated low beam and high beam to satisfy regulations. Similarly, the large number of required LEDs would have prevented adding LEDs to perform forward lighting functions due at least to heat management, cost, and packaging considerations described *infra*. Changing the position, size, number, or maximum output of a light source within a headlamp would require changing the optical system including reflectors and lenses to generate an output light beam meeting required standards or regulations.

When using a real light source such as LED with extended light emitting area A_s , light from the extended light source are diverged (or spread) by the optical system. The degree of the collimation depends on both the light source dimensions and the optical system characteristics such as focal length and aperture. If a light source size

A_s with spread angle Ω_s ($2s$ is chosen, for a given lamp aperture A_{lamp} , smaller focal length leads to higher light collection efficiency, but less collimation (a dilemma we always have to face). In addition, in a reflector system, the degree of light collimation varies at different parts of the reflector aperture, while a lens system has consistent light collimation throughout the entire aperture.

(Ex. 2010 at 238.)

When multiple LED sources are used for one headlamp, each LED may have one FFR [Free Form Reflector] unit. The headlamp then consists of several FFR units. Because of the headlamp aperture and package limitations, small FFR unit with short focal lengths, e.g., approximately 10 mm may be used. Longer focal length **multiple LEDs headlamp may take too big of package space** and may not meet lamp size requirement.

(Ex. 2012 at 4, emphasis added.)

32. Even in 2004, it was unclear whether white LEDs would have sufficient light output to generate a light beam meeting applicable regulations and standards similar in intensity to conventional halogen sources.

Although total lumen flux produced by the LEDs may be comparable to the existing light sources, e.g., incandescent bulbs, the optical and mechanical characteristics of LEDs may limit the headlamp applications.

(Ex. 2012 at 3, Abstract.)

However, the currently available white LED's lumen output is around 30 lm (maximum), which is about 3% of the typical tungsten halogen bulb's light flux output (1000 lm for 9006 bulb). **If** the LED's output increases to 100 lm in the near future, it will be 10% of the tungsten halogen bulb's output. This **could lead to an assumption** that 10 LEDs with 100 lm output of each can be used to design an adequate tungsten halogen equivalent low-beam headlamp **if** the lamp system has the same light collection efficiency.

(Ex. 2012 at 3, emphasis added.)

Although the LED current application for headlamp design is limited, because of the flexibility of how to share aperture, it opens a great opportunity and challenge to optical engineers to develop the design concepts that are more efficient. Overall, our experiences have shown that with additional losses introduced by sharing aperture, more LEDs must be added to meet the headlamp beam pattern and total aperture needs. For instance, a headlamp package with approximately 15 LEDs each has 100 lm output (again, total of 1,500 lm input) may be able to meet both performance and aperture requirements discussed in the above. However the total system efficiency is lower than tungsten halogen system.

(Ex. 2010 at 242.)

For designing an adequate (SAE) automotive headlamp low-beam, several design performance values are desired: A) total lumen within the required beam pattern is around 420 lm; B) hotspot candela value is around 25,000 cd; C) large spread angle, 1,000 cd reaches to 35°

left and right. In order to achieve the low-beam performance (420 lm inside the beam pattern, and 25,000 cd in the hotspot), **it takes 50% larger effective aperture when using LEDs that have equivalent total lumen output as a tungsten halogen bulb.**

(Ex. 2012 at 7, emphasis added.)

Similar to the low-beam, for designing an automotive high-beam headlamp that meets the SAE photometry requirements, the desired lamp photometric performance is: A) total lumen within the required beam pattern approximately 600 lm; B) hotspot candela value around 50,000 cd; C) large spread angle with 2,000 cd at 15° left and right.

* * *

In order to achieve the high-beam performance (600 lm inside the beam pattern, and 50,000 cd in the hotspot), it **takes 150% larger effective aperture when using LEDs that have equivalent total lumen output as a tungsten halogen bulb** in aperture 8,000 mm².

(Ex. 2012 at 8, emphasis added.)

D. Hardware

33. Because light output from a single LED was insufficient to satisfy vehicle forward lighting regulations, multiple LEDs were needed. However, this presented challenges with respect to collecting and directing the light from an extended source as compared to a point source to generate the required beam pattern with corresponding luminance at designated points.

Because of the principle and the design restrictions for the system aperture and package size, the luminance of LEDs must be comparable or higher than the existing tungsten halogen light sources.

(Ex. 2012 at 3.)

The limitations or difficulties of using multiple LED to design headlamp may be summaries as two major parts: (A) as the total lamp aperture is being divided into several sub-apertures, the portion of the sub-apertures $A_{(lamp,i)}$ used for LEDs to project lights into hotspot zone with smaller spread angle $\Omega_{(lamp,i)}$ is small. **As a result, there may not be enough light for hotspot;** (B) the smaller sub-structure of the lamp has much smaller focal length comparing to tungsten halogen source, it then requires higher accuracy.

(Ex. 2012 at 10.)

One major difficulty for forming a headlamp beam pattern is to obtain sufficient candela values in the hotspot while the lamp total aperture is limited.

(Ex. 2010 at 237.)

E. Optical System

34. Headlamp optical system design requires a number of design considerations that may change depending on the type of light source being a conventional filament, a linear array of LEDs, a planar array of LEDs, etc. Selection and design of conventional geometric optics or free form reflectors (FFR), passive/active baffles, shields, deflectors, light sinks, modulators, imaging

or non-imaging optics, position/focal points of extended array source including depth/distance between light source and reflectors and output lens(es), etc., all impact the resulting output light beam.

Although there are several typical optical systems to form a headlamp beam pattern such as reflector system, lens system, projector system, and others, the size of the effective aperture is essential for ensure the desired photometry performance.

(Ex. 2010 at 240.)

In order to maintain the system collection efficiency, one can shorten the focal length of the optical unit used for the LED source. However, smaller focal length system leads to larger light source images as well as higher system accuracy required. Both will be adding difficulties to the headlamp design and manufacturing.

(Ex. 2012 at 3.)

In both tungsten halogen and HID cases, the light emitting area is contained in small dimensions, and the light intensity distributions are in general, Lambertian. The light intensity distribution or beam pattern from a forward lighting device is regulated by federal, state and international laws for safety. The optical system design to provide such beam patterns has been largely associated with the characteristics of the tungsten halogen or HID sources. White LEDs, on the other hand, have different optical characteristics, which in turn have impacted the headlamp optical system design. In addition, the lumen output per LED is still much less than that the exiting tungsten

halogen or HID sources provide, multiple LED sources must be used for one head lamp.

(Ex. 2010 at 234.)

[F]ive basic optical transforms used in the automotive lamp optical design have been discussed.

* * *

The limitations for these transforms are based on the etendue conservation. These limitations are the intrinsic properties of the optical systems used in the illumination applications including automotive lamps.

* * *

[T]he overall balance between the total lumen and luminance of the LEDs and the headlamp optical structure is controlled by these limitations.

* * *

[T]o achieve high performance for a headlamp, when the system losses caused by manufacturing . . . are not avoidable, sufficient lumen and luminance of the light sources and sufficient optical systems are always necessary and important.

(Ex. 2013⁵ at 10.)

⁵ Ben Wang and Jianzhong Jiao “Optical Transform Limitations in Headlamp Photometric Performance”, SAE Technical Paper Series 2005-01-0861, published

In the design of the above prototype LED headlamp, because the plastic dome of the LED magnifies the chip image, each LED emitter then has effective size of 1.5 mm X 1.5 mm. As shown in the Fig. 11A & 11B, **the hotpots [sic] intensity of both low-beam and high-beam pattern are not high enough to provide sufficient down-the-road light.**

(Ex. 2012 at 10, emphasis added.)

When designing the low-beam headlamp using tungsten halogen bulb with FFR, the filament is in an axial orientation along the optical axis of the FFR. With such arrangement, it is quite natural to form the desired hotspot horizontal angular spread. Regardless what aspect ratio or shape of the LED chip could be, it is important to realize that one of the chip demission must be small, or comparable to the size of the tungsten halogen filament diameter unless the LED emitter has extremely high luminance.

(Ex. 2012 at 11.)

F. Spatial Light Modulator

35. A POSA would have understood a spatial light modulator (SLM), such as described by Beam (Ex. 1005) or Karlsson (Ex. 1010), to be an array of

by Society of Automotive Engineers (April 2005). Ex 2013 is a true and accurate copy of a technical paper that I understand was published by SAE in April 2005.

individually electrically controllable elements each operable as an optical switch. A transmissive SLM may be constructed using optical elements such as liquid crystals (LCs) that selectively transmit light in a first state (ON, for example) and selectively block light in a second state (OFF, for example). (Ex. 2020⁶, 8.29-8.30, pp. 342-343.) Alternatively, a reflective SLM, such as a digital light processor (DLP) used in projectors, may be constructed using optical elements such as micromirrors that reflect light at predetermined first/second angles depending on whether the switch is ON/OFF. (Ex. 2021⁷.) Light reflected at the first angle exits the device, while light reflected at the second angle is blocked by the device. (Ex. 2022⁸.)

⁶ Michael Bass, *Handbook of Optics* 3RD Edition Volume V, (McGraw-Hill, 2010.) Ex. 2020 is a true and accurate copy of excerpts of a book that I understand was published by McGraw Hill in 2010.

⁷ Texas Instruments/Digikey “How DLP Technology Works.” Ex. 2021 is a true and accurate copy of a Digikey webpage (<https://www.digikey.com/en/product-highlight/t/texas-instruments/dlp-technology>) that was accessed on September 12, 2023.

⁸ Texas Instruments “Introduction to +/- 12 Degree Orthogonal Digital Micromirror Devices (DMDs). Ex. 2022 is a true and accurate copy of a Texas

36. An SLM is used by Beam and Karlsson to convert a light beam generated by a light source, such as an incandescent halogen bulb, for example, to multiple separate and individually controllable smaller light beams (microbeams as described by Beam, or spotlight beams as described by Karlsson) so that the smaller light beams can be individually blanked or blocked and do not exit the headlamp. (*See e.g.*, Ex. 1005 at 4:36-41; Ex. 1010, 5:4-15.)

37. In addition to embodiments that use a single light source with an SLM to generate the multiple controllable microbeams or spotlight beams, Beam and Karlsson also describe alternative embodiments that replace the single light source and SLM with multiple individually controllable light sources, such as LEDs, that may be individually switched ON/OFF to generate the multiple controllable microbeams or spotlight beams without an SLM. (*See e.g.*, Ex. 1005, Figs. 4, 6; Ex. 1010, Fig. 14.)

38. As described by Beam and Karlsson, and as would be recognized by a POSA, in view of the redundant functionality there is no reason to use an SLM in combination with individually controllable light sources such as LEDs for adaptive

Instruments Document that was revised in February 2018 and is available online at (<https://www.ti.com/lit/an/dlpa008b/dlpa008b.pdf?HQS=dis-dk-null-digikeymode-dsf-pf-null-ww&DCM=yes&distId=10>) (Accessed September 12, 2023.)

headlamp applications. On the contrary, for a POSA there are numerous reasons associated with cost and complexity that counsel against such a combination. For example:

- additional assembly and corresponding control complexity would be introduced in aligning positions of the LEDs within an array with corresponding SLM elements and determining which LEDs and SLM switches to control in combination;
- due to losses inherent to each optical element (SLM, lens, reflector, etc.) positioned in the path of a light beam, and the relatively low luminous flux generating ability of available LEDs at the time, light output from the LEDs would be further reduced by an SLM even while being operated in a transmitting state;
- use of an SLM to blank/block light being generated by one or more LEDs would result in increased power consumption and heat generation as compared to simply turning the corresponding LEDs off; and
- packaging considerations of placing a redundant device having multiple electrical connections with proper positioning relative to other optical elements of the headlamp, such as reflectors, lenses, etc.

39. For at least the reasons described herein, a POSA would not use an

SLM in combination with a light source, such as an LED array, that already has the ability to individually control portions of the generated light beam to provide adaptive headlamp functionality because the functionality of the two components is redundant, and thus unnecessary.

40. Intentionally left blank.

41. Intentionally left blank.

G. Heat management

42. The light output from an LED source varies with temperature and decreases as temperature increases. Similarly, the spectral characteristics or color of the light emitted by the LED varies with temperature. As such, heat management was an important consideration with respect to meeting regulations during operation of an LED headlamp. Furthermore, heat management imposed an additional design constraint such that POSAs were attempting to minimize the number of LEDs and/or maximize the efficiency of light output from the headlamp and would not be motivated to add LEDs to an array to provide additional functionality.

LED, in principle, is a temperature-dependent light source. In all cases, the higher the temperature, the lower the luminous flux output from LED is. As such, managing the heat generated in the LED, or heat from external environment of LED lamp, has been challenging because LED light output reduced when the temperature goes up.

(Ex. 2007, 50:2-9.)

When multiple chips are arranged linearly, such as 2 or 4 1mm x 1mm chips lined up inside of the LED package, if the current density of the package is assumed the same for the above chip arrangement, higher temperature or high heat is generated for the LED packages with larger chip numbers. In practice, the heat dissipation may not be linearly related to the power of the LED packages, thus, due to the junction temperature dependence, the luminous flux of the LEDs is not linearly related to the chip numbers.

(Ex. 2015⁹ at 7.)

In recent years the push for solid-state white lighting has resulted in a transition to larger HB-LED chip sizes and an increase in the operating current densities. The latter brings new constraints to packaging due to the increased need for thermal management in an effort to keep the junction temperature of the HB-LED as low as possible. While the traditional packaging formats have proven very effective for standard drive current use, they are not suitable for high

⁹ Jianzhong Jiao and Ben Wang “High-Efficiency Reflector Optics for LED Forward Lighting”, SPIE Proceedings Vol. 6670, published by the International Society for Optics and Photonics (September 2007). Ex. 2015 is a true and accurate copy of a technical paper that I understand was published by SPIE in September 2007.

drive current applications using large area HB-LEDs since they do not provide adequate thermal management.

* * *

Most HB-LEDs use sapphire substrates that provide very poor heat dissipation from the LED junction due to the low thermal conductivity of sapphire.

* * *

Standard clear epoxies that are used in conventional packages typically cannot withstand temperatures much above 100°C. In flip chip high drive packages this can be easily exceeded and would cause thermal damage to conventional epoxies.

(Ex. 2011, at 18.6.)

H. Packaging

43. Packaging considerations for automotive headlamps presented challenges even years after the earliest priority date of '503 Patent. These included the depth required based on longer focal lengths associated with LEDs, multiple LEDs required to achieve required light output at reduced collection efficiency due to extended array, sufficient heat sinks, driver electronics, and other components required for operation while meeting vehicle design aesthetic requirements.

One major difficulty for forming a headlamp beam pattern is to obtain sufficient candela values in the hotspot while the lamp total aperture is limited.

(Ex. 2010 at 237.)

With desires of high performance and compact packaging sizes for both high and low beam headlamps, using LED light sources is a great challenge for the headlamp design optical engineers for light collecting efficiency, beam pattern compression and optical accuracy.

(Ex. 2012 at 3.)

Besides the aperture, another limitation to form an adequate headlamp beam pattern is the overall size of the optical system and depth. Because of vehicle styling and packaging needs, the depth of a headlamp is also often restricted. As a consequence, the amount of lumen being collected and projected into the beam pattern through the optical system may not be sufficient to meet all the desires.

(Ex. 2010 at 238.)

I. Cost

44. The higher cost associated with LEDs to provide similar illumination relative to conventional light sources such as halogen or HID sources was another factor that contributed to the uncertainty of whether LEDs were, even if feasible, a suitable replacement for conventional light sources in vehicle forward lighting applications.

[T]he added cost of solid-state white lighting has slowed the market acceptance. A common cost comparison is the first cost of a light source, typically measured in terms of the cost per kilolumen (klm). Incandescent and fluorescent light sources fall in the \$0.5 to \$3.00 per

klm, while current light emitting diode sources fall easily in the \$20 to \$30 per klm range.

(Ex. 2011 at 18.5.)

[T]he LED light source can be more than 20 times as expensive as the incandescent light source it replaces.

(Ex. 2016¹⁰ at 66.)

45. Intentionally left blank.

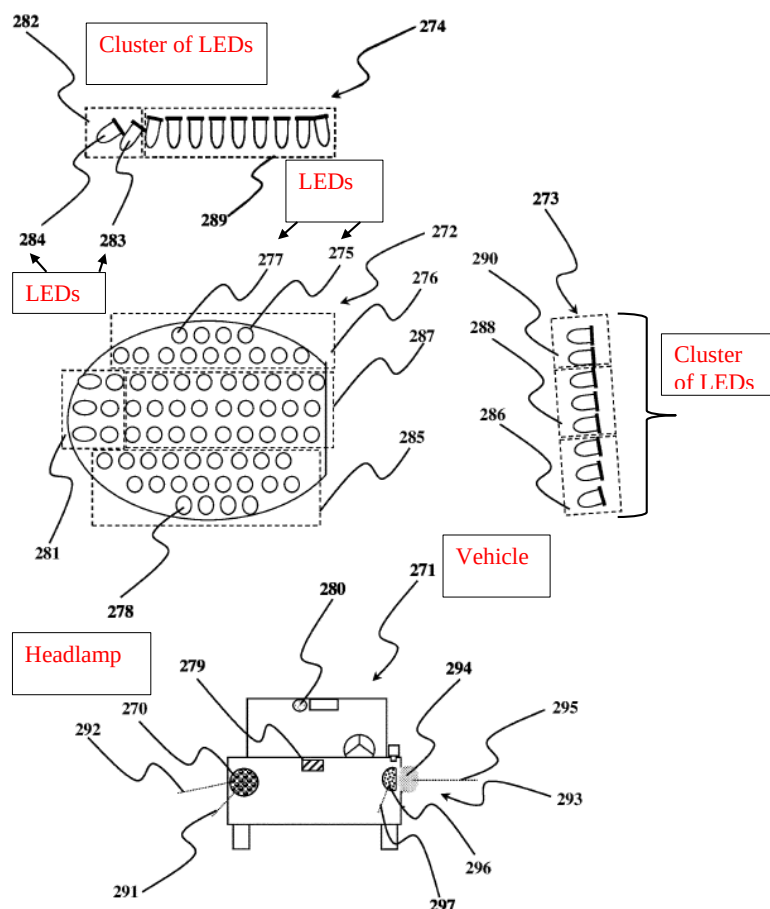
46. Intentionally left blank.

IV. Overview of the ‘503 Patent

47. The ’503 Patent is directed to “a novel multi-light source approach to the design and construction of solid-state lighting fixtures (vs. solid state lamps), which is termed a ‘Digital Lighting Fixture’, due to the control of individual lighting element ‘digits’ to provide the ‘correct’ lighting solution for the situation at hand.” (Ex.1001, 11:11-16.) The ’503 Patent further explains that “[t]he terminology ‘digital’ as used herein refers to the discrete nature of the multiple

¹⁰ Ex. 2016 Navigant Consulting “Energy Saving Estimates of Light Emitting Diodes in Niche Lighting Applications” Building Technologies Program Office of Energy Efficiency and Renewable Energy U.S. Department of Energy (September 2008). Ex. 2016 is a true and accurate copy of a technical paper that I understand was published by the DOE in September 2008.

LED lamps provided in the luminaire, whereby, ‘digital’ control results from the individual control of the discrete, i.e., ‘digital’ lighting elements, the LEDs, in the luminaire.” (Id., 2:67-3:5.)



(Ex. 1001, Fig. 15, Annotated)

48. “The added controllability offered by breaking the total light output up into discrete (‘digital’) specifically aimable and dimmable elements which can be addressed by control electronics to effect intensity, spectrum and spatial distribution of intensity and spectrum, yields a lighting fixture (vs. lamp) of unparalleled performance.” (Ex.1001, 11:61-67, emphasis added.) The ’503 Patent

describes using a digital light fixture (DLF) to provide multiple functions, for example “[i]n a DLF it is possible to combine a task light having a very narrow ‘spot’ beam at the correct aiming with a general area lighting ‘flood’ beam into one fixture.” (Id., 22:18-20.)

49. More specifically, the ‘503 Patent describes methods of using a multi-LED light source to segment a field of view and deliver varied, optimized illumination to the different segments within the field of view based on the presence of a detected object therein, “covering a wide scope of applications”, including transportation. (Ex.1001, 11:18-21, 4:20-24, 50:40-41.)

50. In the context of headlights,

[a]dditional features can include an optional very narrow flashlight type of beam. . . Such a beam at the correct narrow aiming can continue to illuminate far ahead (in high beam) without blinding oncoming traffic. Analysis by a detector or an imaging system of the oncoming vehicles position (using its headlights for example) can be used to determine which exact aiming is the maximum allowable for any given traffic situation and road layout.

(Ex.1001, 52:58-53:2.)

51. Additionally, a spatially differentiated illumination pattern can be determined to differently illuminate segments of a field of view based on the detection of an object:

Using color and pattern recognition techniques it is possible to determine what is a sign. It is then possible to provide the equivalent of “task lighting” and use the controller and properly aimed SLS to follow and illuminate distant overhead and roadside signs for a longer time, yet not blind oncoming traffic due to the narrow beam.

(Ex.1001, 53:3-8.)

52. The claimed invention of the ‘503 Patent is thus directed to multi-LED headlight systems that precisely determine anti-glaring illumination output to optimize illumination for the vehicle operator under a myriad of driving situations, whilst reducing glaring illumination for oncoming vehicles.

53. The Challenged Claims include independent claims 26 and 65, which are reproduced below with claim identifiers:

[26.P] A method for generating a headlight beam in an adaptive headlight system that provides illumination to at least a portion of a field-of-view, comprising:
--

[26.1] utilizing one or more sensors of a vehicle including the adaptive headlight system to obtain and provide data predefined as relevant to a determination of illumination requirements for the field-of-view, the data including data indicative of at least one of one or more other vehicles or a pedestrian;
--

[26.2] determining illumination requirements for the field-of-view based on the data sensed by the sensors, including determining illumination for at least a first subsection of the field-of-view including the other vehicle or pedestrian, as indicated by the sensor data, and for at least a second subsection of the field-of-view not including the other vehicle or pedestrian;

[26.3] determining a control strategy for controlling one or more directional light clusters in a headlight assembly to create an output headlight beam meeting the determined illumination requirements, the headlight beam spatial light distribution shaped to provide high beam illumination for a driver of the vehicle, in at least the second subsection, while mitigating glaring light illuminating at least the first subsection including detected other vehicles or pedestrians;

[26.4] sending control signals implementing the control strategy to an electronic control circuitry configured to operate the light-clusters; and;

[26.5] controlling the light clusters via the electronic control circuitry to collectively emit the headlight beam meeting the determined illumination requirements.

[65.P] A method for generating a headlight beam in an adaptive headlight

system that provides illumination to at least a portion of a field-of-view, comprising:

[65.1] utilizing one or more sensors of a first vehicle to obtain and provide data, the data including data indicating at least a second vehicle;

[65.2] determining illumination for at least a first subsection including the second vehicle and at least one or more second subsections, to either side of the first subsection, including determining an illumination level for the first subsection below a predefined illuminance, and determining an illumination level for the one or more second subsections that substantially illuminates the one or more second subsections above the predefined illuminance;

[65.3] determining control instructions for controlling one or more directional light sources included in the adaptive headlight system to achieve the determined illumination levels for at least the first and one or more second subsections; and

[65.4] controlling the light sources to emit the headlight beam in accordance with the control instructions.

54. The dependent claims include additional innovative features that specify illumination strategies for a myriad of driving situations.

V. Qualifications of one of ordinary skill in the art

55. I have been asked to provide my opinion as to the level of skill of a person having ordinary skill in the art (“POSA”) of the ’503 Patent at the time of the claimed invention. In determining the characteristics of a hypothetical person of ordinary skill in the art of the ’503 Patent at the time of the claimed invention, I was told to consider several factors, including the type of problems encountered in the art, the solutions to those problems, the rapidity with which innovations are made in the field, the sophistication of the technology, and the education level of active workers in the field. I also placed myself back in the time frame of the claimed invention and considered the skill level of colleagues with whom I had worked at that time.

56. I understand that Petitioner has proposed the following level of ordinary skill:

[A] POSA at the time of the alleged invention would have had a bachelor’s degree (B.S.) in mechanical engineering, electrical engineering, optical engineering, applied physics, or an equivalent field, as well as at least 2 years of industry experience in the area of automotive lighting and lighting-control systems.

(Petition at 7.)

57. I also understand that Board adopted a modified version of Petitioner’s proposed level of ordinary skill that removed the “at least” qualifier:

[A] POSA at the time of the alleged invention would have had a bachelor's degree (B.S.) in mechanical engineering, electrical engineering, optical engineering, applied physics, or an equivalent field, as well as ~~at least~~ 2 years of industry experience in the area of automotive lighting and lighting-control systems.

(DI at 8.)

58. I understand that Patent Owner accepts the Board's proposed level of ordinary skill.

VI. Proposed Claim Constructions

59. In order to properly evaluate these claims, I understand that the terms of the claims must first be construed. For purposes of this declaration, I am applying the following claim construction for my analysis regarding patentability. I understand that the proposed construction of the term "light source" is "any system that is capable of receiving an electrical signal and producing light in response to the signal."

VII. Overview of the Prior Art

A. Beam: U.S. Patent No. 6,144,158

60. Beam discloses an Adaptive Anti-Blinding Headlight ("AABH"). (Ex. 1005.) Beam recognized that existing headlight systems operated "either as a 'high beam' or as a 'low beam'" often under manual control, and various unsatisfactory attempts to solve this problem included:

systems which attempt to control the intensity profile of the beam by using a reflector or lens shaped to control the output beam in some predetermined way; systems to move the headlamps in response to changes that occur to the automobile on which they are mounted; . . . movement of headlight beams in response to changes in the vehicle's steering mechanism, etc.

(Ex. 1005, 1:21-23, 1:63-2:5.)

61. Beam solves the identified problems by providing a non-moveable AABH system having a multiplicity of microbeams that “will operate at maximum intensity at all times” allowing “the driver to have the equivalent of high beam headlights or brighter on at all times, greatly enhancing the ability to see at night.”

(Ex. 1005, 6:11-12, 6:54-55, emphasis added.) Beam further discloses that:

From the viewpoint of the driver of an automobile equipped with AABH, it will be like having bright high beams on at all times but without concern that the other motorists within the extent of his headlight beam will be dazzled.

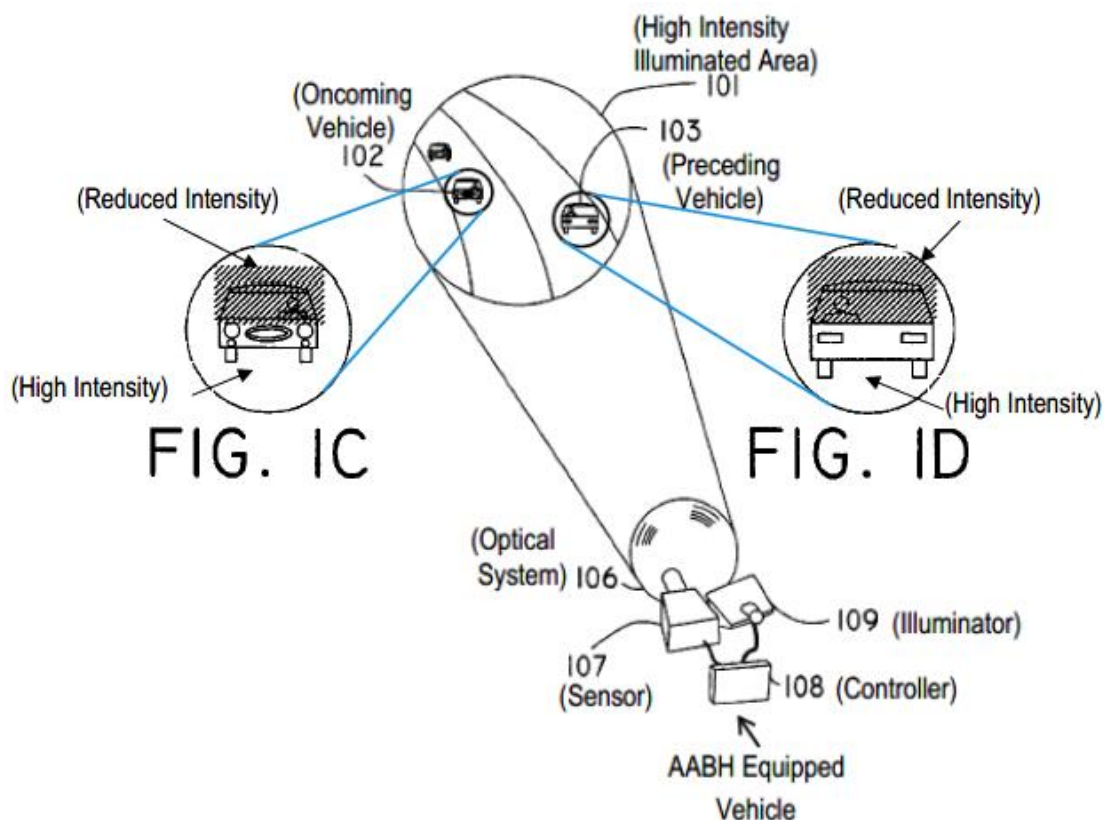
* * *

Accordingly, several objects and advantages of this invention are to provide greatly improved safety and comfort to the motoring public, in particular, and to others who may be affected by them by providing the driver of an automobile equipped with the instant invention with a far brighter headlight beam while simultaneously protecting the drivers of all vehicles ahead from being dazzled by the light.

(Ex. 1005, 6:40-44, 3:8-15.)

62. A POSA would have understood that Beam teaches providing a high beam operating at maximum intensity at all times in the illuminated region, other than any areas around detected light sources from other vehicles.

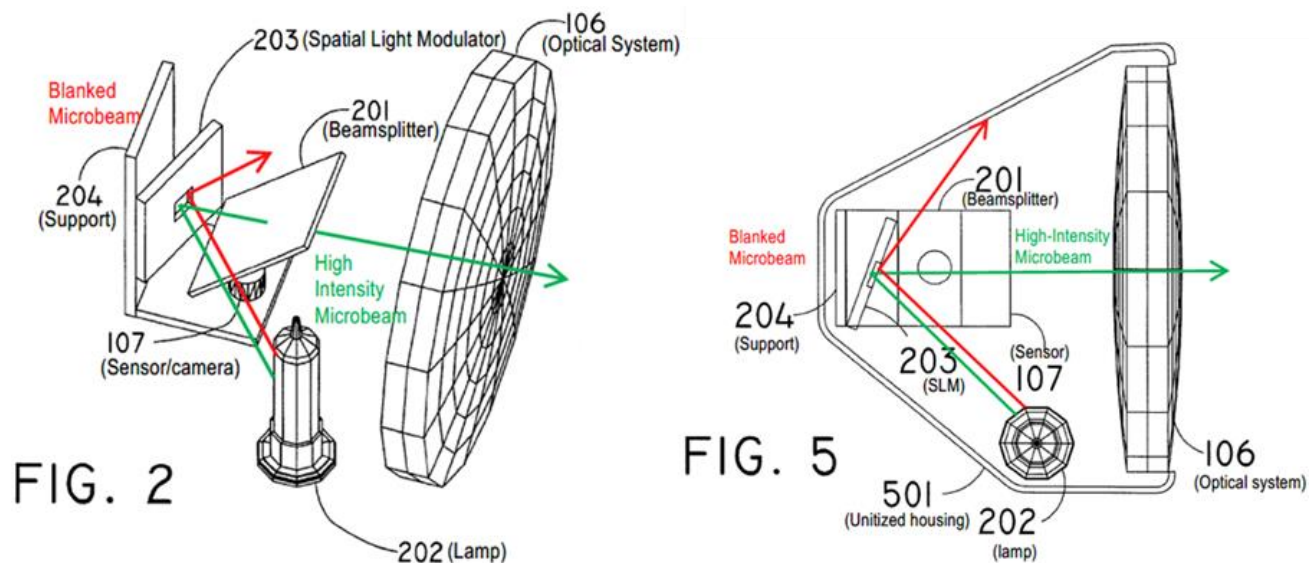
63. Beam provides significantly **reduced** illumination only in those portions of the headlight beam that would otherwise dazzle or annoy other drivers. This is accomplished by “darken[ing] those microbeams that would otherwise illuminate areas near to the source of the impinging beam, thus eliminating the blinding of a driver in an oncoming vehicle, while continuing to provide intense forward illumination.” (Ex. 1005, 1:15-19, Claims 4, 5, emphasis added.) While Beam discloses blanking or darkening microbeams that would otherwise dazzle other drivers, it does not disclose or teach changing direction of any microbeams exiting the lamp.



(Ex. 1005, FIG. 1C, 1D, Annotated)

64. In the AABH system, illuminator 109 projects individually controlled narrow-angle microbeams to provide high-intensity illumination of illuminated area 101. Headlights of an oncoming vehicle 102 and/or taillights of a preceding vehicle 103 are transmitted through optical system 106 and detected by a sensor (camera) 107. Data from sensor 107 is used by controller 108 to map the “angular position of the vehicles ahead” to a corresponding position/size of microbeams that must be significantly reduced in intensity corresponding to the shaded areas shown for oncoming vehicle 102 in Fig. 1C, and preceding vehicle 103 in Fig. 1D. (Ex. 1005, 4:9-24, 53-59, 62-64.)

65. Beam describes two distinct embodiments using alternative components that significantly reduce illumination intensity of individual microbeams in response to detecting incoming headlights/taillights or other light sources. However, neither embodiment discloses increasing intensity beyond the maximum intensity for any microbeams, or changing direction of any of the microbeams exiting the lamp.

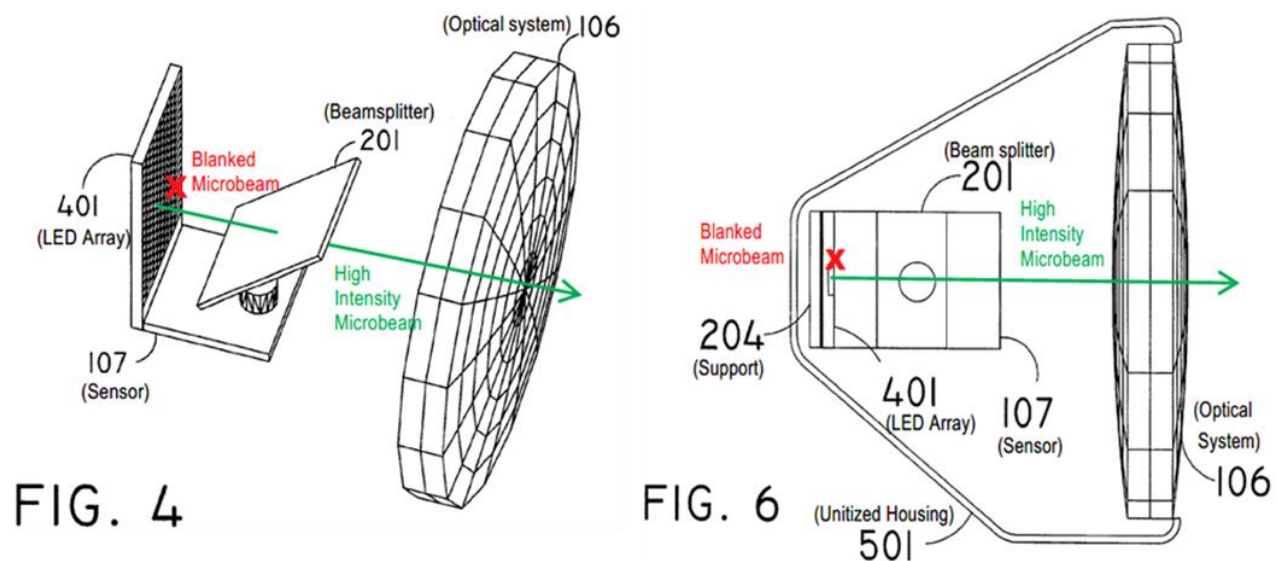


(Ex. 1005, FIGs. 2, 5, Annotated)

66. In the first embodiment illustrated in Fig. 2 (perspective view) and Fig. 5 (top view), light from lamp 202 falls on spatial light modulator (SLM) 203, which is controlled so that the associated individual microbeams are either 1) reflected by SLM 203 at full intensity through beam splitter 201 and out through headlamp optical system 106, or 2) “blanked (attenuated by being either absorbed or deflected [by SLM 203] to an absorbing surface” so that they do not exit the

headlamp optical system 106. (Ex. 1005, 4:36-40, 5:65-66, emphasis added.)

While SLM 203 blanks one or more microbeams by deflecting the blanked microbeams to an internal absorbing surface of the headlamp 501, it does not change direction or angular position of the headlamp beam exiting optical system 106 because the blanked microbeams are “diverted or attenuated at the source” and never exit the headlamp optical system 106. (*Id.* at 5:66.) The Beam SLM 203 appears to work in a similar fashion as a digital light processing (DLP) chip that was in existence on or before the time of filing of the Beam Patent and is used in DLP projectors.



(Ex. 1005, FIGs. 4, 6, Annotated)

67. The second embodiment is illustrated and described with respect to Fig. 4 (perspective view) and Fig. 6 (top view). The second embodiment replaces both SLM 203 and lamp 202 used to generate and modulate (reduce) intensity of

the microbeams of the first embodiment, with an array of light sources 401, such as an LED array, that generates the narrow-angle microbeams. Microbeam blanking is accomplished by dimming one or more of the LEDs making the modulator of the first embodiment superfluous, and it is thus omitted from the second embodiment.

68. In operation, light from oncoming/preceding vehicles or other sources enters through optical system 106 and is reflected by beamsplitter 201 to sensor 107. The sensor signals corresponding to the angular position (azimuth/elevation) or spatial location of the detected light are mapped by controller 108 to associated microbeams to determine the size (number) and location of the LEDs within LED array 401 to be blanked or dimmed to prevent blinding/dazzling other drivers. The output of the active LEDs creates the high-intensity microbeams projected out through optical system 106. (Ex. 1005, 3:62-64, 4:53-5:16.)

69. Beam's AABH system eliminates moving components to overcome the problems identified with the prior art. The AABH system generates a high-intensity beam formed by non-moveable microbeams with individual microbeams blanked, attenuated, or otherwise dimmed in response to detected incoming light to darken portions of the high-intensity illumination and prevent blinding of other drivers.

70. Intentionally left blank.

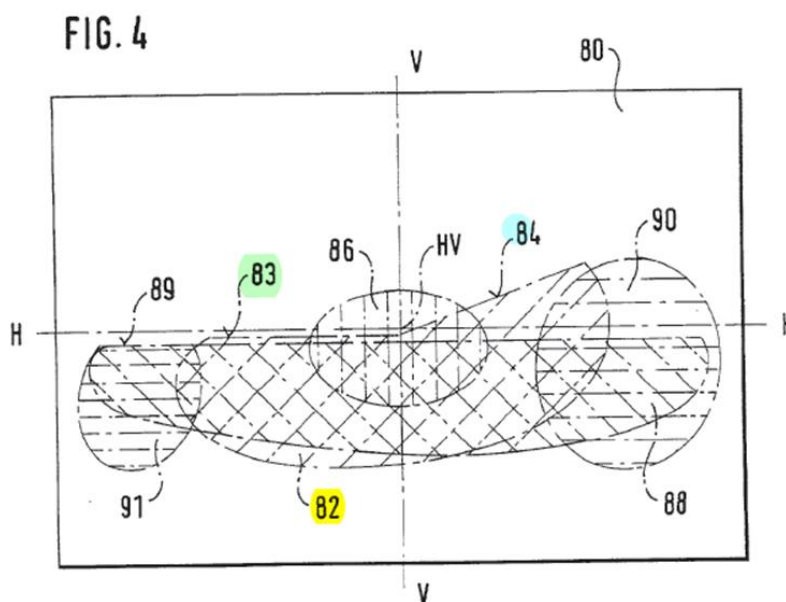
B. Thominet: U.S. Application Pub. No. 2001/0019486

71. Thominet discloses an array of LEDs with independently controllable intensity. However, unlike the simpler Beam AABH system that uses the entire LED array to provide high beam illumination across the field of view (other than in areas of detected incoming light), Thominet discloses the concept of assigning different LEDs within the LED array to provide different illumination functions (low beam, high beam). More specifically, the different illumination functions in Thominet are provided by LEDs “arranged in partial quantities in different defined partial regions of the matrix” and these partial regions are “operatable independently from one another.” (Ex. 1006, claim 1; Abstract, ¶20.) As such, Thominet improves upon prior art implementations having an LED array that has only one function (such as the Stam reference described below) by assigning the LEDs within a single array different functions e.g. to produce light of different colors (for a signal function and a headlight), a concentric high beam, a horizontally dispersed light beam with wider front illumination or to provide “one side oriented light”. (Ex. 1006, ¶¶ 2, 4-9, 25.) All embodiments teach LEDs arranged in functionally predefined regions actuated as a group to achieve an associated illumination function.

72. While Thominet discloses that LEDs can be arranged in one plane or distributed “over a concavely curved surface or a stepped surface,” Thominet does not suggest any advantages, disadvantages, functional differences or other reasons

to select any of the possible arrangements for any particular application. (Ex. 1006, claim 8, ¶0018.)

73. Thominet teaches using a screen 16 to create a bright-dark limit, which blocks a portion of light from light sources 10, creating illumination patterns similar to conventional high beam/low beam patterns. (Ex. 1006, ¶22.)



(Ex. 1006, Fig. 4, Annotated)

74. On review of Thominet, a POSA would understand that the LEDs of the array are neither controlled as a single group (as in the recognized prior art) nor as individual light sources as in Beam's AABH system to create the different illumination patterns as shown in Fig. 4. Rather, predefined groups of LEDs are actuated depending on the associated desired functions to be operated. A POSA would also understand that by segmenting the LED array into sections with

different functions, the intensity of the resulting beam is necessarily reduced relative to a maximum attainable intensity associated with actuation of the entire array of LEDs.

75. Separate from the lower attainable intensity and coarser control provided by the segmented groups, use of a screen to create a bright-dark limit blocks light generated by the actuated group of LEDs, further reducing intensity of the beam exiting the headlamp above the bright-dark limit.

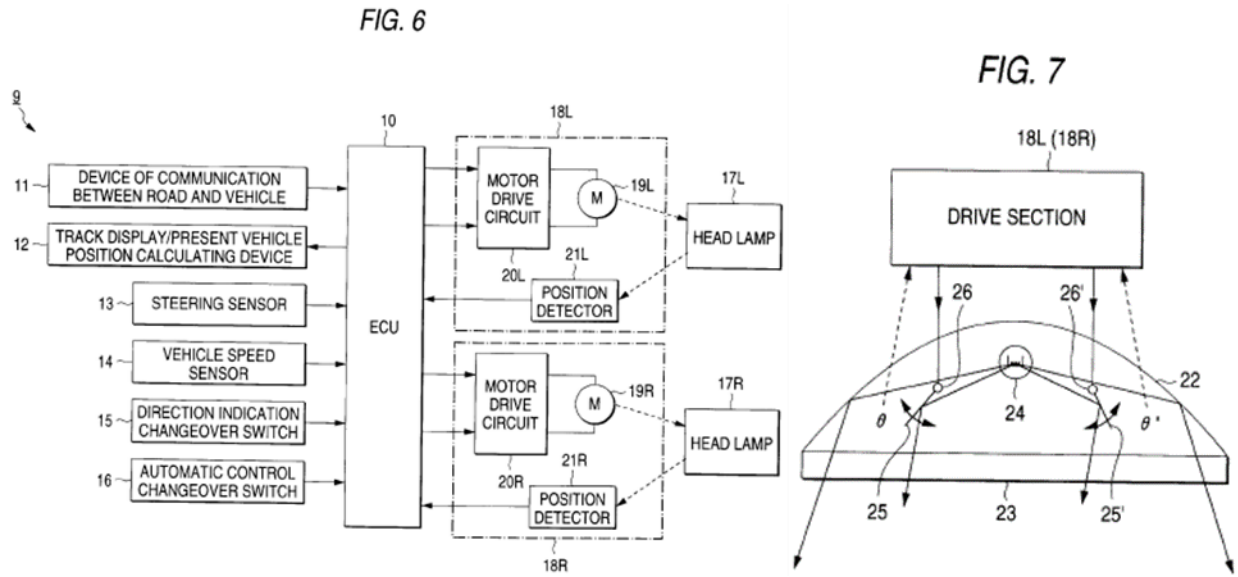
76. A POSA would also understand that Thominet describes conceptual arrangements and generalized automatic switching between illumination functions based on parameters such as speed, steering wheel action, wiper system, or a sensor system for recognizing counter traffic without describing any processing strategies to actuate one or more of the predefined functional groups of LEDs in response to a particular parameter to implement the different functions.

C. Kobayashi: U.S. Patent No. 6,049,749

77. Kobayashi discloses a “Lighting Device for a Vehicle.” (Ex. 1008.) Kobayashi is directed to a headlight control system that changes direction or range of a headlight beam using map information unless a predicted vehicle travel direction as indicated by a turn indicator, steering angle, and vehicle speed/acceleration differs from the map data, i.e., “[w]hen the vehicle advancing direction at which the driver aims does not coincide with the profile of the road.”

(Ex. 1008, 3:10-27.) More specifically, Kobayashi discloses a headlamp system with moveable components to control irradiation (illumination) direction and range in accordance with a road profile when the vehicle travels along a scheduled course, or in accordance with a steering angle and vehicle speed when the predicted advancing direction of the vehicle deviates from the scheduled course (Ex. 1008, 6:4-10; 17:59-67.) A “mechanical” and “moveable” system as used in this context refers to a system with moving parts and/or mechanisms to position the light beam.

78. Kobayashi changes irradiation direction using a motor to either rotate the entire lighting device about its axis, or to change relative position among internal lighting device components, such as a reflecting mirror, lens, light source, or shielding member. (Ex. 1008, 6:11-39.) Irradiation range is controlled by either combining different lighting devices with each other (such as a fog lamp, head lamp, and cornering lamp), or by controlling a motor to change position of the internal components (such as reflecting mirrors lenses, or shades) relative to one another. (Ex. 1008, 6:40-7:14.) Irradiation range may be changed responsive to a branch (intersection) ahead on a road by moving the internal lighting device components to change a horizontal irradiating angle α . (Ex. 1008, 8:1-32.)



(Ex. 1008, FIGs. 6, 7)

79. Kobayashi's ECU 10 receives signals from: communication device 11 (conducting communication between a road and vehicle), track display/present vehicle position calculating device 12, steering sensor 13, vehicle speed sensor 14, direction indicating switch 15 and automatic control change-over switch 16. ECU 10 generates signals for drive sections 18L, 18R of head lamps 17L, 17R arranged on the left and right front portion of a vehicle. (Ex. 1008, 10:1-17.) Drive sections 18L, 18R include associated motor drive circuits 20L, 20R to drive associated motors 19L, 19R with position detectors 21L, 21R to detect the posture of the head lamps 17L, 17R or their composing members (internal components). (Ex. 1008, 10:66-11:4.)

80. Figure 7 illustrates a headlamp with moveable composing members to control the direction and range of irradiation. Light source 24 and movable

81. Figures 4 and 10 illustrate operation of the moveable composing members of the headlamps to control irradiation range and direction while approaching an intersection and running on a curved road, respectively. (Ex. 1008, 2:48-49, 65-67.)



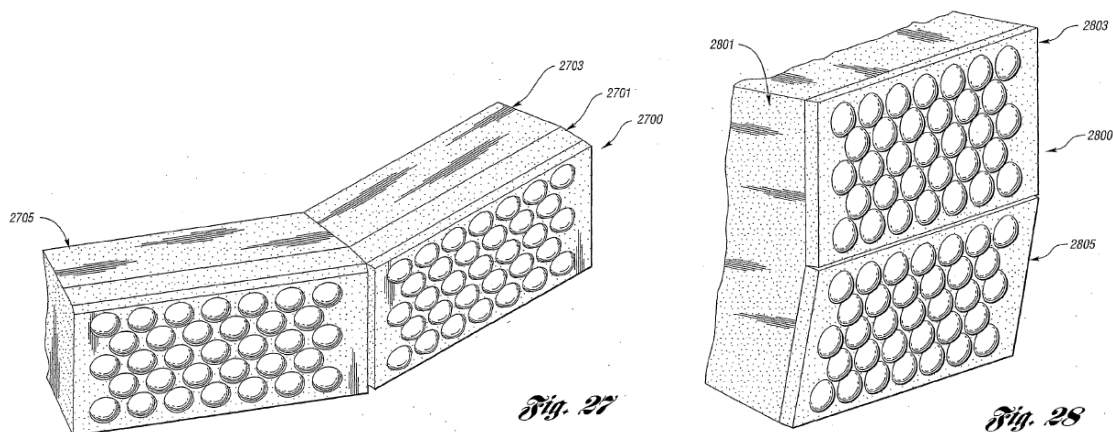
82. As shown in Figure 4, Kobayashi's headlamp motors are operated to increase horizontal irradiating angle α_0 to $\alpha > \alpha_0$ based on a distance L from intersection CC and vehicle speed. (Ex. 1008, 8:14-25.) In Figure 10, the headlamp

motors are operated according to road profile information and vehicle speed to change the irradiating direction toward a determined irradiating position for the driver's line of sight at each position of the vehicle. When the vehicle turns to the left at point A, the left shoulder is irradiated. When the vehicle turns to right, the right shoulder is irradiated, etc. If the driver operates the steering wheel by an angle larger than necessary for the curve, irradiation control is conducted in accordance with the vehicle advancing direction predicted by the steering angle. (Ex. 1008, 14:53-15:39.)

83. Intentionally left blank.

D. Stam: WIPO Publication No. 2001/1070538

84. Stam discloses a headlamp having single-function LED arrays with actuation of all LEDs within the array for a particular function, such as low beams or high beams. In the embodiment of Fig. 27, LED headlamp 2700 is controlled to actuate a first LED array in a first lamp section 2703 or a second LED array in a second lamp section 2705. Similarly, in the embodiment of Fig. 28, headlamp 2800 is controlled to actuate a first LED array in a first lamp section 2803 to provide a high beam function, or a second LED array in a second lamp section 2805 to provide a low beam function. (Ex.1007, 77:30-78:9, 84:21-85:2.)



(Ex.1007, Figs. 27, 28)

E. Braun: WIPO Publication No. 2002/004247A

85. Braun discloses a “Method and Apparatus for Providing Adaptive Illumination.” (Ex. 1009, Title.)

86. Intentionally left blank.

F. Karlsson: PCT Application Pub. No. WO1998/054030

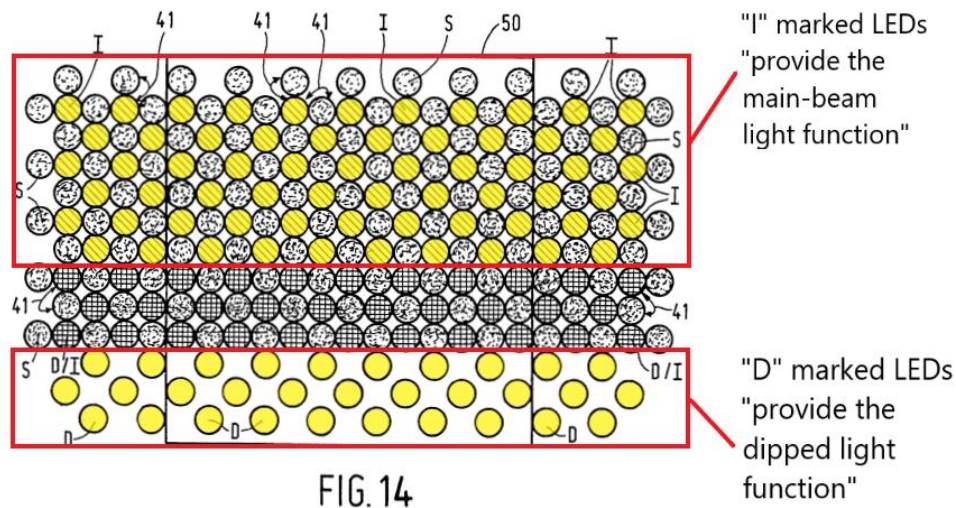
87. Karlsson discloses a “Lighting Device Having a Controllable Lighting Pattern,” wherein light sensors are interspersed with the LED “spotlight beams” to provide anti-blinding functionality, and the LEDs are dimmed during light sensor measurements so light from the LEDs doesn’t interfere with detecting light from oncoming traffic. (Ex. 1010, Abstract, 2:10-29.)

88. Despite the lack of details, one consistent and reasonable interpretation emerges from the Karlsson reference when viewed in totality along with the referential prior art, contemporaneous evidence, applicable regulations

and Petitioner’s own admissions: Karlsson, like Beam, forms emitted beam 7 (Fig. 1) by using the entire beam array at full intensity, except when avoiding glare, at which point, window 50, of reduced illumination (Fig. 14) is created to address glare situations. Per Karlsson, this configuration creates an “optimum” lighting effect — which, in Petitioner’s words, results from “maximiz[ing] the area that is fully illuminated.” (Ex. 1010, 2:7-9; Petition at 73.) Moreover, per Karlsson, main beams are optimized for long range illumination (Ex. 1010, 1:19-20) and “constant” main beam usage is “highly desirable” (*Id.*, 1:21-24). Karlsson’s removal of situational glare permits this.

1. Karlsson’s Window 50 Depicts Illumination Being Reduced for Situational Glare

89. Karlsson’s lighting device includes a headlamp embodiment that provides a light beam 7 usable for driving, which includes dipped-beam LEDs (low beam), main-beam LEDs (high beams), and combined dipped/main beam LEDs that span the full width of the LED array. (Ex. 1010, 19:24-28; 20:24-29.)



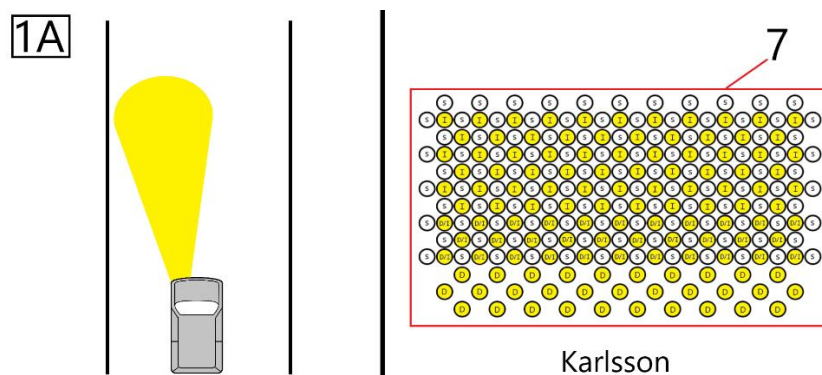
(Ex. 1010, Fig. 14, Annotated)

90. In Fig. 14, for example, Karlsson discloses that “spotlight sources indicated at D provide the dipped light [low-beam] function **in accordance with existing vehicle headlights**,” and “sources indicated at I provide the main-beam light function of **existing vehicle headlights**.” (Ex. 1010, 19:22-28, emphasis added). Karlsson also discloses that the “spotlight sources indicated at D/I are both operative as dipped and main beam lights.” (*Id.*)

91. In normal driving situations where glare adjustment is not needed, Karlsson’s array would operate “**to the greatest extent possible**” (as Petitioner admits), i.e., the entire main beam and dipped beam would be on full intensity—to “perform the function of existing headlights.” (Ex. 1010, 19:22-28; Petition at 74.)

92. For example, Figure 1A below illustrates Karlsson’s Fig. 14 LED array with all spotlight sources activated to collectively emit a beam of light 7; and

Figure 2A illustrates an “existing headlight” with incandescent dipped (Low) and main (High) beam light sources activated to provide a comparable beam of light. While Figure 1A illustrates exemplary operation with all LEDs for the dipped and main beams on, operation of a main beam mode with only the “I” LEDs or “I” and “D/I” LEDs, but without the dipped beam LEDs results in the same analysis and conclusions.



(Figure 1A, Ex. 1010, Fig. 14, Annotated)

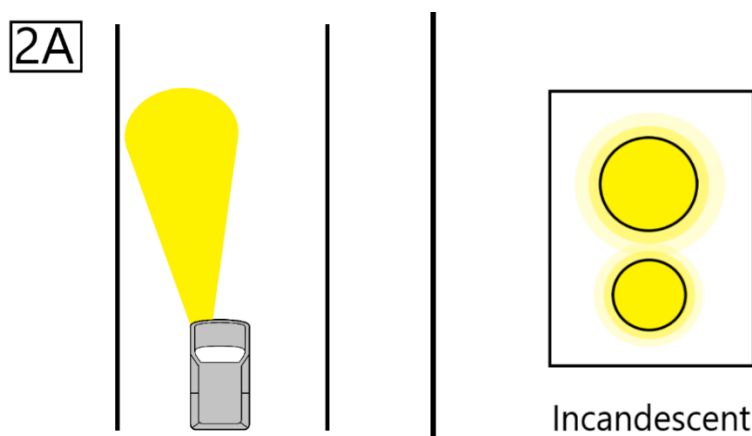


Figure 2A

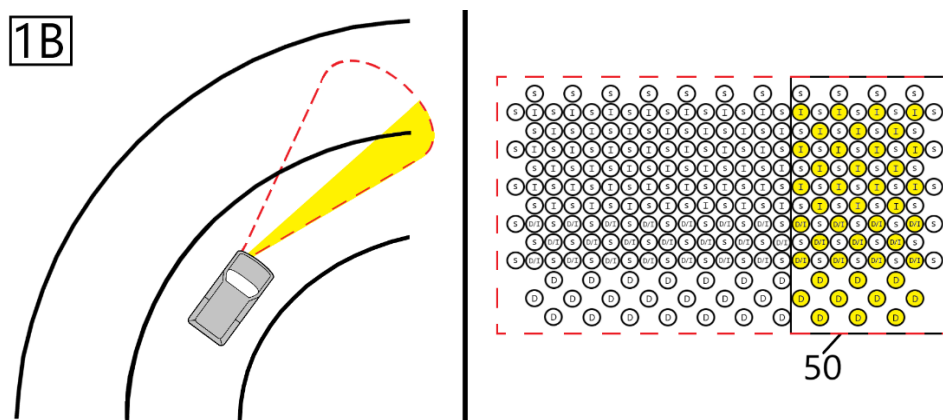
93. Karlsson then uses Fig. 14 to illustrate a “reduction” control strategy to reduce emitted beam 7 in a manner that provides anti-glare functionality for specific situations, and allows for expanded usage of the main/high beam light. (Ex. 1010, 20:6-11.) The situationally adjustable beam 50 illustrates how glare reduction can be achieved.

94. Karlsson teaches that glare occurs in multiple situations when using high beams (*Id.*, 1:19-26) when rapid velocity changes or overloading pitches the vehicle (*Id.*, 1:30-34), and when turning (*Id.*, 1:35-2:1.) Absent glare situations, Karlsson prefers providing “a light beam, the intensity of which is optimally adapted to the road and to the ambient light,” meaning all spotlight sources are on. (Ex. 1010, 2:7-9, 4:17-21, 9:23-26, Fig. 1.)

95. To address glare situations, Karlsson describes adaptation via: 1) use of light sensors to detect light and to control the LED array to prevent or diminish emission in the direction of detected light (*Id.*, 9:19-23); and adapting light to prevent glare. (Ex. 1010, 20:24-32.) Karlsson even explains, in the context of Fig. 14, that “an emitted light beam 50 is represented as a window which can shift” left-to-right and top-to-bottom “in dependence on the desired pattern and direction of the beam.” (Ex. 1010, 19:29-33.) The window 50 in Fig. 14 is an exemplar, to illustrate the concept of situational reduction of full beam 7. As shown below in Figures 1B – 1D, the shifting window can be used to temporarily reduce the full

beam 7 in order to adapt to possible glare in exactly the situations Karlsson describes. When there is no risk of glare, beam 50 would expand its dimension to the greatest extent possible – i.e., to fully utilize the array and create full beam 7.

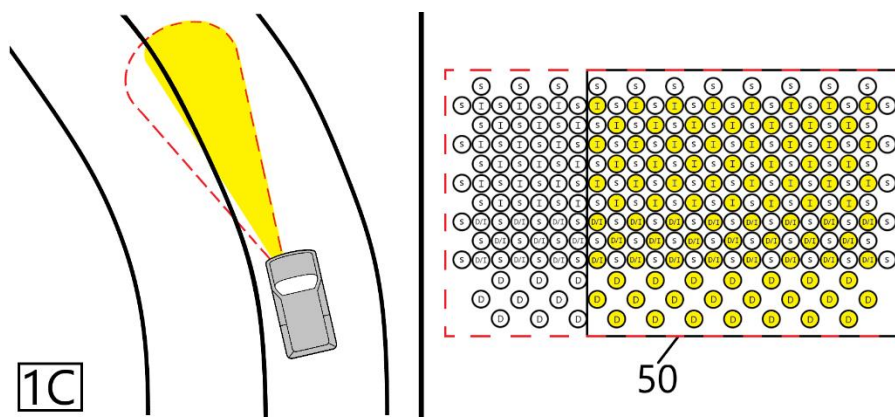
96. Karlsson addresses glare caused when a vehicle is taking a curve, the beam may be “adapted” (shifted) away from the other lane. (Ex. 1010, 1:34-2:1; 20:29-32.) This shift, however, is not a shift of the entire main driving beam 7, it is a temporary **reduction** of the beam aimed at the opposite lane, achieved by temporarily shutting off some portion of the array. Figures 1B and 1C below illustrate Karlsson’s Reduction Control Strategy during a turning maneuver, showing possible shifts in right and left turns, respectively.



(Figure 1B, Ex. 1010, Fig. 14, Annotated)

97. The above Figure 1B illustrates a full beam in dashed red-line as the vehicle takes a sharp right turn. Figure 1B also illustrates a reduced beam portion

in yellow line, according to Karlsson's Reduction Control Strategy to avoid glaring illumination spillover onto the opposing lane. This beam reduction may be achieved by deactivating the LEDs on the left side of the array, "shifting" the window 50 to the right, as illustrated above. (Ex. 1010, 20:23-32.)

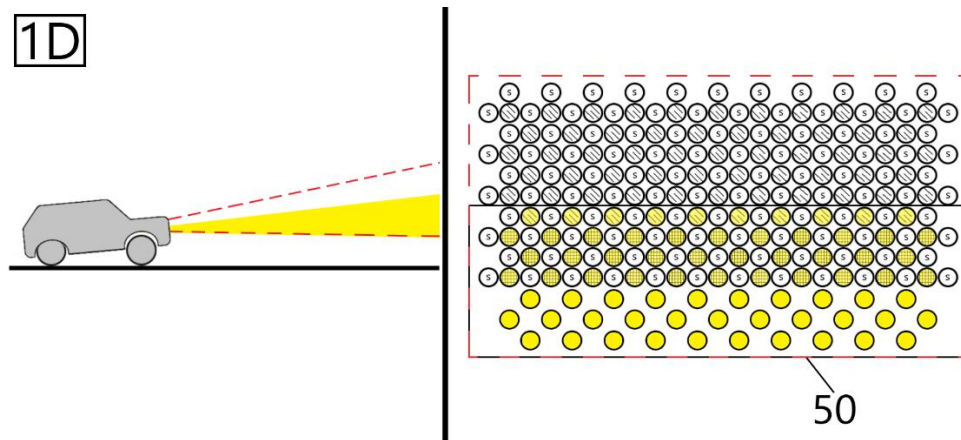


(Ex. 1010, Fig. 14, Annotated)

98. Figure 1C illustrated above depicts a vehicle taking a gradual left turn. The beam may be reduced using Karlsson's Reduction Control Strategy to deactivate LEDs on the left side of the array, shifting the window 50 to the right again based on direction sensor 54, but less so. The remaining yellow beam is wider than the one illustrated in Figure 1B due to the gradual nature of the turn, since there would be less potential glaring light than with a sharp turn. (Ex. 1010, 20:23-32.)

99. In reference to Figure 16, Karlsson also addresses glare caused when a vehicle pitches due to velocity changes or is overloaded-- the inclination sensors

detect “any deviation from the horizontal position,” allowing the pitched beam, possibly glaring other drivers, to be “shifted” down via deactivation of the upper rows of the array, as shown in Fig. 1D below. (Ex. 1010, 6:26-30.)



(Ex. 1010, Fig. 14, Annotated)

100. Thus, Karlsson deals with a variety of possible glare situations. If light-detection is the predicate for possible glare, light beam 7 is selectively reduced (*Id.*, 5:28-32) as needed. If the vehicle is pitched, the light beam 7 is adapted to account for pitch (*Id.*, 20:25-29) – per the vertical shift example described with reference to Fig. 14. If the vehicle is taking a curve, the light beam 7 is adapted to prevent glare in the opposite lane (*Id.*, 20:29-33) — per the horizontal shift described for Fig. 14.

2. The Base Device That Karlsson Improves Takes A Similar Approach To Situationally Reducing Full Emission

101. Karlsson describes that it seeks to improve aspects of a prior art

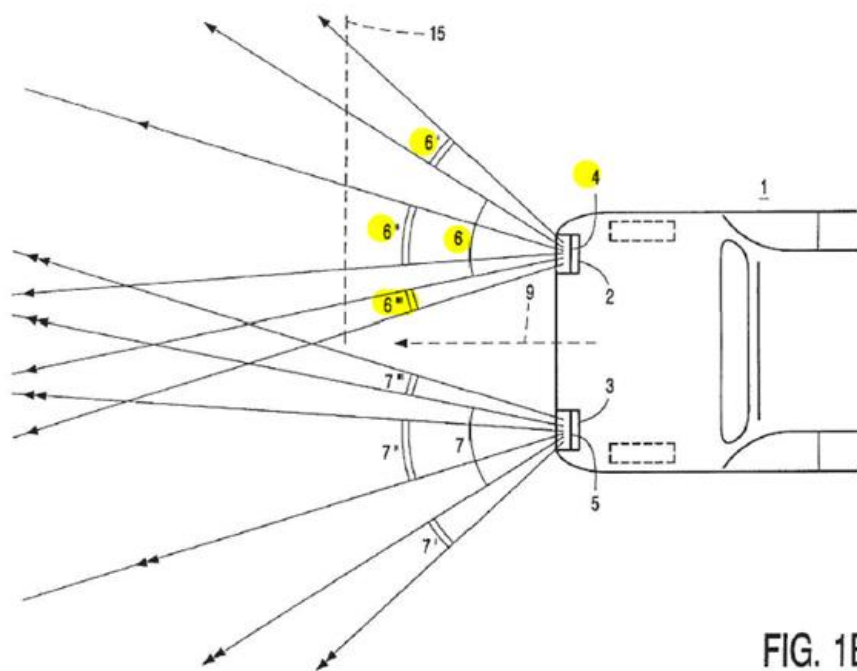
device of the “type known from” WIPO Patent Publication WO 86/05147 (“Flaaten,” Ex. 2017), which uses light sensitive detectors and a control unit to detect and control the light distribution pattern of a headlight “based on the distribution of detected light.” (Ex. 2017, Abstract; Ex. 1010, 1:1-7) Flaaten states a clear objective: the light from a vehicle is dipped selectively so that “**only that portion of the light is removed that would otherwise inconvenience the driver of oncoming cars...** at the same time as the roadway, the edges of the road, curves, etc. are satisfactorily illuminated.” (Ex. 2017 at 1-2.) Karlsson even explains that the Flaaten “prior art lighting device” “retain[ing] an **optimum lighting** effect for the driver of the vehicle...” (Ex. 1010, 2:2-9.)

102. Flaaten, like Karlsson, recognizes the desire for full illumination to the “greatest extent possible” while also removing glare: “It is ... desirable to enable such control of the light that **only the portion of the light that would inconvenience the driver of meeting cars is removed, leaving as much as possible of the roadway and the surroundings illuminated.**” (Ex. 2017 at 1.) The reduced illumination provided by window 50 corresponds with Karlsson’s desire to retain “an optimum lighting effect,” even under glaring situations, per the base device in Flaaten.

G. Harbers: WIPO Publication No. 2001/001038

103. Harbers discloses a headlamp system having fixed, planar LED arrays

with groups of LEDs associated with different illumination functions. As depicted in Figure 1B of Harbers, a “headlamp (2;3) of a vehicle (1) has a light source (4;5) comprising a plurality of opto-electronic elements (11;12;13;14), preferably light-emitting diodes (LEDs). . . The light beam generated by the light source comprises at least two light beam segments (6, 6'; 7,7') which define the spatial distribution of the light beam.” (Ex.1011, Abstract.)



(Ex. 1011, FIG 1B, Annotated)

104. As depicted in the asymmetric light distribution patterns of FIGS 3A and 3B, Harbers discloses a headlamp that provides light along multiple optical axes. (Ex.1011, FIGS 3A and 3B.) Spatial distribution of the light beam is achieved by selectively switching on and off individual LEDs and the

corresponding light beam segments. (*Id.*, 7:15-19, 8:21-25.)

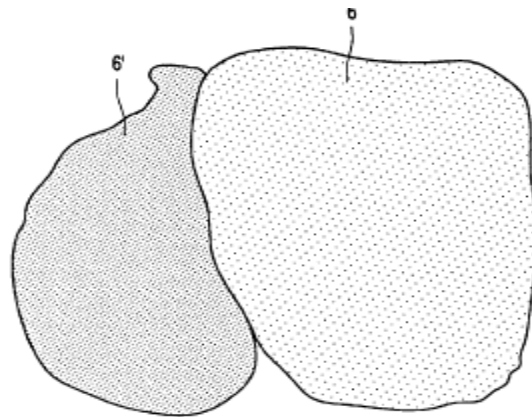


FIG. 3A

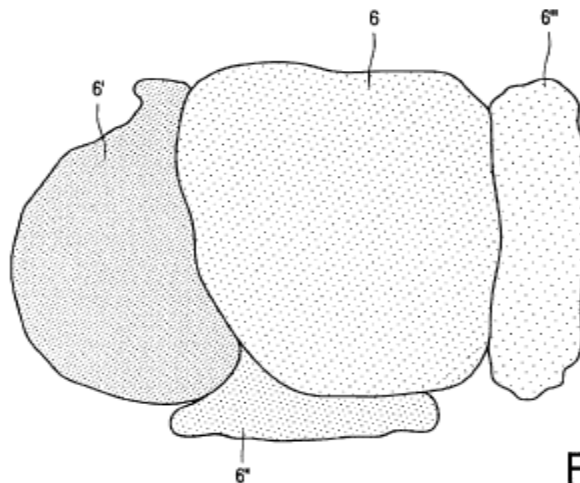


FIG. 3B

(Ex. 1011, FIGS 3A, 3B)

105. Harbers identifies specific parameters that can be used to define the desired spatial distribution of the light beam. Per Harbers, “the spatial distribution of the light beam can be influenced by the velocity of the vehicle...It may also be desirable for the width of the light beam to decrease and/or the intensity distribution between on-axis viewing and off-axis viewing to change.” (*Id.*, 3:28-

34.)

106. In another embodiment, Harbers discloses that:

the spatial distribution of the light beam can be influenced by the rotational position of the steering wheel of the vehicle. This enables the spatial distribution of the light beam of the vehicle headlamps to be adapted to the position of the steering wheel of the vehicle...By switching on or off one or more opto-electronic elements at specific-limiting values of the rotational position of the steering wheel of the vehicle, a continuously adjustable spatial distribution of the light emitted by the vehicle is obtained.

(*Id.*, 4:5-14.)

107. In yet another embodiment, “the spatial distribution of the light beam can be influenced by the weather conditions.” (*Id.*, 4:16-17.) In a final embodiment, “the spatial distribution, for example, the range and/or the width of the light beam, . . . [may] be adjusted by the driver” of the vehicle. (*Id.*, 4:24-25.) Apart from the above-identified inputs that could be used to define the spatial distribution of the light beam, Harbers provides no control teachings related to sensors or map data and thus no ability to control the LEDs to illuminate a desired region.

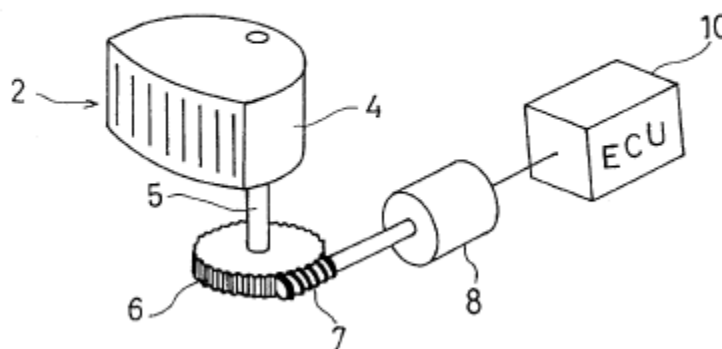
H. Gotou: U.S. Patent No. 5,588,733

108. Gotou discloses a “Head Lamp Device for Vehicle.” (Ex. 1012.) Gotou discloses headlamps that are rotated by a motor to change

leftward/rightward illumination direction using map information indicative of forward road shape, or in accordance with vehicle signals such as a direction indicating signal, a steering angle signal, and a vehicle speed signal “in the case that a vehicle runs on a place having no road information in a navigation system or the vehicle turns out of the planned course.” (Ex. 1012, Abstract, Fig. 1, Fig. 5, Fig. 6, 1:42-2:18, 3:31-41.)

109. Gotou discloses a “swinging mechanism,” shown in Figure 2, wherein “a lamp unit 4 of the head light 2 is fixed to a rotary shaft 5, and a worm gear 7 formed at a driving shaft of a motor 8 is engaged with a worm wheel 6 fitted to the rotary shaft 5.” (*Id.* at 3:36-41.)

FIG. 2

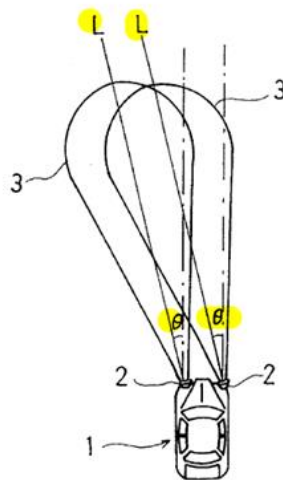


(Ex. 1012, FIG. 2)

110. As shown below in Figure 1 of Gotou, each headlight 2 provides light along a single optical axis L. “The right and left headlights 2 and 2 are swung

together in the same direction by the same angle and shown in FIG. 1, angles of their optical axes L and L, with respect to the advancing direction of the vehicle, i.e. optical axis angles are both set to be θ .” (Ex. 1012, 3:31-35.) Optical axes L and L are imaginary straight lines that pass through the center of the corresponding headlight projection, resulting in light output that is symmetric with respect to the optical axis at the chosen angle. Notably, while Gotou relies on adjustments to the optical axes to change the lighting region “in front of the vehicle in rightward and leftward directions,” it does not contemplate turning lamp unit 4 on/off or otherwise changing its intensity. (Ex. 1012, 1:60-64.)

FIG. 1



(Ex. 1012, FIG. 1, Annotated)

111. The driving of motor 8 is controlled by a light distributing control ECU 10, depicted in FIG. 3. Under the mechanical control system of Gotou, the ECU processes a series of inputs from the map information and vehicle signals

such as a “direction indicating signal,” “a steering angle signal” and a “vehicle speed signal” and “processes the information and signals to determine a requisite optical axis angle θ and an indicating signal is outputted to a motor driver 14 so as to achieve the optical axis angle θ , and thereby the right and left motors 8 and 8 are controlled in driving with the motor driver 14.” (Ex. 1012, 3:51-66.) When the “winker lever is operated, the optical axis angle is changed at once to a predetermined angle for lighting the turning direction of the vehicle early, and the determined optical axis angle is larger as the vehicle speed is faster.” (Ex. 1012, 4:58-64.)

112. Gotou further describes the state of the art at the time of the invention, pointing out the deficiencies in prior art systems predicated on steering wheel position:

[T]here are many proposals in the prior art in which the lamp optical axes are controlled for their movements in the horizontal rightward or leftward direction in response to a steering angle of the steering wheel. . . However, the lighting region in such prior art as above is not changed unless the steering wheel is operated, so that a turning direction can not be lighted at a stage before entering the curved part.

(Ex. 1012, 1:21-29, emphasis added.)

113. On review of the Gotou reference in its entirety, a POSA would also understand that Gotou does not disclose: 1) LEDs or any other “digital” lighting

source; 2) fixed or non-moveable light sources, 3) headlamps with multiple light sources with corresponding multiple optical axes; 4) any light sensor or other sensor to detect forward vehicles, or 5) any functions related to anti-blinding or preventing glare.

VIII. Petitioner Asserts Alternate Combinations

114. The Petition presents at least two discrete obviousness combinations to challenge each of the Challenged Claims. When unpacked, it becomes clear that Grounds 1 and 8 are each multiple distinct sub-grounds.

115. Intentionally left blank.

IX. Petitioner Failed to Address, Explain or Solve Any of The Multitude of Problems Arising from The Proposed Combinations

A. Failings of Petitioner Relating to All Combinations in Grounds 1-7 Including “Beam-Thominet”

116. Petitioner proposes to combine Beam with Thominet to achieve “multiple directional beam regions . . . for different functions.” (Petition, 10) In all instances, the stated motivation is that sources create “regions 22, 24, 26, 28 for different driving situations.” (Petition, 13.) Petitioner contends that Thominet “*automatically* provide[s] different spatial distributions for improved visibility in different situations.” (*Id.*, 10-11.) At the same time, Petitioner notes that Beam teaches controllable headlamps that “provide greatly improved safety” and “a brighter headlight beam . . . increases safety” by “enabling the driver to see more

clearly at night.” (*Id.*, 12.) These benefits of Beam are based on teachings of maximum illumination, except where glare-reduction occurs. (Ex. 1005, 6:10-11.) Accordingly, to achieve all Petitioner’s proposed combination benefits, both Thominet’s segmentation **and** Beam’s maximum illumination are required. Further, Thominet’s segmentation must also accommodate Beam’s selective blanking.

117. Beam and Thominet solve the problem of “how” to provide increased visibility in a conflicting and incompatible manner. Beam solves the problem by addressing every possible situation with maximum illumination (using all light), while Thominet solves the problem by choosing different subsets of light for each situation. (Ex.1005, 6:11-12; Ex.1006, [0026].) Equally important is the fact that Beam teaches selective and repeated blanking emission, based on detected illumination, and Thominet does not contemplate, and therefore accommodate, such selective anti-glare functionality.

118. Thominet’s segmented beam regions, all using **less** than the full LED array, are in direct conflict with Beam’s “maximum intensity at all times.” (Ex.1005, 6:11-1.9.) Thominet’s segments create conflicting results when utilized with Beam’s selective blanking. Petitioner does not explain how a POSA would have integrated these disparate control strategies to combine these systems. Nor does Petitioner explain why Thominet’s segmenting still preserves the primary

purpose of Beam, maximum illumination. All of this undercuts Petitioner's proposition that a POSA would have been motivated to combine these systems at all, let alone with any expectation of success.

119. Petitioner makes at least three different combinations of Beam/Thominet. The "software" combination uses both Thominet's (segmentation) and Beam's (selective control) software with Beam's Lamp + SLM (Petition, 13.) The "hardware" alternatives use either Thominet's LED array "substituted" for Beam's (also with Beam's selective control), or a "modification" of Beam's flat array surface 401 with a "curved substrate" from Thominet. (*Id.*, 12-16.)

120. As explained below, POSA would recognize that combining Thominet's functional segments with Beam's maximum-illumination + blanking was unsuitable and unpredictable because: a) Beam solved the problem already, albeit differently; b) Beam's "maximum illumination" solution is in direct conflict with Thominet's segmented illumination; and c) Beam's blanking further reduces the already less-than-maximum illumination of Thominet's function-based segments, and does so completely unpredictably.

121. Intentionally left blank.

1. **Petitioner fails to explain how Thominet's automated functions would not conflict with Beam's benefits in software combinations**

122. Thominet discloses minimal “automation” of selecting LEDs for different functions. (Ex.1006, [0026].) The disclosure is limited to “a control device” that performs “switchover” depending on “speed and/or steering wheel position, or wiper, or recognizing counter traffic.” (Ex.1006, [0026].) Thominet thus solves the problem of “improving visibility” by situationally using different segments. (*Id.*, [0004].) Beam solves the same problem by simply illuminating everything, maximally, always. (Beam, 6:10-11.) Petitioner never explains how or why a POSA would have combined the markedly different approaches for solving the same problem.

123. Any Thominet “automatic” segmentation immediately conflicts with Beam’s maximum illumination goal. Thominet’s speed-based adjustments switch between high-intensity beams (high-speeds) and wide beams (low-speeds), neither using the full array as Beam would. (*Id.*, [0023]-[0024]) Thominet does not describe counter-traffic control in detail, but implies automatic switching to lower-intensity beams – i.e., conventional automatic dimming – recreating a problem Beam was trying to solve.

124. The two contradictory control systems, both present in Petitioner’s “software” combinations, are unsuitable in virtually every situation, expressly because they solve “improving visibility” differently. Petitioner never addresses these contradictions in teachings, and instead simply suggests that Beam’s software

would have been modified “to organize Beam’s array... into multiple directional beam regions for different functions.” (Petition, 14.) What those “functions” are, how or when that organization would occur (what SLM portions would be used, when they would be used) and how all of the noted conflicting Thominet “functions” corresponds with Beam’s primary strategy is never explained, which further contributes to the lack of the requisite particularity.

125. Recognizing the destructive nature Thominet’s controls would have on Beam’s maximum illumination, a POSA would not have been motivated to combine the two disparate control strategies as Petitioner proposes. Nor would a POSA have had a reasonable likelihood of success in combining them without at least first noting, and then either dispensing with, or solving, all the above problems – none of which Petitioner does at all, let alone with any particularity.

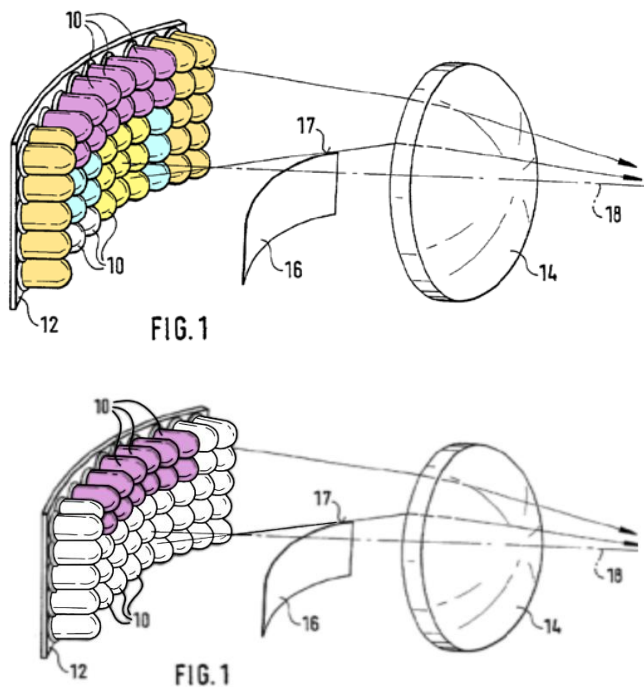
126. Intentionally left blank.

2. Petitioner fails to address issues created by combining Beam’s Software (maximum intensity/blanking) with Thominet’s Software (segmented automatic functionality)

127. Thominet relies on segmented (partial) operation of its array with different segments corresponding to different functions. (Ex.1006, [0026].) Chief among the concerns of Beam is that drivers have adequate illumination. (Ex.1005, 1:54-57, 3:8-14, 3:37-41.) In addition to Thominet’s segmented beams being

generally unsuitable to accomplish Beam's stated goal, once Beam's anti-glare strategy selectively blanks any of Thominet's segments (already an illumination subset), forward illumination is further reduced.

128. Moreover, the number and location of microbeams blanked by Beam's anti-glaring strategy is independent of the automatic control of functional segments, resulting in completely unpredictable illumination output and illumination changes. For example, if Thominet's automatic segmented control were being utilized (via Beam's lamp/SLM, as Petitioner proposed) to create segment 10 noted below in Petitioner's annotated figure (Petition, 14), only approximately 1/3 of the SLM would be allowing light to pass through. **(second annotated fig. below)**. The light controlled in the proposed embodiment is controlled through an SLM 203, not the array, but the array is presented to show the function that Thominet's software is recreating using Beam's SLM.



(Ex.1006, FIG. 1, Annotated)

129. Then, Beam's software subsequently detecting illumination would blank (corresponding to detected illumination) some subset of the segmented emission using the SLM, resulting in further-reduced forward illumination.

130. For example, if the center four LEDs of Thominet's segment (or Beam's SLM-equivalents) were blanked, the remaining illumination would be reduced significantly and less than even Thominet taught. Neither reference, nor Petitioner, explains how this would leave sufficient forward illumination in the scene.

131. Thominet clearly does not contemplate the results of blanking its limited illumination segments, such as opining on whether terminating half of such a segment would leave the segment suitable for use. Thus, it is clearly unsuitable to

use these segments with Beam's anti-glaring solution. Moreover, as the distance to the detected light decreases, the blanked region would grow larger, resulting in increasingly reduced forward illumination.

132. Similar issues would occur when **any** of Thominet's segments was used with Beam's selective blanking. No POSA would have combined the segmented beams of Thominet with the selective blanking of Beam due to the continually variable and unpredictable location of detected light relative to the currently active segment(s).

133. Intentionally left blank.

3. Petitioner fails to explain how automated control or segmentation would be achieved without Thominet's software

134. Petitioner proposes an alternative combination in which it substitutes Thominet's array for Beam's (Petition, 14-16.) This system lacks Thominet's software to automatically identify segments and/or control segments by function. Without such knowledge, Thominet's array is simply an array of LEDs, much like Beam's, although optionally curved. (Ex.1006, [0018].)

135. Petitioner does not explain that this array would be segmented or automatically controlled. In the absence of both automatic control (Petitioner's primary motivation to combine) and segmentation, there is no motivation to use the array from Thominet. Even if segmentation were possible, albeit unexplained,

without Thominet’s control software, Beam would simply use the entire array at all times, just as it uses its own array, because Beam alone does not disclose how or when to use segments. Accordingly, no POSA would have made such a combination.

136. Intentionally left blank.

4. Neither Petitioner nor Thominet suggest any reason or advantage of a curved LED array

137. Thominet notes its segmented automatic functionality can be achieved using either a flat or curved array, but provides no teachings relative to how or why to use one or the other. (Ex.1006, [0018].) Petitioner’s third combination where “the flat surface of Beam’s array 401 is modified with Thominet’s **curved substrate**,” relies on neither the LEDs nor software of Thominet (Petition, 16.) This combination thus also lacks both the segmentation and automatic controllability. As such, there is simply no reason a POSA would have curved the Beam array, as this optional feature is not even a “solution” to any noted problem.

138. Intentionally left blank.

B. Failings of Petitioner Relating to All Combinations in Grounds 8-10 Including “Karlsson-Harbers”

139. Petitioner proposes to combine Karlsson with Harbers for the purpose of providing “directional light clusters/sources for different functions.” (Petition, 81.) Harbers provision of “different spatial distributions for improved visibility in

different driving situations...” is the asserted primary motivation to combine. (Id.) Karlsson discloses the goal to “retain optimum lighting for the driver...,” which includes placing high intensity main-beam light wherever such light is not dimmed/terminated responsive to detected light sources (Ex.1010, 2:2-9; see also, e.g., Petition, 80, 95.) Petitioner explains these examples as a Karlsson system that places main-beam high-intensity illumination everywhere that incoming light is not detected, in a manner similar to Beam. (Id.)

140. As a reason to combine the teachings, Petitioner notes Karlsson “adjusts a pattern and/or intensity of light beam” responsive to detected traffic, and further that Harbers “uses multiple beam segments for different functions.” (Id., 82.) Once again, though, Petitioner fails to recognize a conflict in the implementation of these disparate strategies. Karlsson modifies high-intensity main-beam illumination in regions where that illumination might glare, e.g., when it uses such illumination for the full scene to provide “optimum illumination for the driver.” (Ex.1010, 2:2-9.) Harbers, on the other hand, selectively chooses illumination for different situations, such as selectively engaging or disengaging different beam segments based on velocity (Ex. 1011, 9:1-67:13-15.)

141. As with Beam’s high-intensity microbeams, Karlsson’s high-intensity illumination is designed to provide optimum forward illumination with some of the “spotlight beams” that correspond to detected light deactivated. Similar to

Thominet, Harbers does not contemplate dimming any portion of a chosen beam segment (subset). When combining the systems, the conflicting solutions create similar issues as described with respect to the Beam/Thominet combination such that there would have been no motivation for a POSA to have combined the systems as proposed, and no reasonable expectation of success for the combined system.

142. Petitioner makes at least three combinations using different Harbers components. The software combination uses both Harbers' and Karlsson's software and Karlsson's LED + SLM (see Petition, 83-84.) The hardware combinations use either Harbers' LED array substituted for Karlsson's array with Karlsson's software (selective control), or a "modification" of Karlsson's flat substrate of lighting means 2, 3 with a "curved substrate" from Harbers. (*Id.*, 84-86.)

1. Petitioner never explains how to merge conflicting functionality of Harbers and Karlsson software

143. Harbers does provide for some form of apparent automatic control, based on velocity and steering (Ex.1011, 3:27-4:14.) In low speed situations, wide light of decreased intensity is used. (*Id.*, 3:30-34.) As vehicle speed increases, fewer, but brighter, LEDs are used (*Id.*) When a steering-wheel is turned, the main beam is dimmed (*Id.*, 4:5-14.) Karlsson, on the other hand, prefers "optimum

illumination” and will utilize its full array when possible. (*See, e.g.*, Petition, 91, 94, 95, 97, 99, 102, 103, 105, 107, 108, 110, 112, 114, 116, 118.)

144. Petitioner does not explain how Harbers’ selective functions will not conflict with the “maximal illumination” shown in the fifteen examples. For example, if Harbers control were interposed on a Petitioner-example cited above, as would occur in the combination, and the emitting vehicle slowed, a conflict would arise. Harbers software would attempt to widen the beam and decrease central forward illumination (use the passing and side beam segments) at the same time as Karlsson would attempt to maintain dimming of the sides that Harbers is attempting to illuminate as well as maintain intense forward illumination that Harbers is attempting to dim.

145. Because both control functions are present in the software combinations, such conflicts would necessarily arise, and they are neither noted nor addressed by Petitioner. Without solutions to these conflicts, no POSA would have been motivated to utilize both sets of software as proposed by Petitioner, nor is it clear that such combination would function without solutions to the control conflicts. Petitioner admitted, in IPR2023-00318, that Karlsson’s disclosure teaches that the “remaining areas of light beam 7 are left at full intensity (‘main-beam’ or ‘high beam’ in Karlsson’s terms), ‘permitting a light intensity which is generally higher than that of conventional dipped headlights.’)” (Ex.2008 at 66-67,

emphasis in original, citing Ex.2009, ¶280.) “The greatest extent possible” that “surrounds” a reduced illumination area, is, of course, use of the full LED array, to provide the driving beam 7. As Petitioner explains, this would also “maximize the area that is fully illuminated” to achieve “optimum lighting effect for the driver.” (Ex.2008.) Per Karlsson and Petitioner’s admissions, the only reasoned and consistent interpretation is that Karlsson uses full illumination “to the greatest extent possible” to achieve an “optimum lighting effect” by “maximizing the area that is fully illuminated”— i.e., use the entire array just as Beam does, except for portions dimmed to avoid glare under Karlsson’s specified circumstances.

2. Petitioner never explains how any segmentation would occur in the absence of Harbers’ software

146. Petitioner contends that including Harbers hardware (as an **alternative to software**) into Karlsson’s system would “have provided different spatial distributions for different driving situations.” (Petition, 85.)

147. Petitioner’s argument that “elements 11-14... provide beam segments - 6-6'-6"-6"', 7-7'-7"-7"',” without having Harbers’ software, is completely unfounded in the teachings of Harbers. (See Petition, 85.) All of Harbers’ described control functions are related to software controls (Ex.1011, 3:27-4:14). While the system would have included differently **colored** LEDs, it would not have segmented the beams as Harbers suggests because it would not have known how to

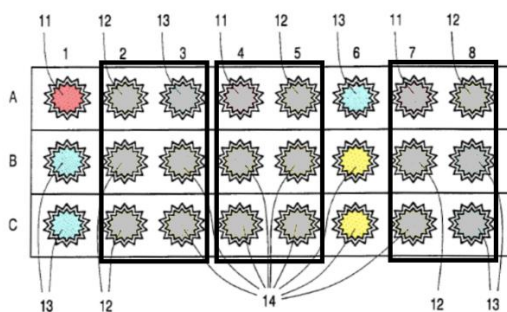
handle colored LEDs.

148. Intentionally left blank.

3. Petitioner fails to address the problems that selective blanking creates in an array of colored LEDs

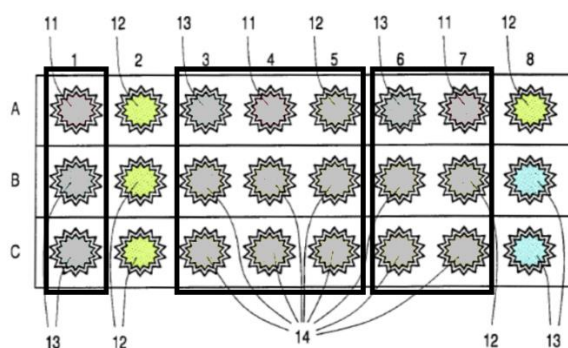
149. When Harbers array, that includes expressly colored LEDs, is utilized in replacement of Karlsson's, problems occur with the selective blanking implemented by Karlsson (the only control software remaining). It is not known exactly how Karlsson blanks LEDs, but, for example, in a high traffic situation where light was detected from many directions, it is reasonable that a high, and certainly random, number of Harbers' LEDs would be blanked in an attempt to accommodate all the incoming light.

150. For example, if Petitioner's proposed vertical blanking (used in its proofs of 26 and 65) were used in the presence of an oncoming leftmost light source and two preceding light sources (i.e., oncoming traffic and two preceding vehicles):



Ex. 1011, Fig. 2 (annotated)

151. At some later point in time, possibly even a second or two later, the output may change as follows, with the leftmost source (oncoming, adjacent lane) moving closer and the emitting vehicle closing in on the central source and the rightmost source. The utilized LEDs shift the color of the illumination, from color combinations RBB and BYY to GGG and GBB.



Ex. 1011, Fig. 2 (annotated)

152. After vertical blanking (or any other Karlsson blanking) the remaining LEDs are of varied colors – unpredictably so, based on where light is detected at any moment. Accordingly, the resulting light output would be: a) the wrong color at many times, b) confusingly colored; c) extremely confusingly colored for vehicles viewing the output (where the color effect will be amplified); and d) continually shifting in color.

153. Petitioner never recognizes this issue or presents a solution, and no POSA would have been motivated to combine Karlsson and Harbers to create such a headlight.

4. Petitioner does not present a reason to use the curve from Harbers

154. Harbers mentions once that a curved substrate can be used as an alternate embodiment. (Ex.1011, 7:27-29.) The curve alone is used in Petitioner's third combination where Petitioner proposes "modifying the flat substrate of Karlsson's lighting means 2, 3 with Harbers's **curved substrate**." (Petition, 86.) No LEDs or software of Harbers are used. Without software, there is no segmentation or control, and without LEDs, there are not even colored LEDs. There is no explained reason why a POSA would have been motivated to modify Karlsson's flat substrate to form a curved substrate in view of Harbers.

155. Intentionally left blank.

C. In combinations having multiple control strategies from software (e.g., Beam-Thominet, Karlsson-Harbers, Karlsson-Harbers-Gotou, etc.), and multiple controllable hardware elements (e.g., LED array with a modulator), Petitioner never explains which controls are applied to which controllable elements

156. Because of the general confusing nature of Petitioner's combinations, it is not clear when, if ever, Petitioner is intended to use both a modulator and LED array. Nonetheless, this ground is never properly explained in any instance where intended, for at least the additional reason that, because there are now two systems that can control light, each control strategy needs to control one, the other, or both, and that explanation is never provided by Petitioner in any such combination or

purported combination.

157. For example, if Karlsson LED + modulator + Harbers Software was an intended combination (sub-ground 8C), then it needs to be explained what is being controlled by Karlsson and what is being controlled by Harbers. For example, although never suggested, if Harbers controlled the array and Karlsson the modulator, then any control of Karlsson to the modulator is going to override anything Harbers is trying to do, since the modulator sits between the array and the lens.

158. Further, since Karlsson has no strategy for controlling a selectively segmented beam created by Harbers, the modulator control is not going to be correctly responsive to Harbers chosen segment being implemented in the array. This issue was neither noted nor addressed.

159. Without an understanding of how the multiple controllable systems of such a combination (LEDs + modulator) would be controlled by the multiple co-existent and often conflicting control strategies, no POSA would have made such a combination. The problem is only amplified when adding software such as Gotou in Ground 9, which then brings in yet another control function that is also never expressly ascribed to a particular controllable system.

X. Grounds for Challenge

A. Ground 1 – Beam or Beam-Thominet Applied to Claims 26-

27 and 30-31

160. The following table lists sub-grounds 1A-1E:

1A	Beam Lamp+SLM		
1B	Beam LED		
1C	Beam Lamp+SLM	Thominet Software	
1D	Beam Control		Thominet LEDs
1E	Beam LEDs		Thominet Curve

1. There is no Motivation to Merely Use the Curve of Thominet as in Ground 1E

161. Petitioner has presented no valid reason to utilize the curve of Thominet as proposed in Ground 1E.

162. As explained in ¶ 161, Neither Petitioner nor Thominet suggest any reason/advantage of a curved LED array.

163. Intentionally left blank.

2. Ground 1D Would Not Provide A System That Allows Beam to Function

164. Sub-ground 1D relies solely on Thominet's hardware (LED Array being "substituted" for Beam's Array 401). Without Thominet's software, this combination has neither segments nor automatic control, and is unmotivated.

165. As explained in ¶¶ 158-159 Petitioner fails to explain how automated control or segmentation would be achieved without Thominet's software.

166. Intentionally left blank.

3. Ground 1C Utilizing Both Selective Control from Beam and Thominet’s Automatic Segmenting Creates Unaddressed Conflicts in Operation

167. Due to the unpredictable results from the two conflicting control strategies advanced for the Beam (Lamp+SLM)-Thominet (Software) combination, no POSA would have made the combination proposed for Ground 1C.

168. As explained in ¶¶146-149 Petitioner fails to explain how Thominet’s automated functions would not conflict with Beam’s benefits in software combinations.

169. As explained in ¶¶151-156 Petitioner fails to address issues created by combining Beam’s Software (maximum intensity/blanking) with Thominet’s Software (segmented automatic functionality).

170. Intentionally left blank.

4. Independent Claim 26

a. Claim 26.4 Petitioner’s Proof is Directly Contrary to the Claimed “determining illumination for at least a first subsection... including the other vehicle”

171. Claim 26.4 calls for “determining illumination for ... a first subsection.” Petitioner proves, at most, that the prior art determination is a determination of where not to illumination, not a determination of illumination for a section as claimed.

172. For claim 26.3, it is Petitioner’s contention that “Beam discloses

“*determining which ... rays of light must be extinguished.*” (Petition, 21.)

173. For claim 26.4, Petitioner states “Beam discloses “*reformatting the pattern of a beam...to prevent it from illuminating certain areas...*” (*Id.*, 23.)

174. Determining which light to “extinguish” is not determining “illumination,” nor is reformatting a pattern to prevent illumination of an area. Petitioner has proven, at most, that Beam determines where not to illuminate, and, in doing so, has proven that Beam does not “determine illumination for... a first subsection... including the other vehicle” as claimed.

b. Claim 26.5 –Beam/Beam-Thominet Is Not Shown to Teach “determining illumination requirements ... for at least a second subsection of the field-of-view not including the other vehicle”

175. Petitioner argues “Beam discloses determining illumination for a second subsection (not including the vehicle) by providing a higher brightness beam in the areas which do not dazzle the driver ahead.” (Petition, 25.) Petitioner then identifies that second subsection in Annotated Figs. 1C-1D. (*Id.*, 26.)

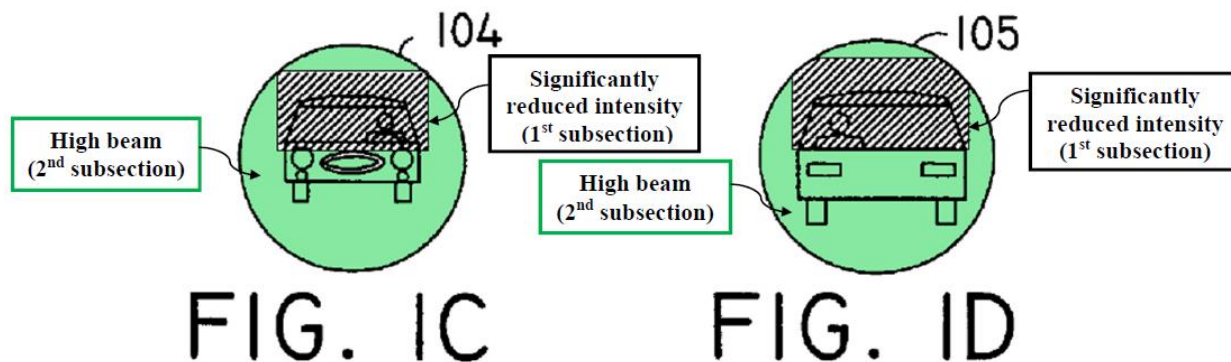


FIG. 1C FIG. 1D

(Ex.1005, FIG. 1C, FIG. 1D)

176. The “2nd subsection” identified in **both** figures, as Petitioner **chose** to label **and explain them, plainly includes the second vehicle.**

177. Beam does not actually “determine” illumination for this section, because that illumination is simply left unchanged.

178. Intentionally left blank.

B. Ground 2 – Beam/Beam-Thominet or Beam-Thominet-Stam Applied to Claim 65

179. The following table lists sub-grounds 2A-2H:

2A	Beam Lamp+SLM			
2B	Beam LED			
2C	Beam Lamp+SLM	Thominet Soft		
2D	Beam Control		Thominet LEDs	
2E	Beam LEDs		Thominet Curve	
2F	Beam Lamp+SLM	Thominet Soft		Stam
2G	Beam Control		Thominet LEDs	Stam
2H	Beam LEDs		Thominet Curve	Stam

1. Sub-grounds 2E and 2H Inherit Deficiencies of Sub-ground 1E

180. As explained for sub-ground 1E, there is no motivation or reason to merely import the “curved substrate” of Thominet, as in sub-grounds 2E and 2H, and adding Stam to this Combination does not change this.

181. As explained in ¶ 161, Neither Petitioner nor Thominet suggest any reason/advantage of a curved LED array.

182. Intentionally left blank.

2. Sub-grounds 2D and 2G Inherit Deficiencies of Sub-ground 1D

183. Sub-grounds 2D and 2G have the inherited deficiencies of sub-ground 1D.

184. As explained in ¶¶158-159 Petitioner fails to explain how automated control or segmentation would be achieved without Thominet’s software.

185. No POSA would have made either combination.

186. Intentionally left blank.

3. Sub-grounds 2C and 2F Inherit Deficiencies of Sub-ground 1C

187. Sub-grounds 2C and 2F have the inherited deficiencies of sub-ground 1C.

188. As explained in ¶¶146-149 Petitioner fails to explain how Thominet’s automated functions would not conflict with Beam’s benefits in software combinations.

189. As explained in ¶¶151-156 Petitioner fails to address issues created by combining Beam’s Software (maximum intensity/blanking) with Thominet’s Software (segmented automatic functionality).

190. No POSA would have made either combination.

191. Intentionally left blank.

4. Independent Claim 65

- c. **Claim 65.4 and 65.5 – Beam’s Extinguishment of Illumination Renders All Grounds Insufficient to Prove “determine illumination that substantially illuminates the first subsection below a predefined illuminance.”**

192. Claim 65 recites “*determine illumination **that substantially illuminates the first subsection** ...*” (Petition, Appendix A, 65.5, 65.6.) This requires positive illumination, as “no” illumination does not “substantially illuminate” anything. Moreover, this requires a “determination” of this illumination. Beam, which utilizes a blanking strategy, provides **no** illumination directed at the “blanked area” because it either **blocks** lamp 202 emission towards that area via the SLM 203 or **changes** LEDs responsible for that area **to a non-emitting state**. (See, e.g., ¶¶ 60-69.)

193. Petitioner’s own explanation for 65.5 undercuts its position – Petitioner states, quoting Beam, “Beam discloses ‘reformatting the pattern... **to prevent it from illuminating certain areas.**’” (Petition, 44.) “Preventing

illumination” of an area is plainly not “illumination that **substantially illuminates.**” Petitioner reinforces this understanding with its prior explanation for 26.3 – “Beam discloses “*determining* which of said multiple rays of light must be *extinguished.*” (Petition, 21.) Neither concept is “determining illumination that substantially illuminates...”

194. Spillover illumination from areas intentionally illuminated may result in non-zero illumination of the shaded areas in Petitioner’s annotated figure, but Beam never determines, for example, what or how much spillover there will be, and the claim includes “determining” the illumination that illuminates the first section. (Ex.1005, 6:44-48.)

195. Beam’s base function, **emphasized by Petitioner**, is to **prevent** illumination. Adding a “level” from Stam will not change this function. Moreover, the teaching imported from Stam is merely about **when** one should modify lamp emission, so at best, Stam merely adds **when** to institute Beam’s emission-prevention.

196. If Beam’s “reformatting the pattern” is the alleged “determination” for the first area, then by Petitioner’s own argument, Beam prevents illumination of this certain area, at best Beam is determining **not** to illuminate this area. That, of course, is not the claimed “determine illumination that substantially illuminates.”

197. Intentionally left blank.

C. Ground 3 – Beam-Thominet-Kobayashi Applied to Claims 32-36

198. The following table lists sub-grounds 3A-3I:

3A	Beam Lamp+SLM	Thominet Software		Kobayashi Map Data	Profile Means 2	
3B	Beam Control		Thominet LEDs	Kobayashi Map Data	Profile Means 2	
3C	Beam LEDs		Thominet Curve	Kobayashi Map Data	Profile Means 2	
3D	Beam Lamp+SLM	Thominet Software		Kobayashi Map Data		Advancing Direction Means 3
3E	Beam Control		Thominet LEDs	Kobayashi Map Data		Advancing Direction Means 3
3F	Beam LEDs		Thominet Curve	Kobayashi Map Data		Advancing Direction Means 3
3G	Beam Lamp+SLM	Thominet Software		Kobayashi Map Data	Profile Means 2	Advancing Direction Means 3
3H	Beam Control		Thominet LEDs	Kobayashi Map Data	Profile Means 2	Advancing Direction Means 3
3I	Beam LEDs		Thominet Curve	Kobayashi Map Data	Profile Means 2	Advancing Direction Means 3

1. All Sub-grounds Have Deficiencies Inherited from Included sub-grounds 1C-1E

199. All combinations involving Beam-Thominet fail for the reasons noted with respect to sub-grounds 1C-1E.

2. Petitioner Fails to Address Specific Differences in

Claims 34/36, A Fatal Deficiency

200. Petitioner improperly combines all of claims 32-36 as though they claim the same thing, contending that “the language of claims 33 and 34 is patentably indistinct from claim 32” and “the language of claims 34 and 36 is identical.” (Petition, 59.)

201. Claim 34 recites “determining illumination the increases illumination of an upcoming turn...” This expressly requires an **increase** of illumination. Claim 32 includes no such recitation.

3. Beam-Thominet-Kobayashi Is Never Shown to “Increase” Illumination as in Claims 34 /36

202. As noted above Petitioner’s argument does not even address the requirements of claims 34 and 36 – “determining illumination th[at] increases illumination of an upcoming turn...”

203. The combined system of Beam-Thominet-Kobayashi cannot produce the claimed illumination “increase” because the system of Beam already maximally illuminates the scene to the fullest extent possible.

204. Petitioner does not explain how a system utilizing maximal illumination would **increase** illumination.

205. Intentionally left blank.

i. A POSA Would Not Have Combined Beam- Thominet With Kobayashi

206. The combination with Kobayashi is unmotivated, as the combined system of Beam-Thominet, even were it appropriate, would have no use for Kobayashi's techniques.

207. Claims 32 and 33-36 require determining "illumination **for** the upcoming curve" (claim 32) or "**for** the upcoming turn" (claims 33-36).

208. Beam, as Petitioner admits, "operat[es] 'at maximum intensity at all times.'" (Petition, 25, 37.) Accordingly, regardless of whether there is Kobayashi data indicating a curve or knowledge of a road profile or advancing direction, Beam is already maximally illuminating everything it can illuminate. (Ex.1005, 4:57-59.)

209. If there is "maximum intensity at all times," as Petitioner contends, then any curve that Beam **could** illuminate is already **maximally** illuminated. This leaves the combined system with no use for Kobayashi's map data.

210. In light of the fact that the presented combination can do nothing with this information, there is no reason to make such a combination that merely adds unusable, extraneous information.

211. For at least this reason, Petitioner's combination is not a combination any POSA would have been motivated to make.

212. Intentionally left blank.

D. Ground 4 – Beam-Thominet-Stam-Kobayashi Applied to

Claim 70

213. The following table lists sub-grounds 4A-4I:

4A	Beam Lamp+SLM	Thominet Software		Stam	Kobayashi Map Data	Profile Means 2	
4B	Beam Control		Thominet LEDs	Stam	Kobayashi Map Data	Profile Means 2	
4C	Beam LEDs		Thominet Curve	Stam	Kobayashi Map Data	Profile Means 2	
4D	Beam Lamp+SLM	Thominet Software		Stam	Kobayashi Map Data		Advancing Direction Means 3
4E	Beam Control		Thominet LEDs	Stam	Kobayashi Map Data		Advancing Direction Means 3
4F	Beam LEDs		Thominet Curve	Stam	Kobayashi Map Data		Advancing Direction Means 3
4G	Beam Lamp+SLM	Thominet Software		Stam	Kobayashi Map Data	Profile Means 2	Advancing Direction Means 3
4H	Beam Control		Thominet LEDs	Stam	Kobayashi Map Data	Profile Means 2	Advancing Direction Means 3
4I	Beam LEDs		Thominet Curve	Stam	Kobayashi Map Data	Profile Means 2	Advancing Direction Means 3

1. All Sub-grounds Have Deficiencies Inherited from Included sub-grounds 1C-1E

214. All combinations involving Beam-Thominet fail for the reasons noted with respect the sub-ground 1C-1E combinations for Ground 1.

2. Petitioner Fails to Address Specific Differences in Claim 70

215. Petitioner’s statement that “the language of claim 70 is patentably indistinct from claim 34,” is not technically accurate – claim 34 relates to increasing illumination of “an upcoming turn” (a decidedly planned maneuver) and claim 70 relates to increasing illumination of “an upcoming curve.” The Petition fails to properly note and address the difference.

3. Beam-Thominet-Stam-Kobayashi Is Never Shown to “Increase” Illumination as Claimed in Claim 70

216. Claim 70 also requires that the determination “increases illumination.” For the reasons noted in Ground 3 with respect to claim 34, the Petition fails to prove this point for claim 70 as well – a failing extending to all nine sub-grounds of Ground 4.

4. A POSA Would Not Have Combined Beam-Thominet-Stam With Kobayashi

217. Claim 70 requires “determining illumination that increases illumination of an upcoming curve.” For reasons noted with respect to claims 32-36 above, no POSA would have been motivated to make a combination where such a determination would be extraneous, given that the combination cannot achieve the claimed “increase” and therefore lacks any utility for such a determination.

218. For at least this reason, a POSA would not have combined Thominet and Stam with Kobayashi.

219. Intentionally left blank.

E. Ground 5 – Beam-Thominet-Stam-Braun Applied to Claims 66-67

220. Claims 66-67 depend from claim 65, which Petitioner fails to prove unpatentable, extending the failure to 66-67. Petitioner’s discrete proofs about claims 66-67 also fail.

221. The following table lists Ground 5:

5	Beam Lamp+SLM	Thominet Software	Stam	Braun
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1. Ground 5 Has Deficiencies Inherited from Included sub-ground 1C

222. Ground 5 includes sub-ground 1C and thus fails for the reasons noted with respect the sub-ground 1C combinations for Ground 1.

2. Petitioner’s Proposed Usage of Braun to “Spotlight” Pedestrians or Signs Renders the Combination Unmotivated, As Beam-Thominet-Stam Has No Illumination Left to Use for a “Spotlight”

223. First, for the reasons presented with respect to claim 34, there is no un-used illumination of the Beam-Thominet-Stam combination to use to “spotlight” anything – rendering the addition of Braun for this function also superfluous. Braun’s teachings are cited for “spotlighting”, an impossibility for a system already maximally using its emitters. (Petition, 66.)

224. For at least this reason, there is no motivation to add Braun to Beam-Thominet-Stam.

i. Petitioner Fails to Explain How the Combination Would Function with Requisite Particularity

225. Petitioner proposes adding software of Braun to provide pattern recognition for identifying pedestrians (claim 66) and/or signs (claim 67). Then, according to Petitioner, Braun control would provide “spotlight” illumination of “people” or “roadway signs.” (Petition, 66.)

226. In addition to failing to explain how this can be achieved when the array is already fully utilized, Petitioner does not explain whether or how this control would be used in conjunction with blanking. That is, if the control were used to “spotlight” part of a blanked area (because a person/sign was detected within the region), how this would not negatively affect a driver in the area. At times, Braun’s control will attempt to place light in places Beam’s control is attempting to blank, and the conflicting strategies are never resolved by Petitioner.

227. Without a solution (which neither Braun nor Petitioner provide) for the contemporaneous operation of these two functions, these conflicting functions would not have been combined into a single headlamp system by a POSA. Since Petitioner did not address this issue of the combination, Petitioner has failed to provide the requisite explanation as to why these two systems would be combined

in the manner proposed.

228. Intentionally left blank.

F. Ground 6 – Beam-Thominet-Harbers Applied to Claims 28-29

229. The following table lists sub-grounds 6A-6D:

6A	Beam Lamp+SLM	Thominet Software		Harbers Software
6B	Beam Control		Thominet LEDs	Harbers Software
6C	Beam Control		Thominet Curve	Harbers LEDs
6D	Beam LEDs		Thominet Curve	Harbers Curve

1. All Sub-grounds Have Deficiencies Inherited from Included sub-grounds 1C-1E

230. All combinations involving Beam-Thominet fail for the reasons noted with respect the sub-ground 1C-1E combinations for Ground 1.

2. Combinations 6A and 6D Lack Any Colored Sources

231. Combinations 6A and 6D both lack colored light sources – and neither Thominet’s nor Harbers’ software describes how to derive color in the absence of colored LEDs. Therefore, the coloration of road portions (claim 28) or shift to yellow in the presence of fog (claim 29) are not possible under the explanation provided using the combinations presented for sub-grounds 6A/6D.

3. Any Combination Involving Colored LEDs Would Create a Color-Shifting Output whenever the Control Function of Beam Began

232. For all other combinations, if Thominet teaches colored LEDs, then at least one light source of the combination includes a colored LED. Thus, regardless of whether the color comes from Thominet or Harbers, this creates the unaddressed color-shifting issue noted above as a problem with Karlsson-Harbers.

233. Beam, which selectively blanks illumination, will, similar to Karlsson, unpredictably blank sections of the LED array (now including color) and will therefore produce an unpredictably color-changing forward beam, as various different colored LEDs are blanked or illuminated. Thus, no POSA would have been motivated to make such an unpredictable and often non-functional combination.

234. Intentionally left blank.

4. Petitioner Fails to Show How Beam-Thominet-Harbers Teaches “sensed fog or snow” as in Claim 29

235. For “sensed fog or snow” in claim 29, Petitioner cites “lowering the beams for conditions like rain, snow... or fog” in Beam – but this is a manual function of Beam and not an illumination requirement determined by the processor as claimed. (Ex.1005, 3:34-36). Petitioner further cites “under unfavorable weather conditions, in particular fog and snow... a relatively wide beam 16 is obtained...” from Harbers. (Ex.1011, 10:6-14.) This teaching merely notes that “the spectral composition of the light beams generated by the light source can be adapted...;”

there is no teaching of automatic adaptation and still no teaching of “**sensed** fog or snow” as claimed. All Petitioner has demonstrated is that both systems can produce light suitable for use in low-visibility.

236. Since Petitioner has at least failed to prove that any of the references in the combination can react to “**sensed** fog or snow,” for at least the failure to demonstrate **how** any of the references **can sense** fog or snow, the proof fails for this additional reason.

G. Ground 7 – Beam-Thominet-Stam-Harbers Applied to Claims 68 and 69

237. The following table lists sub-grounds 7A-7D:

7A	Beam Lamp+SLM	Thominet Software		Stam	Harbers Software
7B	Beam Control		Thominet LEDs	Stam	Harbers Software
7C	Beam Control		Thominet Curve	Stam	Harbers LEDs
7D	Beam LEDs		Thominet Curve	Stam	Harbers Curve

1. All Sub-grounds Have Deficiencies Inherited from Included sub-grounds 1C-1E

238. All combinations involving Beam-Thominet fail for the reasons noted with respect the sub-ground 1C-1E combinations for Ground 1.

2. Grounds 7A and 7D Suffer from the Same Shortcomings as Grounds 6A and 6D, Lack of Colored Light Sources

239. Stam does not add colored light sources, and so sub-grounds 7A and

7D are deficient for the same reasons as sub-grounds 6A and 6D.

3. Grounds 7B and 7C Suffer from the Same Color-Shifting Problem as Grounds 6B and 6C

240. Stam does not prevent the color-shifting issue noted with respect to sub-grounds 6B and 6C, and so grounds 7B and 7C suffer from the same issue and no POSA would have been motivated to make this non-functional combination.

4. Petitioner Fails to show “[sensor] data includes data indicating fog or snow” as in claim 69

241. Just as Petitioner failed to show that there was “*sensed fog or snow*” in claim 29, here Petitioner, in rejecting by analogy, also fails to even note or show the specific requirement that the “*data*” (sensor data of claim 65) “*includes data indicating fog or snow.*” This element is simply missing from the analysis, because Petitioner never explained how this element was inconsequentially different from the elements of claim 29.

242. Intentionally left blank.

H. Ground 8 – Karlsson or Karlsson-Harbers Applied to Claims 26-31, 65, and 68-69

243. The following table lists sub-grounds:

8A	Karlsson LEDs		
8B	Karlsson LEDs + Mod		
8C	Karlsson LEDs + Mod	Harbers Software	
8D	Karlsson Control		Harbers Array
8E	Karlsson LEDs + Mod		Harbers Curve

1. There is no Motivation to Merely Use the Curve of Harbers as in Ground 8E

244. Harbers curved substrate alone has not been shown to add anything useful to the combination.

245. As explained in ¶ 178, Petitioner does not present a reason to use the curve from Harbers.

246. Intentionally left blank.

2. Lacking Harbers' Software, Ground 8D Is an Unmotivated Combination That Lacks Harbers' Segmentation and Further Presents Color-Shifting Issues

247. Without light segmentation the motivation to use Harbers hardware alone is lacking.

248. As explained in ¶¶ 170-171, Petitioner never explains how any segmentation would occur in the absence of Harbers' software.

249. Further, the use of Harbers' colored array creates a color-shifting problem.

250. As explained in ¶¶ 173-177 Petitioner fails to address the problems that selective blanking creates in an array of colored LEDs.

251. Intentionally left blank.

3. Ground 8C Is An Unmotivated Combination Due to the Unaddressed Issues Arising From Conflicting Control Strategies

252. Petitioner never explains how Karlsson's selective dimming and Harbers particular automatic controls would contemporaneously function in situations where the two strategies required conflicting control.

253. As explained in ¶¶ 167–169 Petitioner never explains how to merge conflicting functionality of Harbers and Karlsson software.

254. Intentionally left blank.

4. Ground 8C Fatally Lacks Necessary Particularity

255. In Ground 8C, there are two controllable systems, an LED array 2 and a modulator 3. There are also two control strategies, Karlsson's blanking and Harbers automatic selectivity and beam segmentation.

256. Petitioner never explains which controllable structure would be controlled by which control function, rendering the argument fatally flawed for a lack of particularity.

257. As explained in ¶¶ 180–183, In combinations having multiple control strategies from software (e.g., Beam-Thominet, Karlsson-Harbers, Karlsson-Harbers-Gotou, etc.), and multiple controllable hardware elements (e.g., LED array with a modulator), Petitioner never explains which controls are applied to which controllable elements.

258. Intentionally left blank.

5. Karlsson's Failings Alone Are Sufficient To Defeat All

**Proposed Grounds Utilized Against Claims 26-31, 65,
and 68-69**

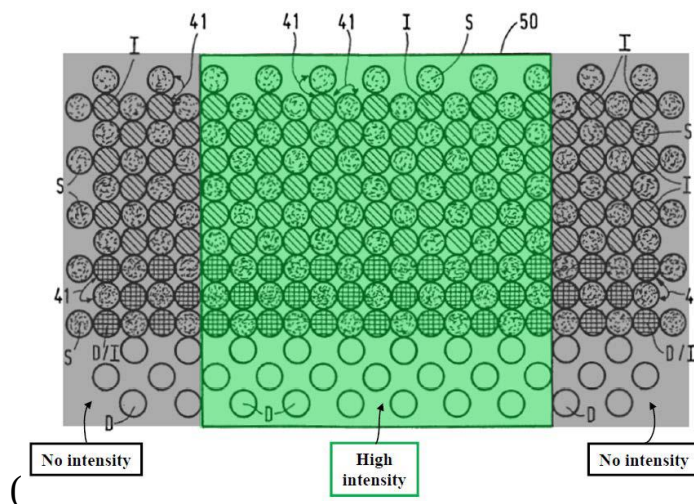
259. Karlsson’s teachings, depending on the situation, are misapplied, are non-existent as alleged, or fail to meet a limitation of a given claim – substantive failings that extend across all sub-grounds.

260. Petitioner contends that Fig. 14 is a functional representation of the actual operation of Karlsson in the presence of detected light, stating that “the shaded subsections below are “no/low intensity” sections **that correspond to detected light.** (Petition, 80.) That is, these are not merely electively unused areas, they are, by Petitioner’s contention, “shaded areas (outside emitted light beam 50) – [where] ‘no light or light having a low intensity is emitted **in those directions from which light is detected.**’” (*Id.*) Karlsson, however, does not actually say this with respect to Fig. 14.

261. Moreover, Petitioner’s Fig. 14 annotations represent that vertical blanking occurs, i.e., an entire column of light is extinguished in response to detected illumination. That is also not supported by any evidence from Karlsson, but an apparent “guess” as to how Karlsson would address detected light using LEDs; Karlsson itself is very vague on this point.

262. On the other hand, Petitioner’s statement, that those “shaded areas” are sections that correspond to “directions from which light is detected,” is useful

to understand Petitioner's position on how Karlsson generally functions— namely, these Annotations present an array that would be fully utilized were light not being detected.



(Ex.1010, Fig. 14, Annotated by Petitioner)

263. Intentionally left blank.

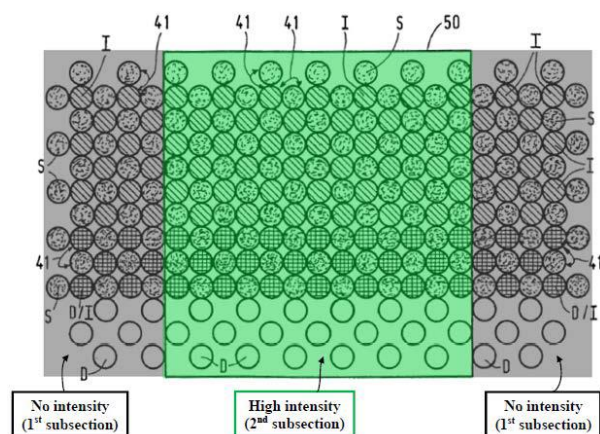
a. Claim 26 – Karlsson, Alone or In Combination, Fails to Teach or Suggest Elements Petitioner Refers to as 26.4 and 26.5

264. Claim 26 recites “determining illumination for at least a first subsection ... including the other vehicle ..., as indicated by the sensor data, and for at least a second subsection ... not including the other vehicle ...” Collectively, the Petition addresses these as elements 26.4 and 26.5.

(1) 26.4

265. For the explanation of claim 26.4, “determining illumination for at least a first subsection ... including the other vehicle ...,” Petitioner alleges that

Fig. 14 of Karlsson shows this element in the “shaded area with no intensity.”
(Petition, 93.) Petitioner’s annotated figure, recreated below, represents the two grey areas as the claimed “first subsection.”



(Ex.1010, Fig. 14, Annotated by Petitioner)

266. Again, there is no teaching in Karlsson that Fig. 14 represents control over an array responsive to detected light, or that such control would include vertical blanking of LEDs – so the argument first fails as mere conjecture, as the “evidence” presented is not supported by the record as showing what it purports to show.

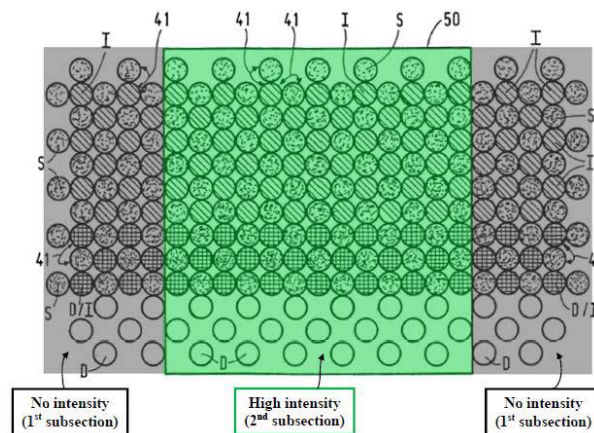
267. Thus, the conclusion about annotated Fig. 14 is not explained with sufficient particularity to result in a proof, lacking actual supported evidence, and results in an incomplete proof as presented.

268. Intentionally left blank.

(2) 26.5

269. Also, Petitioner's explanation with respect to 26.5, "including determining illumination ... for at least a second subsection of the field-of-view **not including the other vehicle**" is both confusing in explanation and deficient in its proof.

270. Petitioner again presents the above annotated Fig. 14 and contends "Karlsson thus determines illumination for a different subsection outside of the detected vehicle (e.g., high intensity area to either side of the first subsection). The figure does not show an alleged high-intensity area "to either side of the first subsection."



(Ex.1010, Fig. 14)

271. For the annotated "high intensity subsection" **between** the two first subsections, Petitioner makes no valid proof, nor even attempts to prove, that this region is a region "not including the other vehicle."

272. Karlsson does not explain exactly which LEDs it chooses in response

to a detected light source. Petitioner assumes Karlsson would block off vertical strips of LEDs by speciously assuming that Fig. 14 shows Karlsson's response to detected light.

273. Petitioner also assumes that those vertical strips would extend laterally far enough (i.e., in **horizontal** width) to **fully encompass** an oncoming vehicle, i.e., that the “first subsection” in the Fig. 14 above would be wide enough so that no portion of the vehicle would be contained in the central region. This assumption is made despite the fact that all Karlsson discloses how to detect is light.

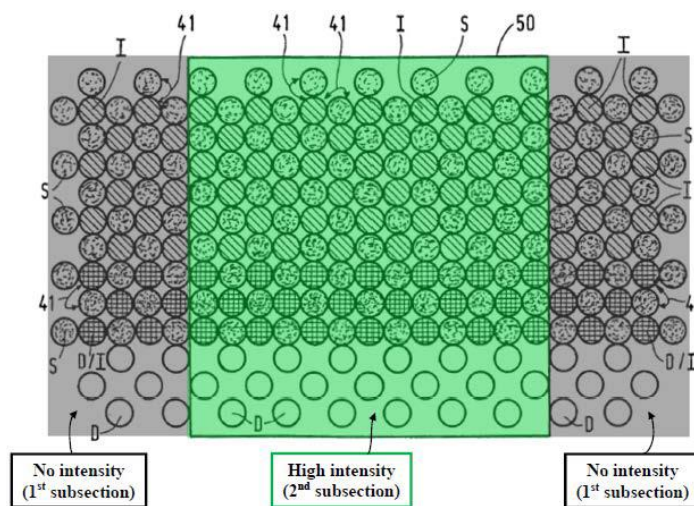
274. That interpretation, that Karlsson just happens to exclude all portions of a vehicle from the illuminated central portion, merely on the basis of detected light that Karlsson cannot even correlate to a vehicle, is unsupported on the record. Nor is there any proof of this shown in explanation or the figure. Petitioner never explains why or how the 1st subsection would fully encompass the vehicle, required for the 2nd subsection to “not include” the vehicle as claimed.

275. Thus, Petitioner fails to prove the presence of “determining illumination ... for at least a second subsection of the field-of-view not including the other vehicle” and fails to prove that claim 26 is unpatentable — in a manner that extends across all sub-grounds of Ground 8.

276. Intentionally left blank.

b. Claim 65 — Petitioner Fails to Prove That Karlsson, Alone or In Combination, Teaches or Suggests “*determining illumination ... for one or more subsections, to either side of the first subsection*”

277. Claim 65.4 recites “determining illumination ... for one or more subsections, to either side of the first subsection.” Presumably this limitation is why Petitioner made the confusing statement, as part of its combined 26/65 analysis, that “Karlsson thus determines illumination for a different subsection outside of the detected vehicle (e.g., high intensity area **to either side of the first subsection**).” But, the Figure, the only actual alleged **evidence** of the “to either side of the first subsection,” notably actually fails to show what it is alleged to show.



(Ex.1010, Fig. 14, Annotated by Petitioner)

278. Further, Petitioner has provided no suitable explanation that Fig. 14 is even the system of Karlsson functioning to provide selective illumination in the

presence of detected light.

279. Petitioner does not demonstrate that illumination is being varied as claimed. For example, if Petitioner is correct about Fig. 14, then the **singular** window of light is never shown to exist on both sides of a detected vehicle. Karlsson never describes creating a plurality of such windows, and it is possible (for the sake of argument only, using Petitioner's explanation) that Karlsson simply uses this **single** window of light, shifting and shrinking/expanding it as more or less illumination is detected.

280. Accordingly, Petitioner fails to prove that claim 65 is unpatentable.

281. Intentionally left blank.

c. Claim 27

282. Claim 27 depends from claim 26 and has thus not been proven unpatentable by Petitioner.

d. Claims 28/68 – Only Sub-ground 8D Includes Colored Light Sources and That Sub-ground is a Combination no POSA Would Have Made Due to Its Unpredictable Nature and Distracting Output

283. Petitioner relies on a combination of Harbers-Karlsson for the proof of claims 28/68, rendering any sub-grounds exclusively reliant on Karlsson alone inapplicable.

284. Combinations 8C and 8E lack any teaching of or capability to create color. Sub-ground 8C uses Karlsson's light source, never been shown to emit color. Sub-ground 8E merely curves Karlsson's array, also not resulting in color.

285. Sub-ground 8D is the only sub-ground where the colored LEDs of Harbers, relied on in Petitioner's explanation of claims 28/68, exist in the combination. That combination, however, suffers from the issues noted with respect to using singularly colored LEDs to achieve a color shifting.

286. Accordingly, the sub-ground 8D constitutes a ground that no POSA would have been motivated to create or use in the manner proposed. For at least these reasons, Petitioner has failed to prove the unpatentability of claims 28/68.

287. Intentionally left blank.

e. Claims 29/69 – In Addition To The Shortcomings For Claims 28/29, Petitioner's Argument Fails to Address Limitations of the Claims

(1) No POSA would have made the proposed combination

288. Claims 29/69 also call for colored illumination, and on this front all the deficiencies of the Karlsson-Harbers combinations from Claims 28/68 apply.

289. Intentionally left blank.

(2) Petitioner further fails to demonstrate how Karlsson-Harbers accommodates “sensed snow or fog.”

290. Additionally, Petitioner never proves the presence of “**sensed** fog or snow,” or any sensor capable of creating “[sensor] data including data indicating fog or snow.” Merely noting that certain beams of Harbers are created for use in fog or snow is insufficient to prove that any processor is determining illumination requirements that accommodate sensed fog or snow (claim 29) or that any sensor data indicates fog or snow (claim 69.) These separate limitations are not argued differently, another fatal failure by Petitioner in failing to note the different requirements of the claims.

291. These shortcomings render this argument additionally deficient for a failing in particularly with respect to claims 29 and 69.

292. Intentionally left blank.

XI. Claims 30/31

293. Claims 30/31 depend from claim 26. Petitioner’s failures to demonstrate the unpatentability of claim 26 extend to claims 30/31. Claims 30/31 have thus not been proven unpatentable by Petitioner.

294. Intentionally left blank.

A. Ground 9 – Karlsson-Harbers-Gotou Applied to Claims 32-36/70

295. The following table lists sub-grounds 9A-9C:

9A	Karlsson LEDs + Mod	Harbers Software		Gotou
9B	Karlsson Control		Harbers Array	Gotou
9C	Karlsson LEDs + Mod		Harbers Curve	Gotou

1. The Inclusion of Gotou Does Not Remove the Noted Problems with the Combination of Karlsson-Harbers

296. Initially, none of the shortcomings of the various imported sub-grounds 8C-8E from Karlsson-Harbers are cured by including Gotou, and some are amplified as noted below. So, for at least the reasons already presented, all sub-grounds would not be combinations a POSA would have made.

297. In sub-ground 9B where colored LEDs are utilized with Gotou, any change to a beam that allegedly “increases” the light or changes the light to illuminate a curve is going to potentially change the color of the beam as well, because certain outer colored LEDs would utilized in the presence of a turn, simply based on their placement (assuming the combination could even achieve the function as Petitioner contends). Petitioner never recognizes or addresses this issue, and this is yet another reason why a person would not be motivated to utilize the colored LEDs of Harbers in a Gotou strategy that allegedly attempts to accommodate a curve or turn through changes or increases to illumination. This would only serve to create additional unpredictable usages of colored LEDs in the proposed combination.

298. Accordingly, there are no grounds that should actually survive to address claims 32-36/70. However, additional shortcomings will be proven with respect to all grounds.

2. Karlsson’s Strategy to Utilize All LEDs for High Beam Illumination, Except When Preventing Glare, Leaves No Light Remaining to Be Controlled or Increased Into a Curve or Turn

299. As noted in the description of Karlsson above, and as Petitioner’s proposed interpretation of Karlsson’s Fig. 14 supports, Karlsson’s general strategy is to operate optimally at all times, leaving nothing left to be determined for a curvature (claims 32), to be determined for a turn (claims 33, 35) and certainly nothing left to be “increased” (claims 34, 36, 70). Further, Petitioner’s usage of Karlsson’s array for claims 26/65 as a maximally illuminating array (except when selectively dimmed), carries forward to these claims via dependency. The elements of those claims are part of these claims, and the array is never explained to function differently — i.e., in a manner whereby some number of unused LEDs would remain for achieving claims 32-36/70.

a. Claims 32/33/35 – The Inclusion of Gotou Would Be Recognizes as Superfluous by a POSA and The Combination Would Not Have Been Made

300. These claims recite determining illumination for an upcoming curve (32) or turn (33, 35). Gotou is introduced as providing this determination, but the

determination is superfluous, as there is nothing Karlsson could do to comply with any change desired by Gotou, when operating as proposed by Petitioner for claim 26.

301. Thus, no POSA would have been motivated to include the system of Gotou only to make a determination with which Karlsson-Harbers can do nothing.

302. Further, when Petitioner argues that Karlsson would “direct light of the spotlight beams appropriately,” that is an explanation devoid of substantive evidence or reasoning. (Petition, 130.) Petitioner never explains how Karlsson-Harbers is doing this or which combination of which sub-ground is doing this, or, for that matter, which controllable system is doing this, in combinations 9A and 9C, which both have multiple controllable systems – LED array 2 and modulator 3. This is a fatal failing in particularity.

303. Petitioner now has three varied functions that are all apparently just simply supposed to work in concert — Harbers’ beam segmentation, Karlsson’s selective dimming, and now Karlsson-Harbers re-direction of illumination into a curve based on Gotou’s information.

304. There are a multitude of possible problems resulting from the contemporaneous use of three proposed control functions that were never designed to be used in concert. A massive degree of experimentation would be required to even have a system that functioned in an acceptable manner, assuming such a

system even existed – one is certainly never explained. Petitioner never even addresses the existence of these problems, let alone tries to provide a solution to even a single one.

305. Given the multitude of possible situations arising from systems that purportedly individually accommodate varied instances of weather, curves, turns and traffic, all features that are highly prevalent on roads and which thus occur in almost limitless combinations, any POSA seeking to make a combination of Karlsson-Harbers, let alone Karlsson-Harbers-Gotou, would have needed to understand and adapt the system to deal with all the likely scenarios — an absurdly complex undertaking when working with three systems not actually designed to work with each other and none of which had built in accommodation of un-contemplated alternative control functions. Yet Petitioner simply combines all the parts and assumes that the system is just going to work.

306. Accordingly, the highly unpredictable combination is not a combination a POSA would have made, regardless of which embodiment of Karlsson-Harbers were combined with Gotou.

b. Petitioner Additionally Fails to Demonstrate the Presence of An Upcoming Turn Indicated By Sensor Data

307. In claims 33 and 35, the upcoming turn is claimed to be “indicated by the sensor data.” Petitioner argues that this is taught by Gotou — making a

statement that “illumination is controlled along the ‘planned running direction’” that, for some unexplained reason, cites Patent Owner’s Patent. (Petition, 132.)

308. Whether a “planned running direction” indicates an upcoming “turn” (not curve) and how that “planned running direction” results from sensor data is never explained.

309. Part of the problem is that Petitioner tried to deal with claims having different limitations all at the same time, without ever addressing those different limitations.

310. “What is never explained, for example, is where or how the “intended direction of the driver” or “planned running data” is indicated by **sensor data** as claimed. Karlsson’s steering sensor only functions when the vehicle is already being turned, and is useless for indicating “an **upcoming** turn,” and there is no evidence presented that Karlsson’s light sensor can somehow “see” curves or turns ahead. Those sensors are the only sensors ever actually noted by Petitioner. (*Id.*, 131). No proof is provided or explained for how any “sensor” of Karlsson indicates an “upcoming” turn.

c. Claims 34/36/70 – Petitioner Does Not Explain How Karlsson’s Maximum Illumination Usage can Be Further Used to “Increase” Illumination

311. Claims 34, 36 and 70 all recite “determining illumination that **increases** illumination” of either an upcoming turn (34, 36) or road curve (70).

With this additional requirement, the combinations of Karlsson-Harbers-Gotou now have an additional problem meeting the limitations of the claims.

312. The claims now call for an express “increase” in illumination, and as Petitioner’s argument in 26.5 supports, the LEDs are already maximally utilized by Karlsson’s strategy. Therefore, under any situation where illumination is not detected, there is nothing remaining to increase.

d. Claims 34/36/70 – Petitioner Does Not Even Address The Requirement to “Increase” Illumination

313. Claims 34, 36 and 70 all recite “determining illumination that **increases** illumination” of either an upcoming turn (34, 36) or road curve (70). Nothing in the explanation for claims 32-36/70, all addressed collectively, even remotely attempts to mention or discuss “increased” illumination as required by claims 34, 36 and 70.

314. This is an additional shortcoming in particularity, fatal in Petitioner’s failure to address the claimed feature and/or explain why such a feature was otherwise inconsequential.

315. Intentionally left blank.

B. Ground 10 – Karlsson-Harbers-Braun Applied to Claims 66/67

316. The following table lists sub-grounds 10A-10C:

10A	Karlsson LEDs + Mod	Harbers Software		Braun
10B	Karlsson Control		Harbers Array	Braun
10C	Karlsson LEDs + Mod		Harbers Curve	Braun

1. The Inclusion of Braun Does Not Remove the Noted Problems with the Combination of Karlsson-Harbers

317. Initially, none of the shortcomings of the various imported sub-grounds 8C-8E from Karlsson-Harbers are cured by including Braun. So, for at least the reasons already presented, all sub-grounds would not be combinations a POSA would have made.

318. In sub-ground 9B where colored LEDs are utilized with Braun, any utilization of a beam to “spotlight” a person or sign will potentially use colored LEDs, possibly even a single colored LED. Petitioner never recognizes or addresses this issue, never explaining which LEDs would be used when, but this is yet another reason why a person would not be motivated to utilize the colored LEDs of Harbers in a strategy that now additionally and unpredictably creates “spotlights” in the scene. This would only serve to create additional unpredictable usages of colored LEDs in the proposed combination.

319. Accordingly, there are no grounds that should actually survive to address claims 66/67. Out of an abundance of caution, however, additional shortcomings will be proven with respect to all grounds.

2. Karlsson’s Strategy to Utilize All LEDs for High Beam Illumination, Except When Preventing Glare, Leaves No Light Remaining to Be Used for “Spotlighting”

320. Karlsson is already fully utilizing its array, leaving no LEDs left to utilize to “illuminate” anything, as Braun is stated to do. (Petition, 136.) Thus, the combination at best results in an unusable determination of the presence of a person or sign. Accordingly, no POSA would have been motivated to combined Braun with Karlsson-Harbers as contended, all additional determinations would be extraneous at best.

3. Petitioner Fails To Explain How the Proposed System Would Function — Including Which Control Strategies Would Control Which Controllable Systems

321. Petitioner fails to address which control function, Karlsson, Harbers or Braun, would be given primacy, as with Beam-Thominet-Braun or how the three control functions would otherwise interact in scenarios where at least two control functions demanded contradictory results. Nor does Petitioner, in this case, describe which functions are controlling which of the two (LED array 2, modulator 3) controllable light-related systems of the proposed combination.

322. Karlsson has two controllable systems to control light, the source array 2 and the modulator 3 and three discrete control functions are presented in a single combination. None were designed with the others in mind. All except

Karlsson were designed to work with an LED array alone. Petitioner never explains, for example, whether Karlsson would control the LED array or the SLM, whether Harbers strategy would be implemented with the LED or SLM, and/or whether Braun's strategy would be implemented with the LED or SLM. Both control systems control the same ultimate light output, so an understanding of which strategy is controlling what, as well as which strategies have primacy or how they otherwise interact, is necessary for any combination, and none of this is ever even noted by Petitioner, let alone explained. The combination has not been explained with any functional particularity, and moreover all the conflicts are clear motivations not to combine these systems.

4. A Person of Ordinary Skill in the Art Would Not Have Been Motivated to Combine Braun With Karlsson-Harbers Because of the Conflicting Strategies

323. In addition to a lack of explanation about the particulars of implementing control strategies, Petitioner never addresses the conflicts from combining three control strategies with two controllable light-related systems. The various strategies will attempt to control elements in conflicting manners, having different desired outcomes and being responsive to discrete variables - e.g., Karlsson may instruct vertical blanking of a region (under Petitioner's solution) where Braun instructs illumination of a person or sign.

324. No POSA would have undertaken the task of combining all these elements with such conflicting control plans as part of a combined strategy, without understanding and addressing the conflicts, two required undertakings never presented in the Petition. Moreover, it is not clear, and unexplained, how these conflicts even result in a functional system.

325. For these additional reasons, Petitioner presents unmotivated combinations, leaving no suitable combination usable to demonstrate alleged unpatentability of claims 66-67.

326. Intentionally left blank.

XII. Conclusion

327. In my opinion, the prior art references discussed above taken alone or in any permissible combination do not disclose or suggest each and every element of the challenged claims.

328. I reserve the right to supplement my opinions to address any information obtained, or positions taken, based on any new information that comes to light throughout this proceeding.

I declare under penalty of perjury that the foregoing is true and accurate to the best of my ability.

Executed on: October 12, 2023



Matthew A. Turk PhD