

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

MERCEDES-BENZ USA, LLC
Petitioner,

v.

YECHEZKAL EVAN SPERO
Patent Owner.

U.S. Patent No. 9,955,551

IPR Case No.: 2023-01040

SECOND DECLARATION OF MATTHEW A. TURK, PhD

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List of Exhibits

Exhibit No.	Description
2001	Declaration of Matthew A. Turk, Ph.D.
2002	Curriculum Vitae of Matthew A. Turk, Ph.D.
2003	Best Practices and FAQs for Filing Requests for Reexamination Compliant with 37 CFR 1.510 and 1.915, PTAB, May 2010
2004	<i>Intentionally left blank.</i>
2005	Petition challenging U.S. Patent No. 9,955,551, <i>Mercedes-Benz USA LLC v. Yechezkal Evan Spero</i> , IPR2023-01040, June 7, 2023
2006	U.S. Published Patent Application US2003/0137849A1 to Alden, Prosecution History in the U.S. Patent and Trademark Office
2007	Wards Auto “Prospects Bright for Lighting Sensor Supplier Hella,” Roger Schreffler Wards Auto, June 6, 2017 (Available at https://www.wardsauto.com/technology/prospects-bright-lighting-sensor-supplier-hella)
2008	Automotive World, “Hella: Matrix LED technology makes its debut”, February 13, 2014 (Available at https://www.automotiveworld.com/news-releases/hella-matrix-led-technology-makes-debut/)
2009	<i>Intentionally left blank.</i>
2010	ATZ Worldwide “Multi-row Headlamp System in the Mercedes-Benz E-Class,” Franz-Josef Kalze, February 2016 (Available at https://link.springer.com/article/10.1007/s38311-015-0105-y)
2011	<i>Intentionally left blank.</i>
2012	PR Newswire, “Mercedes Multibeam LED headlamps – in a class of their own,” June 22, 2016 (Available at https://www.prnewswire.com/news-releases/mercedes-multibeam-led-headlamps--in-a-class-of-their-own-300288628.html)
2013	Complaint, <i>Torchlight v. Daimler et al.</i> , Case No. 1:21-CV-751 District of Delaware, filed June 7, 2022

Exhibit No.	Description
2014	Reexamination Application Certified File History of U.S. Patent No. 9,955,551
2015	<i>Intentionally left blank</i>
2016	<i>Intentionally left blank</i>
2017	<i>Intentionally left blank</i>
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2037	<i>Intentionally left blank</i>
2038	<i>Intentionally left blank</i>
2039	<i>Intentionally left blank</i>
2040	Second Declaration of Matthew A. Turk, Ph.D.
2041	Transcript of Deposition of Nikolaos Papanikolopoulos, Ph.D. Mercedes Benz-USA, LLC v. Yechezkal Evan Spero, taken on February 23, 2024 IPR2023-01039, IPR2023-01040
2042	<i>Intentionally left blank</i>
2043	<i>Intentionally left blank</i>
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Exhibit No.	Description
2048	<i>Intentionally left blank</i>
2049	<i>Intentionally left blank</i>
2050	<i>Intentionally left blank</i>
2050	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)
2051	Michael Bass, <i>Handbook of Optics</i> 3 RD Edition Volume II, (McGraw-Hill, 2010) (Available at https://www.worldcat.org/title/555545456)
2052	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/)
2053	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/)
2054	<i>Intentionally left blank</i>
2055	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)
2056	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.)
2057	<i>Intentionally left blank</i>

Exhibit No.	Description
2058	<i>Intentionally left blank</i>
2059	<i>Intentionally left blank</i>
2060	Michael Bass, <i>Handbook of Optics</i> 3 RD Edition Volume V, (McGraw-Hill, 2010) (Available at https://www.worldcat.org/title/557121959 .)
2061	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.)
2062	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-null-digikeymode-dsf-pf-null-ww&DCM=yes&distId=10) (Accessed September 12, 2023.)
2063	Surendra Gupte, Osama Masoud, Robert F.K. Martin, and Nikolaos P. Papanikolopoulos “Detection and Classification of Vehicles” IEEE Transactions on Intelligent Transportation Systems, Vol. 3, No. 1, (March 2002) (Available at https://ieeexplore.ieee.org/document/994794) (Accessed February 20, 2024)
2064	<i>Intentionally left blank</i>
2065	Webster’s New Universal Unabridged Dictionary Deluxe 2 nd Edition excerpts, Simon and Schuster (1983)

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. 9,955,551 (“the ’551 Patent”) to Yechezkal Evan Spero.

3. I previously prepared a declaration in this proceeding dated September 14, 2023, submitted as an exhibit (Ex. 2001) with a Patent Owner Preliminary Response of the ’551 Patent to a Petition filed on June 7, 2023 by Petitioner Mercedes Benz USA, LLC. I understand that the Board instituted the Petition on December 12, 2023.

4. For this second declaration, I have been asked to again provide opinions on the claims of the ’551 Patent in light of the prior art, Petitioner’s arguments in the Petition and the corresponding declaration and testimony of Dr. Papanikolopoulos. 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 in my report, Dr. Papanikolopoulos's declaration (Ex. 1003) and his deposition transcript (Ex. 2041).

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

computer vision, computer imaging, human computer interaction, probabilistic models and methods, artificial intelligence, computer graphics, machine learning, and other areas. My graduate Computer Imaging course covered the fundamentals of imaging systems, including the capture, storage, display, retrieval, and processing of images, as well as the nature of light, color, optics, human vision, non-visible (UV and IR) and multispectral imaging, sensors, cameras, and illumination.

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. I have also published research focused on “multi-flash imaging” – using optics, illumination, and computer vision techniques all together, including: “A projector-camera setup for geometry-invariant frequency demultiplexing,”

IEEE Conference on Computer Vision and Pattern Recognition (CVPR 2009), Miami, FL, June 2009; “Characterizing the shadow space of camera-light pairs,” IEEE Conference on Computer Vision and Pattern Recognition (CVPR 2008), Anchorage, Alaska, June 24-26, 2008; “Multi-flash stereopsis: depth edge preserving stereo with small baseline illumination,” IEEE Transactions on Pattern Analysis and Machine Intelligence, Vol. 30, No. 1, pp. 147-159, January 2008; “Dealing with multi-scale depth changes and motion in depth edge detection,” Brazilian Symposium on Computer Graphics and Image Processing, October 2006. (Awarded “One of the Best Image Processing and Computer Vision Papers”); “Specular highlights detection and reduction with multi-flash photography,” Journal of the Brazilian Computer Society, Vol. 1, No. 12, pp. 35-42, 2006; “Efficient depth edge detection using structured light,” International Symposium on Visual Computing, Lake Tahoe, NV, December 5-7, 2005; “Discontinuity preserving stereo with small baseline multi-flash illumination,” International Conference on Computer Vision (ICCV'05), Beijing, China, 2005; “Harnessing real-world depth edges with multi-flash imaging,” IEEE Computer Graphics and Applications, Vol. 25, Issue 1, pp 32-38, January 2005; “Specular reflection reduction with multi-flash imaging,” Brazilian Symposium on Computer Graphics and Image Processing, pp. 316-323, Curitiba, PR, Brazil, October 2004; and “A non-photorealistic camera: depth edge detection and stylized rendering using

multi-flash imaging,” ACM SIGGRAPH, Los Angeles, August 2004 (also ACM Transactions on Graphics, Vol. 23, No. 3, pp. 676-685, August 2004.)

21. In 2020, I was elected as 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. In 2023, I was named as a Fellow of the Artificial Intelligence Industry Alliance (AIIA). 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.

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

II. Relevant Legal Standards

23. I have been asked to provide opinions on the claims of the ‘551 Patent in light of the prior art.

24. 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.

25. 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

26. 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

27. 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. 2050¹ at 237.)

¹ Jianzhong Jiao and Ben Wang, "Etendue Concern for Automotive Headlamp Using LEDs", SPIE Proceedings Vol. 5187, published by the international society

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

(Ex. 2050 at 234.)

28. 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

for optics and photonics (January 2004). Ex. 2050 is a true and accurate copy of a technical paper that I understand was published by SPIE in January 2004.

hotspot, the light that spreads to left and right or foreground has much less intensity and a large diverge or spread angle instead.

(Ex. 2050 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. 2051² 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

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

Ex. 2051 is a true and accurate copy of excerpts of a book that I understand was published by McGraw Hill in 2010.

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

(Ex. 2052³ 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. 2050 at 237-238.)

The light intensity distribution or beam pattern from a forward lighting device is regulated by federal, state and international laws for

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. 2052 is a true and accurate copy of a technical paper that I understand was published by SAE in March 2004.

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. 2050 at 234.)

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

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)

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 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. 2051 at 18.5.)

C. Design Tradeoffs

30. 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. 2052 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. 2050 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. 2050 at 240.)

31. 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. 2052 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. 2050 at 238, emphasis added.)

32. 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. 2052 at 3.) Furthermore, “the luminance of LEDs must be comparable or higher than the existing tungsten halogen light sources.” (Ex. 2052 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. 2050 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. 2052 at 4, emphasis added.)

33. 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. 2052 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. 2052 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. 2050 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. 2052 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. 2052 at 8, emphasis added.)

D. Hardware

34. 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. 2052 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. 2052 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. 2050 at 237.)

E. Optical System

35. 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. 2050 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. 2052 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. 2050 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. 2053⁵ at 10.)

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. 2052 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

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

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. 2052 at 11.)

F. Spatial Light Modulator

36. A POSA would have understood a spatial light modulator (SLM), such as described by Beam (Ex. 1005), to be an array of 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. 2060⁶, 8.29-8.30, . 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.

⁶ Michael Bass, *Handbook of Optics* 3RD Edition Volume V, (McGraw-Hill, 2010.)

Ex. 2060 is a true and accurate copy of excerpts of a book that I understand was published by McGraw Hill in 2010.

(Ex. 2061⁷.) Light reflected at the first angle exits the device, while light reflected at the second angle is blocked by the device. (Ex. 2062⁸.)

37. An SLM is used by Beam 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) so that the smaller light beams can be individually blanked or blocked and do not exit the headlamp. (*See e.g.*, Ex. 1007 at 4:36-41.)

38. In addition to embodiments that use a single light source with an SLM to generate the multiple controllable microbeams or spotlight beams, Beam also describes alternative embodiments that replace the single light source and SLM

⁷ Texas Instruments/Digikey “How DLP Technology Works.” Ex. 2061 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. 2062 is a true and accurate copy of a Texas 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.)

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. 1007, Figs. 4, 6.)

39. As described by Beam, 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 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.

40. 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.

41. Intentionally left blank.

42. Intentionally left blank.

G. Heat management

43. 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. 2055⁹ at 7.)

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. 2055 is a true and accurate copy of a technical paper that I understand was published by SPIE in September 2007.

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 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. 2051, at 18.6.)

H. Packaging

44. Packaging considerations for automotive headlamps presented challenges even years after the earliest priority date of the '551 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. 2050 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. 2052 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. 2050 at 238.)

I. Cost

45. 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. 2051 at 18.5.)

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

(Ex. 2056¹⁰ at 66.)

J. Detection and Classification of Vehicles

46. Automotive adaptive forward lighting systems use various sensors and processing systems to detect and classify vehicles. In 2002, “magnetic loop

¹⁰ Ex. 2056 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. 2056 is a true and accurate copy of a technical paper that I understand was published by the DOE in September 2008.

detectors” were often used to detect or count vehicles passing over them. However, “Vision-based video monitoring systems offer a number of advantages” over such detection systems for example, “[i]n addition to vehicle counts, a much larger set of traffic parameters such as vehicle classifications, lane changes, etc., can be measured.” (Ex. 2063¹¹, 37.) Dr. Papanikoloplous explained that “there has been relatively little work done in the field of vehicle classification . . . because [it] is an inherently hard problem” due to, e.g., vehicles having different “shapes and sizes” and “occlusions, shadows, camera noise, changes in lighting and weather conditions” in “real-world traffic scenes.” *Id.*

47. Dr. Papanikolopoulos also explained that stereo cameras, e.g., cameras with two or more lenses with a separate image sensor or film frame for each lens, were unfeasible for real-time vehicle classification systems:

In addition, stereo cameras are rarely used for traffic monitoring. This makes the recovery of vehicle parameters—such as length, width,

¹¹ Surendra Gupte, Osama Masoud, Robert F. K. Martin, and Nikolaos P. Papanikolopoulos, “Detection and Classification of Vehicles” IEEE Transactions on Intelligent Transportation Systems, Vol. 3, No. 1 (March 2002). Ex. 2063 is a true and accurate copy of a technical paper that I understand was published by IEEE in March 2002.

height etc., even more difficult given a single camera view. The inherent complexity of stereo algorithms and the need to solve the correspondence problem makes them unfeasible for real-time applications.

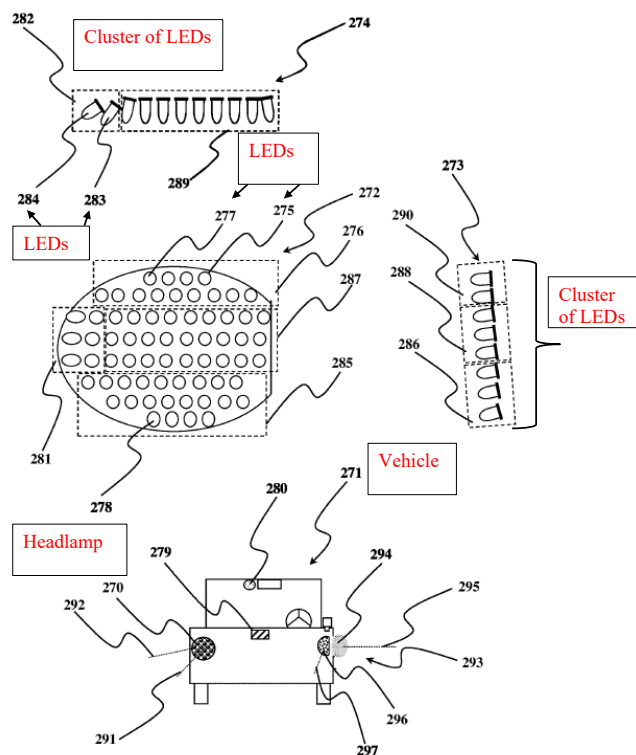
Id.

48. Accordingly, Dr. Papanikolopoulos proposed a system comprising six stages: 1) segmentation, 2) region tracking, 3) recovery of vehicle parameters, 4, vehicle identification, 5) vehicle tracking, and 6) vehicle classification. (*Id.* at 38.)

49. Intentionally left blank.

IV. Overview of the '551 Patent

50. The '551 Patent discloses “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, 11:8-13.) The '551 Patent further explains that “[t]he terminology ‘digital’ as used herein refers to the discrete nature of the multiple 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.*, 2:65-3:3.)



(Ex. 1001, Figure 15, Annotated)

51. The '551 Patent describes “a different approach which is to provide the end user with the most correct lighting solution not a new technology lamp to replace the old one.” (*Id.*, 11:5-8.) “In contrast to a prior art, single large, lamp replacement like light source, the present invention provides multiple, small sized sources of differing characteristics such that the effect of the whole is greater than the sum of the individual parts.” (*Id.*, 11:45-49.) “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.” (*Id.*, 11:56-62.) The '551

patent explains how to use its “digital lighting” in the context of headlamps to “provide the optimal lighting solution in real-time” — whether that be for predictive curve illumination (*Id.*, 57:31-37), to preserve forward illumination while preventing glare (*Id.*, 52:54-65), or both (*Id.*, 53:33-44).

52. The ’551 Patent describes a multitude of sensor-based techniques for observing a scene, analyzing a scene, determining varied illumination for a scene, etc. This can include determining what objects are within the scene and what illumination should correlate to those objects. (*Id.*, 44:36-45:44.) The ’551 Patent notes the general applicability of the varied concepts across embodiments and specifically notes that techniques described elsewhere at least correspond to headlights (*Id.*, 52:66-53:4.) The ’551 Patent explains that, by using “digital” headlamps with known light directionality of discrete source elements, such as LEDs, it is possible to “continue to illuminate far ahead (in high beam) without blinding oncoming traffic.” (*Id.*, 52:54-61.) This allows for determination of “what exact aiming is the maximum allowable for any given traffic situation and the road layout.” (*Id.*, 52:64-65.)

53. The ’551 Patent also recognizes that different “objects” may be in the field of view in a variety of lighting situations, and that different light output may be appropriate to accommodate these different objects. (*Id.*, 44:36-45:44.) In the context of headlamps, it can, for example, determine types of objects, *e.g.*, without

limitation, whether something is a vehicle or a sign, and respond differently to each object. With regards to a preceding vehicle it may reduce illumination of the vehicle and with regards to a preceding sign it may increase illumination of the sign. It can also make these accommodations at the same time, because of the discrete nature of the directional light sources – “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.” (*Id.*, 52:43-53:4.) This is a headlamp embodiment employing, among other things, the described notion of “task lighting” — contemplation of varied illumination needs within an illuminated scene. (*Id.*, 52:67-53:1.)

54. Thus, the '551 Patent provides a comprehensive solution for the control and use of light and extends the application to headlamps that can accommodate other traffic without blinding it, predictively illuminate road curvatures, and differentially illuminate objects in a scene based on object recognition. All of this lends itself to the complete headlamp solution contemplated and described — a solution where “[a]t any instant in time the intensity, spectrum and beam pattern of the headlamp may be varied as a function of the driver’s intent, lay of the road and environmental factors.” (*Id.*, 51:49-52.) The marrying of the '551 techniques with the headlamp embodiments results in a headlamp with highly controllable emission elements that, “[w]hen combined with devices

capable of detection changes in the surrounding environment the flexible DLF is capable of changing the illumination so as to provide the optimal lighting solution in real-time.” (*Id.*, 57:24-26, 33-37.)

V. The Challenged Claims

55. The Challenged Claims are claims 48-87. Of those, claims 48, 56, 64, 72, and 80 are independent claims. (Ex. 2014, 1186-1190, 1216-1219) Each of the remaining Challenged Claims depends directly or indirectly from one of those independent claims. (Petition at 5.)

No.	Element
48.p	48. An illuminating device having automatic control of light provided to an illuminated area comprising: and
48.1	a structure for incorporating illuminating device elements, wherein the structure comprises a motor vehicle;
48.2	a plurality of individually controllable LEDs incorporated in the structure via at least one headlamp mounted to the structure, each headlamp including at least one of the LEDs, the LEDs in communication with a power source;
48.3	electronic circuitry apparatus for the controlled powering of the LEDs and other of the illuminating device elements;

48.5	one or more processors;
48.6	one or more sensors, including one or more cameras, placed on the structure for detecting coordinate-specific information about the illuminated area, at least one of said cameras in communication with power, and in communication with at least one of the one or more processors;
48.7	a controller, including at least one of the one or more processors, integrated with the structure via mounting, in communication with the LED controlling power electronic circuitry apparatus, said controller arranged to process the information communicated from the cameras and to automatically control the light provided to the illuminated area; and
48.8	memory storing instructions that, when executed by one or more processors of the controller, enable the controller to:
48.9a	illuminate a portion of at least one object, indicated by data from at least one of the one or more sensors, by selecting a first cluster of the LEDs to emit first light directed towards a first area including the at least the portion of at least one object, the first area determined based at least in part on the data, the first cluster selected based at least in

	part on known aimings of light associated with the first cluster determined to correspond to the first area, and the first light determined based at least in part on classifying the object based at least in part on the data; and
48.9b	control light emitted from the first cluster directed towards the first area to be different in at least one emission characteristic, based on the first light determination, from second light emitted from a second, different cluster of the LEDs, directed towards one or more illuminated second areas at a common elevation with the first area and laterally adjacent to the first area.
49.	49. The illuminating device of claim 48, wherein: the data includes image data; the memory further stores instructions that, when executed by one or more processors of the controller, enable the controller to illuminate the at least the portion with light below at least a predefined glare level; the at least one object includes at least one of a pedestrian, a sign, or another vehicle; at least one of the first cluster or the second cluster includes a plurality

	of the LEDs and at least one of the first cluster or the second cluster includes non-contiguous LEDs; the control of the light emitted from the first cluster includes a change of at least one LED of the cluster to a non-emitting state; the at least one emission characteristic is different following modification by an optical control element; and the known aimings of light associated with the first cluster is based at least in part on known directionality of light emitted by LEDs of the first cluster exiting from the at least one headlamp.
50.	50. The illuminating device of claim 48, wherein the memory further stores instructions that, when executed by one or more processors of the controller, enable the controller to: identify an upcoming road curvature along a road on which the motor vehicle is traveling; and accommodate the upcoming road curvature by adaptation of a light pattern of at least one of the headlamps.
51.	51. The illuminating device of claim 50, wherein: the memory further stores instructions that, when executed by one or more processors of the controller, enable the controller to illuminate

	the at least the portion with light below at least a predefined glare level; the at least one object includes at least one of a pedestrian, a sign, or another vehicle; at least one of the first cluster or the second cluster includes a plurality of the LEDs and at least one of the first cluster or the second cluster includes non-contiguous LEDs; the control of the light emitted from the first cluster includes a change of at least one LED of the cluster to a non-emitting state; the at least one emission characteristic is different following modification by an optical control element; the known aimings of light associated with the first cluster is based at least in part on known directionality of light emitted by LEDs of the first cluster exiting from the at least one headlamp; and the memory further stores instructions that, when executed by one or more processors of the controller, enable the controller to accommodate the road curvature by changing illumination in at least a direction of the road curvature by adaptation of the light pattern in at least one of color, intensity or spatial distribution by modification of
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	light associated with one or more of the LEDs.
52.	52. The illuminating device of claim 50, wherein the identification of the upcoming road curvature is based at least in part on map data and wherein the adaptation of the light pattern is based at least in part on the map data.
53.	53. The illuminating device of claim 50, wherein the identification of the upcoming road curvature is based at least in part on sensor data provided by one or more of the sensors of the vehicle and wherein the adaptation of the light pattern is based at least in part on the sensor data.
54.	54. The illuminating device of claim 48, further including one or more optical control elements to control light emitted from one or more of the LEDs.
55.	55. The illuminating device of claim 54, wherein the optical control elements include at least one of one or more reflectors, refractors or lenses.
56	56. An illuminating device having automatic control of light provided to an illuminated area comprising:

56.01	a structure for incorporating illuminating device elements, wherein the structure comprises a motor vehicle;
56.02	a plurality of individually controllable LEDs incorporated in the structure via at least one headlamp mounted to the structure, each headlamp including at least one of the LEDs, the LEDs in communication with a power source;
56.03	electronic circuitry apparatus for the controlled powering of the LEDs and other of the illuminating device elements;
56.04	one or more processors;
56.05	one or more sensors, including one or more cameras, placed on the structure for detecting coordinate-specific information about the illuminated area and positioned to capture an image of at least one other vehicle ahead of the motor vehicle, at least one of said cameras in communication with power, and in communication with at least one of the one or more processors;
56.06	a controller, including at least one of the one or more processors, integrated with the structure via mounting, in communication with the LED controlling power electronic circuitry apparatus, said controller arranged to process the information communicated from the cameras

	and to automatically control the light provided to the illuminated area; and
56.07	memory storing instructions that, when executed by one or more processors of the controller, enable the controller to:
56.08	determine, based on data from one or more of the sensors, a vertical and horizontal position associated with the at least one other vehicle;
56.09	select a first cluster of the LEDs based at least in part on at least one of the vertical and horizontal position compared to known aimings of light associated with the first cluster; and
56.10	reduce intensity of illumination to non-glaring illumination of a first area associated with the at least one other vehicle, relative to intensity of illumination on both sides of the first area at elevations common with the first area illuminated by a second cluster of the LEDs, by control of emission from the first cluster.
57	57. The illuminating device of claim 56, wherein:
57.1	the data includes image data;
57.2	the control of emission of the first cluster includes a change of at least one of color or intensity or control of at least one LED of the first

	cluster into a non-emitting state;
57.3	at least one of the first cluster or the second cluster includes a plurality of the LEDs and at least one of the first cluster or the second cluster includes non-contiguous LEDs; and
57.4	the known light aimings associated with the first cluster is based at least on part on known directionality of light emitted by LEDs of the first cluster exiting from the at least one headlamp.
58	58. The illuminating device of claim 56 wherein the memory further stores instructions that, when executed by one or more processors of the controller, enable the controller to:
58.1	identify an upcoming road curvature along a road on which the motor vehicle is traveling; and
58.2	accommodate the upcoming road curvature by adaptation of a light pattern of at least one of the headlamps.
59	59. The illuminating device of claim 58, wherein:
59.1	the control of emission of the first cluster includes a change of at least one of color or intensity or control of at least one LED of the first cluster into a non-emitting state;

59.2	at least one of the first cluster or the second cluster includes a plurality of the LEDs and at least one of the first cluster or the second cluster includes non-contiguous LEDs;
59.3	the known light aimings associated with the first cluster is based at least in part on known directionality of light emitted by LEDs of the first cluster exiting from the at least one headlamp; and
59.4	the memory further stores instructions that, when executed by one or more processors of the controller, enable the controller to accommodate the road curvature by changing illumination in at least a direction of the road curvature by adaptation of the light pattern in at least one of color, intensity or spatial distribution by modification of light associated with one or more of the LEDs.
60	60. The illuminating device of claim 58, wherein the identification of the upcoming road curvature is based at least in part on map data and wherein the adaptation of the light pattern is based at least in part on the map data.
61	61. The illuminating device of claim 58, wherein the identification of the upcoming road curvature is based at least in part on sensor data provided by one or more of the sensors of the vehicle and wherein the

	adaptation of the light pattern is based at least in part on the sensor data.
62	62. The illuminating device of claim 56, further including one or more optical control elements to control light emitted from one or more of the LEDs.
63	63. The illuminating device of claim 62, wherein the optical control elements include at least one of one or more reflectors, refractors or lenses.
64	64. An illuminating device having automatic control of light provided to an illuminated area comprising:
64.01	a structure for incorporating illuminating device elements, wherein the structure comprises a motor vehicle;
64.02	a plurality of individually controllable LEDs incorporated in the structure via at least one headlamp mounted to the structure, each headlamp including at least one of the LEDs and in communication with a power source;
64.03	electronic circuitry apparatus for the controlled powering of the LEDs and other of the illuminating device elements;
64.04	one or more processors;

64.05	one or more sensors, including one or more cameras, placed on the structure for detecting coordinate-specific information about the illuminated area and positioned to capture an image of another vehicle, at least one of said cameras in communication with power, and in communication with at least one of the one or more processors;
64.06	a controller, including at least one of the one or more processors, integrated with the structure via mounting, in communication with the LED controlling power electronic circuitry apparatus, said controller arranged to process the information communicated from the cameras and to automatically control the light provided to the illuminated area; and
64.07	memory storing instructions that, when executed by one or more processors of the controller, enable the controller to:
64.08	select a first cluster of the LEDs having light associated therewith that is directed towards the other vehicle based at least in part on first data from one or more of the sensors indicating a first position associated with the other vehicle;
64.09	control a first change to one or more characteristics of the light associated with the first cluster of the LEDs that is directed towards the

	other vehicle, that diminishes glare to a driver of the other vehicle when the other vehicle is at the first position;
64.1	select a second, different cluster of the LEDs having light associated therewith that is directed towards the other vehicle based at least in part on second, subsequent data from one or more of the sensors indicating a second, subsequent position associated with the other vehicle; and
64.11	control a second, subsequent change, to one or more characteristics of the light that is subsequently directed towards the other vehicle, that diminishes glare to the driver of the other vehicle when the other vehicle is at the second position.
65	65. The illuminating device of claim 64, wherein:
65.1	the first data or second data includes image data;
65.2	at least one of the first or second change to characteristics of light associated with at least one of the first or second cluster of LEDs includes at least one of a change to color, to intensity, or a change of at least one LED of the respective cluster to a non-emitting state;
65.3	at least one of the first cluster or the second cluster includes a plurality of the LEDs and at least one of the first cluster or the second cluster includes non-contiguous LEDs; and

65.4	the light that is directed or subsequently directed towards the other vehicle is determined based at least in part on known directionality of light emitted by the respective first or second cluster exiting the at least one headlamp.
66	66. The illuminating device of claim 64, wherein the memory further stores instructions that, when executed by one or more processors of the controller, enable the controller to:
66.1	identify an upcoming road curvature along a road on which the motor vehicle is traveling; and
66.2	accommodate the upcoming road curvature by adaptation of a light pattern of at least one of the headlamps.
67	67. The illuminating device of claim 66, wherein:
67.1	at least one of the first or second change to characteristics of light associated with at least one of the first or second cluster of LEDs includes at least one of a change to color, to intensity, or a change of at least one LED of the respective cluster to a non-emitting state;
67.2	at least one of the first cluster or the second cluster includes a plurality of the LEDs and at least one of the first cluster or the second cluster includes non-contiguous LEDs;

67.3	the light that is directed or subsequently directed towards the other vehicle is determined based at least in part on known directionality of light emitted by the respective first or second cluster exiting the at least one headlamp; and
67.4	the memory further stores instructions that, when executed by one or more processors of the controller, enable the controller to accommodate the road curvature by changing illumination in at least a direction of the road curvature by adaptation of the light pattern in at least one of color, intensity or spatial distribution by modification of light associated with one or more of the LEDs.
68	68. The illuminating device of claim 66, wherein the identification of the upcoming road curvature is based at least in part on map data and wherein the adaptation of the light pattern is based at least in part on the map data.
69	69. The illuminating device of claim 66, wherein the identification of the upcoming road curvature is based at least in part on sensor data provided by one or more of the sensors of the vehicle and wherein the adaptation of the light pattern is based at least in part on the sensor data.

70	70. The illuminating device of claim 64, further including one or more optical control elements to control light emitted from one or more of the LEDs.
71	71. The illuminating device of claim 70, wherein the optical control elements include at least one of one or more reflectors, refractors or lenses.
72	72. An illuminating device having automatic control of the light provided to an illuminated area comprising:
72.01	a structure for incorporating illuminating device elements, wherein the structure comprises a motor vehicle;
72.02	a plurality of individually controllable LEDs incorporated in the structure via at least one headlamp mounted to the structure, each headlamp including at least one of the LEDs, the LEDs in communication with a power source;
72.03	electronic circuitry apparatus for the controlled powering of the LEDs and other elements of the illuminating device elements;
72.04	one or more processors;
72.05	one or more sensors, including one or more cameras, placed on the structure for detecting coordinate-specific information about the

	illuminated area, at least one of said cameras in communication with power, and in communication with at least one of the one or more processors;
72.06	a controller, including at least one of the one or more processors, integrated with the structure via mounting, in communication with the LED controlling power electronic circuitry apparatus, said controller arranged to process the information communicated from the cameras and to automatically control the light provided to the illuminated area; and
72.07	memory storing instructions that, when executed by one or more processors of the controller, enable the controller to:
72.08	determine a target based on first data from one or more of the sensors;
72.09	determine a first target location based on the first data;
72.10	select a cluster of the LEDs having light associated therewith that is directed at the target, determined based on the first target location;
72.11	vary illumination provided to the target by the selected cluster, relative to illumination provided to areas laterally adjacent to the target and provided by at least one LED different from LEDs in the selected cluster; and

72.12	maintain a variance of illumination provided to the target relative to the laterally adjacent areas, when subsequent data from one or more of the cameras indicates a change in position of the target relative to the motor vehicle, by repeating the determination of target location, selection of the cluster and variance to illumination provided to the target, relative to the laterally adjacent areas, based on the subsequent data.
73	73. The illuminating device of claim 72, wherein:
73.1	the variation of illumination provided to the target includes variation in at least one of color or intensity or at least a change of at least one LED of the selected cluster to a non-emitting state;
73.2	the cluster includes a plurality of the LEDs and the cluster includes non-contiguous LEDs;
73.3	the light directed at the target is determined based at least in part on known directionality of light emitted by the first cluster exiting from the at least one headlamp; and
73.4	at least one of the first data or the subsequent data includes image data.
74	74. The illuminating device of claim 72, wherein the memory further stores instructions that, when executed by one or more processors of

	the controller, enable the controller to:
74.1	identify an upcoming road curvature along a road on which the motor vehicle is traveling; and
74.2	accommodate the upcoming road curvature by adaptation of a light pattern of at least one of the headlamps.
75	75. The illuminating device of claim 74, wherein:
75.1	the variation of illumination provided to the target includes variation in at least one of color or intensity or at least a change of at least one LED of the selected cluster to a non-emitting state;
75.2	the selected cluster includes a plurality of the LEDs and the selected cluster includes non-contiguous LEDs;
75.3	the light directed at the target is determined based at least in part on known directionality of light emitted by the first cluster exiting from the at least one headlamp; and
75.4	the memory further stores instructions that, when executed by one or more processors of the controller, enable the controller to accommodate the road curvature by changing illumination in at least a direction of the road curvature by adaptation of the light pattern in at least one of color, intensity or spatial distribution by modification of light associated with

	one or more of the LEDs.
76	76. The illuminating device of claim 74, wherein the identification of the upcoming road curvature is based at least in part on map data and wherein the adaptation of the light pattern is based at least in part on the map data.
77	77. The illuminating device of claim 74, wherein the identification of the upcoming road curvature is based at least in part on sensor data provided by one or more of the sensors of the vehicle and wherein the adaptation of the light pattern is based at least in part on the sensor data.
78	78. The illuminating device of claim 72, further including one or more optical control elements to control light emitted from one or more of the LEDs.
79	79. The illuminating device of claim 78 wherein the optical control elements include at least one of one or more reflectors, refractors or lenses.
80	80. An illuminating device having automatic control of light provided

	to an illuminated area comprising:
80.1	a structure for incorporating illuminating device elements, wherein the structure comprises a motor vehicle;
80.2	a plurality of individually controllable LEDs incorporated in the structure via at least one headlamp mounted to the structure, each headlamp including at least one of the LEDs, the LEDs in communication with a power source;
80.3	electronic circuitry apparatus for the controlled powering of the LEDs and other of the illuminating device elements;
80.4	one or more processors;
80.5	one or more sensors, including one or more cameras, placed on the structure for detecting coordinate-specific information about the illuminated area and positioned to capture camera data indicating a target ahead of the motor vehicle, at least one of said cameras in communication with power, and in communication with at least one of the one or more processors;
80.6	a controller, including at least one of the one or more processors, integrated with the structure via mounting, in communication with the LED controlling power electronic circuitry apparatus, said controller

	arranged to process the information communicated from the cameras and to automatically control the light provided to the illuminated area; and
80.7	memory storing instructions that, when executed by one or more processors of the controller, enable the controller to:
80.8	identify, based on data received from one or more of the sensors, a plurality of positions associated with the target as the target moves relative to the motor vehicle; and
80.9	change, responsive to the positions associated with the target, first light associated with one or more LEDs aimed toward at least a portion of the target, relative to second light associated with other one or more of the LEDs aimed laterally adjacent the target on either side, as the target moves relative to the motor vehicle.
81	81. The illuminating device of claim 80, wherein:
81.1	the data includes image data;
81.2	the memory further stores instructions that, when executed by one or more processors of the controller, enable the controller to select a first cluster of LEDs, associated with the first light, for the change, based at least in part on known aimings of the first light associated with the first

	cluster having a correlation to the at least the portion, the known aimings based at least in part on at least one of known directionality of light emitted by the first cluster or known directionality of light emitted by the first cluster exiting the headlamp; and
81.3	the change to emission of the one or more LEDs aimed towards the at least the portion includes a change to intensity or color or a change of at least one of the LEDs to a non-emitting state.
82	82. The illuminating device of claim 80, wherein the memory further stores instructions that, when executed by one or more processors of the controller, enable the controller to:
82.1	identify an upcoming road curvature along a road on which the motor vehicle is traveling; and
82.2	accommodate the upcoming road curvature by adaptation of a light pattern of at least one of the at least one headlamps.
83	83. The illuminating device of claim 82, wherein:
83.1	the change to emission of the one or more LEDs aimed towards the at least the portion includes a change to intensity or color or a change of at least one of the LEDs to a non-emitting state;

83.2	the memory further stores instructions that, when executed by one or more processors of the controller, enable the controller to select a first cluster of LEDs, associated with the first light, for the change, based at least in part on known aimings of the first light associated with the first cluster having a correlation to the at least the portion, the known aimings based at least in part on at least one of known directionality of light emitted by the first cluster or known directionality of light emitted by the first cluster exiting the headlamp; and
83.3	the memory further stores instructions that, when executed by one or more processors of the controller, enable the controller to accommodate the road curvature by changing illumination in at least a direction of the road curvature by adaptation of the light pattern in at least one of color, intensity or spatial distribution by modification of light associated with one or more of the LEDs.
84	84. The illuminating device of claim 82, wherein the identification of the upcoming road curvature is based at least in part on map data and wherein the adaptation of the light pattern is based at least in part on the map data.

85	85. The illuminating device of claim 82, wherein the identification of the upcoming road curvature is based at least in part on sensor data provided by one or more of the sensors of the vehicle and wherein the adaptation of the light pattern is based at least in part on the sensor data.
86	86. The illuminating device of claim 80, further including one or more optical control elements to control light emitted from one or more of the LEDs.
87	87. The illuminating device of claim 86, wherein the optical control elements include at least one of one or more reflectors, refractors or lenses.

VI. Qualifications of one of ordinary skill in the art

56. 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 ‘551 Patent at the time of the claimed invention. In determining the characteristics of a hypothetical person of ordinary skill in the art of the ‘551 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.

57. In my opinion a POSA for the invention claimed in the '551 Patent, would have had an undergraduate degree in mechanical engineering, electrical engineering, automotive engineering, optical engineering, applied physics, computer science, or similar disciplines, along with two years of experience working with intelligent vehicle systems, automotive control systems, or lighting control systems.

58. The more education one has, the less experience needed to attain an ordinary level of skill. Similarly, more experience in the field may serve as a substitute for formal education.

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

A person of ordinary skill in the art (“POSITA”) in the field of the '551 would have had an undergraduate degree in mechanical engineering, electrical engineering, automotive engineering, optical engineering, applied physics, computer science, or similar disciplines, along with two years of experience working with intelligent vehicle systems, automotive control systems, or lighting control systems. (Papanikolopoulos Decl., ¶33.) The more education one has, the less experience needed to attain an ordinary level of skill. (Id.) Similarly,

more experience in the field may serve as a substitute for formal education. (Id.)

(Petition, 9.)

60. I understand that Patent Owner does not dispute Petitioner's proposed skill level because I satisfy it.

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VII. Proposed Claim Constructions

62. To properly evaluate these claims, I understand that the terms of the claims must first be construed. In my opinion, the claims of the '551 Patent include terms that an ordinary artisan would understand according to their plain and ordinary meaning.

63. Here, properly construed according to its ordinary meaning, and as supported by the specification and prosecution history of the '551 Patent, the independent claim 48 term "classifying the object" is not taught by the Alden reference relied upon by Petitioner. Similarly, properly construed according to its ordinary meaning, and as supported by the specification and prosecution history of the '551 Patent, the dependent claim 53/61/69/77/85 term "the sensor data" also is not taught by the Alden reference relied upon by Petitioner.

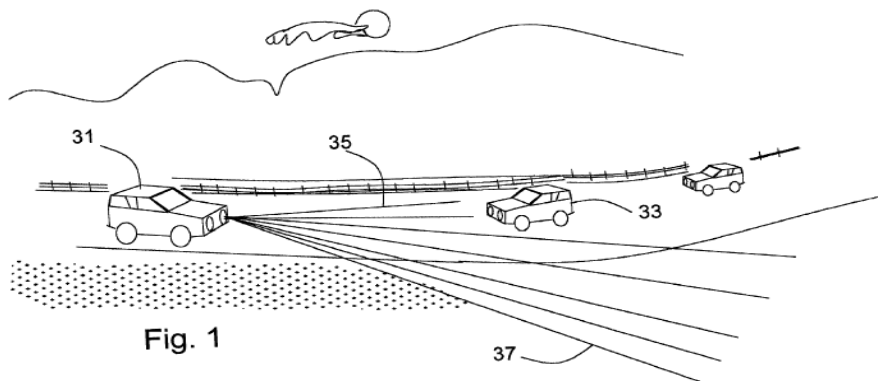
64. Intentionally left blank.

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VIII. Overview of the Prior Art

A. Alden

66. Alden is directed to controlling the distribution of light by a vehicle headlight. Alden's systems include headlights that produce multiple individually controllable beam segments of light, each illuminating a sector of an area ("distribution area") ahead of the vehicle equipped therewith ("equipped vehicle"). (Ex. 1005, ¶¶[0002, 0004-0006, 0008].)



(Ex. 1005, FIGURE 1)

67. The systems also include sensors 51a, 51b for detecting incoming light received from the distribution area, which sensors 51a, 51b are divided into multiple sectors associated with sectors of the distribution area illuminated by the beam segments of the headlight of the equipped vehicle. (Ex. 1005, ¶¶[0027-0028], Fig. 4.) The systems further include a central processing unit (CPU) 71 that determines whether incoming light detected in each sector of the sensors 51a, 51b has an intensity that exceeds a threshold value. (Ex. 1005, ¶¶[0027-0028].)

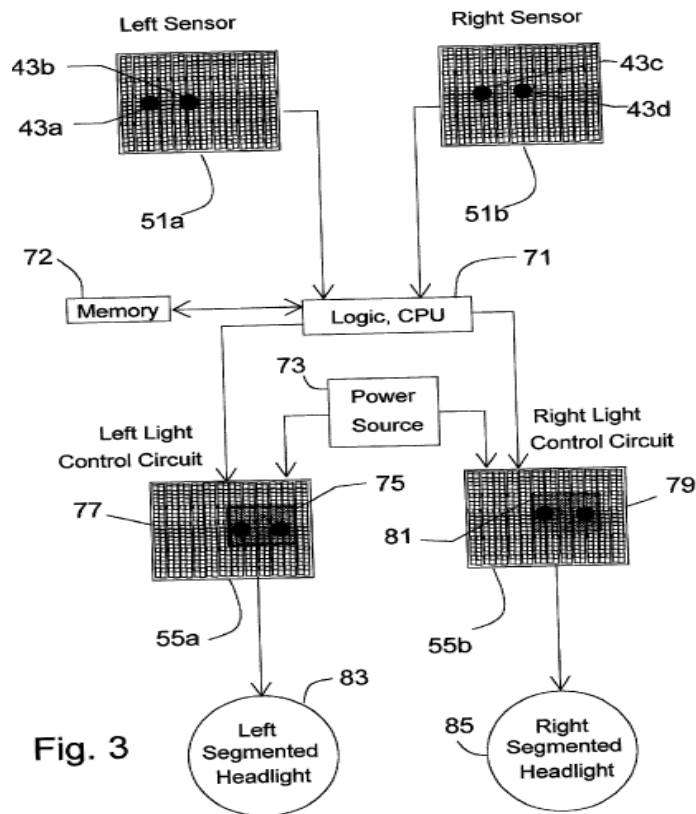
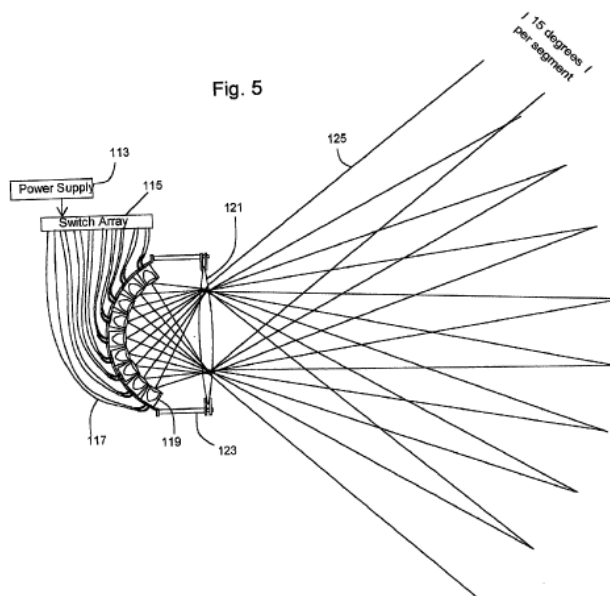


Fig. 3

(Ex. 1005, FIGURE 3)

68. In one of the three distinct embodiments, the headlight system dims the intensity of selected beam segments produced by the headlight of an equipped vehicle that are incident on a sector or sectors in the distribution area. A headlight 123 employs a single-row array of light emitting diode (LED) elements 119 and a double convex lens 121 for directing the beam segments produced by the LED elements 119 that illuminate different sectors of the distribution area. (Ex. 1005, ¶¶[0025-0026, 0029].)

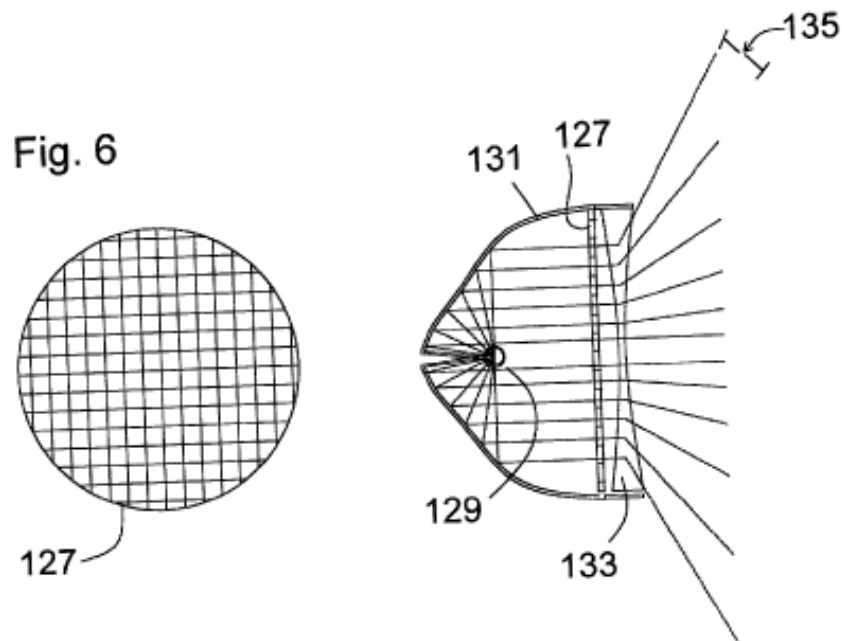


(Ex. 1005, FIGURE 5)

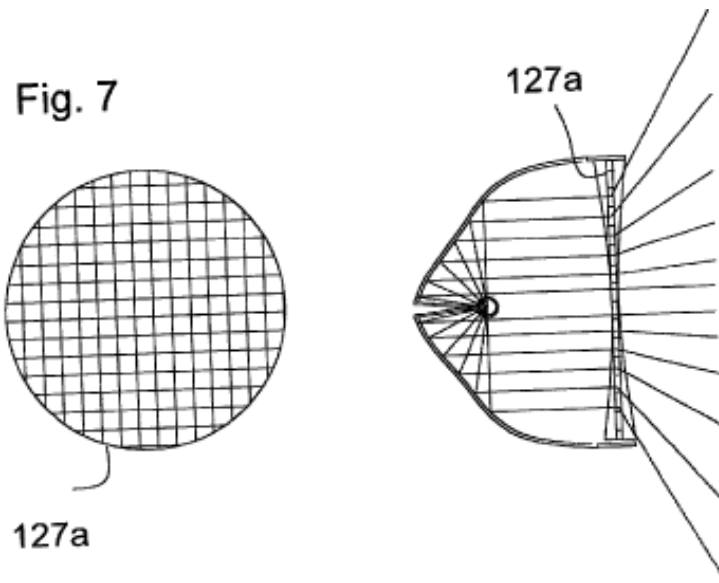
69. The CPU 71 may determine the sector or sectors of the sensors 51a, 51b receiving incoming light from the distribution area that have a detected threshold intensity, which are used to create a region within which light is to be dimmed. In response, the CPU 71 controls the headlight 123 to dim some number of beam segments produced by the individual LED elements 119 . (*Id.*) Alden uses a convex lens with a curved LED array in this arrangement to create output where LED 119 is responsible for sector 125. (Ex. 1005, ¶¶[0026-0029].)

70. Such operations may also be accomplished by another different headlight system embodiment of Alden shown in Figures 6 and 7. As seen therein, that embodiment employs a single light source 129 and a collimating reflector 131 to produce collimated light which may be segmented using electro-chromatic dimming elements 127 that, in conjunction with a double concave lens 133, can

dim a given segment. In Fig. 7 the electro-chromatic elements 127a are within the double concave lens. (Ex. 1005, ¶[0030-0031]).



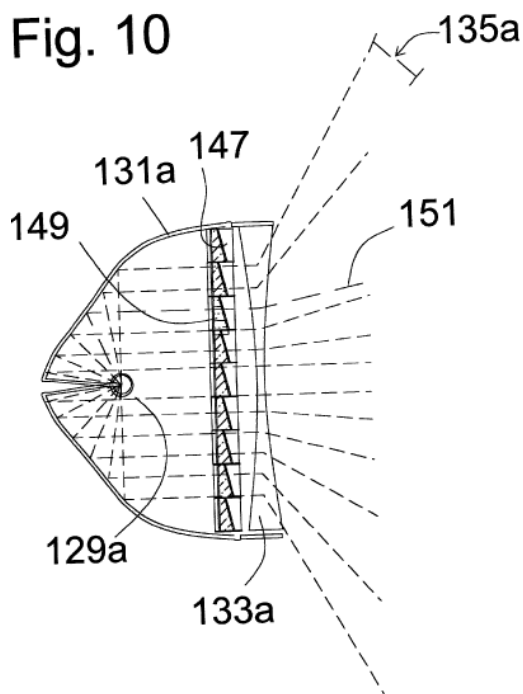
(Ex. 1005, FIGURE 6)



(Ex. 1005, FIGURE 7)

71. A third, further distinct embodiment is shown in Figure 10, in which

the headlight system employs a single light source 129, a collimating reflector 131, and electro-optic refractive material 147, 149 to produce multiple light beam segments. (Ex. 1001, ¶¶[0032-0035], Figure 10.) The CPU 71 can control the electro-optic refractive material 147, 149 to change the direction of the beam segments passing through that element. (Ex. 1001, ¶¶[0032-0035], Figure 10.)



(Ex. 1005, FIGURE 10)

72. In this embodiment, the electro-optic refractive material 147, 149 are bi-refringent liquid crystals, the principles of which Alden describes as well known in the prior art. (Ex. 1005, ¶[0033].)¹² Therefore, as seen in Figures 8 and 9, they

¹² Birefringent: “having the quality of birefringence”; Birefringence: “the power of double refraction.” (Ex. 2065, 186).

can direct light in only two directions – straight and “bent” in one direction. (*Id.*, [0050-0052].)

Fig. 8

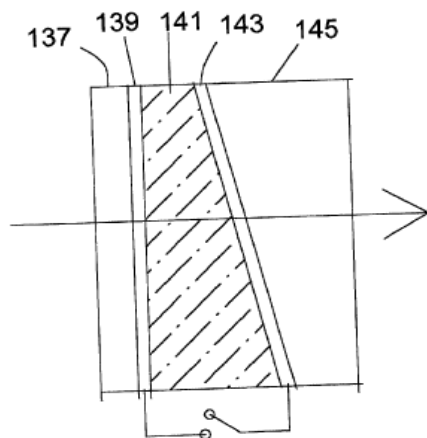
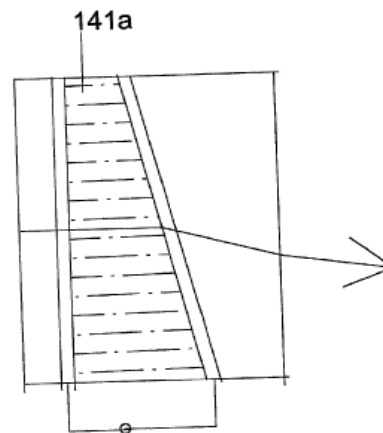


Fig. 9



(Ex. 1005, FIGURES 8, 9)

73. In addition, all beam segments of Alden’s various segmented beam headlight embodiments are always at high beam intensity/direction unless specifically dimmed. (Ex. 1005, ¶¶[0006, 0026]). In that regard, Alden states in connection with Figure 3 that those portions of the segmented headlight not dimmed will be on high beam. (*Id.*, ¶[0027].) In connection with Figure 6, Alden states that distribution of light is dimmed for an oncoming vehicle but on high beam elsewhere. (Ex. 1005, ¶[0030].) In connection with Figure 10, Alden states that those beam segments not diverted for an oncoming vehicle are in high beam. (Ex. 1005, ¶[0035].) In general, Alden states in conjunction with Fig. 2 that “the driver of [vehicle] 47 can see everything illuminated to the maximum except the

area where [vehicle] 41 is”, providing a “highly functional and reliable means for providing maximum light for an equipped vehicle’s driver.” (Ex. 1005, ¶¶[0026, 0060]).

74. Alden thus discloses headlight embodiments that provide segmented illumination to defined illumination sectors of the light distribution area. (*Id.*, ¶¶[0008], [0029-0038].) Alden illustrates three distinct embodiments thereof. (*Id.*, ¶¶[0029-0030, 0035].) For example, Alden states that “FIG. 5 illustrates the segmented headlight means and controlling switch array in a first embodiment.” (*Id.*, ¶[0029].) Alden also states that “FIG. 6 illustrates headlight distribution area segmenting means of a second embodiment. ... The collimated light passes through a segmented array 127 of electro-chromatic cells” (*Id.*, ¶[0030]), and that “FIG. 7 is identical to [the second embodiment of] FIG. 6 except that the alternate segmented electro-chromatic element 127a is incorporated into the optic (whereas they were separate components in FIG. 6)” (*Id.*, ¶[0031].) Alden further states that “FIG. 10 depicts a segmented headlight with individually controlled sectors of distribution of the third embodiment.” (*Id.*, ¶[0035].)

75. In these distinct embodiments, Alden’s headlight systems with segmented light distribution elements are designed to provide a high beam to all sectors except sectors where light exceeding a threshold has been detected, in which sectors the systems either selectively change the intensity or lower the

direction of beam segments. (*Id.*, ¶¶[0029-0030, 0033-0035].) As demonstrated above, Figure 5 illustrates a first headlight embodiment that is capable of selectively dimming beam segments produced by multiple LEDs 119. (*Id.*, ¶[0029], Fig. 5.) Figures 6 and 7 illustrate a second headlight embodiment that is capable of selectively dimming beam segments having a single light source 129 and a collimating reflector 131. In this second embodiment, an electro-chromatic material is used that changes transmissivity depending on its state. (*Id.*, ¶[0030-0031], Figs. 6-7.) In Alden's third embodiment described in connection with Figures 8-10, the electro-optic refractive material 147, 149 allows collimated light to be emitted either along a normal axis or an angled axis via refraction. (*Id.*, ¶[0033], Figs. 8-9.)

76. These embodiments disclosed by Alden are also discrete and include features that are incompatible with each other. For example, the second headlight system embodiment of Figures 8-10 having electro-optic refractive material 147, 149 for changing the direction of light passing therethrough is designed to work with collimated light produced by single point light source 129 and collimating reflector 131. (Ex. 1005, ¶¶[0033-0035], Figs. 8-10.) However, in the first headlight system embodiment of Figure 5, the LED elements 119 of headlight 123 produce non-collimated light. Non-collimated light could not be directed in any meaningful fashion by electro-optic refractive material 147, 149 as shown in

Figure 10. (*Id.*) Rather, non-collimated light would blend and have different incident angles on the electro-optic refractive material 147, 149, thereby preventing the electro-optic refractive material 147, 149 from performing any meaningful control of beam segments, as well as redirecting much of the non-collimated input light away from the desired sectors of the distribution area. (*Id.*) Any headlight resulting from a combination of Alden's incompatible features would therefore be incapable of meeting the basic requirements of a headlight, *i.e.*, effectively illuminating the area ahead of the equipped vehicle, let alone directing its emitted light in any meaningful fashion. (*Id.*) Indeed, rather than suggesting combinations of various features of its different headlight system embodiments, Alden only states generally that each of its headlight system embodiments may employ the sensing elements 51a, 51b discussed in connection with Figures 3 and 4. (*Id.*, ¶¶[0044-0046].)

77. Additionally, Alden's disclosure is theoretical in nature. It is ambiguous and fails to enable its disclosure in critical respects. (Ex. 1005, ¶[0027-0035].) In that regard, the disclosure in Alden broadly describes certain features of headlight systems and the general functions such features and systems would desirably provide but lacks detailed explanations as to how those features and systems are practically implemented or how those functions are realized thereby. (*Id.*) For example, while Alden depicts control circuit switch array switches in

Figure 3 for dimming certain headlight beam segments while leaving other beam segments on high intensity, it does not clearly describe or specifically demonstrate how such operations are accomplished using the single-row array of LED elements 119 of headlight 123 illustrated in Figure 5. (*Id.*) In connection with Figure 4, Alden describes progressing through the sectors of sensors 51a, 51b of Figure 3 to detect incoming light, but it does not explain how those sensor sectors are mapped to either the single-row array of LED elements 119 shown in Figure 5, the single-row array of switches 115 for that array, or the particular distribution area sectors depicted therein. (*Id.*) In fact, Alden specifically states that the switch arrays of the light control circuits 55a, 55b shown in Figure 3 are merely for illustrative purposes. (*Id.*)

78. Relatedly, Alden contacted Gentex Corporation, an automotive industry supplier, regarding his segmented headlight system and was informed that Gentex's technical staff had determined the system to be "futuristic" and likely "years away from any practical use." (Ex. 2006, 39.)

B. Beam

79. Beam discloses an Adaptive Anti-Blinding Headlight ("AABH"). (Ex. 1007.) 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. 1007, 1:21-23, 1:63-2:5.)

80. 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. 1007, 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.

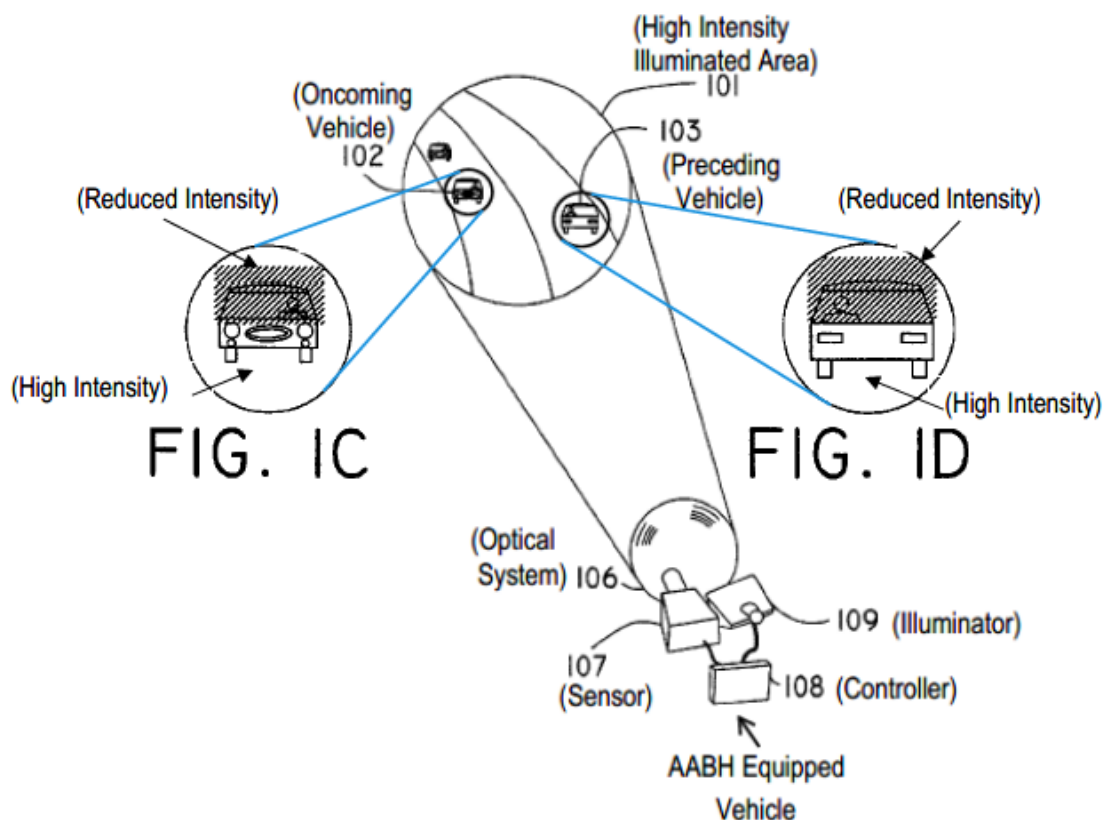
* * *

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. 1007, 6:40-44, 3:8-15.)

81. 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.

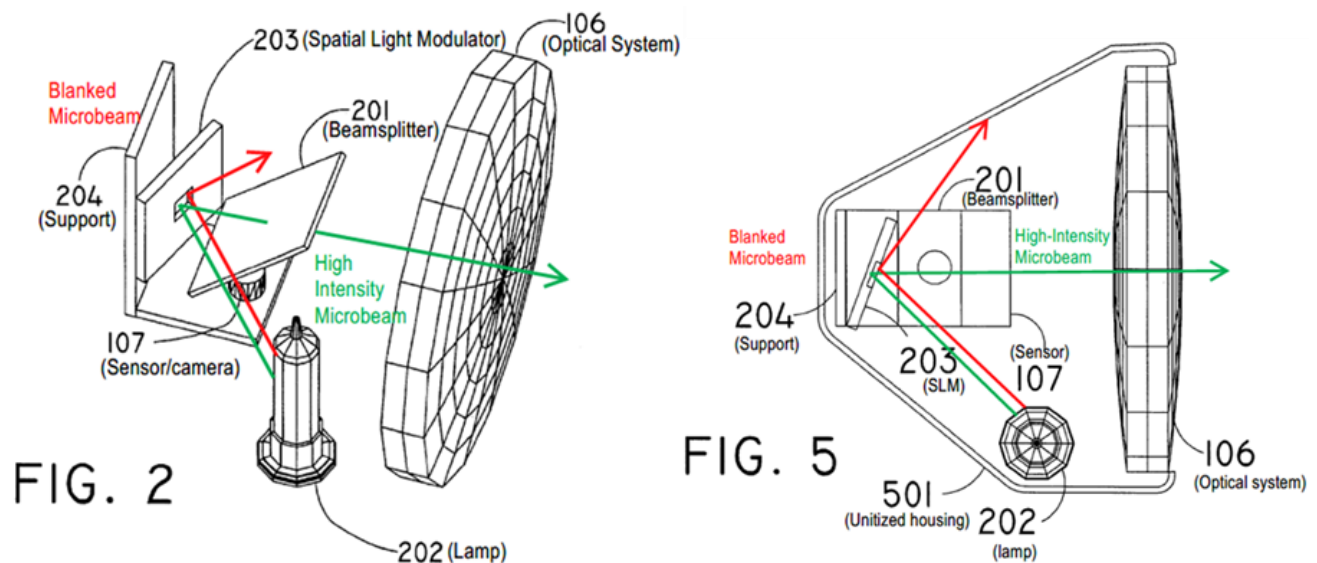
82. Beam provides significantly **reduced** illumination only in those portions of the headlight beam that would otherwise dazzle or annoy other drivers. This is accomplished by “darken[ing] those microbeams that would otherwise illuminate areas near to the source of the impinging beam, thus eliminating the blinding of a driver in an oncoming vehicle, while continuing to provide intense forward illumination.” (Ex. 1007, 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. 1007, FIG. 1C, 1D, Annotated)

83. 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. 1007, 4:9-24, 53-59, 62-64.)

84. 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.

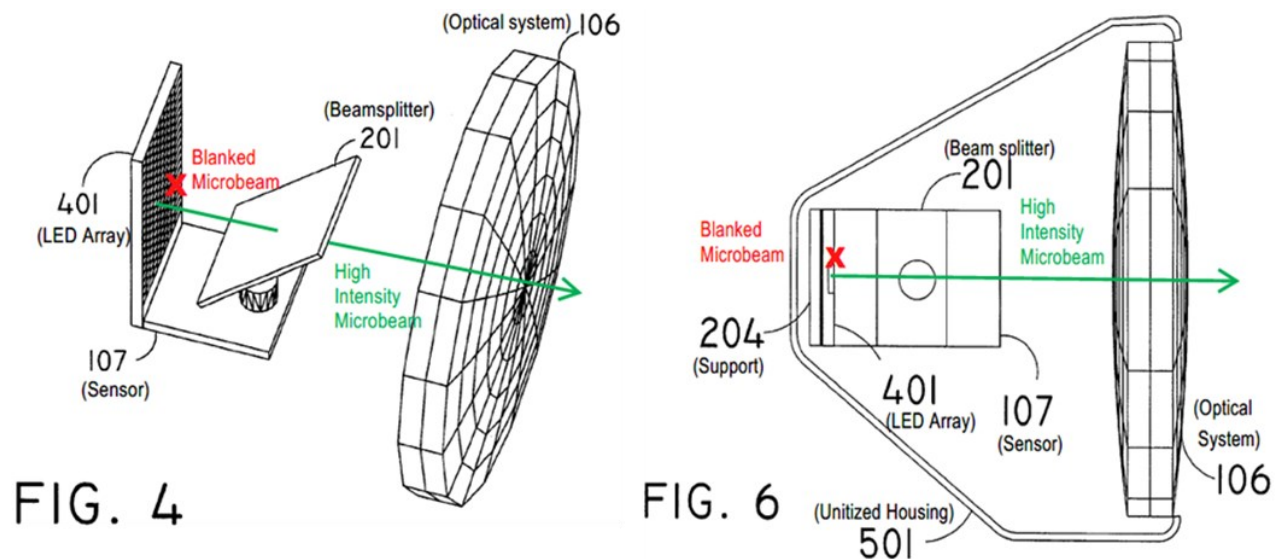


(Ex. 1007, FIGs. 2, 5, Annotated)

85. 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. 1007, 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. 1007, FIGs. 4, 6, Annotated)

86. 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.

87. 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. 1007, 3:62-64, 4:53-5:16.)

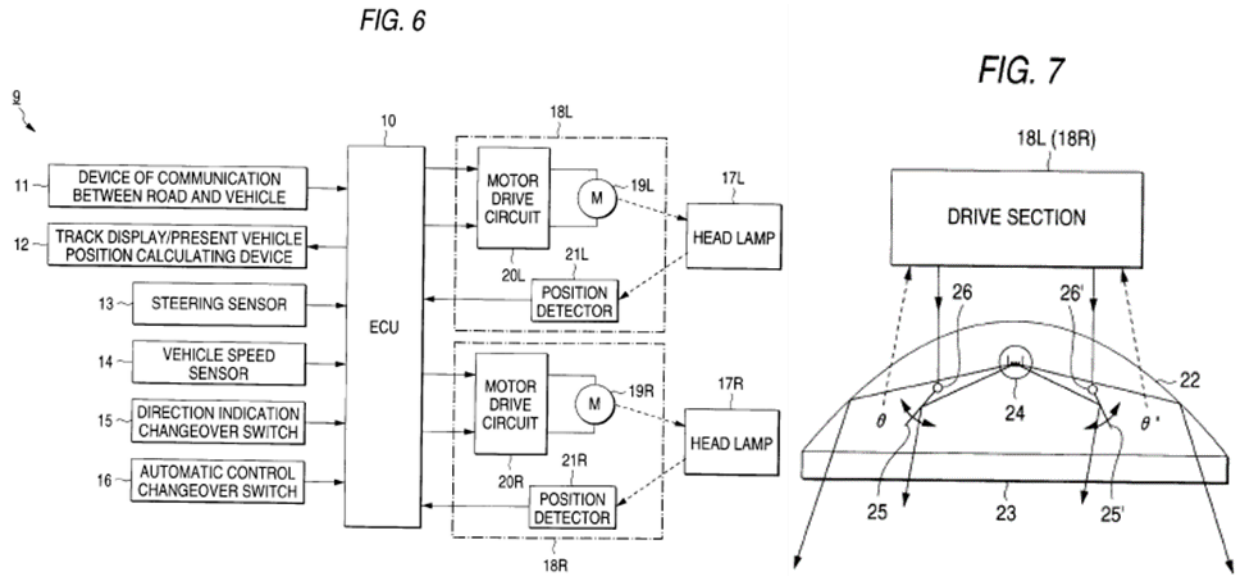
88. Intentionally left blank.

C. Kobayashi

89. Kobayashi discloses a “Lighting Device for a Vehicle.” (Ex. 1006.) 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. 1006, 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. 1006, 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.

90. 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. 1006, 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. 1006, 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. 1006, 8:1-32.)



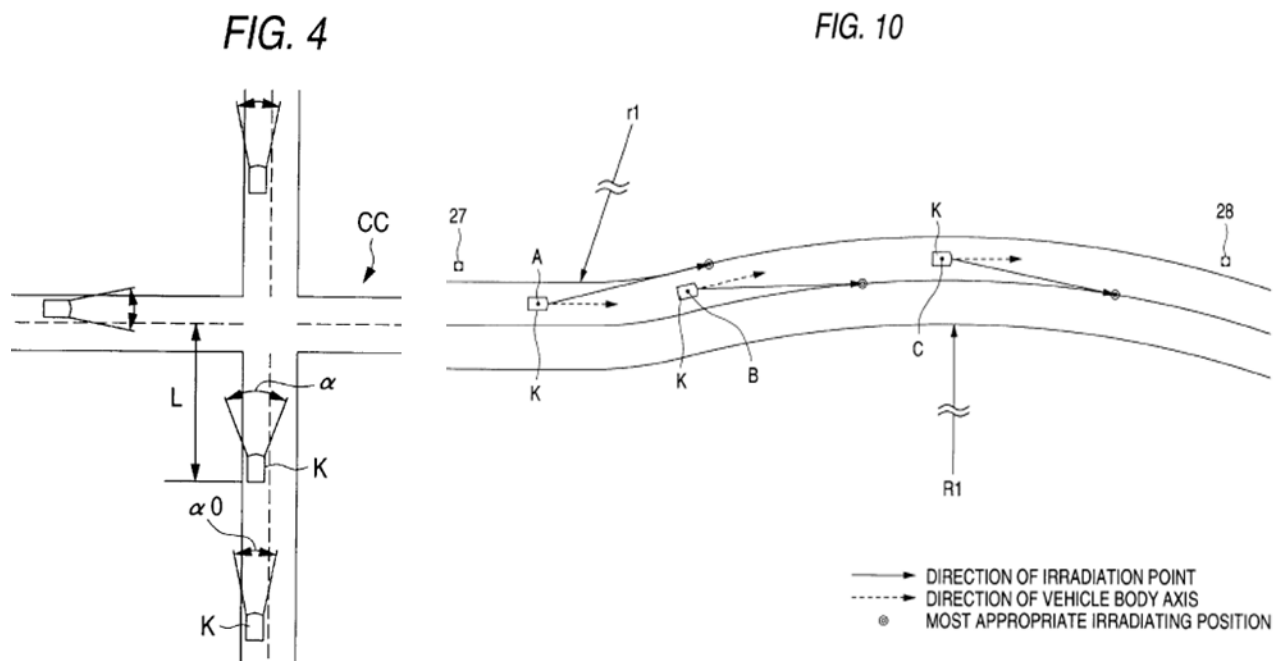
(Ex. 1006, FIGs. 6, 7)

91. 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. 1006, 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. 1006, 10:66-11:4.)

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

reflecting mirrors 25, 25' are positioned between stationary reflecting mirror 22 and front lens 23. Movable reflecting mirrors 25, 25' are rotated about respective rotating axes 26, 26' by a link mechanism to a rotation angle (θ , θ') to provide partial direction control of irradiating light. (Ex. 1006, 11:5-14.)

93. 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. 1006, 2:48-49, 65-67.)



(Ex. 1006, FIGs. 4, 10)

94. 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. 1006, 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. 1006, 14:53-15:39.)

95. Intentionally left blank.

IX. Grounds for Challenge

96. For **Ground 1**, Petitioner relies on Alden to satisfy the elements of claims 48, 50-51, 53-59, 61-67, 69-75, 77-83, and 85-87. Of those, claims 48, 56, 64, 72, and 80 are independent claims, with the remaining claims depending directly or indirectly from one of those independent claims. For **Ground 2**, Petitioner relies on Alden (alone or as modified by Stam) and Beam to satisfy the elements of dependent claim 49, which depends from independent claim 48. For **Ground 3**, Petitioner relies on the combination of Alden and Kobayashi to satisfy the elements of dependent claims 52, 60, 68, 76, and 84, which depend from independent claims 48, 56, 64, 72, and 80, respectively. In my opinion, Petitioner has failed to show that Alden alone or combined with Beam, Kobayashi, and/or

Stam teaches or discloses all claim limitations.

A. All Grounds- Petitioner's Reading of Alden's Figure 5 Embodiment is Outside the Four Corners of the Reference

97. Petitioner reads the teachings of Alden's first embodiment, the Figure 5 LED embodiment, contrary to the rest of the Alden reference. Petitioner's contentions, assume two-dimensional columnar control, though Alden provides none of the details needed to implement such functionality. (Petition, 34-36.)

98. Regarding the Figure 5 LED first embodiment, Alden merely describes a row of LEDs positioned along the focal point of a lens. (Ex. 1005, ¶[0029].) Alden never mentions any additional rows/columns of LEDs next to the single row of LEDs shown in Figure 5, let alone provides an explanation of how LEDs in any such additional rows/columns of a two-dimensional array would be configured to work relative to a single focal point. Alden's depiction of the row of LEDs being positioned along the focal point of the lens undermines any conclusion that the Figure 5 LED embodiment expressly discloses a two-dimensional array. (Id.)

99. Reliance on the Figure 3 description and/or the Figure 6 second embodiment to help understand the Figure 5 first embodiment is incorrect. First, Petitioner never makes such reliance with regards to Figure 6. The Figure 5 LED first embodiment is distinct from and incompatible with the Figure 6 second

embodiment, which uses an electro-chromatic dimming means and a collimating surface, to generate a two-dimensional array of collimated light. Because Figure 6 generates a two-dimensional array of collimated light and Figure 3 shows a two-dimensional sensor and switch array, the two are compatible. Without altering Figure 5, no such compatibility exists. Given the fundamental differences between the Figure 6 electro-chromatic second embodiment and the Figure 5 LED first embodiment, the two embodiments are not analogous. (Id.) And, Alden's statement that the Figure 6 embodiment uses a "switch array similar to 115 and the process previously described herein" (Ex. 1005, [0030]) lacks sufficient precision and detail to "necessarily require" the Figure 5 LED embodiment to include a two-dimensional array.

100. On the contrary, with respect to the second and third embodiments, shown in Figures 6 and 10 respectively, Alden shows both a lamp configuration and a two-dimensional array depiction. Yet, with respect to Figure 5, Alden merely shows the lamp configuration and no array depiction. Given Alden's express disclosure of arranging the LEDs "on a curve along the focal point" of the lens (Ex. 1005, [0047]), it is reasonable to understand that Alden only intended usage of a single row of LEDs for this embodiment, and that anything else would require "speculation" outside the four corners of Alden's teachings.

101. Moreover, I understand that a prior art reference does not anticipate if

it must be modified to meet a challenged claim limitation. Alden fails to explain the existence of a two-dimensional array in Figure 5 in any manner – rendering it non-enabling as an anticipatory reference for claims that would require usage of a two-dimensional array and/or arguments relying on Figure 5 as showing a two-dimensional array.

102. Additionally, Alden’s Figure 5 LED embodiment fails to provide an enabling disclosure of Petitioner’s desired subject matter. Petitioner does not explain how the two-dimensional switch array in Figure 3 could be used to operate even the one-dimensional LED array in Figure 5.

103. Dr. Papanikolopoulos indicated that it is “not clear” and could not explain how the switch array shown in Figure 3 controls the LED array shown in Figure 5 to create the beam spread illustrated therein:

Q. Okay. So does the figure 3 description affect the total beam spread of the figure 5 embodiment?

A. The figure 3 can inform. But, again, this is a **concept**. So if you look at the number of rows on 77 and 79, it's not clear how many. Assuming that each element controls one LED, **it's not clear and I cannot count here.**

* * *

A. In figure 3. It's a reference as an array matrix. In other words, there are rows and columns. So here basically the disclosure is that each one of these controls one LED. And this is what the POSITA would

understand at that time. So **it doesn't give me any information how many rows, how many columns we have. It's a concept diagram. There are no dimensions, no scale.**

(Ex. 2041, 108:11-109:5.)

104. Moreover, since given sensor elements will correlate to different LEDs for creating emission responsive to illumination detected at different distances, when using the beam pattern of Figure 5, the lack of a mapping function for the Figure 5 beam pattern would require modification to create such a function to achieve control under the teachings of Figures 3/4. The need for modifications limits Alden's use as an anticipatory reference for the Challenged Claims.

105. The operation of Alden's LED headlight embodiment shown in Figure 5 is simply unclear. The lack of detail creates ambiguity as to how the Figure 5 array is controlled. Similarly, while Alden describes progressing through the sectors of sensors 51a, 51b of Figure 3 to detect incoming light in connection with Figure 4, it does not explain how those sensor sectors are mapped to either the one-dimensional array of LED elements 119 shown in Figure 5, the one-dimensional array of switches 115 for that array, or the particular distribution area sectors depicted therein. (Id.) In fact, Alden specifically states that the switch arrays of the light control circuits 55a, 55b shown in Figure 3 are merely for "illustrative purposes." (Id.) These ambiguities on core functionality establish that Alden's Fig.

5 embodiment is not enabled for usage with the detection array shown, especially given the fact that Petitioner's expert could not explain how the sensor array specifically controlled Fig. 5's LEDs. (Ex. 2041, 108:11-109:5.) Petitioner's anticipation proofs thus fail for reliance on a non-enabled embodiment of Alden.

B. Ground 1: Alden, Ground 2: Alden-Beam, and Ground 3: Alden-Kobayashi

1. Independent Claim 48 (Alden)

106. To demonstrate anticipation, it is my understanding that Petitioner must show that the prior art reference discloses each and every limitation of the claim, either expressly or inherently, and that a prior art reference does not anticipate if it must be modified to meet a disputed claim limitation. It is also my understanding that an inoperative prior art device cannot be relied on for anticipation. It is still further my understanding that inherency requires a basis in fact and/or technical reasoning to reasonably support a determination that an allegedly inherent characteristic necessarily flows from the teaching of the applied reference, and that a certain result or characteristic may occur or be present in an applied reference is insufficient to establish inherency of that result or characteristic.

107. To anticipate, it is also my understanding that a prior art reference must enable a POSA to make the claimed invention without undue experimentation

and that a claimed invention is not anticipated if the allegedly anticipatory prior art disclosures are not enabled.

108. It is further my understanding that is not enough that a reference includes multiple, distinct teachings that a POSA might somehow combine to achieve the claimed invention. It is also my understanding that a prior art reference must clearly and unequivocally disclose the claimed invention or direct a POSA to the invention without any need for picking, choosing, and combining various disclosures not directly related to each other by the teachings of the reference. It is also my understanding that anticipation cannot be proven merely by multiple, distinct teachings in a single document that a POSA might somehow combine to achieve the claimed invention but that, instead, a reference may anticipate only if a POSA would at once envisage the claimed arrangement or combination.

109. It is still further my understanding that anticipation requires that a single prior art reference describe the claimed invention with sufficient precision and detail to establish that the subject matter existed in the prior art and that ambiguous references therefore do not anticipate a claimed invention.

**a. Alden Does Not Teach the Claim Limitations
“selecting a first cluster of the LEDs to emit first light
directed towards a first area including the at least the
portion of at least one object . . . the first light
determined based at least in part on classifying the**

object”

110. Independent claim 48 requires “selecting a first cluster of the LEDs to emit first light directed towards a first area including the at least the portion of at least one object . . . the first light determined based at least in part on classifying the object.” It is my opinion that Alden fails to teach these claim limitations.

111. It is my understanding that the words of a claim are generally given their ordinary and customary meaning, which is the meaning that the words would have to a POSA at the time of the invention. Because of their context, the claims themselves provide substantial guidance as to the meaning of particular claim terms, but do not stand alone and must be read in view of the specification of which they are a part. The specification is highly relevant to the claim construction analysis and is usually dispositive. The specification is the single best guide to the meaning of a claim term. A POSA is deemed to read the claim term not only in the context of the particular claim in which the term appears, but in the context of the entire patent, including the specification.

112. The ordinary meaning of “classify” is to arrange or group in classes according to some system or principle. (Classify: “to arrange or group in classes according to some system or principle.” (Ex. 2065, 334.) Therefore “classifying an object” means arranging or grouping an object into one of multiple object classes according to some system or principle. That ordinary meaning is supported by the

specification of the '551 patent, which describes classifying between different types of objects, such as a person, sign, or vehicle. (*See, e.g.*, Ex. 1001, 44:67-45:3; 51:59-56; 52:19-27; 52:66-53:4; 63:9-12; 64:46-49; 69:54-57; 76:33-39.)

113. Rather than identifying and classifying a vehicle from multiple types of objects, Alden's system detects incoming light having an intensity above a threshold. In response, the system dims those segmented light distribution elements whose beam segments illuminate those sectors of the distribution area where the detected light is located and selected surrounding sectors. (Ex. 1005, ¶[0027-0028].) Thus, Alden's system merely assumes that such detected light indicates the presence of an oncoming vehicle.

114. Alden's system would therefore respond in the same fashion regardless of the actual source of such light, *e.g.*, motorcycles, streetlights, house lights, roadside reflectors, *etc.* Alden does not teach any other operation or result in connection with incoming light above the threshold. While Alden mentions in a single sentence determining a curve based on the detection of incoming light from roadside reflectors, there is no teaching or description of how this is accomplished. (Ex. 1005, ¶[0036].) Indeed, Petitioner's expert confirmed that Alden's detection of incoming light from roadside reflectors is accomplished using the "same logic" in the same fashion as its detection of any other incoming light:

Q. Okay. So which of the light sources described in Alden are used to generate this beam pattern that's illustrated in figure 11?

A. So it's the dual problem. Again, one is actually high beam so I don't create glare for the oncoming driver or if I'm on a turn the system can use these refractors (sic) by using the same logic of detecting lights -- using the same reflectors in order basically to just have direct LED light in order for the driver to make inferences about the curvature.

I don't know if this answers your question.

Q. So using the figure 5 embodiment you're saying that light reflects off these reflectors on the side of the road and the headlamp detects these and then dims those corresponding lights?

MR. HUGHES: Objection. Mischaracterizes his testimony.

A. No. What I'm saying is the following: There are two main use cases in Alden. One is basically headlights maximizing visibility for the driver and minimizing -- we discussed this.

The second one is actually using the same logic, which is described in figures 3, 4, and 5. I detect that, so my dots here in the figure 3 are going to be the reflectors. The reflectors are going to be something that corresponds -- **it will have the same appearance on the image like the headlights.**

(Ex. 2041, 74:25-75:2, 79:8-80:8.)

115. The only response to which is dimming selected segmented light

distribution elements. (Ex. 1005, ¶¶[0027-0028].) There is no teaching or description in Alden of how detected light from roadside reflectors is otherwise distinguished from any other detected light. It is my understanding that Alden’s discussion of determining a curve based on the detection of incoming light from roadside reflectors is therefore not enabled. (*See*, §VIII.A.6., *infra*.)

116. Because Alden’s system, at best, merely assumes that such detected incoming light above a threshold from any and all sources always indicates the presence of an oncoming vehicle, the system never performs the function of assigning an object a classification from among multiple classes or types of objects and therefore does not, as properly construed, perform the function of classifying an object, as required by claim 48. That, in some instances, the source of such detected incoming light might actually be an oncoming vehicle does not negate the fact that the Alden’s system never performs the function of classifying an object. Rather, once again, the system merely assumes that such detected incoming light always indicates the presence of an oncoming vehicle.

117. Alden thus discloses nothing more than detecting light above a threshold. (Ex. 1005, ¶¶[0026-0027].) The ordinary meaning of “detect” is to discover the presence or existence of something (Detect: “to discover the presence or existence of (anything hidden, not clear, etc.)” (Ex. 2065, 496), which is a binary determination. Therefore, the ordinary meaning of the term “detect” is

clearly different from that of “classify” previously noted. Simply detecting light above a threshold and then merely assuming that such light always indicates the presence of an oncoming vehicle is not performing the function of assigning an object a classification among multiple classes or types of objects. It is only by misconstruing “classifying the object” in an unreasonably broad manner – *i.e.*, as merely detecting light – that Petitioner can contend Alden teaches that claim limitation.

118. Alden therefore fails to teach the independent claim 48 limitation of “classifying an object.” As a result, per my understanding, Petitioner’s anticipation assertion fails.

119. Intentionally left blank.

b. Alden Does Not Teach the Claim Limitations “control light emitted from the first cluster directed towards the first area to be different in at least one emission characteristic, based on the first light determination, from second light emitted from a second, different cluster of the LEDs, directed towards one or more illuminated second areas at a common elevation with the first area and laterally adjacent to the area”

120. Petitioner’s contentions regarding the general and broad functionality of the system described by Alden assume the specific details needed to implement such functionality and to meet the specific independent claim 48 limitations

“control light emitted from the first cluster directed towards the first area to be different in at least one emission characteristic, based on the first light determination, from second light emitted from a second, different cluster of the LEDs, directed towards one or more illuminated second areas at a common elevation with the first area and laterally adjacent to the area.” It is my understanding that the absence of such specific details from Alden’s disclosure demonstrates that Alden is inoperative, ambiguous, fails to provide an enabling disclosure of such claim limitations, and fails to teach such claim limitations expressly or inherently.

121. For example, in its anticipation contention regarding independent claim 48, Petitioner relies on the headlight 123 with multiple LEDs 119 shown in Figure 5 of Alden. (Petition, 29.) However, Figure 5 does not show a single row of a two-dimensional LED array controlled by the two-dimensional switch array of Figure 3. Alden never describes Figure 5 as such. Instead, Alden merely describes a row of LEDs positioned along **the focal point** of a lens. (Ex. 1005, ¶[0029].) Alden never mentions “adjacent” rows/columns of LEDs, let alone providing an explanation how LEDs in any “adjacent” rows/columns of a two-dimensional LED array would be configured to work relative to that focal point. To the contrary, Alden’s description of the row of LEDs shown being positioned along the focal point of the lens undermines a conclusion that Figure 5 does not restrict LED

headlight embodiment to a single-row LED array.

122. That same description also undermines a conclusion that the mere discussion of the two-dimensional switch array shown in Figure 3 demonstrates that the LED headlight shown in Figure 5 works with such a two-dimensional array. To the contrary, Figure 5 depicts a single-row LED array in contrast to a two-dimensional light sensor and a two-dimensional switch array shown in Figure 3 without teaching how the single-row LED array shown in Figure 5 would be controlled by such. Indeed, Petitioner's expert indicated that it is not clear and that he could not explain how the switch array shown in Figure 3 controls the LED array shown in Figure 5 to create the beam spread illustrated therein:

Q. Okay. So does the figure 3 description affect the total beam spread of the figure 5 embodiment?

A. The figure 3 can inform. But, again, this is a **concept**. So if you look at the number of rows on 77 and 79, it's not clear how many. Assuming that each element controls one LED, **it's not clear and I cannot count here.**

* * *

A. In figure 3. It's a reference as an array matrix. In other words, there are rows and columns. So here basically the disclosure is that each one of these controls one LED. And this is what the POSITA would understand at that time. So **it doesn't give me any information how**

many rows, how many columns we have. It's a concept diagram.

There are no dimensions, no scale.

(Ex. 2041, 108:11-109:5.)

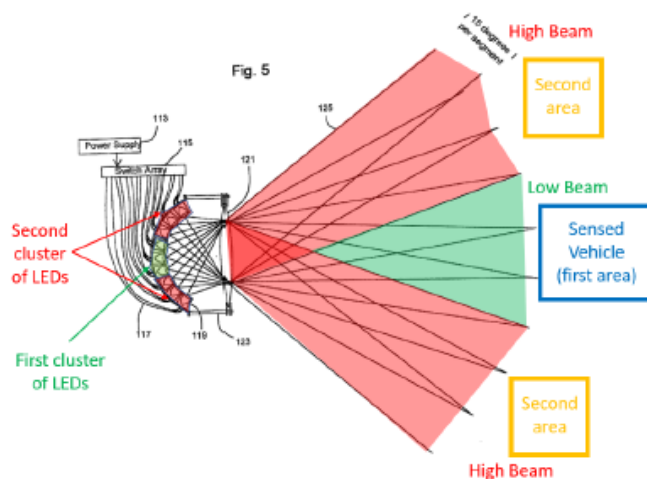
123. Indeed, there is no disclosure in Alden of how the nine (9) LEDs 119 of Figure 5 are controlled by the 200+ switches of switch array 55a/55b.

124. The operation of Alden's LED headlight embodiment shown in Figure 5 is simply unclear. Alden does not describe the above-noted limitations of claim 48 clearly. I understand that Alden also fails to enable those limitations because it does not describe them with sufficient precision to establish their existence as prior art. Therefore, it is my understanding that Alden once again cannot anticipate independent claim 48.

125. It is also my understanding that a reference does not anticipate if it must be modified to meet a challenged claim limitation. Because it fails to expressly teach how the two-dimensional switch array of Figure 3 controls the single-row LED array shown in Figure 5, Alden can only meet the above-noted claim limitations if such control is inherent in its disclosure. That is, how the two-dimensional switch array of Figure 3 controls the single-row LED array shown in Figure 5 must necessarily flow from Alden's express disclosure. Once again, however, Petitioner's expert indicated that it is not clear and could not explain how the switch array shown in Figure 3 controls the LED array shown in Figure 5 to

create the beam spread illustrated therein. (Ex. 2041, 108:11-109:5.) It is therefore my understanding that Alden also fails to inherently anticipate independent claims 48.

126. Petitioner has also mischaracterized Alden's disclosure. Petitioner contends that the LED headlight of Alden teaches the claimed limitations based on its annotated versions of Figure 5 and the accompanying description in the specification. (Petition, 29.) Petitioner's annotated Figure 5 is shown below.



(Petition at 29, Annotated)

127. As seen therein, at the distance shown from the headlight, the annotated oncoming vehicle is too small relative to the size of the headlight. Indeed, the annotated vehicle has a width less than that of the headlight structure. Petitioner's annotations are therefore clearly inaccurate and, consequently, a mischaracterization of Alden's disclosure. Properly sized at the distance shown relative to the size of the headlight, an annotated vehicle would be so large that it

would be illuminated by all the beam segments of the headlight. Hence, according to the disclosure of Alden, all the beam segments shown would be dimmed. The annotated scenario illustrated thus fails to satisfy the independent claim 48 limitations “*control light emitted from the first cluster directed towards the first area to be different in at least one emission characteristic, based on the first light determination, from second light emitted from a second, different cluster of the LEDs, directed towards one or more illuminated second areas at a common elevation with the first area and laterally adjacent to the area.*”

128. It is only by rendering the annotated sensed vehicle with an inaccurate scale relative to headlight 123 that Petitioner can contend that Alden “teaches” these independent claim 48 features. As a result, it is my understanding that Petitioner’s contention that Alden anticipates independent claim 48 therefore fails.

129. Thus, Petitioner’s annotations do not accurately represent Alden’s disclosure. Instead, correctly understood, Alden’s disclosure clearly fails to expressly teach the above-noted limitations of independent claim 48. Indeed, Petitioner’s expert admits that its annotations “should be considered only as high-level representations.” (Ex. 1003, ¶75.) In that regard, Petitioner’s reliance on the patterns and shapes of emission are misplaced. Annotating a “high-level representation” for which Dr. Papanikolopoulos cannot describe the beam shapes and/or whether the beams overlap, fails to provide correlation between the Fig. 5

annotation and an actual output other than maybe that Fig. 5 is generally suggestive of an output. (Ex. 2041, 110:20-111:8.) Given Dr. Papanikolopoulos's uncertain opinions about Figure 5, the placement of a vehicle into that Figure, proves little, except maybe that the vehicle would be illuminated by the lamp at some scale. Id. Once again, it is my understanding that a reference does not anticipate if it must be modified to meet a challenged claim limitation.

130. Even if it is assumed that Petitioner's annotations do not and need not precisely represent Alden's disclosure, that disclosure also fails to inherently teach those claim limitations. If Petitioner's annotations do not precisely represent Alden's disclosure, then they necessarily depict operations and/or scenarios not expressly described in Alden. As a result, any purported anticipation must then be based on inherency. I understand that Petitioner's annotations must therefore necessarily flow from Alden's express disclosure. However, per Petitioner's expert, Fig. 5 "does not give any information how many rows ... we have," (Ex. 2041, 108:11-109:5) therefore Petitioner cannot rely on Alden's express teachings and Petitioner's anticipation proofs fail.

131. Intentionally left blank.

2. **Independent Claim 56: Alden Does Not Teach the Claim Limitations “*reduce intensity of illumination to non-glaring illumination of a first area associated with the at least one other vehicle, relative to intensity of illumination on both sides of the first area at elevations*”**

common with the first area illuminated by a second cluster of the LEDs, by control of emission from the first cluster”

132. Alden fails to teach the above-noted independent claim 56 limitations for at least the same reasons as set forth above in connection with independent claim 48. That is, Alden is ambiguous because it does not describe the above-noted independent claim 56 limitations clearly and unambiguously. Indeed, Alden is also inoperative and incapable of satisfying those claim limitations, particularly *“reduce intensity of illumination to non-glaring illumination of a first area associated with the at least one other vehicle . . . relative to intensity of illumination on both sides of the first area at elevations common with the first area illuminated by a second cluster of the LEDs.”* Alden also fails to enable the above-noted independent 56 claim limitations because it does not describe them with sufficient precision to establish their existence as prior art. Petitioner has also mischaracterized Alden’s disclosure which, properly understood, fails to teach those claim limitations either expressly or inherently. It is my understanding that Alden therefore fails to anticipate independent claim 56.

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134. Intentionally left blank.

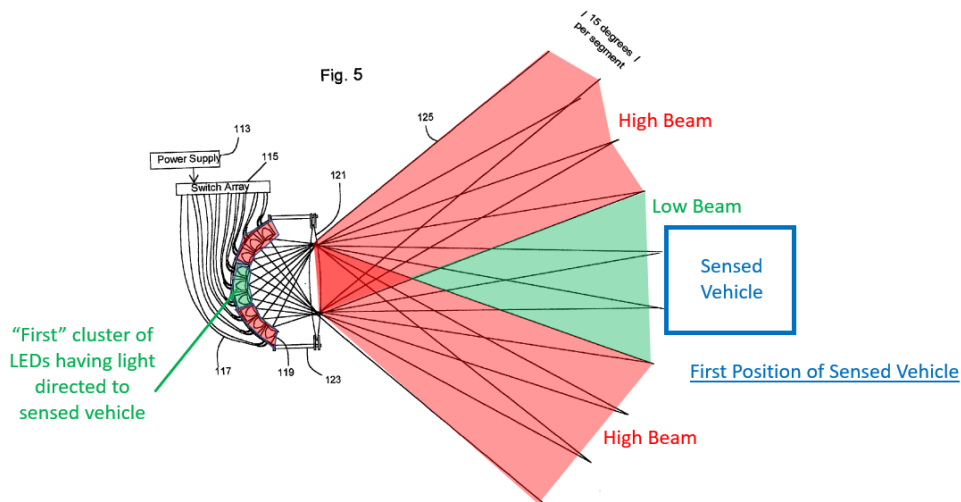
3. Independent Claim 64: Alden Does Not Teach the Claim Limitations (i) *“control a first change to one or more characteristics of the light associated with the first*

cluster of the LEDs that is directed towards the other vehicle, that diminishes glare to a driver of the other vehicle when the other vehicle is at the first position”, and (ii) “control a second, subsequent change, to one or more characteristics of the light that is subsequently directed towards the other vehicle, that diminishes glare to the driver of the other vehicle when the other vehicle is at the second position”

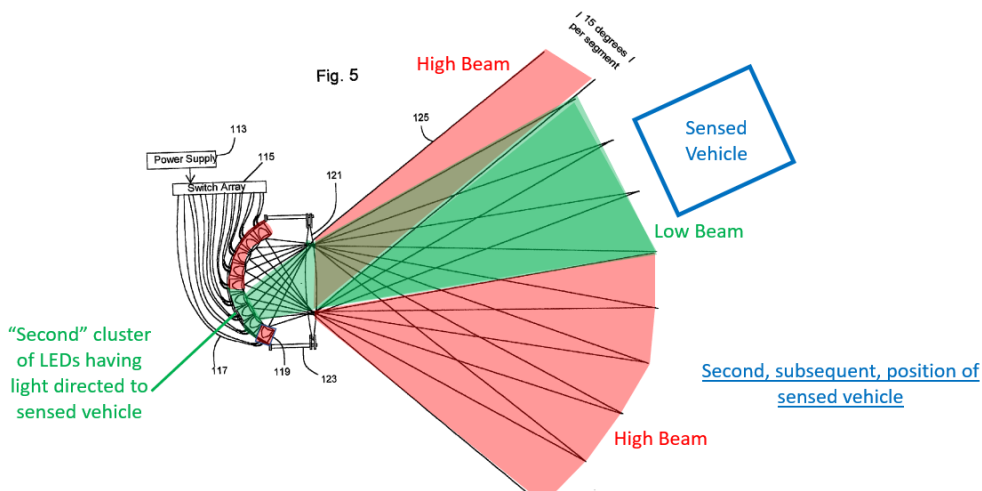
135. Alden fails to teach the above-noted independent claim 64 limitations for at least the same reasons as set forth above in connection with independent claim 48 and 56. That is, Alden is ambiguous because it does not describe the above-noted independent claim 64 limitations clearly and unambiguously. Indeed, Alden is also inoperative and incapable of satisfying those claim limitations, particularly “*control a first change to one or more characteristics of the light associated with the first cluster of the LEDs that is directed towards the other vehicle, that diminishes glare to a driver of the other vehicle*” and “*control a second, subsequent change, to one or more characteristics of the light that is subsequently directed towards the other vehicle, that diminishes glare to the driver of the other vehicle when the other vehicle is at the second position.*” Alden also fails to enable the above-noted independent 64 claim limitations because it does not describe them with sufficient precision to establish their existence as prior art. Petitioner has also mischaracterized Alden’s disclosure which, properly understood, fails to teach those claim limitations either expressly or inherently. It

is my understanding that Alden therefore fails to anticipate independent claim 64.

136. As noted, Petitioner has mischaracterized Alden's disclosure. Petitioner contends that the LED headlight of Alden teaches the claimed limitations based on its annotated versions of Figure 5 and the accompanying description in the specification. Petitioner's annotated Figure 5 is shown below.



(Petition, 47, 49)



(Petition, 50)

137. Petitioner's annotations of Figure 5, however, are inaccurate. The

annotated vehicle is an oncoming vehicle that is traveling toward the equipped vehicle.¹³ The distance between those vehicles is therefore decreasing over time. As a result, the annotated oncoming vehicle could not physically move from the first position shown to the subsequent second position shown yet remain at the same distance shown from the headlight. That is, the annotated oncoming vehicle is physically incapable of moving from the first to the second position shown while remaining at substantially the same distance from the equipped vehicle headlamp. The only way a vehicle could move from the first position to the second and remain at the same distance from the headlight would be if that vehicle is moving laterally relative to the equipped vehicle, in which case the light emitted by the headlights of that laterally moving vehicle would not be detected by the sensors of the equipped vehicle.

138. Thus, the argument that movement of Petitioner's annotated vehicle and its distance from the LED headlamp of Figure 5 does not rely on scale or a "collision course" between the equipped vehicle and the annotated vehicle, but on the laws of physics and Alden's light sensor. In that regard, the annotated vehicle

¹³Petitioner states that the annotated vehicle is an "oncoming vehicle [that] moves across the field-of-view" in connection with similar argumentation concerning independent claim 72. (Petition at 56.)

is not “generally oncoming.” (DI, 19.) Rather, the annotated vehicle cannot be an oncoming vehicle – presenting two headlights emitting light for detection by the equipped vehicle light sensors – yet remain at the same distance from the equipped vehicle at two different points in time. Conversely, the annotated vehicle moving laterally relative to the equipped vehicle will not present two headlights emitting light for detection by the equipped vehicle light sensors.

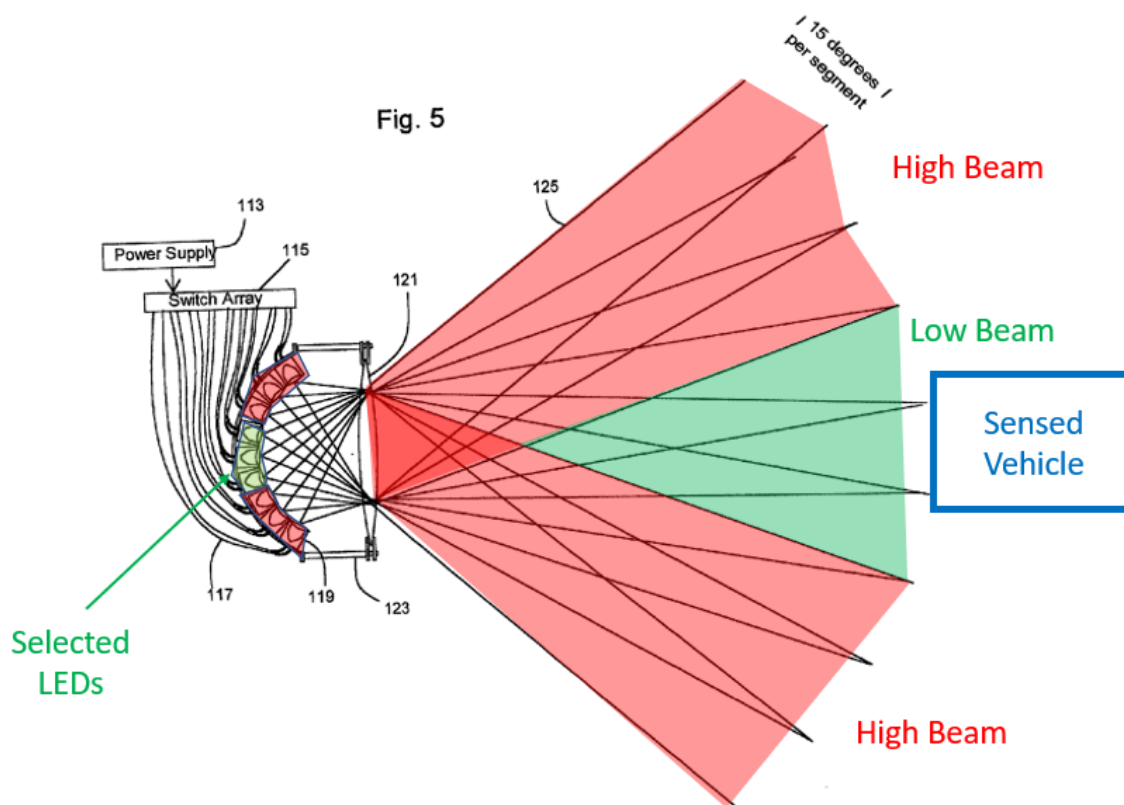
139. It is only by disregarding these physical realities that Petitioner can contend that Alden “teaches” these independent claim 64 features. It is my understanding that Petitioner’s contention that Alden anticipates independent claim 64 therefore again fails.

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141. Intentionally left blank.

- 4. Independent Claim 72: Alden Does Not Teach the Claim Limitations (i) “vary illumination provided to the target by the selected cluster, relative to illumination provided to areas laterally adjacent to the target and provided by at least one LED different from LEDs in the selected cluster” and (ii) “maintain a variance of illumination provided to the target relative to the laterally adjacent areas, when subsequent data from one or more of the cameras indicates a change in position of the target relative to the motor vehicle, by repeating the determination of target location, selection of the cluster and variance to illumination provided to the target, relative to the laterally adjacent areas, based on the subsequent data”**

142. Alden fails to teach the above-noted independent claim 72 limitations clearly. Petitioner's proof for "vary illumination provided to the target.... Relative to illumination provided to areas laterally adjacent to the target" fails. Petitioner shows the following figure:



(Petition, 54)

143. It is clear from this figure that the areas laterally adjacent the target are also illuminated in low beams. Further, even were there a point in space where the corners of the annotated vehicle abut the edges of the triangular beam shown, the claim also calls for "maintaining the variance... relative to the laterally

adjacent areas when subsequent data indicates a change in position of the target relative to the motor vehicle.” Alden’s control function of Figure 3/4 does not clearly provide for such a second situation – especially using the beam pattern shown in Figure 5.

144. When subsequent data indicates a change in position, since the position of the target is definitionally changed, Petitioner’s proof must show or explain a second location to which the claimed constraints apply, and this is not shown. Petitioner contends that Alden selects and controls LEDs providing “light to the sectors (or zones) where the target, or oncoming vehicle, is present, and dimming the light directed to these sectors relative to laterally adjacent sectors that are switched to high beam.” (Petition, 56.) Accordingly, the nine-beam, disparately aimed array of Figure 9 has never been shown to be able to create and maintain the claimed variance of illumination, which is relative to the target, and not the sector. Alden has not been shown to satisfy, and indeed may be incapable of satisfying, those claim limitations.

145. Indeed, Alden is also inoperative and incapable of satisfying those claim limitations, particularly “*vary illumination provided to the target by the selected cluster, relative to illumination provided to areas laterally adjacent to the target*” and “*maintain a variance of illumination provided to the target relative to the laterally adjacent areas, when subsequent data . . . indicates a change in*

position of the target relative to the motor vehicle, by repeating . . . variance to illumination provided to the target, relative to the laterally adjacent areas, based on the subsequent data.” Alden also fails to enable the above-noted independent 72 claim limitations because it does not describe them with sufficient precision to establish their existence as prior art. Petitioner has also mischaracterized Alden’s disclosure which, properly understood, fails to teach those claim limitations either expressly or inherently. It is my understanding that Alden therefore fails to anticipate independent claim 72.

5. Independent Claim 80: Alden Does Not Teach the Claim Limitations “*change, responsive to the positions associated with the target, first light associated with one or more LEDs aimed toward at least a portion of the target, relative to second light associated with other one or more of the LEDs aimed laterally adjacent the target on either side, as the target moves relative to the motor vehicle*”

146. Alden fails to teach the above-noted independent claim 80 limitations clearly. Petitioner fails to identify, for example, which LEDs are providing “light associated with one or more of the LEDs aimed laterally adjacent the target on either side.” Similar to claim 72, Petitioner does not adequately demonstrate that the claimed change occurs as the target moves, because Petitioner does not demonstrate the subsequent change at a second time, as claimed.

147. Petitioner rejects the claim by analogy to claim 48[g], 64[l] and

72[m]. Because elements 48[g] and 64[l] do not relate to the relativistic concept of control as claimed in 80, the analogy thereto is not adequately explained. Indeed, Alden is also inoperative and incapable of satisfying those claim limitations, particularly “*change . . . first light associated with one or more LEDs aimed toward at least a portion of the target, relative to second light associated with other one or more of the LEDs aimed laterally adjacent the target on either side, as the target moves relative to the motor vehicle.*” Alden also fails to enable the above-noted independent 80 claim limitations because it does not describe them with sufficient precision to establish their existence as prior art. Petitioner has also mischaracterized Alden’s disclosure which, properly understood, fails to teach those claim limitations either expressly or inherently. It is my understanding that Alden therefore fails to anticipate independent claim 80.

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149. Intentionally left blank.

6. Dependent Claims 50/58/66/74/82: Alden Does Not Teach the Claim Limitations “*accommodate the upcoming road curvature by adaptation of a light pattern of at least one of the at least one headlamps*”

150. Dependent claims 50/58/66/74/82 require that the illuminating device accommodate the upcoming road curvature by adaptation of a light pattern of at least one of the at least one headlamps. Contrary to Petitioner’s contentions, Alden

fails to teach such claim limitations.

151. Alden's disclosure does nothing more than mention in a single sentence sensing that a road curves by receiving light from roadside reflectors. (Ex. 1005, ¶[0036].) Alden's disclosure lacks any teaching or description of how to do so. Alden never describes *how* its system can sense a "corner" by detecting incoming light from a reflector or what to do with beam segments and distribution area sectors if it did sense a corner.

152. Dependent claims 50/58/66/74/82 recite "identify an upcoming road curvature." Alden includes no methodology for distinguishing between a detected road reflector and a detected vehicle headlamp. Petitioner's expert opined that there are "two use cases in Alden. One is basically headlights maximizing visibility for the driver... the second one is actually using the same logic, which is described in figures 3, 4 and 5." (Ex. 2041, 74:25-75:2.) He continued "the reflectors... will have the same appearance on the image like the headlights." (*Id.*) This is problematic, because, as Petitioner's expert stated – "so I will have a rectangle like – but instead of having dim light I'm going to have high beam." (Ex. 2041, 80:9-14.) This means that though Alden will require completely different controls, it views the reflectors and headlamps as "the same."

153. Petitioner also includes the rotation sensor in its argument. (Petition, 55.) The claims call for an "upcoming" road curvature, and the suggestion that

people are going to be steering into the curve prior to reaching the curve is unreasonable. Even using the “steering sensor,” the system could not identify an “upcoming road curvature.” *Id.* Also, vehicles not turning in curves use steering while driving, specifically, to change lanes. *Id.* Thus, the suggestion that the mere detection of light coupled with a steering change would be sufficient to distinguish between road signs and detected vehicles is outside the corners of Alden and could raise significant problems – every time a vehicle tried to change lanes while detecting an oncoming vehicle, it would presumably create the output pattern of Fig. 11. *Id.*

154. Indeed, there is no teaching or description in Alden of how detected light from roadside reflectors is distinguished from any other detected light. Petitioner’s own expert indicated that Alden’s detection of incoming light from roadside reflectors is accomplished in the same fashion as its detection of any other incoming light (Ex. 2041, 74:25-75:2), the only response to which described in Alden is the dimming of selected segmented light distribution elements. (Ex. 1005, ¶¶[0027-0029].)

155. It is my understanding that Alden’s single mention of sensing that a road curves by receiving light from roadside reflectors is therefore not enabled. Consequently, Alden does not and cannot teach accommodating an upcoming road curve by adaptation of a light pattern of a headlight. My understanding is that

Petitioner's anticipation contentions concerning claims 51/58/66/74/82 therefore fail.

7. Dependent Claims 51/59/67/75/83: (Alden) Alden Does Not Teach the Claim Limitations “*accommodate the road curvature by changing illumination in at least a direction of the road curvature by adaptation of the light pattern in at least one of color, intensity, or spatial distribution*”

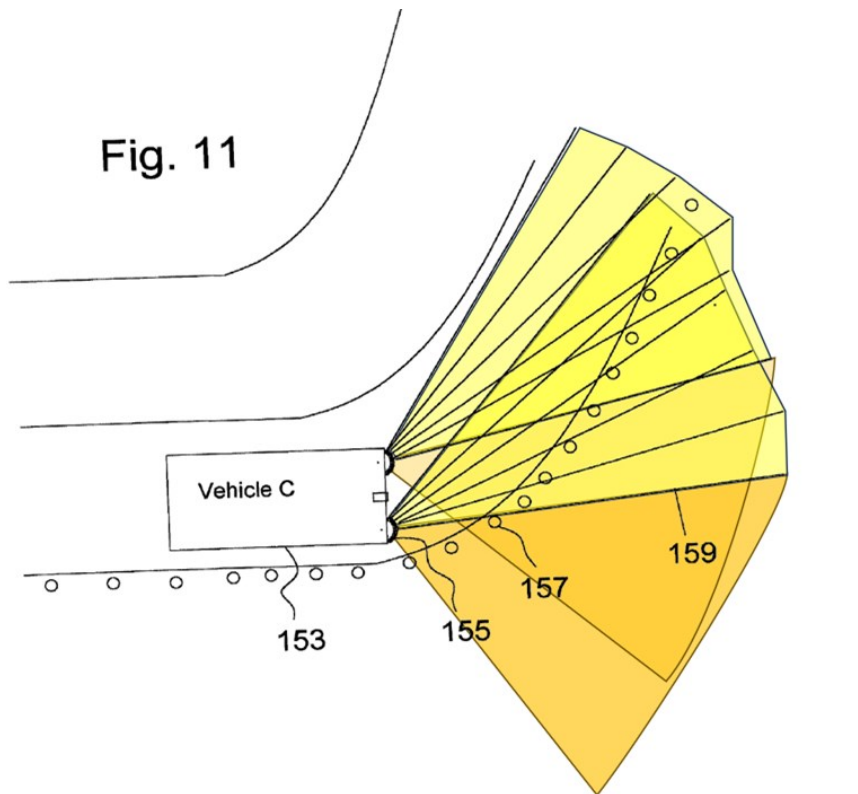
156. Dependent claims 51/59/67/75/83 require that the illuminating device accommodate the road curvature by changing illumination in at least a direction of the road curvature by adaptation of light pattern in at least one of color, intensity or spatial distribution. However, Alden fails to teach such claim limitations, for the reasons set forth above in connection with claims 51/58/66/74/82 as well as those detailed below.

157. Dependent claims 51/59/67/75/83 depend indirectly from independent claims 48/56/64/72/80, respectively. Because those independent claims recite LEDs, Petitioner's anticipation contentions relating thereto rely on Alden's LED headlight embodiment of Figure 5. (Petition, 11-42, 45-50, 53-56, 58-59.)

158. In its anticipation contentions concerning dependent claims 51/59/67/75/83, Petitioner asserts that Figure 11 of Alden is an illustration of the operation of the LED headlight embodiment of Figure 5. More specifically, according to Petitioner, the headlights 155 in Figure 11 are controlled to dim to

low beam those LEDs 119 emitting beam segments in directions generally away from the curve, while the beam segments emitted by the remaining LEDs 119 are at high beam. (Petition, 62-67; Ex. 1003, ¶¶134-136; Ex. 2041, 74:25-75:2.)

Figure 11 is annotated below to demonstrate such operation.



(Ex. 1005, FIGURE 11, Annotated)

159. Significantly, however, in all segmented beam headlight embodiments of Alden, all beam segments are always active at high intensity unless specifically dimmed. (Ex. 1005, ¶¶[0027, 0030, 0035].) (See, §VI.A., *infra.*) As a result, dimming to low beam intensity only those LEDs 119 emitting beam segments in directions generally away from the curve while leaving all other LEDs 119

activated at high beam intensity does not result in any adaptation in intensity of the pattern output by the LED headlights 155 in the direction of the curve. For the same reason, and because all LEDs 119 in the headlights 155 remain activated at all times, such operation also does not result in any adaptation of a spatial distribution of the pattern output by the LED headlights 155 in the direction of the curve.

160. In view of the foregoing, the operation illustrated in Figure 11 of the LED headlight 123 of Figure 5 clearly does not change illumination in a direction of a road curvature by adaptation of a light pattern in color, intensity, or spatial distribution. My understanding is that Petitioner's anticipation contentions concerning dependent claims 51/59/67/75/83 therefore fail.

161. Additionally, there is no teaching in Alden of dimming to low beam intensity only those LEDs 119 emitting beam segments in directions generally away from the curve while switching all other LEDs 119 to high beam. (Petition, 62-67; Ex. 1003, ¶¶134-136; Ex. 2041, 74:3-78:4.) As previously demonstrated, in all segmented beam headlight embodiments of Alden, all beam segments are always active at high intensity unless specifically dimmed. (Ex. 1005, ¶¶[0027, 0030, 0035].) (See, §VIII.A., *infra*.) It is my understanding that Alden does not anticipate if it must be modified to meet a challenged claim limitation.

162. Because it fails to expressly teach dimming to low beam intensity

only those LEDs 119 emitting beam segments in directions generally away from the curve while switching all other LEDs 119 to high beam, Alden can only meet the above-noted claim limitations if such operation is inherent in its disclosure. That is, such operation must be inevitable or necessarily flow from Alden's express disclosure. As demonstrated immediately above, however, those LEDs 119 emitting beam segments in directions generally away from the curve could be dimmed to low beam while all other LEDs 119 already active at high beam intensity remain at high beam intensity. It is my understanding that Alden therefore also fails to inherently anticipate dependent claims 51/59/67/75/83.

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8. Dependent Claim 51: (Alden) Alden Does Not Teach the Claim Limitations “*the control of the light emitted from the first cluster includes a change of at least one LED of the cluster to a non-emitting state*”

165. Dependent claims 51 also requires that the control of the light emitted from the first cluster includes a change of at least one LED of the cluster to a non-emitting state. In addition to the deficiencies in Petitioner's anticipation contentions concerning dependent claim 51 demonstrated above, Alden also fails to teach these additional dependent claim 51 limitations.

166. No section of Alden cited by Petitioner teaches changing any LEDs to

a non-emitting state. (Petition, 66 (*citing* Ex. 1005, ¶¶[0026-0029], [0036], [0039-0040].) To the contrary, all segments of Alden’s various segmented beam headlight embodiments are always activated at high intensity unless specifically dimmed. (Ex. 1005, ¶¶[0027], [0030], [0035].) (*See*, §VIII.A., *infra*.)

167. Petitioner admits Alden’s failure to teach changing any LEDs to a non-emitting state in its invalidity contentions concerning dependent claim 49, which includes similar claim limitations of changing at least one LED of the cluster to a non-emitting state. Petitioner contends that dependent claim 49 is an obvious combination of Alden and Beam, relying only on Beam for the purported teaching of changing at least one LED of the cluster to a non-emitting state. (Petition, 76-80.)

168. It is my understanding that Petitioner’s contention that Alden anticipates dependent claim 51 therefore fails.

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9. Dependent Claims 53/61/69/77/85: (Alden) Alden Does Not Teach the Claim Limitations “*identification of the upcoming road curvature based at least in part on sensor data provided by one or more of the sensors of the vehicle and wherein the adaptation of the light pattern is based at least in part on the sensor data*”

171. Dependent claims 53/61/69/77/85 require identification of the

upcoming road curvature based at least in part on sensor data provided by one or more of the sensors of the vehicle and wherein the adaptation of the light pattern is based at least in part on the sensor data. Dependent claims 53/61/69/77/85 depend directly from dependent claims 50/58/66/74/82, respectively, which require accommodating an upcoming road curvature by adaptation of a light pattern. However, Alden fails to teach the above-noted limitations of claims 53/61/69/77/85.

172. Dependent claims 53/61/69/77/85 depend indirectly from independent claims 48/56/64/72/80, respectively. Each of those independent claims define the sensor recited as one or more *for detecting coordinate specific information about the illuminated area*.

173. In its anticipation contentions regarding independent claims 48/56/64/72/80, Petitioner cites Alden's light sensors as the claimed one or more sensors for detecting coordinate specific information about an illuminated area. (Petition, 20-22, 36-37, 45, 53, 58.) But in its anticipation contentions regarding adaptation of the light pattern based on "the sensor data" recited in dependent claims 53/61/69/77/85, Petitioner cites Alden's equipped vehicle steering wheel rotation sensor as the sensor providing "the sensor data." (Petition, 67.)

174. However, the antecedent basis for "the sensor data" recited in dependent claims 53/61/69/77/85 is "sensor data provided by one or more of the

sensors of the vehicle” recited earlier in those same claims. Such sensors are defined in independent claims 48/56/64/72/80 as one or more *for detecting coordinate specific information about the illuminated area*. The vehicle steering wheel rotation sensor disclosed in Alden is clearly not a sensor for detecting, and neither detects nor provides, coordinate specific information about the illuminated area.

175. My understanding is that Petitioner’s anticipation contentions thus fail because Alden’s rotation sensor relied upon by Petitioner does not provide “the sensor data” required by claims 53/61/69/77/85 due to their respective dependence from independent claims 48/56/64/72/80, which recite a sensor for detecting coordinate specific information about the illuminated area.

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C. Alden Alone Does Not Render Obvious Any of the Challenged Claims

178. In addition to its contentions that the Challenge Claims treated in Ground 1 are anticipated by Alden, Petitioner contends in the alternative that those Challenged Claims are obvious based on Alden alone. (Petition, 11, 36, 42, 45, 51, 53, 56, 58, 59, 62, 65, 67, 68.) However, Petitioner has failed to meet any of the requirements necessary to demonstrate obviousness based on Alden alone.

179. Nowhere in its petition does Petitioner explain its obviousness contention at any level of detail. Instead, Petitioner's contention is based on cursory and conclusory statements consisting of no more than a single sentence.

180. Petitioner has failed to establish or identify the elements required to support an obviousness conclusion, including explaining how Alden must be modified (*i.e.*, identifying the differences between the claimed invention and Alden, or those claim elements not taught by but obvious in view of Alden) and explaining why a POSA would be motivated to so modify Alden (*i.e.*, providing some articulated reasoning with some rational underpinning to support an obviousness conclusion).

181. It is also my understanding that Petitioner cannot simply treat the various features of Alden's embodiments as interchangeable, particularly for anticipation, but also for obviousness. Instead, Alden's disclosure must support any contention of interchangeability. Extrinsic evidence, such as an expert declaration, on what Alden's different embodiments could include or would accommodate are not the same as what Alden specifically discloses. It is further my understanding that a patent composed of several elements is not proved obvious by merely demonstrating that each of its elements was, independently, known in the prior art and that, in the absence of supporting evidence to enable a skilled artisan to make the claimed invention, a standalone obviousness reference

must enable the portions of its disclosure being relied upon.

182. It is my understanding that Petitioner must provide a sufficient rationale to combine Alden's different embodiments. Having failed to explain sufficiently why a POSA would have found it obvious to combine those embodiments, my understanding is that any contentions by Petitioner of obviousness based thereon fail.

X. Conclusion

183. 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.

184. 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: 3/5/2024


Matthew A. Turk Ph.D.