

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

VOLKSWAGEN GROUP OF AMERICA, INC.,
Petitioner,

v.

YECHEZKAL EVAN SPERO,
Patent Owner.

U.S. Patent No. 11,208,029 to Spero

Case No.: IPR2022-01586

DECLARATION OF MATTHEW A. TURK PhD

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List of Exhibits

Exhibit No.	Description	Identifier
2001	Declaration of Matthew A. Turk, PhD	Turk Decl.
2002	Curriculum Vitae of Matthew A. Turk, PhD	Turk CV
2003	Petition challenging U.S. Patent No. 11,208,029, <i>Unified Patents, LLC v. Torchlight Technologies LLC</i> IPR2022-01500, Paper 1, September 22, 2022	Unified Petition
2004	U.S. 6,406,172 to Harbers	Harbers '172
2005	Comparison of Harbers (Ex. 1011) to Harbers '172 (Ex. 2004)	Harbers Comparison

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. 11,208,029 (“the ‘209 Patent”) to Yechezkal Evan Spero.
3. I am being compensated for my work in this matter at a rate of \$490/hour for 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.
4. In preparation of this declaration, I have studied the exhibits as listed in the Exhibit List shown above in my report.
5. 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

6. 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.

7. 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.

8. 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).

9. 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.

10. 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.

11. 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.

12. 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.

13. 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.

14. 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.

15. 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.”

16. 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).

17. 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.

18. In 2020, I was elected a Fellow of the Association for Computing Machinery (ACM), the main professional society in the field of computer science, for “contributions to face recognition, computer vision, and multimodal interaction.” In 2013, I was elected as a Fellow of the IEEE (the Institute of Electrical and Electronics Engineers), an award conferred by the Board of Directors of the IEEE upon a person with an extraordinary record of

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

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

II. Relevant Legal Standards

20. I have been asked to provide opinions on the claims of the '029 Patent in light of the prior art.

21. 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

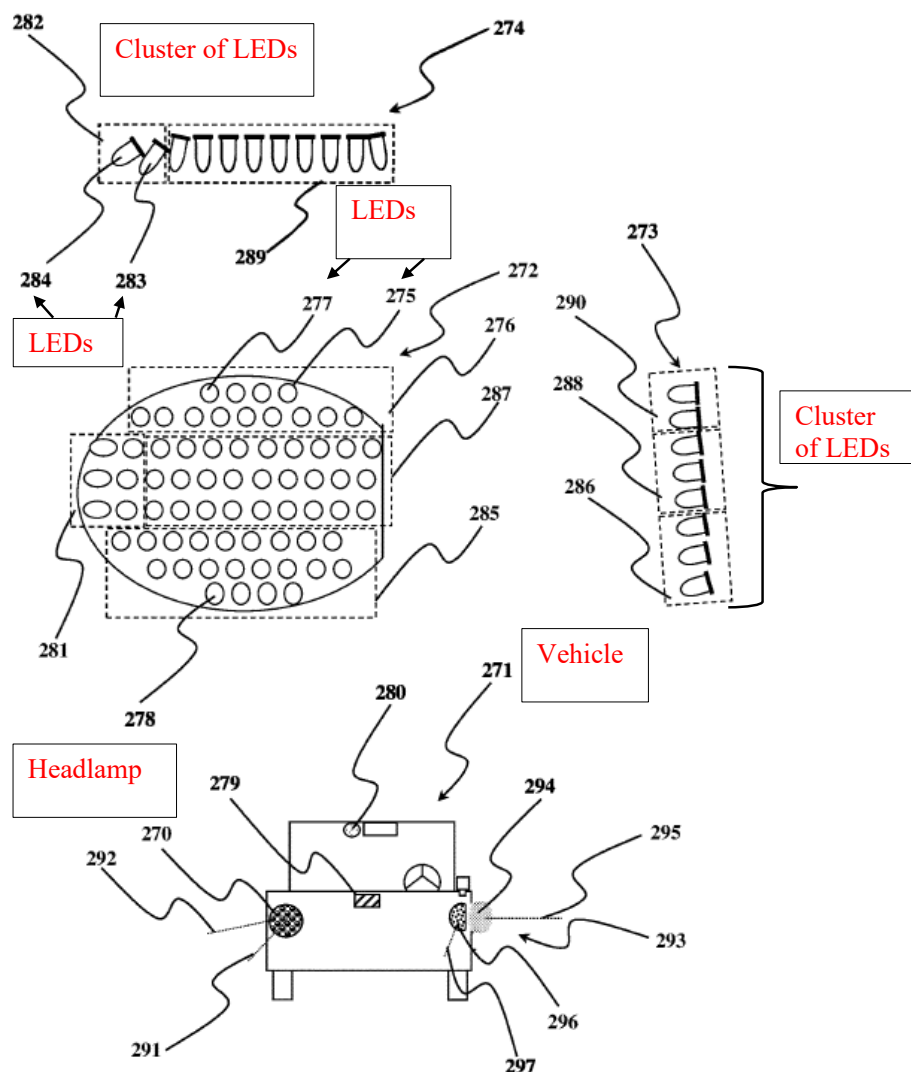
subject matter.

22. 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. Overview of the ‘029 patent

23. The ‘029 Patent is directed to “a novel multi-light source approach to the design and construction of solid-state lighting fixtures (vs. solid state lamps), which is termed a ‘Digital Lighting Fixture’, due to the control of individual lighting element ‘digits’ to provide the ‘correct’ lighting solution for the situation at hand.” (Ex. 1001, 11:5-13.) The ‘029 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.* at 2:67-3:5.) The ‘029 Patent describes a non-mechanical and non-movable system. A “non-mechanical and non-moveable” system as used in this context refers to a system with no moving parts or mechanisms to position the light beam.



(Ex. 1001, FIG 15, Annotated)

24. The '029 Patent also describes the deficiencies of prior art lighting systems that replace conventional lights with solid-state LED light sources “with some minor adjustments” but do not utilize the full “digital” control of the LEDs. (*Id.* at 9:60-63.) The '029 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.* at 11:5-7.) “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.* at 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.* at 11:56-62.) “The invention embraces LED-illuminating devices covering a wide scope of applications,” including transportation. (*Id.* at 11:14-21, 4:18-20, 50: 50-51.)

25. The claimed invention of the ‘029 Patent, titled “Adaptive Headlight System,” is directed to multi-LED headlight systems that provide predictive curve illumination with the receipt of *map data indicating a road curvature upcoming along a road on which the motor vehicle is traveling*. The ‘029 claimed invention solves the problem of how to provide a digital lighting solution that can “provide the optimal lighting solution in real-time” to predictively illuminate an upcoming road curvature. (*See* ‘029 Patent, 57:43-49.) More specifically, the ‘029 Patent discloses and claims an adaptive multi-LED headlight system that receives map data to determine and control at least a first plurality of the LED light sources to provide predictive curve illumination—by increasing and shaping light based on

the *direction of the road curvature ahead of the motor vehicle, **prior to the motor vehicle reaching the road curvature.*** (See e.g., Ex. 1001, Claim 1, 96:5-8, emphasis added.)

A. Challenged Independent Claims

26. The Challenged Claims include independent claims 1, 12, and 23, which are reproduced below with claim identifiers:

[1.P] A system, for a motor vehicle, comprising:
[1.1] a plurality of headlamps, each comprising a plurality of LED light sources;
[1.2] one or more processors; and
[1.3] a memory storing instructions that, when executed by one or more of the one or more processors, enable the one or more processors to:
[1.4] receive first data, including at least map data, indicating a road curvature upcoming along a road on which the motor vehicle is traveling;
[1.5] determine a light change, the change adapting a light pattern of the headlamps in at least one of color, intensity or spatial distribution to increase light in a direction of the road curvature ahead of the motor vehicle and shaping light based at least in part on the road curvature; and
[1.6] control at least a first plurality of the LED light sources to provide light

based at least in part on the determined light change and prior to the motor vehicle reaching the road curvature.

[12.P] A non-transitory computer-readable storage medium, storing instructions that, when executed by one or more processors of a motor vehicle that includes a plurality of headlamps that each comprise a plurality of LED light sources, enable the one or more processors to:

[12.4]¹ receive first data, including at least map data, indicating a road curvature upcoming along a road on which the motor vehicle is traveling;

[12.5] determine a light change, the change adapting a light pattern of the headlamps in at least one of color, intensity or spatial distribution to increase light in a direction of the road curvature ahead of the motor vehicle and shaping light based at least in part on the road curvature; and

[12.6] control at least a first plurality of the LED light sources to provide light based at least in part on the determined light change and prior to the

¹ I'm using the same claim identifiers as VW's Expert, however he did not explain why he skipped claim identifiers [12.1] - [12.3] and [23.1] – [23.3] in the sequence. (See Ex. 1001, ¶65.)

motor vehicle reaching the road curvature.
[23.P] A computer-implemented method for adapting light from headlamps of a motor vehicle to accommodate road shape changes, the headlamps including a plurality of LED light sources, comprising:
[23.4] determining an upcoming shape change of a road, ahead of the motor vehicle, based on first data, including map data, indicating the shape change;
[23.5] determining a light output, the output adapting a light pattern of the headlamps in at least one of color, intensity or spatial distribution to increase light in a direction associated with the shape change ahead of the motor vehicle and shaping light based on the shape change; and
[23.6] prior to reaching the road shape change, causing at least a first plurality of the LED light sources to provide light based at least in part on the determined light output.

27. The ‘029 Patent describes multiple techniques for predicting an upcoming curve in the road. For example, Adaptive Frontal-lighting Systems are provided that “aid in seeing around curves and other features in the road.” (Ex. 1001, 51:54-56.) More specifically, these systems predict upcoming curves in the

road based on “instantaneous road conditions” and map data. (*Id.* at 51:56-67.) “A GPS system on the car may also let the headlamps system know of curves up ahead, one-way traffic and others [sp] factors such [that] the headlamp may be operated in the optimal mode at that instantaneous location.” (*Id.*) The ‘029 Patent also describes adjusting “the intensity, spectrum and beam pattern of the headlamp” based on “instantaneous road conditions” and map data indicative of an upcoming curve. (*Id.*)

B. Qualifications of one of ordinary skill in the art

28. I have been asked to provide my opinion as to the level of skill of a person having ordinary skill in the art (“POSITA”) of the ’029 Patent at the time of the claimed invention. In determining the characteristics of a hypothetical person of ordinary skill in the art of the ‘029 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.

29. In my opinion, a POSITA of the ‘029 Patent at the time of its filing would have been a person having a Master of Science Degree (or a similar

technical Master's Degree, or higher degree) in an academic area emphasizing electrical engineering, computer engineering, or computer science with experience or education in optics and imaging systems or, alternatively, a Bachelor's Degree (or higher degree) in an academic area emphasizing electrical, computer engineering or computer science and having two or more years of experience in the field of optical and imaging systems.

30. At the time of the filing of the '029 Patent, a skilled artisan developing a lighting system utilizing LEDs and corresponding controls would have encountered new challenges with respect to both optics and LED controls. Accordingly, it is my opinion that a POSITA would have had experience with both, i.e., engineering and optics.

C. Proposed claim constructions

31. In order to properly evaluate these claims, I understand that the terms of the claims must first be construed. In my opinion, the claims of the '029 Patent do not include any terms that require specific construction. Instead, each of the claims includes terms that an ordinary artisan would understand according to their plain and ordinary meaning.

IV. Overview of the prior art

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

32. Beam discloses an Adaptive Anti-Blinding Headlight ("AABH")

system that is non-mechanical and non-moveable. Beam recognized that existing headlight systems operated “either as a ‘high beam’ or as a ‘low beam’” often under manual control, and various unsatisfactory attempts to solve this problem included “systems which attempt to control the intensity profile of the beam by using a reflector or lens shaped to control the output beam in some predetermined way; systems to move the headlamps in response to changes that occur to the automobile on which they are mounted; . . . movement of headlight beams in response to changes in the vehicle's steering mechanism, etc.” (Ex. 1005, 1:21-23, 1:63-2:5.)

33. Beam solves the identified problems by providing a non-moveable AABH system having a multiplicity of microbeams that “will operate at maximum intensity at all times” allowing “the driver to have the equivalent of high beam headlights or brighter on at all times, greatly enhancing the ability to see at night.” (Ex. 1005, 6:11-12, 6:54-55, emphasis added.) Beam further discloses that:

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

* * *

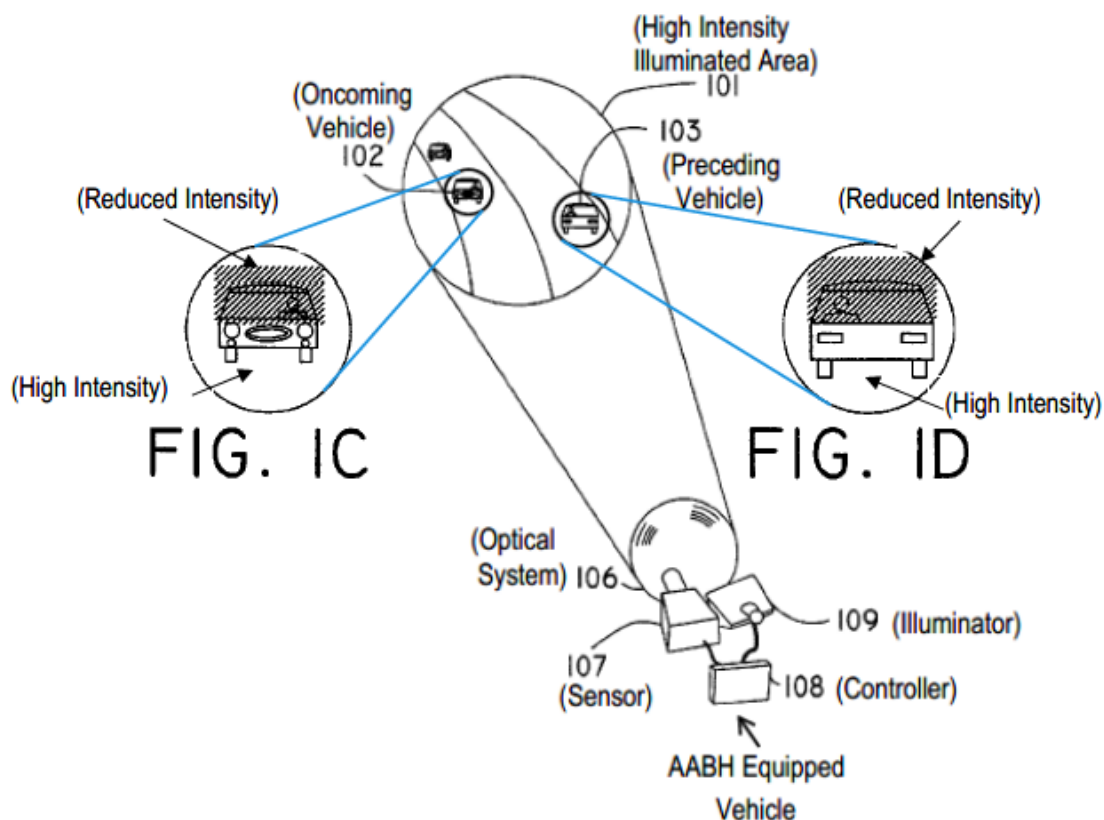
Accordingly, several objects and advantages of this invention are to provide greatly improved safety and comfort to the motoring public,

in particular, and to others who may be affected by them by providing the driver of an automobile equipped with the instant invention with a far brighter headlight beam while simultaneously protecting the drivers of all vehicles ahead from being dazzled by the light.

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

34. A POSITA 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.

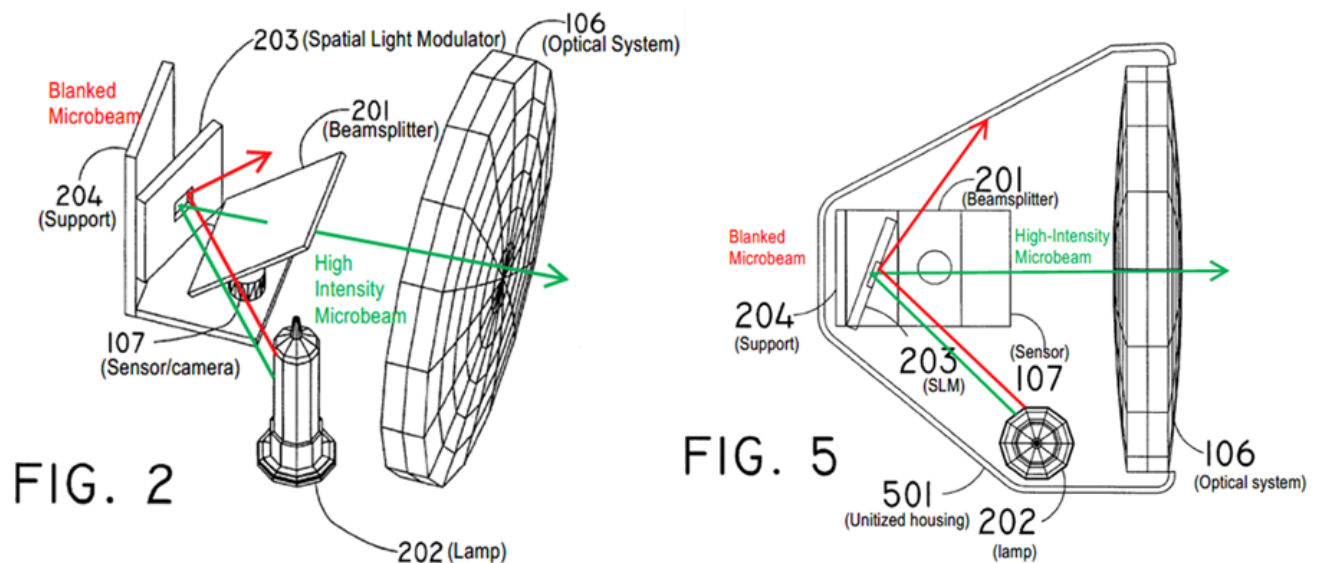
35. Beam provides significantly **reduced** illumination only in those portions of the headlight beam that would otherwise dazzle or annoy other drivers. This is accomplished by “darken[ing] those microbeams that would otherwise illuminate areas near to the source of the impinging beam, thus eliminating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



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

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

37. 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.

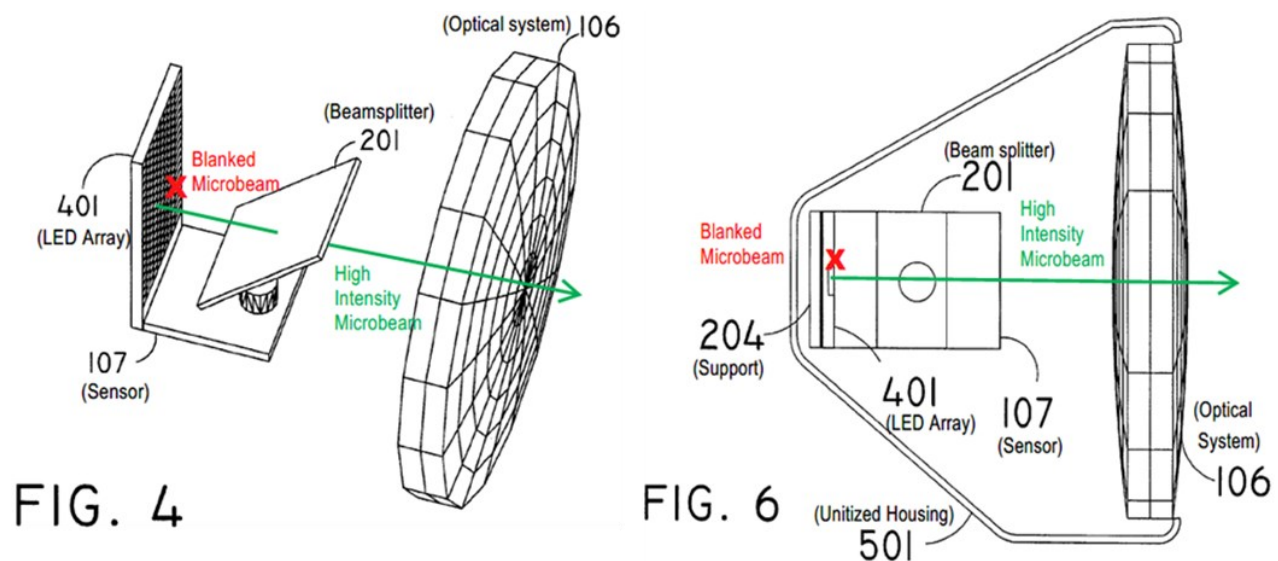


(Ex. 1005, FIGs. 2, 5, Annotated)

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

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

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



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

39. 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.

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

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

42. As detailed in Section V.A., Petitioner relies on a combination of their own creation, in which the spatial light modulator, 203 in the embodiment of

Figures 2 and 5, is inserted into the LED array embodiment of Figures 4 and 6. In doing so, Petitioner improperly conflates the functionality of the embodiments and ignores Beam's express teaching that the lamp AND modulator are replaced by the LED array in the second embodiment. A POSITA would never interpret the SLM as being included in the LED embodiment because the functionality of the two components is redundant, and thus unnecessary.

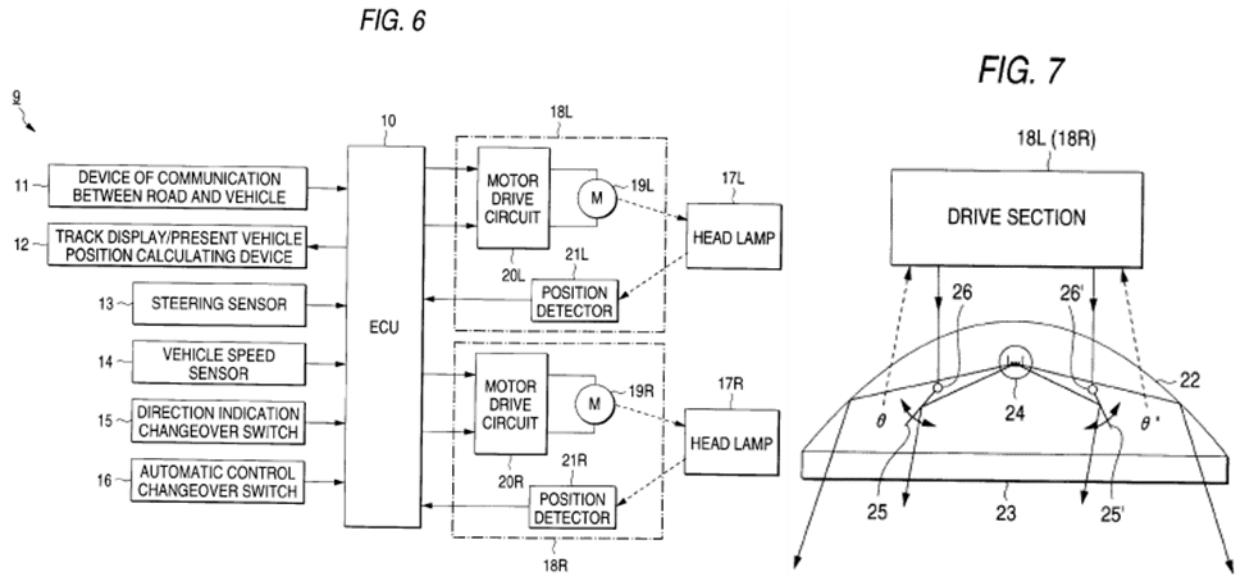
43. Notwithstanding Petitioner's assertions, a POSITA would clearly understand that Beam does not disclose 1) LEDs with controllable directionality, 2) the ability to point or steer the headlight beam for any purpose, or 3) the ability to "increase light" beyond a "maximum intensity" in any direction.

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

44. Kobayashi is directed to a mechanical headlight control system that changes direction or range of a headlight beam using map information unless a predicted vehicle travel direction as indicated by a turn indicator, steering angle, and vehicle speed/acceleration differs from the map data, i.e., "[w]hen the vehicle advancing direction at which the driver aims does not coincide with the profile of the road." (Ex. 1008, 4:39.) More specifically, Kobayashi discloses a headlamp system with moveable components to control irradiation (illumination) direction and range in accordance with a road profile when the vehicle travels along a scheduled course, or in accordance with a steering angle and vehicle speed when

the predicted advancing direction of the vehicle deviates from the scheduled course (Ex. 1008, 6:4-10; 17:59-67.) A “mechanical” and “moveable” system as used in this context refers to a system with moving parts and/or mechanisms to position the light beam.

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



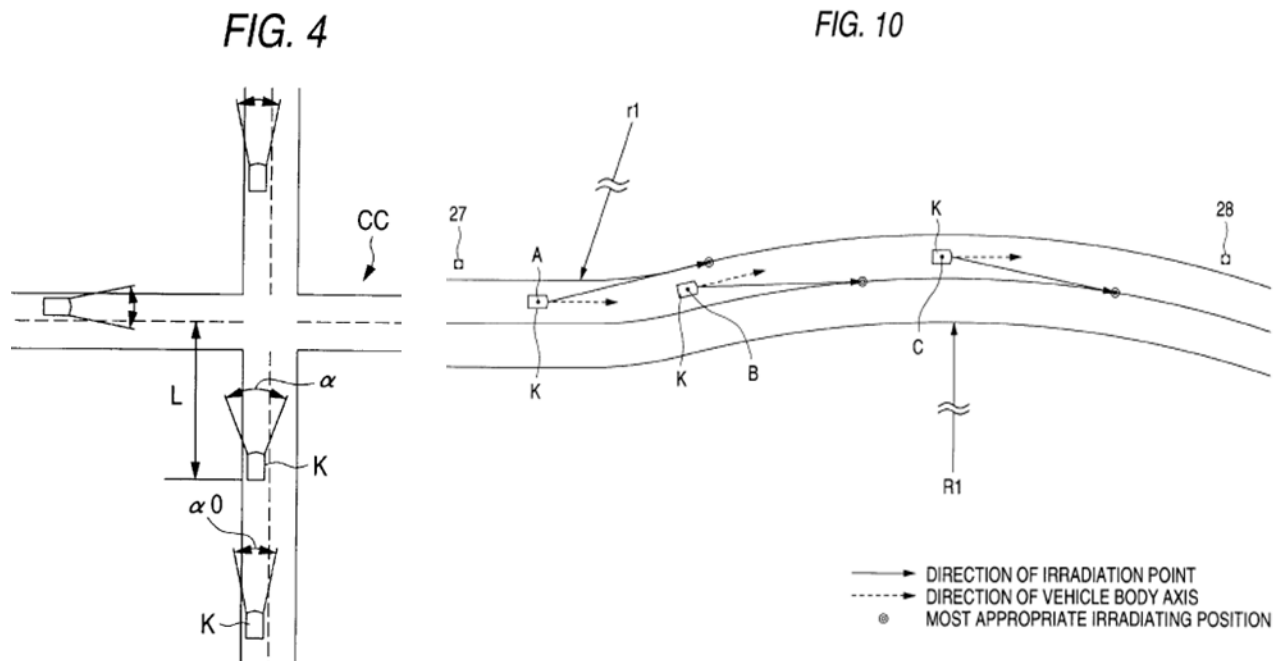
(Ex. 1008, FIGs. 6, 7)

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

47. 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. 1008, 11:5-14.)

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



(Ex. 1008, FIGs. 4, 10)

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

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

50. Kobayashi clearly does not disclose: 1) LEDs or any other “digital” lighting sources; 2) a light sensor or detecting light for any purpose; or 3) any control of headlight irradiation direction or range related to anti-blinding or preventing glare for preceding or oncoming vehicle drivers.

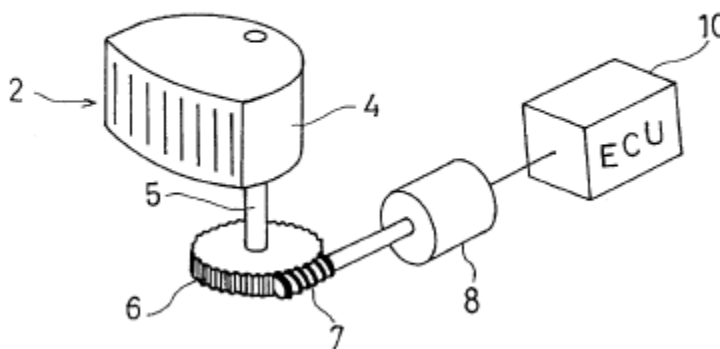
C. Gotou: U.S. Patent No. 8,588,733

51. Gotou discloses a mechanical headlamp system with moveable headlamps. Gotou's headlamps are rotated by a motor to change leftward/rightward illumination direction using map information indicative of forward road shape, or in accordance with vehicle signals such as a direction indicating signal, a steering angle signal, and a vehicle speed signal “in the case that a vehicle runs on a place having no road information in a navigation system or

the vehicle turns out of the planned course.” (Ex. 1012, 1:42-2:18, Abstract, Fig. 4.)

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

FIG. 2

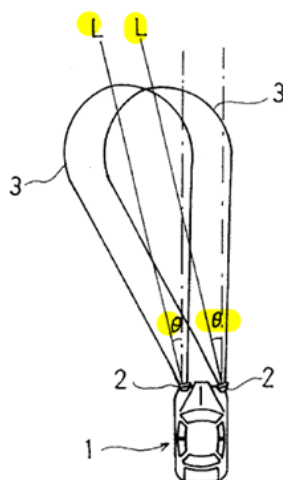


(Ex. 1012, FIG 2)

53. As shown below in Figure 1 of Gotou, each headlight 2 provides light along a single optical axis L. “The right and left headlights 2 and 2 are swung together in the same direction by the same angle and shown in FIG 1, angles of their optical axes L and L, with respect to the advancing direction of the vehicle, i.e. optical axis angles are both set to be θ .” (Ex. 1012, 3:31-35.) Optical axes L and L are imaginary straight lines that pass through the center of the corresponding

headlight projection, resulting in light output that is symmetric with respect to the optical axis at the chosen angle. Notably, while Gotou relies on adjustments to the optical axes to change the lighting region “in front of the vehicle in rightward and leftward directions,” it does not contemplate turning lamp unit 4 on/off or otherwise changing its intensity. (Ex. 1012, 1:60-64.)

FIG. 1



(Ex. 1012, FIG 1, Annotated)

54. The driving of motor 8 is controlled by a light distributing control ECU 10, depicted in FIG 3. Under the mechanical control system of Gotou, the ECU processes a series of inputs from the map information and vehicle signals such as a “direction indicating signal,” “a steering angle signal” and a “vehicle speed signal” and “processes the information and signals to determine a requisite optical axis angle θ and an indicating signal is outputted to a motor driver 14 so as to achieve the optical axis angle θ , and thereby the right and left motors 8 and 8 are

controlled in driving with the motor driver 14.” (Ex. 1012, 3:51-66.) When the “winker lever is operated, the optical axis angle is changed at once to a predetermined angle for lighting the turning direction of the vehicle early, and the determined optical axis angle is larger as the vehicle speed is faster.” (Ex. 1012, 4:58-64.)

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

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

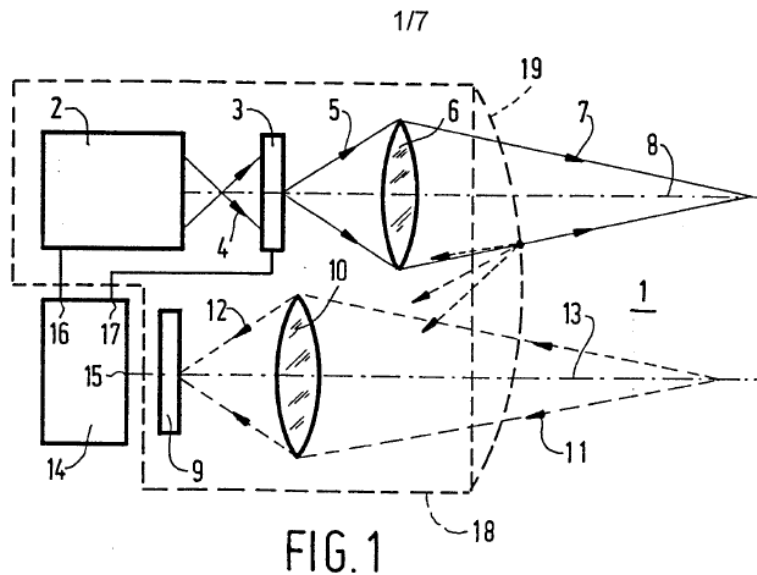
(Ex. 1012, 1:21-29, emphasis added.)

56. On review of the Gotou reference in its entirety, a POSITA would also understand that Gotou does not disclose: 1) LEDs or any other “digital” lighting source; 2) fixed or non-moveable light sources, 3) headlamps with multiple light sources with corresponding multiple optical axes; 4) any light sensor or other sensor to detect forward vehicles, or 5) any functions related to anti-blinding or preventing glare.

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

57. Karlsson discloses a non-mechanical headlight system with fixed, non-moveable arrays of LEDs. Individually controllable LEDs create “spotlight beams” to provide forward illumination brighter than low beams or dipped headlights with light sensors to provide anti-blinding functionality by turning off LEDs corresponding to detected light. Unlike similar prior art systems that use a light sensor mounted to the windscreen, Karlsson provides light sensors interspersed with the LEDs. The LEDs are dimmed or blanked during light sensor measurements so light from the LEDs doesn’t interfere with detecting light from oncoming traffic. (Ex. 1010, Abstract, 2:10-29.)

58. In particular, Karlsson discloses “a lighting device 1 . . . [with] lighting means in the form of a light source 2 and light modulator means 3.” (Ex. 1010, 8:10-18.) “The light source 2, the light modulator means 3 and the lens 6 are arranged on an optical axis 8” to form light 5 “into a desired emitted light beam 7.” (*Id.* at 8:10-18.) The system includes “sensor means consisting of a light-sensitive sensor 9 and a further lens 10 disposed on the side of sensor 9 that is exposed to the incident light, such that incident light 11 on the lens 10 is formed into an incident light beam 12 on light-sensitive sensor 9.” (*Id.* at 8:19-23.)



(Ex. 1010, FIG 1)

59. Karlsson further discloses that “[t]he light modulator means 3 are controlled by the control means 14 in such a manner that the light 4 emitted by the light source 2 is processed into a light beam 7 having a desired pattern and intensity” that is “determined on the basis of the light 11 that is detected by the light-sensitive sensor 9 via the further lens 10.” (*Id.* at 9:3-8.) Controlling “the pattern and the intensity of the light beam 7” of a headlight “in such a manner that no light at all or light having a low intensity is emitted in those directions from which light is detected by the light-sensitive sensor 9” prevents “glaring or blinding of oncoming traffic.” (*Id.* at 9:18-23, emphasis added.)

60. “[C]ontrol means 14 are preferably arranged to switch the incident light 5 on the lens 6 periodically on and off” and detecting incident light with the sensor 9 “during the time that the light 5 is off” avoids “reflected light being

scattered by the cover glass 19 as indicated by dashed arrows.” (*Id.* at 9:27-33.)

61. With reference to Figure 6, Karlsson discloses “a light beam 33 which is composed of separate, spatially distributed . . . spotlight beams 34.” (*Id.* at 13:31-32.) The “spotlight beams 34 can be obtained, for example, by using a light source 2 which is composed of a grid of separate light sources, such as LEDs, which can preferably be controlled either individually or in groups.” (*Id.* at 14:1-4, emphasis added.)

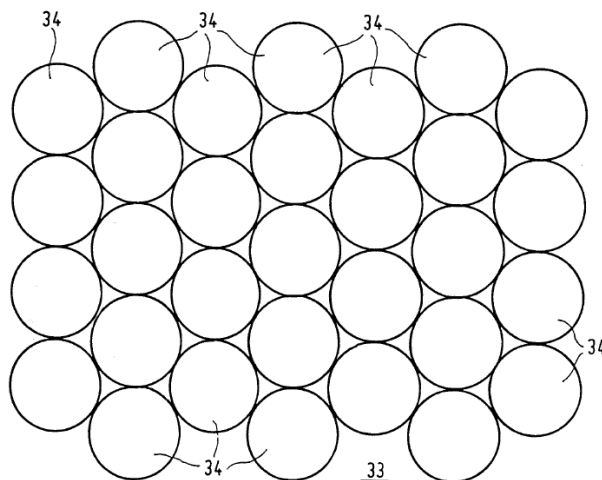


FIG. 6

(Ex. 1010, FIG 6)

62. Referring to Figure 14, “a number of the spotlight sources are grouped in specified levels” where “non-shaded spotlight sources indicated at D provide the dipped light function in accordance with existing vehicle headlights, whilst the single-shaded spotlight sources indicated at I provide the main-beam light function of existing vehicle headlights.” (*Id.* at 19:23-28.) Further “[t]he double-shaded

spotlight sources indicated at D/I are both operative as dipped and main-beam [lights].” (*Id.*)

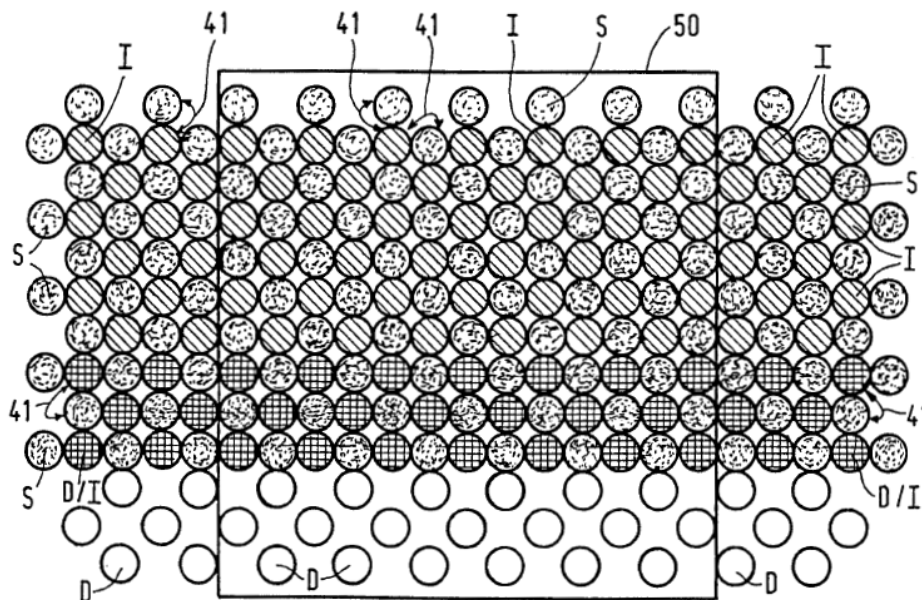


FIG. 14

(Ex. 1010, FIG 14)

63. The “emitted light beam 50 is represented as a window which can shift in the plane of the drawings from the left to the right and from the top to the bottom, if desired, and vice versa, and which may vary as regards its shape and dimension in dependence on the desired pattern and direction of the beam” (*Id.* at 19:29-33.)

64. Any shifting of the emitted light beam is constrained by the number and arrangement of LEDs within the LED array and is not capable of swinging the emitted beam optical axis in the direction of a curve. (Ex. 1010, 20:24-32.)

65. On review of the Karlsson reference in its entirety, a POSITA would understand that Karlsson does not disclose: 1) changing direction of the emitted beam to adapt to the road; 2) changing the emitted beam before an upcoming curve; or 3) use of GPS/map data.

V. Grounds for Challenge

A. A Person of Ordinary Skill in the Art Would Not Have Been Motivated to Combine Beam and Kobayashi or Gotou and Karlsson

1. Inoperable

66. I understand that if a proposed modification would render the prior art invention being modified unsatisfactory for its intended purpose, then there is no suggestion or motivation to make the proposed modification.

a. Ground 1 – The Proposed Combination Defeats Beam’s High-Intensity Illumination “At All Times” and Renders Beam Inoperable

67. Petitioner admits on pp. 26-27 that “Beam does not disclose using map data, such as from GPS or navigation beacons, as an input to control the intensity, shape, and/or angular position of the LEDs (or their resultant beam)” but Petitioner asserts that “it would have been obvious to a POSA to do so” to make “Beam’s system even more active than prior systems”—parroting unsupported expert opinion devoid of any actual evidence.

68. Beam contravenes Petitioner's unsupported arguments. Beam expressly disparages prior art devices that control "the shape and direction of the headlight beam" "in a predetermined profile that is expected to cause the fewest problems to the oncoming drivers under a variety of circumstances"—referring to them as a "compromise, at best between reducing glare and providing enough light to the driver for adequate visibility." (Ex. 1005, 2:15-22). Contrary to Petitioner's assertions, Beam has no need for map data to provide curve illumination or beam shaping and would not benefit in any way from having the map data or control strategies disclosed by Kobayashi.

69. Beam sought to solve the problems associated with systems such as the one provided in Kobayashi "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" and systems that control "movement of headlight beams in response to changes in the vehicle's steering mechanism, etc." (*Id.* at 1:60-2:5.)

70. Petitioner's proposed modification of Beam by adding map data and associated control complexity from Kobayashi would render Beam's AABH system inoperative or unsatisfactory for its stated purpose. In particular, Petitioner's proposed combination would: 1) defeat Beam's stated purpose of providing high-intensity illumination all the time with the only exception being microbeam portions of the headlight beam that would otherwise dazzle other

driver, 2) be inoperative in that Beam's AABH system is incapable of changing the direction of light from the headlamps, or of increasing light beyond maximum intensity of the light source(s), and 3) not accomplish Petitioner's proffered purpose of "improving driver safety" as a result.

71. Petitioner contorts the description of Beam's AABH system using selective *partial* quotes repeatedly taken out of context to conclude that the AABH system somehow controls the direction or steering of one or more microbeams to **increase** light, apparently based solely on the limitations of the Challenged Claims. However, Beam is abundantly clear beginning with the title and extending throughout the detailed description and claims that it is an anti-blinding system that darkens or blanks individual microbeams to **reduce** illumination based on direction of an incoming beam of light, e.g., from an oncoming vehicle, preceding vehicle and/or any other light source.

72. Beam specifically recognizes and disparages prior art attempts to control the direction of the headlight beams, whether in response to vehicle loading, steering wheel, etc. (Ex. 1005, 1:60-2:6.) In contrast to the prior art systems:

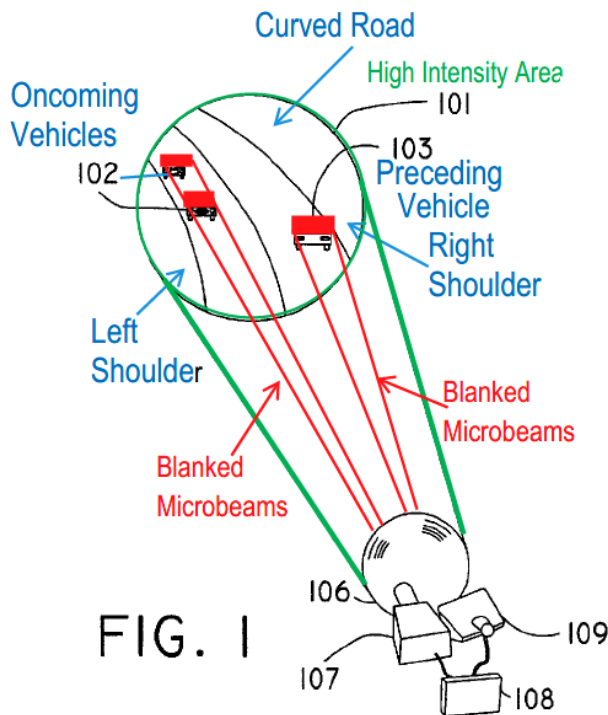
The instant invention solves all of the enumerated problems by automatically sensing the presence and location of headlights and taillights ahead of the car on which it is mounted. It will then control the light output of a group selected from a multiplicity of narrow

angle beams (microbeams) which comprise the overall headlight beam pattern. By controlling an area determined by analyzing the position of the lights sensed ahead, the area of the beam that would dazzle the driver will be darkened, **while maintaining [full] intensity elsewhere.**”

(Ex. 1005, 2:52-64, emphasis added.)

73. The prior art, according to Beam, had problems because it had to choose where to put light, and it was not always correct and/or subject to misalignment. (*Id.* at 2:15-26.) Beam’s solution to the prior art problems associated with changing direction of the headlamp beam is to provide “the equivalent of high beam headlights or brighter on at all times, greatly enhancing the ability to see at night” (*Id.* at 6:53-56.), except for areas where incoming light is detected. Since Beam is already putting high-beam+ light everywhere light could be needed, there would be no reason to provide the ability to change the direction of microbeams in the AABH system. As illustrated in Beam’s Figure 1 as annotated below, the high intensity illumination area 101 is sufficient to illuminate oncoming vehicles 102 and preceding vehicle 103, as well as both lanes of the curved road including the left shoulder and right shoulder. The AABH system prevents blinding drivers of the oncoming vehicles 102 and preceding vehicle 103 by blanking associated microbeams at corresponding angular positions of the X-Y matrix/array of LEDs.

As such, there is no need for the AABH system to point or direct light in any particular direction.



Ex 1005, Fig. 1 (Annotated)

74. Even if changing the direction of microbeams in response to map data as proposed by Petitioner was possible, it would allow the microbeams to illuminate areas outside the field-of-view (FOV) of sensor 107 and thus defeat the anti-blinding operability in at least part of the illuminated area 101. It would also reduce the maximum intensity of illumination of regions within the road ahead, contrary to Beam's stated purpose. For example, changing the direction of microbeams in the direction of an upcoming left hand curve in response to map data would reduce illumination below the maximum possible in regions to the right

of oncoming vehicles 102 and would defeat anti-blinding operability for any vehicles outside of the intersection of the illumination and sensor fields of view.

75. The specification details the central tenet of the Beam reference - to darken the area of the beam that would dazzle the driver, **“while maintaining [full] intensity elsewhere”**:

These AABH headlights will operate at maximum intensity at all times. **An imaging sensor (such as a video camera) faces forward, boresighted with the headlight.** The output of the sensor is connected to the controller. The controller module uses the sensor spatial data (video) **to determine whether there are illumination sources (headlights or tail lights) present in the headlight's field-of-view**, determines their location relative to the Adaptive Anti-Blinding Headlights beam, and uses these data to control the Illuminator. When an oncoming vehicle's headlights are detected (whether or not it is equipped with the AABH system), an area slightly wider than the headlight spacing and approximately six feet high, and whose bottom edge is centered on the oncoming headlights, is **dimmed** in the beam-bundle of the vehicle equipped with the AABH system.

(Ex. 1005, 6:11-19, emphasis added.)

In operation, the AABH produces a multiplicity of individually directed narrow-angle beams which are herein referred to as microbeams, each being controlled by a processor responsive to incoming data from an imaging sensor. Any microbeams that would

blind the oncoming driver **are diverted or attenuated at the source.** Selection of the particular microbeams that form the dimmed area is performed continuously and dynamically (they would be adjusted based on input to the sensor, as opposed to older systems which shape the intensity profile of the beam following a presupposed distribution requirement.) The AABH system will also sense taillights of a vehicle being followed and control those microbeams that would otherwise dazzle or annoy its driver when reflected by a rear-view mirror.

(Ex. 1005, 5:61-6:8, emphasis added.)

76. The Beam specification further underscores that “[t]he primary advantage of the present invention over the prior art is that it produces a beam of high intensity light that enables the driver to see more clearly at night, while simultaneously protecting drivers in front from dangerous glare.” (Ex. 1005, 3:37-41, emphasis added.) Accordingly, the fixed direction of the microbeams operating at maximum intensity would obviate the need to change the direction or angle of illumination to accommodate a curve or any other road feature as alleged by Petitioner to increase illumination, because Beam’s AABH system already operates at maximum intensity and already illuminates such road features while detecting incoming light from forward headlights/taillights. Additionally, Beam’s AABH system processes sensor inputs to significantly reduce, not increase, illumination based on sensor data.

77. Moreover, Beam’s AABH system is incapable of operating as

Petitioner contends. Beam's AABH embodiments provide fixed, non-movable components controllable to reduce intensity of individual microbeams in response to detecting incoming headlights/taillights or other light sources. In the first embodiment illustrated in Figures 2 and 5, the spatial light modulator (SLM) is controlled so that the individual microbeams are either 1) reflected at full intensity out through the headlamp, or 2) any microbeams that would blind the oncoming driver are blanked by being absorbed or deflected to an absorbing surface so that they do not exit the headlamp, i.e., "microbeams that would blind the oncoming driver are diverted [] at the source." (Ex. 1005, 5:65-66, emphasis added.) The SLM is thus not capable of pointing or otherwise changing direction of microbeams exiting the headlamp.

78. Similarly, the second embodiment illustrated and described with respect to Figures 4 and 6 *replaces* the SLM 203 and lamp 202 with individually controllable light sources, such as an array of LEDs, that generate the narrow-angle LED beams, and are selectively attenuated or blanked to prevent blinding/dazzling other drivers. As a POSITA would understand from review of the Beam reference, the disclosed LED array has no controllable elements capable of changing the position or otherwise pointing or steering the associated microbeams illuminating the road.

79. As such, Petitioner's proposed combination renders Beam's AABH

system unsatisfactory for its intended purpose of providing maximum intensity illumination everywhere (other than regions surrounding detected light sources) all the time without the use of moving components. Furthermore, the proposed combination is inoperable in that, unlike Kobayashi's system that changes position of components (such as reflecting mirrors lenses, or shades) relative to one another to change a horizontal irradiating angle α . (Ex. 1008, 8:1-32.), Beam's LED embodiment of Figures 4 and 6 has no way of controlling the direction of output light in response to Kobayashi's map data. Perhaps more importantly, it has no *need* to control the direction of emitted light, as it already fully illuminates the FOV of the headlights (and FOV of the aligned, bore-sighted sensor) at "maximum intensity." Accordingly, there is no suggestion or motivation to make Petitioner's proposed combination and modification.

**b. Ground 2 – Removing Gotou's Moving Parts Would
Render Gotou Inoperable Relative to Swinging the
Optical Axis**

80. Petitioner states that a "POSA would have been motivated to combine Gotou's adaptive vehicle headlamp that uses map data as a control input to predict and adjust illumination direction with Karlsson's controllable LEDs as a light source." (Petition at 55.) Petitioner further states that "Karlsson's controllable LEDs would have simplified controlling the illumination direction and beam shape by removing Gotou's moving parts (e.g., motors), while also providing expanded

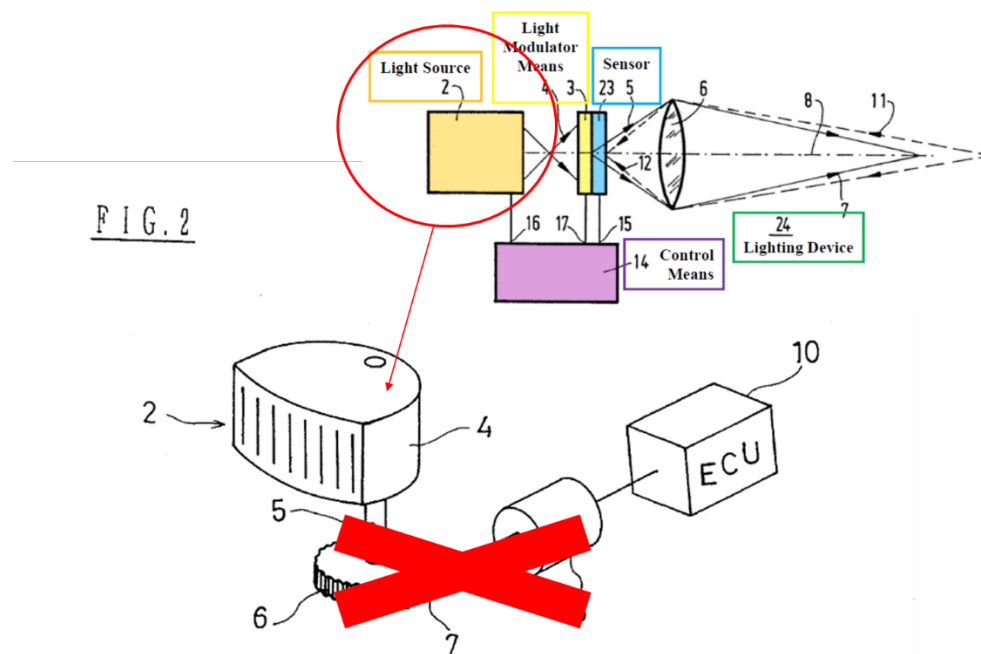
beam shaping abilities.” (*Id.*) However, Karlsson’s “controllable LEDs” are incapable of swinging the optical axis to change the illumination direction as taught by Gotou rendering Petitioner’s combination and modification inoperable for its intended purpose.

81. Gotou discloses a relatively simple “swinging mechanism” for adjusting the optical axis of each headlamp 4. (Ex. 1012, 3:36-41.) With reference to Figure 2, Gotou explains that “a lamp unit 4 of the head light 2 is fixed to a rotary shaft 5, and a worm gear 7 formed at a driving shaft of a motor 8 is engaged with a worm wheel 6 fitted to the rotary shaft 5.” (*Id.*) Gotou further discloses “varying the optical axis toward the planned running direction at an early stage before the steering wheel is actually turned” by controlling the motor 8 of the swinging mechanism. (Ex. 1012, 6:40-44.)

82. Karlsson discloses a lighting device that provides forward illumination, i.e., it projects light in front of a vehicle. (Ex. 1010, Fig. 16.) Karlsson also discloses adapting a light beam pattern by turning off spotlight sources of a light beam while the vehicle is taking a bend, based on a signal from a direction sensor 54 that is connected to a steering wheel, to avoid blinding oncoming traffic: “The direction sensor 54 is in particular intended for determining when the car 56 is taking a bend, so that the light beam 7 can be adapted to prevent the traffic on the other side of the road from being blinded as much as possible.”

(Ex. 1010, 20:22-32.).

83. Removing Gotou's "moving parts" as proposed by Petitioner, would eliminate the ability to "swing" the headlamp to change an angle of the optical axis of the lights prior to a turn, i.e., in a direction that is different from the advancing direction of the vehicle. The following graphic illustrates Dr. Jiao's proposed modification of Gotou's headlight 2 to include Karlsson's light source 2 and to remove its moving parts (swinging mechanism).



Karlsson (Ex. 1010) Fig. 3 (Annotated by Petitioner at 62) and

Gotou (Ex. 1012), Fig. 2 (Annotated)

84. Karlsson's LED array is incapable of swinging an optical axis of the beam as disclosed by Gotou. Rather, controlling Karlsson's LED array to laterally

shift the window of active LEDs would shift the beam optical axis left/right for each headlight as indicated in red in the figure below, with the maximum shift constrained by the limited width of the array as indicated in blue in the figure below - resulting in a beam that may shift laterally, but would still be aimed in the same direction as the vehicle (i.e., forward).

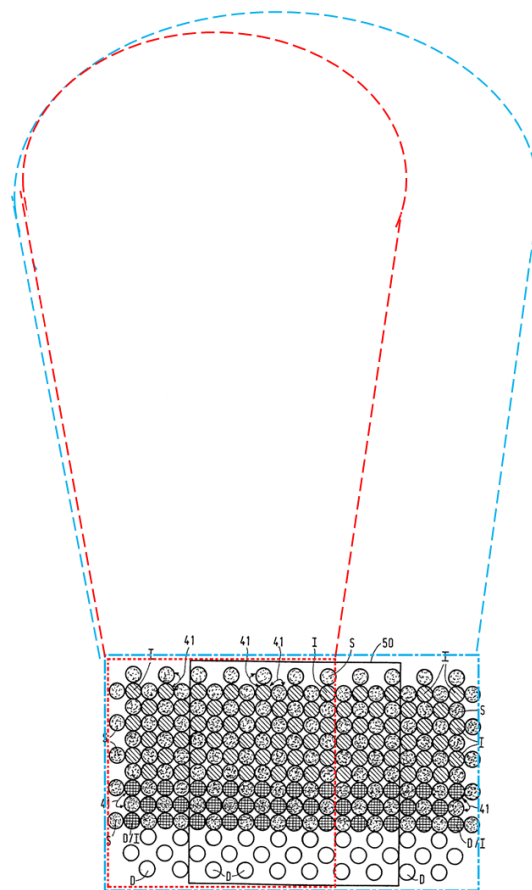
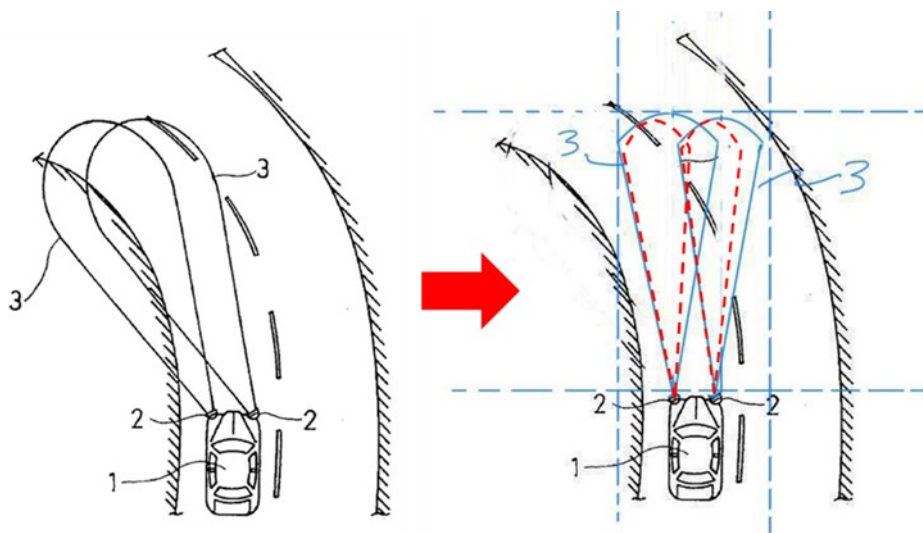


FIG. 14

(Ex. 1010, Fig. 14, Annotated)

85. As shown in the annotated figure below, Gotou, as modified by Karlsson, may provide a limited shift of the beam while maintaining forward illumination within the revised lighting region (3, 3). The blue cones define the

maximum beam spread of the headlights of Petitioner's proposed Gotou/Karlsson combination, and the red cones represent the shifting window as taught by Karlsson within the maximum beam spread of the LED array. Thus, Petitioner's proposed Gotou/Karlsson combination as shown in Figure 9 (below right) would result in a subset of the blue beam cone being illuminated. This minor shift is insignificant with little to no curve illumination when compared to Gotou's unmodified lighting regions resulting from swinging/rotating the optical axis shown in Figure 9 (below left).



Ex. 1012, Fig. 9 (Annotated)

86. Thus, Petitioner's proposed modification to Gotou would render Gotou unsatisfactory for its intended purpose of "varying the optical axis . . . before the steering wheel is actually turned." (Ex. 1012, 6:40-44.) Furthermore, there would be no adjustment to the optical axis by an angle θ as required by

Gotou. Accordingly, there is no suggestion or motivation to make Petitioner's proposed modification. Rather, there are good reasons not to make the proposed modification.

2. Teaches Away

87. I understand that an inference of nonobviousness is strong where the prior art's teachings undermine the very reason being proffered as to why a person of ordinary skill would have combined the known elements.

a. Ground 1 – Beam Teaches Away from Kobayashi's Steering of the Headlight Beam

88. Beam provides “a headlight with an output comprising a multiplicity of microbeams projecting a composite beam of light in the forward direction” and darkening microbeams that would blind a driver in an oncoming vehicle “while continuing to provide intense forward illumination.” (Ex. 1005, 1:9-18.) Beam identifies problems with various prior art systems including low beam illumination often being too dim to see street signs, terrain features, etc., and availability of using a high beam (even if automatic) may be limited to prevent dazzling drivers of other vehicles. Beam also identifies problems with controlling the shape and direction of headlight beams. (Ex. 1005, 1:60-2:50.) Beam specifically disparages systems such as disclosed by Kobayashi that “attempt to control the intensity profile of the beam by using a reflector or lens shaped to control the output beam”

and systems that control “movement of headlight beams in response to changes in the vehicle's steering mechanism, etc.” (*Id.* at 1:61-2:5.)

89. Beam solves all identified problems by providing a “far brighter headlight beam while simultaneously protecting the drivers of all vehicles ahead from being dazzled by the light.” (Ex. 1005, 3:13-15.) As such, it is wholly unclear why a POSITA would have wanted to modify Beam’s LED system with unnecessary features of a mechanical prior art system as disclosed by Kobayashi with known shortcomings.

b. Ground 2 – Gotou Teaches Away from Petitioner’s Proposed Combination

90. Gotou describes the deficiencies of prior art systems that adjust a lighting region based on the steering wheel position:

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

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

91. Relatedly, Gotou underscores “**it is important that a timing of optical axis control is appropriate**” to vary the optical axis toward the planned

running direction **at an early stage before the steering wheel is actually turned.**

(Ex. 1012, 6:40-44, emphasis added.)

92. However, Petitioner’s proposed modification to Gotou would result in a deficient lighting system that is unable to control the LED array of Karlsson to swing the optical axis of illumination as taught by Gotou before the steering wheel is turned, and therefore would operate like the prior art systems that Gotou discourages or “teaches away” from.

3. Petitioner Lacks Explanation of How the Combination Would Operate for its Intended Purpose

93. I understand that an obviousness determination is improper where the record lacks a clear, evidence-supported account of how the combination would work.

a. Ground 1 – Petitioner Does Not Explain How a POSITA Would Have Used Kobayashi’s Map Data to Control Direction of Beam’s Maximum Intensity Microbeams to Increase Light

94. Petitioner does not explain how the AABH system of Beam could use the map data of Kobayashi to determine a light change to increase light as Beam’s embodiments operate at maximum intensity and only disclose significantly reducing illumination. Petitioner does not explain how a POSITA would convert Kobayashi’s mechanical headlamp motor control signals for “rotating the entire lighting device about its axis” or “controlling the posture of a member composing

the lighting device such as a reflecting mirror, lens, light source and shielding member” in response to map data to control blanking of microbeams in Beam’s LED array to increase illumination based on the map data. Petitioner also does not:

- 1) explain how the combined Beam-Kobayashi system would determine which microbeams to blank as compared to which microbeams to change direction;
- 2) explain how Beam’s AABH system would control the direction of the microbeams of Beam’s LED array using Kobayashi’s motor control signals;
- 3) explain how the system would change direction of some microbeams based on Kobayashi’s road profile data “while continuing to provide intense forward illumination” as the AABH system already operates at maximum intensity to provide “bright high beams on at all times”; or
- 4) provide Beam’s anti-blinding feature for microbeams that change direction based on a road profile and are therefore no longer aligned with the field-of-view of Beam’s sensor/camera.

95. As previously described, Beam disparages controlling direction of the headlight beam. Beam’s AABH system is directed to high-intensity forward illumination. As such, neither of the embodiments disclosed by Beam control direction of the headlight beam. Rather, both the SLM and LED embodiments are controlled to blank selected microbeams to provide the anti-blinding features of the AABH system “while continuing to provide intense forward illumination.” Petitioner does not explain how to reconcile Beam’s stated goal of providing

maximum intensity all the time with providing even more than maximum intensity when approaching a curve identified by Kobayashi's map data.

b. Ground 2 – Petitioner Does Not Explain How a POSITA Would Have Used Gotou's Swinging of the Optical Axis Angle with Karlsson's LED Array

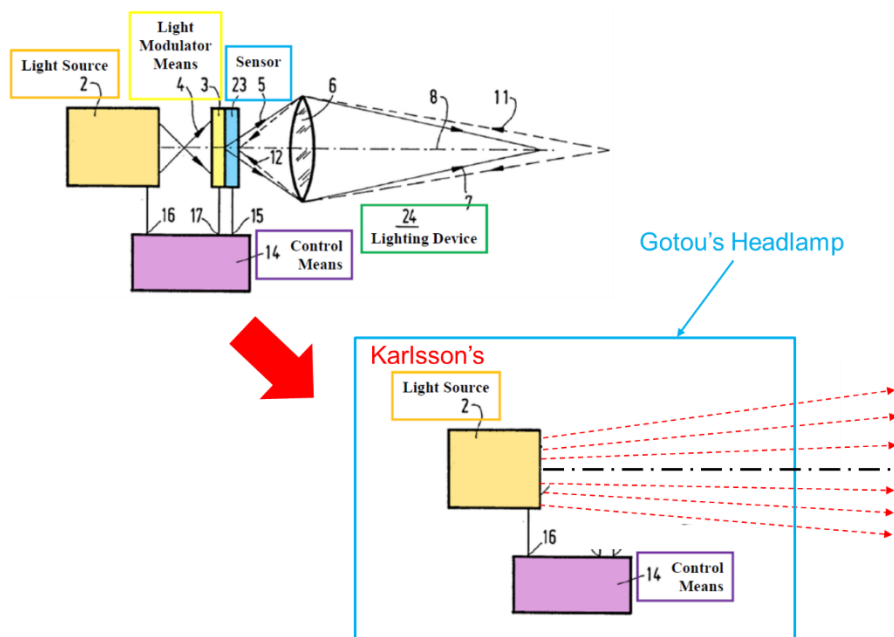
96. Petitioner states that:

A POSA would have had a reasonable expectation of success combining Gotou and Karlsson. EX1003, ¶246. Indeed, a POSA would have understood how to combine the teachings of Gotou and Karlsson by simply substituting Gotou's system with Karlsson's LED array and control, as shown, for example, in Karlsson's Figures 14 (*see also* FIGs. 3 and 15). *Id.*, ¶246.

(Petition at 64.)

97. It is however unclear what features of each of Gotou and Karlsson's systems are retained in the proffered combination. For example, Petitioner discloses modifying Gotou to include Karlsson's light source 2, but not its light modulator means 3 and lens 6 (see Figure 1). However, as shown in the figure below, without these additional components, Karlsson would provide light from the LED array along multiple optical axes. Petitioner thus fails to explain how Gotou's determination of an adjustment to the optical axis angle for a single optical axis applies to Karlsson's LED array that includes multiple optical axes. Petitioner

oversimplifies the differences between the moveable Gotou reference and the fixed LED system in Karlsson, resulting in an incompatible combination.



Karlsson, Ex. 1010, Fig. 3 (Annotated)

98. Petitioner does not explain how “Simply substituting Gotou’s system with Karlsson’s LED array and control” (Petition at 64.) would reconcile Karlsson’s input from “direction sensor 54, which is for example connected to the steering wheel . . . for determining when the car is taking a bend, so that the light beam 7 can be adapted to prevent the traffic on the other side of the road from being blinded” (Ex. 1010, 20:22-32.) that would reduce light, and Gotou’s map information that swings “the optical axis toward the planned running direction at

an early stage before the steering wheel is actually turned” (Ex. 1012, 6:40-44.) that would increase light.

99. Petitioner does not explain how the proposed Gotou-Karlsson combination would operate with respect to: 1) exactly what elements of Karlsson’s “LED array and control” are being substituted into Gotou’s system, and what elements of Gotou’s system those elements replace; 2) controlling Karlssons’s LED array based on Gotou’s determination of motor control signal to adjust an optical axis angle using map information before the steering wheel is turned; and 3) controlling Karlsson’s LED array using Karlsson’s direction sensor while the steering wheel is being turned. Petitioner has therefore failed to explain how and why a POSITA would have modified or combined Gotou and Karlsson.

4. Hindsight Bias

100. I understand that a determination of obviousness cannot be based on the hindsight combination of components selectively culled from the prior art to fit the parameters of the patented invention. Instead, there must be a teaching or suggestion within the prior art, or within the field of the invention, to look to particular sources of information, to select particular elements, and to combine them in the way they are combined by the inventor.

a. Ground 1 – Petitioner Fails to Identify Why a POSITA would Add Map Data to Beam’s AABH System, which Already Illuminates Curves, Without

Hindsight Bias

101. As clearly shown in Figure 1 of Beam and acknowledged by Petitioner, Beam's AABH system provides higher than high-beam intensity that illuminates both lanes of the roadway including oncoming vehicles, a preceding vehicle, left shoulder, right shoulder, and the upcoming curve (and would also illuminate upcoming intersections and any other road feature). As such, Beam's AABH system is agnostic to the road profile. There is simply no plausible reason to add superfluous map data and related control complexity of Kobayashi's moveable mechanical system to Beam's superior AABH LED system that provides high intensity illumination of the driver's entire field of view, other than using hindsight bias in a failed attempt to meet the limitations of the Challenged Claims of the '029 patent.

b. Ground 2 – The only reason for adding an LED array to Gotou's headlight is to meet the '029 Patent claims

102. The proposed combination of Gotou and Karlsson results in a worse, materially deficient form of curve illumination than Gotou provides alone. Therefore, a POSITA would not have been motivated to combine the references. Accordingly, the only *actual* motivation to add Karlsson's LED array was to meet the claim limitations, which is improper.

B. Petitioner’s Combinations of References Do Not Teach the Control Limitations of Independent Claims 1, 12, and 23

103. Independent claims 1, 12, and 23 each require the Predictive Curve Limitation [1.5], [12.5], [23.5] and the Control Limitation [1.6], [12.6], [23.6]. Claim 1 is representative and requires: “*a plurality of headlamps, each comprising a plurality of LED light sources; . . . and . . . one or more processors*” to provide the Predictive Curve Limitation (“*determine a light change, the change adapting a light pattern of the headlamps in at least one of color, intensity or spatial distribution to increase light in a direction of the road curvature ahead of the motor vehicle and shaping light based at least in part on the road curvature*”) and the Control Limitation (“*control at least a first plurality of the LED light sources to provide light based at least in part on the determined light change and prior to the motor vehicle reaching the road curvature*”).

1. Ground 1 – The combination of Beam and Kobayashi does not teach the Control Limitations of Independent Claims 1, 12, and 23

104. Petitioner states that “Beam’s adaptive anti-blinding headlight (AABH) system adjusts vehicle headlight illumination to provide significantly reduced illumination in certain areas to protect the vision of other drivers” on p. 30; Petitioner concludes on p. 37 that “Modified with Kobayashi’s ECU functionality, the combined system uses the map data from Kobayashi’s GPS

navigation device 29 to ‘increase light in a direction of the road curvature ahead of the motor vehicle,’ thus shaping light based in part on the road curvature.”

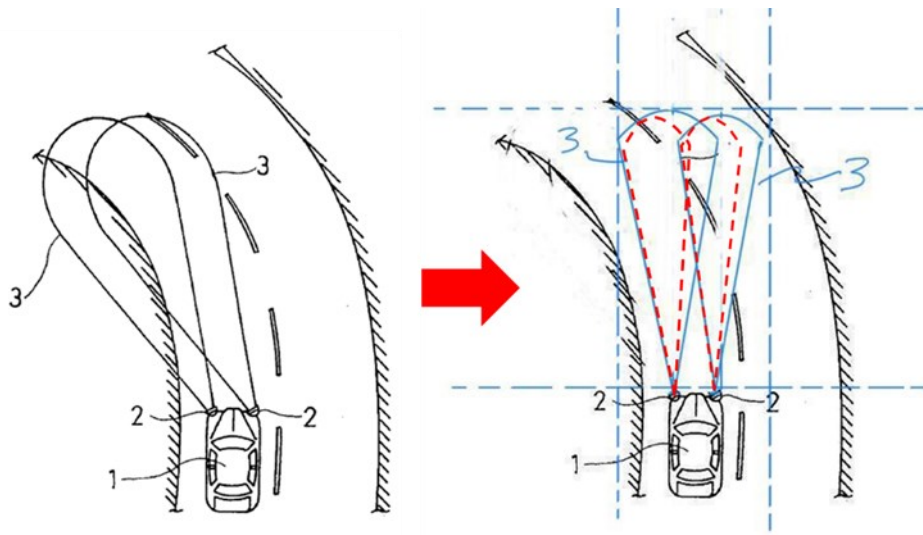
105. However, Petitioner does not explain how a POSITA would have converted Kobayashi’s headlamp motor control signals for “rotating the entire lighting device about its axis” or “controlling the posture of a member composing the lighting device such as a reflecting mirror, lens, light source and shielding member” in response to map data to control Beam’s LED array. Petitioner also does not explain how the combined Beam-Kobayashi system would 1) determine which microbeams to blank as compared to which microbeams to control in a particular direction, 2) how Beam’s AABH system would control the direction of the microbeams using Beam’s LED array, or 3) how the system would INCREASE light in the direction of a curve as claimed “*while continuing to provide intense forward illumination*” as the AABH system already operates at maximum intensity to provide “bright high beams on at all times.”

2. Ground 2 – The combination of Gotou and Karlsson does not teach the Control Limitations of Independent Claims 1, 12, and 23

106. Petitioner relies on Gotou’s headlamp device for satisfying the “*headlamp*” limitations, and Karlsson’s LED arrays for satisfying the “*LED*” limitations. (Petition at 66-67; Ex. 1003, ¶256.) Petitioner also relies on Gotou’s disclosure at 6:40-44 for satisfying the “*control[ling] at least a first plurality of the*

LED light sources to provide light” “to increase light in a direction of the road curvature ahead of the motor vehicle” limitations. (Petition at 78-79; Ex. 1003, ¶282.) Petitioner’s combination of Gotou and Karlsson also includes modifying Gotou to remove its moving parts: “Karlsson’s controllable LEDs (and camera-based glare reduction system) would have simplified controlling the illumination direction and beam shape by removing Gotou’s complex moving parts (e.g., motors), while at the same time providing expanded beam shaping abilities.” (Ex. 1003, ¶234.)

107. However, removing Gotou’s “moving parts” as proposed by Petitioner, would eliminate Gotou’s ability to “swing” the lamps prior to a turn, i.e., in a direction that is different from a current steering angle. Instead Gotou, as modified by Petitioner, would be limited to providing front illumination within the revised lighting region (3, 3), as shown in annotated figure below.



Ex. 1012, Fig. 9 (Annotated)

108. Petitioner’s proposed combination of Gotou and Karlsson, including modifying Gotou to remove its moving parts, does not teach one or more processors to “*control at least a first plurality of the LED light sources to provide light*” “*in a direction of the road curvature ahead of the motor vehicle*” “*based at least in part on the determined light change and prior to the motor vehicle reaching the road curvature*” as claimed.

VI. Conclusion


109. 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.

110. 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: 02/28/2023



Matthew A. Turk PhD