UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE PATENT TRIAL AND APPEAL BOARD

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PORSCHE CARS NORTH AMERICA, INC.,
Petitioner

v.

YECHEZKAL EVAN SPERO,
Patent Owner

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Case IPR2023-01122

U.S. Patent No. 11,208,029 B2

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**PETITION FOR *INTER PARTES* REVIEW**
**OF U.S. PATENT NO. 11,208,029**

**Mail Stop PATENT BOARD**
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| **1001** | U.S. Patent No. 11,208,029 B2 to Spero ("the '029 patent") |
| **1002** | Prosecution File History of U.S. Patent No. 11,208,029 B2 ("'029 File History") |
| **1003** | Declaration of Scott Andrews |
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| **1005** | U.S. Patent No. 6,144,158 to Beam |
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| **1007** | *Intentionally Left Blank* |
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| **1009** | WIPO Patent Publication No. 2002/04247 to Braun *et al.* |
| **1010** | WIPO Patent Publication No. 1998/54030 to Karlsson |
| **1011** | WIPO Patent Publication No. 2001/01038 to Harbers *et al.* |
| **1012** | U.S. Patent No. 5,588,733 to Gotou |
| **1013** | *Intentionally Left Blank* |
| **1014** | *Intentionally Left Blank* |
| **1015** | Westermann, "History and Scientific Back-up," 48th Session of GRE, EUREKA Project 1403, Informal Document No. 30, April 30, 2002 |
| **1016** | "Adaptive Front Lighting Systems (AFS)," 48th Session of GRE, EUREKA Project 1403, Informal Document No. 28, April 12, 2002 |

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| **1018** | Löwenau et al., "Adaptive Light Control – A New Light Concept Controlled by Vehicle Dynamics and Navigation, SAE Transactions, Vol. 107, No. 6, pp. 33-38, February 26, 1998 |
| **1019** | Manassero et al., "Adaptive Headlamp: A contribution for Design and Development of Motorway Light," SAE Transactions, Vol. 107, No. 6, February 26, 1998 |
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| **1022** | U.S. Patent No. 5,975,734 to Müller |
| **1023** | Manassero et al., Adaptive Lighting Systems: Technical Solutions and Methodological Approach for Photometric Specifications, Progress in Automotive Lighting Vol. 6, pp. 514-525 (1999). |
| **1024** | Hanno Westermann, Lighting Performance Requirements in Vehicle Lighting Exemplified by System Requirements for AFS, Progress in Automotive Lighting Vol. 6, pp. 807-820 (1999). |
| **1025** | Diem et al., Analysis of the Eye-Movement Behaviour During Use Moveable Headlamps, Progress in Automotive Lighting Vol. 5, pp. 185-207 (1999). |
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| **1027** | Alejandro Vukotiich, Evaluation of the applicability of digital maps for the reconstruction of the real street shape, Progress in Automotive Lighting Vol. 6, pp. 774-790 (1999). |

| *Exhibit #* | *Description* |
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| **1028** | Bernhard Wörner, Adaptive Frontlighting – Experimental System, Development and Functional Evaluation, Progress in Automotive Lighting Vol. 6, pp. 844-853 (1999). |
| **1029** | Mark van den Berg, Development of high Brightness LED's for Automotive Applications, Progress in Automotive Lighting Vol. 9, 987-993 (2001). |
| **1030** | Assessment of Headlamp Glare and Potential Countermeasures, Survey of Advanced Front Lighting System (AFS) Research and Technology, National Highway Traffic Safety Administration (2005) |
| **1031** | Watanabe et al., The Research on the Effectiveness of AFS Bending Lamp in Japanese Road Environment, Progress in Automotive Lighting Vol. 9, 1042-1053 (2001). |
| **1032** | First Amended Complaint, *Torchlight Techs. LLC v. Daimler AG, et al.*, Civil Action No. 1:22-cv-00751 (D. Del.), filed August 26, 2022 (ECF No. 24) |
| **1033** | File History of *Ex Parte* Reexamination of U.S. Patent No. 9,955,551, Control No. 90/014,815 |
| **1034** | U.S. Patent No. 6,127,947 to Uchida *et al*. |

# I. INTRODUCTION AND TECHNOLOGY OVERVIEW

Petitioner Porsche Cars North America, Inc. ("Petitioner") requests *inter partes* review ("IPR") and cancellation of claims 1-33 of U.S. Patent No. 11,208,029 ("the '029 patent") to Yechezkal Evan Spero, purportedly exclusively licensed to Torchlight Technologies LLC (collectively "Patent Owner"). EX1032, Amended Complaint, 8.

By 2000—several years before the earliest possible priority date, all technologies claimed in the '029 patent were well-known by developers of adaptive automotive lighting systems. No individual claim elements were new and there was nothing new about how those elements were combined in the claims.

Indeed, Ground 1 demonstrates why it would have been obvious to modify an LED adaptive headlamp to utilize map data as an additional control input; and Ground 2 demonstrates why it would have been equally obvious to modify a map data input controlled adaptive headlamp to utilize LEDs as light sources. Thus, claims 1-33 would have been obvious no matter how a person of ordinary skill in the art ("POSA") viewed the prior art. EX1003, ¶61.

Petitioner's expert, Scott Andrews has a bachelor's degree and a master's degree in electrical engineering, and several decades of industry experience with automotive control systems. EX1003, ¶¶ 9-20. His testimony supports that the Grounds demonstrate the conventional functionality of the '029 patent claims,

rendering all claims unpatentable. *Id.*, ¶¶1-40. The claimed adaptive LED headlamps—controlled using map data to light road curvatures—would have been obvious. *Id.*, ¶61.

Adaptive headlamp lighting to control illumination characteristics was well-known. As early as the 1940s and 1950s, vehicles such as the Tucker Torpedo and Citroen DS-19 included headlamps that swiveled with the turning angle of the wheels via mechanical linkage. EX1030, 3-4. EX1003, ¶47. From 1992-1999, a global consortium of headlamp and automotive manufacturers participated in the EUREKA project to advance adaptive front lighting systems (AFS). EX1003 ¶47; EX1015, 3-6; EX1016, 1-19; EX1023, 514-15; EX1024, 819.

By 1997, adaptive (dynamic) lighting was designed to increase driving safety and visual comfort over fixed (static) headlamps. EX1003, ¶48; EX1017, 3-10; EX1018, 33-36; EX1019, 1-2; EX1020, 368, 370, 374-378; EX1024, 819; EX1025, 202; EX1028, 844. Multiple directional light sources produced an adaptive light pattern by varying illumination characteristics including intensity, shape, color, direction around curves, and glare. EX1003, ¶¶48-50; EX1017, 3-10; EX1018, 33-36; EX1019, 1-2; EX1020, 368, 370, 374-378.

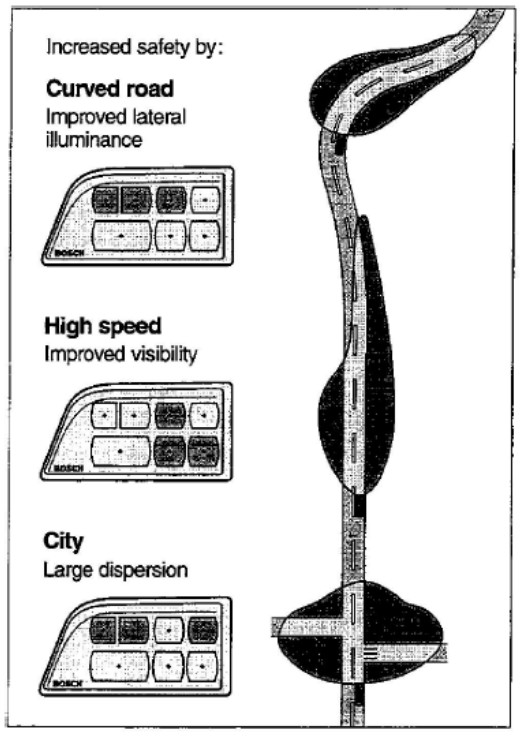



*Fig.1: Three standard driving situations with adapted light pattern seen from the bird eye's view.*

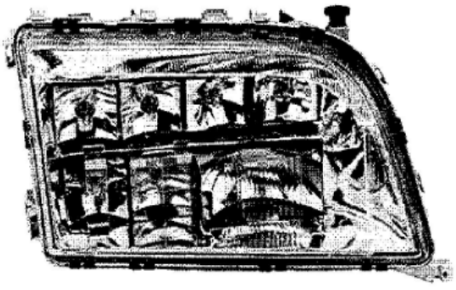
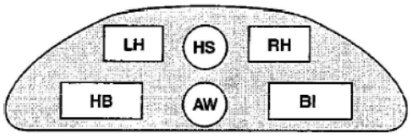


Fig 4: ALP *headlamp* sample




Single components:

LH Left hand bend
RH Right hand bend
HB High beam
BI Basic illumination
AW Adverse weather illumination
HS Hot spot

Fig. 5 Advanced ALP sample layout

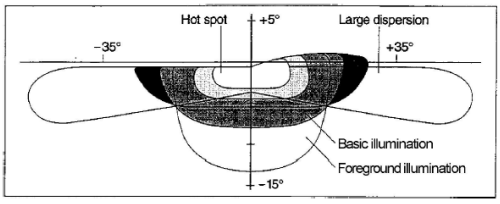



Fig. 3: Light pattern of multiple beam *headlamp* (*Isolux* curves in wall projection):
The individual light *pattern* of multiple sub-units sum up to the total adaptive light pattern

EX1017, FIGS. 1 and 3-5.

Adaptive lighting to reduce glare within a field-of-view was also well-known. By 2000, adaptive headlamps with multiple directional light sources and sensors detected and reduced glare for oncoming/preceding vehicles. EX1003, ¶¶51-52; EX1005, Beam, 1:5-3:44, 4:9-59; EX1010, Karlsson, 1:10-26, 9:18-26, 20:29-32; *see also* EX1015, 6-18, 21; EX1009, Braun, 16:6-25, 20:15-33; EX1023, 514-15; EX1024, 815-16. Arrays of independently controlled narrow-beam directional light sources (e.g., LED arrays) were developed with sufficient illuminance, directionality, and dynamic control as an improvement over traditional incandescent and gas discharge bulbs, providing adaptive light patterns from real-time feedback. EX1005, 1:5-3:44, 4:9-59; EX1010, 1:10-26, 9:18-26, 20:29-32;

EX1015, 6-18, 21; EX1009, 16:6-25, 20:15-33; *see also* EX1029, van den Berg, 987. Moreover, using map data (e.g., GPS) to control directionality of headlamp lighting was also well-known. EX1003, ¶¶53, 57; *See e.g.*, EX1008, Kobayashi, Abstract, 1:10-63; EX1012, Gotou, Abstract, 1:6-47, 51-59, 3:24-4:49, 8:9-41; *see also* EX1025, 186; EX1026, 461-62; EX1024, 815-6; EX1023, 525; EX1027, Abstract.

## II. GROUNDS FOR STANDING (37 C.F.R. § 42.104(A))

Petitioner certifies that the '029 patent is available for IPR. Petitioner is not barred or estopped from requesting IPR. This Petition is timely because it is filed within one month of the Board's institution decision in IPR2022-01586 on May 24, 2023, which Petitioner has filed a motion to join. *See* 35 U.S.C. §§ 315(b), (c); 37 C.F.R. § 42.122(b).

## III. IDENTIFICATION OF CHALLENGE (37 C.F.R. § 42.104(B))

| Ground | References | Basis | Claims |
|---|---|---|---|
| 1 | Beam, Kobayashi | §103 | 1-33 |
| 2 | Gotou, Karlsson | §103 | 1-33 |

The '029 patent is not entitled to the July 12, 2002 priority benefit of its earliest-filed provisional application, but even if it were:

- **Beam, U.S. Patent No. 6,144,158**, issued November 7, 2000, is prior art under § 102(b).

- **Kobayashi, U.S. Patent No. 6,049,749**, issued April 11, 2000, is prior art under § 102(b).
- **Gotou, U.S. Patent No. 5,588,733**, issued December 31, 1996, is prior art under § 102(b).
- **Karlsson, WIPO Patent Publication No. 98/54030**, published December 3, 1998, is prior art under § 102(b).

## IV. THE '029 PATENT

### A. Summary

The '029 patent claims are directed to systems and methods previously known in the art for controlling LEDs in vehicle headlamps using map data (e.g., from GPS or navigation beacons) indicating a road curvature. The claims recite known control schemes implemented by a known controller so that particular LEDs are on or off (or dimmed) based on a known control input, map data, for better visibility around curves. EX1003, ¶¶2, 53. Thus, a known control input (map data) is applied to a known way of controlling light patterns and intensity (vehicle headlamp LED array). *Id.*

Claim 1 recites a system to:

> *receive* first data, *including at least map data, indicating a road curvature upcoming along a road* on which the motor vehicle is traveling;

*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

*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*.

'029 patent, claim 1.[1] The dependent claims merely add known features: responding to additional curves; known glare-reduction techniques (e.g., using camera sensors); and other inputs to adjust beam intensity, direction, etc. EX1003, ¶54.

The '029 patent's system includes a headlamp 270, a controller 279, and sensors 280 on a vehicle 271. EX1001, 53:24-56:61, FIG. 15. Headlamp 270 includes one or more clusters 276 (290), 281 (282), 285 (286), 287 (288, 289) of differently aimed solid-state light sources such as LEDs 275, 277, 278, 283, 284. *Id*.; EX1003, ¶55.

[1] Emphasis added throughout, unless noted.

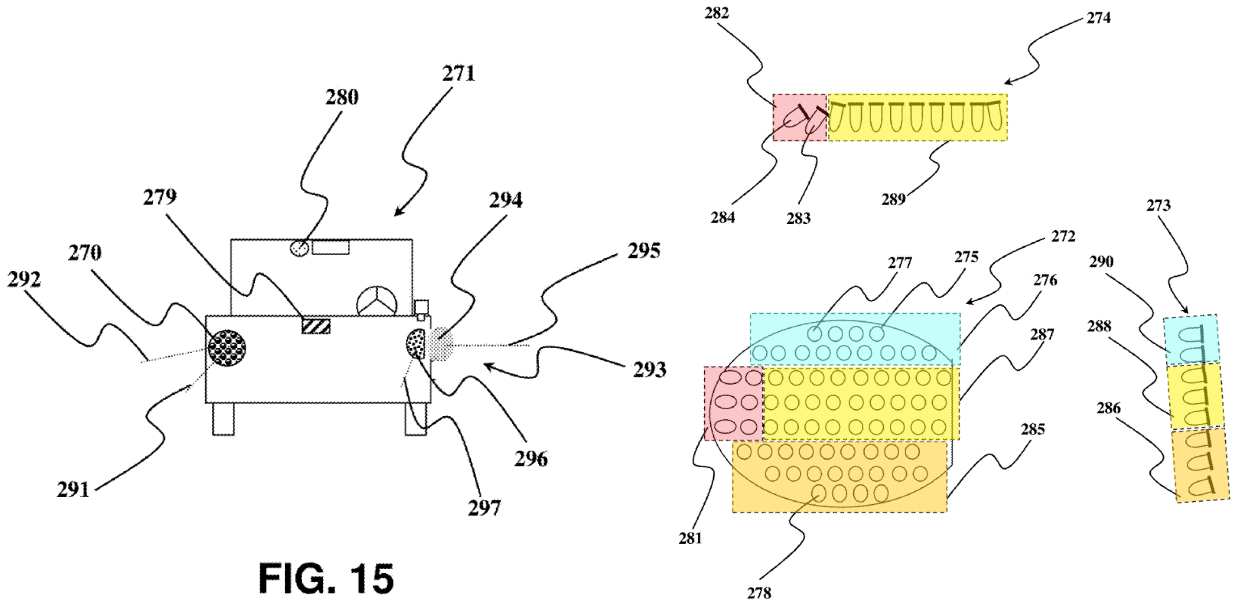



FIG. 15

EX1001, FIG. 15 (annotated).

Without detail, the '029 patent states that a "GPS system on the car may also let the headlamps system know of curves up ahead, one-way traffic and others factors such [that] the headlamp may be operated in the optimal mode at that instantaneous location." *Id.*, 51:63-67. The '029 patent leaves it to a POSA to determine the "optimal mode at that instantaneous location," without describing algorithms or control steps to achieve this. EX1003, ¶56. Unsurprisingly, a POSA would have readily incorporated GPS input into a controllable LED headlamp system, or substituted an LED array into a GPS-controlled system using a non-LED headlamp/light source, as demonstrated by the applied prior art. EX1003, ¶57; EX1025, 186; EX1026, 461-2; EX1024, 815-6; EX1023, 525; EX1027, Abstract. There was nothing new about using map data to control headlamp beam directionality, nor was there any technical challenge evolving from controlling

directionality of conventional headlamp beams to LED headlamp beams. EX1003, ¶¶58-59; EX1023, 524; EX1025, 202, 205-6; EX1026, 451-2; s*ee also* EX1031, 1051-52.

Regarding anti-blinding features, controller 279 receives traffic data from sensors 280, and adjusts illumination to avoid blinding traffic. *See* EX1001, 53:54-54:7. Again, this control scheme was known—none of the claimed features were new. EX1003, ¶60.

**B. Independent claims 1, 12, and 23**

The independent claims recite substantially similar elements and concepts; thus, the same prior art disclosures map to corresponding elements. EX1003, ¶62.

For example, independent claim 1 recites a "system, for a motor vehicle," with headlamps having a plurality of LED light sources, processor(s), and memory storing instructions to enable the processor(s) to perform light changes relative to a road curvature; and independent claim 12 recites a "non-transitory computer-readable storage medium, storing instructions that, when executed" by processor(s) of a motor vehicle with headlamps having a plurality of LED light sources, enable the processor(s) to provide the same light-changing functions in claim 1. Independent claim 23 recites a "computer-implemented method" carrying out the

same functions.[2] EX1003, ¶63. Dependent claims can also be grouped according to the same or substantially the same feature.[3] *Id*., ¶¶66-68, Table 2.

Thus, the disclosures mapped below for the processor(s), memory, instructions, etc., of claim 1, apply equally to and render obvious the system claims (1-11), non-transitory computer-readable storage medium claims (12-22) and computer-implemented method claims (23-33). *Id.*, ¶64. Minor phrasing differences do not affect the substantive application of the prior art. *Id*., ¶¶64-65, Table 1.

### C. Prosecution History Summary

The application that became the '029 patent underwent minimal prosecution. The only Office Action rejected claims 1-5, 12-16, and 23-27 as obvious over Yamada in view of Nishitani. EX1002, '029 Patent Prosecution History, 190-195.[4] Applicant did not amend any claims, alleging support in U.S. Pat. Appl. No. 10/604,360 (filed July 14, 2003) to exclude the applied references as prior art. *Id.*,

[2] Appendix A demonstrates the overwhelming overlap between independent claims. *Infra* Section XII.A.

[3] *Infra* Section XII.B.

[4] Claims 6-11, 17-22, 28-33 were indicated as allowable without substantive comment.

390.[5] The Office did not comment further, mailing a Notice of Allowance quoting the majority of the independent claims as reasons for allowance. *Id.*, 395-403; EX1003, ¶¶69-70.

### D. Level of Ordinary Skill in the Art

For the '029 patent, a POSA at the time of the alleged invention would have had a bachelor's degree (B.S.) in mechanical engineering, electrical engineering, optical engineering, applied physics, or an equivalent field, as well as at least 2 years of industry experience in the area of automotive lighting and lighting-control systems. The POSA may work as part of a team, for example, with computer engineers to integrate, program, etc., controllers and various control inputs to affect control of a given light source. EX1003, ¶¶41-43.

### E. Claim Construction

In IPR, claims are "construed using the same claim construction standard that would be used to construe the claim in a civil action under 35 U.S.C. 282(b)." 37 C.F.R. § 42.100(b). Claim terms must be given their ordinary and customary meaning as understood by a POSA at the time of the invention, in light of the

[5] The '029 patent is not entitled to its earliest possible priority date or the later July 14, 2003 date asserted during prosecution; however, this is moot—the applied prior art predates the *earliest possible priority date*.

specification and prosecution history. *Id.*; *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312-1313 (Fed. Cir. 2005) (en banc); *see also* 83 Fed. Reg. 51,340 (Oct. 11, 2018).

Without waiver, Petitioner does not believe any claim terms require specific construction and thus should receive their plain and ordinary meaning, in the context of the '029 patent specification, under *Phillips*.[6] Petitioner notes that "map data," "road curvature," "shaping light," "determine a light change," "subsequent to and accommodative of," and "determined light change," are not found in the '029 patent *except* for the claims[7], but submits that for this proceeding they should be given their ordinary and customary meaning. Under any reasonable construction, the challenged claims are unpatentable. EX1003, ¶¶70-73.

## V. OVERVIEW OF APPLIED REFERENCES

### A. Beam (U.S. Patent No. 6,144,158)

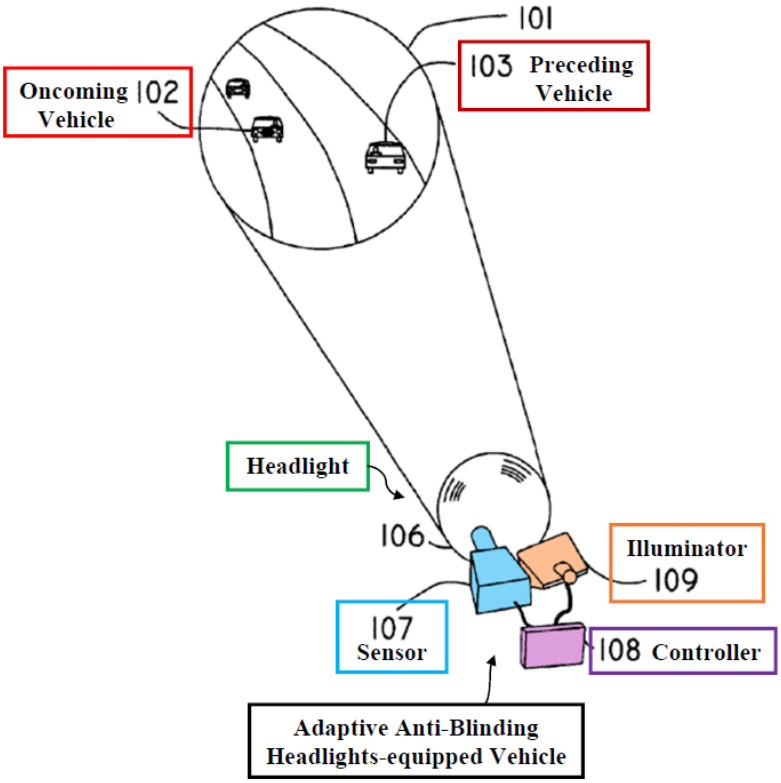
Beam's adaptive anti-blinding headlights/headlamps ("AABH") controls the intensity, shape, and/or angular position (e.g., direction) of narrow microbeams

[6] Petitioner reserves the right to challenge the claims under 35 U.S.C. § 112 in other forums.

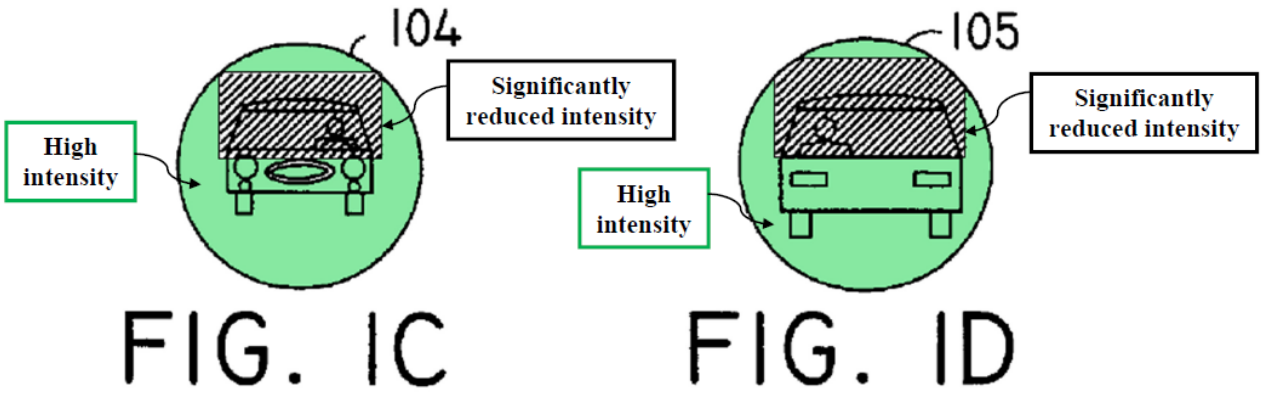
[7] This adds to the evidence that the '029 patent's claims are not entitled to the earliest possible priority date, but rather would be entitled to the actual filing date of the '029 patent, almost 20 years *after* the provisional filing.

emanating from a microbeam source, such as individual, controllable, light-emitting diodes (LEDs). EX1005, Abstract, claims 4 and 5. Beam's LEDs control direction, pattern, intensity, etc., to provide enhanced driver safety. EX1005, 3:8-45, 6:53-7:13; EX1003, ¶¶74-76.

Beam's AABH system detects oncoming vehicle headlights and adjusts illumination to provide certain areas with significantly reduced illumination to protect the vision of oncoming drivers. EX1005, 4:9-25. Beam's AABH system uses an optical system 106, sensor 107 (e.g., camera), controller 108, and illuminator 109. *Id*. Data from sensor 107 are input to controller 108 for controlling illuminator 109 to illuminate an area 101. EX1005, 4:9-25; EX1003, ¶77.




EX1005, FIG. 1 (annotated)




EX1005, FIGS. 1C and 1D (annotated).

Reduced illumination, represented by shaded dark areas, is *automatically provided* to specific oncoming or leading vehicle areas 104, 105 to reduce blinding drivers *while retaining high illumination for the driver* of the AABH-equipped vehicle in unshaded areas. *Id*., 2:53-3:3, 4:9-59; EX1003, ¶78. Sensor 107 images the scene and controller 108 uses the sensor data to determine which LED microbeams to reduce. EX1005, 4:26-59; EX1003, ¶78. The LEDs are arranged in an X-Y matrix and controller 108 independently controls the intensity and angular position of each LED. EX1005, 4:26-59. Beam's controller 108 uses the camera data to (1) determine the position of the vehicle, and (2) control the LEDs to diminish glare. EX1005, 5:46-54; *see also id.*, 2:59-3:3, 4:9-25; EX1003, ¶78. "As the positions of both vehicles move, the *blanked area tracks the location of the oncoming vehicle, dynamically varying in position and in size*." EX1005, 6:24-27, 5:46-54.

### B. Kobayashi (U.S. Patent No. 6,049,749)

Kobayashi controls headlight shaping (e.g., changing an "irradiating" or "illumination" direction, range, shape, etc.) based on map data/information, including GPS data and navigation beacon data. *See* EX1008, Abstract, 1:10-63; EX1003, ¶79.

Kobayashi's ECU 10 receives input "from GPS navigation device 29, steering sensor 13, vehicle speed sensor 14, direction indicating switch 15, and automatic control changeover switch 16." EX1008, 17:8-15. "GPS navigation device 29 corresponding to the road profile calculating means 2 includes: GPS receiving section 32, gyrosensor 33, calculating section 34, guide route setting section 35, map information output section 36, and display section 37." EX1008, 17:16-20; EX1003, ¶80.

FIG. 12

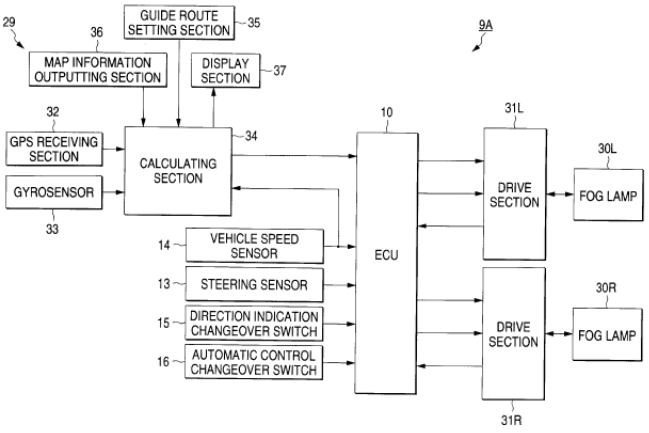
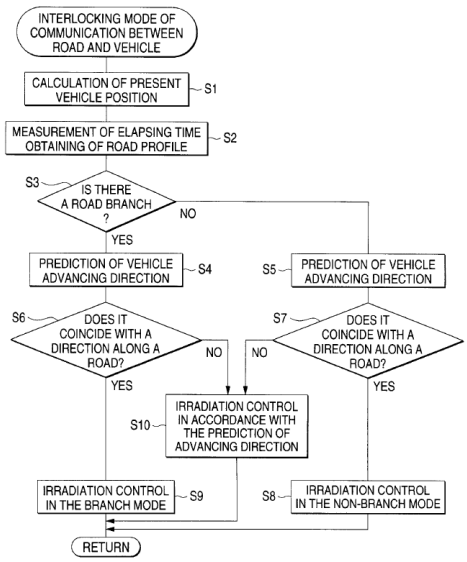



FIG. 9



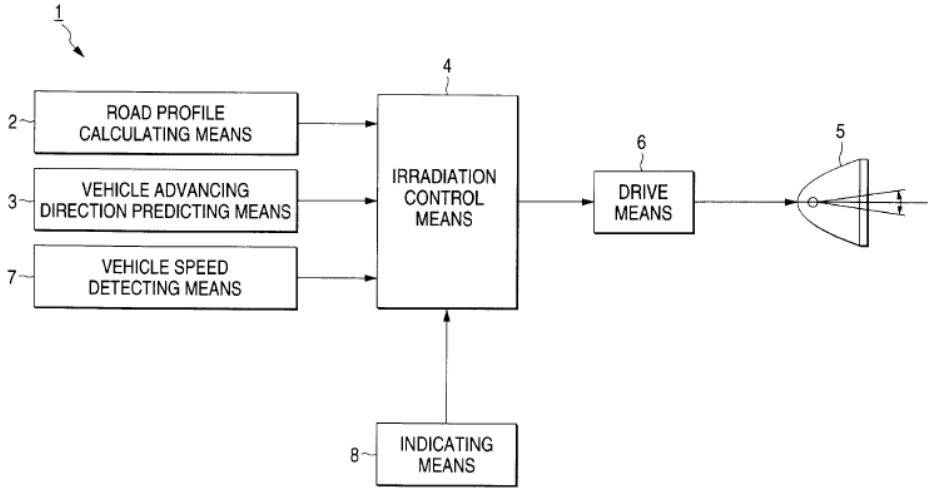

EX1008, FIGS. 9, 12.

GPS navigation device 29 sends information about the road profile and present vehicle position to ECU 10. EX1008, 17:39-40. Output signals from ECU 10 are sent to drive sections 31L, 31R of the fog lamps 30L, 30R (which are headlamps). *Id. See also id.*, FIG. 6, showing directional headlamps 17L and 17R, FIG. 1 and 3:9-20, describing the lighting device (e.g., head lamp can include headlamp, fog lamp, and corner lamp). ECU 10 processes information in FIG. 12 in substantially the same way as Kobayashi's FIG. 9 example. *See id.*, 10:1-11:4, 11:34-14:52, including representative lookup tables; *see also id.*, 17:41-50; EX1003, ¶81.

Figure 12 uses map data (e.g., from GPS navigation device 29) as the method of obtaining information, to implement the more general system diagram in FIG. 1. EX1008, 17:44-50. A scheduled course of the vehicle set by the guide route setting section 35 is fed to the "prediction of the vehicle advancing direction" in steps S4 and S5. *Id.*; EX1003, ¶82.

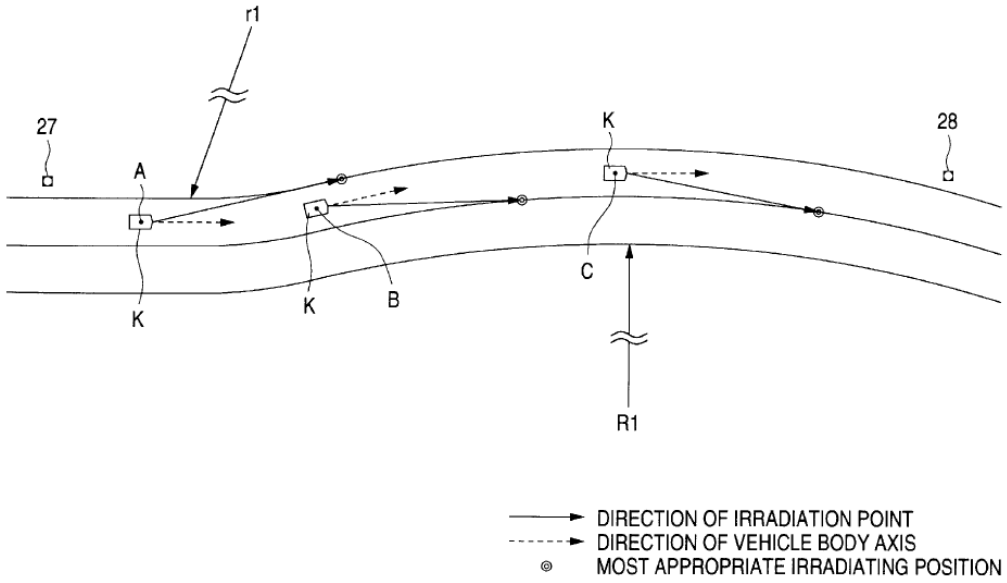
Kobayashi's road profile calculating means 2 (using map data such as GPS data) and vehicle advancing direction predicting means 3 cooperate with control means 4 to alter the direction/shape/intensity of headlamp 5. EX1008, 3:9-50; FIG. 1. Kobayashi discloses directional control, including via components composing the lighting device, e.g., mirrors, plurality of lighting devices, etc. *See, generally*, EX1008, 6:4-62; EX1003, ¶83.

FIG. 1




EX1008, FIG. 1.

Kobayashi's system responds to real-world conditions—multiple curves, intersections, etc. EX1003, ¶84. For example, Figure 10 shows that the illumination control (including shaping/reshaping light and directionality) of vehicle K can be planned and controlled on curved roads to improve safety. *Id*., ¶84. When vehicle K turns left (point A), the light shape is adjusted to illuminate the left shoulder; and when vehicle K turns right on a subsequent curve (point C), the light is reshaped to illuminate the right shoulder. EX1008, 14:53-15:28; EX1003, ¶84. Figure 10 is described relating to beacons 27 and 28, but GPS and other map data are also accounted for in ECU 10. *See also* FIG. 12, 17:3-18:67. Moreover, a POSA would have understood that the beacons 27 and 28 also convey map data, e.g., as road profile information. EX1003, ¶84.



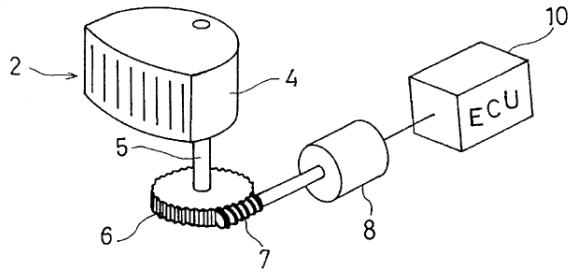

EX1008, FIG. 10.

### C. Gotou (U.S. Patent No. 5,588,733)

Gotou's headlight direction can be adjusted based on map data from GPS. EX1012, Abstract, 1:6-47, 1:51-59, 3:24-4:49, 8:9-41. Gotou compares systems using steering wheel-based directional control (*id.*, 1:21-29) with navigation system control (*id.*, 1:30-40). When "a *curved part* or the like is *foreseen in advance in reference to both map information of the navigation system* and information of the proper or subject vehicle position on the map, and the lighting region is changed *before* entering the *curved part*." *See id.*; EX1003, ¶85.

Gotou's ECU 10 controls motor 8, adjusting the position of the headlight 2 based on the map data. EX1012, 3:24-47.

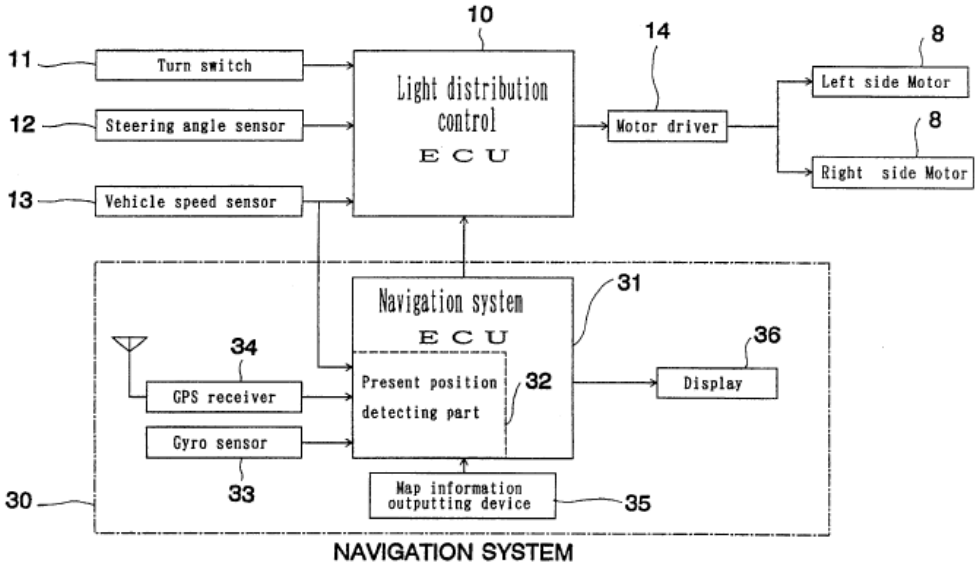
FIG. 2




EX1012, FIG. 2.

Gotou describes independent headlight movement, as well as (1) a plurality of light sources in each headlight and changing light distribution by separately using one or more illumination sources, and (2) using one or more sub-reflectors to change light distribution. *Id.*, 8:9-22; EX1003, ¶¶86-87.

FIG. 3

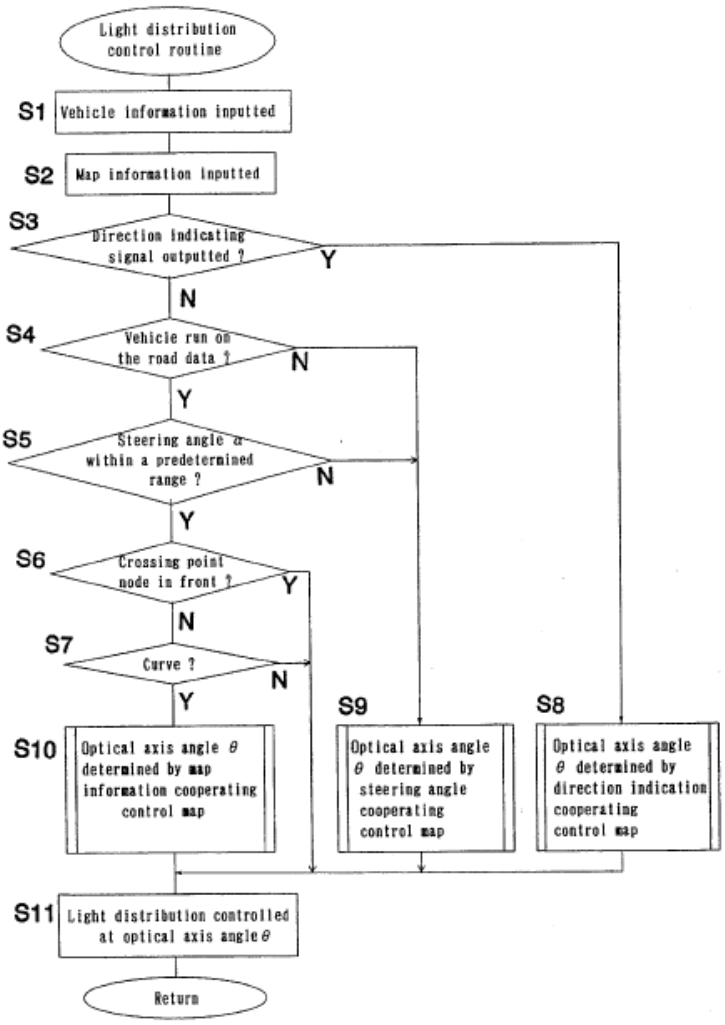



EX1012, FIG. 3.

Navigation system 30 sends map data to light distributing control ECU 10, which controls light shaping from the headlampsa. EX1012, 3:52-62. Gotou provides additional details of the navigation system 30, including the GPS receiver 34, for example at 4:1-29. EX1003, ¶88.

Light distribution control ECU 10 receives additional inputs, such as turn switch 11, steering angle sensor 12, vehicle speed sensor 13, etc.. *See* EX1012, 3:52-62. ECU 10 processes the information and signals to determine an optical axis angle θ, and outputs a signal to motor driver 14 to achieve the optical axis angle θ. *Id.*, 3:62-67, FIG. 4. EX1003, ¶89.

FIG. 4

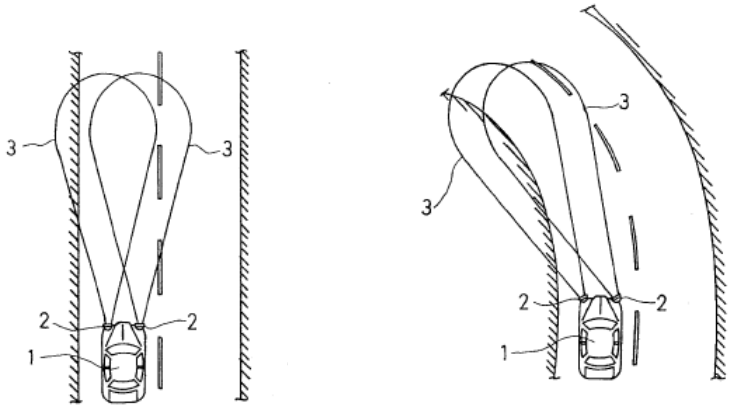



EX1012, FIG. 4.

At S2, map data is input. EX1012, 4:36-40. At S7, the system determines whether there is a curve. *Id.*, 6:18-27. If so, the optical axis angle is adjusted via the map. *See id.*, 6:28-7:4. Gotou's Figures 8 (straight road) and 9 (curved road) show this adjustment. EX1003, ¶¶90-91.

FIG.8

FIG.9




EX1012, FIGS. 8, 9.

### D. Karlsson (WO 1998/054030)

Karlsson's headlights include LEDs with automatically controlled direction and/or intensity. EX1003, ¶92. Sensors detect oncoming traffic and an LED lighting pattern of is automatically changed to reduce blinding oncoming traffic. EX1010, Abstract. Karlsson automatically varies the LED pattern in an efficient manner with maximum sensitivity in response to control signals from light-sensitive sensors. *Id*., 2:30-35, 9:18-26, 13:24-14:4, FIG. 3; EX1003, ¶92.

Switching one or more LEDs on or off or adjusting the emitted light intensity provides a desired pattern. EX1012, 2:30-35, 9:18-26, 13:24-14:4, FIG. 3. Karlsson's spotlight beams 34 can be provided by a light source 2 composed of a grid of LEDs, controlled individually or in groups. *Id*. The headlight includes a spatial distribution of LEDs (D, I, and D/I) and spotlight sensors S. *Id*., 19:18-20:3. The emitted light beam 50 is represented as a window that can shift left to right and

top to bottom, produced by LEDs based on the data from inputs, e.g., from spotlight sensors S. *Id.*; EX1003, ¶93.

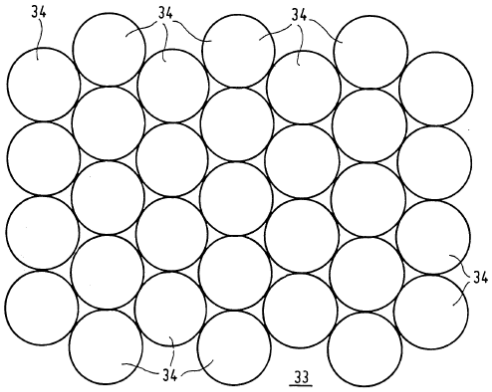
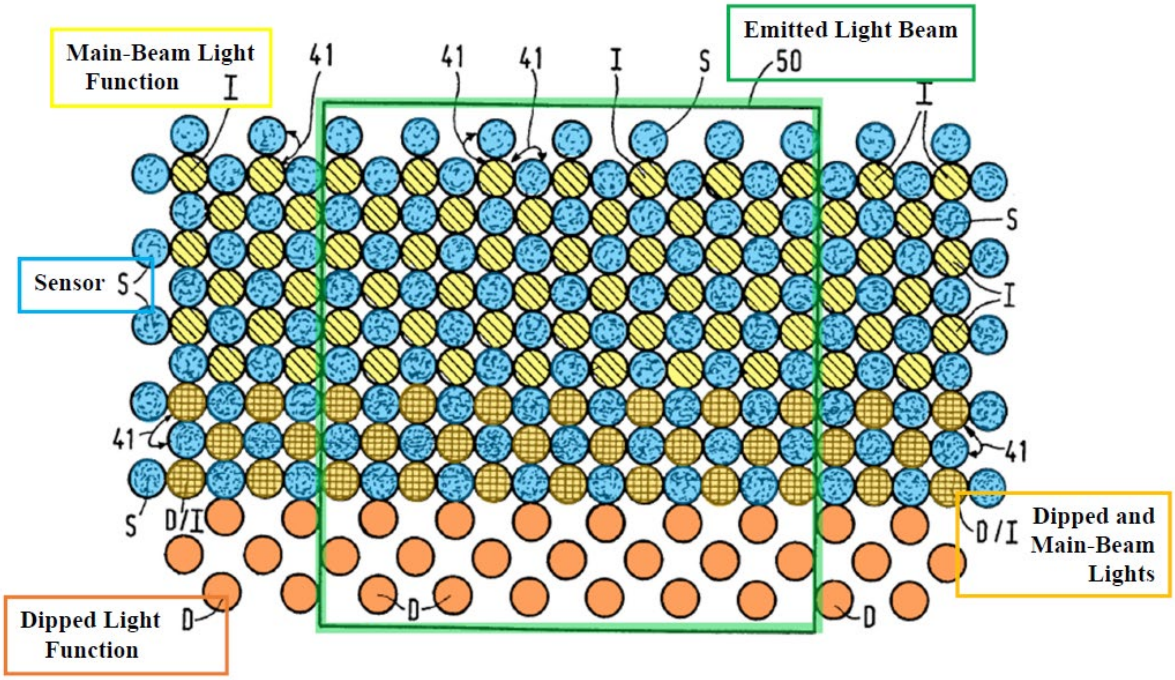
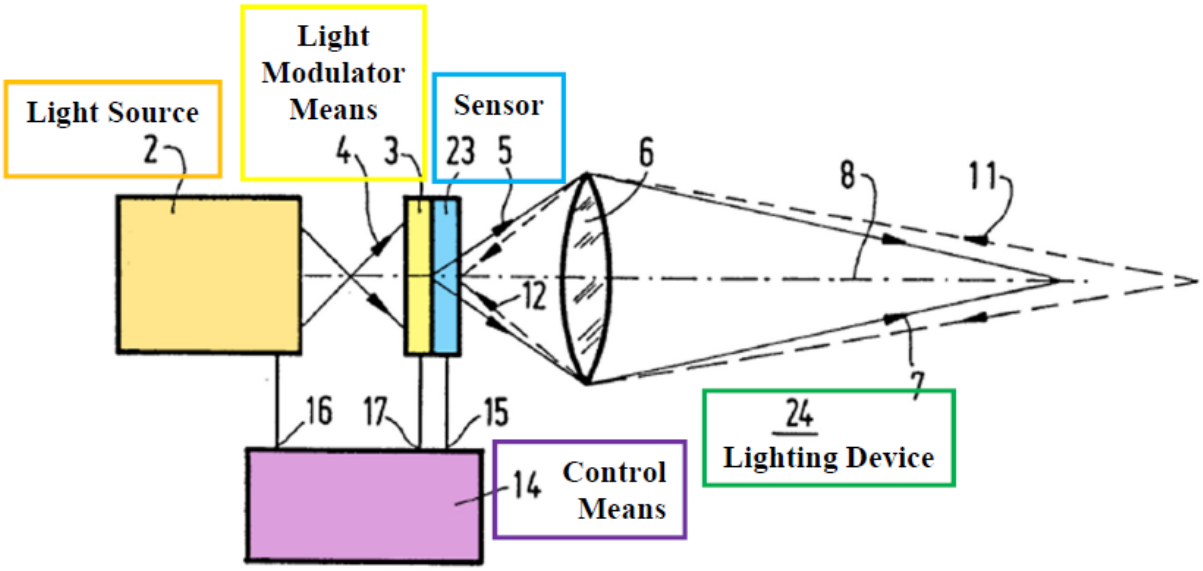



FIG. 6

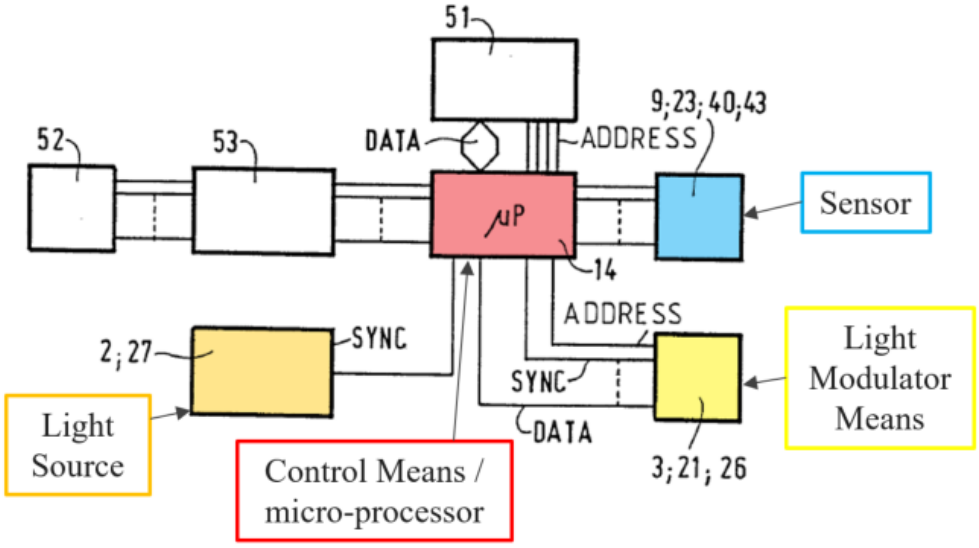
EX1010, FIG. 6.




EX1010, FIG. 14 (annotated).




EX1010, FIG. 3 (annotated).




EX1010, FIG. 15 (annotated).

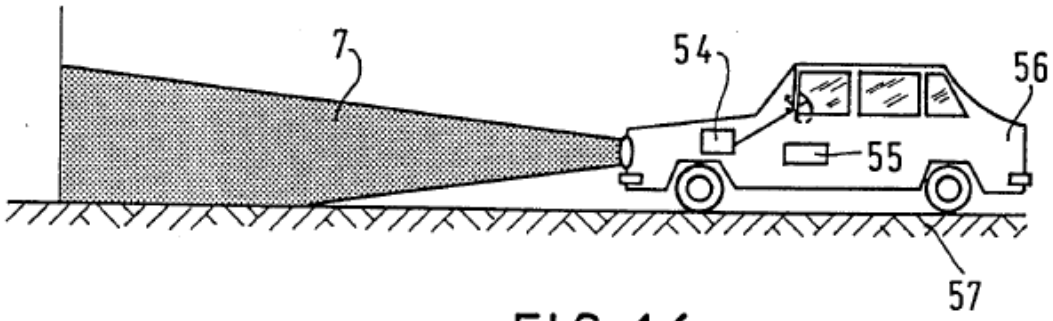



FIG.16

EX1010, FIG. 16.

## VI. GROUND 1: THE COMBINATION OF BEAM AND KOBAYASHI RENDERS OBVIOUS CLAIMS 1-33.

### A. Independent claims 1, 12, and 23

Independent claims 1, 12, and 23 are substantively similar and rendered obvious based on the same prior art disclosures and rationales. EX1003, ¶¶94-95, 150; *supra*, Section IV.B; *infra*, Section XII.A.

#### 1. A POSA would have been motivated to combine Beam and Kobayashi with a reasonable expectation of success.

A POSA would have been motivated to modify Beam's adaptive anti-blinding headlamp system to adjust light based on map data, as in Kobayashi, to further control Beam's directional LEDs to illuminate roadway curves, thereby improving driver safety—an express purpose of Beam's AABH system. EX1003, ¶96; *see*, *e.g.*, EX1005, 5:33-54, 3:8-45; 6:53-7:13.

*First*, including an additional data source for Beam's controller 108—Kobayashi's *known technique* of using map—would have enhanced Beam's AABH system by increasing or adjusting illumination based on the road curvature, improving driver safety by providing light to where it is needed. *Second*, a POSA would have easily incorporated *known components* of Kobayashi's road profile calculating means 2 and vehicle advancing direction predicting means 3 (e.g., including GPS navigation device 29, *see* EX1008, Abstract, 1:10-2:35, 4:60-64, FIGS. 1, 10, 12) into Beam's AABH system (e.g., with sensor 107 and controller 108). EX1003, ¶97. This would have provided road curvature data of Beam's detected scene 101, allowing Beam's AABH system to increase illumination in a direction of the road curvature in advance of the curve like Kobayashi, further improving safety. *Id*.

Beam and Kobayashi are from the same field and include the same building blocks. *Id*., ¶98. Both disclose controllable headlamps with dynamic illumination to provide the most appropriate light, in the right direction. *Id.* Each include controllable light sources, input sensors, and one or more controllers, processors, and memory to execute commands and control the direction and/or intensity of light. *Id*., ¶¶98-100. Moreover, driver safety is paramount in both—for the driver of the vehicle equipped with the adaptive headlamp system and others on the road. *Id*., ¶101; *see*, *e.g.*, EX1005, 5:33-54, 3:8-45, 6:53-7:13; EX1008, 15:6-28.

Indeed, Beam's techniques and system of controlling individual LEDs emphasize safety of all drivers. EX1005, 3:8-45; 6:53-7:13. Beam recognizes that controllable headlamps "provide greatly improved safety and comfort to the motoring public," and a "brighter headlight beam while simultaneously protecting the drivers of all vehicles ahead" increases safety. *Id*., 3:8-45. Beam's AABH enables "the driver to see more clearly at night," while protecting other drivers from glare. *Id*.; *see also* EX1003, ¶102.

Beam's controller 108 uses input data from sensor 107 to determine which LEDs to adjust to protect other drivers, while maintaining appropriate forward lighting. EX1005, 4:16-19. The system "*determine[s] the location of light sources* forward of the apparatus and us[es] that information to *control the intensity, and/or the angular position*, of one or more" LEDs. *See id*., Abstract. Control is "*dynamically varying* in position and in size," in response to the input. EX1005, 6:24-27, 5:46-54; EX1003, ¶103.

Beam recognizes prior systems that control headlamps in response to changes in the vehicle's position (e.g., tilt on a hill) and steering mechanism (e.g., along a curve) and acknowledges those systems' safety benefits—noting that more active systems decrease the compromise between "reducing glare and providing enough light to the driver for adequate visibility." *See* EX1005, 2:1-6, 2:15-22; *see also* EX1003, ¶104. 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 it would have been obvious to a POSA to do so. EX1003, ¶105. This would have made Beam's system even more active than prior systems, as Beam seeks to do (*see* EX1005, 2:15-22), and further achieves Beam's purpose of improving driver safety. EX1003, ¶105; EX1005, 3:8-45, 6:53-7:13. Kobayashi provides additional active techniques, specifically map data-based control.

Kobayashi's *techniques and system components*, like Beam, seek to enhance driver safety—by using map data-based control. EX1008, 15:6-28; EX1003, ¶106. Kobayashi explains that controlling the shape of the light to correspond with the driver's changing line of sight (ahead of a curve) enhances safety. EX1008, 15:6-28. Kobayashi's road profile calculating means 2 and vehicle advancing direction predicting means 3 are inputs to control means 4, which alters the light direction from headlamp 5 in response to map data input, directing light where it is needed at a given time. *Id.*, 3:9-50, 6:4-62, FIG. 1. Kobayashi's system responds to real-world conditions, multiple curves, intersections, etc., *see id.*, 11:34-14:52, for example, using representative lookup tables, *see also id.*, 17:41-50; EX1003, ¶106.

Kobayashi's Figure 10 shows that illumination control (including shaping/reshaping light and directionality) can be planned and controlled on roads with multiple curves. EX1003, ¶107. When vehicle K turns left (point A), the light

the shape is adjusted to illuminate the left shoulder. Likewise, when vehicle K turns right on a subsequent curve (point C), the light is reshaped to illuminate the right shoulder. *Id*., 14:53-15:28; *see also id.*, FIG. 12, 17:3-18:67; EX1003, ¶107.

A POSA would have understood that including an additional data source for Beam's controller 108, Kobayashi's map data, would have enhanced Beam's AABH system by increasing illumination based on the road curvature (and directing it to needed areas), improving driver safety. EX1003, ¶108. Doing so would have merely been applying Kobayashi's known technique (using map data from Kobayashi's GPS to shape and reshape light and/or adjust intensity) to Beam's similar, known device (dynamic AABH system based on light sensing inputs that directs light to needed areas and away from undesired areas), in the same way. EX1003, ¶108; *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 417 (2007). Kobayashi's known technique is fully described along with its benefits (e.g., improved safety); thus, a POSA would have readily applied it to similar systems, such as Beam's, in the same way. EX1003, ¶108-09; *KSR*, 550 U.S. at 419-421.

Additionally, or alternatively, such a modification would have been simply combining known prior-art elements (e.g., Beam's adaptive, directional-controllable LED headlamps with Kobayashi's directional control based on map data from road profile calculating means 2 and vehicle advancing direction predicting means 3) according to known methods (disclosed in Beam and Kobayashi) to yield

predictable results (e.g., improved safety for the equipped vehicle and other vehicles on the road, further directional light control to where it is needed, and preemptive light control before entering a curve). EX1003, ¶110; *KSR* 550 U.S. at 415-416.

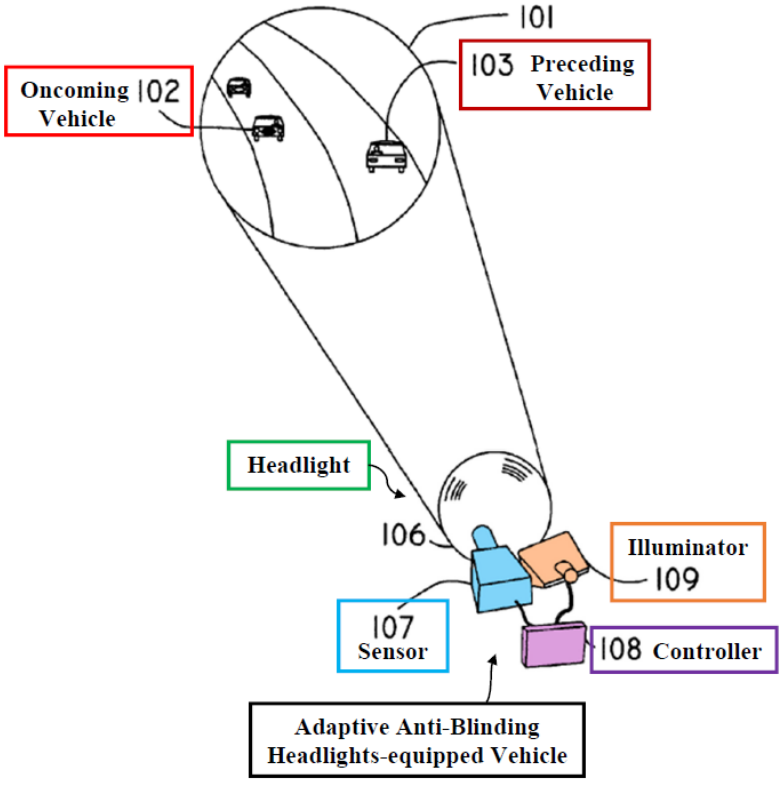
A POSA would have had a reasonable expectation of success combining Beam and Kobayashi. EX1003, ¶111. A POSA would have understood *how* to combine the teachings of Beam and Kobayashi, for example, by simply modifying software instructions stored in memory of Beam's controller/processor (e.g., ECU) to adjust and direct light of the LEDs appropriately in view of Kobayashi's map data. *Id*. It also would have been straightforward to combine Kobayashi's road profile calculating means 2 and vehicle advancing direction predicting means 3 (e.g., including GPS navigation device 29) with Beam's system. *Id.*

Such modifications would have been routine and well within a POSA's skill due to the similarities in Beam's and Kobayashi's adaptive light control systems and methods—their common components were well-known and there would have been no limitations for a POSA to make such modifications. *Id*., ¶112. In applying Kobayashi's technique to Beam, a POSA would have simply been applying a known technique in a predictable way— controlling headlights in part based on map data—in the same way already disclosed in the art. *See KSR*, 550 U.S. at 415-421. And in combining Beam's system with Kobayashi's road profile calculating means 2 and vehicle advancing direction predicting means 3 (e.g., simply revising control

input/output on an ECU), a POSA would have simply been combining known elements according to known methods (disclosed in Kobayashi) to yield predictable results (additional light control). EX1003, ¶113-14; *KSR* 550 U.S. at 415-416.

**2. [1.P]/[12.P]/[23.P]**

Beam discloses a system for a motor vehicle. EX1003, ¶¶115-16. 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. EX1005, Abstract, 1:5-18, 2:53-3:3, 3:8-24, 4:10-59, 5:33-54, 5:61-6:4, 6:9-27, 6:40-50. Data from Beam's sensor 107 are input to the controller 108 to control the illuminator 109 and illuminate an area 101. *Id*.




EX1005, FIG. 1 (annotated).

Likewise, Kobayashi discloses a motor vehicle system, specifically a lighting device that steers light ("changing the irradiating direction") based in part on map data/information, including GPS data or beacon data. *See* EX1008, Abstract, 1:10-63; EX1003. ¶117.

The preambles of independent claims 12 and 23 recite additional features recited in [1.1], [1.2], and [1.3], that are disclosed in the prior art. EX1003, ¶118. The disclosures mapped below relating to the processor(s), memory, and instructions of claim 1 apply equally to and render obvious the system claims (1-11), non-transitory computer-readable storage medium claims (12-22), and computer-implemented method claims (23-33). *Id*. Minor phrasing differences do not affect the substantive application of the prior art. *Id*., ¶¶118, 134-35, 142, 148; *infra*, Sections VI.A.3-4, XII.

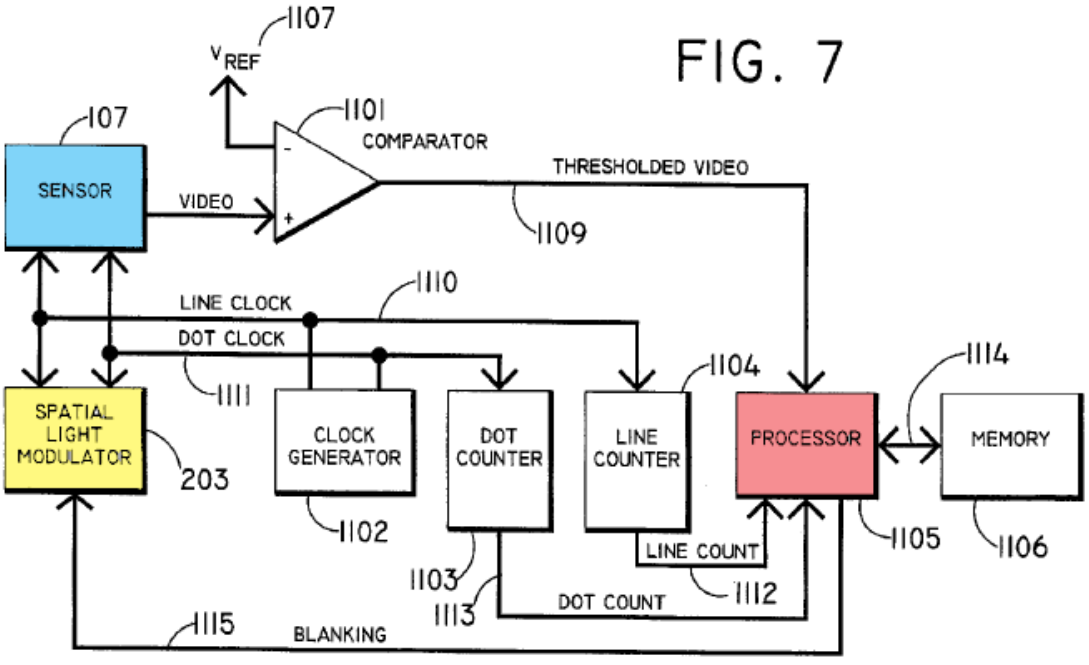
### 3. [1.1]/[*See* 12.P]/[*See* 23.P]

LEDs were well-known as advantageous light sources for headlamps. *See, e.g.,* EX1022, Müller, 2:22-26, 3:44-47; EX1005, 4:9-15, 6:9-12, Claims 4 and 5; EX1006, Thominet, ¶¶[0005], [0007], [0008], [0020], [0027]; EX1009, 19:27-29, 20:9-12, 23:8-12; EX1010, 4:25-35, 13:24-29, 11:29-32; EX1011, Harbers, 1:18-2:3, 3:18-26, 8:13-20, 10:6-11, 10:21-22; EX1029, 987; EX1003, ¶120. Indeed, Beam discloses a plurality of headlamps, each comprising a plurality of LED light sources that may be configured as "an array of individual, independently

controllable microbeam sources." EX1005, claims 4, 5 (expressly disclosing the light source as an array of individual, independently controllable LEDs), 2:53-3:3, 4:10-59; EX1003, ¶119-21. Kobayashi also includes a plurality of headlamps. *See, e.g.*, EX1008, 17:3-15, FIGS. 6, 12.

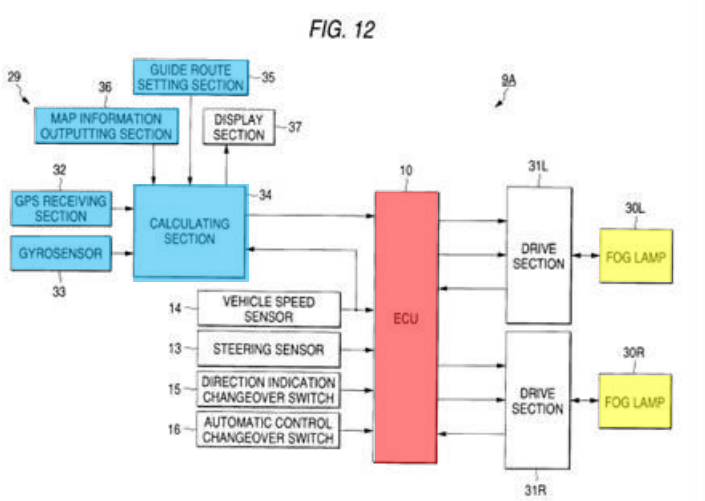
**4. [1.2]/[*See* 12.P]/[*See* 23.P]**

Beam discloses at least one processor, for example, in Figure 7 and its accompanying description. EX1003, ¶122. "The *spatial scene data* from sensor 107 … becomes the input to *a processor 1105*." EX1005, 5:34-36. Figure 7 shows that controller 108 includes processor 1105 that uses appropriate algorithms to determine locations to blank. *Id*., 5:33-6:4.




EX1005, FIG. 7 (annotated).

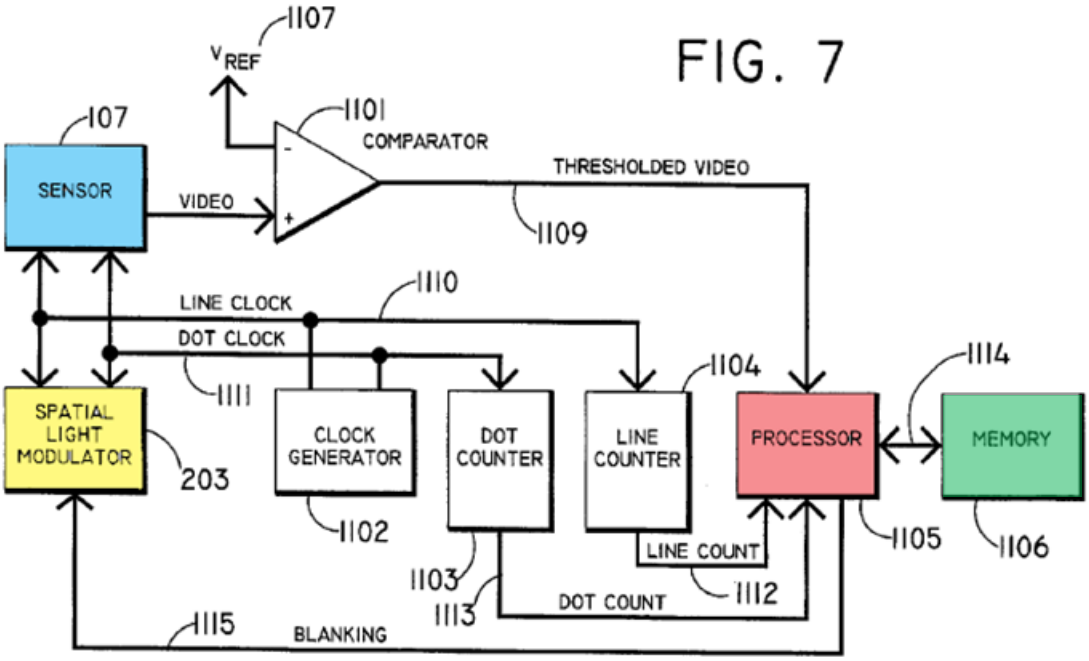
Likewise, Kobayashi includes ECU 10, which receives control signals (e.g., map data) as input, processes information, and sends output signals to control the headlamps. EX1008, 17:3-15, 17:29-43; 10:1-17; EX1003, ¶¶123-24.




EX1008, FIG. 12.

### 5. [1.3]/[*See* 12.P]/[*See* 23.P]

Beam discloses that controller 108 includes processor 1105 with memory 1106, which stores instructions, with appropriate algorithms determining the locations to blank. EX1005, 5:33-54; EX1003, ¶125. A POSA would have understood that Kobayashi's ECU 10 also has a memory that stores instructions and prediction logic. *See*, *e.g.*, EX1008, 10:1-17, 11:34-14:52 (representative lookup tables); *see also id.*, 17:29-50, FIGS. 1, 9, 12; EX1003, ¶126. Indeed, a POSA would have understood that the "instructions" in the '029 patent claims would have been the typical way the processor (system) operates. EX1003, ¶127-28; *See also* EX1034, FIG. 2, 1:24-38; 14:7-51.




EX1005, FIG. 7 (annotated).

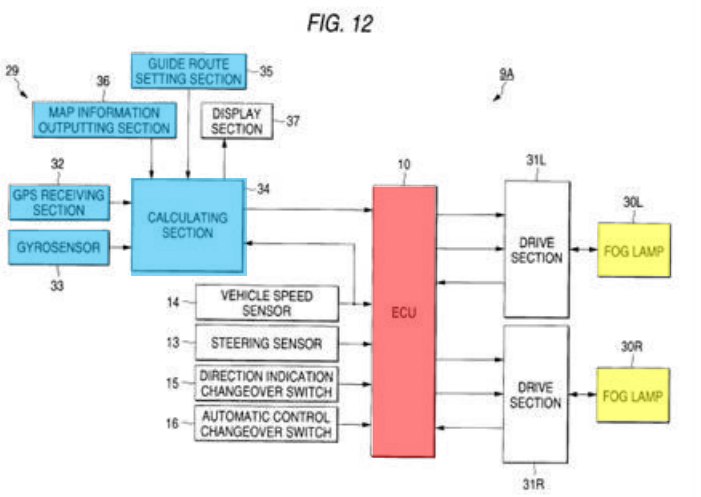
### 6. [1.4]/[12.4]/[23.4][8]

Beam does not expressly disclose receiving map data indicating an upcoming road curvature. But Beam does disclose prior systems that control headlamps in response to changes in the vehicle's position (e.g., tilt on a hill) and steering mechanism (e.g., along a curve). *See* EX1005, 2:1-6, 15-22; EX1003, ¶129. And a

[8] Because of its method claim structure, claim 23 and its dependents use slightly different terminology, but that does not change the substance or applicable disclosure. There is no substantive difference across the corresponding claim elements. EX1003, ¶¶134-35.

POSA would have been motived to combine Beam with Kobayashi, which discloses the map data features. *Supra*, Section VI.A.1; EX1003, ¶129.

Indeed, Kobayashi discloses a lighting device that steers light ("changing an irradiating direction") based in part on map data received from GPS navigation device 29, controlled via ECU 10. EX1008, Abstract, 17:8-15. Kobayashi uses map data from GPS navigation device 29 to predict and adjust illumination toward an advancing direction of the vehicle, including tracking upcoming road curvatures. EX1008, Abstract, 1:10-2:35, 4:60-64, FIGS. 1, 10, 12; EX1003, ¶130.




EX1008, FIG. 12 (annotated).

As explained, a POSA would have modified Beam's system to include Kobayashi's map data functions to further control Beam's directional LEDs, improving driver safety. *See*, *e.g.*, EX1005, 5:33-54; *supra* Section VI.A.1; EX1003, ¶131. For example, a POSA would have incorporated Kobayashi's road profile calculating means 2 (EX1008, Abstract, 1:10-2:35, 4:60-64, FIGS. 1, 10, 12) into

Beam's AABH system (e.g., with sensor 107 and controller 108). EX1003, ¶131. By including an additional data source for Beam's controller 108, Kobayashi's map data, a POSA would have recognized the safety enhancement to Beam's AABH system by increasing illumination based on the road curvature. *Id*., ¶132. Doing so would have merely been applying Kobayashi's known technique of using map data to shape and re-shape light and/or adjust intensity in Beam's similar, known device based on light sensing inputs, in the same way. *KSR*, 550 U.S. at 417; *supra*, Section VI.A.1; EX1003, ¶132-36.

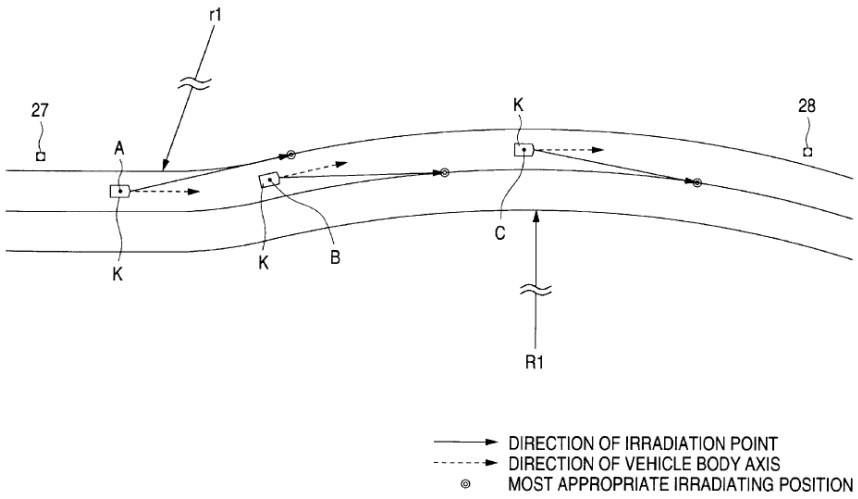
**7. [1.5]/[12.5]/[23.5]**

The combined Beam-Kobayashi system determines a light change and adapts the headlamps' light pattern (e.g., control/steers light via "changing the irradiating direction") toward a road curvature based in part on map data (e.g., road curvatures). *See* EX1008, Abstract; EX1003, ¶139.

Beam's controller 108 uses input data from sensor 107 to determine which LEDs to adjust to protect other drivers, while maintaining appropriate forward lighting. EX1005, 4:16-19. The system "us[es] that information to *control the intensity, and/or the angular position*, of one or more" LEDs. *See id*., Abstract. Such control is "*dynamically varying* in position and in size," in response to the control input. EX1005, 6:24-27, 5:46-54; EX1003, ¶137. So, Beam "determine[s] a light

change," and adapts the headlamps' light pattern in both intensity *and* spatial distribution. EX1003, ¶137.

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. EX1008, 17:8-15, 1:21-29, 4:6-21, 15:15-28. Kobayashi plans and controls illumination—including light direction ahead of curves on curved roads to improve safety. *Id*., 14:53-15:28. When vehicle K turns left (point A), the left shoulder is illuminated, and when vehicle K turns right (point C), the right shoulder is illuminated, thereby adapting the light pattern in intensity and spatial distribution, shaping light based in part on road curvature, based on the map data. *Id*.; EX1003, ¶138.




EX1008, FIG. 10.

As discussed, including an additional data source for Beam's controller 108 (Kobayashi's technique of using map data) would have enhanced Beam's AABH system by increasing or directing illumination based on the road curvature, improving driver safety as Beam seeks to do. *Supra*, Section VI.A.1; EX1003, ¶140. Again, a POSA would have incorporated Kobayashi's known components into Beam's AABH system (e.g., with sensor 107 and controller 108, as or separate components) to provide road curvature data of Beam's detected scene 101, allowing Beam's AABH system to increase illumination in a direction of the road curvature, improving safety. *Supra*, Section VI.A.1; EX1003, ¶¶140-43.

**8. [1.6]/[12.6]/[23.6]**

These elements simply implement the LED control based on the determined light change in [1.5]/[12.5]/[23.5]. EX1003, ¶144.

Again, Beam's controller 108 uses input data from sensor 107 to determine which LEDs to adjust, while maintaining appropriate forward lighting. EX1005, 4:16-19. The system "us[es] that information to *control the intensity, and/or the angular position*, of one or more" LEDs. *See id*., Abstract. Such control is "*dynamically varying* in position and in size," in response to the control input. EX1005, 5:34-54; EX1003, ¶145. Beam's processor 1105 (*see* EX1005, 5:34-36) uses appropriate algorithms to determine which LEDs to control, e.g., blanked. *Id*., 5:33-54, FIG. 7. Thus, Beam discloses "control[ling] at least a first plurality of the

LED light sources to provide light based at least in part on the determined light change," as recited. EX1003, ¶145.

As combined, Beam's LEDs would operate at least partly based on Kobayashi's map data functions, via Kobayashi's road profile calculating means 2 and vehicle advancing direction predicting means 3 (e.g., including GPS navigation device 29) to further control Beam's directional LEDs, prior to the curvature as in Kobayashi. *See*, *e.g.*, EX1008, 14:53-15:28, FIG. 10; *supra*, Section VI.A.7 EX1003, ¶¶146-50.

**B. Dependent claims**

None of the dependent claims recite patentable subject matter.[9] EX1003, ¶151. Instead, they recite obvious, iterative processes that occur when travelling on a road with curves, other vehicles, etc.—adaptive headlamps are continuously controlled in response to driving conditions. *Id.* The dependent claims simply illustrate what was apparent to a POSA—such systems should (1) re-align when the

[9] The method claim structure of claims depending from claim 23 differ slightly in claim language from corresponding claims depending from claim 1 and 12, but the same disclosures and rationales apply equally. EX1003, ¶¶153, 156, 163, 169, 176, 184-85, 195-96, 205, 216, 221.

vehicle exits the curve and (2) respond to a future curve or a vehicle not yet encountered—which was disclosed in the prior art. *Id*., ¶152.

**1. Claims 2/13/24**

These claims simply recite selecting a first group of LEDs. EX1003, ¶154. Beam's controller 108 uses sensor data input "to *determine which microbeams*," e.g., LEDs, "*must be reduced in intensity* to protect the other drivers." EX1005, 4:15-18, Abstract; EX1003, ¶154. Indeed, such inputs "*control the intensity, and/or the angular position*, of one or more" LEDs. EX1005, Abstract; EX1003, ¶154. Beam's processor 1105 uses appropriate algorithms to determine the locations to blank, selecting which LEDs should be on or off/reduced. EX1005, 5:33-54; EX1003, ¶154. Thus, when Beam determines a light change should be made, it selects a first plurality of LEDs to provide light. EX1003, ¶¶154-57.

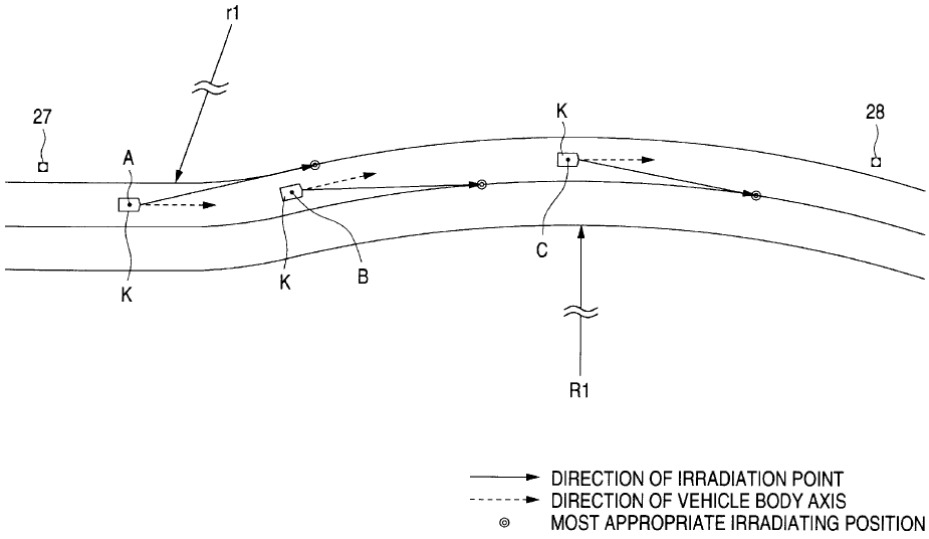
**2. Claims 3/14/25**

These claims simply implement "*reshaping*" the light based on road curvature as the vehicle travels "at least to or through the road curvature," (or "shape change") e.g., through the customary step of instructions stored in the memory and executed by the processor. *See supra* Section VI.A.5; EX1003, ¶158. They are rendered obvious by the Beam-Kobayashi combination. EX1003, ¶¶158-64.

As with controlling the LEDs based on the determined light change (*see* EX1003, ¶¶144-47, [1.6]/[12.6]/[23.6]), Beam's controller 108 uses sensor data input "to *determine which microbeams*," e.g., LEDs, "*must be reduced in intensity*

to protect the other drivers." EX1005, 4:15-18, Abstract. The inputs are used to "*control the intensity, and/or the angular position*, of one or more" LEDs. *Id*., Abstract. The process is iterative—recalculating and adjusting light as needed. *See id.*; EX1003, ¶159. Beam's processor 1105 (*see* EX1005, 5:34-36) uses appropriate algorithms to determine which LEDs to control, e.g., blanked, to direct the light. *Id*., 5:33-54, FIG. 7; EX1003, ¶159.

Kobayashi expressly describes *reshaping* the light *based on road curvature*, as recited, which would have easily been implemented with Beam's controller 108, which is already configured to reshape the light based on various inputs. EX1008, 14:53-15:28, FIGS. 10, 12; EX1003, ¶160. In so doing, the combined system achieves the aim that such systems should (1) re-align when the vehicle exits the curve and (2) respond to a future curve or a vehicle not yet encountered. EX1003, ¶160.

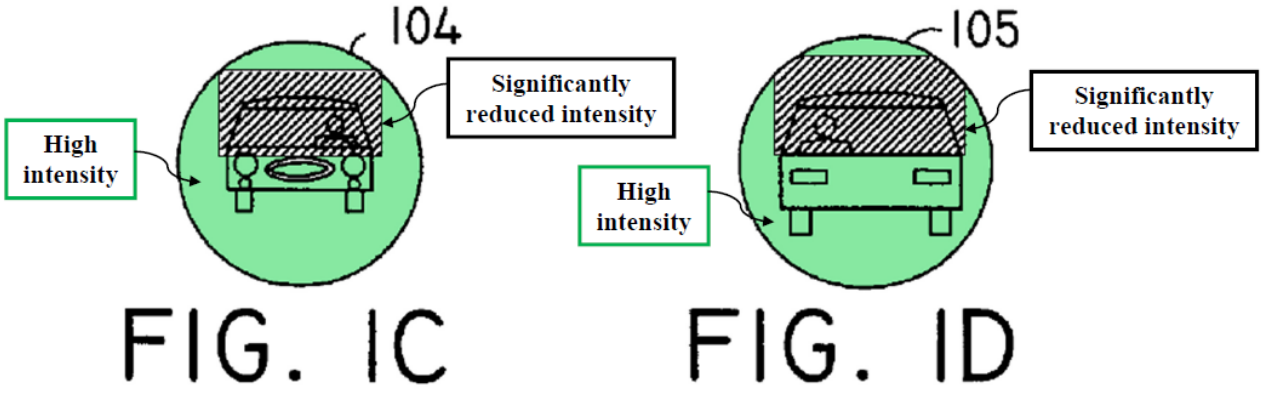



EX1008, FIG. 10.

Kobayashi plans and controls illumination—shaping and re-shaping light direction ahead of and through curves to improve safety. *Id*., 14:53-15:28. When vehicle K turns right (point C), the right shoulder is illuminated, adapting the light pattern in intensity and spatial distribution, *reshaping* light relative to the previous curve based in part on road curvature from map data. *Id*., 14:53-15:28; EX1003, ¶¶161-64; *supra*, Section VI.A.1.

### 3. Claims 4/15/26

Similar to claims 3/14/25, from which they depend, these claims further contemplate selecting one of the first plurality of LED's or some second plurality of LEDs with one different LED from the first to provide the *reshaped* light. EX1003, ¶165, 168. A POSA would have recognized that *reshaping* Beam's light in any sense would require taking action with *at least one* of the LEDs. *Id*., ¶165. Beam illustrates this, i.e., the first and second plurality of LEDs do not overlap entirely, in Figures 1C and 1D. *Id*.




EX1005, FIGS. 1C and 1D (annotated).

Sensed inputs into controller 108 result in significant illumination intensity reduction in a specific section (shaded area). EX1005, 4:10-25. Beam's controller 108 uses sensor data input "to *determine which microbeams*," e.g., LEDs, "*must be reduced in intensity* to protect the other drivers." EX1005, 4:15-18, Abstract. The inputs are used to "*control the intensity, and/or the angular position*, of one or more" LEDs. *Id*., Abstract. Beam's processor 1105 (*see id*., 5:34-36) uses appropriate algorithms to determine which LEDs to control, e.g., blanked; thus, a specific LED is used in one situation (e.g., Figure 1C) but not in another situation (e.g., Figure 1D, having an enlarged blanked area) EX1005, 5:33-54, FIGS. 7, 1A-D; EX1003, ¶166. Control is "*dynamically varying* in position and in size," in response to the control input. EX1005, 6:24-27, 5:46-54; EX1003, ¶166.

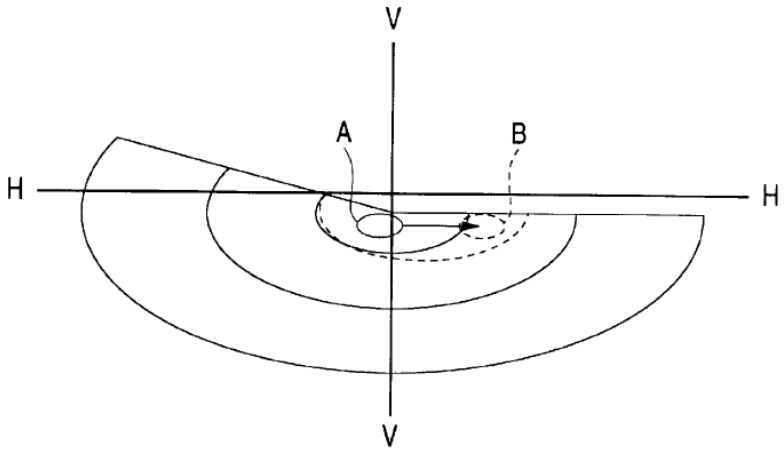
As above for claims [3]/[14]/[25], for example, Kobayashi expressly describes reshaping the light based on road curvature, which would be implemented with Beam's controller 108. EX1008, 14:53-15:28, FIGS. 10, 12; *supra*, Sections VI.A.1, VI.B.2; EX1003, ¶¶167-70.

#### 4. Claims 5/16/27

Beam and Kobayashi both disclose these claims, which amount to merely directing any light (other than high-beam) in the direction of the road curvature. EX1003, ¶171.

Beam's AABH provides a "default illumination level will be the equivalent of today's *low beams*" (i.e., a level below high-beam light) and the illumination in the "darkened" or "shaded areas" is "significantly less than with current low beams." EX1005, 2:60-61, 2:65-3:3, 4:23-25, 6:30-33. Kobayashi describes increasing light emitted at a level below high-beam light and directed in the direction of the road curvature, for example, with reference to FIG. 8. EX1003, ¶¶172-73.

FIG. 8




EX1008, FIG. 8.

The light distribution pattern of a low beam shows the center of luminous intensity moves from section A to section B, so that the luminous intensity distribution is changed to a curve shown by a broken line in the drawing. EX1008, 11:14-33. In Figure 8, "H—H" and "V—V" are reference lines on a screen located in the front of the vehicle by a predetermined distance, where "H—H" is a

horizontal line and "V—V" is a vertical line. *Id.*[10] Thus, the combined system provides an "increase of light emitted at a level below high-beam light and directed in the direction of the road curvature," as recited. EX1003, ¶¶174-77.

**5. Claims 6/17/28, elements [6.1]-[6.3], [17.1]-[17.3], [28.1]-[28.3]**

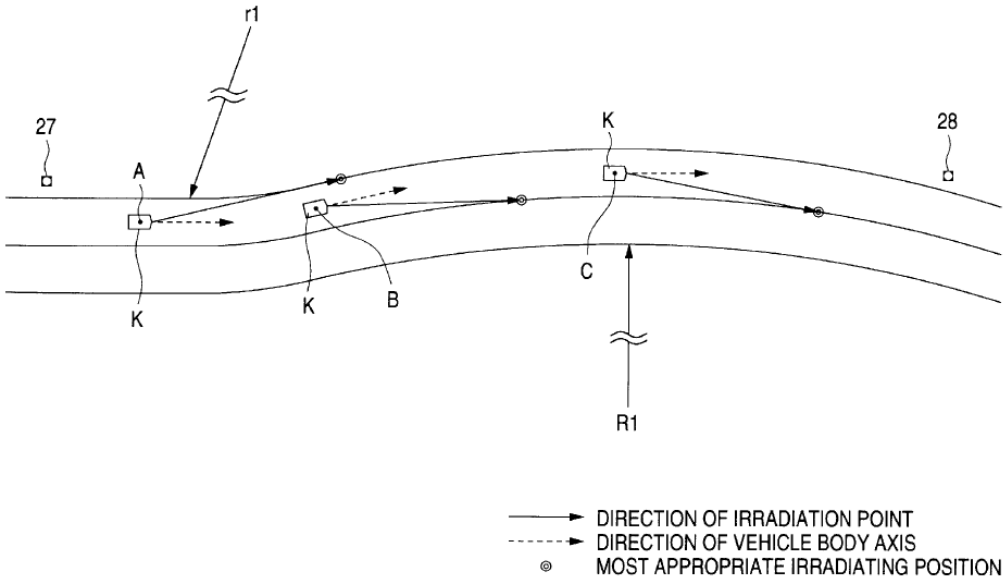
As discussed above, the combined Beam-Kobayashi system is iterative. *Supra* Section VI.B.2; EX1003, ¶159. These claims are a verbose way of reciting that the system (including instructions) [6.1]/[17.1]/[28.1] (1) determines a second light change for a second (i.e., next) road curvature[6.2]/[17.2]/[18.2], and (2) controls the LEDs to provide light toward the second road curvature (i.e., "shaping light") based on map data [6.3]/[17.3]/[28.3]. EX1003, ¶178. The Beam-Kobayashi combination discloses this function for the same reasons as in Sections VI.A.1, V.I.A.7, VI.A.8, VI.B.2, VI.B.3. This is merely a subsequent, repeated step in the continuous, iterative processes of the '029 patent and Beam-Kobayashi systems. *Id.*

A POSA would have known that reshaping the light requires taking action with at least one of the LEDs. *Id*., ¶179. Beam's controller 108 uses sensor data input "to *determine which microbeams*," e.g., LEDs, "*must be reduced in intensity*

[10] Of course, controlling direction and range may also be conducted on a main beam. EX1008, 11:23-33. Also, the entire range may be directed to a desired direction. *Id.*

to protect the other drivers" [6.2]/[17.2]/[18.2]. EX1005, 4:15-18, Abstract. The inputs are used to "*control the intensity, and/or the angular position*, of one or more" LEDs [6.3]/[17.3]/[28.3]. *Id*., Abstract. Beam's processor 1105 (*see id*., 5:34-36) uses appropriate algorithms to determine which LEDs to control, e.g., blanked. *Id*., 5:33-54, FIG. 7. Control is "*dynamically varying* in position and in size," in response to the control input. EX1005, 6:24-27, 5:46-54; EX1003, ¶179.

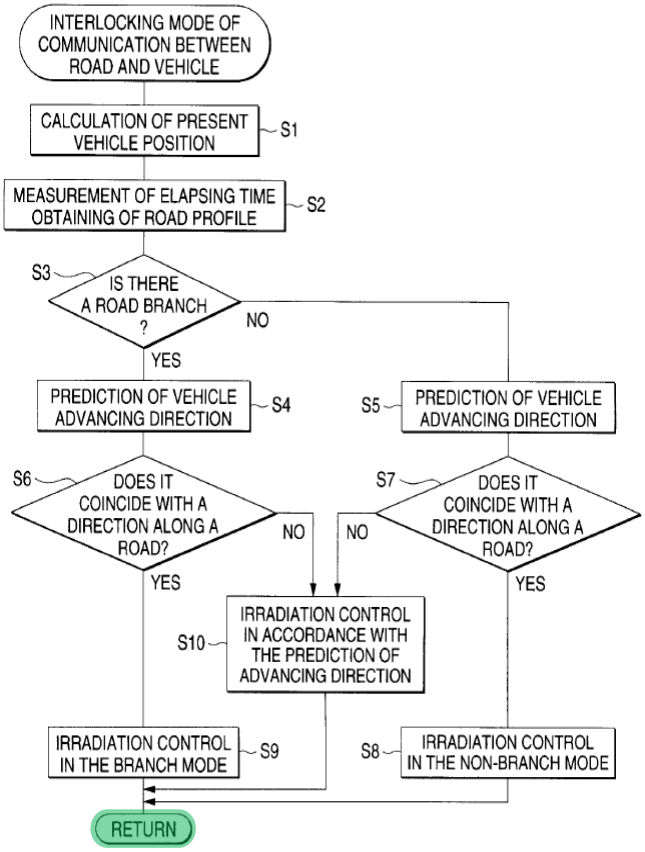
As modified with Kobayashi's ECU functionality, the combined system receives signals from GPS navigation device 29 among others, and applies an iterative control scheme. *See, e.g.*, EX1008, 17:8-15, 17:41-50; EX1003, ¶180. The iterative control scheme, applying map data from GPS, beacon, etc., allows for directional light control on curved roads, in accordance with the driver's line of sight to improve safety by adapting the light pattern in intensity and spatial distribution, shaping and reshaping light based in part on road curvature—*no matter how many curves the vehicle encounters on its travels* [6.2]/[17.2]/[18.2], [6.3]/[17.3]/[28.3]. EX1008, 14:53-15:28, FIGS. 9, 10, 12; EX1003, ¶180.




EX1008, FIG. 10.

*See also* EX1008, FIG. 9, where the final flowchart step is "RETURN," indicating a continuous, iterative process—it starts over. EX1003, ¶¶181-86.

FIG. 9



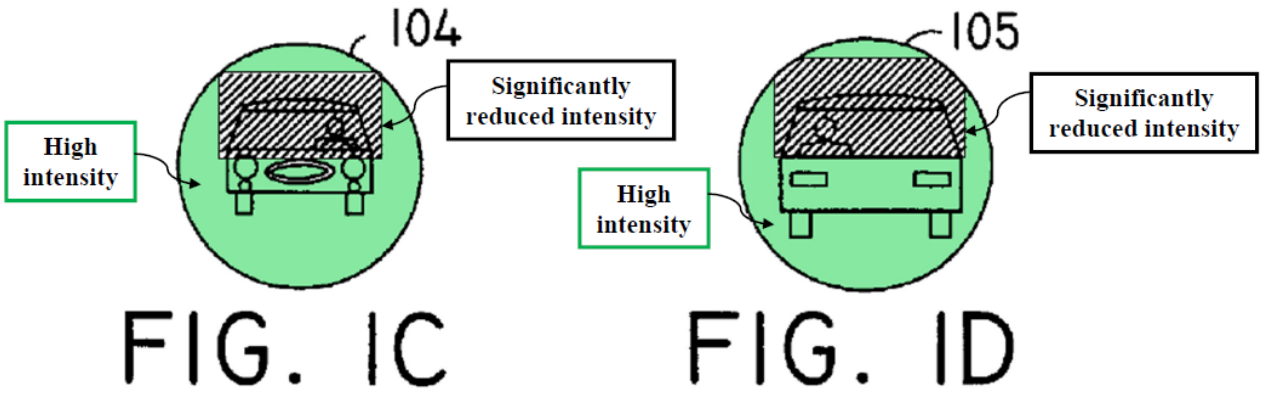

EX1008, FIG. 10 (annotated).

### 6. Claims 7/18/29, elements [7.1]-[7.4], [18.1]-[18.4], [29.1]-[29.2]

These convoluted, redundant claims merely recite well-known alternatives for increasing light toward the road curvature[7.1]/[18.1]/[29.1], [7.2]/[18.2]/[29.2]: (1) increasing the intensity of the lights [7.3]/[18.3], *or* (2) increasing the number of lights that are "on" and directed toward the road curvature [7.4]/[18.4]/[29.2]. EX1003, ¶187. These basic alternatives are disclosed by the Beam-Kobayashi combination. *Id*., ¶187.

The Beam-Kobayashi system increases light and intensity in the direction of the curvature, prior to the curve [7.1]/[18.1]/[29.1], [7.2]/[18.2]/[29.2]. EX1008, 14:53-15:28, FIG. 10; EX1003, ¶188; *see also* Sections VI.A.1, V.I.A.7, VI.A.8, VI.B.2, VI.B.3. Again, Beam uses input "information to *control the intensity, and/or the angular position*, of one or more narrow-angle microbeams." EX1005, Abstract. Beam's "controller 108 [including] processor 1105] … uses appropriate algorithms on the incoming data to determine" which LEDs to control [7.3]/[18.3], [7.4]/[18.4]/[29.2]. *Id*., 5:33-54. With Kobayashi's map data functions as additional input for controlling the LEDs, the combined system renders the claimed features obvious. *See supra*, Section VI.A.1. Put simply, in Beam's AABH "[t]he angular position or attenuation" of each LED is independently set by the controller 108. EX1005, 4:46-48. Thus, Beam varies at least intensity of individual LEDs of the first plurality of LED light sources. EX1003, ¶189.

Further, and alternatively, Beam shows that the combined Beam-Kobayashi system is configured to provide light in the direction of the road curvature from an LED not providing light in the direction of the road curvature prior to the change, as evidenced by the individual control of its LEDs and blanking scheme. *Id*., ¶190.




EX1005, FIGS. 1C and 1D (annotated).

Sensed inputs into controller 108 result in significant illumination intensity reduction in a specific section (shaded area). EX1005, 4:10-25. These inputs are used to "*control the intensity, and/or the angular position*, of one or more" LEDs. *Id*., Abstract. Beam's processor 1105 (*see id*., 5:34-36) uses appropriate algorithms to determine which LEDs to control, e.g., blanked, disclosing or at least rendering obvious a specific LED used in one situation (e.g., first straightaway or first curve) but not in another situation (e.g., further curve beyond the first straightaway/curve) [7.3]/[18.3], [7.4]/[18.4]/[29.2]. EX1005, 5:33-54, FIG. 7; EX1003, ¶¶191-97.

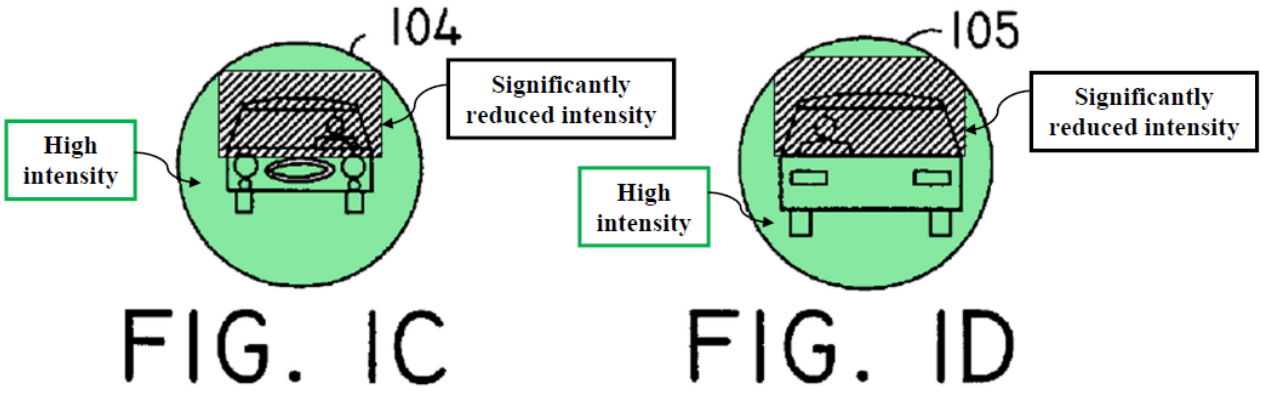
**7. Claims 8/19/30, elements [8.1]-[8.4], [19.1]-[19.3], [30.1]-[30.3]**

Beam discloses these claims, which more simply put, recite using camera data to detect another vehicle and control the lighting. EX1003, ¶198. Beam describes that a camera "faces forward, boresighted with the headlight." EX1005, 6:12-14, 4:10-36, claim 2, FIGS. 1, 2, 5; EX1003, ¶198. Beam's sensor 107—which can specifically be a video *camera*—detects headlights of an oncoming vehicle 102

and/or taillights of a preceding vehicle 103. EX1005, 4:10-32; claim 2. So Beam's camera "capture[s] data indicating at least one other vehicle ahead of the motor vehicle," as claimed. EX1003, ¶198.

The "instructions" sub-elements recite that the processor can use the camera data to *determine* the position of another vehicle and then *control* the LEDs to diminish glare to the other driver. *Id*., ¶199.

Beam's sensor 107 (i.e., camera) detects an oncoming vehicle 102 and/or taillights of a preceding vehicle 103 in a subsection (shaded area) of the field-of-view (e.g., scene 101) and controller 108 significantly reduces illumination intensity in that subsection (shaded area). EX1005, 4:10-25; EX1003, ¶200.




EX1005, FIGS. 1C and 1D (annotated).

Beam's controller 108 thus uses the data from the camera to (1) *determine the position of the vehicle*, and (2) *control the LEDs to diminish glare* to the other driver. EX1003, ¶201.

> *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*. As the positions of both vehicles move, the *blanked area tracks the location of the oncoming vehicle, dynamically varying in position and in size*.

EX1005, 6:19-27, 5:46-54; *see also id.*, 2:59-3:3.

Thus, the combined system uses camera data to detect another vehicle and control the LEDs to provide an area of decreased light intensity to reduce glare for the other driver, as the claims recite. EX1003, ¶¶202-06.

**8. Claims 9/20/31, elements [9.1]-[9.8], [20.1]-[20.8], [31.1]-[31.8]**

These claims recite many words, but no patentable concepts. EX1003, ¶207. In short, at least one LED is common to both the first and second pluralities of LEDs [9.1]/[20.1]/[31.1], [9.2]/[20.2]/[31.2]; the second plurality of LEDs is controlled based in part on third data received from a *non-camera sensor* [9.3]/[20.3]/[31.3]; and the first data includes data from a *non-camera* sensor [9.5]/[20.5]/[31.5]. EX1003, ¶207. Kobayashi's map data is *not* from a camera sensor (among other examples in Beam and Kobayashi, *see* EX1003, ¶¶80, 103-04, 207), and thus in combination with Beam discloses the features related to both first and third data from a *non-camera* sensor. *Id*., ¶207. *See also*, *e.g.*, EX1008, Abstract, 1:10-63; EX1005, Abstract, 5:33-54, 4:46-48;

Additionally, the claims recite that controlling the second plurality of LEDs includes terminating light from an LED providing light directed to the area—simply

turning an LED off [9.7]/[20.7]/[31.7], and controlling an illumination pattern or an emission pattern of the headlamps [9.8]/[20.8]/[31.8]. EX1003, ¶208. Combined with Kobayashi's map data functions, these features are rendered obvious, since selective LED control—e.g., turning them on and off—is expressly disclosed in Beam. EX1003, ¶208; *see*, *e.g.*, EX1005, Abstract, 5:33-54, 4:46-48, FIG. 14. Beam "*control[s] the intensity, and/or the angular position*, of one or more" LEDs via "controller 108 [including processor 1105] … that uses appropriate algorithms on the incoming data to determine the locations to be blanked" (terminated/turned off). EX1005, Abstract, 5:33-54. Put simply, Beam's AABH unit explicitly discloses "[t]he angular position or attenuation of each of these microbeams is independently set by the controller 108," which includes termination. EX1005, 4:46-48; EX1003, ¶208.

The combined system's iterative nature provides that control of the first and second LED light sources is subsequent to and accommodative of the other [9.6]/[20.6]/[31.6]. EX1003, ¶209. Beam's controller 107, modified by Kobayashi's ECU functionality, allows processor 1105 (that uses appropriate algorithms on incoming data) to determine the locations to be blanked—*accommodating both map data from a non-camera sensor (GPS or beacon data) and the camera-based AABH function* of Beam. EX1005, 5:33-54; EX1008, Abstract, 1:10-2:35, 4:60-64, FIGS. 1, 10, 12; EX1003, ¶209.

Finally, Beam discloses at least one of the alternate properties of "the position" [9.4]/[20.4]/[31.4] (determined and associated with the other vehicle, as discussed *supra*, Section VI.B.7). EX1003, ¶210. Specifically, Beam discloses that the position includes at least a position within image data captured by the camera. EX1005, 2:59-3:3, 5:33-54, 4:10-25, FIGS. 1C, 1D. Beam's camera detects headlights of an oncoming vehicle 102 and/or taillights of a preceding vehicle 103, in such a position within the image data captured. EX1005, 4:10-32, claim 2; *supra* Sections VI.A., VI.B.1.–VI.B.8; EX1003, ¶¶211-17.

**9. Claims 10/21/32**

Beam discloses these claims with at least beamsplitter 201 and spatial light modulator 203. EX1005, 4:26-59, 5:17-21, 8:4-12, 1:63-65, FIGS. 2, 5; EX1003, ¶218. Furthermore, reflectors and lenses can control the light from at least one of the microbeams (e.g., emanating from its LEDs). EX1005, 4:26-59, 5:17-21, 8:4-12, 1:63-65, FIGS. 2, 5. These are all "optical control elements" for controlling the LED light. EX1003, ¶218.

Kobayashi, too, discloses controlling light with reflecting mirrors, lens, shielding member, etc. *See*, *e.g.*, EX1008, 6:20-23; EX1003, ¶¶219-22.

**10. Claims 11/22/33**

These specific optical control elements are disclosed by Beam (and Kobayashi) as discussed in Section VI.B.9. EX1003, ¶¶223-28.

## VII. GROUND 2: THE COMBINATION OF GOTOU AND KARLSSON RENDERS OBVIOUS CLAIMS 1-33.

### A. Independent claims 1, 12, and 23

#### 1. A POSA would have been motivated to combine Gotou and Karlsson with a reasonable expectation of success.

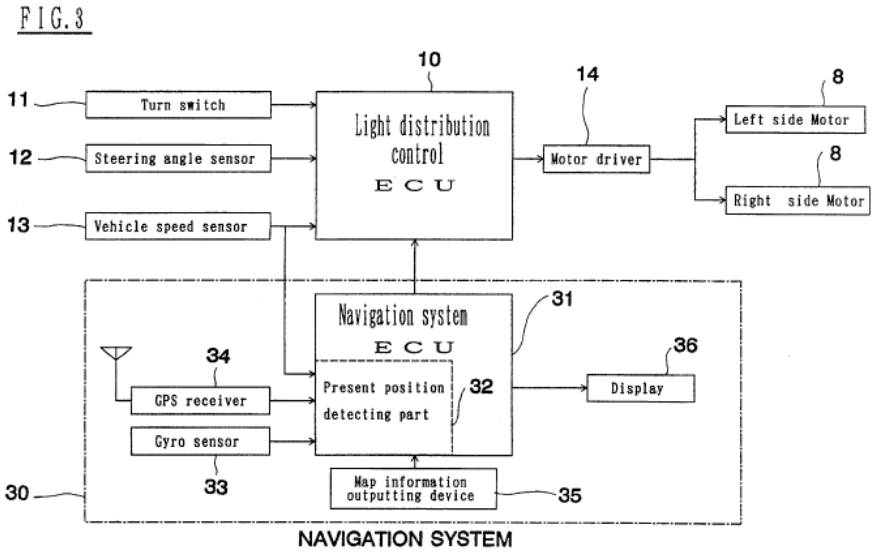
A POSA would have been motivated to combine Gotou's adaptive vehicle headlamp that uses map data as a control input to predict and adjust illumination direction with Karlsson's controllable LEDs as a light source. EX1003, ¶229-30. *First*, a POSA would have sought to use Karlsson's LEDs because of the well-known benefits of LEDs in vehicle headlamps—for example, life expectancy and redundancy, adaptation during unfavorable weather, and low-voltage direct current operation. EX1003, ¶¶231-3, 235-6; EX1010, 14:1-15, 14:26-30, 2:30-35, 6:1-5; EX1011, 3:18-26, 10:21-22. *Second*, 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. EX1003, ¶234.

To the first point, Volkswagen AG recognized—more than four years before the '029 patent's earliest possible priority date—that LEDs "are advantageously used as light sources" in headlamps. EX1022, 2:22-26. Müller explains that "light-emitting diodes are very reliable and may … be mounted in locations which are barely accessible after installation, e.g. in vehicle-part cavities, without being in any way disadvantageous." *Id.*, 2:22-26. Further, because of the reliability of LEDs, "in

contrast to conventional lamps, the lamp only needs to be changed very infrequently." *Id.*, 2:22-26, 3:44-47. Many others recognized the benefit of LEDs as light sources for headlamps well before the '029 patent's earliest possible priority date. *See*, *e.g.*, EX1005, 4:9-15, 6:9-12, Claims 4 and 5; EX1006, ¶¶[0005], [0007], [0008], [0020], [0027]; EX1009, 19:27-29, 20:9-12, 23:8-12; EX1010, 4:25-35, 13:24-29, 11:29-32; EX1011, 1:18-2:3, 3:18-26, 8:13-20, 10:6-11, 10:21-22. Additional advantages included: an array of LEDs meets the standard of luminous flux; there is no appreciable size difference in the overall headlamp packaging using such LEDs; the service life of LEDs is very long compared to conventional light sources (EX1011, 3:18-26); and LEDs may be adapted under unfavorable weather (*id.*, 10:6-11), and at a low-voltage direct current (*id.*, 10:21-22). Thus, the evolution from prior "conventional lamps" to LEDs as headlamp light sources would have been apparent to a POSA. EX1003, ¶¶235-36.

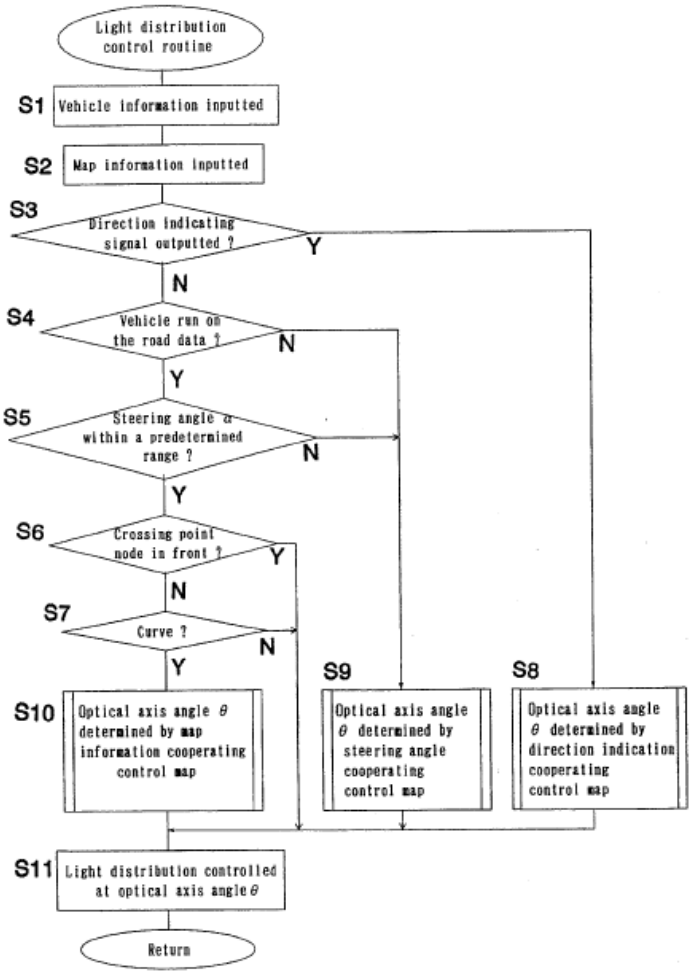
This natural evolution is evident in the combination of Gotou and Karlsson—the references are in the same field and disclose dynamic vehicle headlamps to increase illumination in a particular direction. *Id*., ¶237. The building blocks of Gotou and Karlsson are the same: controllable headlamps, input sensors, controller(s) including processors and memory, to execute commands to control headlamp light direction and/or intensity. *Id*.

Beginning with Gotou, light distributing control ECU 10 receives map data from the navigation system 30, processing the data to determine optical axis angle θ and controlling motor driver 14 to achieve the optical axis angle θ. EX1012, 3:52-67; EX1003, ¶238. Gotou provides additional details of the navigation system 30, including the GPS receiver 34, for example at EX1012, 4:1-29. *See also id.*, 5:8-6:3, 6:18-7:4, FIGS. 4, 7.



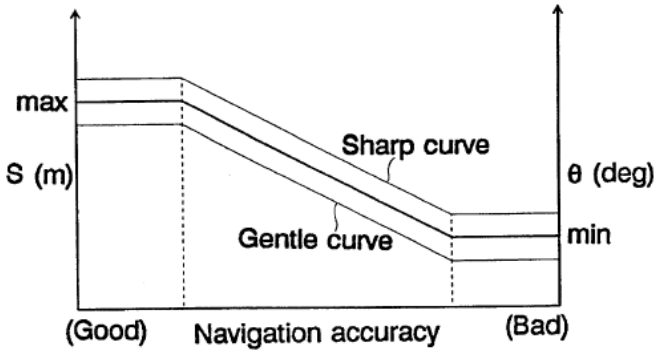

EX1012, FIG. 3.

FIG. 4




EX1012, FIG. 4.

FIG. 7




EX1012, FIG. 7.

While Gotou does not disclose that its lamp units 4 include LEDs—a technology well-known to be used as headlamps (EX1003, ¶232-36)—it does describe that plural bulbs may be installed in one headlight, so the light distribution is changed by "separately using one bulb illumination and two-bulb illumination, respectively." EX1012, 8:16-19; EX1003, ¶239.

Karlsson expands control of plural light sources, specifically describing benefits of an individually controllable grid of separate light sources (LEDs) for controlling the light direction. EX1010, 14:1-15, 14:26-30, 2:30-35, 6:1-5; EX1003, ¶240. It would have been obvious to use Karlsson's LED array in Gotou's system to improve driving safety in an efficient, compact manner and with automatic sensitivity, gaining the well-known advantages of LEDs used as headlamp light sources. EX1003, ¶240; EX1010, 14:1-15, 14:26-30, 2:30-35, 6:1-5; EX1005, 4:9-15, 6:9-12, claims 4 and 5; EX1006, ¶¶[0005], [0007], [0008], [0020], [0027];

EX1009, 19:27-29, 20:9-12, 23:8-12; EX1010, 4:25-35, 13:24-29, 11:29-32; EX1011, 1:18-2:3, 3:18-26, 8:13-20, 10:6-11, 10:21-22.

To the second point, substituting Karlsson's controllable LED array and glare reduction features utilizing Karlsson's camera would have reduced the number of moving parts from Gotou's system, while expanding Gotou's plural bulb control. EX1003, ¶241. Thus, a POSA would have been motivated to make this obvious improvement, resulting in a more compact system with fewer moving parts, while gaining the well-known benefits of LEDs as a controllable light source. EX1003, ¶241; EX1022, 2:22-26, 3:44-47; EX1005, 4:9-15, 6:9-12, claims 4 and 5; EX1006, ¶¶[0005], [0007], [0008], [0020], [0027]; EX1009, 19:27-29, 20:9-12, 23:8-12; EX1010, 4:25-35, 13:24-29, 11:29-32; EX1011, 1:18-2:3, 3:18-26, 8:13-20, 10:6-11, 10:21-22.

Karlsson recognizes the advantages of LEDs—spotlight beams 34 come from of a grid of separate LEDs that can be controlled individually or in groups. EX1010, 14:1-15, 14:26-30, 2:30-35, 6:1-5; EX1003, ¶242. Its headlight includes a spatial distribution of LEDs D, I, and D/I and spotlight sensors S. EX1010, 19:18-20:3. As shown in Figure 6, emitted light beam 50 is represented as a window that shifts left to right and top to bottom in the plane, based on data from inputs to Karlsson's controller. *Id*.

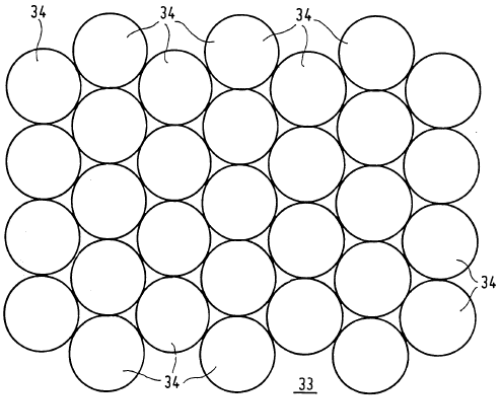
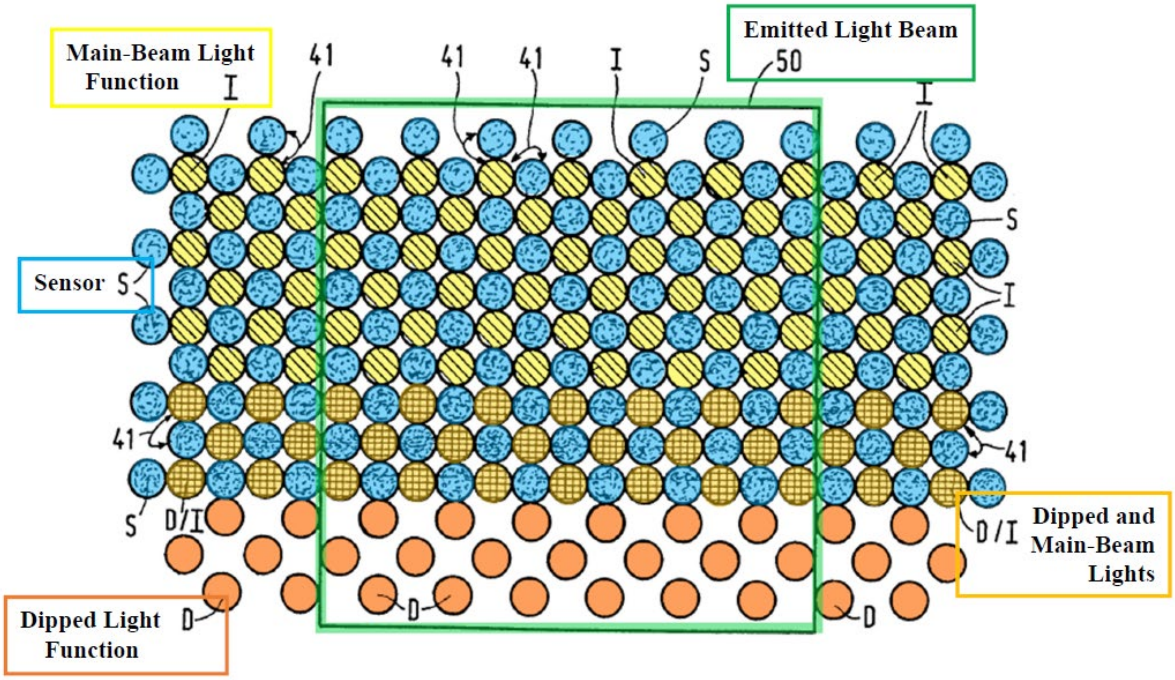
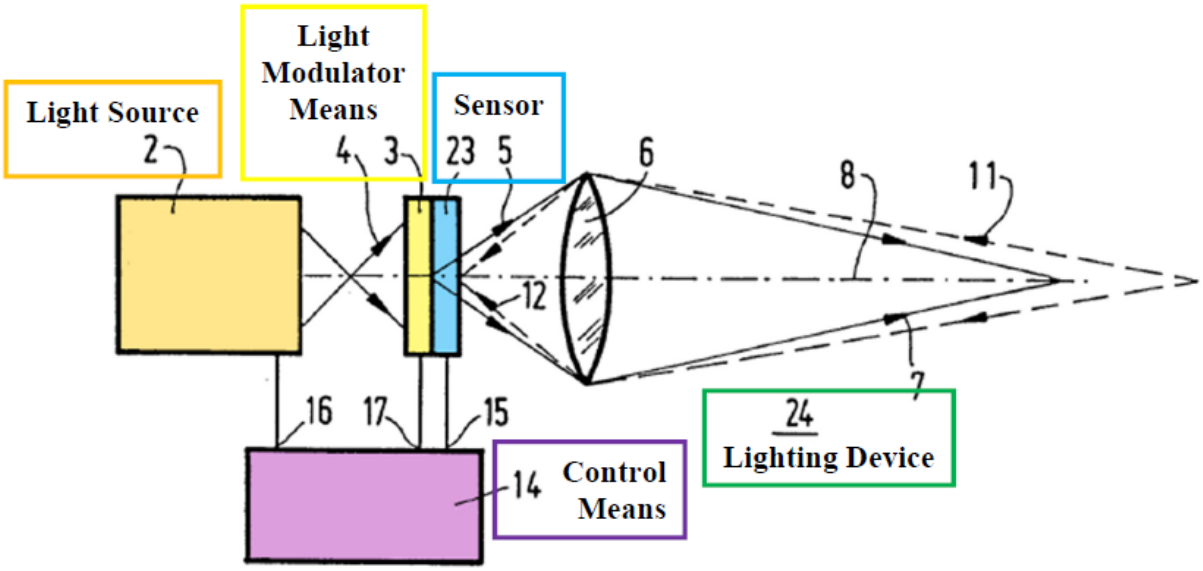



FIG. 6

EX1010, FIG. 6.




EX1010, FIG. 14 (annotated).




EX1010, FIG. 3 (annotated).

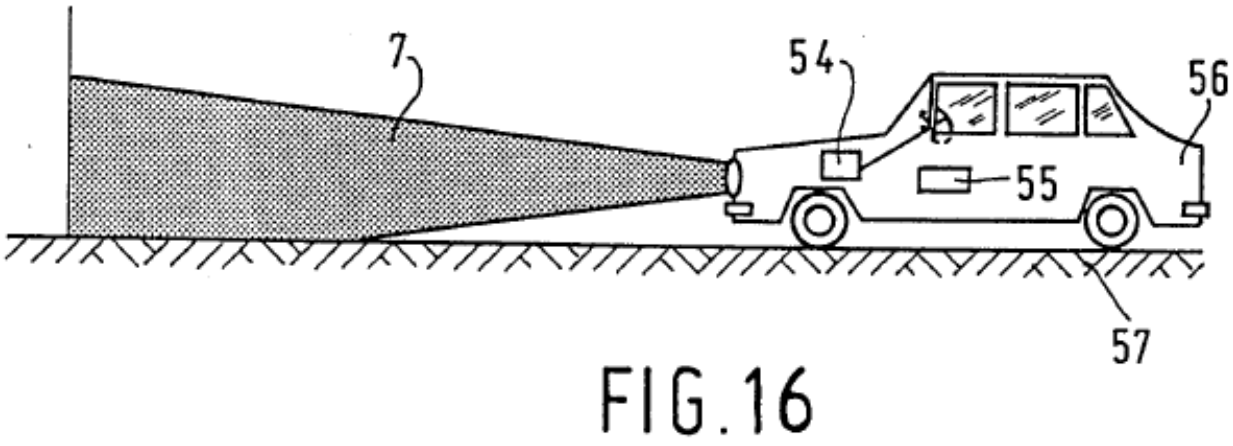
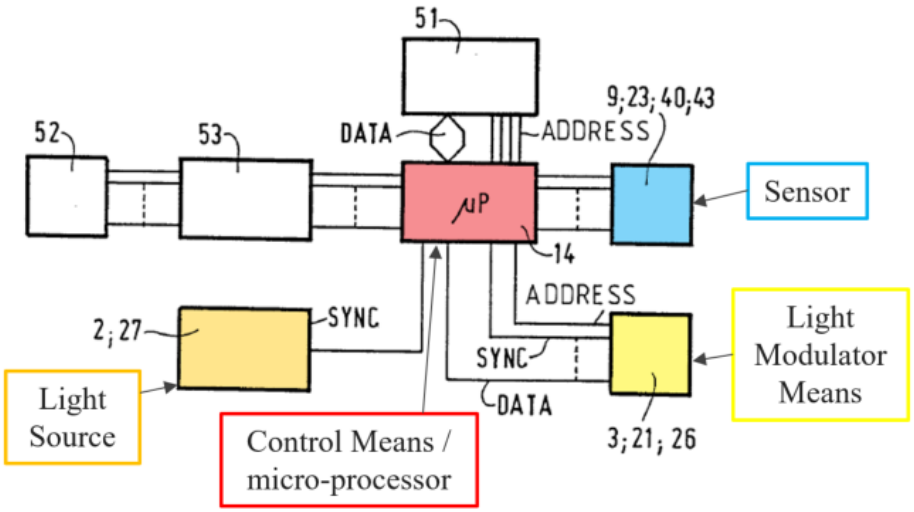



FIG. 16

EX1010, FIG. 16.




EX1010, FIG. 15 (annotated).

Implementing Karlsson's controllable LED arrays for Gotou's non-LED headlamp system would have achieved additional control based on individualized LEDs. EX1003, ¶243. Indeed, Karlsson expressly recognized benefits of directional control using direction sensor 54. EX1010, 20:22-32. Gotou's use of GPS map data suggests the advantages of changing and controlling the direction of headlamps; and Karlsson's LED array makes that control easier. EX1012, 3:52-67, 4:1-29, 5:8-6:3, 6:18-7:4, 8:15-19, FIGS. 4, 7, 12; EX1010, 14:1-15, 14:26-30, 2:30-35, 6:1-5; EX1003, ¶243.

The combination would have merely been substituting Karlsson's known controllable LED arrays to control the shape and/or intensity of headlights for Gotou's similar, known control of a non-LED headlamp/light source, in the same way. *KSR*, 550 U.S. at 417-421; EX1003, ¶244. It would have been a simple

substitution of one known element (Gotou's directional headlamp control via motor) for another (Karlsson's directional headlamp control via LED arrays). *KSR*, 550 U.S. at 419-421; *see* EX1022, 2:22-26, 3:44-47 (describing the reliability of LEDs as compared to alternative light sources). A POSA would have also understood that Karlsson's directional LED input and control technique would have been combined in a known way to provide the predictable benefits disclosed in both Karlsson and Gotou. *KSR*, 550 U.S. at 419-421; EX1003, ¶244.

Moreover, such a modification would have been simply applying a known technique (Karlsson's light shaping via an LED array) to a known device ready for improvement (Gotou's headlamp using a motor to swing lamp units) with predictable results. *KSR*, 550 U.S. at 417; EX1003, ¶245.

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. This would have been routine and well within the skill of a POSA due to the similarities in Gotou's and Karlsson's adaptive light control systems and methods. *Id*., ¶246.

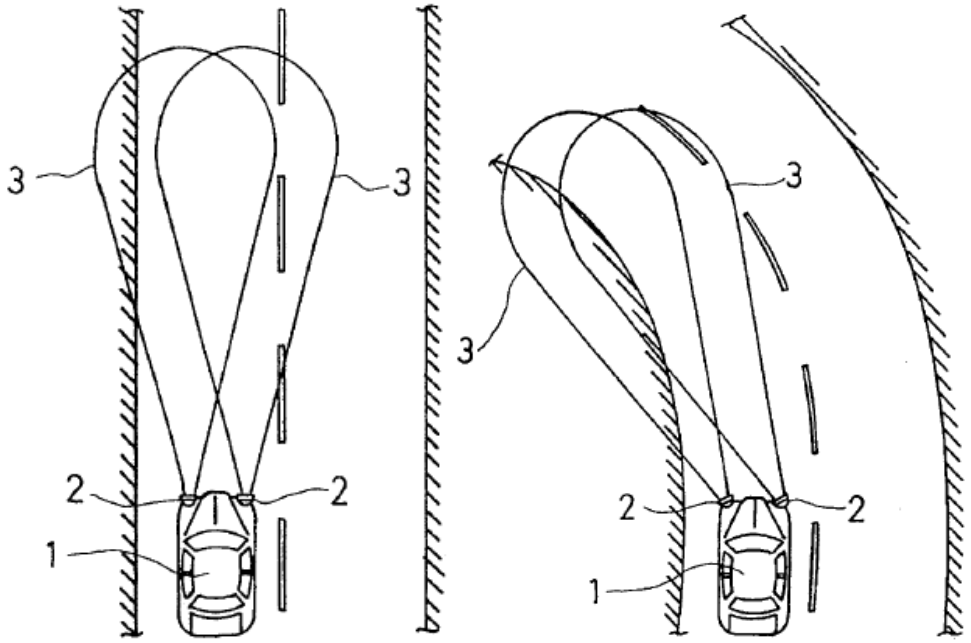
This modification would have been merely substituting known prior-art elements (e.g., Gotou's non-LED light sources, with Karlsson's directional-

controllable LED headlamps) according to known methods (disclosed in Karlsson) to yield predictable results (e.g., improved longevity and reliability of LEDs versus conventional light sources). *Id*., ¶¶247, 248-51. Karlsson's known technique of individualized LED control is fully described along with its benefits, such that it would have been obvious to a POSA to apply to similar systems, such as Gotou's GPS-enabled adaptive headlamp system, in the same way. *Id.* A POSA would have had a reasonable expectation of success in combining a controllable LED array headlamp, as disclosed by Karlsson, in the context of the Gotou's adaptive vehicle headlamp, at least because it was well-known in the field to use LEDs to control headlight illumination (e.g., intensity, shape, and/or angular position) to improve driving safety, in an efficient manner and with automatic sensitivity. EX1010, 14:1-15, 14:26-30, 2:30-35; 6:1-5; EX1003, ¶¶247-52.

**2. [1.P]/[12.P]/[23.P]**

Gotou's adaptive vehicle headlamp uses map data, including road profile and present position of the vehicle, to predict and adjust the illumination direction. EX1012, Abstract, 1:35-40, 2:8-26, 3:24-62, 4:45-49, 6:4-61, 7:32-43, 8:28-35, FIGS. 1-3, 8-10. Vehicle 1 includes headlights 2 with lighting regions 3 that are adjusted relative to an intended advancing direction of vehicle 1. *Id*., 3:24-62, 7:32-43, 8:28-35. For example, when there is a leftward curve, the light distribution is

adjusted leftward prior to reaching the curve. *Id*., 3:24-62, 7:32-43, 8:28-35; EX1003, ¶253.




EX1012, FIGS. 8 and 9.

Karlsson's system discloses headlights having spotlight beams and spotlight sensors to detect light from oncoming traffic and automatically control a headlight lighting pattern to reduce blinding oncoming traffic. EX1010, Abstract; EX1003, ¶¶254-55.

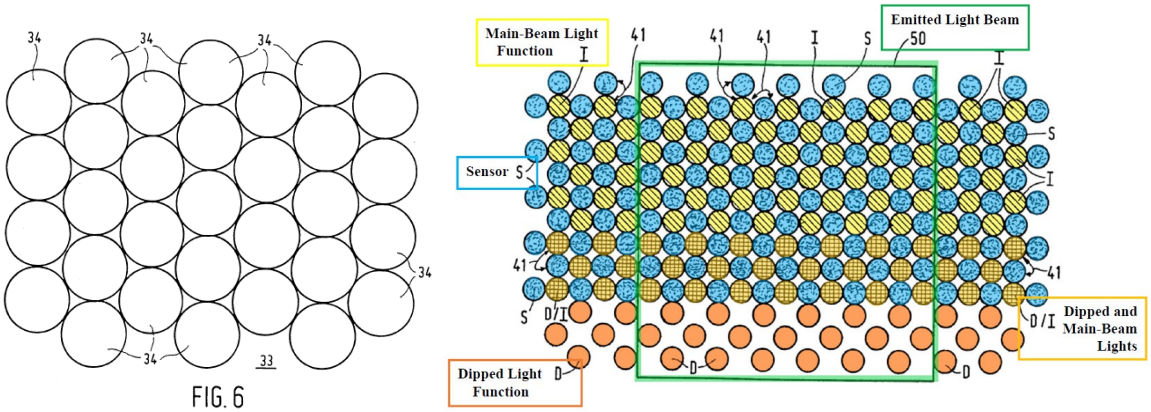
### 3. [1.1]/[*See* 12.P]/[*See* 23.P]

Gotou focuses on an embodiment where the right and left headlights concurrently swing in the same direction to change the light distribution. EX1012, 3:52-67, 4:1-29, 5:8-6:3, 6:18-7:4. However, Gotou also provides independent movement, as well as (1) using a plurality of light sources in each headlight and

changing the light distribution by separately using one or more sources for illumination and (2) using one or more sub-reflectors to change the light distribution. *Id.*, 8:9-22; EX1003, ¶256. Gotou does not identify using LED light sources for its headlights.

But this was not novel—headlamps with LED arrays were well-known years before the '029 patent's earliest possible priority date. EX1003, ¶257; EX1005, 4:9-15, 6:9-12, claims 4 and 5; EX1006, ¶¶[0005], [0007], [0008], [0020], [0027]; EX1009, 19:27-29, 20:9-12, 23:8-12; EX1010, 4:25-35, 13:24-29, 11:29-32; EX1011, 1:18-2:3, 3:18-26, 8:13-20, 10:6-11, 10:21-22. Thus, implementing LEDs—with their many known benefits—as the light source of choice in Gotou's system would have been obvious. EX1003, ¶258-60. Indeed, it would have been obvious to substitute Karlsson's known controllable LED arrays to control the headlight shape and/or intensity for Gotou's similar, known control of a non-LED light source, in the same way. *KSR*, 550 U.S. at 417-421; EX1003, ¶261; *see* EX1022, 2:22-26, 3:44-47. Replacing Gotou's controllable non-LED light sources with Karlsson's controllable LED light sources would have also merely been applying a known prior-art solution from a finite number of identified, predictable solutions, with a reasonable expectation of success. EX1003, ¶261; *KSR*, 550 U.S. at 415-421; *supra* Section VII.A.1.

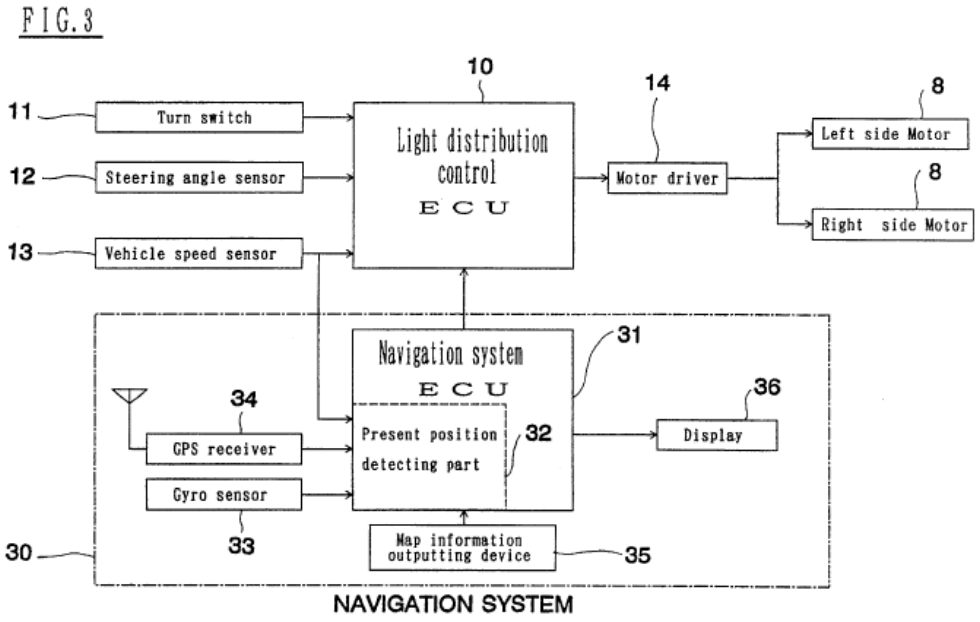
Karlsson's headlights have a plurality of controllable spotlight beams (e.g., from LEDs), using spotlight sensors to detect light from oncoming traffic and automatically control the headlight lighting pattern (to reduce blinding oncoming traffic). EX1010, Abstract, 13:24-14:4, 2:30-35, 9:18-26. Karlsson's system includes a grid of separate LEDs, which can be controlled individually or in groups. *Id*. The pattern and intensity (Figure 14) of a light beam 33 can be effected by switching one or more LEDs on or off, or by adjusting the intensity of the light emitted by an individual LED. *Id*.; EX1003, ¶¶262-63.




EX1010, FIG. 6 and 14 (annotated).

### 4. [1.2]/[*See* 12.P]/[*See* 23.P]

Gotou's Figure 3 shows a schematic control system diagram, including ECU 10, which includes one or more processors. EX1003, ¶264.

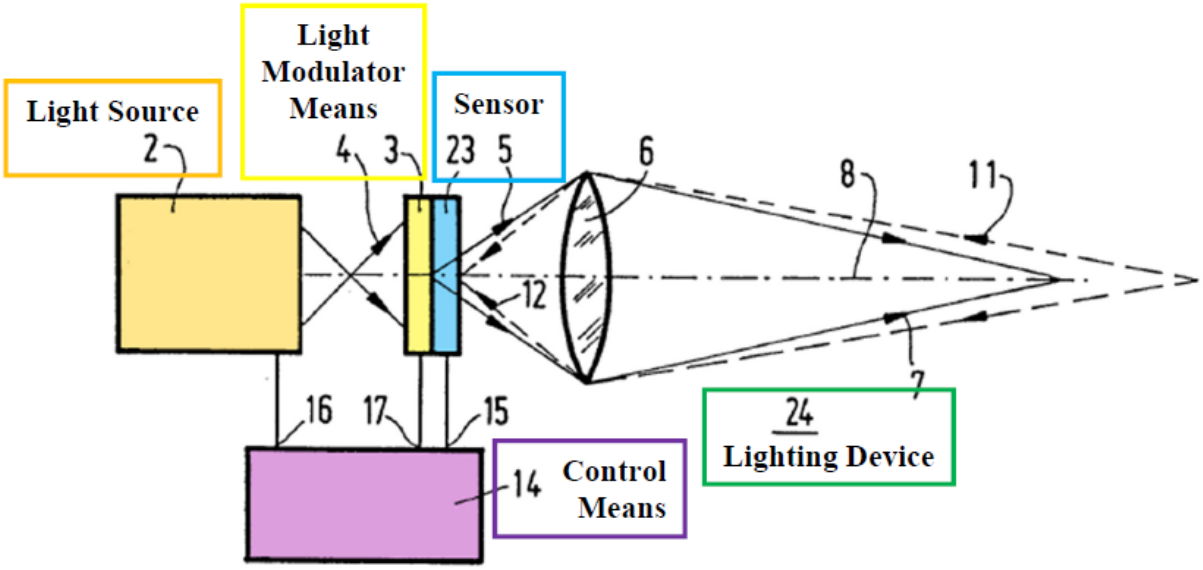



EX1012, FIG. 3.

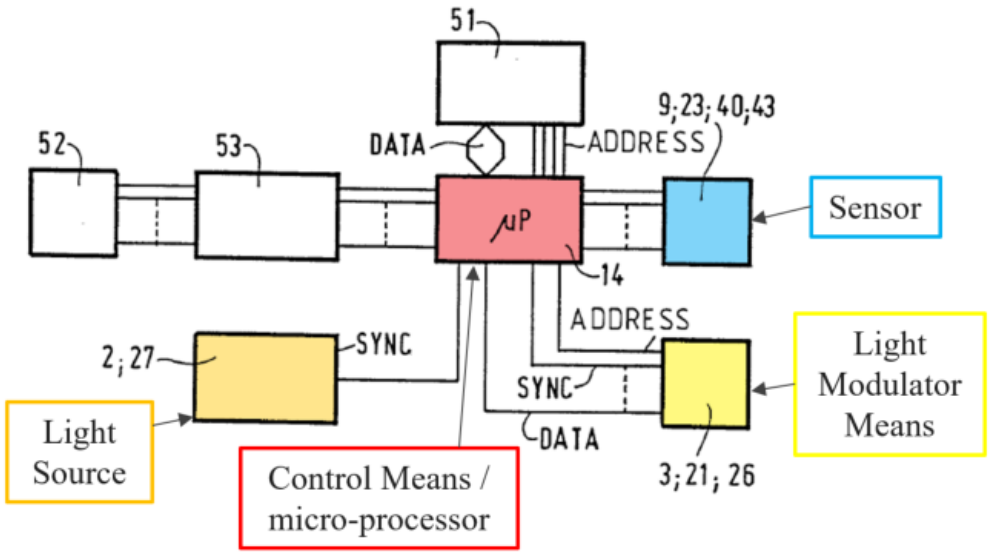
Gotou's ECU 10 "*processes* the information and signals to determine a requisite optical axis angle θ, and an indicating signal is outputted to motor driver 14 so as to achieve the optical axis angle θ." EX1012, 3:62-67, 3:52-62, 4:1-29.

Should Patent Owner argue, incorrectly, that Gotou does not expressly disclose one or more processors, it would have been obvious to a POSA to include. EX1003, ¶¶265-66. Indeed, Karlsson's control system includes processors, memory, etc., specifically disclosing that "[t]he *control means* may likewise be built up of various components, such as a *microprocessor, a microcontroller, programmable logic circuits, or of discrete logic components*…A non-volatile *memory* 51 type PROM, EPROM or EEPROM may be used for *storing and recording the various adjustments*." EX1010, 21:36-22:4, 20:6-20, FIG. 15. These were all well-known components of a control system that a POSA would have known were included (or

at a minimum obvious to include) in Gotou's ECU 10. EX1003, ¶¶267-68; *See also* EX1034, FIG. 2, 1:24-38; 14:7-51.



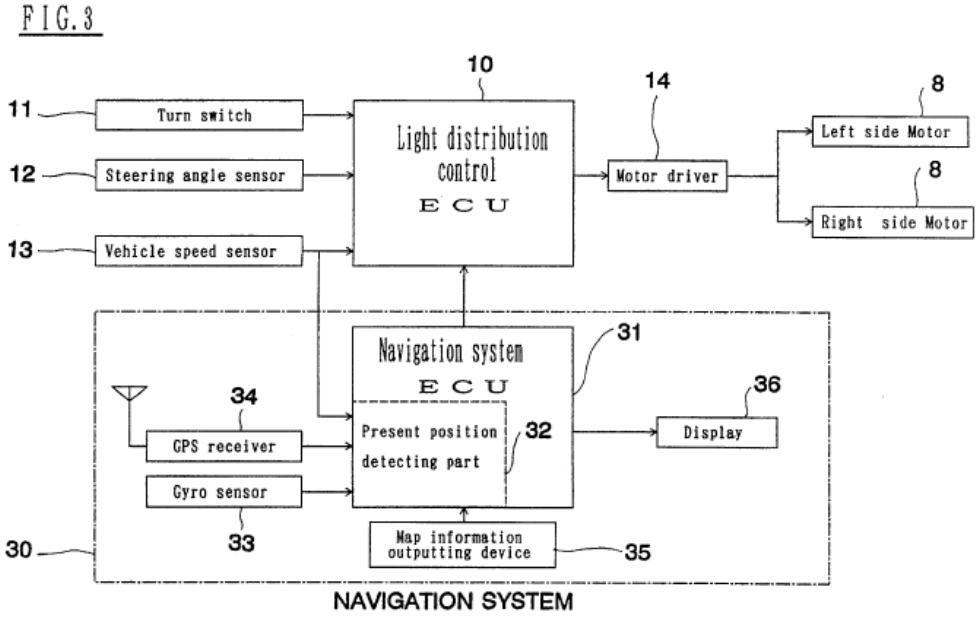

EX1010, FIG. 3 (annotated).




EX1010, FIG. 15 (annotated).

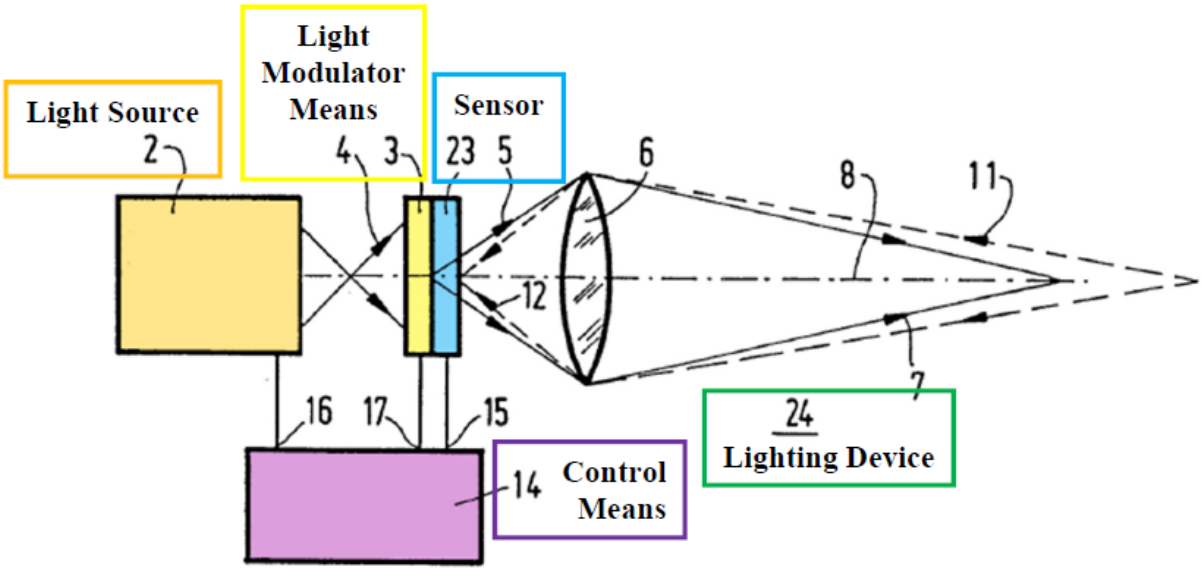
### 5. [1.3]/[*See* 12.P]/[*See* 23.P]

As with the processor(s) above, a POSA would have also understood that Gotou's light distribution control ECU 10 includes a memory (to store instructions for the processor). EX1003, ¶269. Similarly, a POSA would have understood that ECU 31 also includes a memory. *Id*. Gotou explains that "[v]arious kinds of road information on the map, for example, degrees of curves or the like on the road are *stored* in correspondence with each of the nodes." EX1012, 4:23-25, 8:23-27, 4:36-40, FIG. 3. And as above, Gotou's ECU 10 "*processes*"—via instructions—"the information and signals to determine a requisite optical axis angle θ, and an indicating signal is outputted to motor driver 14 so as to achieve the optical axis angle θ." *Id.*, 3:52-67.

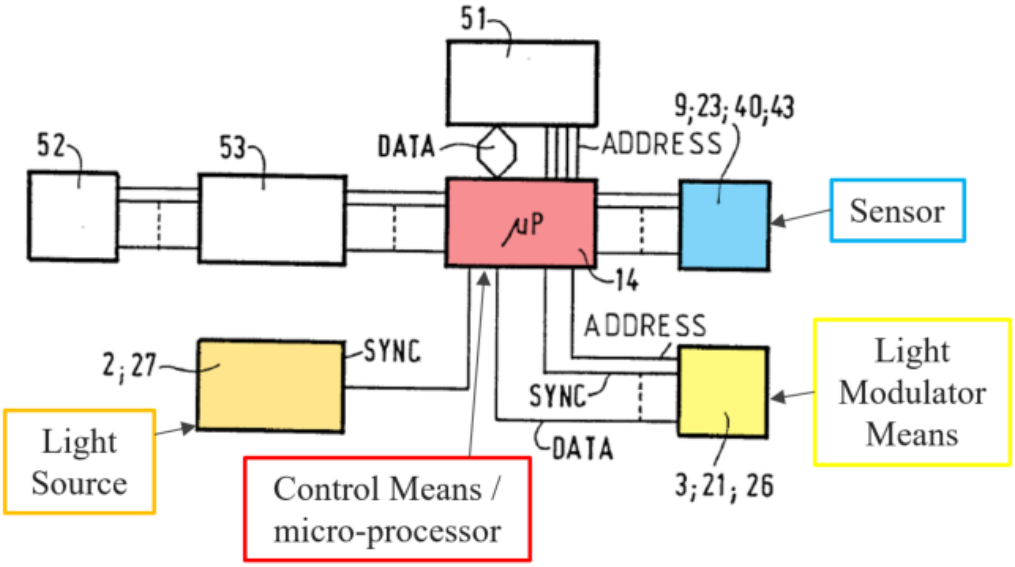



EX1012, FIG. 3.

Should Patent Owner argue, incorrectly, that Gotou does not expressly disclose memory storing instructions that are executed by one or more processors, this would have been obvious to a POSA in view of Karlsson. EX1003, ¶270. Karlsson too describes a control system with a memory. EX1010, 21:36-22:4, 20:6-20, FIG. 15. Karlsson's system includes processors, memory, etc., and discloses that "[t]he *control means* may likewise be built up of various components, such as a *microprocessor, a microcontroller, programmable logic circuits, or of discrete logic components* …. A non-volatile *memory* 51 type PROM, EPROM or EEPROM may be used for *storing and recording the various adjustments*." *Id*. These were all well-known components of a control system that a POSA would have known were included (or at a minimum obvious to include) in Gotou's ECU 10. EX1003, ¶¶271-72.




EX1010, FIG. 3 (annotated).

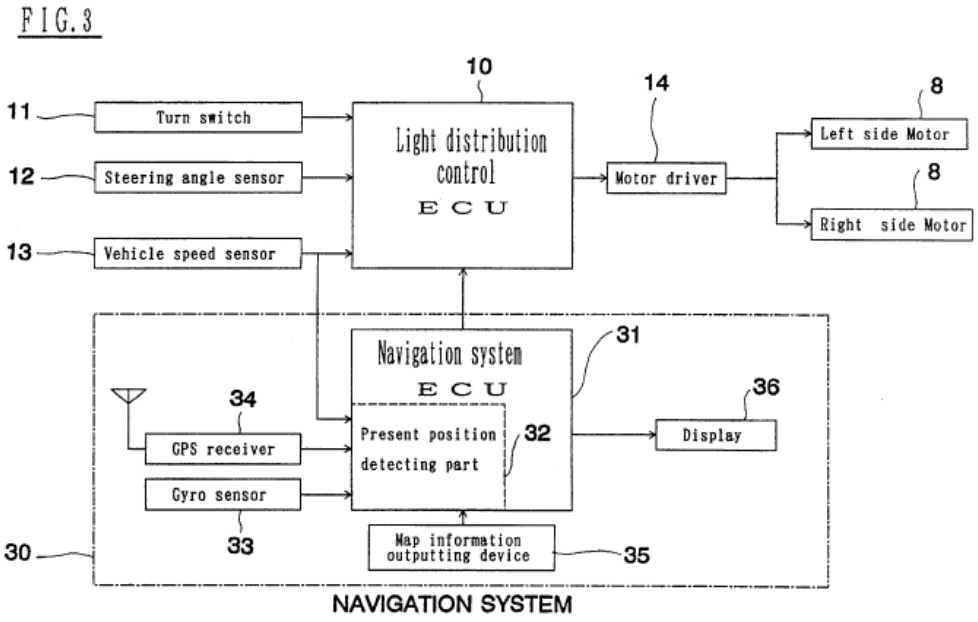



EX1010, FIG. 15 (annotated).

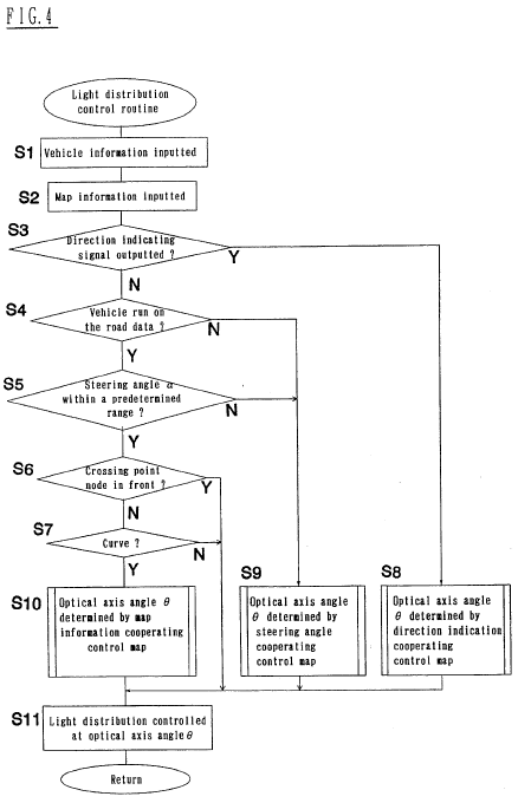
**6. [1.4]/[12.4]/[23.4]**

Gotou's ECU 10 receives map data and processes the information and signals to determine a requisite optical axis angle θ, and output an indicating signal motor driver 14 to achieve the optical axis angle θ. EX1012, 3:52-67, 4:1-29; EX1003, ¶273. Indeed, Gotou discloses that using map data "improves the visibility by varying the optical axis" (the shape of the light) "at an early stage before the steering wheel is actually turned" (before the road curvature). EX1012, 6:40-44, 5:8-6:3, 6:18-7:4, FIGS. 4, 7.

Thus, a POSA would have understood that the received map data indicated an upcoming road curvature, as recited. EX1003, ¶273.

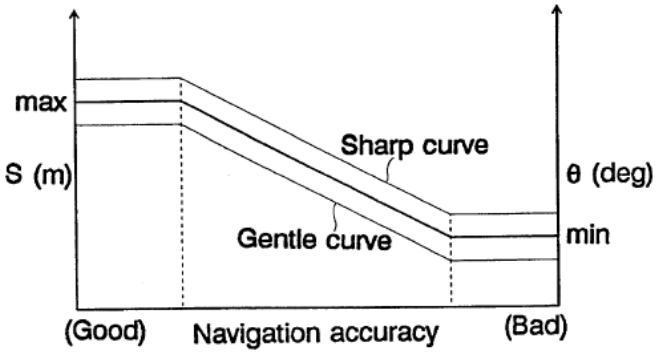



EX1012, FIG. 3.




EX1012, FIG. 4.

FIG. 7



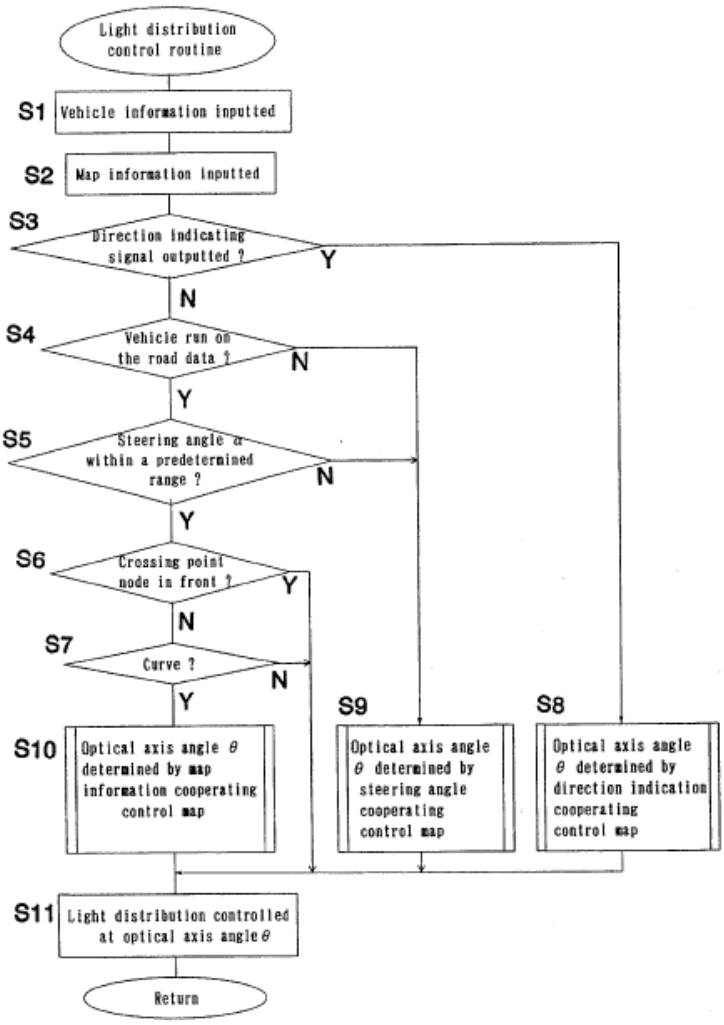

EX1012, FIG. 7.

Similarly, Karlsson discloses direction sensor 54, 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." EX1010, 20:22-32; EX1003, ¶¶274-75.

**7. [1.5]/[12.5]/[23.5]**

Gotou's ECU 10 processes the information and signals to determine a requisite optical axis angle θ (*determining* a light change), and output an indicating signal to motor driver 14 to achieve the optical axis angle θ, thereby *adapting and shaping* the light pattern in intensity and spatial distribution in a direction of and based upon the road curvature. EX1012, 3:62-67; EX1003, ¶276.

FIG. 4



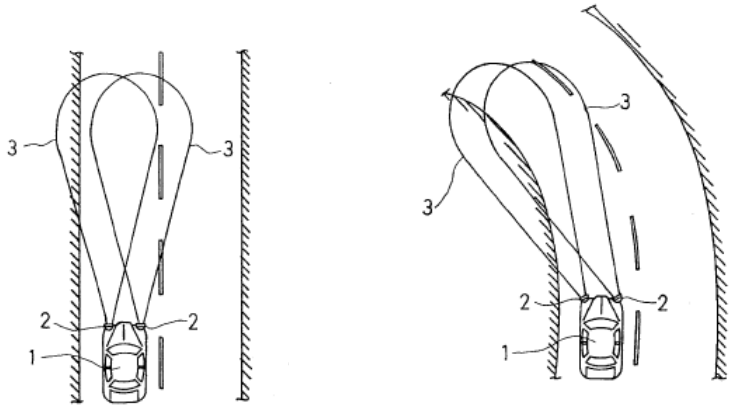

EX1012, FIG. 4.

At S2, map information is input (e.g., crossing points, directions of curves, or degrees of sharpness of curves). EX1012, 4:36-40. At S7, the system determines whether or not there is a curve. EX1012, 6:18-27, 5:8-6:3; 6:28-7:4; EX1003, ¶277.

Gotou's Figures 8 and 9 show the effect of this determination—light is shaped in the direction of the curve. EX1003, ¶278.

FIG.8

FIG.9




EX1012, FIGS. 8 and 9.

Karlsson also describes discrete control of the light pattern (shaping light). EX1003, ¶279. For example, "the objective of the invention is to provide … a headlight of a motor vehicle, wherein the pattern of the emitted light beam is *varied automatically* in an efficient manner and with maximum sensitivity *in response to at least one control signal*." EX1010, 2:30-35, 20:22-32. Indeed, Karlsson's grid of separate LEDs are controlled individually or in groups, and Figures 6 and 14 show a pattern and intensity (Figure 14) of a light beam 33 can be effected by switching one or more LEDs on or off, or by adjusting the intensity of the light emitted by an individual LED. *Id*.; EX1003, ¶¶279-81.

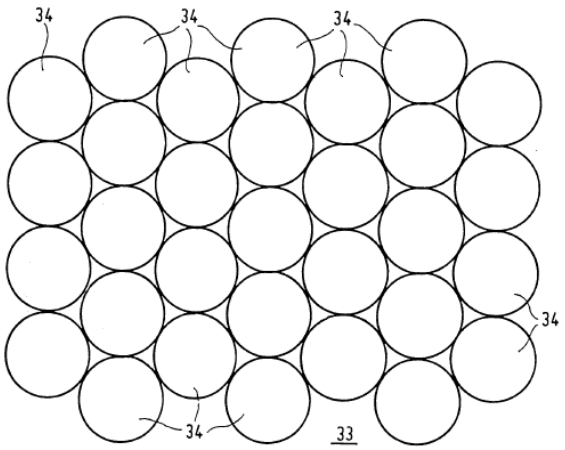
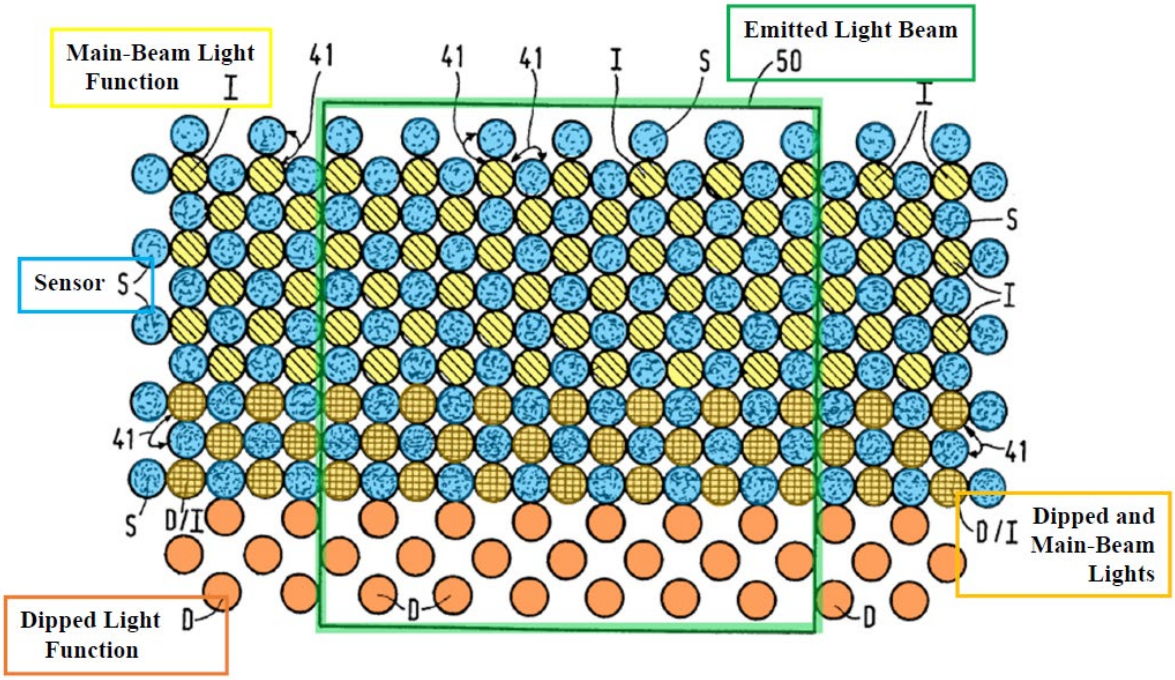



FIG. 6

EX1010, FIG. 6.




EX1010, FIG. 14 (annotated).

**8. [1.6]/[12.6]/[23.6]**

The combined Gotou-Karlsson system renders obvious this feature—controlling the LEDs based on the determined light change prior to the vehicle reaching the curve. EX1003, ¶¶285-86. Indeed, Gotou discloses that using map data

"improves the visibility by varying the optical axis" (the shape of the light) "at an early stage before the steering wheel is actually turned" (before the road curvature). EX1012, 6:40-44; EX1003, ¶282.

Karlsson's lighting device 1 provides a light beam 7 from LEDs, with the intensity and pattern controlled by lighting means 2, 3 and control means 14 that are optimally adapted to the road. *Id*., 9:18-26. As in Section VII.A.7, Karlsson's grid of separate LEDs are controlled individually or in groups, and Figures 6 and 14 show a pattern and intensity (Figure 14) of a light beam 33 can be effected by switching one or more LEDs on or off, or by adjusting the intensity of the light emitted by an individual LED. *Id*.; EX1003, ¶¶283.

So, a POSA would have been motivated to combine Gotou and Karlsson to take advantage of Karlsson's individually controllable grid of LEDs to better control the light direction in Gotou and realize the benefits of LED light sources. *Supra*, Sections VII.A.1, VII.A.2; EX1012, 7:32-43, 1:10-40; EX1010, 14:1-15, 14:26-30, 2:30-35, 6:1-5; EX1003, ¶¶284-87.

### B. Dependent claims

#### 1. Claims 2/13/24

The Gotou-Karlsson combined system renders obvious these claims. EX1003, ¶¶288-90. As in Section VII.A.7, Karlsson's grid of separate LEDs are controlled individually or in groups, and Figures 6 and 14 show a pattern and intensity (Figure 14) of a light beam 33 can be effected by switching one or more LEDs on or off, or

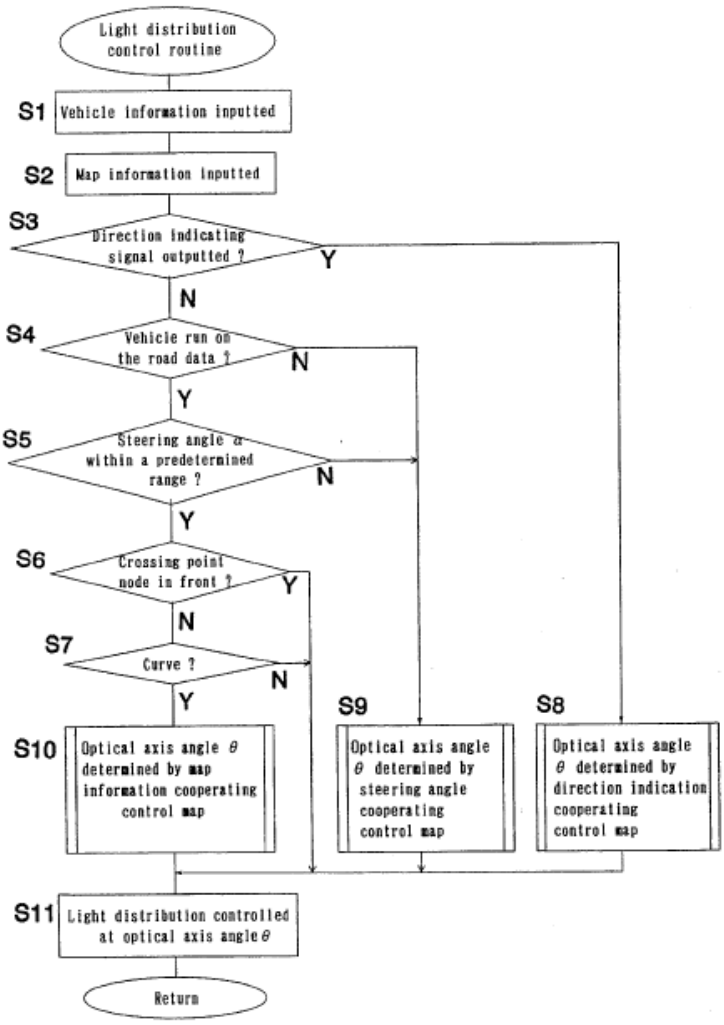
by adjusting the intensity of the light emitted by an individual LED. EX1010, 14:1-15, 14:26-30, 2:30-35, 6:1-5; EX1003, ¶288. The combined system thus selects which LEDs should be on or off/reduced. *Id*., 5:33-54; EX1003, ¶288. Thus, when the combined system determines a light change should be made, it selects a first plurality of LEDs to provide light. EX1003, ¶288.

Again, a POSA would have been motivated to combine the teachings of Gotou and Karlsson for the benefits of Karlsson's individual controllable grid of LEDs—better reliability and longevity, advanced light direction control, adaptability in unfavorable weather, and low-voltage direct current operation—in Gotou's system in an efficient manner and with automatic sensitivity. EX1003, ¶289; *supra*, Sections VII.A.1, VII.A.2; EX1010, 14:1-15, 14:26-30, 2:30-35, 6:1-5.

**2. Claims 3/14/25**

Again, these claims simply implement "*reshaping*" the light based on road curvature via the customary step of the instructions stored in the memory and executed by the processor. EX1003, ¶291; *supra* Section VI.A.5; EX1003, ¶¶125-27. Gotou's ECU 10 receives map data, processing the information and signals to determine a requisite optical axis angle θ, and thus controlling the optical axis angle θ. EX1012, 3:62-67, 3:52-62, 4:129. Gotou's control method for light distribution includes "is an iterative process ("Return") for reshaping light. *Id.*, 5:8-6:3, 6:18-7:4; EX1003, ¶292.

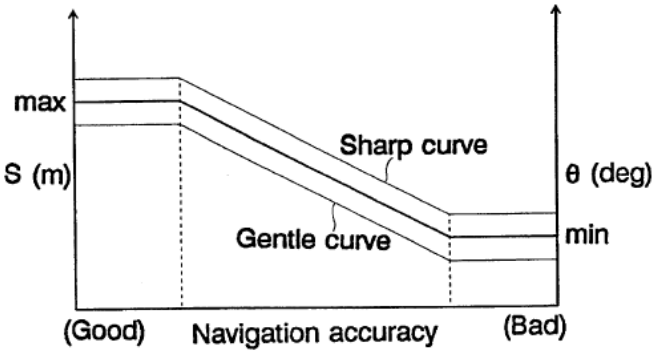
FIG. 4




EX1012, FIG. 4.

Indeed, Figure 7 shows how light distribution may be changed to accommodate a variety of curvatures and reshaping. EX1003, ¶¶293-94.

FIG.7



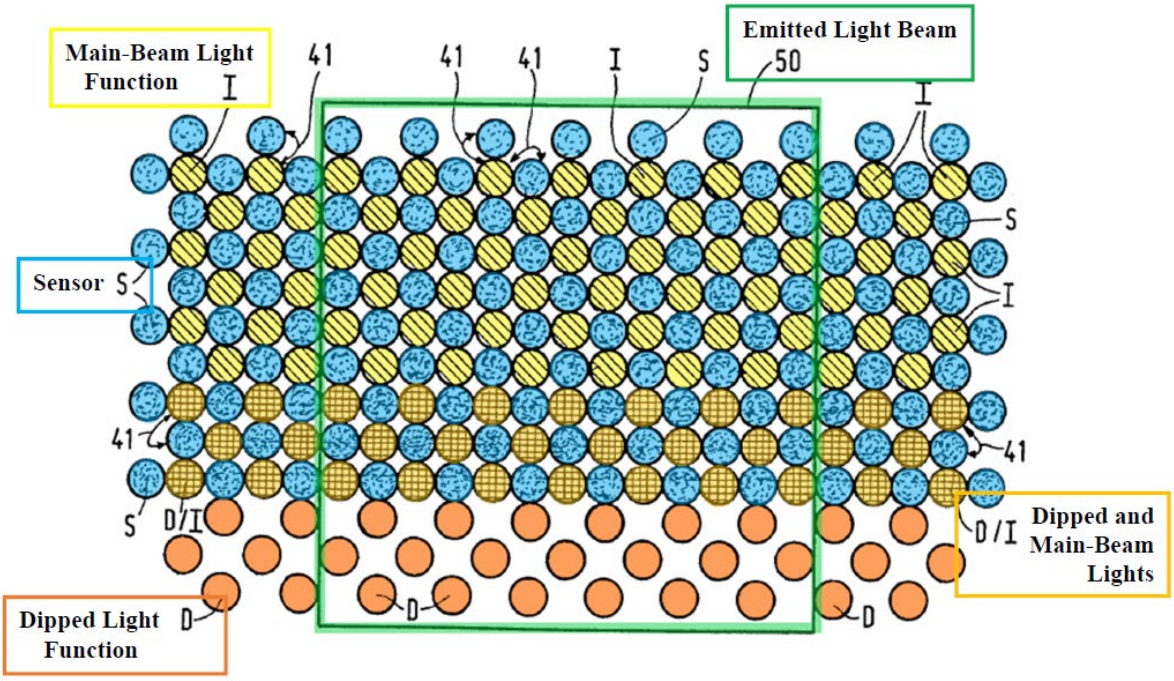

EX1012, FIG. 7; *see also id*., 6:28-61.

### 3. Claims 4/15/26

Again, as with claims 3/14/25, from which they depend, these claims further contemplate selecting one of the first plurality of LED's or some second plurality of LEDs with one different LED from the first to provide *reshaped* light. EX1003, ¶295. This would have been obvious, at least because *reshaping* the combined system's light would have required taking action with *at least one* of Gotou's modified headlamps utilizing Karlsson's LEDs. *Id*. Indeed, as above, Gotou's ECU 10 receives map data, processing the information and signals to determine a requisite optical axis angle θ, and thus controlling the optical axis angle θ. EX1012, 3:62-67, 3:52-62, 4:1-29. Gotou's control method for light distribution is an iterative process ("Return") that reshapes light. *Id.*, FIG. 7, 6:28-61; EX1003, ¶295.

The combined system using Karlsson's spatial distribution of LEDs (D, I, and D/I) and spotlight sensors S (EX1010, 19:18-20:3) provides an emitted light beam

50 (represented as a window below) produced by LEDs that can shift left to right and top to bottom in the plane based on the data from inputs. EX1003, ¶296. Thus, a specific LED is used in one situation (e.g., prior to entering a curve) but not in another situation (e.g., while driving through a curve). *Id*.




EX1010, FIG. 14 (annotated).

Thus, Gotou–Karlsson's combined system renders these claims obvious. *Id*., ¶¶297-98. A POSA would have been motivated to combine Gotou and Karlsson for the benefits of Karlsson's individual controllable grid of LEDs—better reliability and longevity, controllability of the light direction, adaptability in unfavorable weather, and low-voltage direct current operation—in Gotou's system, in an efficient manner and with automatic sensitivity. *Supra*, Sections VII.A.1, VII.B.1, VII.B.2; EX1010, 14:1-15, 14:26-30, 2:30-35, 6:1-5.

#### 4. Claims 5/16/27

These claims recite, at bottom, increasing any light (other than high-beam intensity) in the direction of the road curvature. EX1003, ¶299. Gotou's variation of high-beam and low-beam is generally in a vertical direction and not affected by horizontal movement—rather, when the vehicle runs along a curved corner or turns right or left, the lamp optical axes are moved in a turning direction to deflect the lighting region at the curve, thereby improving visiblity. EX1012, 1:10-20, 3:52-67, 4:1-29, 4:36-40, 5:8-7:4, FIGS. 4, 8-9; EX1003, ¶300. Thus, the increased lighting toward the curve of the combined Gotou-Karlsson system (using Karlsson's LEDs) would be at a level below high-beam light (i.e., Karlsson's LEDs would implement the same type of light level toward the curve), resulting in the increase of light (output) in the direction of the road curvature or "in the direction associated with the shape change) being "an increase of light emitted at a level below high-beam light." EX1012, 1:10-20; EX1003, ¶¶301-03.

#### 5. Claims 6/17/28, elements [6.1]-[6.3], [17.1]-[17.3], [28.1]-[28.3]

As above, the combined system is iterative, and determines any number of future light changes. EX1003, ¶304. These claims are a verbose way of reciting that the system (1) determines a second light change for a second (i.e., next) road curvature, and (2) controls the LEDs to provide light toward the second road curvature (i.e., "shaping light") based on map data. *Id.* Thus, as above, the Gotou-Karlsson combination discloses this function for the same reasons as in Sections

VII.A.1, V.II.A.7, VII.A.8, VII.B.2, VII.B.3; EX1008, 14:1-15, 14:26-30, 2:30-35, 6:1-5; EX1012, Abstract, 1:35-40, 2:8-26, 3:24-62, 4:45-49, 6:4-61, 7:32-43, 8:28-35, FIGS. 1-3, 8-10; EX1003, ¶¶305-14. This is merely a subsequent, repeated step in the continuous, iterative processes of the '029 patent and Gotou-Karlsson systems. EX1003, ¶¶305-15.

**6. Claims 7/18/29, elements [7.1]-[7.4], [18.1]-[18.4], [29.1]-[29.2]**

Again, these claims are a convoluted, redundant way of reciting well-known alternatives for increasing the light toward the road curvature [7.1]/[18.1]/[29.1], [7.2]/[18.2]/[29.2]: (1) increasing the intensity of the lights[7.3]/[18.3], *or* (2) increasing the number of lights that are "on" that are directed toward the road curvature [7.4]/[18.4]/[29.2]. EX1003, ¶¶316-19. These basic alternatives are disclosed by the Gotou-Karlsson combination. *Id*., ¶¶316, 320.

As with Ground 1, the obviousness of these claims is shown by the same disclosures and rationales as the independent claims. *Supra*, Section VII.A. Indeed, Karlsson's grid of separate LEDs are controlled individually or in groups [7.2]/[18.2]/[29.2], [7.3]/[18.3], and Figures 6 and 14 show a pattern and intensity (Figure 14) of a light beam 33 can be effected by switching one or more LEDs on or off [7.4]/[18.4]/[29.2], or by adjusting the intensity of the light emitted by an individual LED [7.3]/[18.3]. EX1010, Abstract, 13:24-14:4, 2:29-35, 9:18-26; EX1003, ¶¶317-20.

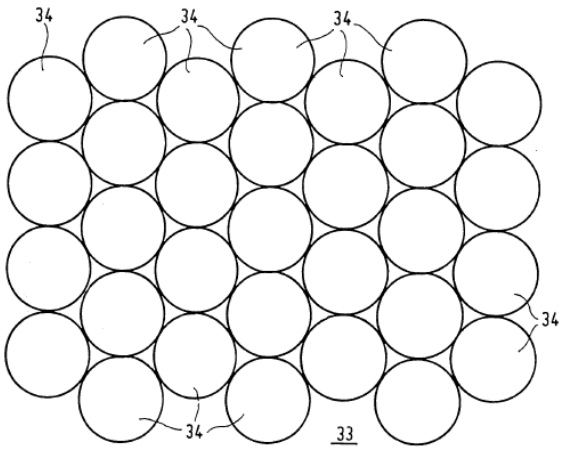
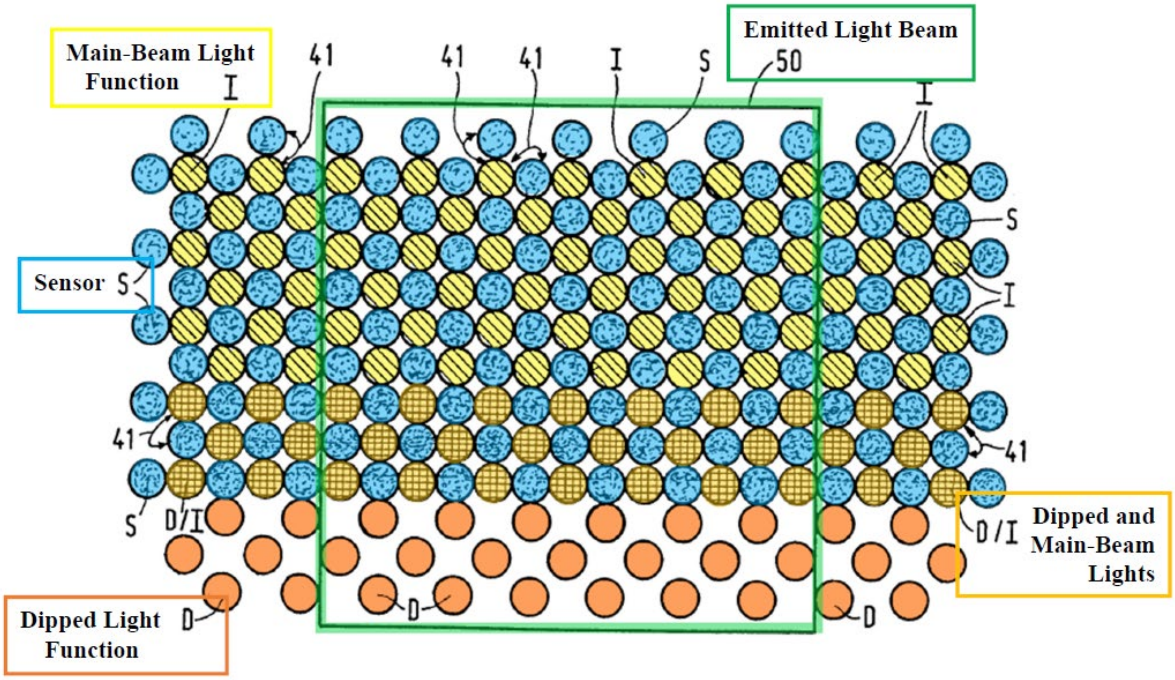



FIG. 6

EX1010, FIG. 6.




EX1010, FIG. 14 (annotated).

### 7. Claims 8/19/30, elements [8.1]-[8.4], [19.1]-[19.3], [30.1]-[30.3]

Karlsson describes using a camera 23 in this way, e.g., using camera data to detect another vehicle and control the LEDs to provide an area of decreased light

intensity to reduce glare for the other driver. EX1003, ¶323; EX1010, 12:19-24, 1:10-26, 9:18-26, 20:29-32.

Karlsson automatically varies a pattern of LEDs in response to control signals delivered by light-sensitive sensors, e.g., from a camera [8.1], [8.2], [19.1]/[30.1], [8.3]/[19.2]/[30.2], [8.4]/[19.3]/[30.3]. EX1010, 2:30-35, 12:19-24. Karlsson's light intensity and pattern are controlled to optimally adapt to the road conditions and effectively prevent glare or blinding oncoming traffic. EX1010, 9:18-26; EX1003, ¶324.

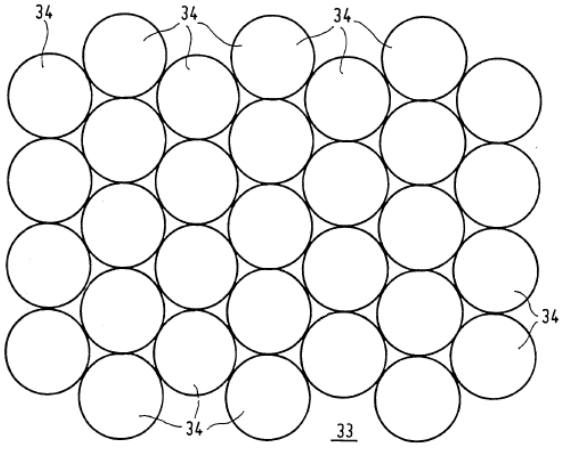
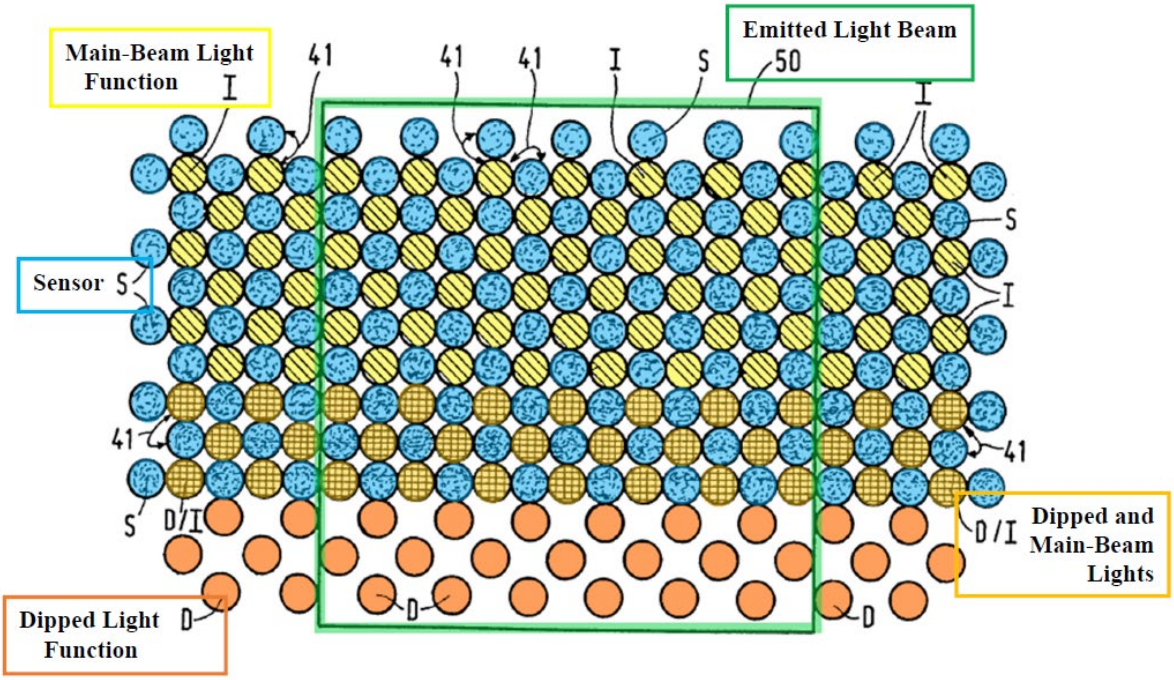


FIG. 6

EX1010, FIG. 6.



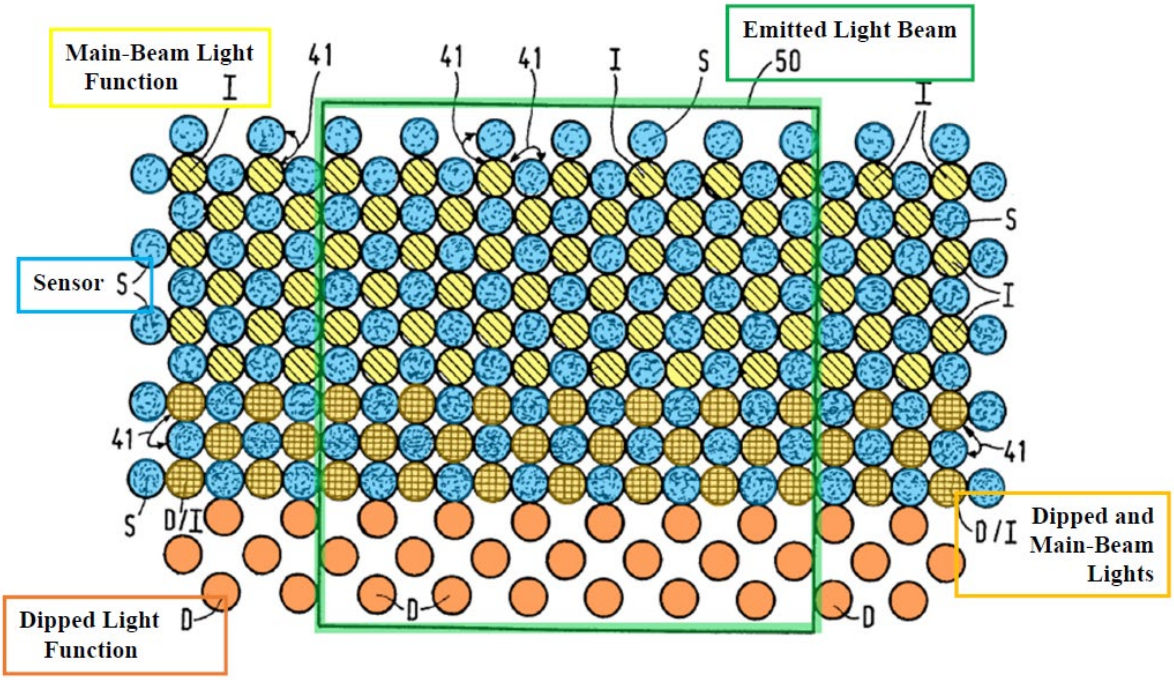

EX1010, FIG. 14 (annotated).

Specifically, a desired pattern and intensity of light beam 33 is achieved by switching one or more LEDs on or off or adapting the intensity of the light emitted by an LED, which can be controlled individually or in groups. *Id.*, 9:18-26; EX1003, ¶¶325-28.

### 8. Claims 9/20/31, elements [9.1]-[9.8], [20.1]-[20.8], [31.1]-[31.8]

Gotou's map data is not from a camera sensor (among other examples in both Gotou and Karlsson), and thus in combination with Karlsson meets the features related to both first and third data not from a camera sensor [9.3]/[20.3]/[31.3], [9.5]/[20.5]/[31.5]. EX1012, 3:52-67, 4:1-29, 5:8-6:3, 6:18-7:4, FIGS. 4, 7; EX1003, ¶¶329-30.

These claims also include that controlling the second plurality of LEDs includes terminating light from an LED providing light directed to the area prior to the termination—simply turning an LED off, and controlling an illumination pattern or an emission pattern of the headlamps [9.7]/[20.7]/[31.7], [9.8]/[20.8]/[31.8], which Karlsson discloses. EX1010, 14:1-15, 14:26-30, 2:30-35, 6:1-5; EX1003, ¶331. Karlsson's system uses separate light sources (LEDs) for better controllability of the light direction. EX1010, 14:1-15, 14:26-30, 2:30-35, 6:1-5. Replacing Gotou's lamp unit 4 with a motor and expanding on Gotou's plural bulb control—with Karlsson's controllable LED array—would have been an obvious improvement, providing a more compact system with fewer moving parts, and taking advantage of the well-known benefits of LEDs as a controllable light source. EX1022, 2:22-26, 3:44-47. Karlsson's grid of separate LEDs are controlled individually or in groups, and Figures 6 and 14 show a pattern and intensity (Figure 14) of a light beam 33 can be effected by switching one or more LEDs on or off, or by adjusting the intensity of the light emitted by an individual LED, thereby disclosing the plurality of LEDs including at least one common LED light source [9.1]/[20.1]/[31.1], [9.2]/[20.2]/[31.2]. EX1010, 14:1-15, 14:26-30, 2:30-35, 6:1-5; EX1003, ¶¶332-33. The emitted light beam 50 is represented as a window that can shift left to right and top to bottom, produced by LEDs based on the data from inputs, e.g., from spotlight sensors S. *Id*.; EX1003, ¶334.




EX1010, FIG. 14 (annotated).

Finally, regarding the additional alternate properties of "the position" [9.6]/[20.6]/[31.6] (i.e., the one determined and associated with the at least one other vehicle based in part on second data captured by at least one of the one or more cameras, as discussed *supra*, Section VII.B.7), Karlsson's lighting device automatically varies a pattern of emitted light in an efficient manner and with maximum sensitivity in response to control signals delivered by light-sensitive sensors—that detect the position determined and associated with the at least one other vehicle based in part on second data captured by at least one of the one or more cameras. EX1010, 2:30-35, 9:18-26, 3:24-14:4, 19:18-20:3, FIG. 3; EX1003, ¶¶335-40.

### 9. Claims 10/21/32

The Gotou-Karlsson combination discloses these claims. EX1003, ¶¶341-43. Gotou discloses using reflectors/sub-reflectors to change light distribution. EX1012, 8:20-22. Karlsson discloses reflectors and lenses throughout. EX1010, 14:1-15, 5:4-10, 10:26-31. These are optical control elements for controlling the LED light. EX1003, ¶342.

### 10. Claims 11/22/33

Gotou discloses using reflectors and Karlsson discloses reflectors and lenses. *Supra*, Section VII.B.9; EX1003, ¶¶344-49.

## VIII. PETITIONER IS UNAWARE OF SECONDARY CONSIDERATIONS

Petitioner is not aware of any evidence of alleged secondary considerations of non-obviousness having nexus to the challenged claims. EX1003, ¶¶350-52. Patent Owner submitted alleged evidence in a reexamination of U.S. Patent No. 9,955,551, but the Central Reexamination Unit did not address it. EX1033, '551 Reexam File History, 66-83, 930-943. Regardless, the '029 patent involves different claims, for which that evidence is inapplicable. Petitioner reserves the right to address any evidence Patent Owner presents.

## IX. THE BOARD SHOULD DECLINE TO EXERCISE ITS DISCRETION TO DENY INSTITUTION FOR THE SAME REASONS IT DECLINED TO DENY INSTITUTION IN IPR2022-01586

The Board previously considered whether, and declined, to exercise its discretion to deny institution of the challenged claims 1-33 of the '029 patent in

IPR2022-01586. *See Volkswagen Group of America, Inc. v. Spero*, IPR2022-01586, Paper 7, at 20-21 (P.T.A.B. May 24, 2023). As explained above, Petitioner has moved to join IPR2022-01586. The Board should decline to exercise its discretion to deny institution in this IPR for the same reasons it declined to deny institution in IPR2022-01586 because the same facts are presented.

First, the Board should decline to exercise its discretion to deny institution under 35 U.S.C. § 312(a)(3). The Board declined to deny institution in IPR2022-01586 because it concluded that the Petition in that IPR was "sufficiently particular." *Id.* at 21. As explained in Petitioner's Motion for Joinder, this Petition and the accompanying expert declaration are substantively identical to the Petition and expert declaration in IPR2022-01586. Therefore, just like the Petition in IPR2022-01856, this Petition is sufficiently particular.

Second, the Board should decline to exercise its discretion to deny institution under 35 U.S.C. § 314(a). The Board declined to deny institution in IPR2022-01586 because it concluded that the Petitioner in that IPR (Volkswagen Group of America, Inc.) and the Petitioner in IPR2022-01500 (Unified Patents, LLC) are "different parties" that do not have "a significant relationship." *Id.* at 21 (citing *Valve Corp. v. Elec. Scripting Prods., Inc.*, IPR2019-00062, Paper 11 (P.T.A.B. Apr. 2, 2019)). The same facts are presented here. Petitioner Porsche Cars North America, Inc. is a

different party than, and does not have "a significant relationship" with, Unified Patents, LLC.

## X. MANDATORY NOTICES (37 C.F.R. § 42.8(A)(1))

**REAL PARTIES IN INTEREST:** The real parties-in-interest are Petitioner Porsche Cars North America, Inc. and its affiliate Dr. Ing. h.c. F. Porsche Aktiengesellschaft.

**RELATED MATTERS:** The '029 patent is the subject of the following pending civil actions: *Torchlight Techs. LLC v. Daimler AG et al.*, Case No. 1:22-cv-00751 (D. Del.), and *Torchlight Techs. LLC v. General Motors LLC et al.*, Case No. 1:22-cv-00752 (D. Del.), both filed on June 7, 2022. These cases remain in their infancy. The foreign defendants were recently served and none of the defendants have responded to the operative complaint. Further, the cases have been indefinitely stayed pending the court's resolution of (i) an outstanding discovery motion and (ii) subsequent motions to dismiss for lack of standing and failure to join necessary parties, which have yet to be filed.

On September 22, 2022, Unified Patents, LLC filed a petition for *inter partes* review of the '029 patent (IPR2022-01500). On October 3, 2022, Volkswagen Group of America, Inc. filed a petition for *inter partes* review of the '029 patent (IPR2022-01586). Both of these IPRs have been instituted (on May 4, 2023 and

May 24, 2023, respectively). As explained above, Petitioner has filed a motion to join IPR2022-01586.

On June 8, 2023, Mercedes-Benz USA, LLC filed a petition for *inter partes* review of the '029 patent (IPR2023-01034).

The '029 patent claims priority to the same applications as U.S. Patent Nos. 10,894,503 ("the '503 patent"), 9,955,551 ("the '551 patent") and 8,100,552.

**LEAD AND BACKUP COUNSEL:** Under 37 C.F.R. §§ 42.8(b)(3) and 42.10(a), Petitioner appoints Edgar H. Haug (Reg. No. 29,309) as lead counsel, and Robert E. Colletti (Reg. No. 76,417) as back-up counsel, both at the address: HAUG PARTNERS LLP, 745 Fifth Avenue, New York, NY, 10151, phone (212) 588-0800, and facsimile (212) 588-0500.

**SERVICE INFORMATION:** Petitioner consents to electronic service by email at: ehaug@haugpartners.com, rcolletti@haugpartners.com, and PTAB-Porsche@haugpartners.com.

## XI. CONCLUSION

The Board should institute review of claims 1-33 of the '029 patent on the grounds set forth above.

Respectfully submitted,

HAUG PARTNERS LLP

*/s/ Edgar H. Haug*

Edgar H. Haug (Reg. No. 29,309)

Attorney for Petitioner
Porsche Cars North America, Inc.

Date: June 22, 2023

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New York, NY 10151
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# XII. APPENDIX A: CHALLENGED CLAIMS

## A. Comparison of Independent Claims

| Claim Element | Independent Claim 1 | | Independent Claim 12 | | Independent Claim 23 |
|---|---|---|---|---|---|
| [1.P] | A system, for a motor vehicle, comprising: | [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: | [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: |
| [1.1] | a plurality of headlamps, each comprising a plurality of LED light sources; | | [*See* 12.P] (a plurality of headlamps that each comprise a plurality of LED light sources,) | | [*See* 23.P] (the headlamps including a plurality of LED light sources,) |

| | | | | | |
|---|---|---|---|---|---|
| [1.2] | one or more processors; and | | [*See* 12.P] (one or more processors) | | [*See* 23.P] (A computer-implemented method) |
| [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: | | [*See* 12.P] (storing instructions that, when executed by one or more processors) | | [*See* 23.P] (A computer-implemented method) |
| [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; | [12.4] | receive first data, including at least map data, indicating a road curvature upcoming along a road on which the motor vehicle is traveling; | [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; |
| [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 | [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 | [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 |

| | | | | | |
|---|---|---|---|---|---|
| | 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 | | 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 | | ahead of the motor vehicle and shaping light based on the shape change; 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. | [12.6] | 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. | [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. |

## B. Groupings of Substantively Similar Dependent Claims

- 2/13/24
- 3/14/25
- 4/15/26
- 5/16/27
- 6/17/28

- 7/18/29
- 8/19/30
- 9/20/31
- 10/21/32
- 11/22/33

### C. Listing of All Challenged Claims

1. **[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.

2. The system of claim 1, wherein the determination of the light change includes selection of the first plurality of the LED light sources.

3. The system of claim 1, wherein the instructions include instructions that, when executed by the one or more processors, enable the one or more processors to reshape light based on the road curvature as the motor vehicle travels at least to or through the road curvature.

4. The system of claim 3, wherein the reshaping of light further includes control to at least one of the first plurality of LED light sources, or a second plurality of LED light sources, including at least one LED light source different from the LED light sources of the first plurality of LED light sources, to provide reshaped light.

5. The system of claim 1, wherein the increase of light in the direction of the road curvature includes at least an increase of light emitted at a level below high-beam light and directed in the direction of the road curvature.

6. **[6.1]** The system of claim 1, wherein the instructions include instructions that, when executed by the one or more processors, enable the one or more processors to:

**[6.2]** determine a second light change, the second change adapting the light pattern of the headlamps in at least one of color, intensity or spatial distribution to increase light in a direction of a second road curvature ahead of the motor vehicle, determined based on at least one of the first data or second data including at least second map data, and the second change shaping light based at least in part on the second road curvature; and

**[6.3]** control at least a second plurality of the LED light sources, having at least one LED light source different from the first plurality of LED light sources, to provide light based at least in part on the determined second light change and prior to the motor vehicle reaching the second road curvature.

7. **[7.1]** The system of claim 1, wherein the increase of light in the direction of the road curvature includes at least one of expansion of the light pattern in the direction of the road curvature or an increase to intensity of light directed in the direction of the road curvature; and

**[7.2]** wherein the determination of the light change includes determination of light changes to individual LEDs of the first plurality of LED light sources, at least one of the changes including at least one of:

**[7.3]** a variation to at least one of intensity or color of individual LEDs of the first plurality of LED light sources, or

**[7.4]** providing light directed in the direction of the road curvature from an LED not providing light directed in the direction of the road curvature prior to the change.

8. **[8.1]** The system of claim 1, further comprising one or more cameras positioned to capture data indicating at least one other vehicle ahead of the motor vehicle;

**[8.2]** wherein the instructions include instructions that, when executed by the one or more processors, enable the one or more processors to:

**[8.3]** determine a position associated with the at least one other vehicle based at least in part on second data captured by at least one of the one or more cameras; and

**[8.4]** control, based at least in part on the position, a second plurality of LED light sources providing light directed towards an area including at least a portion of the other vehicle to diminish glare to a driver of the other vehicle

by a decrease to intensity of light directed towards and illuminating the area, the light that is directed towards and illuminating the area having lower intensity compared to light directed towards points laterally adjacent the area to either side.

9. **[9.1]** The system of claim 8, wherein:

**[9.2]** the first plurality and second plurality of LED light sources include at least one common LED light source;

**[9.3]** the control of the second plurality of LED light sources is based at least in part on third data received from a non-camera sensor of the motor vehicle;

**[9.4]** the position includes at least one of:

a distance associated with the at least one other vehicle,

at least one elevation associated with the at least one other vehicle, or

a position within image data captured by at least one of the cameras;

**[9.5]** the first data includes data from a non-camera sensor of the motor vehicle;

**[9.6]** either one of the control of the first plurality of LED light sources or control of the second plurality of LED light sources is subsequent to and accommodative of the other;

**[9.7]** the control of the second plurality of LED light sources additionally includes termination of light from at least one LED providing light directed to the area prior to the termination; and

**[9.8]** the light pattern includes at least one of an illumination pattern or an emission pattern of the headlamps.

10. The system of claim 1, further including one or more optical control elements for controlling light from one or more of the LED light sources.

11. The system of claim 10, wherein the optical control elements include at least one of one or more reflectors, refractors or lenses.

12. **[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]** 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 motor vehicle reaching the road curvature.

13. The storage medium of claim 12, wherein the determination of the light change includes selection of the first plurality of the LED light sources.

14. The storage medium of claim 12, wherein the instructions include instructions that, when executed by the one or more processors, enable the one or more processors to reshape light based on the road curvature as the motor vehicle travels at least to or through the road curvature.

15. The storage medium of claim 14, wherein the reshaping of light further includes control to at least one of the first plurality of LED light sources, or a second plurality of LED light sources, including at least one LED light source different from the LED light sources of the first plurality of LED light sources, to provide reshaped light.

16. The storage medium of claim 12, wherein the increase of light in the direction of the road curvature includes at least an increase of light emitted at a level below high-beam light and directed in the direction of the road curvature.

17. **[17.1]** The storage medium of claim 12, wherein the instructions include instructions that, when executed by the one or more processors, enable the one or more processors to:

**[17.2]** determine a second light change, the second change adapting the light pattern of the headlamps in at least one of color, intensity or spatial distribution to increase light in a direction of a second road curvature ahead of the motor vehicle, determined based on at least one of the first data or second data including at least second map data, and the second change shaping light based at least in part on the second road curvature; and

**[17.3]** control at least a second plurality of the LED light sources, having at least one LED light source different from the first plurality of LED light sources, to provide light based at least in part on the determined second light change and prior to the motor vehicle reaching the second road curvature.

18. **[18.1]** The storage medium of claim 12, wherein the increase of light in the direction of the road curvature includes at least one of expansion of the light pattern

in the direction of the road curvature or an increase to intensity of light directed in the direction of the road curvature; and

**[18.2]** wherein the determination of the light change includes determination of light changes to individual LEDs of the first plurality of LED light sources, at least one of the changes including at least one of:

**[18.3]** a variation to at least one of intensity or color of individual LEDs of the first plurality, or

**[18.4]** providing light directed in the direction of the road curvature from an LED not providing light directed in the direction of the road curvature prior to the change.

19. **[19.1]** The storage medium of claim 12, wherein the instructions include instructions that, when executed by the one or more processors, enable the one or more processors to:

**[19.2]** determine a position associated with at least one other vehicle based at least in part on second data indicating the at least one other vehicle and captured by at least one camera of the motor vehicle; and

**[19.3]** control, based at least in part on the position, a second plurality of LED light sources providing light directed towards an area including at least a portion of the other vehicle to diminish glare to a driver of the other vehicle by a decrease to

intensity of light directed towards and illuminating the area, the light that is directed towards and illuminating the area having lower intensity compared to light directed towards points laterally adjacent the area to either side.

20. **[20.1]** The storage medium of claim 19, wherein:

**[20.2]** the first plurality and second plurality of LED light sources include at least one common LED light source;

**[20.3]** the control of the second plurality of LED light source is based at least in part on third data received from a non-camera sensor of the motor vehicle;

**[20.4]** the position includes at least one of:

a distance associated with the at least one other vehicle,

at least one elevation associated with the at least one other vehicle, or

a position within image data captured by at least one of the cameras;

**[20.5]** the first data includes data from a non-camera sensor of the motor vehicle;

**[20.6]** either one of the control of the first plurality of LED light sources or control of the second plurality of LED light sources is subsequent to and accommodative of the other;

**[20.7]** the control of the second plurality of LED light sources additionally includes termination of light from at least one LED providing light directed to the area prior to the termination; and

**[20.8]** the light pattern includes at least one of an illumination pattern or an emission pattern of the headlamps.

21. The storage medium of claim 19, wherein the instructions include instructions that, when executed by the one or more processors, enable the one or more processors to utilize one or more optical control elements included in the motor vehicle to control light from at least the first plurality or second plurality of the LED light sources.

22. The storage medium of claim 21, wherein the optical control elements include at least one of one or more reflectors, refractors or lenses.

23. **[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.

24. The method of claim 23, wherein the determining the light includes selecting the first plurality of the LED light sources.

25. The method of claim 23, further comprising reshaping light based on the shape change as the motor vehicle travels at least to or through the shape change.

26. The method of claim 25, wherein the reshaping light further includes controlling at least one of the first plurality of LED light sources, or a second plurality of LED light sources, including at least one LED light source different from the LED light sources of the first plurality of LED light sources, to provide reshaped light.

27. The method of claim 23, wherein the increase of light in the direction associated with the shape change includes at least light output that increases light emitted at a level below high-beam light and directed in the direction associated with shape change.

28. **[28.1]** The method of claim 23, further comprising:

**[28.2]** determining a second light output, the second output adapting the light pattern of the headlamps in at least one of color, intensity or spatial distribution to increase light in a direction associated with a second shape change ahead of the motor vehicle, determined based on at least one of the first data or second data including at least second map data, and the second output shaping light based at least in part on the second shape change; and

**[28.3]** controlling at least a second plurality of the LED light sources, having at least one LED light source different from the first plurality of LED light sources, to provide light based at least in part on the determined second output and prior to the motor vehicle reaching the second shape change.

29. **[29.1]** The method of claim 23, wherein the increase of light in the direction associated with the shape change includes at least one of expansion of the light

pattern in the direction associated with the shape change or an increase to intensity of light directed in the direction associated with the shape change; and

**[29.2]** wherein the determining the light output includes determining output for individual LEDs of the first plurality of LED light sources, the output including providing light directed in the direction associated with the shape change from an LED not providing light directed in the direction associated with the shape change prior to the change.

30. **[30.1]** The method of claim 23, further comprising:

**[30.2]** determining a position associated with at least one other vehicle based at least in part on second data indicating the at least one other vehicle and captured by at least one camera of the motor vehicle; and

**[30.3]** controlling, based at least in part on the position, a second plurality of LED light sources providing light directed towards an area including at least a portion of the other vehicle to diminish glare to a driver of the other vehicle by decreasing intensity of light directed towards and illuminating the area, the light directed towards and illuminating the area having lower intensity compared to light directed towards points laterally adjacent the area to either side.

31. **[31.1]** The method of claim 30, wherein:

**[31.2]** the first plurality and second plurality of LED light sources include at least one common LED light source;

**[31.3]** the controlling the second plurality of LED light sources is based at least in part on third data received from a non-camera sensor of the motor vehicle;

**[31.4]** the position includes at least one of:

a distance associated with the at least one other vehicle,

at least one elevation associated with the at least one other vehicle, or

a position within image data captured by at least one of the cameras;

**[31.5]** the first data includes data from a non-camera sensor of the motor vehicle;

**[31.6]** either one of the determining the light output or controlling the second plurality of LED light sources is subsequent to and accommodative of the other;

**[31.7]** the controlling the second plurality of LED light sources additionally includes terminating light from at least one LED providing light directed to the area prior to the terminating; and

**[31.8]** the light pattern includes at least one of an illumination pattern or an emission pattern of the headlamps.

32. The method of claim 30, further comprising utilizing one or more optical control elements included in the motor vehicle to control light from at least the first plurality or second plurality of the LED light sources.

33. The method of claim 32, wherein the optical control elements include at least one of one or more reflectors, refractors or lenses.

### D. Comparison of Dependent Claims

| Claim Element | Independent Claim 1 set | | Independent Claim 12 set | | Independent Claim 23 set |
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| [2] | The system of claim 1, wherein the determination of the light change includes selection of the first plurality of the LED light sources. | [13] | The storage medium of claim 12, wherein the determination of the light change includes selection of the first plurality of the LED light sources. | [24] | The method of claim 23, wherein the determining the light includes selecting the first plurality of the LED light sources. |
| [3] | The system of claim 1, wherein the instructions include instructions that, when executed by the one or more processors, enable the one or more processors to reshape light based on the | [14] | The storage medium of claim 12, wherein the instructions include instructions that, when executed by the one or more processors, enable the one or more processors to reshape light | [25] | The method of claim 23, further comprising reshaping light based on the shape change as the motor vehicle travels at least to or through the shape change. |

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| | road curvature as the motor vehicle travels at least to or through the road curvature. | | based on the road curvature as the motor vehicle travels at least to or through the road curvature. | | |
| [4] | The system of claim 3, wherein the reshaping of light further includes control to at least one of the first plurality of LED light sources, or a second plurality of LED light sources, including at least one LED light source different from the LED light sources of the first plurality of LED light sources, to provide reshaped light. | [15] | The storage medium of claim 14, wherein the reshaping of light further includes control to at least one of the first plurality of LED light sources, or a second plurality of LED light sources, including at least one LED light source different from the LED light sources of the first plurality of LED light sources, to provide reshaped light. | [26] | The method of claim 25, wherein the reshaping light further includes controlling at least one of the first plurality of LED light sources, or a second plurality of LED light sources, including at least one LED light source different from the LED light sources of the first plurality of LED light sources, to provide reshaped light. |
| [5] | The system of claim 1, wherein the increase of light in the direction of the road curvature includes at least an increase of light emitted at a level below | [16] | The storage medium of claim 12, wherein the increase of light in the direction of the road curvature includes at least an increase of light emitted at a | [27] | The method of claim 23, wherein the increase of light in the direction associated with the shape change includes at least light output that increases light |

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| | high-beam light and directed in the direction of the road curvature. | | level below high-beam light and directed in the direction of the road curvature. | | emitted at a level below high-beam light and directed in the direction associated with shape change. |
| [6.1] | The system of claim 1, wherein the instructions include instructions that, when executed by the one or more processors, enable the one or more processors to: | [17.1] | The storage medium of claim 12, wherein the instructions include instructions that, when executed by the one or more processors, enable the one or more processors to: | [28.1] | The method of claim 23, further comprising: |
| [6.2] | determine a second light change, the second change adapting the light pattern of the headlamps in at least one of color, intensity or spatial distribution to increase light in a direction of a second road curvature ahead of the motor vehicle, determined based on at least one of the first data or second | [17.2] | determine a second light change, the second change adapting the light pattern of the headlamps in at least one of color, intensity or spatial distribution to increase light in a direction of a second road curvature ahead of the motor vehicle, determined based on at least one of the first data or second | [28.2] | determining a second light output, the second output adapting the light pattern of the headlamps in at least one of color, intensity or spatial distribution to increase light in a direction associated with a second shape change ahead of the motor vehicle, determined based on at least one of the first |

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| | data including at least second map data, and the second change shaping light based at least in part on the second road curvature; and | | data including at least second map data, and the second change shaping light based at least in part on the second road curvature; and | | data or second data including at least second map data, and the second output shaping light based at least in part on the second shape change; and |
| [6.3] | control at least a second plurality of the LED light sources, having at least one LED light source different from the first plurality of LED light sources, to provide light based at least in part on the determined second light change and prior to the motor vehicle reaching the second road curvature. | [17.3] | control at least a second plurality of the LED light sources, having at least one LED light source different from the first plurality of LED light sources, to provide light based at least in part on the determined second light change and prior to the motor vehicle reaching the second road curvature. | [28.3] | controlling at least a second plurality of the LED light sources, having at least one LED light source different from the first plurality of LED light sources, to provide light based at least in part on the determined second output and prior to the motor vehicle reaching the second shape change. |
| [7.1] | The system of claim 1, wherein the increase of light in the direction of the road curvature includes at least one of expansion of the light | [18.1] | The storage medium of claim 12, wherein the increase of light in the direction of the road curvature includes at least one of expansion | [29.1] | The method of claim 23, wherein the increase of light in the direction associated with the shape change includes at least one of expansion |

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| | pattern in the direction of the road curvature or an increase to intensity of light directed in the direction of the road curvature; and | | of the light pattern in the direction of the road curvature or an increase to intensity of light directed in the direction of the road curvature; and | | of the light pattern in the direction associated with the shape change or an increase to intensity of light directed in the direction associated with the shape change; and |
| [7.2] | wherein the determination of the light change includes determination of light changes to individual LEDs of the first plurality of LED light sources, at least one of the changes including at least one of: | [18.2] | wherein the determination of the light change includes determination of light changes to individual LEDs of the first plurality of LED light sources, at least one of the changes including at least one of: | [29.2] | wherein the determining the light output includes determining output for individual LEDs of the first plurality of LED light sources, the output including providing light directed in the direction associated with the shape change from an LED not providing light directed in the direction associated with the shape change prior to the change. |
| [7.3] | a variation to at least one of intensity or color of individual | [18.3] | a variation to at least one of intensity or color of individual | | *See* [29.2] (No corresponding |

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| | LEDs of the first plurality of LED light sources, or | | LEDs of the first plurality, or | | element in claim 29) |
| [7.4] | providing light directed in the direction of the road curvature from an LED not providing light directed in the direction of the road curvature prior to the change. | [18.4] | providing light directed in the direction of the road curvature from an LED not providing light directed in the direction of the road curvature prior to the change. | | *See* [29.2] (providing light directed in the direction associated with the shape change from an LED not providing light directed in the direction associated with the shape change prior to the change.) |
| [8.1] | The system of claim 1, further comprising one or more cameras positioned to capture data indicating at least one other vehicle ahead of the motor vehicle; | | *See* [19.2] (captured by at least one camera of the motor vehicle) | | *See* [30.2] (captured by at least one camera of the motor vehicle) |
| [8.2] | wherein the instructions include instructions that, when executed by the one or more processors, enable the one or more processors to: | [19.1] | The storage medium of claim 12, wherein the instructions include instructions that, when executed by the one or more processors, enable the one or more processors to: | [30.1] | The method of claim 23, further comprising: (*See* claim 23: a computer-implemented method) |

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| [8.3] | determine a position associated with the at least one other vehicle based at least in part on second data captured by at least one of the one or more cameras; and | [19.2] | determine a position associated with at least one other vehicle based at least in part on second data indicating the at least one other vehicle and captured by at least one camera of the motor vehicle; and | [30.2] | determining a position associated with at least one other vehicle based at least in part on second data indicating the at least one other vehicle and captured by at least one camera of the motor vehicle; and |
| [8.4] | control, based at least in part on the position, a second plurality of LED light sources providing light directed towards an area including at least a portion of the other vehicle to diminish glare to a driver of the other vehicle by a decrease to intensity of light directed towards and illuminating the area, the light that is directed towards and illuminating the area having lower intensity compared to | [19.3] | control, based at least in part on the position, a second plurality of LED light sources providing light directed towards an area including at least a portion of the other vehicle to diminish glare to a driver of the other vehicle by a decrease to intensity of light directed towards and illuminating the area, the light that is directed towards and illuminating the area having lower intensity compared to | [30.3] | controlling, based at least in part on the position, a second plurality of LED light sources providing light directed towards an area including at least a portion of the other vehicle to diminish glare to a driver of the other vehicle by decreasing intensity of light directed towards and illuminating the area, the light directed towards and illuminating the area having lower intensity compared to |

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| | light directed towards points laterally adjacent the area to either side. | | light directed towards points laterally adjacent the area to either side. | | light directed towards points laterally adjacent the area to either side. |
| [9.1] | The system of claim 8, wherein: | [20.1] | The storage medium of claim 19, wherein: | [31.1] | The method of claim 30, wherein: |
| [9.2] | the first plurality and second plurality of LED light sources include at least one common LED light source; | [20.2] | the first plurality and second plurality of LED light sources include at least one common LED light source; | [31.2] | the first plurality and second plurality of LED light sources include at least one common LED light source; |
| [9.3] | the control of the second plurality of LED light sources is based at least in part on third data received from a non-camera sensor of the motor vehicle; | [20.3] | the control of the second plurality of LED light source is based at least in part on third data received from a non-camera sensor of the motor vehicle; | [31.3] | the controlling the second plurality of LED light sources is based at least in part on third data received from a non-camera sensor of the motor vehicle; |
| [9.4] | the position includes at least one of: | [20.4] | the position includes at least one of: | [31.4] | the position includes at least one of: |
| | a distance associated with the at least one other vehicle, | | a distance associated with the at least one other vehicle, | | a distance associated with the at least one other vehicle, |
| | at least one elevation associated with the at least one other vehicle, or | | at least one elevation associated with the at least one other vehicle, or | | at least one elevation associated with the at least one other vehicle, or |
| | a position within image data | | a position within image data | | a position within image data |

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| | captured by at least one of the cameras; | | captured by at least one of the cameras; | | captured by at least one of the cameras; |
| [9.5] | the first data includes data from a non-camera sensor of the motor vehicle; | [20.5] | the first data includes data from a non-camera sensor of the motor vehicle; | [31.5] | the first data includes data from a non-camera sensor of the motor vehicle; |
| [9.6] | either one of the control of the first plurality of LED light sources or control of the second plurality of LED light sources is subsequent to and accommodative of the other; | [20.6] | either one of the control of the first plurality of LED light sources or control of the second plurality of LED light sources is subsequent to and accommodative of the other; | [31.6] | either one of the determining the light output or controlling the second plurality of LED light sources is subsequent to and accommodative of the other; |
| [9.7] | the control of the second plurality of LED light sources additionally includes termination of light from at least one LED providing light directed to the area prior to the termination; and | [20.7] | the control of the second plurality of LED light sources additionally includes termination of light from at least one LED providing light directed to the area prior to the termination; and | [31.7] | the controlling the second plurality of LED light sources additionally includes terminating light from at least one LED providing light directed to the area prior to the terminating; and |
| [9.8] | the light pattern includes at least one of an illumination pattern or an | [20.8] | the light pattern includes at least one of an illumination pattern or an | [31.8] | the light pattern includes at least one of an illumination pattern or an |

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| | emission pattern of the headlamps. | | emission pattern of the headlamps. | | emission pattern of the headlamps. |
| [10] | The system of claim 1, further including one or more optical control elements for controlling light from one or more of the LED light sources. | [21] | The storage medium of claim 19, wherein the instructions include instructions that, when executed by the one or more processors, enable the one or more processors to utilize one or more optical control elements included in the motor vehicle to control light from at least the first plurality or second plurality of the LED light sources. | [32] | The method of claim 30, further comprising utilizing one or more optical control elements included in the motor vehicle to control light from at least the first plurality or second plurality of the LED light sources. |
| [11] | The system of claim 10, wherein the optical control elements include at least one of one or more reflectors, refractors or lenses. | [22] | The storage medium of claim 21, wherein the optical control elements include at least one of one or more reflectors, refractors or lenses. | [33] | The method of claim 32, wherein the optical control elements include at least one of one or more reflectors, refractors or lenses. |

**CERTIFICATE OF COMPLIANCE WITH TYPE-VOLUME LIMITATION, TYPEFACE REQUIREMENTS, AND TYPE STYLE REQUIREMENTS**

1. This Petition complies with the type-volume limitation of 14,000 words, comprising 13,513 words, excluding the parts exempted by 37 C.F.R. § 42.24(a).

2. This Petition complies with the general format requirements of 37 C.F.R. § 42.6(a) and has been prepared using Microsoft® Word 2010 in 14 point Times New Roman.

HAUG PARTNERS LLP

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Date: June 22, 2023

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**CERTIFICATE OF SERVICE (37 C.F.R. §§ 42.6(e), 42.105(a))**

The undersigned hereby certifies that on June 22, 2023, true and correct copies of the foregoing **PETITION FOR *INTER PARTES* REVIEW OF U.S. PATENT NO. 11,208,029** and all associated exhibits were served in their entireties via FedEx Express® on:

Brooks Kushman
1000 Town Center
22nd Floor
Southfield, MI 48075

*Patent Center Correspondence Address for U.S. Patent No. 11,208,029*

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