UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

VOLKSWAGEN GROUP OF AMERICA, INC.,
Petitioner

v.

YECHEZKAL EVAN SPERO,
Patent Owner

Case IPR2023-00197
U.S. Patent No. 10,894,503 B2

PETITION (1 of 3) FOR INTER PARTES REVIEW OF U.S. PATENT NO. 10,894,503

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PETITIONER'S EXHIBIT LIST

Exhibit #	*Description*
1001	U.S. Patent No. 10,894,503 B2 to Spero ("the '503 patent")
1002	File History of U.S. Patent No. 10,894,503 B2 ("Prosecution History")
1003	Declaration of Dr. Jianzhong Jiao ("Jiao Decl.") in support of Petition for *Inter Partes* Review of U.S. Patent No. 10,894,503
1004	*Curriculum Vitae* of Dr. Jianzhong Jiao
1005	U.S. Patent No. 6,144,158 to Beam
1006	U.S. Patent Publication No. 2001/0019486 to Thominet
1007	WIPO Patent Publication No. 2001/070538 to Stam *et al*.
1008	U.S. Patent No. 6,049,749 to Kobayashi
1009	WIPO Patent Publication No. 2002/004247 to Braun *et al*.
1010	WIPO Patent Publication No. 1998/054030 to Karlsson
1011	WIPO Patent Publication No. 2001/001038 to Harbers *et al*.
1012	U.S. Patent No. 5,588,733 to Gotou
1013	WIPO Patent Publication No. 1986/005147 to Flaaten
1014	U.S. Patent No. 5,707,129 to Kobayashi
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
1017	Hogrefe *et al*., "Adaptive Light Pattern – A New Way to Improve Light Quality," SAE Transactions, Vol. 106, No. 6, pp. 1-10, February 27, 1997
1018	Löwenau *et al*., "Adaptive Light Control – A New Light Concept Controlled by Vehicle Dynamics and Navigation, SAE Transactions, Vol. 107, No. 6, pp. 31-36, February 26, 1998

Exhibit #	***Description***
1019	Manassero *et al*., "Adaptive Headlamp: A contribution for Design and Development of Motorway Light," SAE Transactions, Vol. 107, No. 6, pp. 1-6, February 26, 1998
1020	Michael Hamm, "System Strategies for Adaptive Lighting Systems," 2001 Symposium: Progress in Automobile Lighting (PAL), pp. 368-380, September 26, 2001
1021	U.S. Patent Publication No. 2013/0258688 to Kalapodas
1022	*Intentionally Left Blank*
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).
1026	Kobayashi & Sugimoto, Development of the Phase-I AFS Front Lighting System, Progress in Automotive Lighting Vol. 5, pp. 449-464 (1999).
1027	*Intentionally Left Blank*
1028	Bernhard Wörner, Adaptive Frontlighting – Experimental System, Development and Functional Evaluation, Progress in Automotive Lighting Vol. 6, pp. 844-853 (1999).
1029	*Intentionally Left Blank*
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	*Intentionally Left Blank*
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

Exhibit #	***Description***
1034	*Intentionally Left Blank*
1035	United States District Courts – National Judicial Caseload Profile, June 2022
1036	U.S. Patent No. 5,523,193 to Nelson
1037	U.S. Patent No. 5,537,433 to Watanabe
1038	U.S. Patent No. 4,662,746 to Hornbeck
1039	U.S. Patent No. 5,061,049 to Hornbeck
1040	U.S. Patent No. 5,933,183 to Enomoto *et al*.

I. INTRODUCTION AND TECHNOLOGY OVERVIEW

Petitioner Volkswagen Group of America, Inc. ("Petitioner") requests *inter partes* review ("IPR") and cancellation of claims 20-25 and 59-64 of U.S. Patent No. 10,894,503 ("the '503 patent") to Yechezkal Evan Spero, purportedly exclusively licensed to Torchlight Technologies LLC (collectively "Patent Owner"). EX1032, Amended Complaint, 8.

By 2000—years before the earliest possible priority date, everything claimed in the '503 patent was well-known in adaptive automotive lighting systems. No claim elements were new and nothing was new about how those elements were combined in the claims. EX1003, ¶¶45-47.

Grounds 1-2 and 5 demonstrate why it would have been obvious for an adaptive headlamp system to utilize known sensor inputs to output multiple directional beam regions and output light below and above a predefined illuminance, in response to sensor inputs. Grounds 3-4 and 6 demonstrate why it would have been obvious to include well-known sensor data and techniques to illuminate roadway curves. *Id*., ¶48.

Petitioner's expert, Dr. Jianzhong Jiao, has over 30 years of experience in adaptive lighting, automotive lighting, and optical engineering. *Id*., ¶¶9-20. His testimony supports that the Grounds demonstrate the conventional functionality of the '503 patent claims, rendering all challenged claims unpatentable. *Id*., ¶1-41. The

claimed adaptive headlamps—with multiple directional light sources and providing light below/above a predefined illuminance—would have been obvious. *Id*., ¶59.

Adaptive headlamp lighting to control illumination characteristics was well-known. As early as the 1940s, vehicles such as the Tucker Torpedo and Citroen DS-19 included headlamps that swiveled with the wheel turning angle via mechanical linkage. EX1030, 3-4; EX1003, ¶49. From 1992-1999, a global consortium of headlamp and automotive manufacturers participated in the EUREKA project to advance adaptive front lighting systems (AFS). EX1003, ¶49; EX1015, 3-6; EX1016, 1-19; EX1023, 514-15; EX1023, 819.

By 1997, adaptive (dynamic) lighting was designed to increase driving safety and visual comfort over fixed (static) headlamps. EX1003, ¶50; EX1017, 3-10; EX1018, 33-36; EX1019, 1-2; EX1020, 368, 370, 374-378; EX1023, 819; EX1023, 202; EX1028, 844. Multiple directional light sources produced an adaptive light pattern by varying illumination characteristics including intensity, shape, color, direction, and glare. EX1003, ¶¶52-53; EX1017, 3-10; EX1018, 33-36; EX1019, 1-2; EX1020, 368-378. Further, individually controllable spatial light modulators (SLMs), including digital mirror devices (DMDs), producing directional light beams with different angles/aimings were well-known for illumination applications, including vehicle lighting. EX1003, ¶51; EX1005, 4:26-59, 8:4-17; EX1009, 21:13-

16; EX1010, 5:11-15; EX1038, 1:12-10:3; EX1039, 9:16-11:11; EX1040, 1:16-30; EX1036, 3:52-4:32.

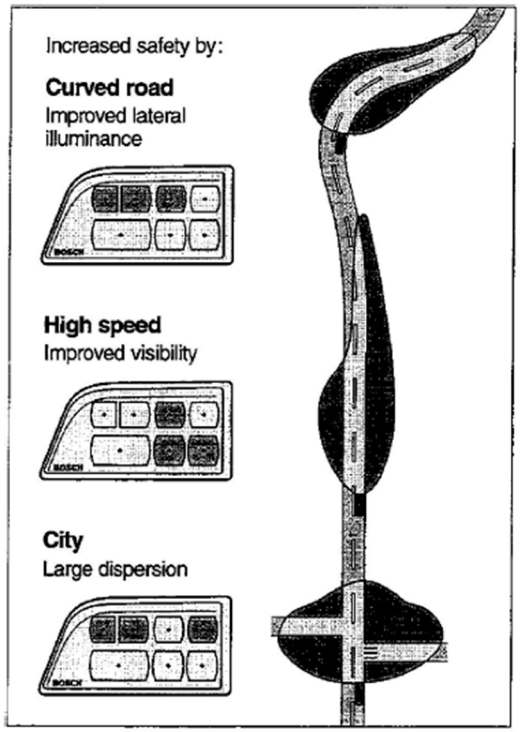


Fig.1: Three standard driving situations with adapted light pattern seen from the bird eye's view.

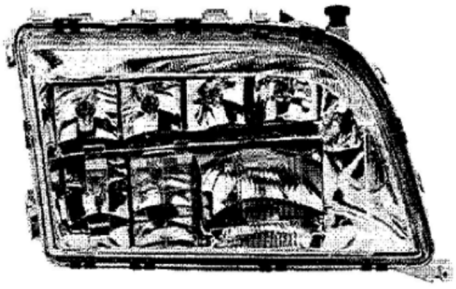
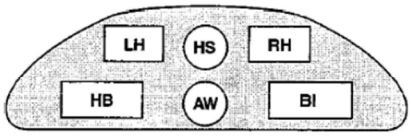


Fig 4: ALP *headlamp* sample



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

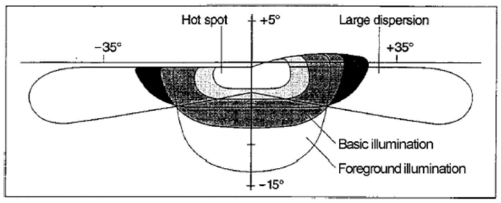


Fig. 3: Light pattern of multiple beam *headlamp* (*Isolux* curves in wall projection): The individual light *pattern* of multiple sub-units sum up to the total adaptive light pattern

EX1017, FIGS. 1, 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, ¶¶54-55; 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; EX1023, 514-15; EX1024, 815-16. Arrays of independently controlled narrow-beam directional light sources (e.g., LEDs) 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. EX1003, ¶55.

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

Petitioner certifies that the '503 patent is available for IPR. Petitioner is not barred or estopped from requesting IPR. Torchlight Technologies LLC filed and served a complaint in Civil No. 1:22-cv-00751 on June 7, 2022, alleging infringement of the '503 patent. This Petition is being filed within one year of service on Volkswagen Group of America, Inc.

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

Ground	References	Basis	Claims Challenged
1	Beam (EX1005), Thominet (EX1006)	§103	20, 24, 25
2	Beam, Thominet, Stam (EX1007)	§103	59, 63, 64
3	Beam, Thominet, Kobayashi (EX1008)	§103	21-23
4	Beam, Thominet, Stam, Kobayashi	§103	60-62
5	Karlsson (EX1010), Harbers (EX1011)	§103	20, 24, 25, 59, 63, 64
6	Karlsson, Harbers, Gotou (EX1012)	§103	21-23, 60-62

The ’503 patent is not entitled to priority benefit of its earliest-filed July 12, 2002 provisional application. Even if Patent Owner alleges the earliest possible priority date:

- Beam, U.S. Patent No. 6,144,158, issued November 7, 2000, is prior art under §102(b).
- Thominet, U.S. Patent Publication No. 2001/0019486, published September 6, 2001, is prior art under §102(a).
- Stam, WIPO Patent Publication No. 2001/070538, published September 27, 2001, is prior art under §102(a).
- Kobayashi, U.S. Patent No. 6,049,749, issued April 11, 2000, is prior art under §102(b).
- Karlsson, WIPO Patent Publication No. 1998/054030, published December 3, 1998, is prior art under §102(b).
- Harbers, WIPO Patent Publication No. 2001/001038, published January 4, 2001, is prior art under §102(b).
- Gotou, U.S. Patent No. 5,588,733, issued December 31, 1996, is prior art under §102(b).

IV. THE ’503 PATENT

A. Summary

The ’503 patent claims are directed to systems previously known in the art for controlling headlamp illumination characteristics. They recite known control

schemes implemented by a known controller to control multiple directional light sources based on sensor data of a field-of-view. To prevent glare, light in a first subsection is below a predefined illuminance and light in a second subsection is above the predefined illuminance. EX1003, ¶56.

Independent claim 59 recites, in part, a system to:

process the *sensor data* to identify a *first subsection*, of a *field of view*, that includes at least a portion of the *second vehicle*;

determine light output for the headlight system that *aims illumination at the first subsection*, the illumination aimed at the first subsection substantially resulting in light *below a first predefined illuminance* in the first subsection, and

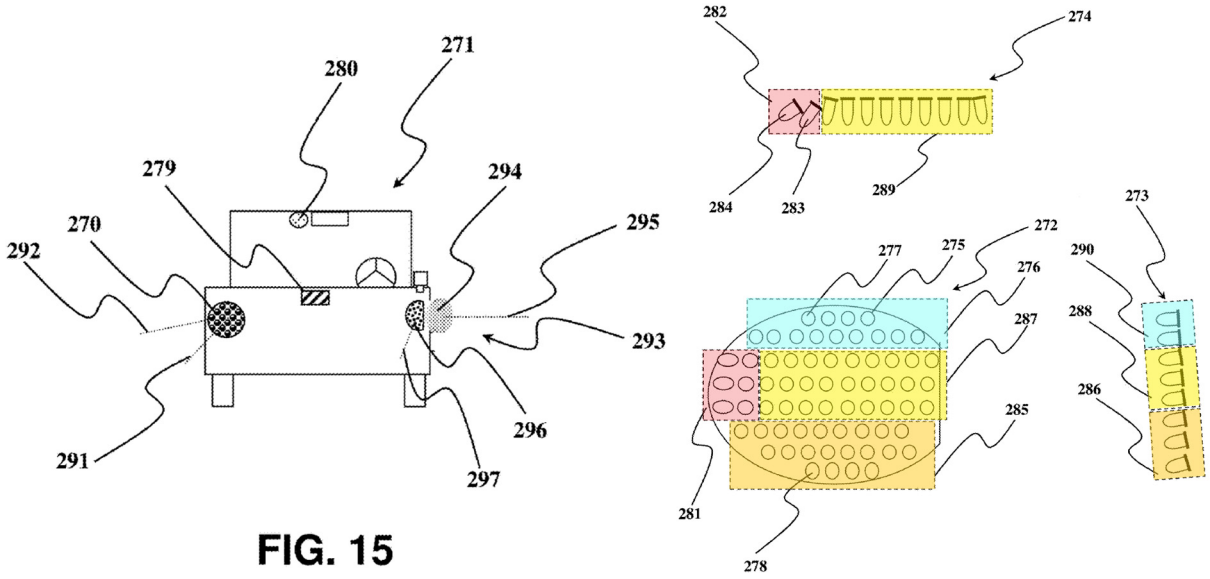
that *aims illumination at one or more second subsections* of the field of view to either side of the first subsection, the illumination aimed at the one or more second subsections substantially resulting in light *above the first predefined illuminance* in the one or more second subsections; and

instruct adjustment of one or more of the light sources to achieve the determined output.

EX1001, 102:14-40.[1] The dependent claims merely add known features: illuminating a road curvature; illuminating a planned turn; reflectors/refractors/lenses; etc. EX1003, ¶57.

[1] Emphasis added throughout, unless noted.

The ’503 patent’s system includes headlamp 270, controller 279, and sensors 280 on vehicle 271. EX1001, 52:63-54:52, FIG. 15. Headlamp 270 includes clusters 276(290), 281(282), 285(286), 287(288, 289) of differently aimed light sources such as LEDs 275, 277, 278, 283, 284, respectively. *Id*.; EX1003, ¶58.



EX1001, FIG. 15 (annotated).

Without detail, the ’503 patent states controller 279 receives traffic data of oncoming vehicles from sensors 280 and determines the maximum illumination allowable for the traffic situation without blinding oncoming traffic. EX1001, 52:63-54:52, FIG. 15. The specification leaves it to a POSA to determine the “predefined illuminance,” without describing an illuminance level, algorithms, or control steps to achieve this. EX1003, ¶59. Unsurprisingly, a POSA would have readily incorporated multiple directional beam control and a predefined illuminance in an adaptive headlamp system, as demonstrated by the applied prior art. *Id.*

B. Independent Claims 20/59[2]

The independent claims recite patentably indistinct elements and concepts; thus, the same prior art disclosures map to corresponding elements. EX1003, ¶60.

For example, claims 20 and 59 recite a "vehicle headlight system" for controlling illumination characteristics of a headlamp with "at least three directional light sources"; and claim 59 further recites a "predefined illuminance." *Id.*, ¶61; Appendix A.

The disclosures mapped below for the directional light sources, sensor, processor, etc., of claims 20-25, apply equally to and render obvious claims 59-64. EX1003, ¶62. Minor phrasing differences do not affect the substantive application of the prior art. *Id.*, ¶¶62-64, Table 1; Appendix A.

C. Prosecution History Summary

The '503 patent underwent nominal prosecution. EX1003, ¶65. The Office did not apply any prior art references with an effective priority date before January 24, **2012**. A first Office Action rejected all claims 1-18. EX1002, Prosecution History, 147-164. Applicant revived the abandoned application, amending claims 1-18, adding new claims 19-20, and arguing that the sole reference *did not qualify as prior art* due to the application *priority claim* of at least January 24, 2012. *Id*., 173-193; EX1021.

[2] Appendix A compares independent claims.

Additional non-art rejections were issued, and claims 1-70 issued without any significant substantive examination since the sole prior art rejection was overcome as allegedly not qualifying as prior art. EX1003, ¶66; EX1002, 194-199, 207-228, 247-252, 272-289, 292-299, 310-337. Regardless, none of the prior art applied here was considered by the Office.

D. Level of Ordinary Skill in the Art

For the '503 patent, a POSA at the time[3] 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, ¶¶42-44.

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

[3] Without conceding, Petitioner uses July 12, 2002 as the earliest effective priority date. The POSA definition would not change based on a later priority date.

specification and prosecution history. *Id.*; *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312-1313 (Fed. Cir. 2005) (en banc); 83 Fed. Reg. 51,340 (Oct. 11, 2018); EX1003, ¶¶67-68.

"light sources" (claims 20, 59)

Patent Owner submitted a proposed claim construction in a reexamination of U.S. Patent No. 9,955,551 ("the '551 patent"), but the Central Reexamination Unit did not address the proposed construction. EX1033, 15 ("*light source* to mean individual LED"), 19 ("*light source* to mean an individual LED"); EX1003, ¶69.

The '503 patent, which shares the same specification, states "[a]s used herein, the term 'light source', LED or 'solid state light source' means any system that is capable of receiving an electrical signal and producing light in response to the signal." EX1001, 17:7-10. Further, the '503 patent states "[t]hus, the term 'light source' should be understood to include light emitting diodes of all types…[and] incandescent and discharge light sources." *Id*., 17:10-20. Therefore, a POSA would have understood that "light source" includes any known headlamp light sources, for example but not limited to, incandescent, discharge, laser diode, and LED light sources that are electrically controllable, which includes the combination of light sources and spatial light modulators, for example, microbeam sources and spotlight beam sources. EX1003, ¶70; EX1005, 8:4-17; EX1010, 4:32-5:10; EX1009, 14:16-20.

Furthermore, Patent Owner's proposed construction would not be applicable here at least because the '503 patent involves different claims. EX1003, ¶71. Additionally, the claims do not recite "LED light source," and therefore do not require the light source to be an LED. *Id*.

Regardless, the applied references cover Patent Owner's proposed construction of a "light source" to mean an "individual LED." EX1005, 8:4-17 ("*light emitting diodes*"); EX1010, 4:32-5:10 ("*light-emitting diodes*"); EX1003, ¶72. Thus, the challenged claims are unpatentable under any construction.

Without waiver, Petitioner does not believe any other claim terms require specific construction and should receive their plain and ordinary meaning, in the context of the '503 patent specification, under *Phillips*.[4] Under any reasonable construction, the challenged claims are unpatentable. EX1003, ¶73.

V. OVERVIEW OF APPLIED REFERENCES

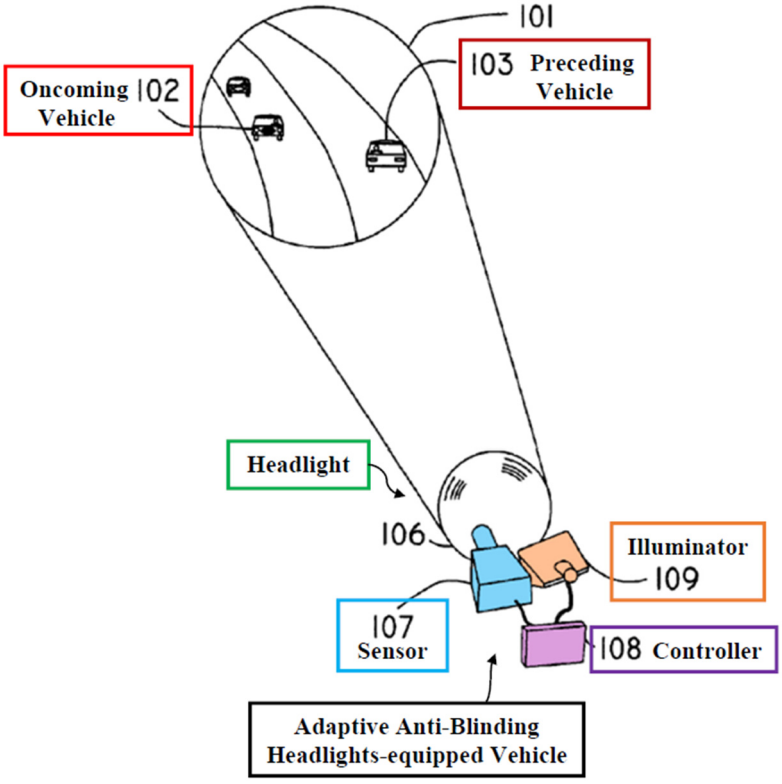
Each applied reference discloses an adaptive automotive lighting system and, thus, is from the same field as the '503 patent. EX1003, ¶¶74-116.

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

A. Ground 1 – Beam and Thominet

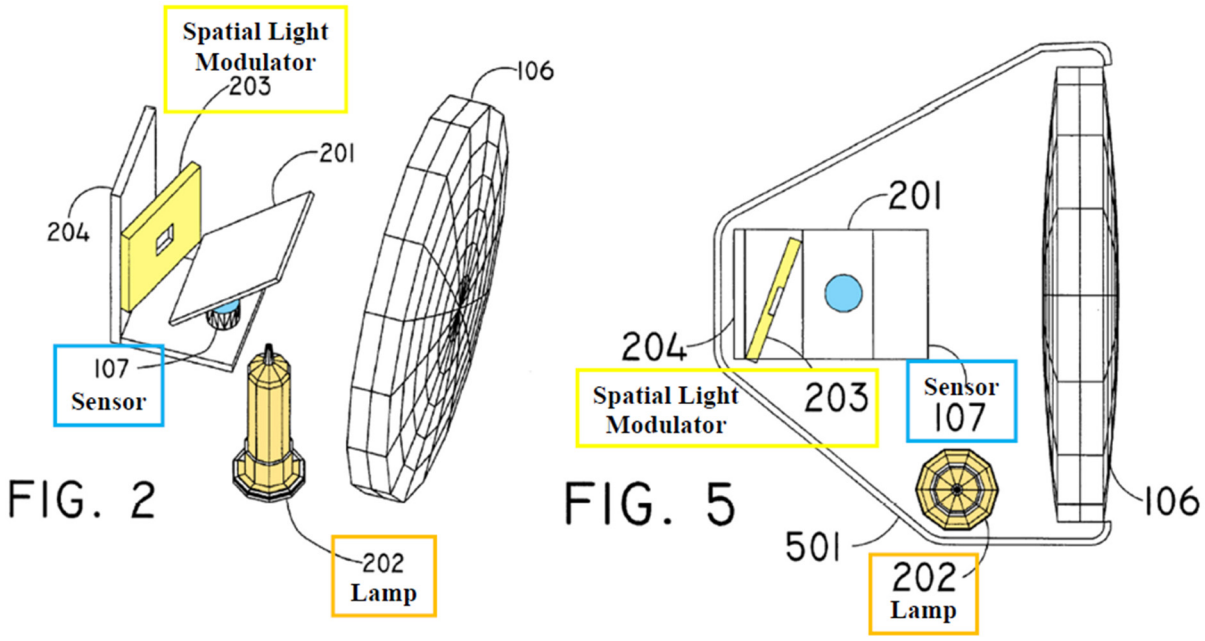
1. Beam

Beam's adaptive anti-blinding headlight/headlamp system ("AABH") controls the intensity, shape, and/or angular position (direction) of one or more microbeam source, such as individual, controllable, light-emitting diodes (LEDs). EX1005, Abstract, 8:4-17; EX1003, ¶74. Beam's AABH detects headlights/taillights of vehicles ahead, and adjusts the headlight to provide significantly reduced illumination in certain areas, protecting other drivers' vision. EX1005, 4:10-25, FIG. 1. Sensor 107 inputs data to controller 108, which controls illuminator 109. EX1005, 4:10-25, FIG. 1; EX1003, ¶¶80-81.



EX1005, FIG. 1 (annotated).

Beam uses the term "microbeam" as light emitted from a "microbeam source," which includes "*individual, controllable, light-emitting diodes*" (LEDs). EX1003, ¶¶75-76. Controller 108 uses imaged data from sensor 107 to determine a particular area of microbeams to reduce. EX1005, 4:26-59, FIGS. 2, 5; EX1003, ¶77. Rays from lamp 202 fall on and are reflected or blanked (attenuated) by spatial light modulator (SLM) 203 to produce an overall beam pattern comprising many individual, differently aimed microbeams. EX1005, 4:26-59, FIGS. 2, 5; EX1003, ¶77.

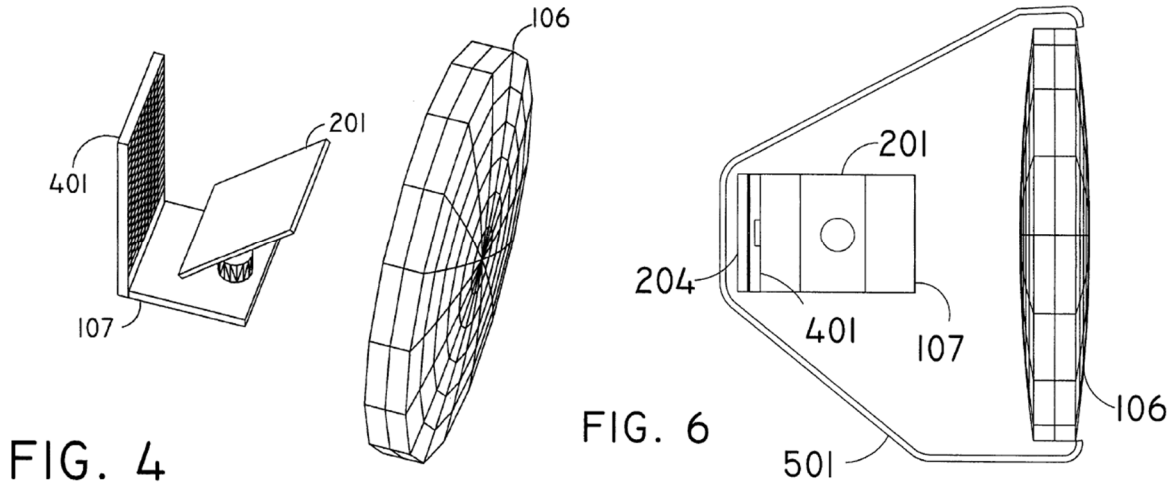


EX1005, FIGS. 2, 5 (annotated).

Microbeams are arranged in an X-Y matrix and the intensity and angular position of each microbeam is independently controlled. EX1005, 4:26-59, FIGS. 2, 5, 8:4-17 ("digital mirror devices"); EX1003, ¶78. Controller 108 selectively

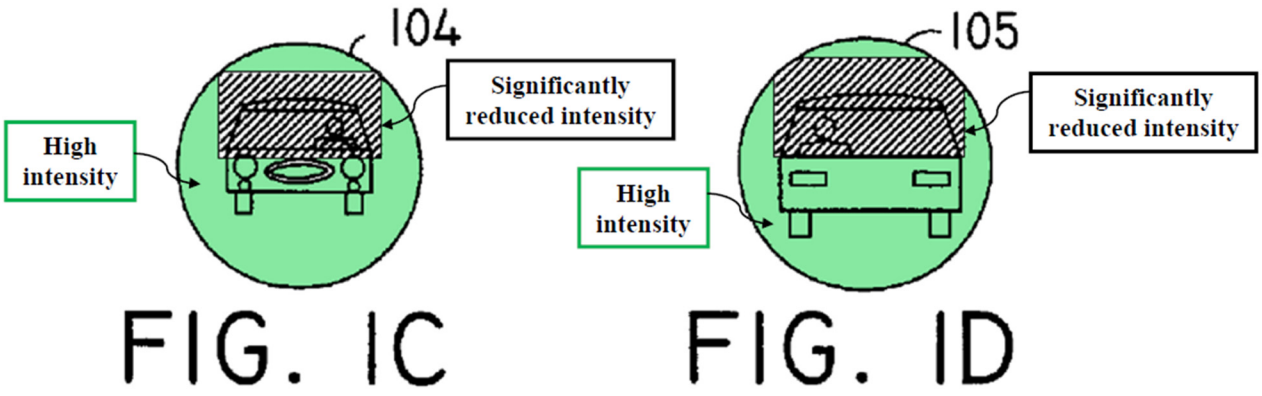
reduces illumination of microbeams directed at a particular object or objects, which commands SLM 203 in illuminator 109 to divert or attenuate the selected microbeams. EX1005, 4:26-59, FIGS. 2, 5; EX1003, ¶¶78, 82.

Additionally, Beam discloses an embodiment with an array of individually controlled light sources 401 (e.g., LEDs) having the same functionality as lamp 202 and SLM 203 shown in Figures 2 and 5. EX1005, 3:61-64, 5:3-16, FIGS. 4, 6, 8:4-17 ("array of individual, independently controllable microbeam sources…light-emitting diodes…digital mirror devices"); EX1003, ¶119.



EX1005, FIGS. 4, 6.

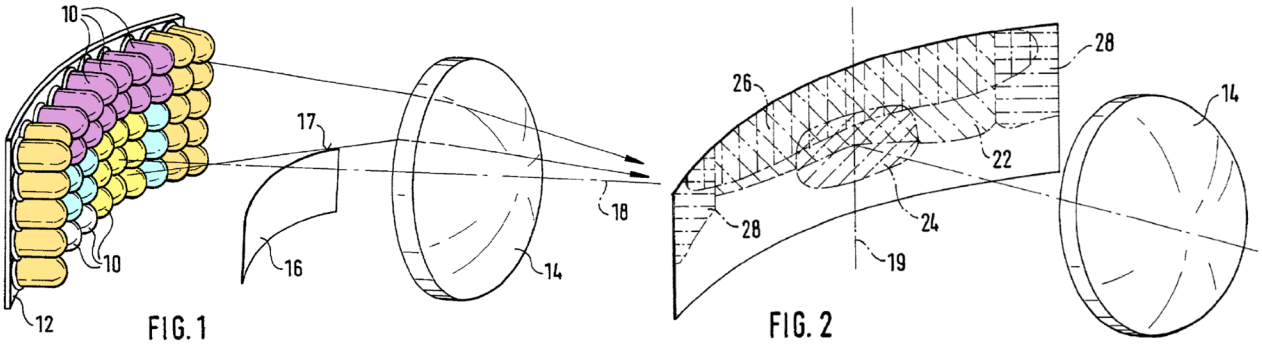
Significantly reduced intensity illumination, represented by shaded areas, is automatically provided to specific vehicle areas 104, 105 to reduce blinding drivers of oncoming/preceding vehicles 102, 103 while retaining high intensity illumination elsewhere. EX1005, 2:53-3:3, 4:10-25, FIGS. 1C-1D; EX1003, ¶79.



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

2. Thominet

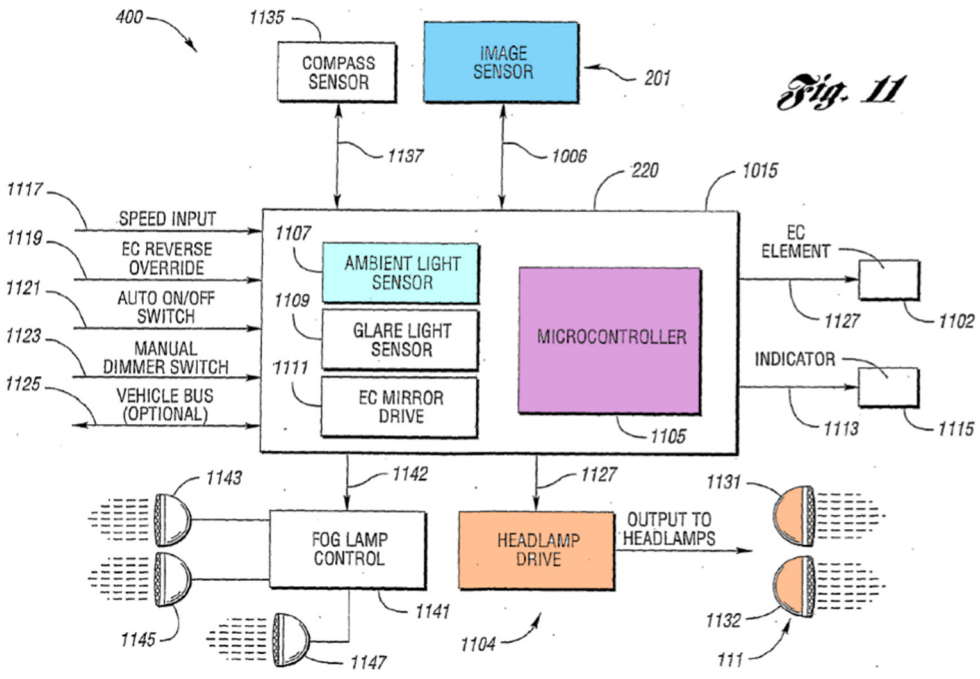
Like Beam, Thominet discloses a headlight with independently controllable LEDs in an array. EX1006, ¶¶17-18, 21-26, FIGS. 1-2, 5; EX1003, ¶¶83-87. Semiconductor light sources 10 (e.g., LEDs) arranged on curved surface 12 provide regions 22, 24, 26, 28 with different aimings, independently controllable to provide different illumination functions (low beam, high beam, low sight, large width). EX1006, ¶¶17-18, 21-26, FIGS. 1-2, 5; EX1003, ¶¶83-87.



EX1006, FIGS. 1-2 (annotated).

B. Ground 2 – Stam with Beam-Thominet

Similarly, Stam's headlight system adjusts beam patterns that maximize the illuminated area without excessive glare. EX1007, Abstract, 9:12-10:8, 77:30-78:17, FIGS. 11, 50A-50C; EX1003, ¶¶88-89. Stam discloses laws and regulations governing the amount of glare experienced by drivers (e.g., a glare tolerance level or "perceived brightness")—stating that a predefined dimmed (low beam) illuminance of no greater than 0.1 foot candles (fc) within 700 ft should be used to avoid glare to other drivers. EX1007, 1:14-31, 9:12-10:8; EX1003, ¶¶90-92.

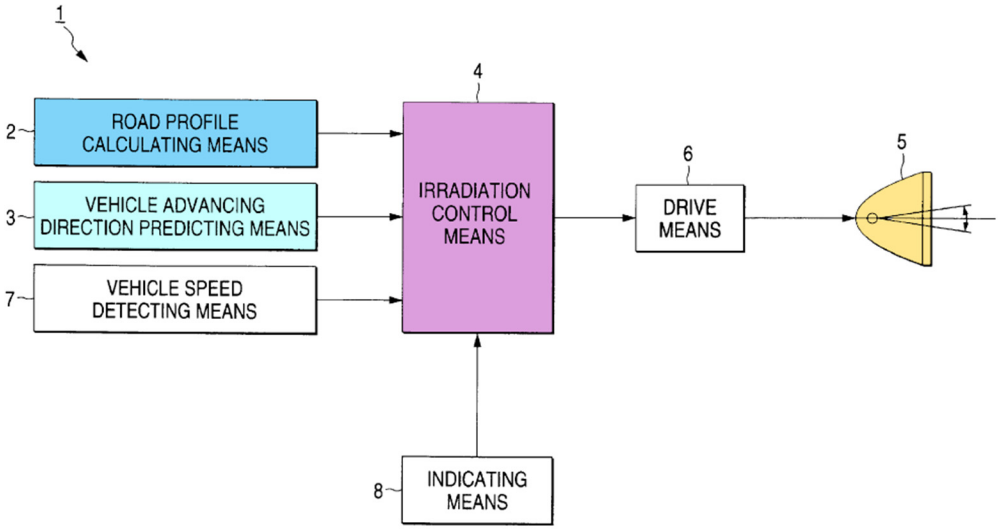


EX1007, FIG. 11 (annotated).

C. Grounds 3/4 – Kobayashi with Beam-Thominet/Beam-Thominet-Stam

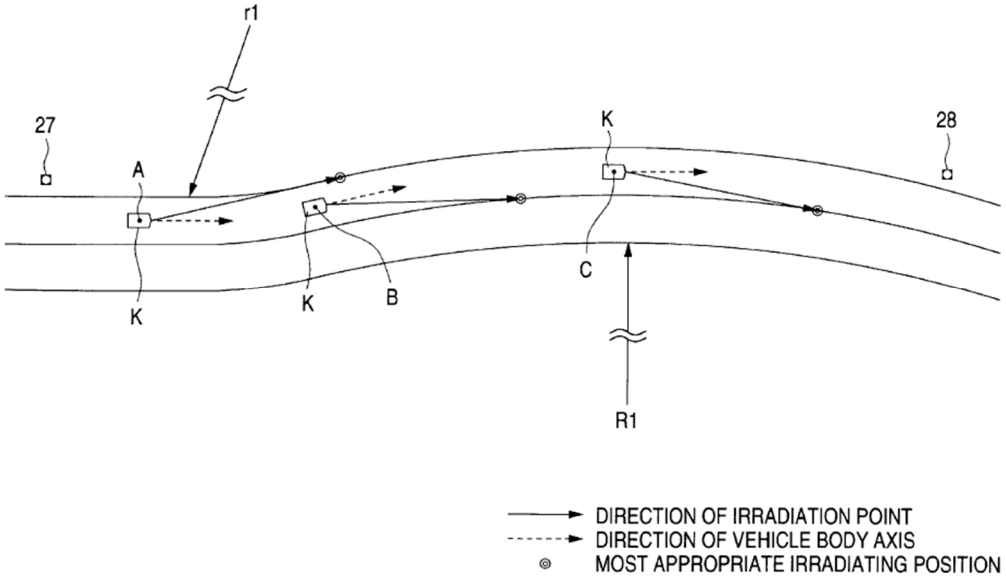
Kobayashi also discloses adaptive headlamps. EX1008, Abstract, 1:66-2:35, 4:60-64, FIGS. 1, 10; EX1003, ¶93. Kobayashi's adaptive lighting uses map

data/information including road curvature to predict and adjust illumination towards curves/turns. EX1008, Abstract, 1:66-2:35, 3:9-30, 4:60-64, FIGS. 1, 10; EX1003, ¶¶93-97.



EX1008, FIG. 1 (annotated).

Lighting is planned and controlled on curved roads—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 to improve safety. EX1008, 14:53-15:28, FIG. 10; EX1003, ¶98.

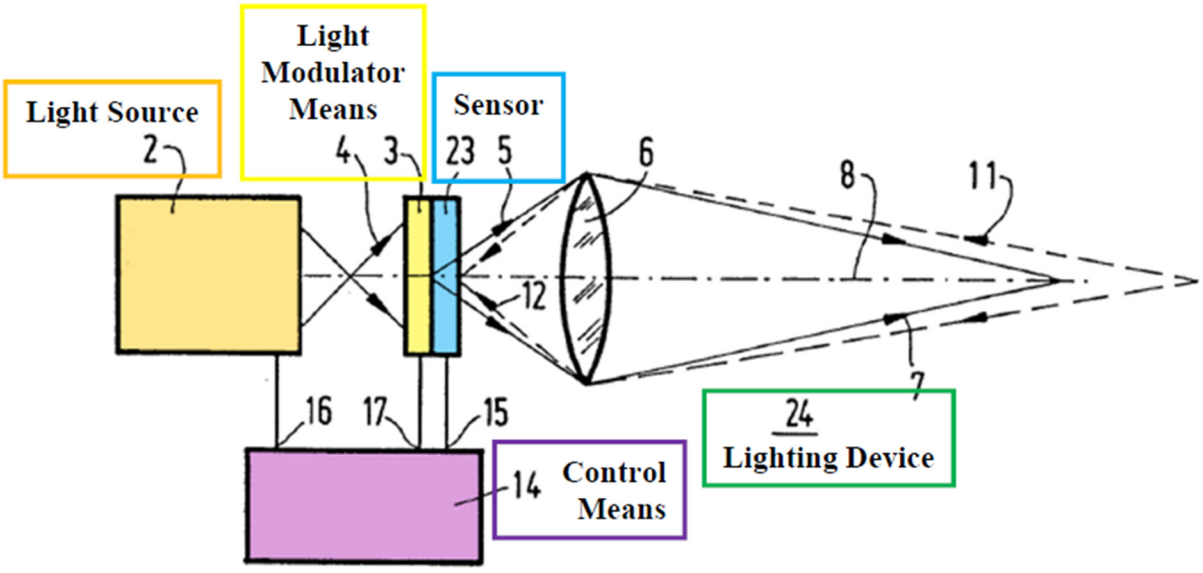


EX1008, FIG. 10.

D. Ground 5 – Karlsson and Harbers

1. Karlsson

Karlsson discloses a headlight having spotlight beams and sensors to detect oncoming traffic and automatically control a lighting pattern to reduce blinding of oncoming traffic. EX1010, Abstract, 2:30-35; EX1003, ¶99. Lighting device 24 provides light beam 7 controlled by light source 2, light modulator means 3, and control means 14 based on light detected by sensor 9, 23, whose intensity and pattern are optimally adapted to the road and prevent glaring. EX1010, 9:18-26, FIG. 3; EX1003, ¶99.



EX1010, FIG. 3 (annotated).

Lighting device 24 includes a plurality of controllable spotlight beams forming light beam 7. EX1010, 13:24-14:4, FIG. 6. Spotlight beams 34 are obtained by light source 2 composed of a grid of separate light sources, such as LEDs, controlled individually or in groups. *Id.*; EX1003, ¶¶100-102.

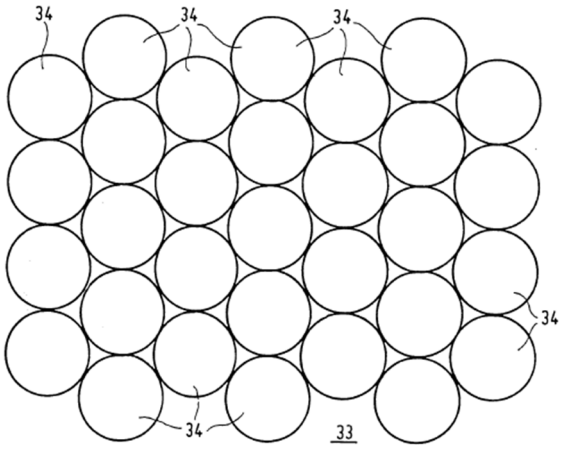
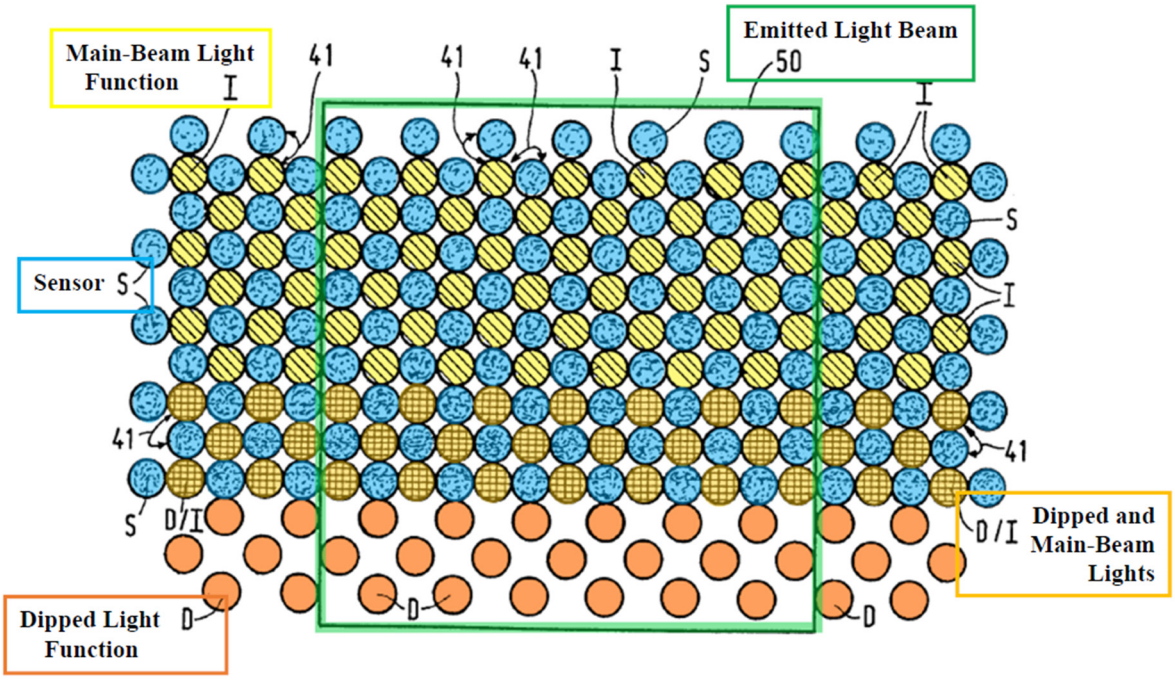


FIG. 6

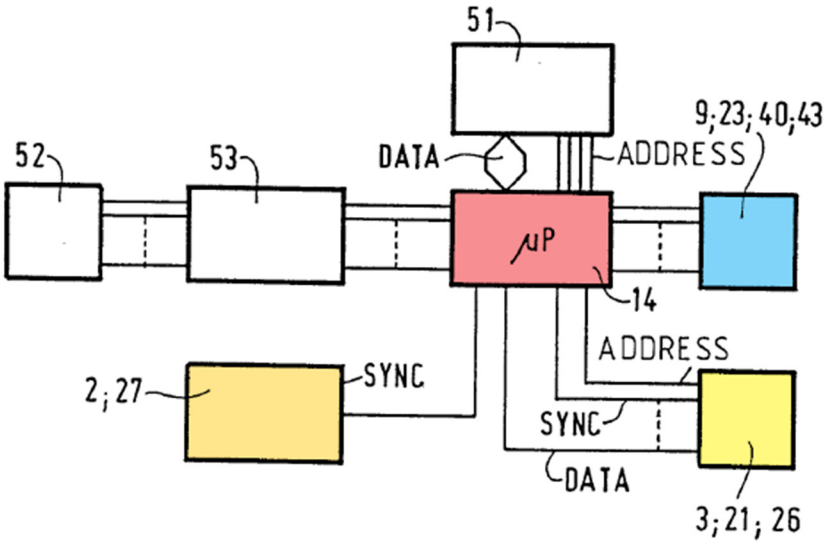
EX1010, FIG. 6.

Light beam 50 shifts in the plane from left to right and top to bottom, produced by spotlight sources D (dipped light), I (main-beam light), and D/I (dipped and main-beam lights) based on data from spotlight sensors S. EX1010, 19:18-20:3, FIG. 14; EX1003, ¶103.



EX1010, FIG. 14 (annotated).

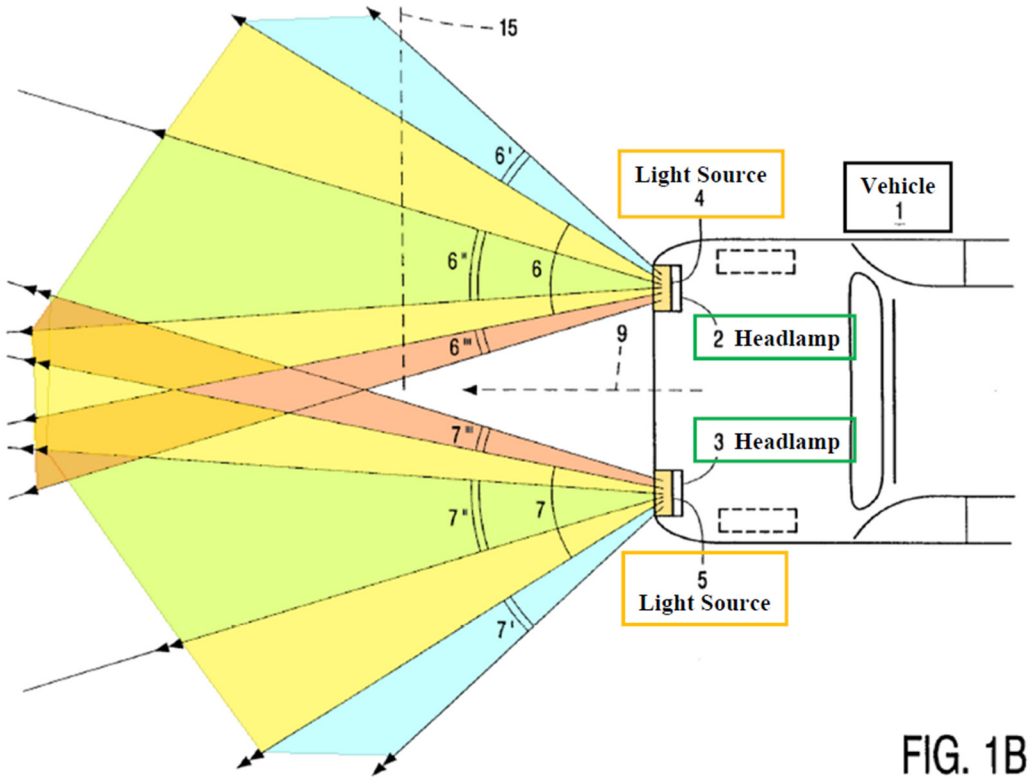
Control means 14 is synchronized to light source 2, light modulator means 3, and sensor 23 to produce adaptive light beam 7, 50. EX1010, 20:12-32, 21:36-22:4, FIG. 15; EX1003, ¶104.



EX1010, FIG. 15 (annotated).

2. Harbers

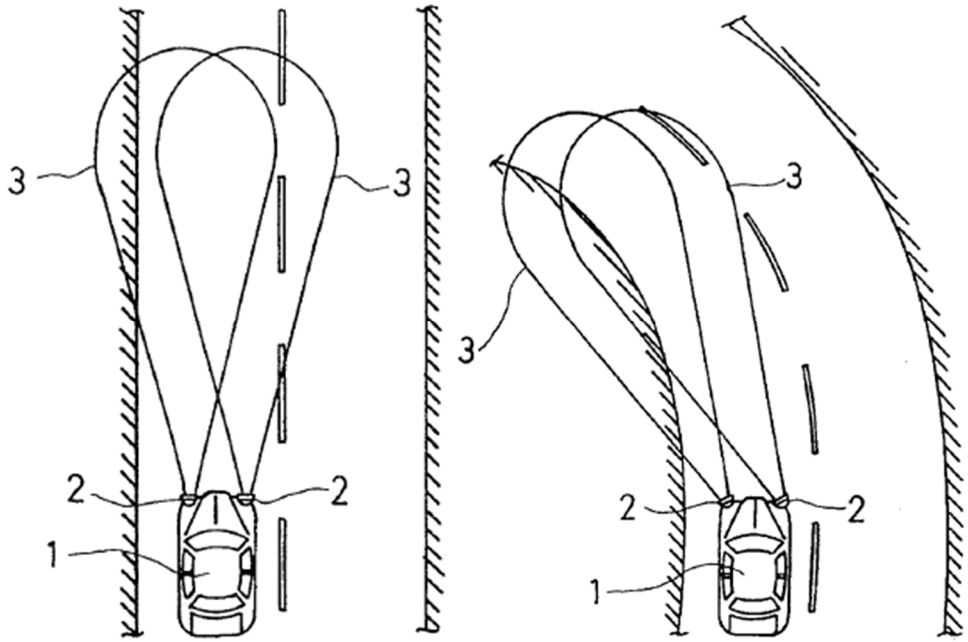
Likewise, Harbers's headlamp includes independently controllable opto-electronic elements (e.g., LEDs) for adaptive illumination. EX1011, Abstract, 2:27-3:10, 5:14-26, 6:27-7:19, 7:27-32, FIGS. 1B, 2; EX1003, ¶105. Light beam segments 6-6'-6"-6'", 7-7'-7"-7'" have different aimings (angles relative to longitudinal direction 9) to improve visibility, thereby increasing safety. EX1011, 5:14-26, 6:1-7, 6:27-7:19, 7:1-17, FIG. 1B; EX1003, ¶¶105-108.



EX1011, FIG. 1B (annotated).

E. Ground 6 – Gotou with Karlsson-Harbers

Similarly, Gotou discloses an adaptive headlamp for illuminating certain areas. EX1012, Abstract, 1:35-40, 2:8-26, 3:24-55, 6:4-61, FIGS. 1-3, 8-10; EX1003, ¶109. Gotou's adaptive lighting uses map data/information including road curvature to predict and adjust illumination—for example, when there is a leftward curve, lighting regions 3 adjust leftward prior to the curve. EX1012, 3:24-55, 7:32-43, 8:28-35, FIGS. 8-9; EX1003, ¶¶109-116.



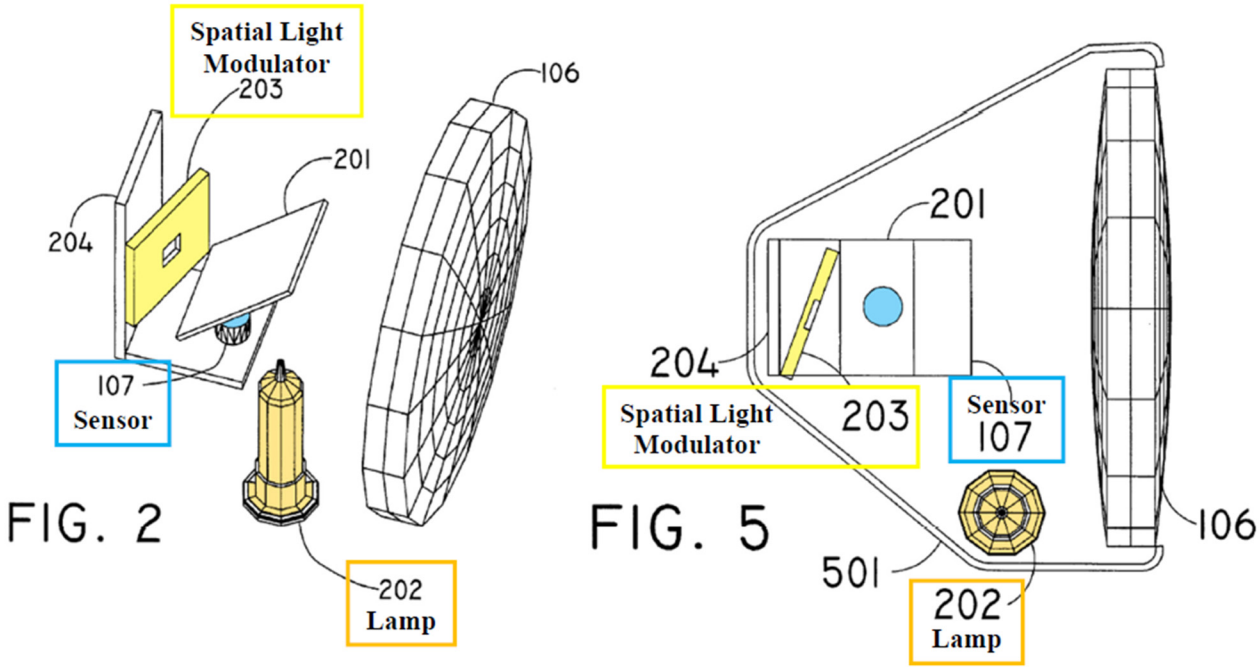
EX1012, FIGS. 8-9.

VI. GROUND 1: THE COMBINATION OF BEAM AND THOMINET RENDERS OBVIOUS CLAIMS 20 AND 24-25.

It is Petitioner's position that Beam explicitly or implicitly discloses every feature in claims 20 and 24-25. But to avoid doubt, Beam is combined with Thominet, for [20.2] (and [59.2] in Ground 2), which discloses a well-known implementation of adaptive headlamps—directional light sources with different angles/aimings for different functions—rendering the claims obvious. EX1003, ¶117.

Beam discloses "[t]he *angular* position or attenuation of *each of the microbeams* is *independently* set by the controller 108." EX1005, 4:46-48, FIGS. 1-2, 4, Abstract, 8:4-17. Each microbeam is a directional "source," having its own independent *angular* position (angle/aiming), that combines to form the headlamp

beam; so Beam's lamp 202 and SLM 203 (see Figure 2) form at least three directional light sources having different angles/aimings. *Id*., 4:26-59, 5:3-21, FIGS. 2, 4-6; EX1003, ¶118.



EX1005, FIGS. 2, 5 (annotated).

Additionally, Beam discloses an array of individually controlled light sources 401 (e.g., LEDs, see Figure 4) having the same functionality as lamp 202 and SLM 203. EX1005, 3:61-64, 5:3-16, FIGS. 4, 6, 8:4-17. Each light source of the array has its own independent *angular* position (angle/aiming), that combines to form the headlamp beam; so Beam's array of light sources 401 form at least three directional light sources having different angles/aimings. *Id*., 3:61-64, 4:26-59, 5:3-16, FIGS. 2, 4-6, 8:4-17; EX1003, ¶119.

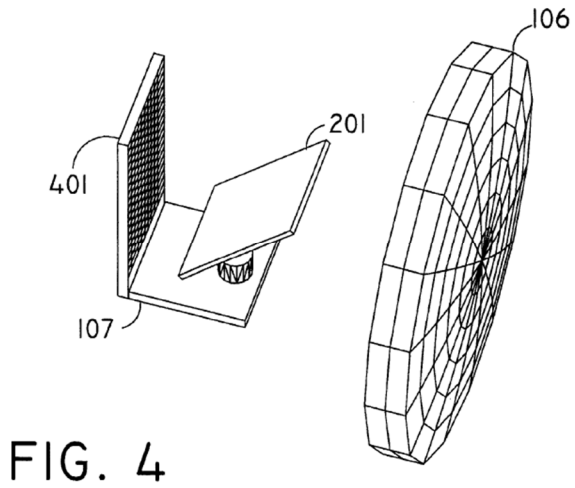


FIG. 4

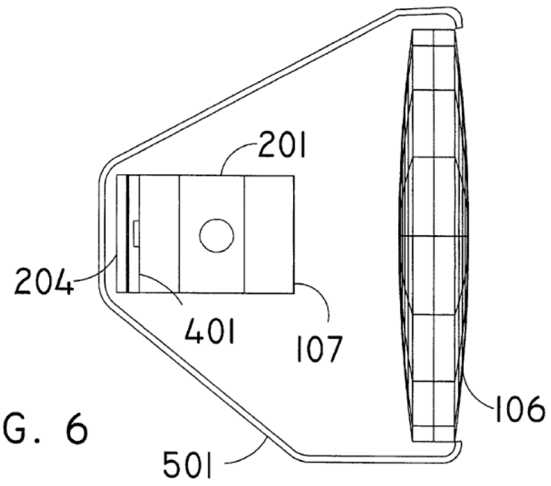


FIG. 6

EX1005, FIGS. 4, 6.

Thus, Beam discloses "at least three directional light sources"—independently controllable angular microbeam sources—that are "aimed at different angles"/"hav[e] different aimings" as recited in [20.2]/[59.2]. EX1003, ¶120.

If Patent Owner argues, incorrectly, that Beam does not disclose [20.2]/[59.2], Thominet does; and it would have been obvious to combine Thominet with Beam. *Id*., ¶¶121-122.

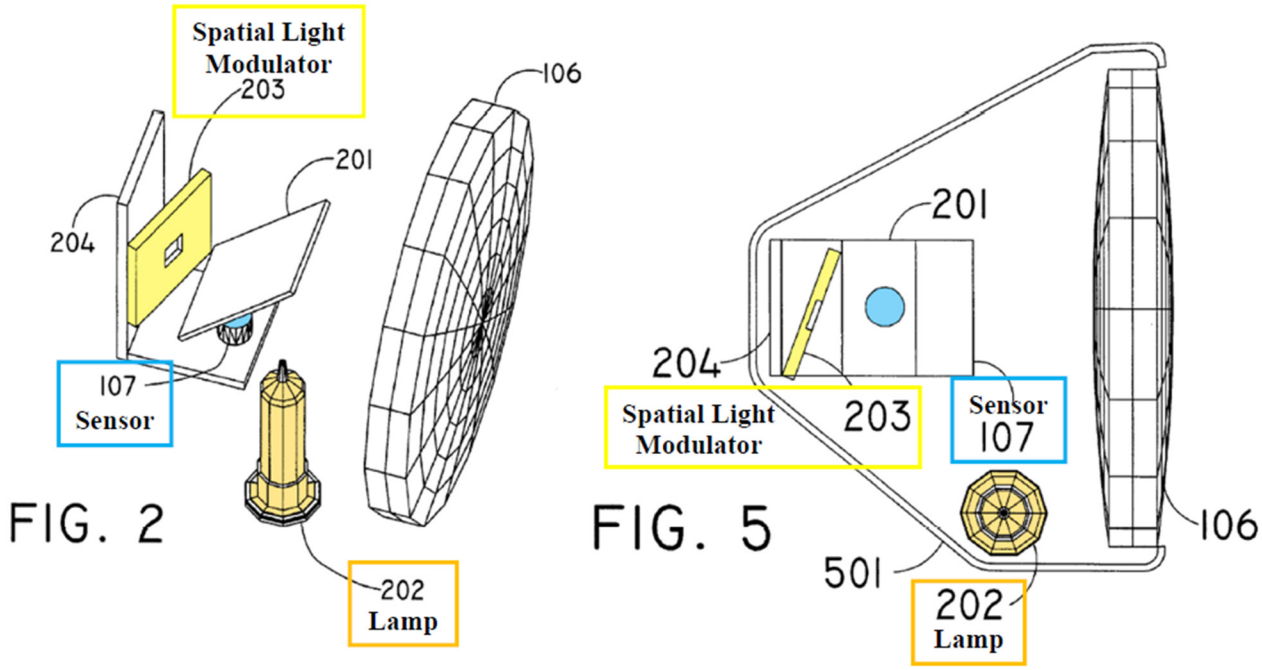
A. A POSA would have been motivated to combine Beam and Thominet with a reasonable expectation of success.

As discussed, Beam discloses "directional light sources" with independently controlled angular positions for reducing glare towards other drivers. EX1003, ¶¶123-124. Thominet provides further detail on ways to implement "directional light sources" for different functions, conceptually and physically. *Id*., ¶124. So naturally, it would have been obvious to a POSA designing an adaptive headlamp to implement Thominet's multiple directional beam regions with different

angles/aimings—through either software or hardware—for different functions in Beam's system. *Id.* Indeed, Thominet discloses such an implementation to provide different spatial distributions for improved visibility in different driving situations (low visibility, low/high speeds, recognizing a counter traffic, curves, etc., *see* EX1006, ¶¶7-8, 23-26, FIGS. 1-2), thereby improving driver safety—an express purpose of Beam. EX1003, ¶¶124, 223; EX1005, 3:8-14, 3:37-44, 5:33-54, 7:1-13.

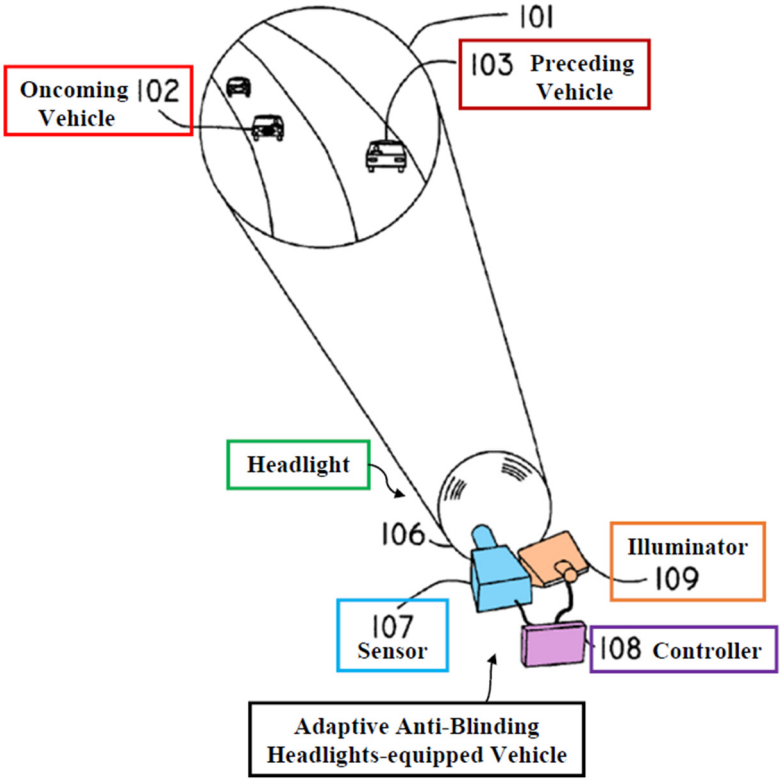
Beam and Thominet are from the same field—controllable headlamps with dynamic illumination—and include the same building blocks (light sources, sensors, controllers). EX1003, ¶¶125, 224. Improved visibility, thereby increasing safety, is paramount in both. *Id*.; EX1005, 1:54-59, 3:8-45, 4:48-59, 6:53-7:13; EX1006, ¶¶3-4, 23.

First, including an additional control technique (software implementation) for Beam—Thominet's *known technique* of using multiple directional beam regions for different functions—would have added more control methods for different functions to Beam's visibility for different driving situations, thereby increasing safety. EX1003, ¶¶126, 155, 225. Beam discloses "[t]he *angular* position" of each microbeam can be set by controller 108, which commands SLM 203 in illuminator 109, to reduce glare. EX1005, 4:26-59, 5:3-21, FIGS. 1-2, 5, Abstract, 8:4-17; EX1003, ¶¶126, 155, 225.



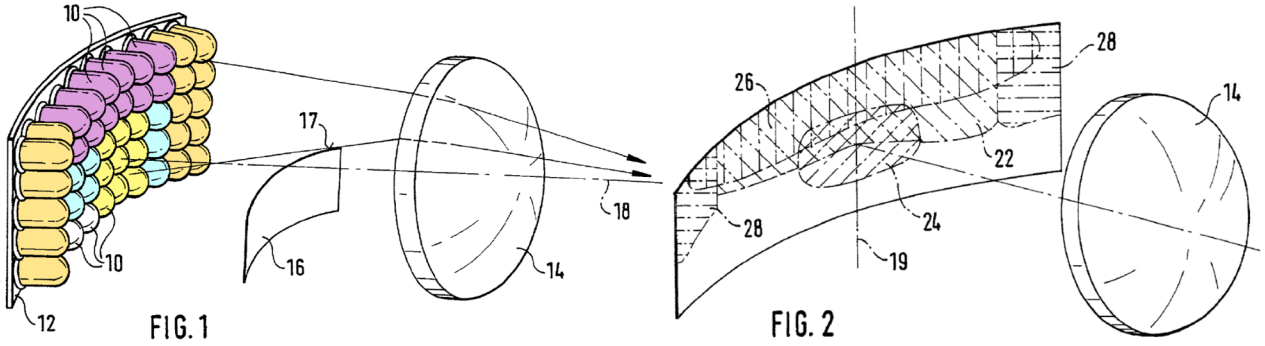
EX1005, FIGS. 2, 5 (annotated).

Indeed, Beam's techniques and system of controlling individual microbeams emphasize safety of all drivers. EX1005, 3:8-45, 6:53-7:13. Controllable headlamps "provide greatly improved safety and comfort to the motoring public," and a "brighter headlight beam while simultaneously protecting…all vehicles ahead," increases safety. *Id*., 3:8-45. Beam enables "the driver to see more clearly at night," while protecting others from glare. *Id*.; *id*., 4:9-24, 6:9-27; EX1003, ¶¶127, 156, 226.



EX1005, FIG. 1 (annotated).

Beam recognizes the safety benefits of different spatial distributions "for conditions like rain, snow, or fog." EX1005, 3:29-36, 1:54-59, 4:48-59; EX1003, ¶128. And Thominet's *technique* (software implementation), like Beam, enhances driver visibility, increasing safety—using multiple directional beam regions for different functions. EX1006, ¶¶17-18, 21-26, FIGS. 1-2, ¶¶3 ("*characteristic* of the light beam…can be used for *different functions*"), 5-8. Semiconductor light sources 10 provide beam regions 22, 24, 26, 28 with different angles/aimings for different driving situations. *Id*., ¶¶7-8, 17-18, 21-26, FIGS. 1-2, ¶¶7 ("*wider* illumination), 23 ("*improving* the illumination…at high speeds); EX1003, ¶¶128-130, 157-159, 227-229.



EX1006, FIGS. 1-2 (annotated).

The additional control of having multiple directional beam regions with different angles/aimings as in Thominet, implemented with Beam's controller 108/illuminator 109 (including SLM 203), would have provided Beam's system with different spatial distributions for different driving situations beyond reducing glare for drivers, thereby improving safety. EX1003, ¶¶131, 160, 230. This would have merely been applying Thominet's known technique (software implementation: using multiple directional beam regions with different angles/aimings for different functions), to Beam's similar, known device (dynamic system with controllable microbeams), in the same way. *Id*., ¶132, 231; *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 417 (2007). Thominet's known technique is fully described along with its benefits (improved visibility for different functions, thereby increased safety); thus, a POSA would have readily applied it to similar systems, such as Beam's, in the same way. EX1003, ¶132, 231; *KSR*, 550 U.S. at 419-421.

A POSA would have had a reasonable expectation of success combining Beam and Thominet, for example, by simply modifying software instructions in

memory of Beam's controller/processor to organize Beam's array of microbeams into multiple directional beam regions with different angles/aimings for different functions. EX1003, ¶¶133, 161-162, 232-233. This would have been routine and well within a POSA's skill due to the similarities in Beam's and Thominet's adaptive systems—their common components were well-known and there would have been no limitations for a POSA to make such modification. *Id*., ¶¶134, 163, 233.

Second, additionally or alternatively, a POSA would have sought to incorporate *known components* (hardware implementation) of Thominet's semiconductor light sources 10 on curved surface 12 (with differently angled/aimed semiconductor light sources relative to the vehicle, *see* EX1006, ¶¶17-20, 23-26, FIGS. 1-2, 5-7) into Beam's system (with flat array of light sources 401). EX1003, ¶¶135, 164, 234. Again, this would have, like Thominet, provided different spatial distributions for different driving situations, improving visibility and thereby safety. *Id.*

Beam discloses flat array of light sources 401 (e.g., LEDs) has the same functionality as lamp 202 and SLM 203 in Figure 2, and each light source is individually controlled. EX1005, 3:61-64, 5:3-16, FIGS. 4, 6, 4:26-59 ("*angular* position"), 8:4-17; EX1003, ¶¶136, 165, 235.

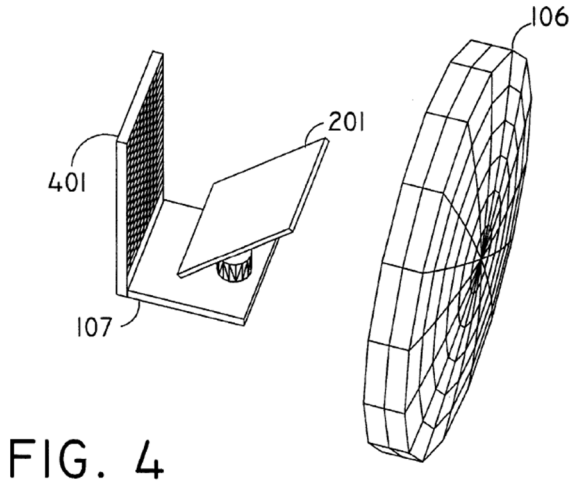


FIG. 4

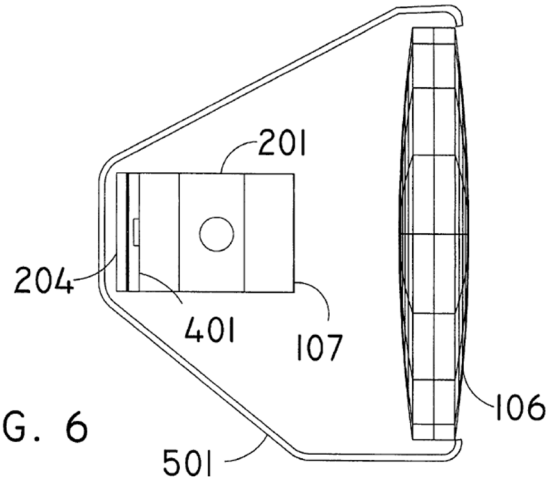


FIG. 6

EX1005, FIGS. 4, 6.

Through its *system components* (hardware implementation), Thominet, like Beam, seeks to enhance driver visibility and thereby increase safety. EX1003, ¶¶137, 166, 236. Indeed, semiconductor light sources 10 arranged on curved surface 12, with different angles/aimings relative to the vehicle, provide beam regions 22, 24, 26, 28 for different driving situations. EX1006, ¶¶7-8, 17-18, 21-26, FIGS. 1-2; EX1003, ¶¶137, 166, 236.

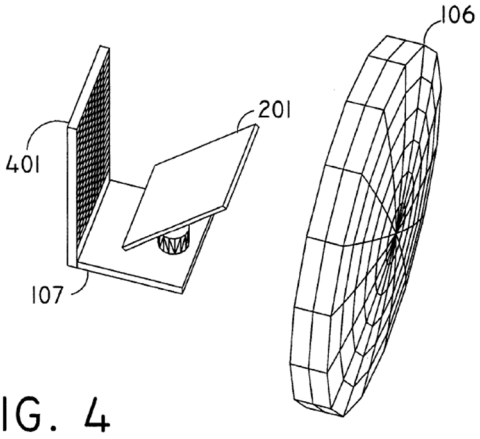


FIG. 4

EX1005, FIG. 4.

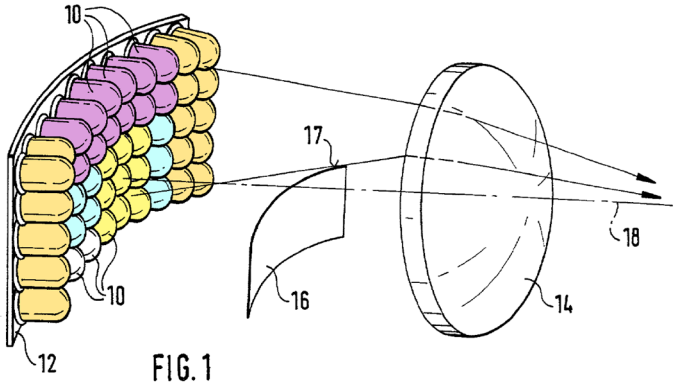


FIG.1

EX1006, FIG. 1 (annotated).

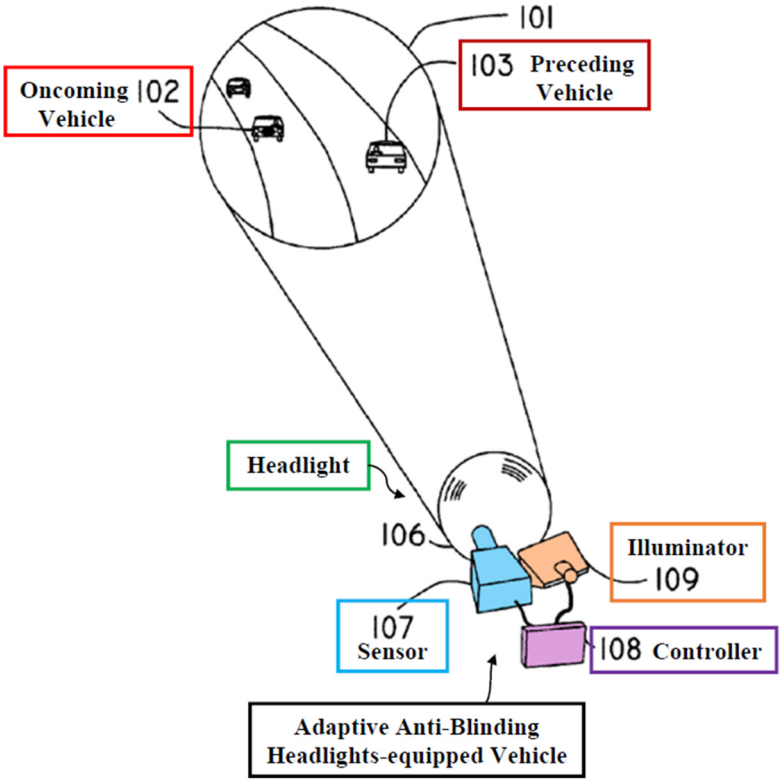
Like the software implementation, this hardware combination—Beam's array of light sources 401 and Thominet's differently angled/aimed semiconductor sources 10 on curved surface 12—would have provided Beam's system with different spatial distributions for different driving situations, as in Thominet, thereby improving driver safety. EX1003, ¶¶138, 167, 237. This would have been merely combining prior-art elements or a simple substitution of one known element for another (Beam's array of light sources 401 on a flat surface and Thominet's semiconductor sources 10 on a curved surface 12) according to known methods (disclosed in Beam and Thominet) to yield predictable results (improved visibility and safety). *Id*.; *KSR*, 550 U.S. at 415-418.

A POSA would have had a reasonable expectation of success combining Beam and Thominet, for example, by simply modifying the flat surface of Beam's array of light sources 401 with Thominet's curved surface 12 to provide multiple light sources with different angles/aimings relative to the vehicle for different functions. EX1003, ¶¶139, 168, 238. This would have been routine and well within a POSA's skill due to the similarities in Beam's and Thominet's adaptive systems—their common components were well-known and there would have been no limitations for a POSA to make such modifications. *Id*., ¶¶140-141, 169-170, 239-240.

B. Independent Claim 20[5]

1. [20.P]

Beam discloses an adaptive anti-blinding headlight (AABH) system of a vehicle. EX1005, 3:8-24, 4:10-59, FIGS. 1-2, 7; EX1003, ¶¶142-143.

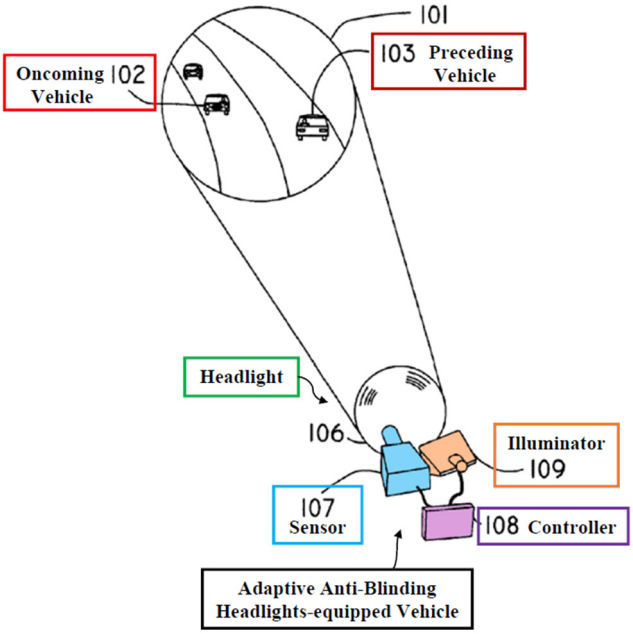


EX1005, FIG. 1 (annotated).

2. [20.1]

Beam discloses "*AABH units* will be mounted on a *vehicle*." EX1005, 6:9-11, FIG. 1, 6:33-34; EX1003, ¶¶144-145.

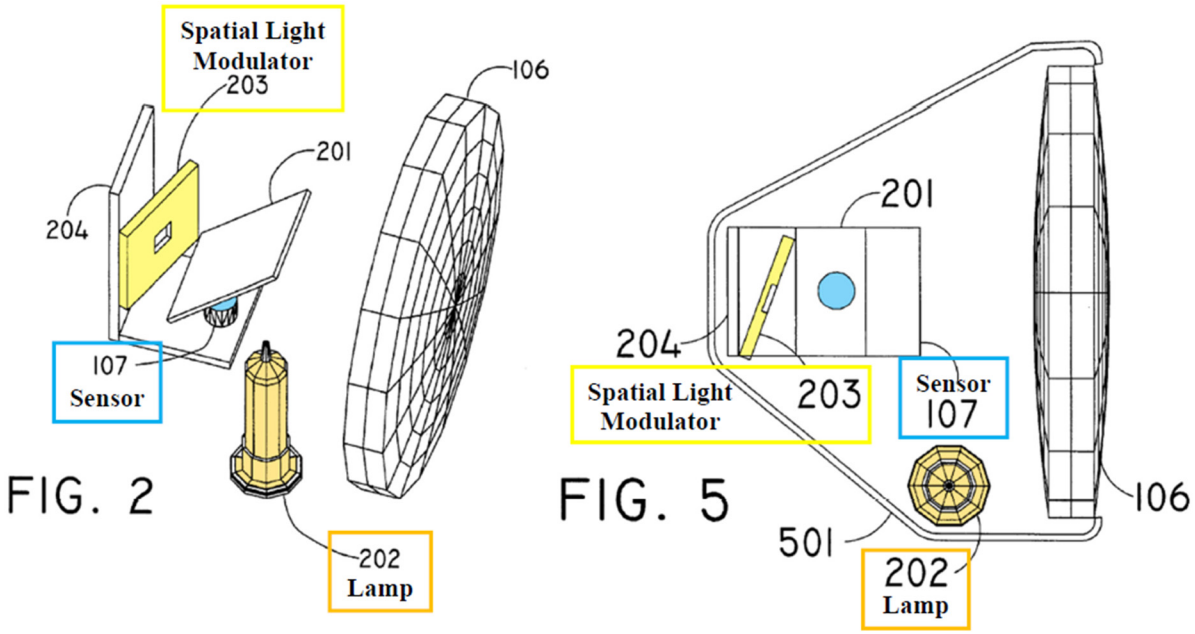
[5] Appendix B includes independent claim language.



EX1005, FIG. 1 (annotated).

3. [20.2]

As discussed, Beam discloses [20.2]. *Supra* Section VI; EX1003, ¶¶146-149; EX1005, 4:26-59, 5:3-21, 5:61-63, 8:4-17, FIGS. 2, 4-6.



EX1005, FIGS. 2, 5 (annotated).

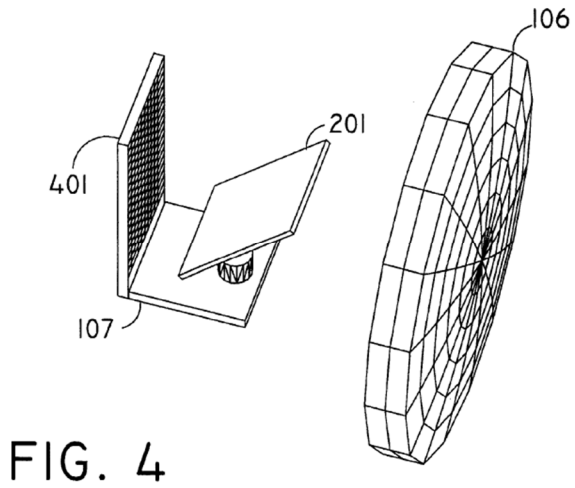


FIG. 4

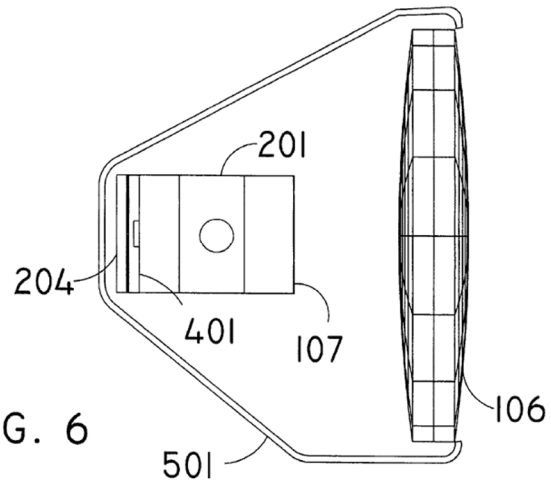
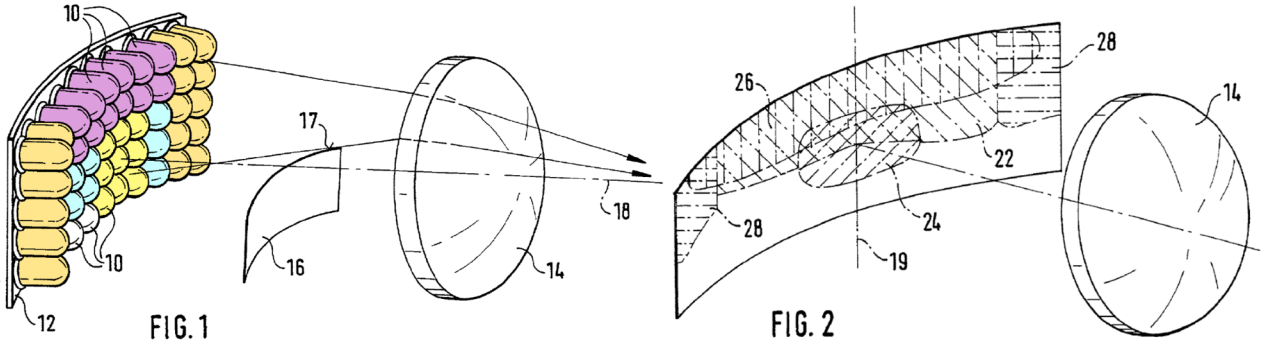


FIG. 6

EX1005, FIGS. 4, 6.

If Patent Owner argues, incorrectly, that Beam does not disclose [20.2], it would have been obvious in view of Thominet. EX1003, ¶150. A POSA would have been motivated to combine Thominet with Beam with a reasonable expectation of success. *Supra* Section VI.A; EX1003, ¶¶152-170.

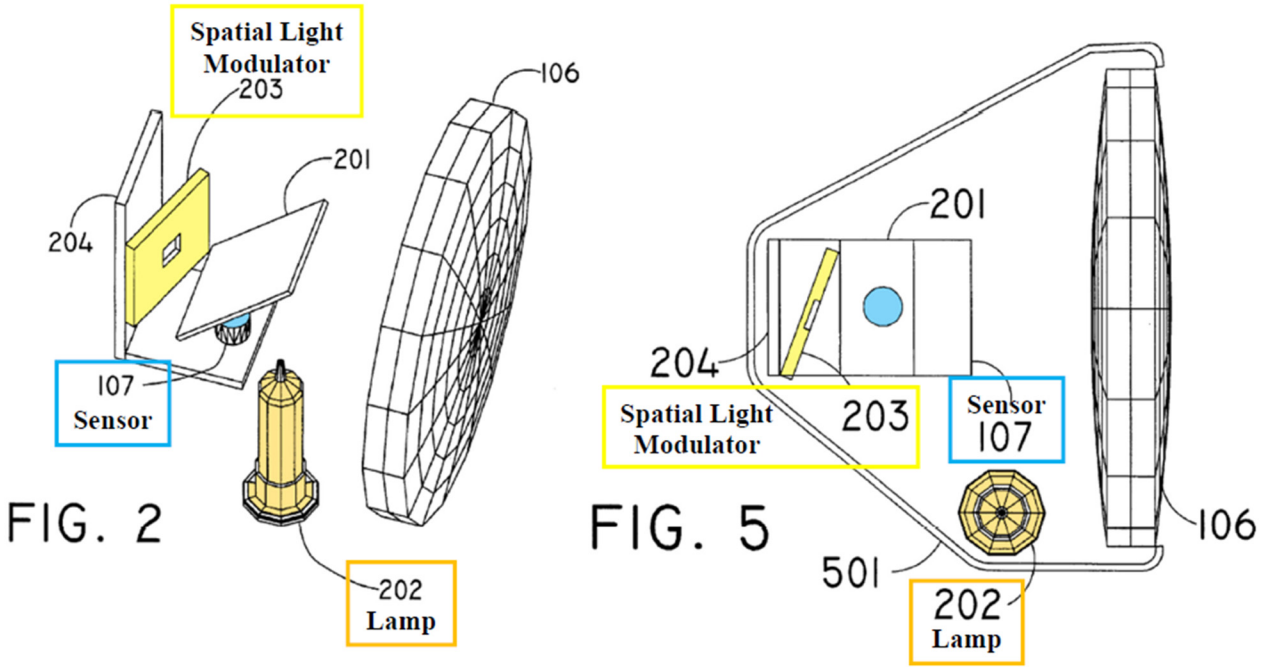
Thominet's headlights include directional, independently controllable semiconductor light sources 10 (e.g., LEDs) arranged on curved surface 12 to provide beam regions 22, 24, 26, 28 with different angles/aimings for different functions. EX1006, ¶¶17-18, 21-26, FIGS. 1-2; EX1003, ¶151. For example, Thominet's region 24 is "in the center" (first angle/aiming) and regions 28 are "near the lateral edges" (second and third angles/aimings). EX1006, ¶¶23, 25, FIGS. 1-2; EX1003, ¶151.



EX1006, FIGS. 1-2 (annotated).

4. [20.3]

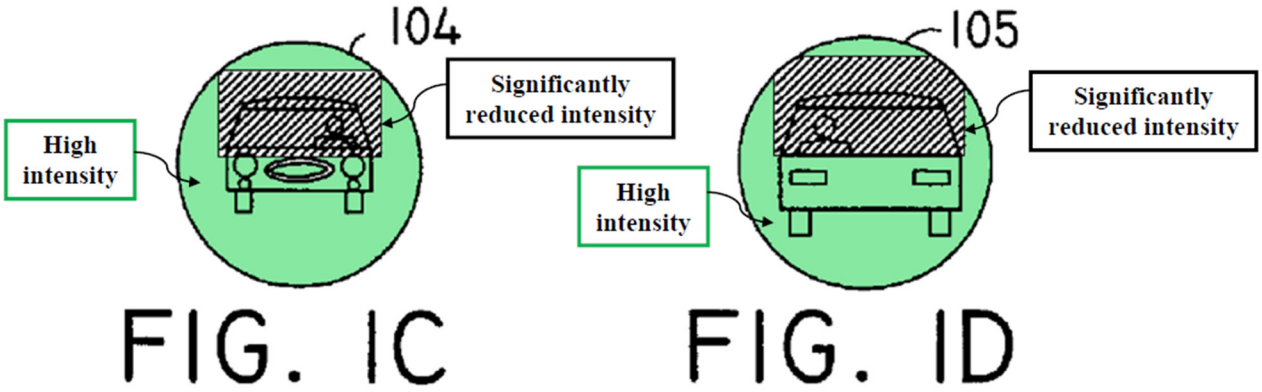
Beam discloses controlling "the *intensity*, and/or the *angular position*" of the microbeams. EX1005, Abstract, 1:6-8 ("*reformatting the pattern*"), 1:13-18 ("*darken those microbeams*"), 4:26-59, 5:17-21; EX1003, ¶¶171-172. Both "intensity" and "angular position" are "controllable light characteristics." EX1003, ¶¶171-172; *see* EX1001, 16:43-50, 2:28-30.



EX1005, FIGS. 2, 5 (annotated).

5. [20.4]

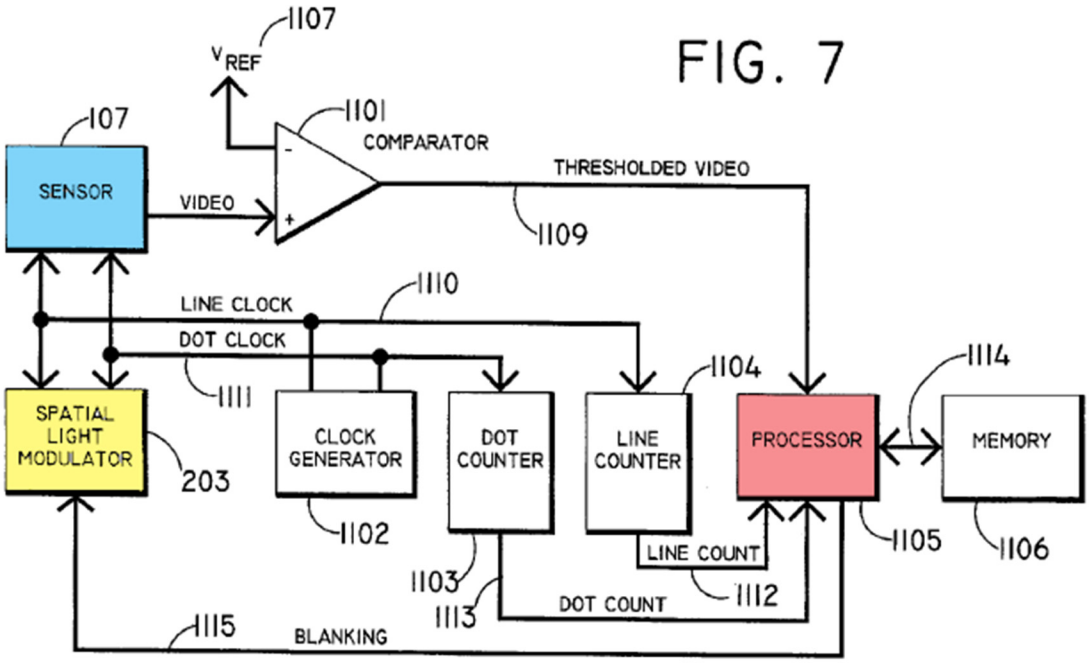
Beam discloses "controller 108…*determine[s]* which microbeams must be *reduced in intensity*" and "us[es] that information to control the intensity, and/or the *angular position*, of one or more narrow-angle microbeams." EX1005, 6:30-33, Abstract, FIGS. 1, 1C-1D, 2:59-3:3 ("area of the beam that would *dazzle* the driver will be *darkened,* while maintaining *f[u]ll intensity elsewhere*"), 5:46-54; EX1003, ¶¶173-174. As discussed, Beam-Thominet discloses "directional light sources aimed at different angles." *Supra* Section VI.B.3; EX1003, ¶¶146-149. Thus, Beam discloses light sources "at a first angle" (shaded area) and "at a second angle" (non-shaded area). EX1003, ¶¶173-174.



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

6. [20.5]

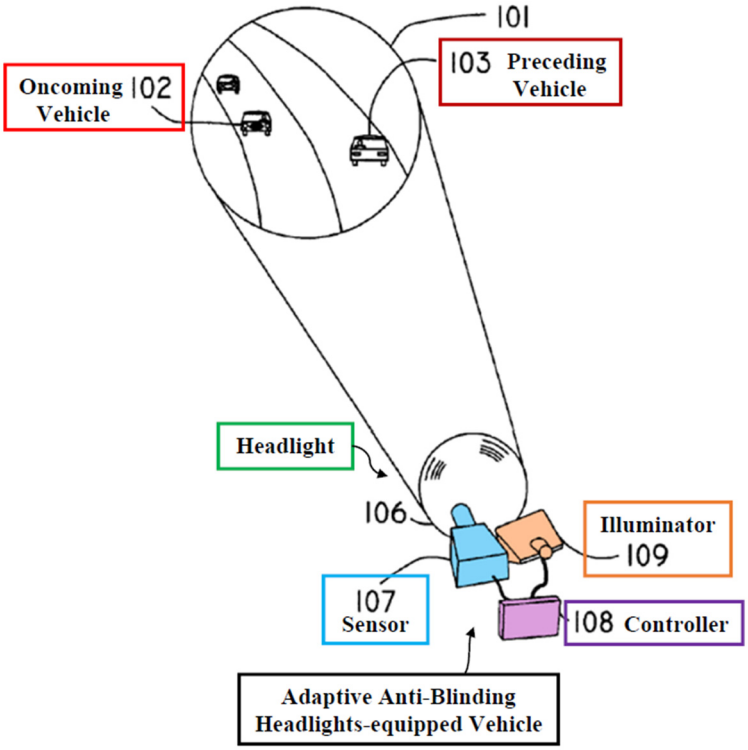
Beam discloses "controller module uses the sensor spatial data (video)…to *control the Illuminator*." EX1005, 5:46-54, FIGS. 1, 1C-1D, 7, 1:5-18 ("*reformatting* the *pattern*"), 6:30-33 ("*determine* which microbeams must be *reduced in intensity*"); EX1003, ¶¶175-177.



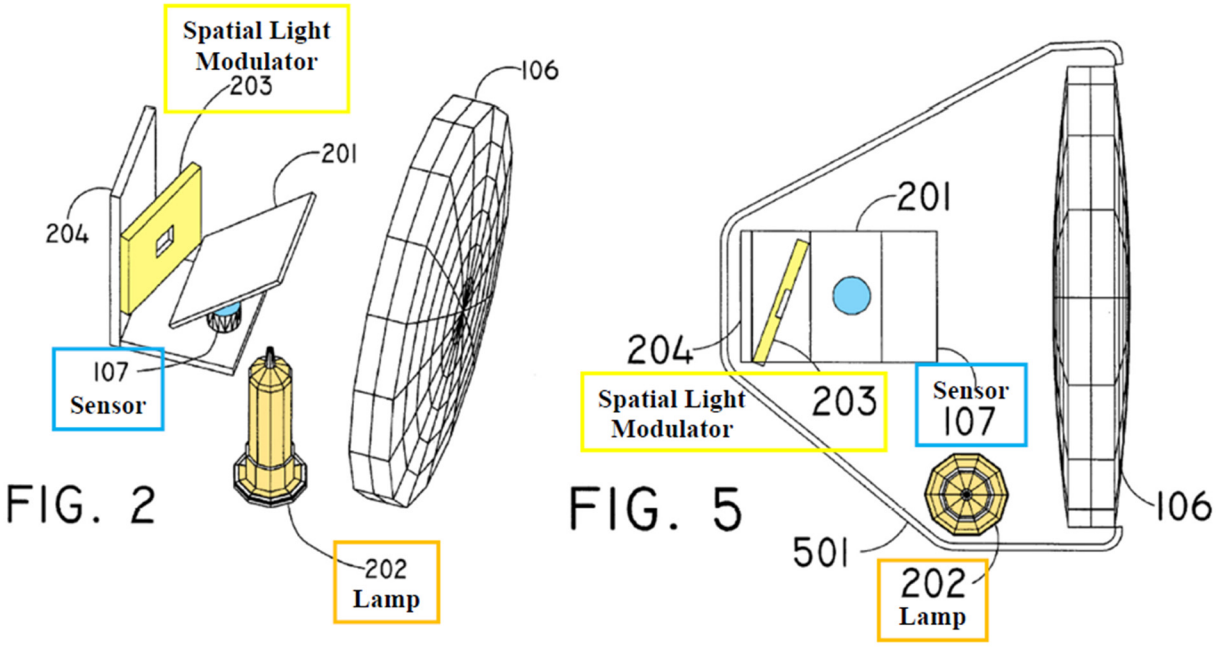
EX1005, FIG. 7 (control circuitry) (annotated).

7. [20.6]

Beam discloses that *sensor 107* detects the headlights/taillights of an oncoming/preceding vehicle 102, 103. EX1005, 4:10-25, FIGS. 1-2, 5, 6:12-14 ("imaging *sensor*"), 4:26-36; EX1003, ¶¶178-179.



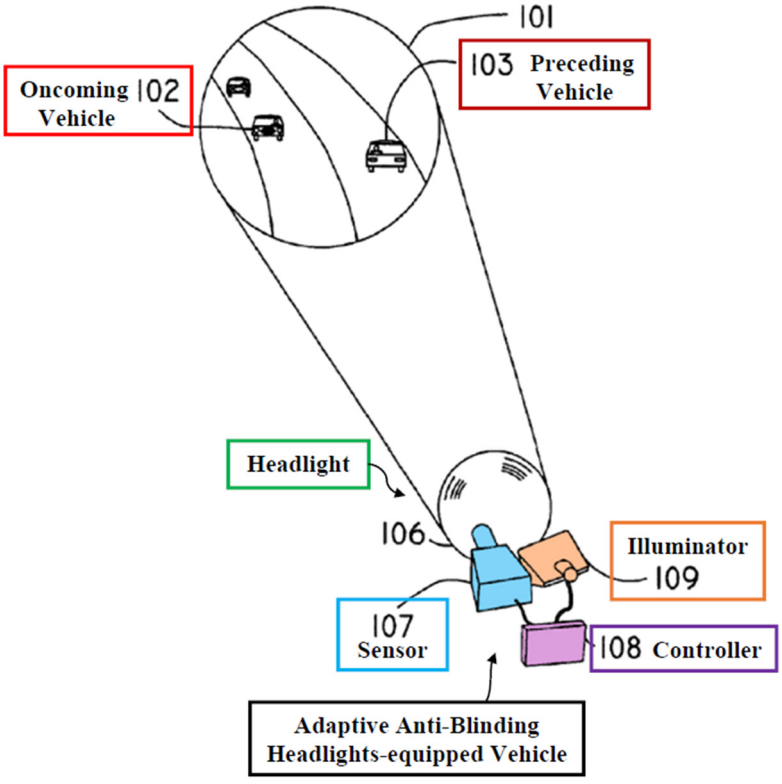
EX1005, FIG. 1 (annotated).



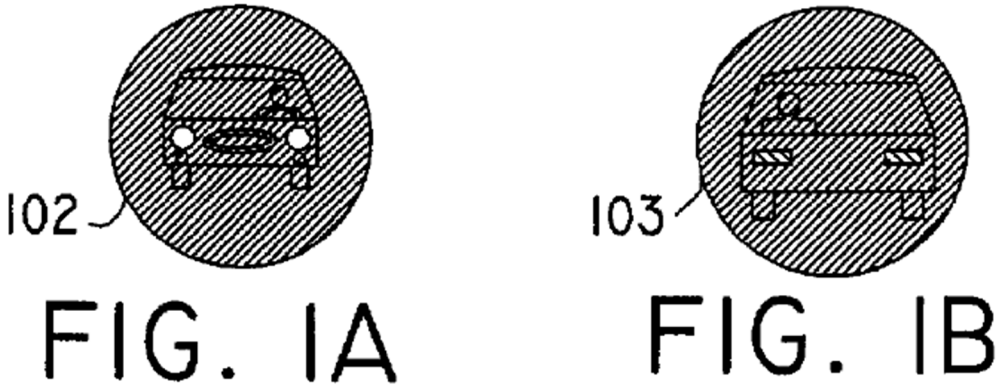
EX1005, FIGS. 2, 5 (annotated).

8. [20.7]

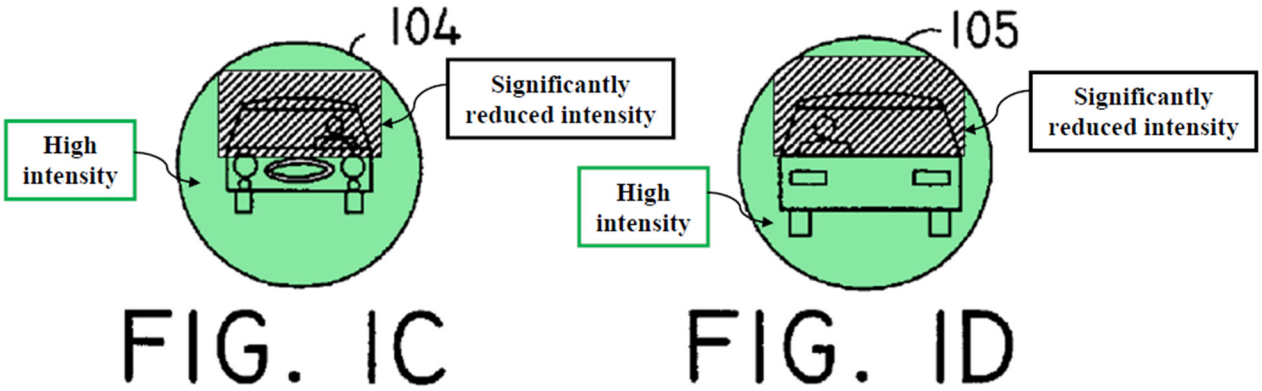
Beam discloses detecting headlights/taillights of an oncoming/preceding vehicle 102, 103 in a field-of-view 101. EX1005, 4:10-25, FIGS. 1, 1A-1B, 6:14-16 ("*determine[s]* whether there are *illumination sources* (headlights or tail lights) present"). The sensor spatial data (oncoming/preceding traffic) is pertinent to determining illumination output because Beam "tracks the location of the…vehicle" and uses the sensor spatial data "to determine the locations to be blanked." *Id*., 5:46-54, 6:11-27, FIGS. 1, 1C-1D, 7; EX1003, ¶¶180-181.



EX1005, FIG. 1 (annotated).



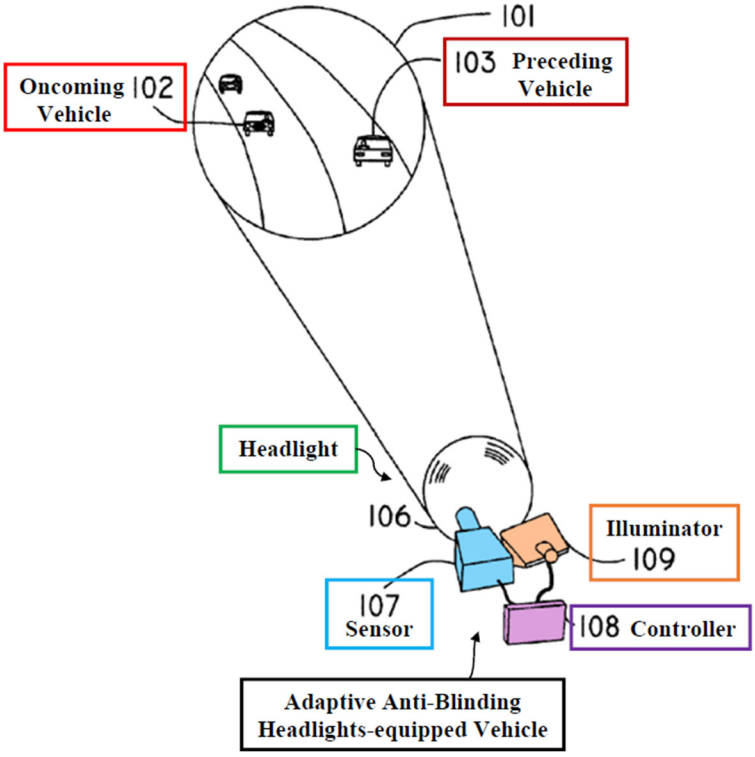
EX1005, FIGS. 1A-1B.



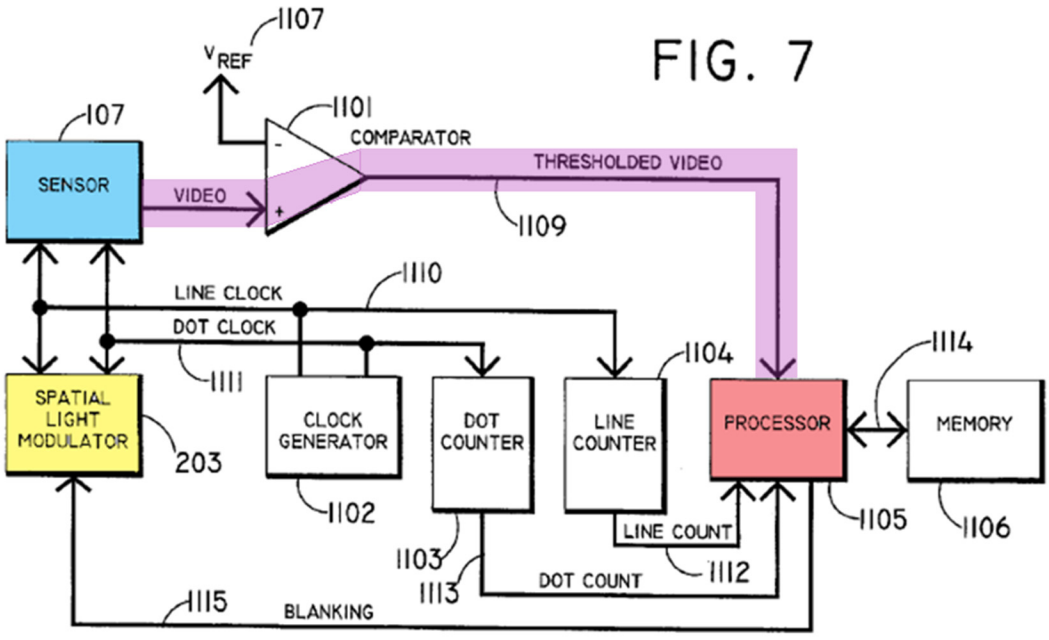
EX1005, FIGS. 1C-1D (annotated).

9. [20.8]

Beam discloses "data from sensor 107 are input to a controller 108" (communicated to a processor) and "*spatial scene data* from sensor 107…becomes the input to *a processor 1105*." EX1005, 4:16-19, 5:33-54, 5:61-65, FIGS. 1, 7; EX1003, ¶¶182-183.



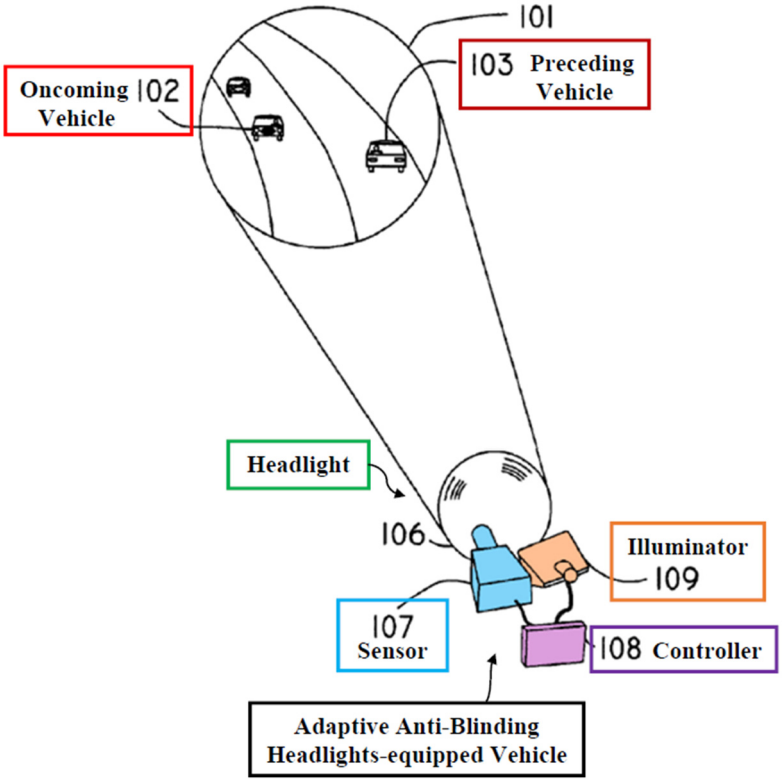
EX1005, FIG. 1 (annotated).



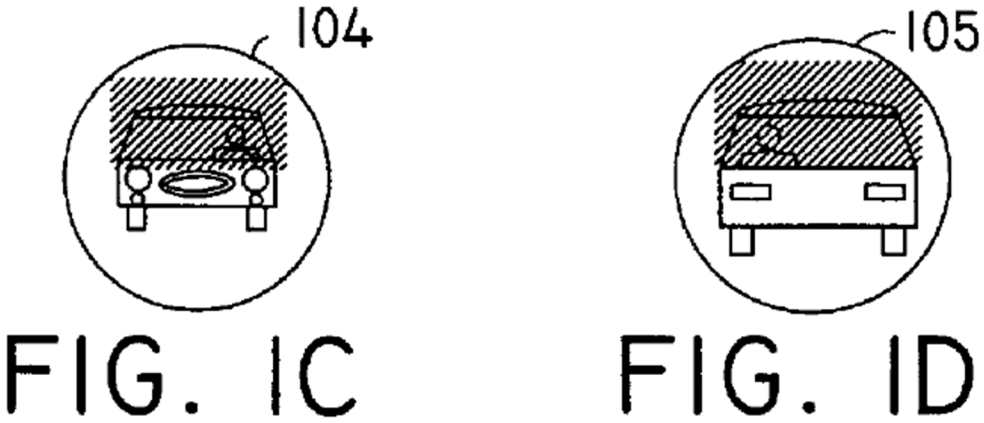
EX1005, FIG. 7 (annotated).

10. [20.9]

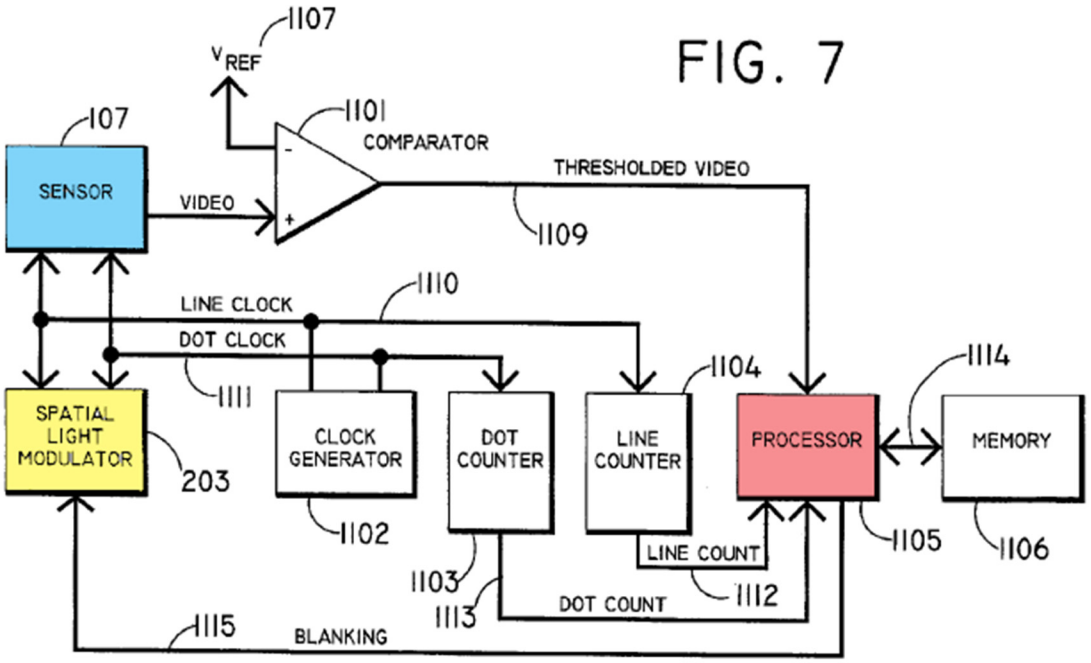
Beam discloses "*spatial scene data* from sensor 107…becomes the input to *a processor 1105*" and "*[p]rocessor 1105* uses appropriate algorithms on the incoming data to *determine the locations to be blanked*…outputs *blanking signals*…*commands* the appropriate pixels to be *reduced in intensity*." EX1005, 5:34-36, 5:46-54, FIGS. 1, 1C-1D, 7, Abstract, 6:14-16 ("headlight's *field-of-view*"), 5:65-6:2 ("a *dimmed area*…based on input to the sensor"); EX1003, ¶184. Thus, the processor processes the inputted spatial sensor data, determines/identifies a vehicle within the field-of-view, and determines/identifies an area to be dimmed within a subsection of the field-of-view (shaded area based on blanking signals). EX1005, 6:12-27, FIGS. 1C-1D, 5:33-54 ("*blanking* signals"), 6:24-27 ("blanked area *tracks* the location of the *oncoming vehicle*"); EX1003, ¶¶184-185.



EX1005, FIG. 1 (annotated).



EX1005, FIGS. 1C-1D.



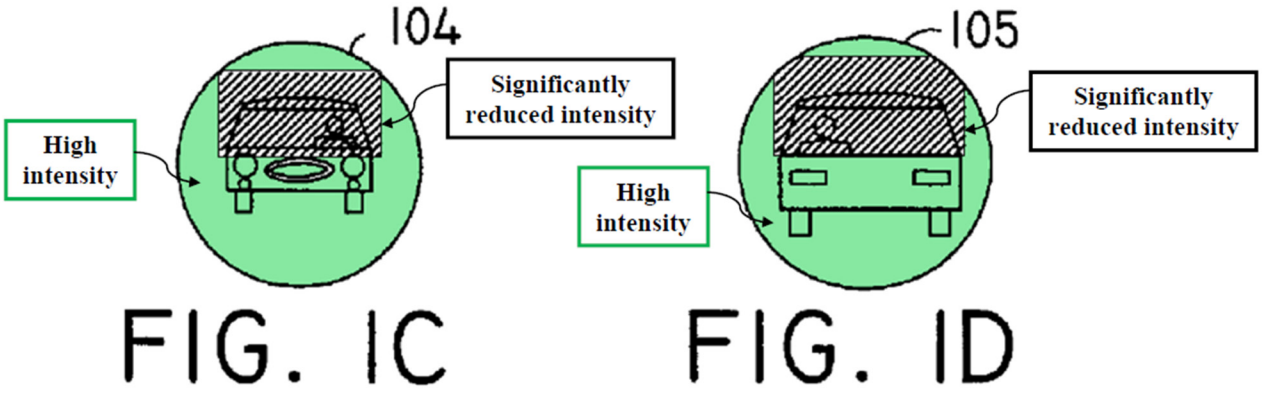
EX1005, FIG. 7 (annotated).

11. [20.10]

Beam discloses "*higher brightness beam* in the areas which *do not dazzle* the drivers ahead" and "the area…that would dazzle the driver will be darkened*, while maintaining f[u]ll intensity elsewhere*." EX1005, 3:19-24, 2:59-3:3, FIGS. 1, 1C-1D, 7, 6:40-44, 6:11-12, 1:5-18 ("eliminating the blinding of a driver in an oncoming vehicle, while continuing to provide *intense forward illumination*"); EX1003, ¶186.

As discussed, Beam discloses determining "a first subsection including a detected vehicle" (shaded area). *Supra* Section VI.B.10; EX1003, ¶184. Conversely, Beam's processor determines an area to *not* be dimmed within a second subsection of the field-of-view (non-shaded area based on non-blanking signals). EX1005,

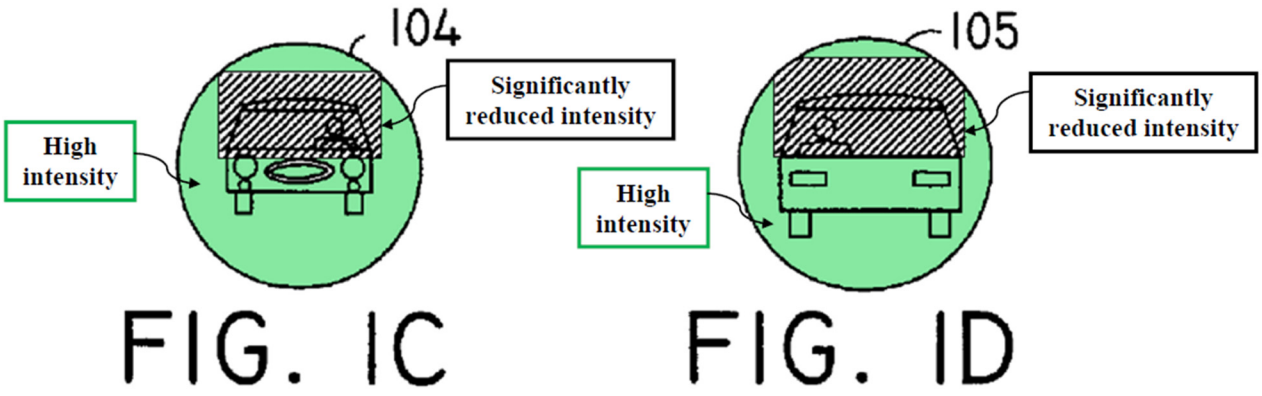
6:12-27, FIGS. 1C-1D, 7, 5:33-54 (each pixel of the X-Y matrix is evaluated by the line clock and dot clock to either be blanking or non-blanking), 4:45-48; EX1003, ¶184. Thus, Beam discloses determining "a second subsection not including the detected vehicle" (non-shaded area). EX1003, ¶187.



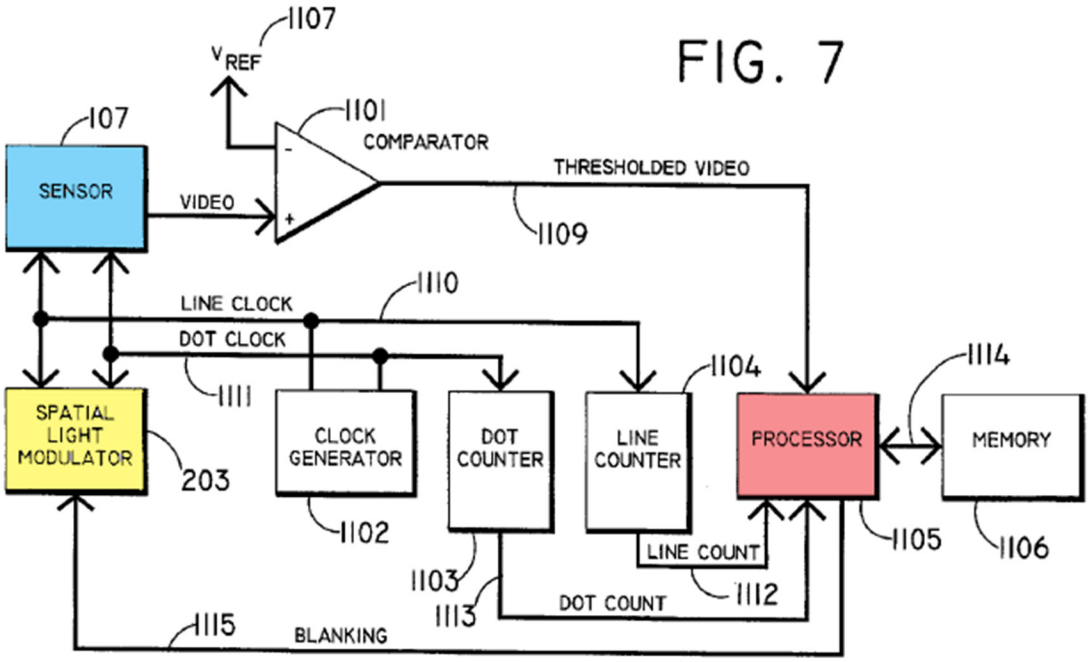
EX1005, FIGS. 1C-1D (annotated).

12. [20.11]

Beam discloses illuminating non-shaded areas "at *maximum* intensity" "like having bright *high beams*." EX1005, 6:30-33, 6:11-12, 6:40-44, FIGS. 1, 1C-1D, 7, 2:59-3:3 ("area of the beam that would dazzle the driver will be darkened, *while maintaining f[u]ll intensity elsewhere*"), 6:53-55; EX1003, ¶188. As discussed, Beam-Thominet discloses "differently aimed directional light sources." *Supra* Section VI.B.3; EX1003, ¶¶146-149. Thus, Beam discloses "maximiz[ing] vehicle operator visibility" in the second subsection (non-shaded area). EX1003, ¶189.



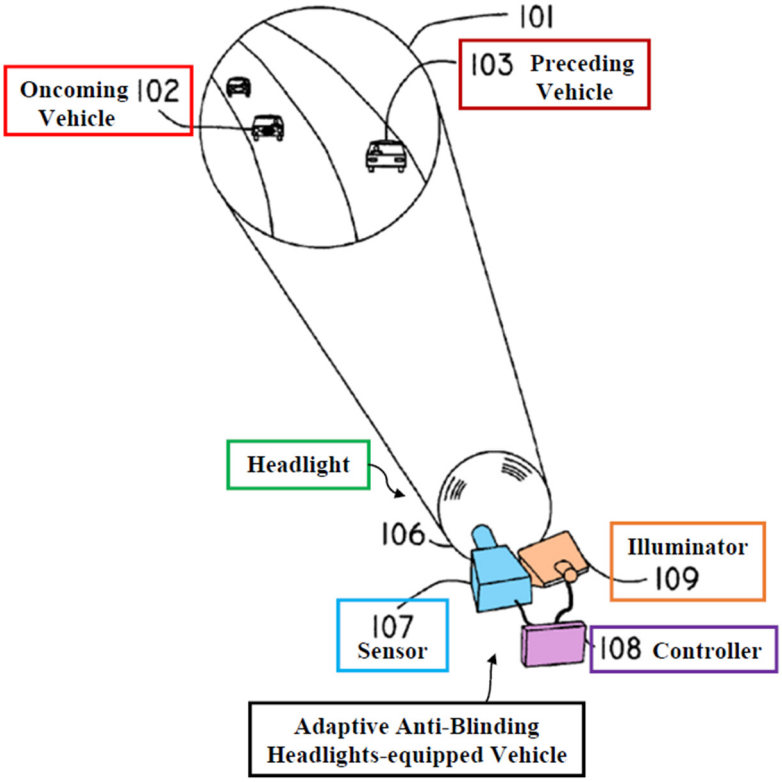
EX1005, FIGS. 1C-1D (annotated).



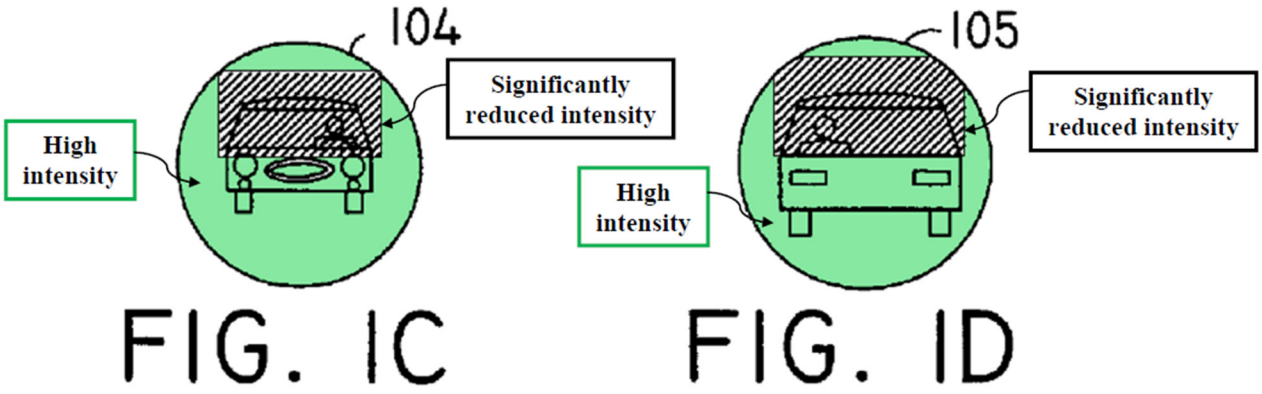
EX1005, FIG. 7 (annotated).

13. [20.12]

Beam discloses illumination in shaded areas is "*significantly less* than with current *low beams*." EX1005, 6:30-33, 2:59-3:3, FIGS. 1, 1C-1D, 7, Abstract, 4:21-25 ("*shaded areas* being *reduced significantly*"), 3:8-24; EX1003, ¶¶190-191. This "minimize[s] a disturbing effect" (glare) to other traffic. EX1003, ¶190.



EX1005, FIG. 1 (annotated).

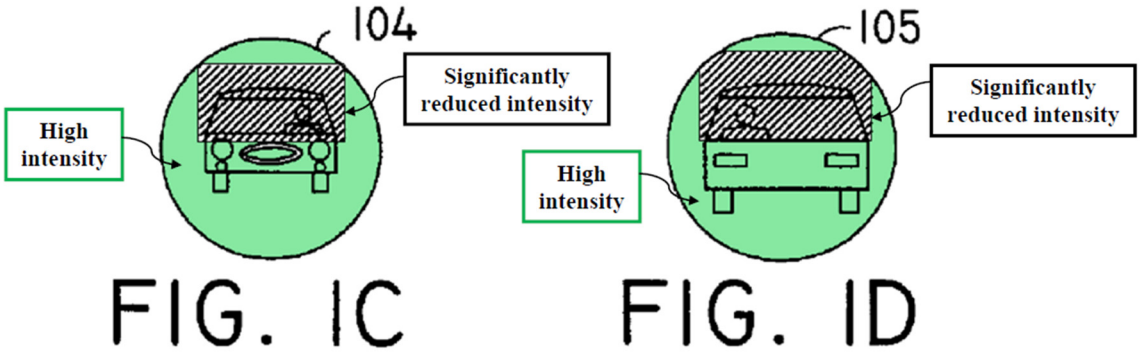


EX1005, FIGS. 1C-1D (annotated).

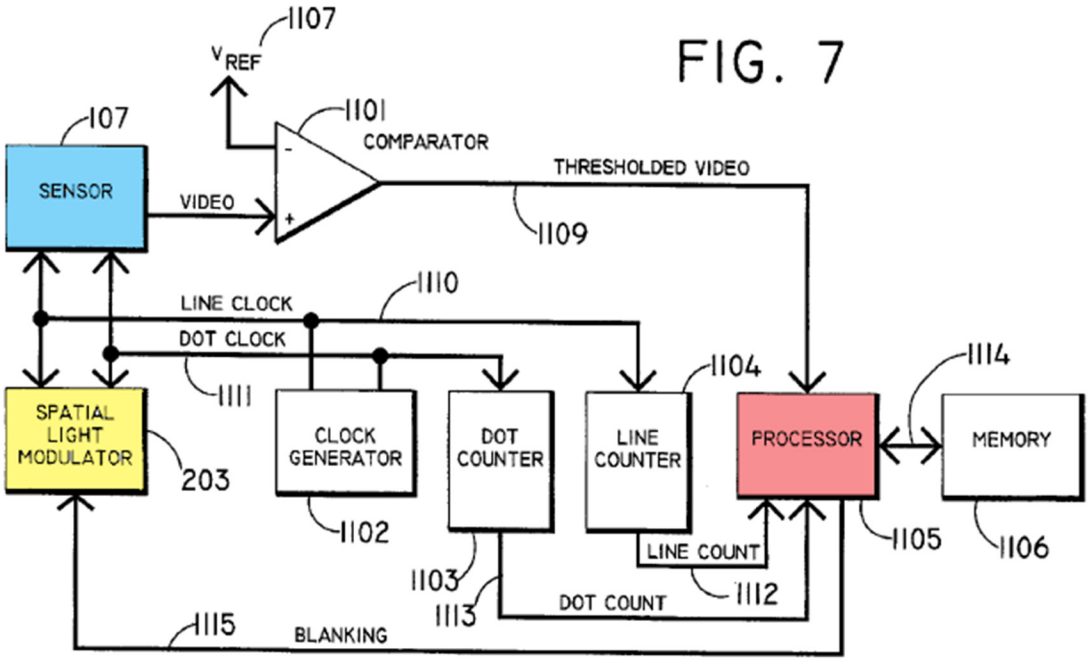
14. [20.13]

Beam discloses "*[p]rocessor…determine[s] the locations to be blanked*…outputs *blanking signals*…*commands* the appropriate pixels to be *reduced in intensity*." EX1005, 5:46-54, FIGS. 1, 1C-1D, 7, 6:14-27 ("controller module uses

the *sensor spatial data (video)*…to *control the Illuminator*"), 4:10-25 ("*determine* which microbeams must be *reduced in intensity*"), 1:5-18, 2:59-3:3 ("area of the beam that would dazzle the driver will be darkened, while maintaining f[u]ll intensity elsewhere"); EX1003, ¶192. Beam thus adjusts the light sources for "optimal use." EX1003, ¶193.



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



EX1005, FIG. 7 (annotated).

C. Claim 24[6]

Beam discloses the light source can include "light-emitting *diodes*" and "*lasers*." EX1005, 8:14-18, 5:3-16 ("*matrix of lasers*"). Thus, a POSA would have understood that Beam discloses "a laser diode." EX1003, ¶194.

Additionally, Thominet discloses "*laser diodes*." EX1006, ¶28, FIGS. 1-2; EX1003, ¶¶195-196. A POSA would have been motivated to combine Thominet with Beam with a reasonable expectation of success, since a laser diode would have been just a simple substitution of one known prior art element for another. *KSR*, 550 U.S. at 416-418; *supra* Section VI.A; EX1003, ¶¶197-198.

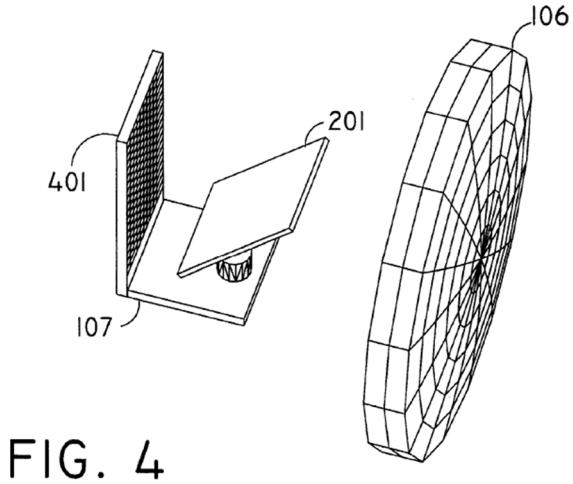


FIG. 4

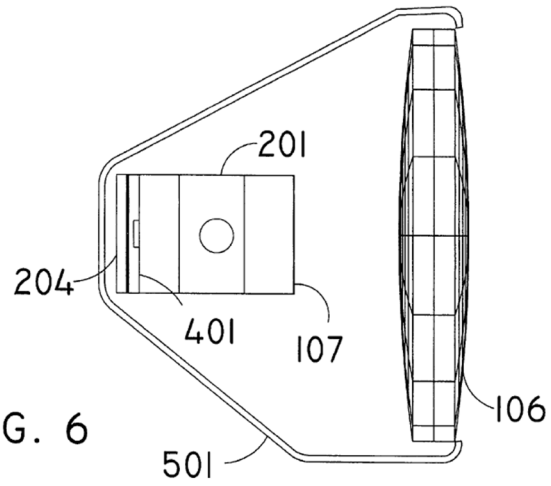


FIG. 6

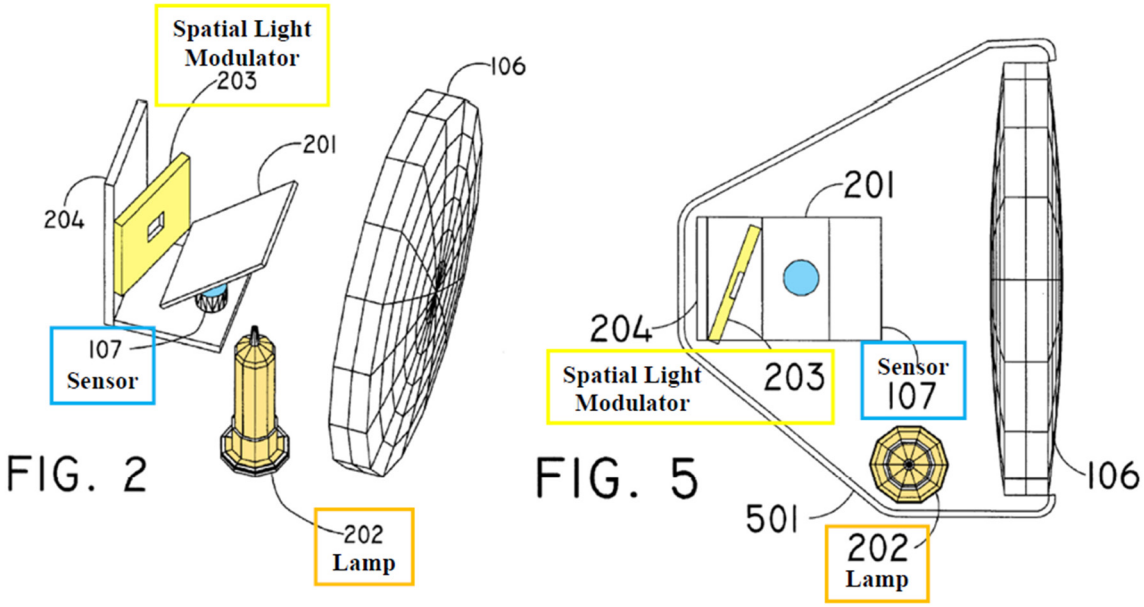
EX1005, FIGS. 4, 6.

D. Claim 25

Beam discloses "a *spatial light modulator*…digital mirror devices" and "an optical system 106" (e.g., a bi-convex lens). EX1005, 8:4-12, FIGS. 2, 5, 1:63-65

[6] Appendix B includes dependent claim language.

("a *reflector* or *lens*"), 4:10-59 ("*reflected* by a *beamsplitter 201*"), 5:17-21; EX1003, ¶¶199-201.



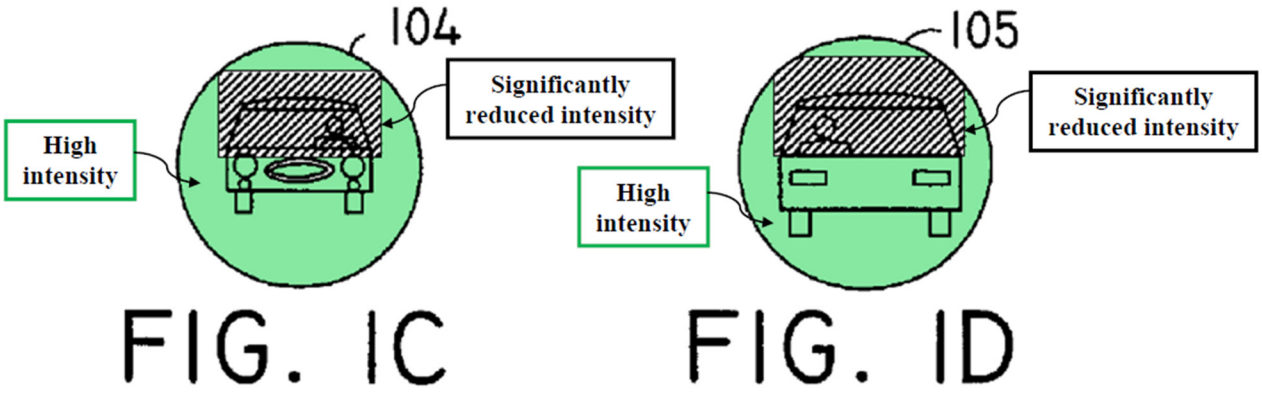
EX1005, FIGS. 2, 5 (annotated).

VII. GROUND 2: THE COMBINATION OF BEAM, THOMINET, AND STAM RENDERS OBVIOUS CLAIMS 59 AND 63-64.

It is Petitioner's position that Beam-Thominet explicitly or implicitly discloses every feature in claims 59 and 63-64. But to avoid doubt, Beam-Thominet is combined with Stam, for [59.9] and [59.11], which discloses a well-known feature of adaptive headlamps—outputting light above or below a predefined illuminance depending on the driving situation—rendering the claims obvious. EX1003, ¶202.

Beam discloses a "*default* illumination level will be the equivalent of today's *low beams*." EX1005, 6:30-33. Thus, Beam's system includes a "predefined" illuminance—a "low beam" illuminance. EX1003, ¶203. Further, illumination in

shaded areas is "*significantly less* than with current *low beams*" (significantly reduced intensity in shaded area is *below* Beam's predefined *low beam* illuminance: shaded illuminance < low beam illuminance); and illumination in non-shaded areas is "at *maximum* intensity" and "like having bright *high beams*" (high intensity in non-shaded area is *above* Beam's predefined *low beam* illuminance: non-shaded illuminance > low beam illuminance). EX1005, 6:30-33, 2:59-3:3, 6:11-12, 6:40-44, FIGS. 1, 1C-1D; EX1003, ¶¶204-205.



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

Thus, Beam discloses a "predefined" (low beam) illuminance and outputting illumination "below…[the] predefined illuminance" and "above…[the] predefined illuminance" (shaded < low beam < non-shaded) recited in [59.9] and [59.11]. EX1003, ¶206.

If Patent Owner argues, incorrectly, that Beam does not disclose [59.9] and [59.11], Stam does; and it would have been obvious to combine Stam with Beam-Thominet. *Id*., ¶¶207-208.

A. A POSA would have been motivated to combine Beam, Thominet, and Stam with a reasonable expectation of success.

As described in Section VI.A, a POSA would have been motivated to combine Beam-Thominet. As discussed, Beam discloses a "predefined illuminance" based on a low beam illuminance. EX1003, ¶¶209-210, 261. Stam provides a specific "predefined illuminance" value based on a dimmed illuminance to reduce glare. *Id*., ¶262. Naturally, it would have been obvious to a POSA designing an adaptive headlamp to implement Stam's predefined (dimmed) illuminance value in Beam-Thominet's system, to further control an intensity of Beam's directional microbeams to prevent glare, furthering the purpose of improving driver safety. *Id*., ¶¶209, 262, 265; EX1005, 3:8-14, 3:37-44, 5:33-54, 7:1-13.

Stam is from the same field—controllable headlamps with dynamic illumination—and includes the same building blocks (light sources, sensors, controllers). EX1003, ¶¶263-265. Like Beam-Thominet, driver visibility and safety is paramount in Stam. *Id*.; EX1005, 3:8-45, 5:33-54, 6:53-7:13; EX1007, 1:14-31, 1:25-27. In fact, Stam explains there are laws and regulations governing the amount of glare experienced by drivers and thus discloses techniques to reduce glare. EX1007, 1:14-31, 9:12-10:8, Abstract, 58:11-33; EX1003, ¶91.

First, including a predefined value for Beam-Thominet's controller—Stam's *technique* of predefined dimmed illuminance—would have further enhanced Beam-Thominet's system by outputting illuminance *relative to* the predefined value

(below or above), preventing glare to other vehicles and increasing illumination to other areas. EX1003, ¶262. *Second*, a POSA would have sought to incorporate this *known feature* of Stam (a predefined dimmed illuminance, *see* EX1007, Abstract, 1:14-31, 9:12-10:8) into Beam's system (with controller 108 and/or illuminator 109). EX1003, ¶262. This would have, like Stam, provided a specific "predefined" illuminance, below and above which to adjust illumination for desired areas, further improving safety. *Id.*

A POSA would have understood that a predefined value for Beam-Thominet's controller/illuminator based on Stam's predefined dimmed illuminance (0.1 fc within 700 ft), would have provided greater illumination control *referenced to* a predefined value to prevent glare and increase illumination to other areas, thereby improving driver safety. *Id*., ¶266. This would have merely been applying Stam's *known technique* (a predefined dimmed illuminance) to Beam-Thominet's similar, known device (dynamic headlamp with controllable beams), in the same way. *Id*., ¶266; *KSR*, 550 U.S. at 417. Stam's known technique is fully described along with its benefits (improved safety); thus, a POSA would have readily applied it to similar systems, such as Beam-Thominet's, in the same way. EX1003, ¶266; *KSR*, 550 U.S. at 419-421.

Additionally, or alternatively, this modification would have been simply combining prior-art elements (Beam-Thominet's adaptive, direction-controllable

headlamps and Stam's predefined dimmed illuminance) according to known methods (disclosed in Beam-Thominet and Stam) to yield predictable results (reduced glare, improving safety). EX1003, ¶267; *KSR*, 550 U.S. at 415-416.

A POSA would have had a reasonable expectation of success combining Beam-Thominet and Stam, for example, by simply storing a specific dimmed illuminance value (e.g., 0.1 fc within 700 ft) in memory of Beam-Thominet's controller/processor to output Beam's headlamp illumination below and above that value for respective illumination areas. EX1003, ¶268. This would have been routine and well within a POSA's skill due to the similarities in Beam-Thominet's and Stam's adaptive systems—their common components were well-known and there would have been no limitations for a POSA to make such a modification. *Id*., ¶¶269-270.

B. Independent Claim 59[7]

1. [59.P]

[59.P]/[20.P] are identical. *Supra* Section VI.B.1; EX1003, ¶¶211-212.

[7] Claims 59 and 20 recite many identical elements or elements that are so technically similar that corresponding elements are patentably indistinct, even where the claim elements may be worded slightly different. (*See* Appendix A.) Patentably indistinct elements are elements for which the same prior art disclosure is applicable; substantive differences are explained, if needed. EX1003, ¶¶211-290.

2. [59.1]

[59.1]/[20.1] are patentably indistinct. *Supra* Section VI.B.2; EX1003, ¶¶213-214.

3. [59.2]

[59.2]/[20.2] are patentably indistinct. *Supra* Section VI.B.3; EX1003, ¶215.

Thus, Beam, or combined with Thominet, discloses [59.2]. EX1003, ¶¶216-240.

4. [59.3]

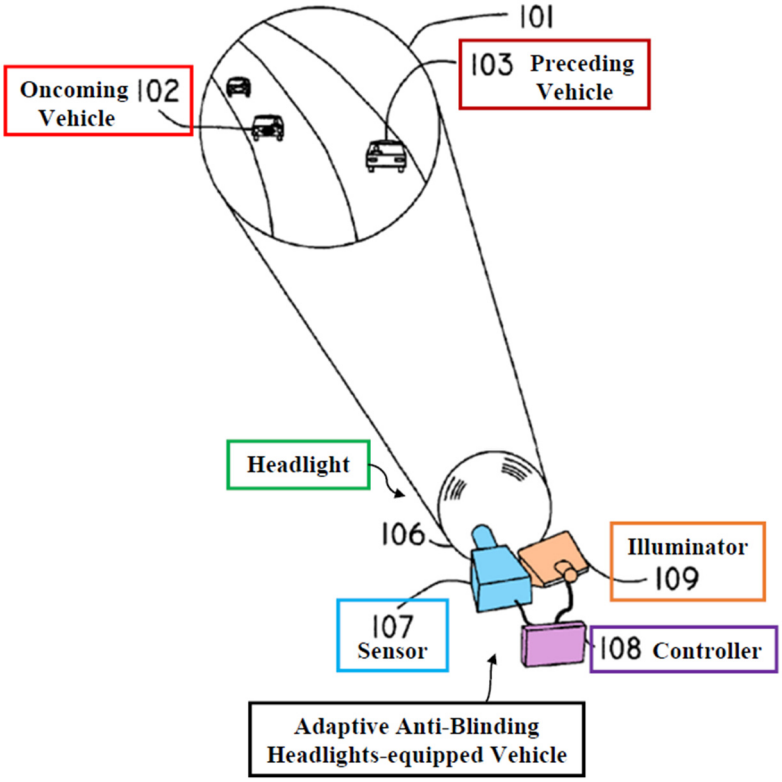
[59.3]/[20.3] are patentably indistinct. *Supra* Section VI.B.4; EX1003, ¶¶241-242.

5. [59.4]

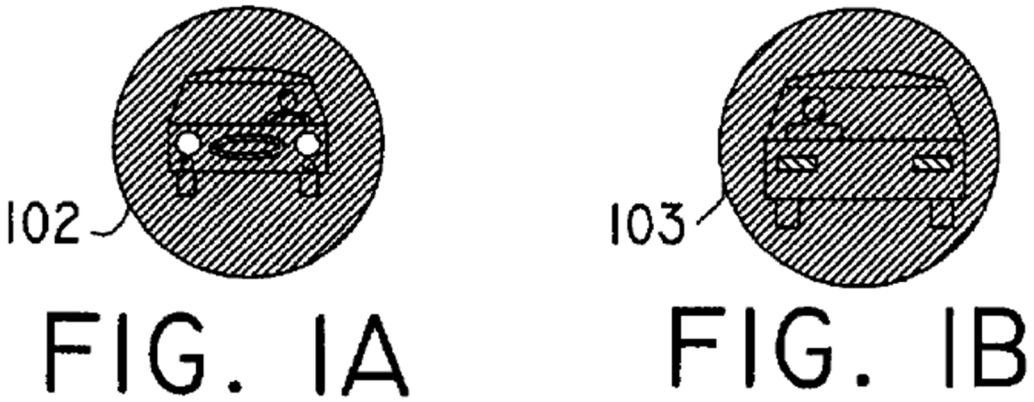
[59.4]/[20.6] are identical. *Supra* Section VI.B.7; EX1003, ¶¶243-244.

6. [59.5]

[59.5]/[20.7] are similar. *Supra* Section VI.B.8; EX1003, ¶245. Beam discloses detecting headlights/taillights of an oncoming/preceding vehicle 102, 103 in a field-of-view 101. EX1005, 4:10-25, FIGS. 1, 1A-1B, 6:14-16 ("*determine[s]* whether there are *illumination sources* (headlights or tail lights) present"), 5:46-54, 6:11-27; EX1003, ¶245. Thus, the spatial sensor data identifies a vehicle within the headlight's field-of-view (e.g., shaded area). *Id*., 5:33-54, 6:12-27, FIGS. 1A-1D, 6:24-27; EX1003, ¶¶245-246.



EX1005, FIG. 1 (annotated).



EX1005, FIGS. 1A-1B.

7. [59.6]

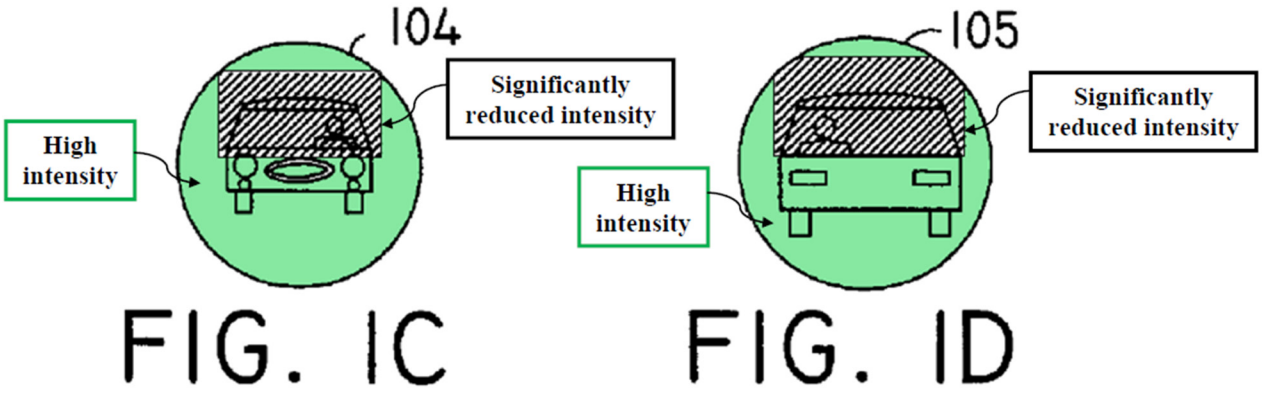
[59.6]/[20.8] are patentably indistinct. *Supra* Section VI.B.9; EX1003, ¶¶247-248.

8. [59.7]

[59.7]/[20.9] are patentably indistinct. *Supra* Section VI.B.10; EX1003, ¶¶249-250.

9. [59.8]

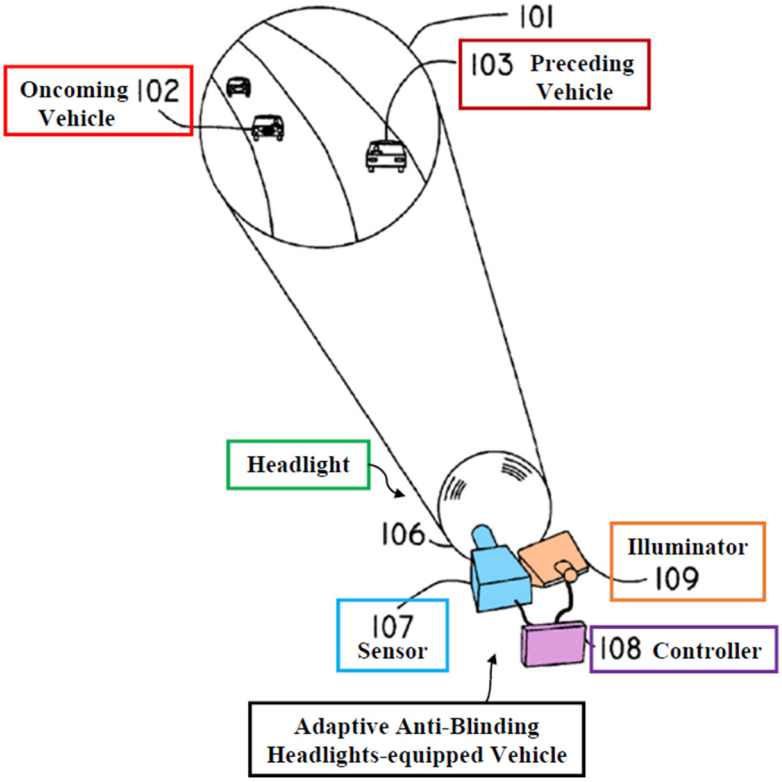
Beam discloses illumination in shaded areas is "*significantly less* than with current *low beams*." EX1005, 6:30-33, 2:59-3:3, FIGS. 1, 1C-1D, 7, Abstract, 4:20-25 ("*shaded areas* being *reduced significantly*"), 3:8-23; EX1003, ¶¶251-252. This "aims illumination at the first subsection" (shaded area) to prevent glare to other traffic. EX1003, ¶251.



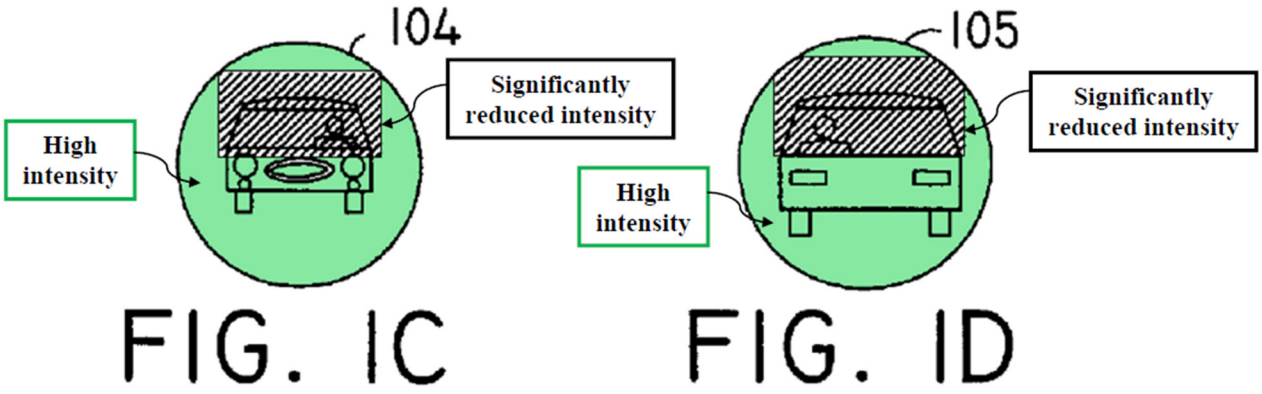
EX1005, FIGS. 1C-1D (annotated).

10. [59.9]

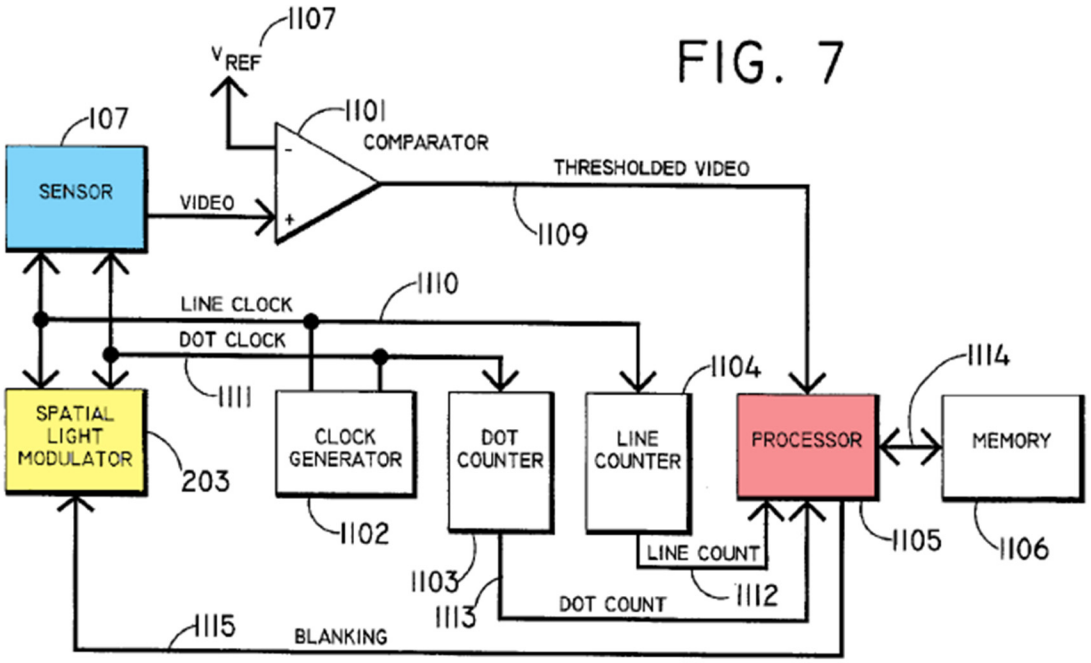
As discussed, Beam discloses [59.9]. *Supra* Section VII; EX1003, ¶¶253-254; EX1005, 6:30-33, 2:59-3:3, Abstract, 4:20-25, FIGS. 1, 1C-1D, 7.



EX1005, FIG. 1 (annotated).



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



EX1005, FIG. 7 (annotated).

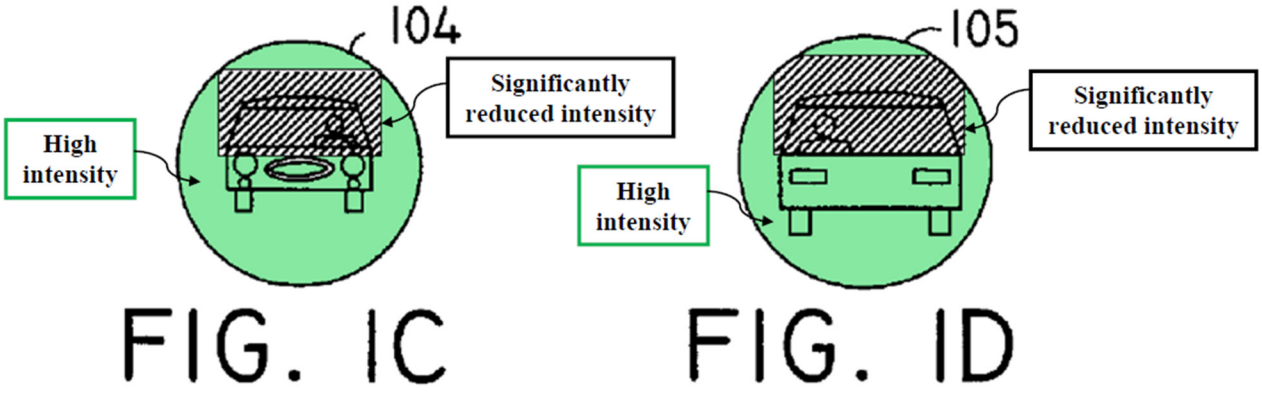
If Patent Owner argues, incorrectly, that Beam-Thominet does not disclose [59.9], Stam does. EX1003, ¶255.

Stam discloses laws and regulations limit the amount of glare experienced by drivers (a glare tolerance level or "perceived brightness") and "to *avoid* an illuminance of *0.1 foot candles (fc)* incident on another vehicle…high beam headlamps should be *dimmed within 700 feet* of another vehicle." EX1007, 1:27-32, Abstract, 1:14-31, 9:12-10:8, FIG. 11; EX1003, ¶256. Thus, Stam defines a "predefined" (dimmed) illuminance value: 0.1 fc within 700 ft (1.1 lux within 700 ft), corresponding to the "predefined illuminance." EX1003, ¶¶256-259. And a POSA would have been motivated to combine Stam with Beam-Thominet with a reasonable expectation of success. *Supra* Section VII.A; EX1003, ¶¶260-269.

Thus, the combined Beam-Thominet-Stam system would illuminate the first subsection (e.g., shaded area) "below a first predefined illuminance." *Supra* Section VII.A; EX1003, ¶270.

11. [59.10]

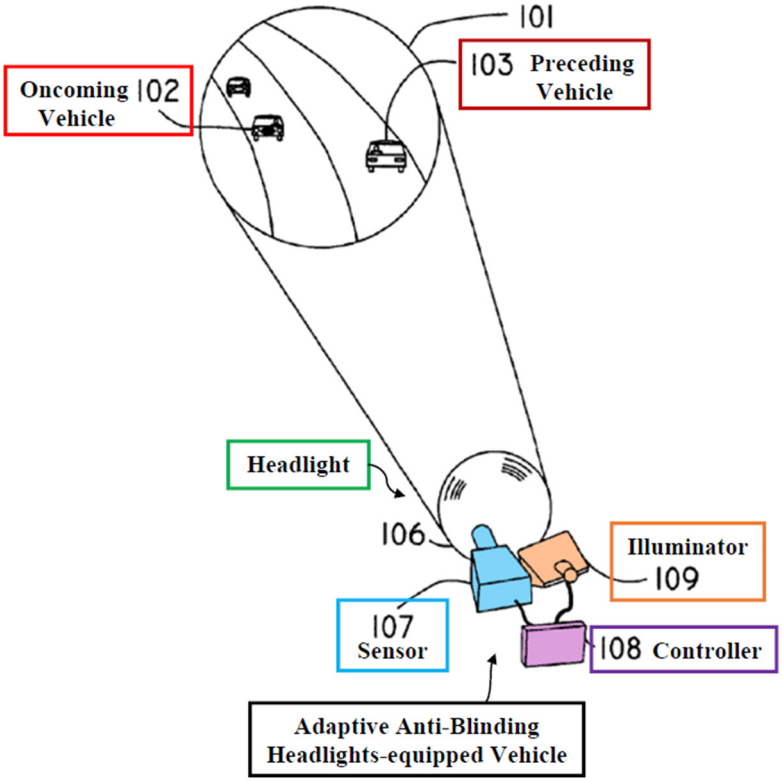
Beam discloses "*higher brightness beam* in the areas which *do not dazzle* the drivers ahead" and "the area…that would dazzle the driver will be darkened*, while maintaining f[u]ll intensity elsewhere*." EX1005, 3:19-24, 2:59-3:3, FIGS. 1, 1C-1D, 7, 6:40-44 ("*bright high beams*"), 6:11-12 ("*maximum intensity*"), 1:5-18 ("eliminating the blinding of a driver in an oncoming vehicle, while continuing to provide *intense forward illumination*"), 6:53-56; EX1003, ¶271. Beam thus "aims" the illumination at the different subsections. EX1003, ¶272.



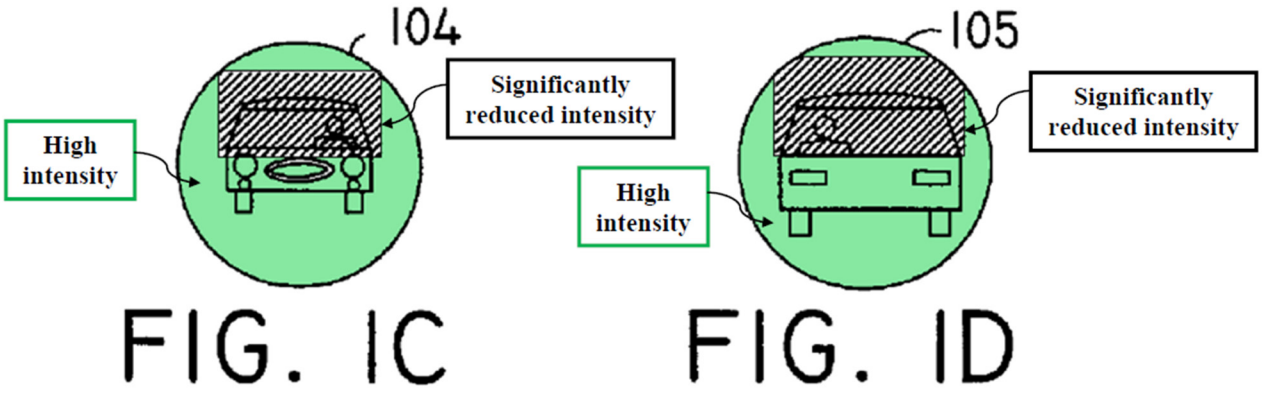
EX1005, FIGS. 1C-1D (annotated).

12. [59.11]

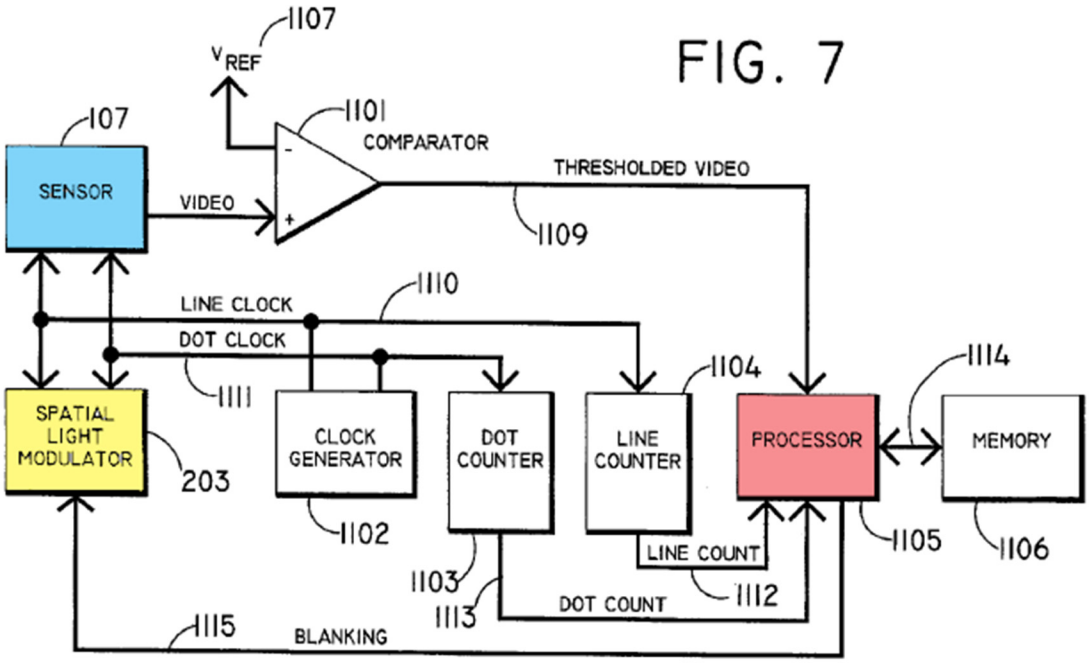
As discussed, Beam discloses [59.11]. *Supra* Section VII; EX1003, ¶273; EX1005, 6:11-56, 2:59-3:3, FIGS. 1, 1C-1D, 7.



EX1005, FIG. 1 (annotated).



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



EX1005, FIG. 7 (annotated).

If Patent Owner argues, incorrectly, that Beam-Thominet does not disclose [59.11], Stam does. EX1003, ¶274.

Stam discloses "to *avoid* an illuminance of *0.1 foot candles (fc)*…high beam headlamps should be *dimmed within 700 feet*." EX1007, 1:14-32, Abstract, 9:12-10:8, FIG. 11; EX1003, ¶¶275-278. Thus, Stam defines a "predefined" (dimmed) illuminance value: 0.1 fc within 700 ft (1.1 lux within 700 ft). EX1003, ¶275. And a POSA would have been motivated to combine Stam with Beam-Thominet with a reasonable expectation of success. *Supra* Section VII.A; EX1003, ¶¶279-287.

Thus, the combined Beam-Thominet-Stam system would illuminate the second subsection (non-shaded area) "above the first predefined illuminance." *Supra* Sections VII.A, VII.B.11; EX1003, ¶288.

13. [59.12]

[59.12]/[20.13] are patentably indistinct. *Supra* Section VI.B.14; EX1003, ¶¶289-290.

C. Claim 63

Claims 63 and 24 are identical. *Supra* Section VI.C; EX1003, ¶¶291-292.

D. Claim 64

Claims 64 and 25 are patentably indistinct. *Supra* Section VI.D; EX1003, ¶¶293-295.

VIII. GROUND 3: THE COMBINATION OF BEAM, THOMINET, AND KOBAYASHI RENDERS OBVIOUS CLAIMS 21-23.

A. A POSA would have been motivated to combine Kobayashi with Beam-Thominet with a reasonable expectation of success.

As described in Section VI.A.1, a POSA would have been motivated to combine Beam-Thominet. EX1003, ¶¶296, 303-305. A POSA would have been further motivated to modify Beam-Thominet to adjust light based on map data including road curvature, as in Kobayashi, to further control Beam's directional microbeams to illuminate roadway curves, thereby improving visibility and driver safety—an express purpose of Beam-Thominet. *Id*., ¶¶296, 303-305; EX1005, 3:8-14, 3:37-44, 5:33-54, 7:1-13; EX1006, ¶¶8 ("over a *curve*"), 25 ("region 28…when the vehicle drives over a *curve* or during a *bending* process"), FIGS. 1B, 2.

Beam-Thominet and Kobayashi are from the same field—controllable headlamps with dynamic illumination—and include the same building blocks (light

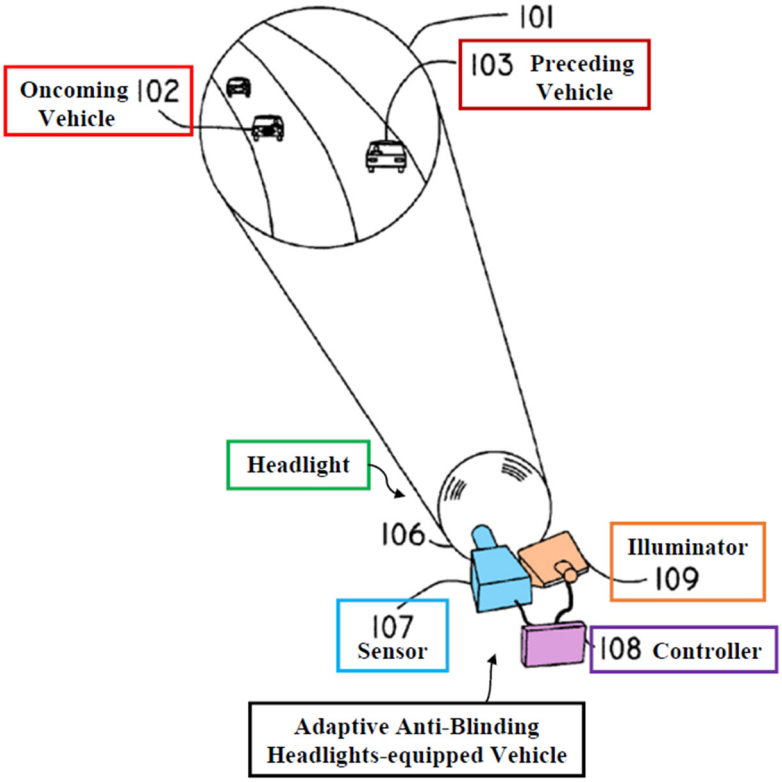
sources, sensors, controllers). EX1003, ¶307. Further, driver safety is paramount. *Id*.; EX1005, 5:33-54, 3:8-45, 6:53-7:13; EX1008, 15:6-28.

First, including an additional data source for Beam-Thominet's controller—Kobayashi's *known technique* of using map data including road curvature—would have enhanced Beam-Thominet by increasing/adjusting illumination based on road curvature or a planned turn, 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/or vehicle advancing direction prediction means 3 (including GPS navigation device 29, *see* EX1008, Abstract, 1:10-2:35, 4:60-64, FIGS. 1, 10, 12) into Beam-Thominet. EX1003, ¶306. This would have, like Kobayashi, provided road curvature data for Beam's detected scene 101, allowing Beam-Thominet's system to increase illumination toward the road curvature, further improving safety. *Id*., ¶308.

Beam "*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" microbeams. EX1005, Abstract, 4:16-19. Control is "*dynamically varying* in position and in size," in response to the input. *Id*., 6:24-27, 5:46-54; EX1003, ¶309. Beam recognizes safety benefits of prior systems that control headlamps in response to the vehicle's position (tilt on a hill) and steering mechanism (along a curve)—noting that more active systems decrease the compromise between

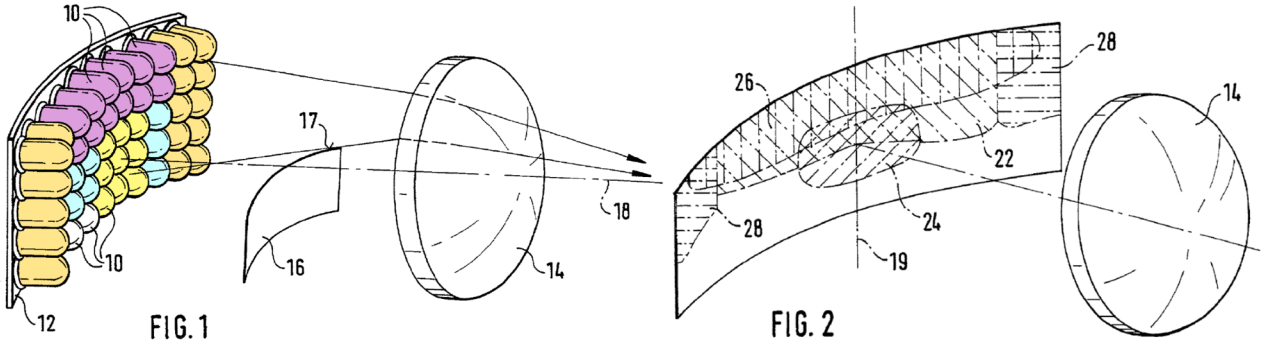
"reducing glare and providing enough light to the driver for adequate visibility."

EX1005, 1:60-2:6, 2:15-22; EX1003, ¶309.



EX1005, FIG. 1 (annotated).

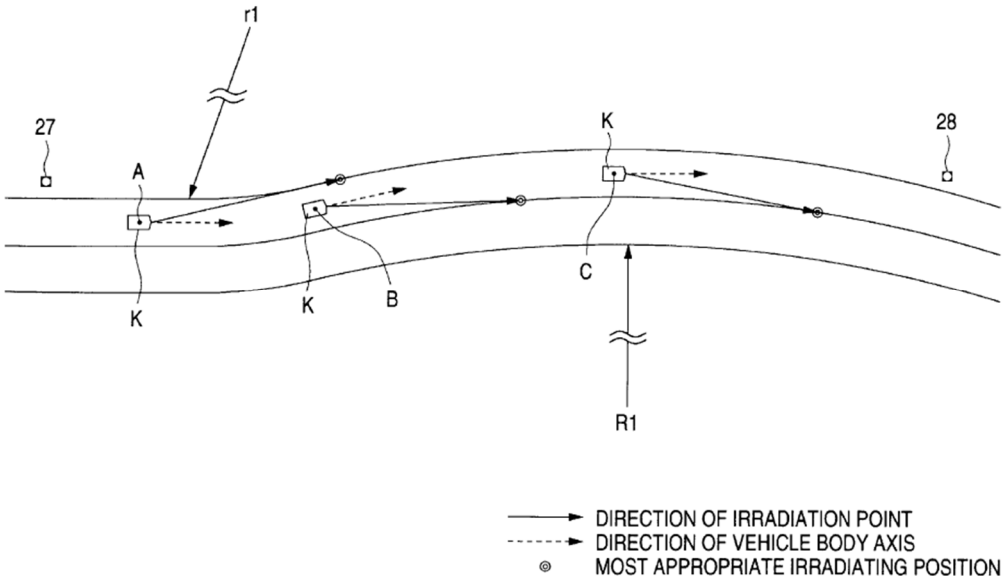
Furthermore, Thominet expresses the importance of illuminating "one side…to the right or to the left…during *d[r]iving over a curve* or…a *bending*" with directional light sources (region 28) to provide illumination in the "traveling direction." EX1006, ¶¶8, 25, FIGS. 1B-2; EX1003, ¶296.



EX1006, FIGS. 1-2 (annotated).

Beam-Thominet does not disclose details on how to detect curves, but this was well-known in the art and it would have been obvious to a POSA to do so. EX1003, ¶¶299, 310. This would have made Beam-Thominet more active than prior systems, as Beam seeks to do (EX1005, 2:15-22), and further achieves Beam's purpose of improving driver safety. EX1003, ¶310; EX1005, 3:8-45, 6:53-7:13. Kobayashi's active *techniques and system components*, like Beam-Thominet, seek to enhance driver safety—using map data-based control including road curvature. EX1008, 15:6-28; EX1003, ¶310. Kobayashi's road profile calculating means 2 and/or vehicle advancing direction prediction means 3 are inputs to control means 4, which alters the light direction from headlamp 5 in response to map data including road curvature input, enhancing safety. EX1008, 3:9-50, 6:4-62, FIG. 1, 15:6-28 ("safety of driving can be enhanced"); EX1003, ¶311. Kobayashi's system responds to real-world conditions, multiple curves, and intersections. EX1008, 11:34-14:52, 17:41-50; EX1003, ¶311.

Kobayashi's Figure 10 shows illumination control can be planned and controlled for multiple curves. EX1003, ¶312. When vehicle K turns left (point A), the light illuminates the left shoulder. Likewise, when vehicle K turns right on a subsequent curve (point C), the light illuminates the right shoulder. EX1008, 14:53-15:28, 17:3-18:67, FIG. 12; EX1003, ¶312.



EX1008, FIG. 10.

Including an additional data source for Beam-Thominet's controller/processor—Kobayashi's map data including road curvature—would have enhanced Beam-Thominet by increasing illumination of road curvatures, thereby improving safety. EX1003, ¶313. This would have merely been applying Kobayashi's known technique (using map data including road curvature from GPS to shape/reshape light) to Beam-Thominet's similar, known device (dynamic headlamp system with controllable beams), in the same way. *Id*.; *KSR*, 550 U.S. at

417. Kobayashi's known technique is fully described along with its benefits (improved safety); thus, a POSA would have readily applied it to similar systems, such as Beam-Thominet's, in the same way. EX1003, ¶313; *KSR*, 550 U.S. at 419-421.

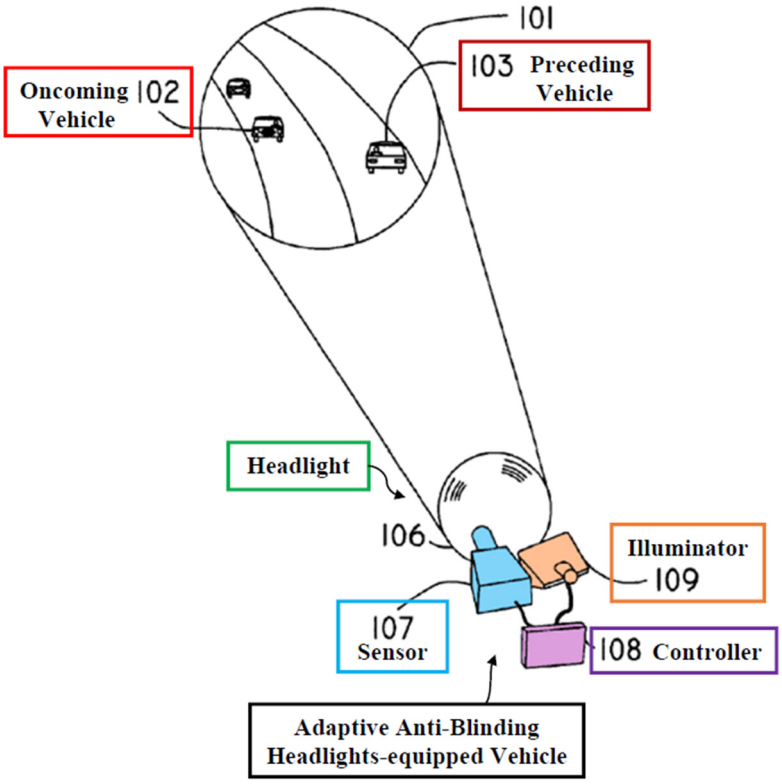
Additionally, or alternatively, this modification would have been simply combining known prior-art elements (Beam-Thominet's adaptive, direction-controllable headlamps with Kobayashi's directional control based on map data including road curvature) according to known methods (disclosed in Beam-Thominet and Kobayashi) to yield predictable results (illuminating curves, improving safety). EX1003, ¶314; *KSR*, 550 U.S. at 415-416.

A POSA would have had a reasonable expectation of success combining Kobayashi with Beam-Thominet, for example, by simply modifying software instructions stored in memory of Beam-Thominet's controller/processor (ECU) to adjust and direct light of the microbeams appropriately in view of Kobayashi's map data including road curvature. EX1003, ¶315. It also would have been a straightforward combination of prior-art elements: Kobayashi's road profile calculating means 2 and/or vehicle advancing direction prediction means 3 (including GPS navigation device 29) with Beam-Thominet (in communication with Beam's controller). *Id.* This would have been routine and well within a POSA's skill due to the similarities in Beam-Thominet's and Kobayashi's adaptive light control

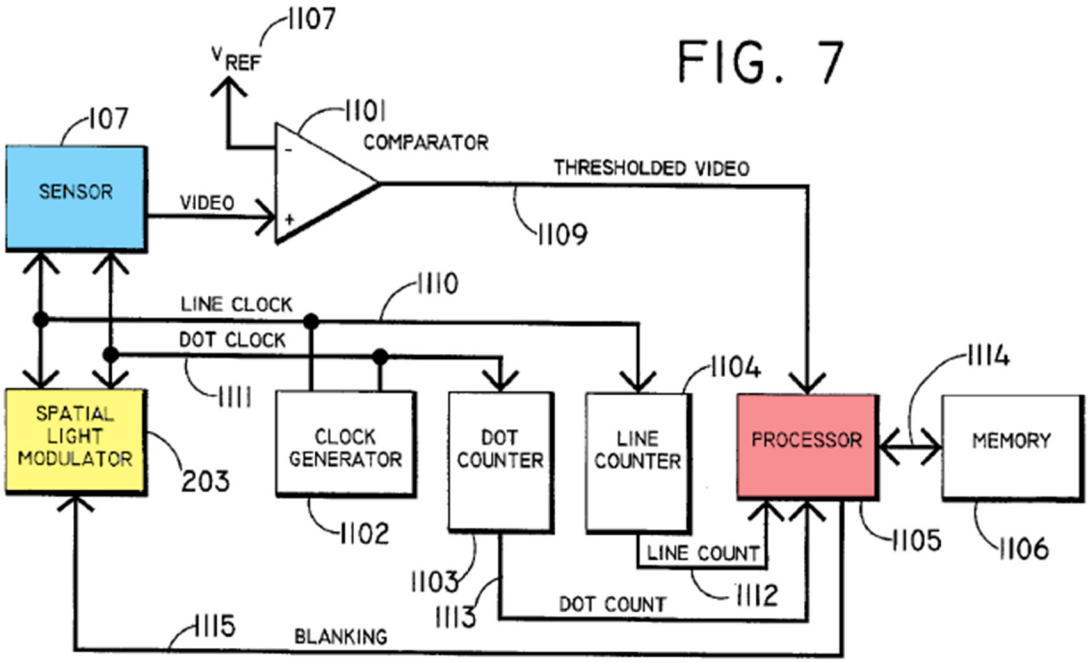
systems and methods—their common components were well-known and there would have been no limitations for a POSA to make such modifications. *Id.*, ¶¶316-317.

B. Claim 21

Beam discloses "controller module uses the *sensor spatial data (video)*…to *control the Illuminator*" and "*[p]rocessor…commands* the appropriate pixels." EX1005, 6:14-27, FIGS. 1, 7, 5:33-54 ("*spatial scene data [101]* from sensor 107…becomes the input to a processor"), 4:53-59, 2:35-38, Abstract; EX1003, ¶¶297-298.



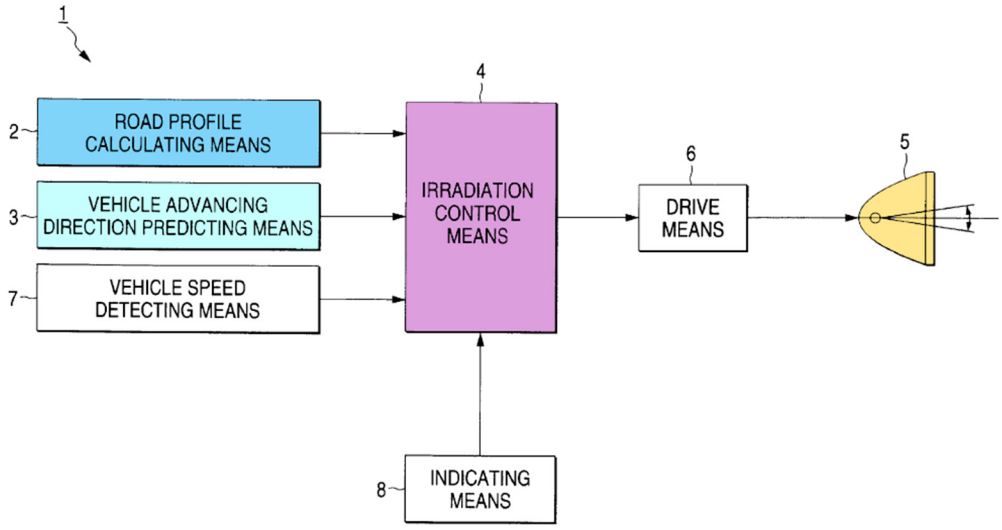
EX1005, FIG. 1 (annotated).



EX1005, FIG. 7 (annotated).

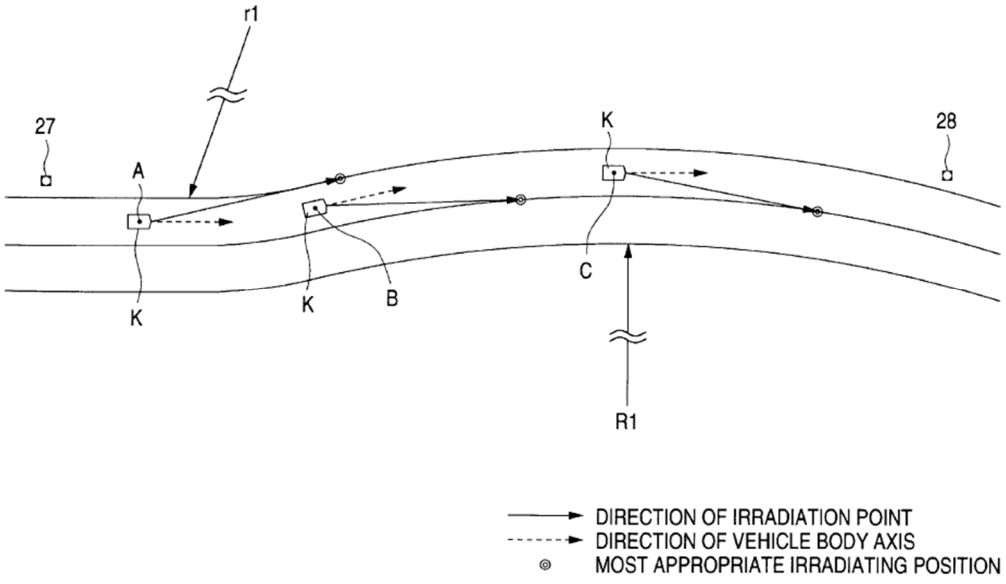
Beam-Thominet does not expressly disclose claim 21, but this feature was well-known in the prior art, as explicitly disclosed by Kobayashi. EX1003, ¶299.

Kobayashi discloses headlamp illumination is controlled "[a]ccording to the *road profile information*" and "applied…[so] a portion of irradiating light is directed to a *specific direction*." EX1008, 14:59-66, 9:38-41, FIGS. 1, 10, 4:60-64 ("irradiation control means 4 conducts irradiation control…with the *road profile*"), 3:9-50, 14:53-15:28; EX1003, ¶300.



EX1008, FIG. 1 (annotated).

Kobayashi discloses illumination can be planned and controlled on curved roads r1, R1 to improve safety: when vehicle K turns left (point A), the left shoulder is illumination, and when vehicle K turns right (point C), the right shoulder is illumination. EX1008, 14:53-15:28, FIG. 10; EX1003, ¶301.



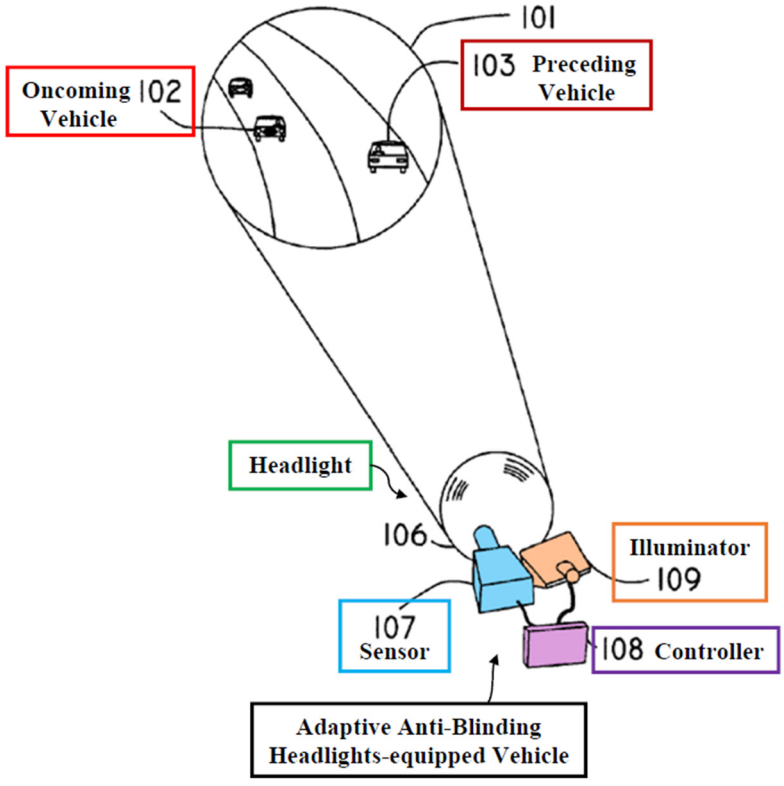
EX1008, FIG. 10.

As discussed, a POSA would have been motivated to combine Kobayashi with Beam-Thominet with a reasonable expectation of success. *Supra* Section VIII.A; EX1003, ¶302.

Thus, Beam-Thominet-Kobayashi renders obvious claim 21. EX1003, ¶317.

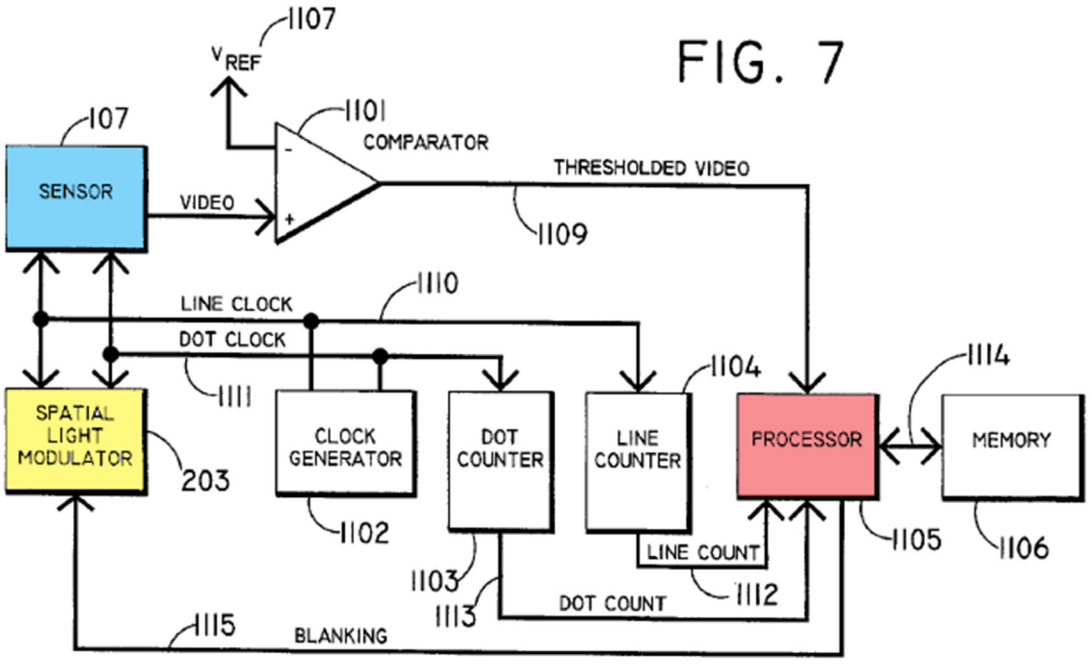
C. Claims 22/23[8]

Beam discloses "controller module uses the *sensor spatial data (video)*…to *control the Illuminator*" and "*[p]rocessor…commands* the appropriate pixels." EX1005, 6:14-27, FIGS. 1, 7, 5:33-54 ("*spatial scene data [101]* from sensor 107…becomes the input to a processor"), 4:53-59, 2:33-38, Abstract; EX1003, ¶319.



[8] Claims 22-23 are identical. EX1003, ¶318.

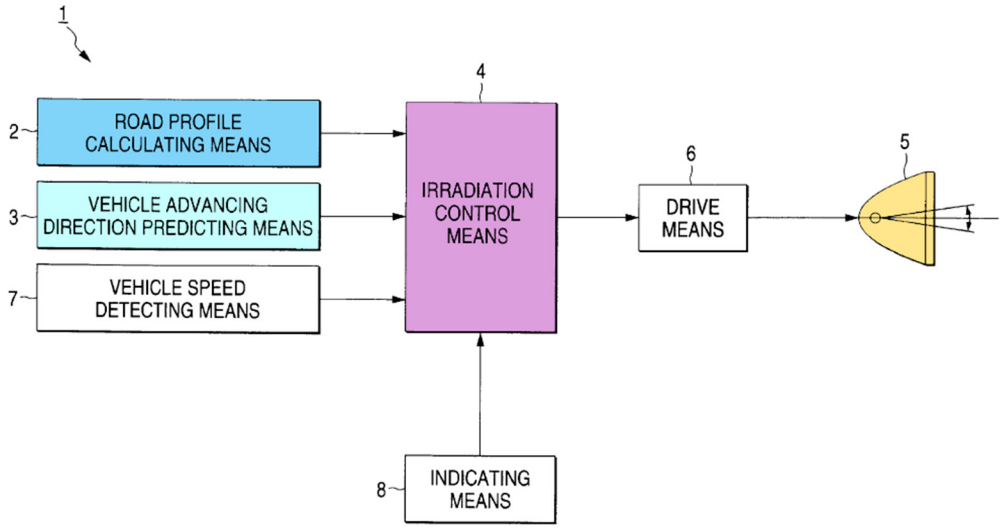
EX1005, FIG. 1 (annotated).



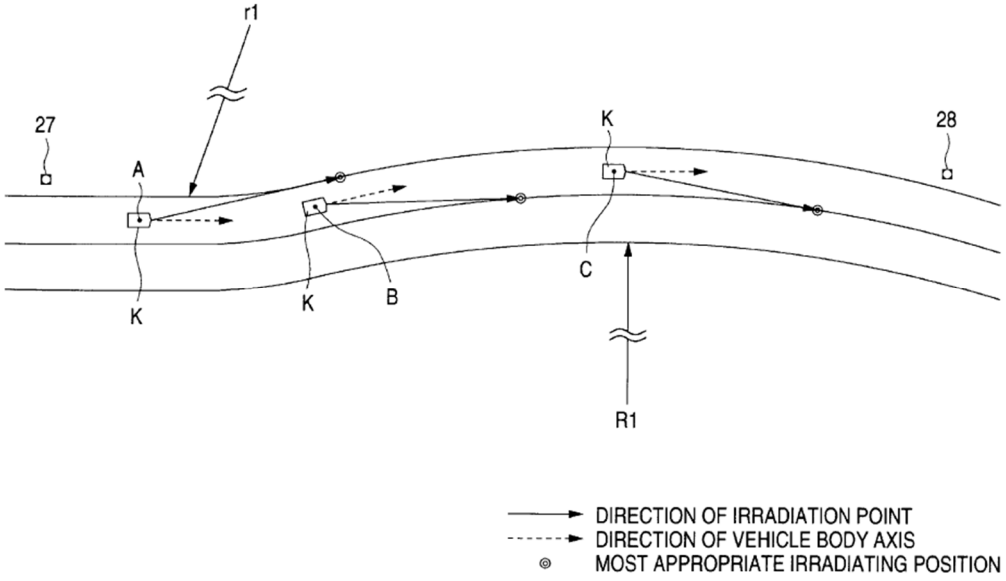
EX1005, FIG. 7 (annotated).

Beam-Thominet does not expressly disclose claims 22-23, but this feature was well-known in the prior art, as explicitly disclosed by Kobayashi. EX1003, ¶320.

Kobayashi discloses headlamp illumination is "applied…to a *specific direction*" and "can be conducted…*along the scheduled course*." EX1008, 9:38-41, 18:53-57, FIGS. 1, 9-10, 4:7-8 ("*predicts a vehicle advancing direction* at which the driver aims"), 3:9-51, 11:34-14:52; EX1003, ¶321. A POSA would have understood that Kobayashi discloses a "planned upcoming turn" because the "scheduled course" includes an intended direction of a driver (e.g., left or right turn). EX1003, ¶321; EX1001, 54:1-15.



EX1008, FIG. 1 (annotated).



EX1008, FIG. 10.

As discussed, a POSA would have been motivated to combine Kobayashi with Beam-Thominet with a reasonable expectation of success. *Supra* Section VIII.A; EX1003, ¶322.

Thus, Beam-Thominet-Kobayashi renders obvious claims 22-23. EX1003, ¶¶323-324.

IX. GROUND 4: THE COMBINATION OF BEAM, THOMINET, STAM, AND KOBAYASHI RENDERS OBVIOUS CLAIMS 60-62.

A. A POSA would have been motivated to combine Kobayashi with Beam-Thominet-Stam with a reasonable expectation of success.

As described in Sections VI.A/VII.A, a POSA would have been motivated to combine Beam-Thominet-Stam. EX1003, ¶325. For the same reasons described in Section VIII.A, a POSA would have been further motivated to combine Kobayashi with Beam-Thominet-Stam. *Id.* The addition of Stam to Beam-Thominet would not change the inclusion of Kobayashi. *Id.*

B. Claim 60

Claims 60 and 21 are patentably indistinct. *Supra* Section VII.B; EX1003, ¶¶326-327.

C. Claims 61/62[9]

Claims 61 and 22 are patentably indistinct. *Supra* Section VIII.C; EX1003, ¶¶328-331.

X. GROUND 5: THE COMBINATION OF KARLSSON AND HARBERS RENDERS OBVIOUS CLAIMS 20, 24-25, 59, AND 63-64.

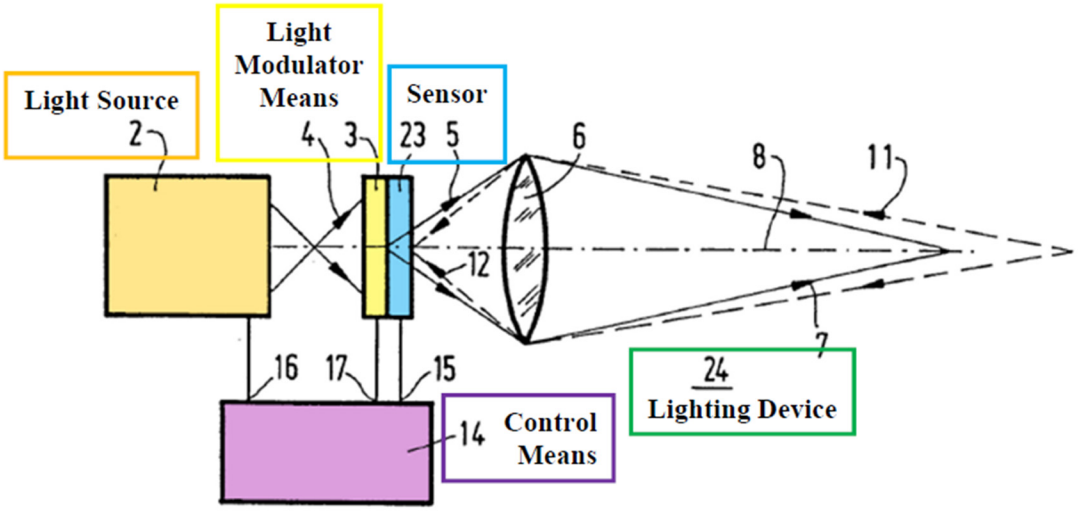
It is Petitioner's position that Karlsson explicitly or implicitly discloses every feature recited in claims 20, 24-25, 59, and 63-64. But to avoid doubt, Karlsson is

[9] Claims 61-62 are identical. EX1003, ¶328.

combined with Harbers, for [20.2] and [59.2], which discloses well-known features of adaptive headlamps—directional light sources with different angles/aimings for different functions—rendering the claims obvious. EX1003, ¶332.

1. "directional light sources" [20.2]/[59.2]

Karlsson discloses "spotlight beams 34 can be…a *grid of separate light sources*, such as *LEDs*…controlled either *individually* or in *groups*…[and] may also be made up of…*light modulator means*" and "*light modulator means 3* advantageously can be switched to…*given directions*." EX1010, 11:25-28, 14:1-9, FIGS. 3, 6, 14; EX1003, ¶333. Each spotlight beam is a directional "source," having its own independent *direction* (angle/aiming), that combines to form the headlamp beam, so the combination of Karlsson's spotlight beams form at least three directional light sources having different angles/aimings. EX1010, 4:25-31, 14:1-15, FIGS. 6, 14; EX1003, ¶333.



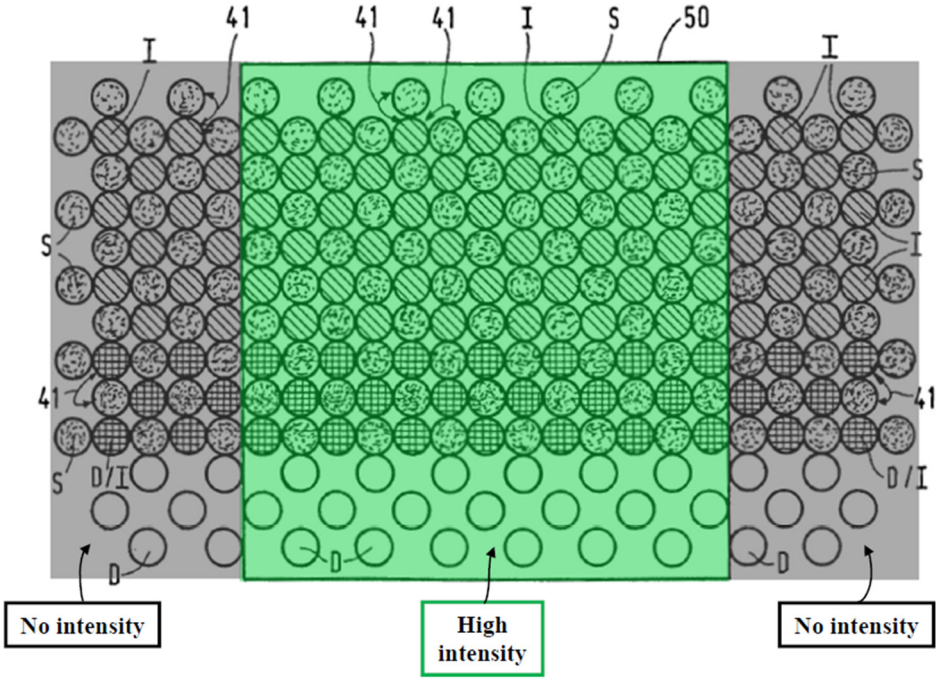
EX1010, FIG. 3 (annotated).

Thus, Karlsson discloses "at least three directional light sources"—independently controllable directional spotlight beams—that are "aimed at different angles"/"hav[e] different aimings" as in [20.2]/[59.2]. EX1003, ¶334.

If Patent Owner argues, incorrectly, that Karlsson does not disclose [20.2]/[59.2], Harbers does, and it would have been obvious to combine Harbers with Karlsson. *Id*., ¶335.

2. "predefined illuminance" [59.9]/[59.11]

Additionally, Karlsson discloses "spotlight sources indicated at D provide the *dipped light function*." EX1010, 19:24-27, FIGS. 14-15, 1:27-30 ("*low beams* or *dipped* headlights"), Abstract, 1:16-18. Thus, Karlsson's system includes a "predefined" illuminance: a "dipped" illuminance. EX1003, ¶¶336-337. Further, illumination in shaded areas (outside emitted light beam 50) is "*no light at all* or light having a low intensity is emitted in those directions from which light is detected" (no intensity in shaded area is *below* Karlsson's predefined *dipped* illuminance: shaded illuminance < dipped illuminance), and illumination in non-shaded areas (within emitted light beam 50) is "*higher than* that of conventional *dipped headlights*" and "longer-range *main-beam*" (high intensity in non-shaded area is *above* Karlsson's predefined *dipped* illuminance: non-shaded illuminance > dipped illuminance). EX1010, Abstract, 1:18-24, 9:18-22, 19:22-27, FIGS. 3, 14:1-15:37; EX1003, ¶¶338-339.



EX1010, FIG. 14 (annotated).

Therefore, Karlsson discloses a "predefined" (dipped) illuminance and outputting illumination below and above the predefined illuminance (shaded < dipped < non-shaded) as in [59.9] and [59.11]. EX1003, ¶340.

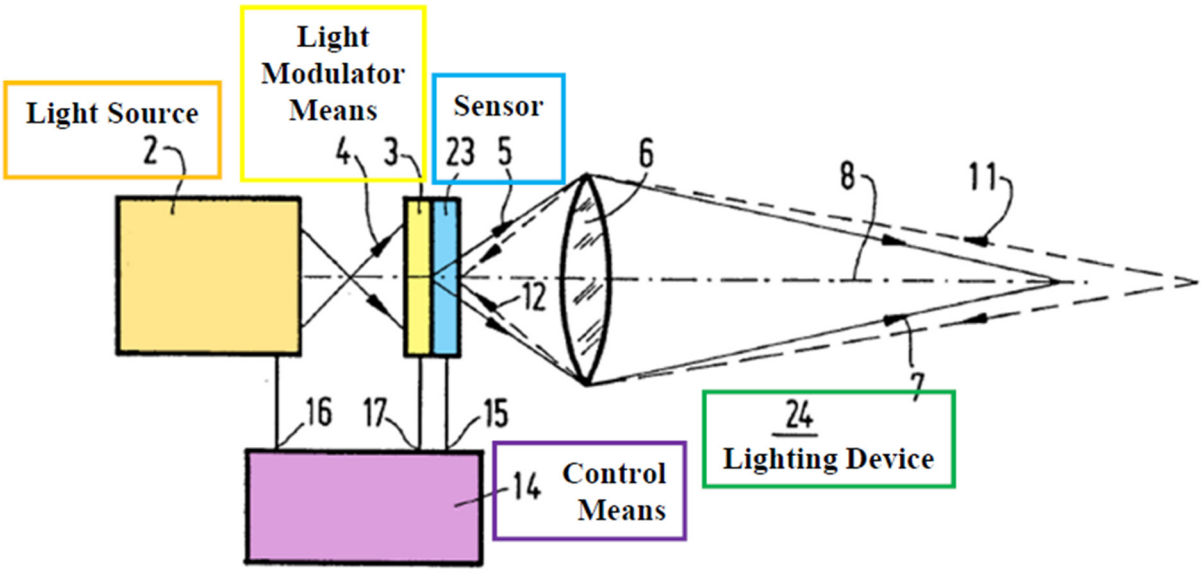
The '503 patent does not disclose a predefined illuminance value, so a value is not required to satisfy [59.9] and [59.11]. *Id.*, ¶341. Further, a POSA reading Karlsson would have understood Karlsson's "dipped" illuminance, for example, teaches a "predefined" illuminance, because Karlsson uses the dipped illuminance as a reference point below and above which to output illumination, preventing glare to other vehicles while increasing illumination to other areas. *Id.*, ¶¶341-342; EX1010, 9:18-26, Abstract, 1:18-24, 19:23-27, FIGS. 3, 6, 14:1-15:37.

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

As discussed, Karlsson discloses "directional light sources" with independently controlled angular positions for reducing glare towards other drivers. *Supra* Section X; EX1003, ¶344. Harbers provides further detail on implementing "directional light sources" for different functions, conceptually and physically. EX1003, ¶344. So naturally, it would have been obvious to a POSA designing an adaptive headlamp to implement Harbers's multiple directional beam segments with different angles/aimings—through either software or hardware—for different functions in Karlsson's system. *Id*. Indeed, Harbers discloses such an implementation to provide different spatial distributions for improved visibility in different driving situations (off-axis viewing, bends, narrow roads, motorways, etc., *see* EX1011, 5:14-26, 6:1-7, 6:27-7:32, 9:28-10:5, 13:5-7, FIGS. 1B, 2), thereby improving driver safety—an express purpose of Karlsson. EX1003, ¶¶343-344; EX1010, 1:10-13, 1:16-26, 4:17-21, 9:18-26.

Karlsson and Harbers are from the same field—controllable headlamps with dynamic illumination—and include the same building blocks (light sources, sensors, controllers). EX1003, ¶345. Further, improved visibility, thereby increasing safety is paramount in both. *Id*.; EX1010, 1:10-26, 4:17-21, 9:18-26; EX1011, 5:1-26, 7:1-14, 9:1-32.

First, including an additional control technique (software implementation) for Karlsson—Harbers's *known technique* of using multiple directional beam segments for different functions—would have added control methods for different functions to Karlsson's system for different driving situations, thereby increasing safety. EX1003, ¶346. Karlsson discloses "*controllable spotlight beams*" are controlled individually or in groups by control means 14 to "*given directions*" to reduce glare. EX1010, 4:25-31, 11:25-28, 14:1-15, 19:29-33, FIGS. 3, 6; EX1003, ¶346.



EX1010, FIG. 3 (annotated).

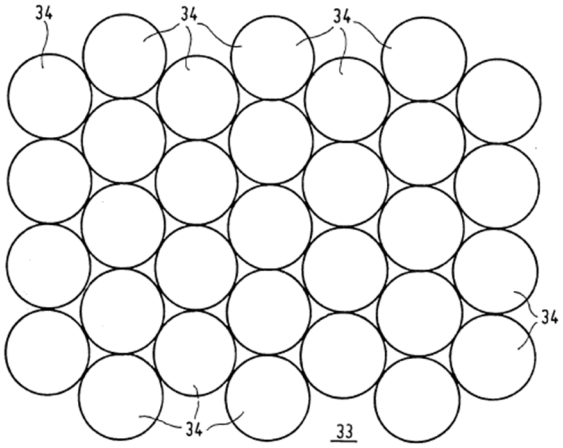


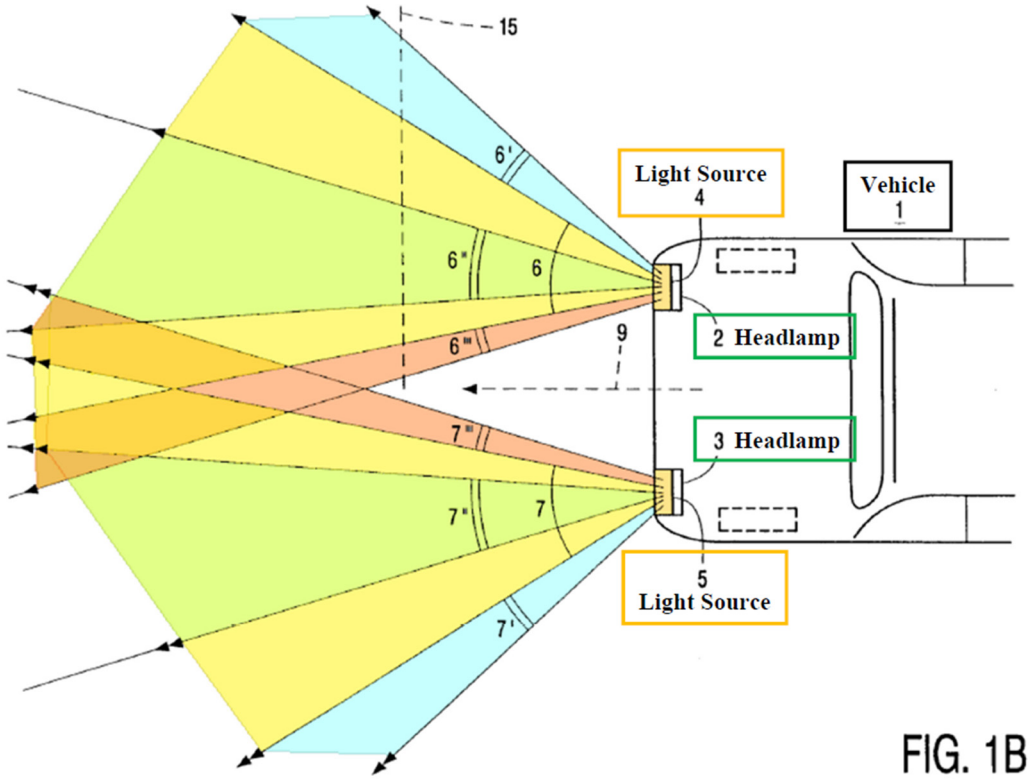
FIG. 6

EX1010, FIG. 6.

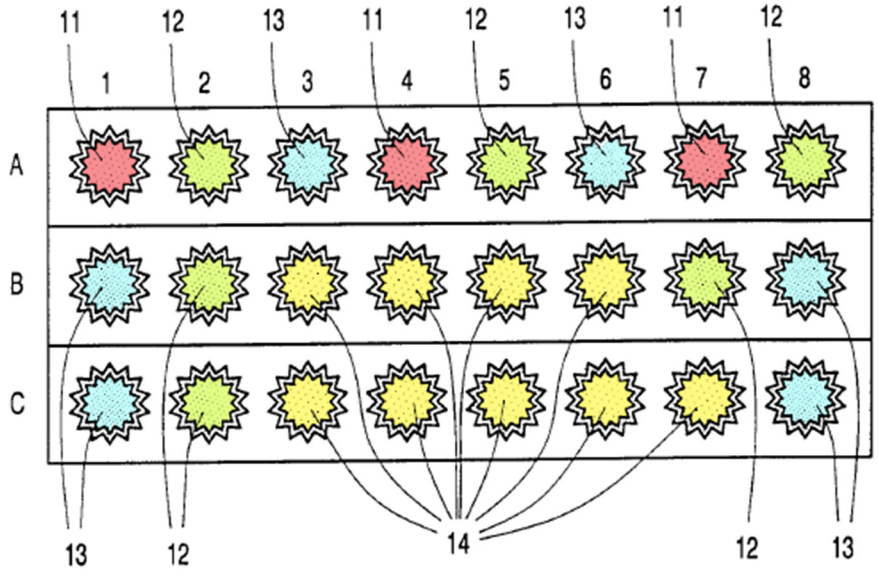
Indeed, Karlsson's techniques and system of controlling individual spotlight beams emphasize safety of all drivers. EX1010, 1:16-26, 4:17-21, 9:18-26; EX1003, ¶347. Controllable headlamps "significantly increase the driving comfort and the road safety," and "glaring and blinding of oncoming traffic [is] effectively prevented," increasing safety. EX1010, 9:18-26. Karlsson enables "higher light intensity," for example "when driving on dark, unilluminated roads," while protecting others from glare. *Id*., 1:21-26, 1:10-13 ("comply with…regulations…preventing the *blinding* or *glare*"); EX1003, ¶347.

Karlsson recognizes the safety benefits of identifying "oncoming traffic" and other objects ("road signs etc.") in the field of view and adjusting a pattern and/or an intensity of light beam 7. EX1010, Abstract, 3:17-31, 12:19-35, 2:2-4, 5:16-32; EX1003, ¶348.

And Harbers's *technique* (software implementation), like Karlsson, seeks to enhance driver visibility, thereby increasing safety—using multiple directional beam segments for different functions. EX1011, 5:14-26, 6:1-7, 6:27-7:19, 8:10-18, FIGS. 1B-2; EX1003, ¶¶348-349. Opto-electronic elements 11-14 provide differently angled/aimed beam segments 6-6'-6"-6'", 7-7'-7"-7'" relative to longitudinal direction 9 to form different spatial distributions. EX1011, 5:14-26, 6:1-7, 6:27-7:19, FIGS. 1B-2, 7:27-32, 7:1-17, 9:28-10:5, 13:5-7; EX1003, ¶349.



EX1011, FIG. 1B (annotated).



EX1011, FIG. 2 (annotated).

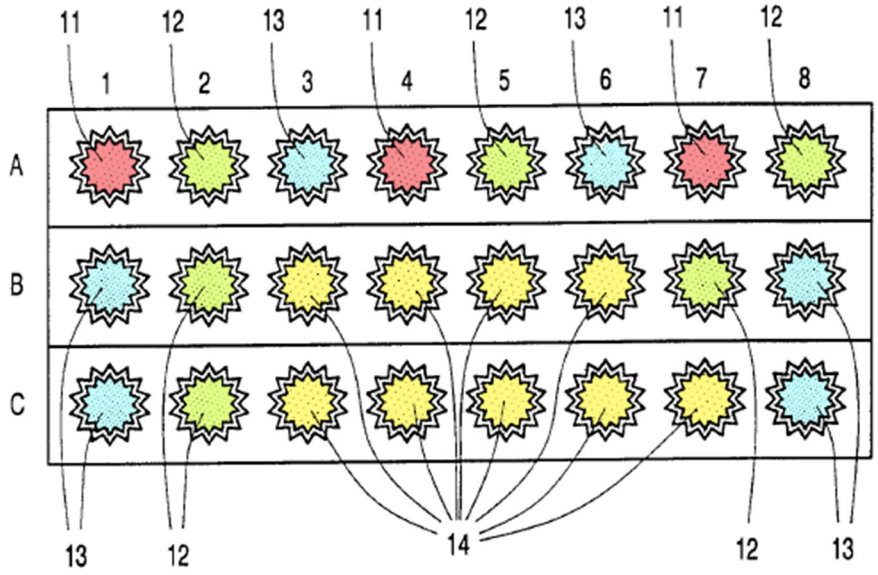
Having multiple directional beam segments with different angles/aimings as in Harbers, implemented with Karlsson's control means 14/spotlight beams 34 (including light modulator means 3), would have provided Karlsson's system with different spatial distributions for different driving situations beyond reducing glare for drivers, thereby improving safety. EX1003, ¶350. This would have merely been applying Harbers's known techniques (software implementation: using multiple directional beam segments with different angles/aimings for different functions) to Karlsson's similar, known device (adaptive system with controllable spotlight beams), in the same way. *Id*., ¶351; *KSR*, 550 U.S. at 417. Harbers's known technique is fully described along with its benefits (improved visibility for different functions, thereby increased safety); thus, a POSA would have readily applied it to similar systems, such as Karlsson's, in the same ways. EX1003, ¶351.

A POSA would have had a reasonable expectation of success combining Harbers with Karlsson, for example, by simply modifying software instructions stored in memory of Karlsson's controller/processor to organize Karlsson's spotlight beams into multiple directional beam segments with different angles/aimings for different functions. *Id*., ¶352. This would have been routine and well within a POSA's skill due to the similarities in Karlsson's and Harbers's adaptive systems—their common components were well-known and there would have been no limitations for a POSA to make such modification. *Id*., ¶353.

Second, additionally or alternatively, a POSA would have sought to incorporate *known components* (hardware implementation) of Harbers's opto-electronic elements 11-14 on a "curved substrate" (with differently angled/aimed opto-electronic elements 11-14 relative to the vehicle, *see* EX1011, 5:14-26, 6:1-7, 6:27-7:32, FIGS. 1B-2) into Karlsson's system (with lighting means 2, 3). EX1003, ¶354. Again, this would have, like Harbers, provided different spatial distributions for different driving situations, improving visibility and thereby safety. *Id.*

Through its *system components*, Harbers, like Karlsson, seeks to enhance driver visibility and thereby increase safety. EX1011, 5:14-26, 6:1-7, 6:27-7:19, 8:10-18, FIGS. 1B-2; EX1003, ¶355. Opto-electronic elements 11-14 arranged on a "curved substrate," with different angles/aimings relative to the vehicle, provide beam segments 6-6'-6"-6"', 7-7'-7"-7"' for different driving situations. EX1011, 5:14-

26, 6:1-7, 6:27-7:19, FIGS. 1B-2, 7:27-32 ("*curved* substrate"), 7:1-17, 9:28-10:5, 13:5-7; EX1003, ¶355.



EX1011, FIG. 2 (annotated).

Like the software implementation, this hardware combination of Karlsson's lighting means 2, 3 and Harbers's differently angled/aimed opto-electronic elements 11-14 on a curved substrate, would have provided Karlsson's system with different spatial distributions for different driving situations, as in Harbers, thereby improving driver safety. EX1003, ¶356. This would have been merely combining prior-art elements or a simple substitution of one known element for another (Karlsson's lighting means 2, 3 on a flat substrate and Harbers's opto-electronic elements 11-14 on a curved substrate) according to known methods (disclosed in Karlsson and Harbers) to yield predictable results (improved visibility and safety). *Id*., ¶356; *KSR*, 550 U.S. at 415-416.

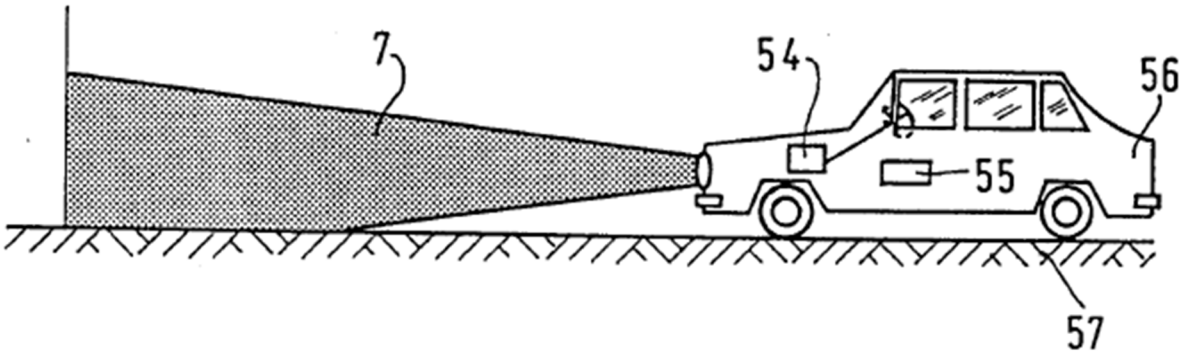
A POSA would have had a reasonable expectation of success combining Harbers with Karlsson, for example, by simply modifying the flat substrate of Karlsson's lighting means 2, 3 with Harbers's curved substrate to provide multiple light sources with different angles/aimings relative to the vehicle for different functions. EX1003, ¶357. This would have been routine and well within a POSA's skill due to the similarities in Karlsson's and Harbers's adaptive systems—their common components were well-known and there would have been no limitations for a POSA to make such modifications. *Id*., ¶358.

B. Independent Claims 20/59

Karlsson-Harbers renders claims 20 and 59 obvious. EX1003, ¶¶359-360.

1. [20.P]/[59.P]

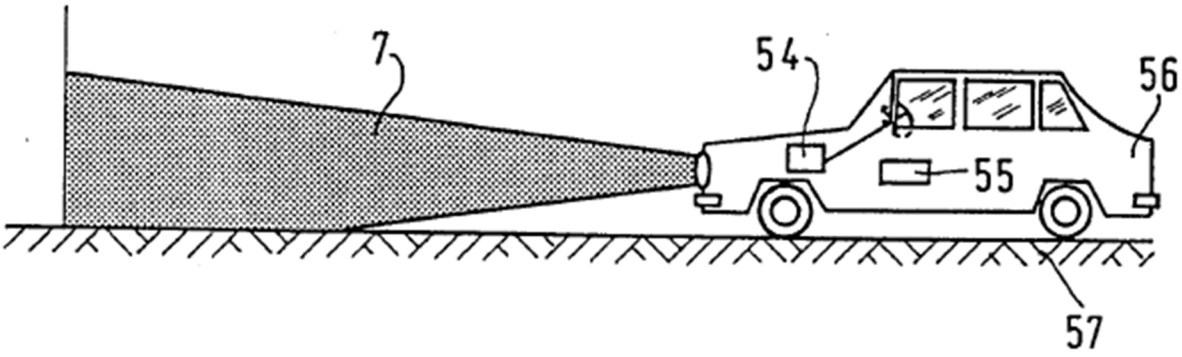
Karlsson discloses a headlight system for a car 56 to provide an adaptive light beam 7. EX1010, 20:16-32, Abstract, FIG. 16; EX1003, ¶¶361-363.



EX1010, FIG. 16.

2. [20.1]/[59.1]

Karlsson's lighting device 1, 24 is affixed to car 56 to provide adaptive light beam 7. EX1010, 20:16-32, FIGS. 1, 3, 16, Abstract, 9:18-22; EX1003, ¶¶364-366.



EX1010, FIG. 16.

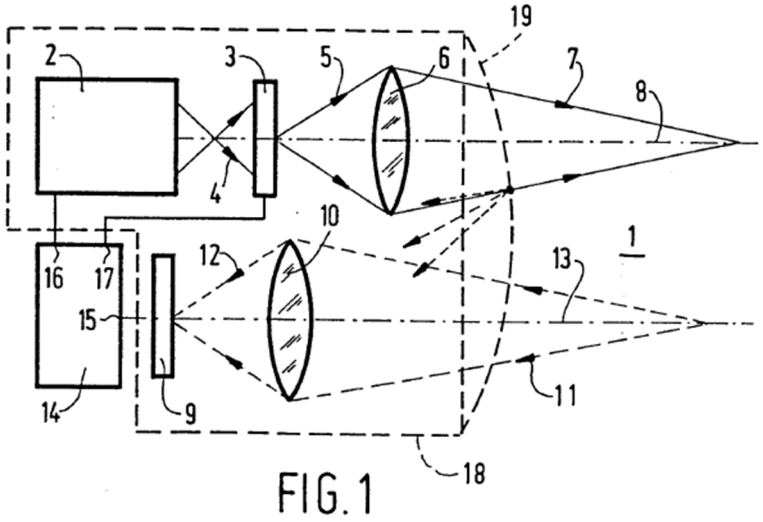
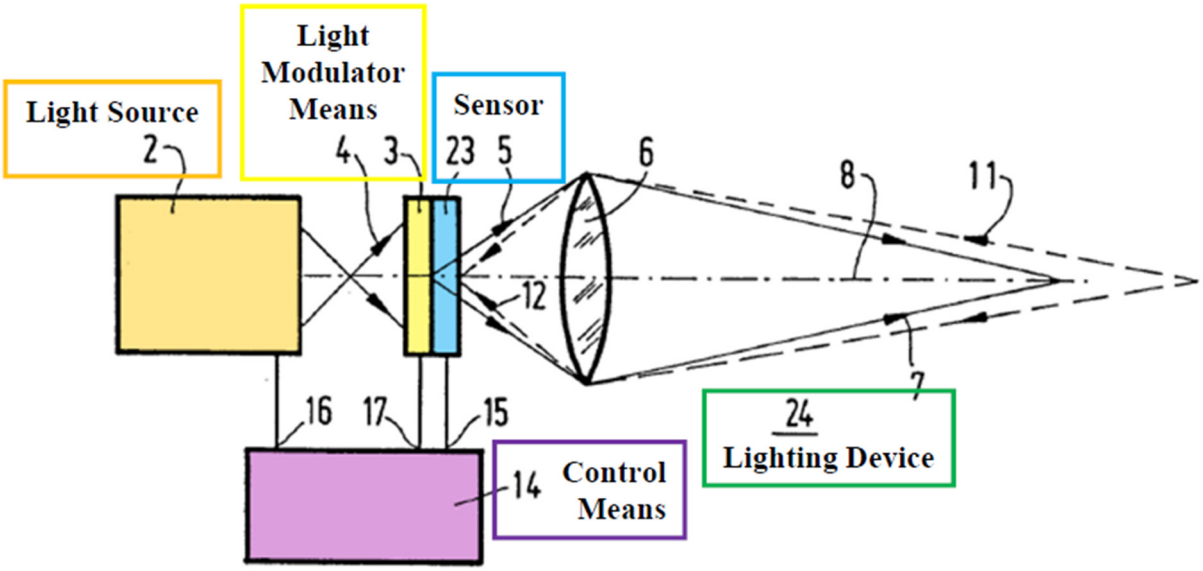


FIG. 1

EX1010, FIG. 1.

3. [20.2]/[59.2]

As discussed, Karlsson discloses [20.2]/[59.2]. *Supra* Section X; EX1003, ¶¶367-369; EX1010, 4:25-31, 14:1-15, 11:25-38, 19:29-33, FIGS. 3, 6, 14-15.



EX1010, FIG. 3 (annotated).

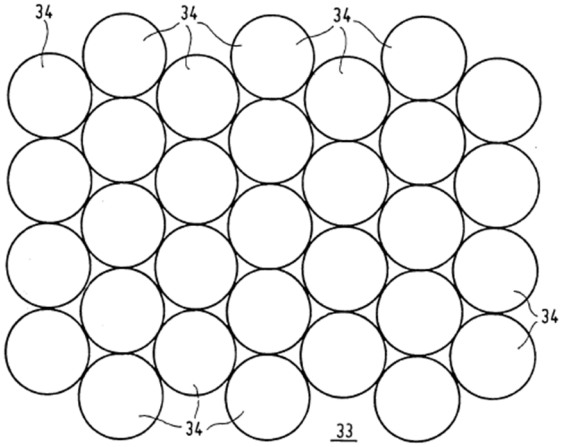
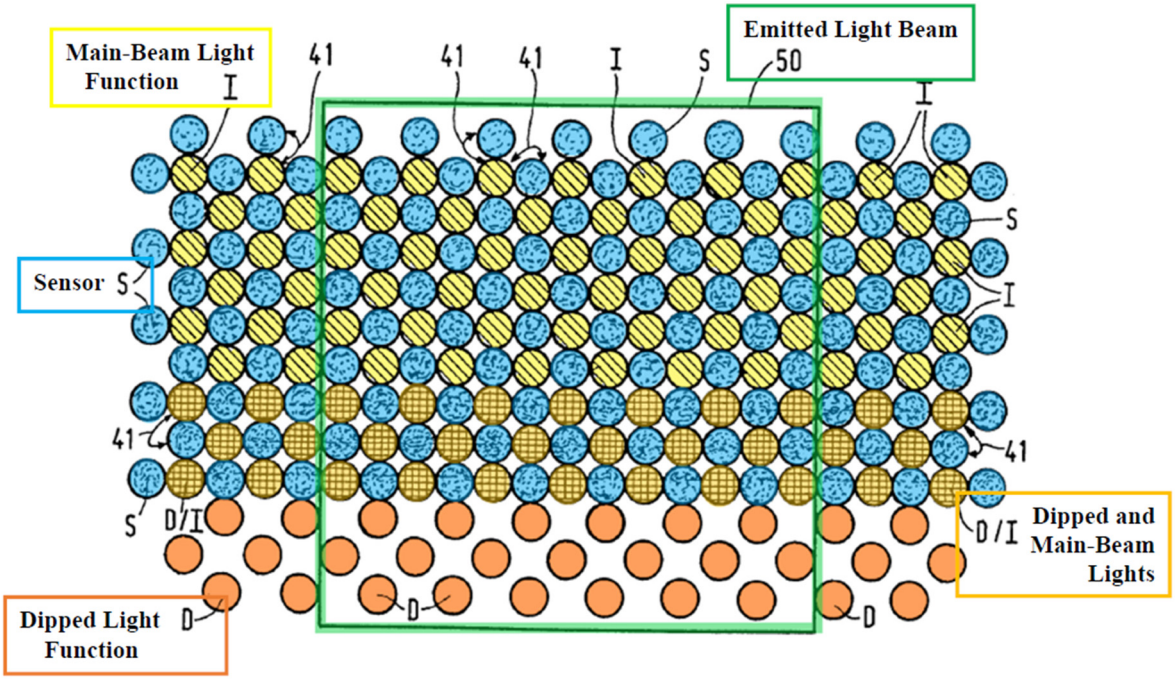


FIG. 6

EX1010, FIG. 6.

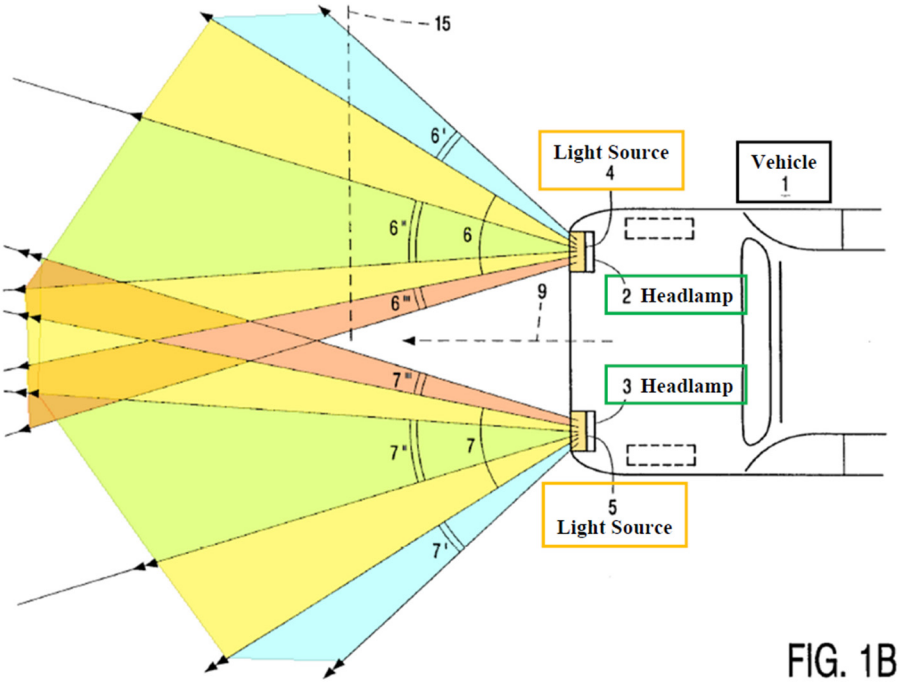


EX1010, FIG. 14 (annotated).

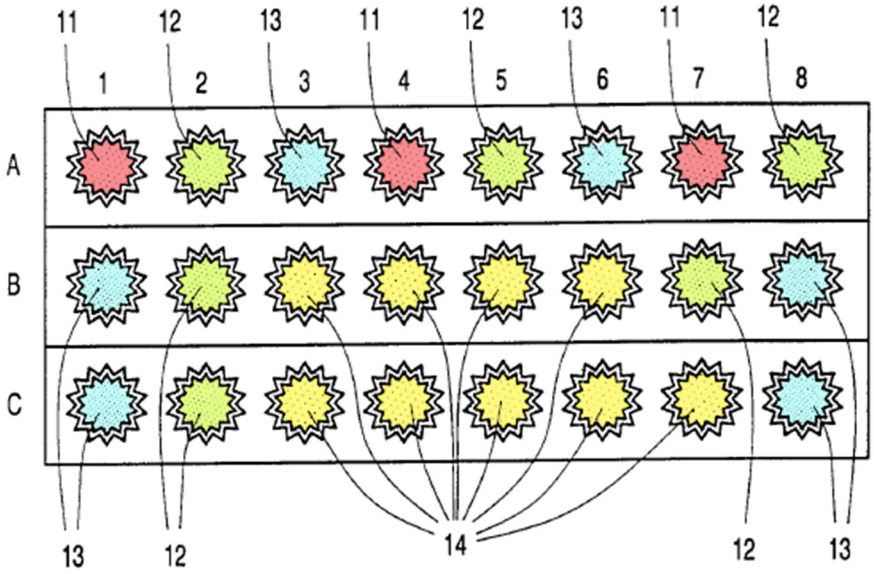
If Patent Owner argues, incorrectly, that Karlsson does not disclose [20.2]/[59.2], it would have been obvious in view of Harbers. EX1003, ¶370. A POSA would have been motivated to combine Harbers with Karlsson with a reasonable expectation of success. *Supra* Section X.A; EX1003, ¶¶370, 372-389.

Harbers discloses an array of opto-electronic elements 11-14 on a curved substrate that emits light beam segments 6-6'-6"-6"', 7-7'-7"-7"' with different angles/aimings relative to longitudinal direction 9 for different functions. EX1011, 5:14-26, 6:1-7, 6:27-7:19, FIGS. 1B-2, 7:27-32 ("*curved substrate…determined* to a substantial degree by the *desired direction* of the light beams emitted"), 7:1-17; EX1003, ¶371. For example, Harbers's beam segment 6, 7 is a "wide…passing beam" (first angle/aiming), beam segment 6', 7' illuminates "the shoulder of the

road" (second angle/aiming), and beam segment 6", 7" illuminates "the center of the road" (third angle/aiming). EX1011, 7:1-17, FIG. 1B; EX1003, ¶371.



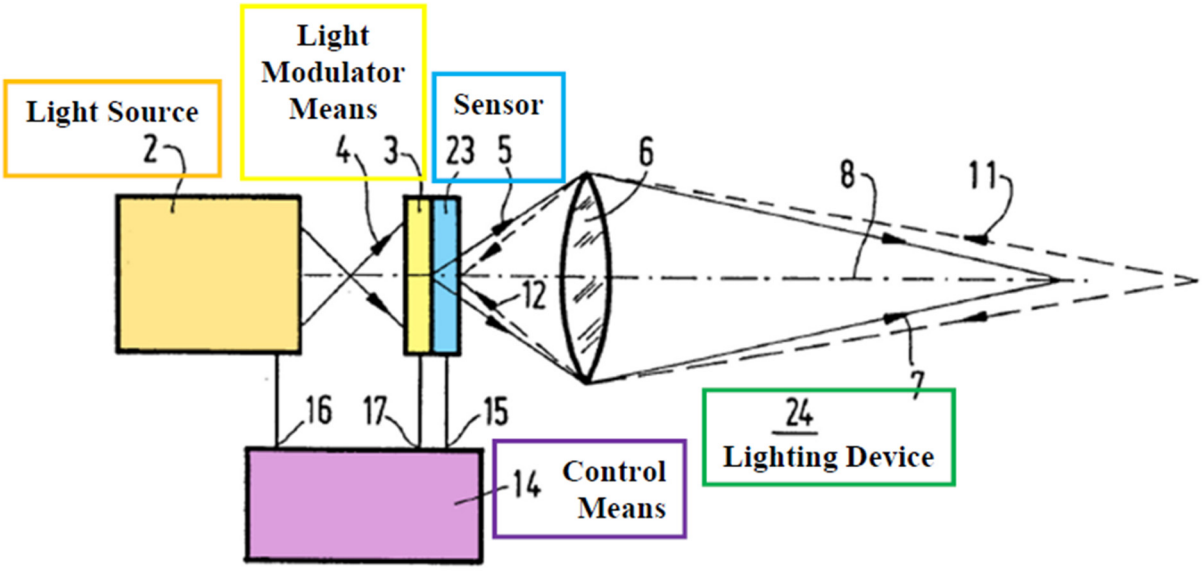
EX1011, FIG. 1B (annotated).



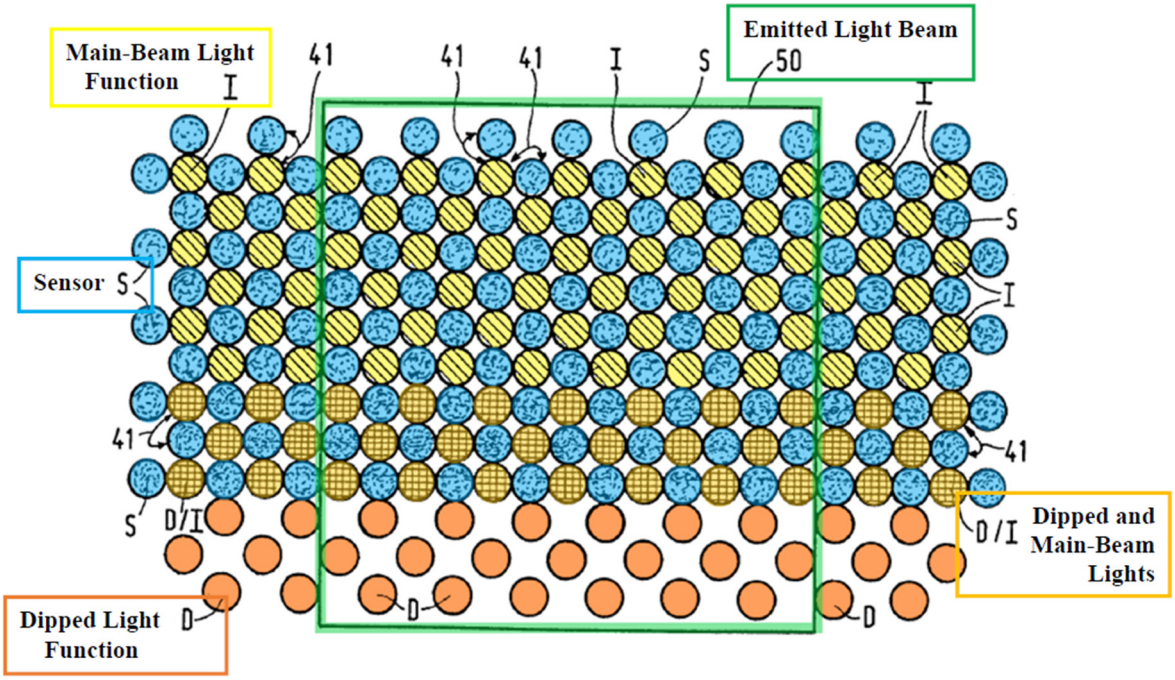
EX1011, FIG. 2 (annotated).

4. [20.3]/[59.3]

Karlsson discloses "light beam 7 having a *desired pattern* and a *desired intensity* is emitted." EX1010, 9:13-17, FIGS. 3, 6, 14, 4:26-29 ("*desired pattern*"), 19:29-33 ("*vary* as regards its *shape* and *dimension*"), 9:18-22; EX1003, ¶¶390-391. Both "intensity" and "pattern" are "controllable light/illumination characteristics." EX1003, ¶¶391-392; *see* EX1001, 16:43-50, 2:28-30.



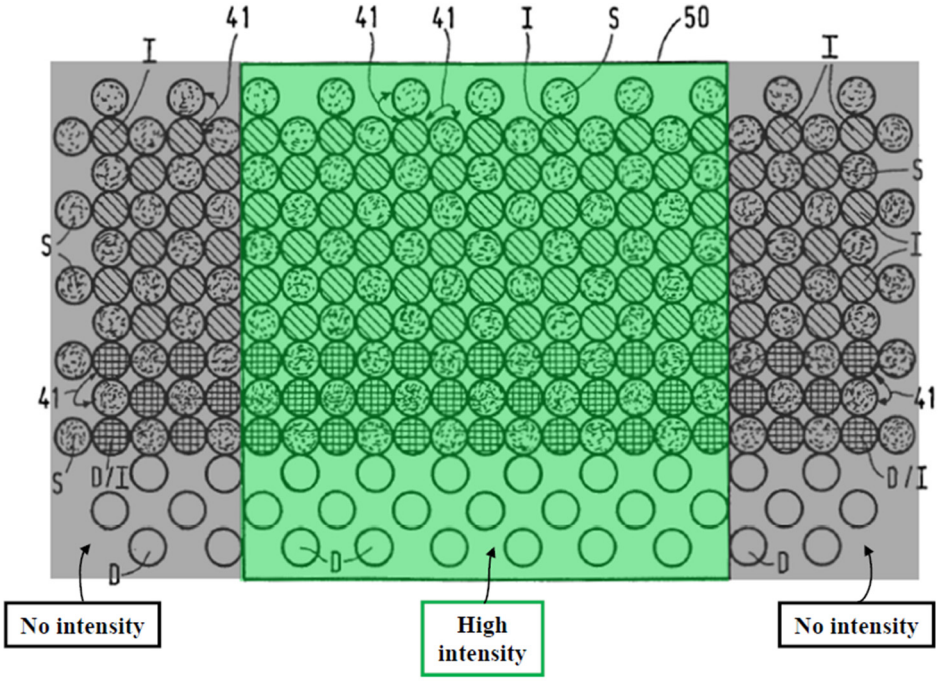
EX1010, FIG. 3 (annotated).



EX1010, FIG. 14 (annotated).

5. [20.4]

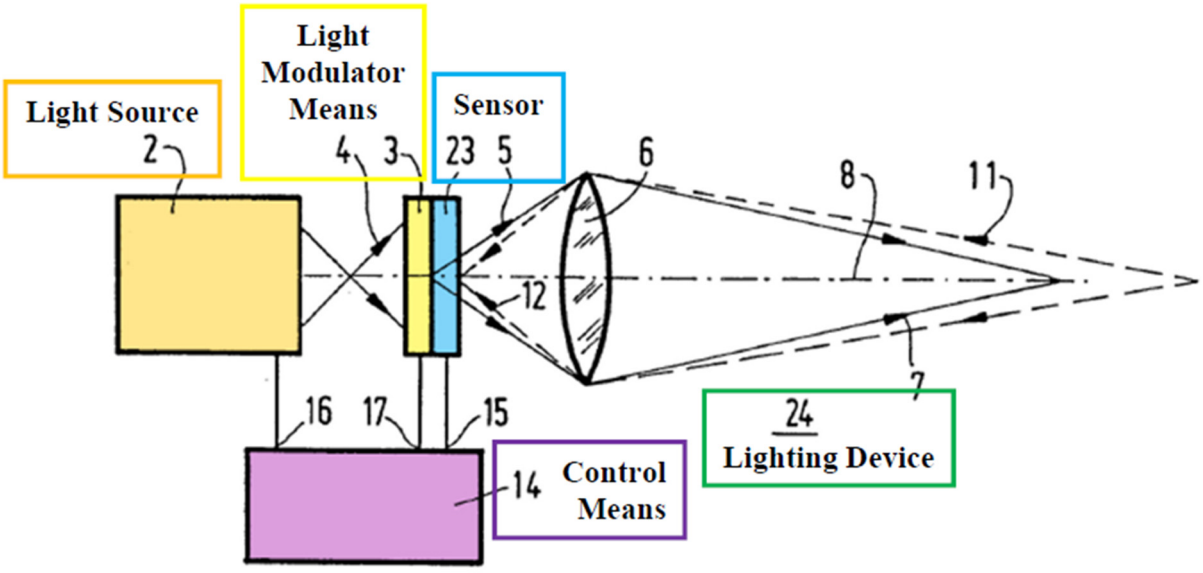
Karlsson discloses "*spotlight beams 34* may also be made up of…*light modulators* which can be controlled to transmit light *to a specified degree*" and "*part of the light beam* which might cause *inconvenience* to oncoming traffic is automatically *suppressed*, whilst *retaining an optimum lighting* effect for the driver." EX1010, 2:7-9, 14:5-15, FIGS. 3, 6, 14, 11:25-28 ("*given directions*"), 9:19-33, 4:26-31; EX1003, ¶393. As discussed, Karlsson-Harbers discloses "directional light sources aimed at different angles." *Supra* Section X.B.3; EX1003, ¶¶376-389. Thus, Karlsson discloses light sources "at a first angle" (shaded area of no intensity) and "at a second angle" (non-shaded area of high intensity). EX1003, ¶394.



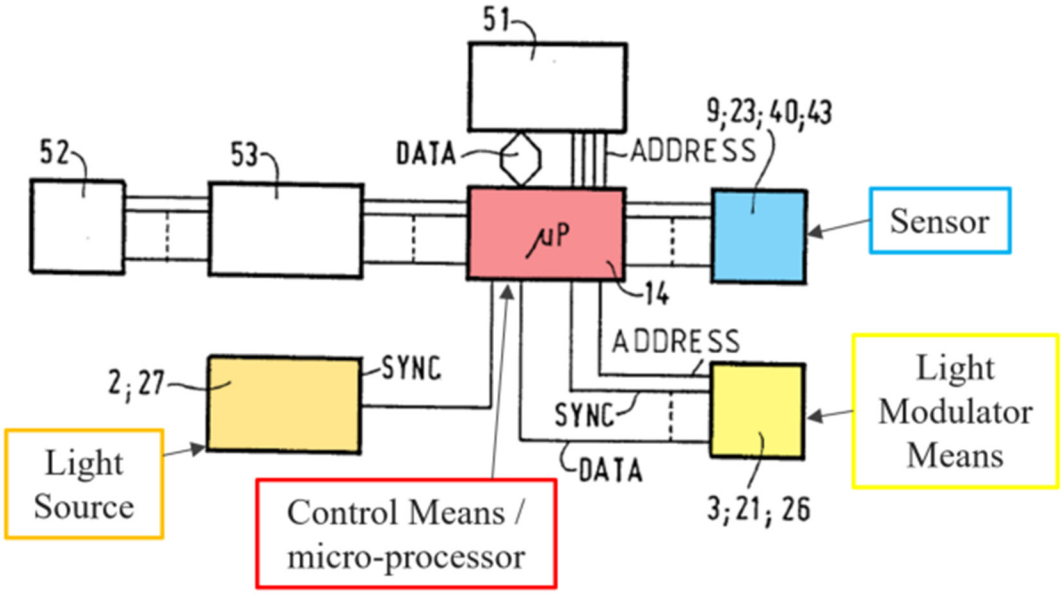
EX1010, FIG. 14 (annotated).

6. [20.5]

Karlsson discloses "lighting means 2, 3…controlled by control means 14, such that the incident light 11 on the light-sensitive sensor 9…is processed into an electric control signal…[and] processed by the control means 14 into output signals…to control…light beam 7 having a desired pattern and a desired intensity." EX1010, 9:11-17, FIGS. 3, 14-15, 20:1-3 ("control electronics 41"), 2:7-10, 19:29-33, 20:12-32, 21:36-22:4; EX1003, ¶¶395-398.



EX1010, FIG. 3 (annotated).

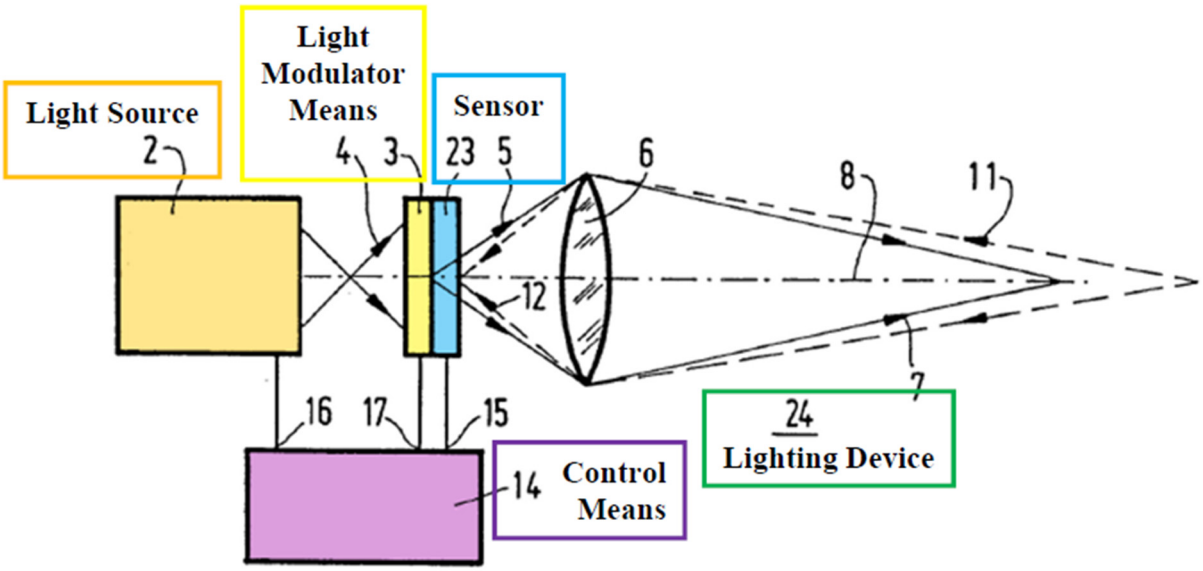


EX1010, FIG. 15 (annotated).

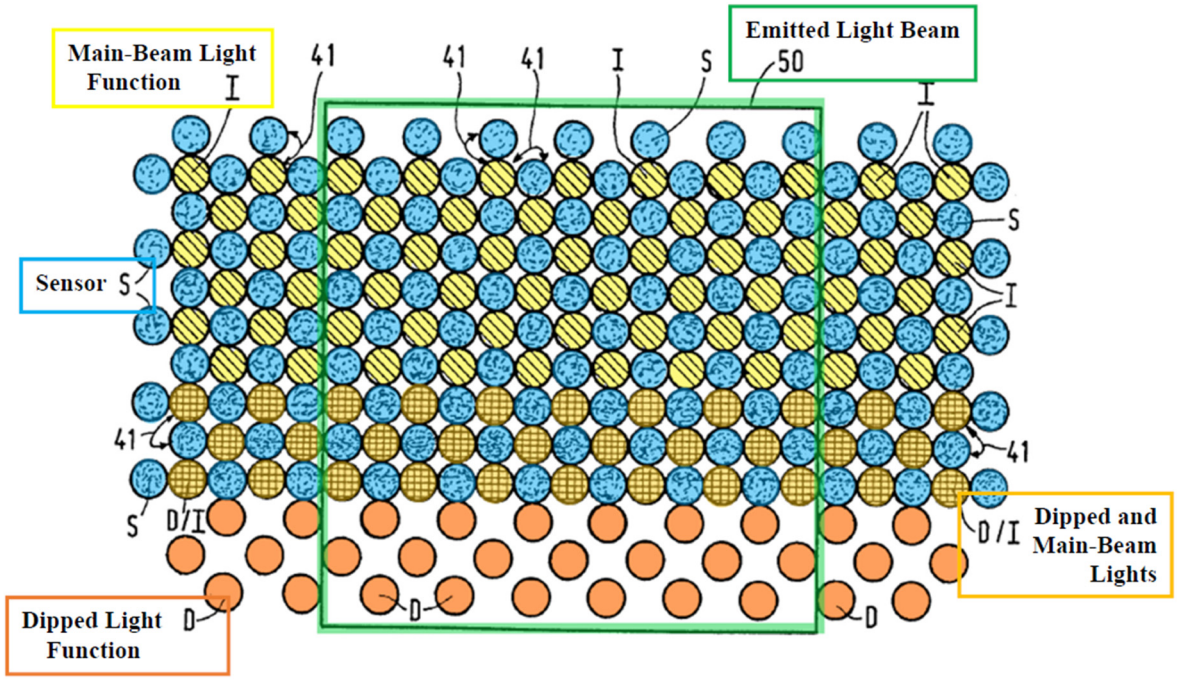
7. [20.6]/[59.4]

Karlsson discloses "*light-sensitive sensors* 9 and 23…*determin[e]* the direction and the intensity of the *detected light 11*." EX1010, 12:19-24, FIGS. 3, 14,

19:18-21 ("*spotlight sensors S*"), 5:16-23 ("*sensor means…spotlight sensors*"), 2:2-4, 9:6-8, 5:28-32; EX1003, ¶¶399-401.



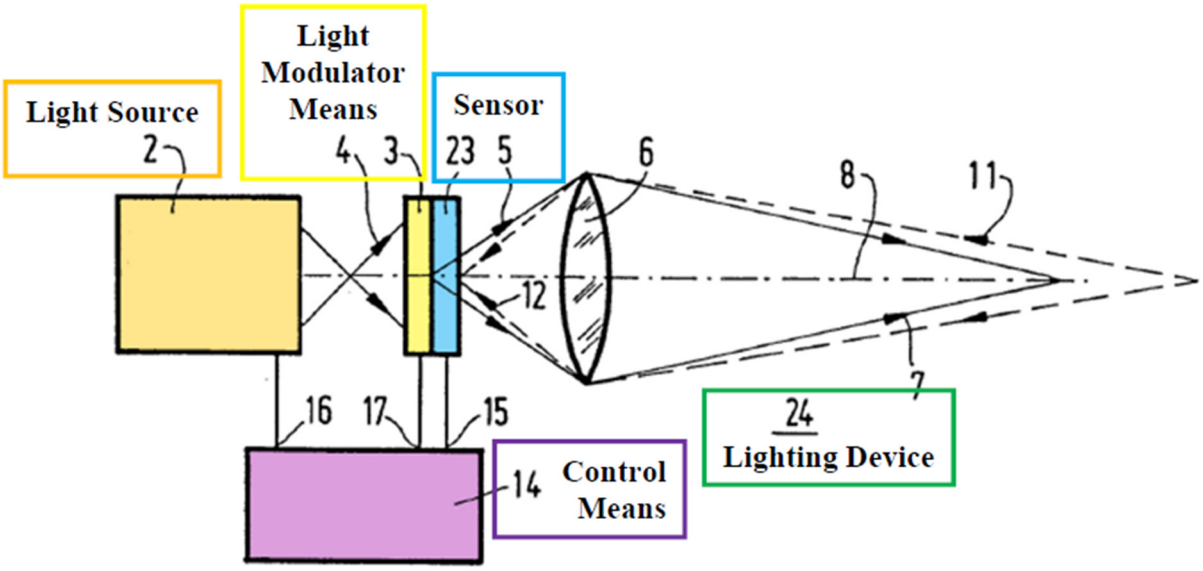
EX1010, FIG. 3 (annotated).



EX1010, FIG. 14 (annotated).

8. [20.7]/[59.5]

Karlsson discloses "light-sensitive sensor…*detects* the distribution and the intensity of light in the *area ahead of a vehicle*" for "detecting light from *oncoming traffic*." EX1010, 2:2-4, Abstract, FIGS. 3, 14, 3:19-20, 12:19-24 ("precisely determining the *direction* and the *intensity* of the *detected light 11*"), 5:16-32, 3:27-31; EX1003, ¶¶402-403. The incident light data is "sensed information indicating a second vehicle" (oncoming/preceding) as in [59.5], which is "pertinent to determining illumination output," as in [20.7]. EX1010, 9:11-17, 12:19-24, FIGS. 3, 15; EX1003, ¶402.

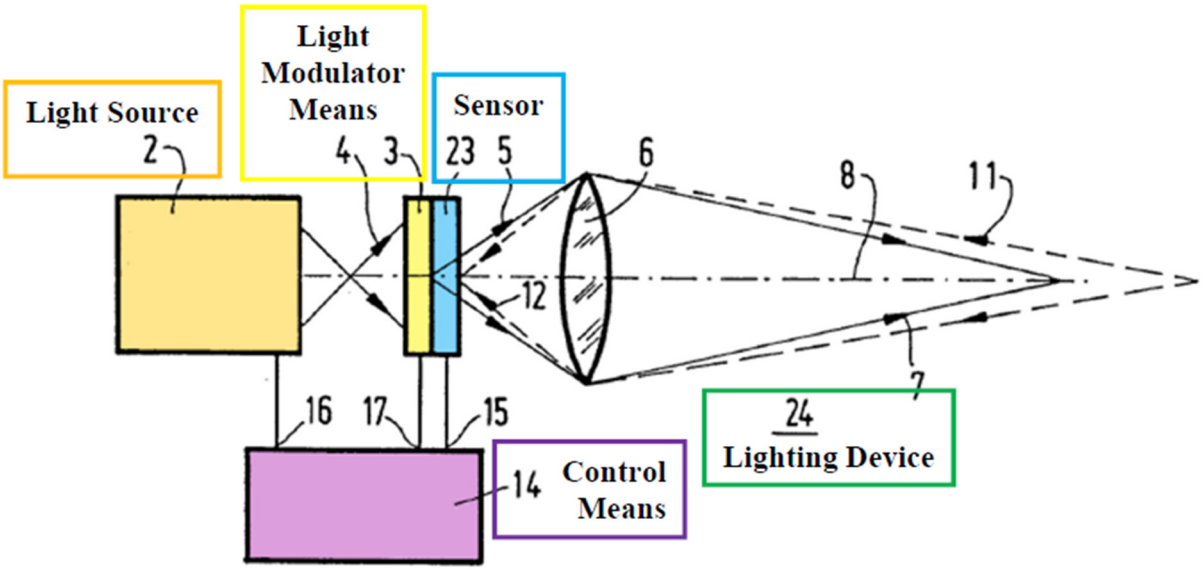


EX1010, FIG. 3 (annotated).

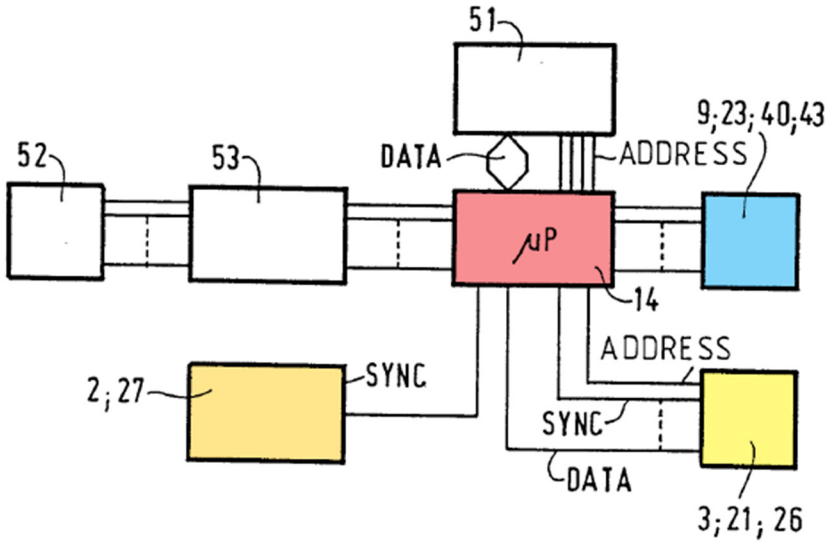
9. [20.8]/[59.6]

Karlsson discloses "*incident light 11* on the *light-sensitive sensor 9*…is *processed* into an *electric control signal* on input 15 of the *control means 14*."

EX1010, 9:9-17, FIGS. 3, 14-15, 21:36-22:1 ("*microprocessor*"), 20:12-32, 21:36-22:4; EX1003, ¶¶404-405. Thus, the incident light data from the sensor is communicated to a processor. *Id*., 9:9-17, 12:19-24, FIG. 15; EX1003, ¶¶405-406.



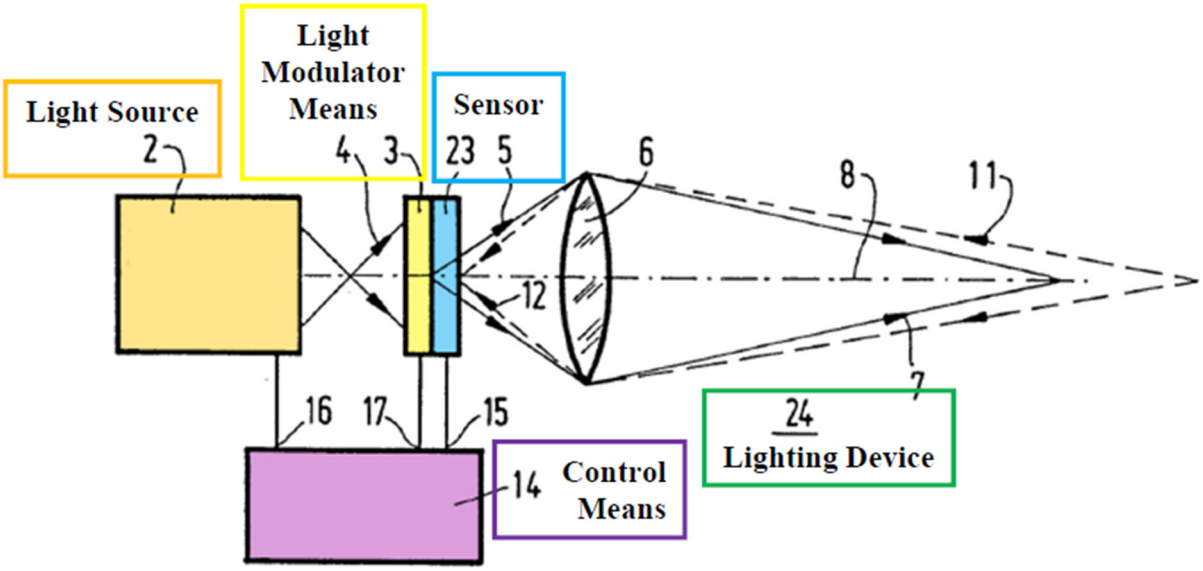
EX1010, FIG. 3 (annotated).



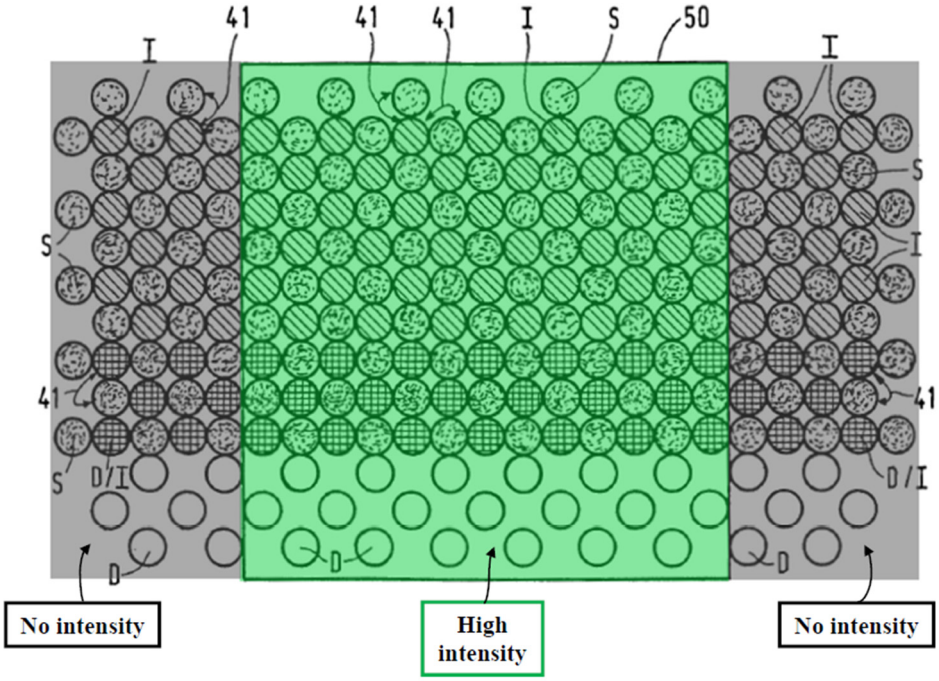
EX1010, FIG. 15 (annotated).

10. [20.9]/[59.7]

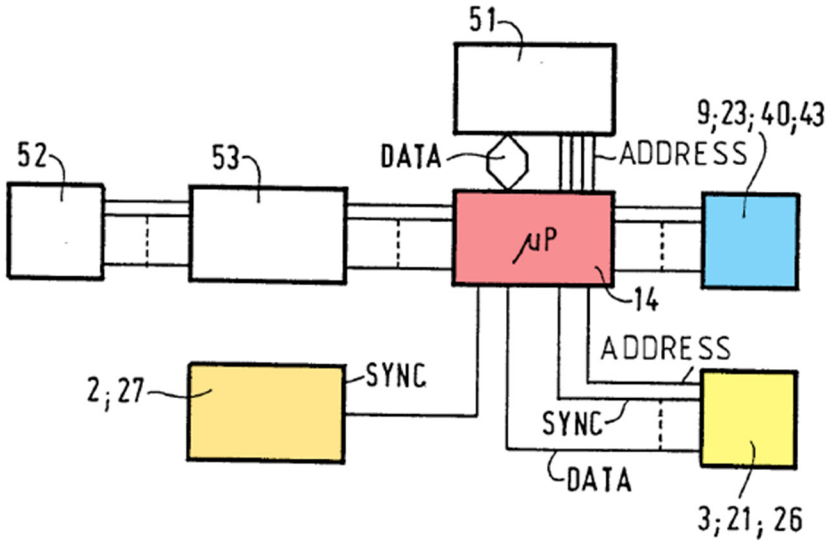
Karlsson discloses "incident light 11 on the light-sensitive sensor 9…is processed into an electric control signal on input 15 of the control means 14." EX1010, 9:9-17, FIGS. 3, 14-15, 5:16-23 ("detecting…oncoming traffic as a parameter"), 2:7-9 ("part of the light beam…is automatically suppressed"), 3:27-31 ("field of view"), 5:28-32, 9:18-26, 20:12-32, 21:36-22:4, 14:26-30; EX1003, ¶¶407-408. Thus, the processor processes the inputted incident light data, determines/identifies a vehicle within the headlight's field-of-view, and determines/identifies an area to be suppressed within a subsection of the field-of-view (shaded area of no intensity). EX1010, 9:9-17, 12:19-24, FIGS. 14-15; EX1003, ¶¶408-409.



EX1010, FIG. 3 (annotated).



EX1010, FIG. 14 (annotated).



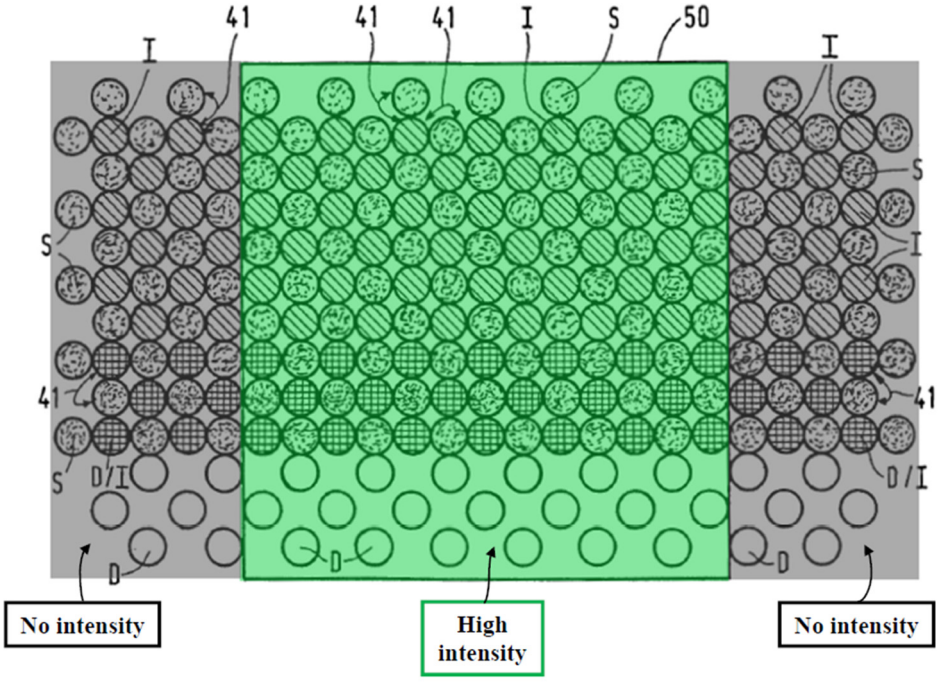
EX1010, FIG. 15 (annotated).

11. [20.10]

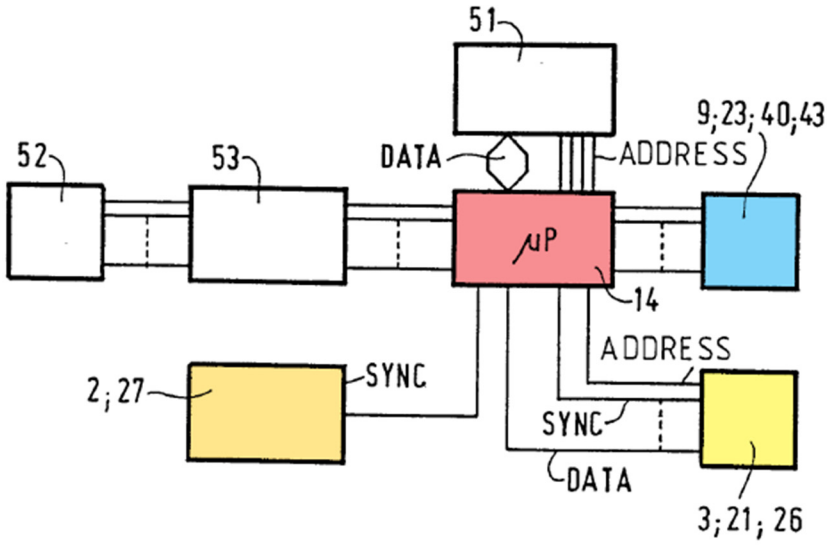
Karlsson discloses "the lighting *pattern* and the lighting *intensity* are *automatically adjusted*…permitting a light intensity which is generally *higher than*

that of conventional dipped headlights." EX1010, Abstract, FIGS. 3, 14-15, 2:7-9 ("*part of the light beam*…is automatically suppressed, whilst *retaining an optimum lighting* effect for the driver"), 19:23-33, 14:26-30, 5:16-32, 9:9-17; EX1003, ¶410.

As discussed, Karlsson discloses determining "a first subsection including a detected vehicle" (shaded area of no intensity). *Supra* Section X.B.10; EX1003, ¶¶407-409. Also, Karlsson's processor determines where light will *not* be suppressed—a second subsection of the field-of-view (non-shaded area of high intensity). EX1010, 5:16-23, 9:9-17, 12:19-24, FIGS. 14-15; EX1003, ¶408. Thus, Karlsson discloses determining "a second subsection not including the detected vehicle" (non-shaded area). EX1003, ¶411.



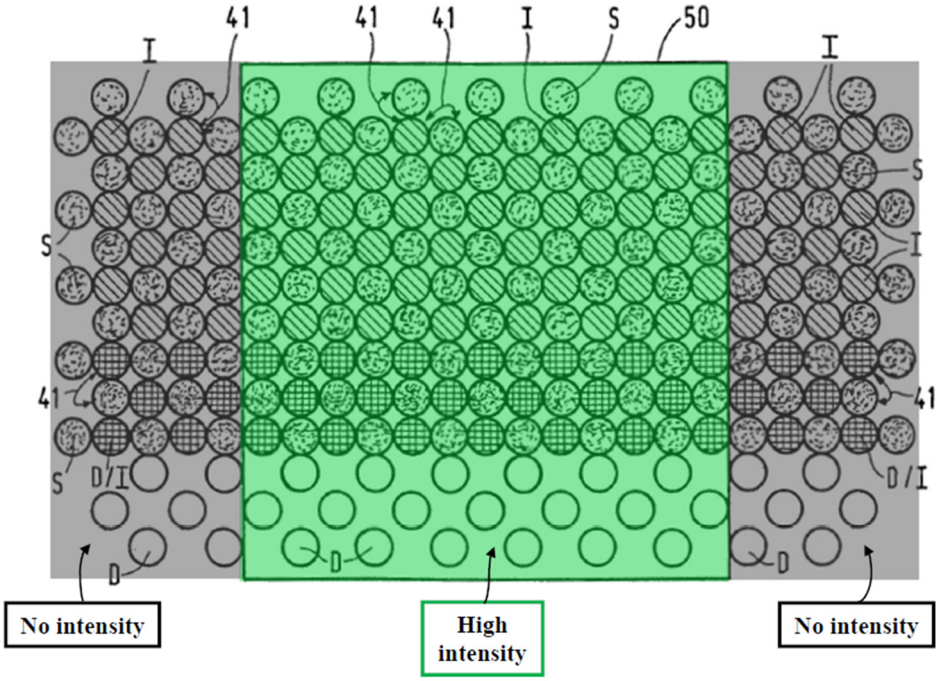
EX1010, FIG. 14 (annotated).



EX1010, FIG. 15 (annotated).

12. [20.11]

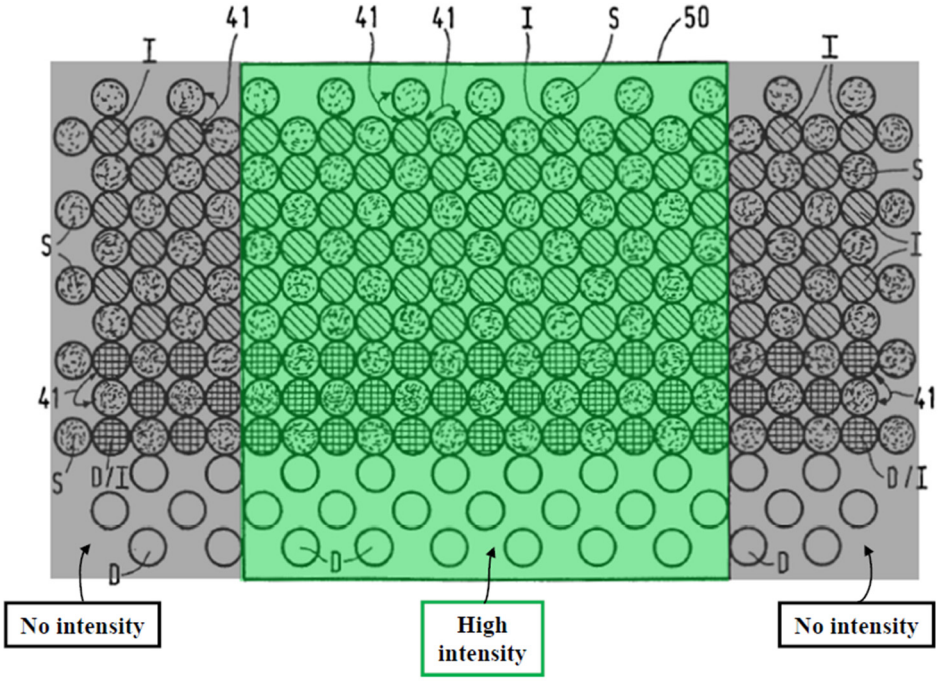
Karlsson discloses "light beam 7…*optimally adapted* to the road and to the ambient light" and "permitting a light intensity which is generally *higher than that of conventional dipped headlights*." EX1010, 9:18-26, Abstract, FIGS. 3, 14-15, 19:23-27 ("*main-beam light function*"), 19:29-33, 2:7-9 ("*part of the light beam*…is automatically suppressed, whilst *retaining an optimum lighting* effect for the driver of the vehicle"), 14:26-30, 5:28-32, 9:9-17, 5:16-32; EX1003, ¶412. As discussed, Karlsson-Harbers discloses "differently aimed directional light sources." *Supra* Section X.B.3; EX1003, ¶¶368-372. Thus, Karlsson discloses "maximiz[ing] vehicle operator visibility" in the second subsection (non-shaded area of high intensity). EX1003, ¶¶412-413.



EX1010, FIG. 14 (annotated).

13. [20.12]/[59.8]

Karlsson discloses "light beam 7…controlled in such a manner that *no light at all* or *light having a low intensity* is emitted in those directions from which light is detected…[thus] *glaring or blinding of oncoming traffic* is effectively *prevented*." EX1010, 9:18-26, FIGS. 3, 14-15, 19:23-27 ("*dipped light function*"), 2:7-9 ("*part of the light beam* which might cause *inconvenience to oncoming traffic* is automatically *suppressed*"), 5:28-32 ("*pattern of the light beam*…so as *not to emit light* in the direction of the detected light"), 14:26-30, 9:9-17, 5:16-32, 3:27-31; EX1003, ¶414. Karlsson thus "aims" suppressed illumination at the identified vehicle area as in [59.8], which "minimize[s] a disturbing effect" (glare) to the vehicle as in [20.12]. EX1010, 9:9-26, 2:7-9, 5:28-32, EX1003, ¶¶414-415.

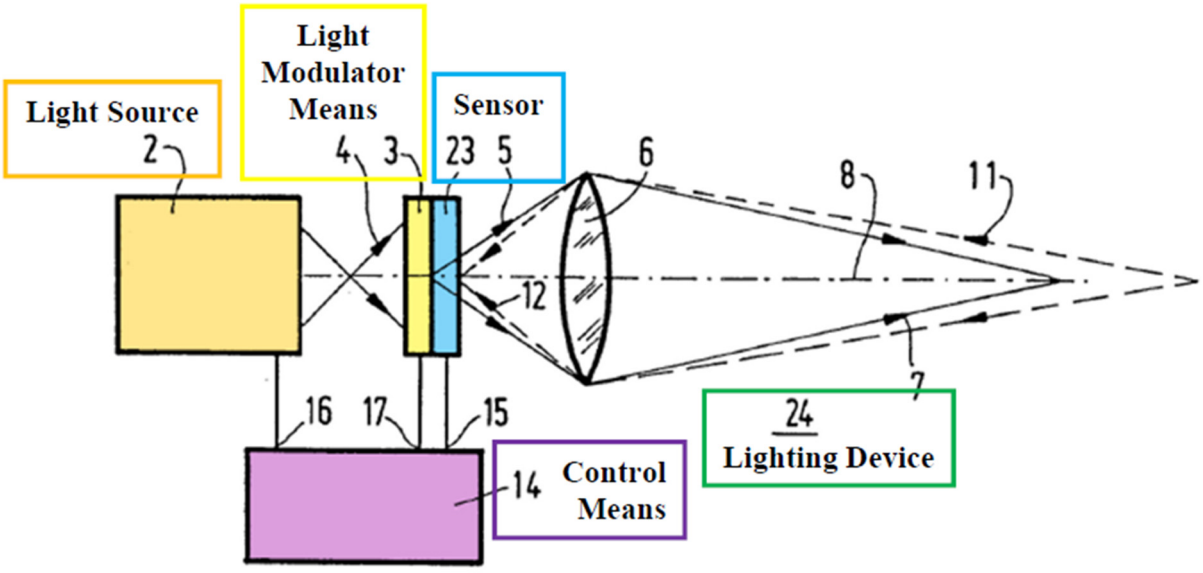


EX1010, FIG. 14 (annotated).

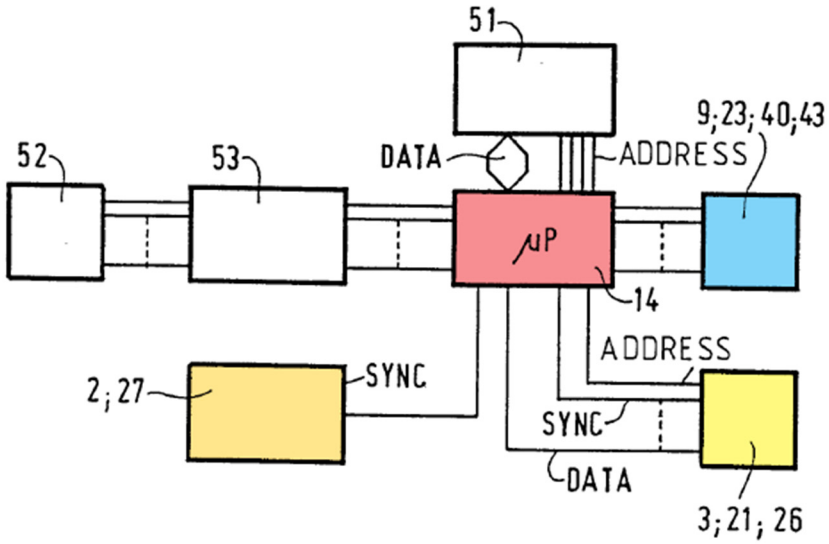
14. [20.13]/[59.12][10]

Karlsson discloses "lighting means 2, 3…controlled by control means 14, such that the incident light 11 on the light-sensitive sensor 9…is processed into an electric control signal on input 15 of the control means 14…[and] processed by the control means 14 into output signals at outputs 16, 17 thereof, so as to control the lighting means 2, 3 in such a manner that a light beam 7 having a desired pattern and a desired intensity is emitted." EX1010, 9:9-17, FIGS. 3, 14-15, 20:12-32, 21:36-22:4; EX1003, ¶¶416-418.

[10] [59.9]-[59.11] are addressed in Section X.C.



EX1010, FIG. 3 (annotated).



EX1010, FIG. 15 (annotated).

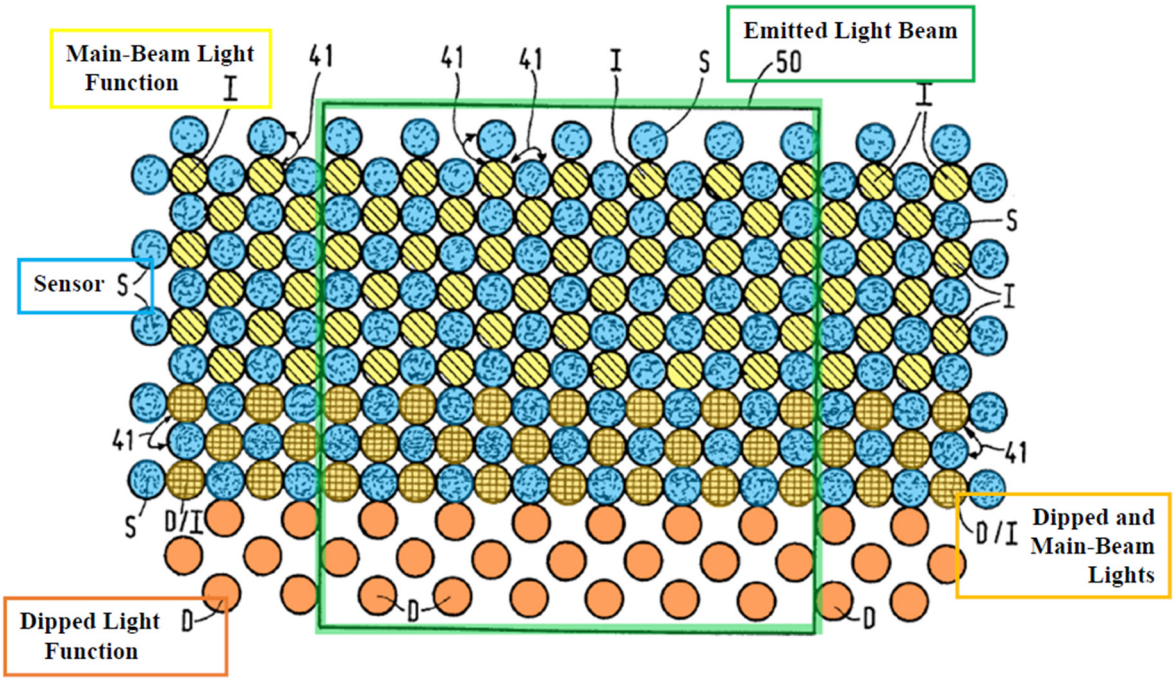
C. Additional Elements of Independent Claim 59

1. [59.9]

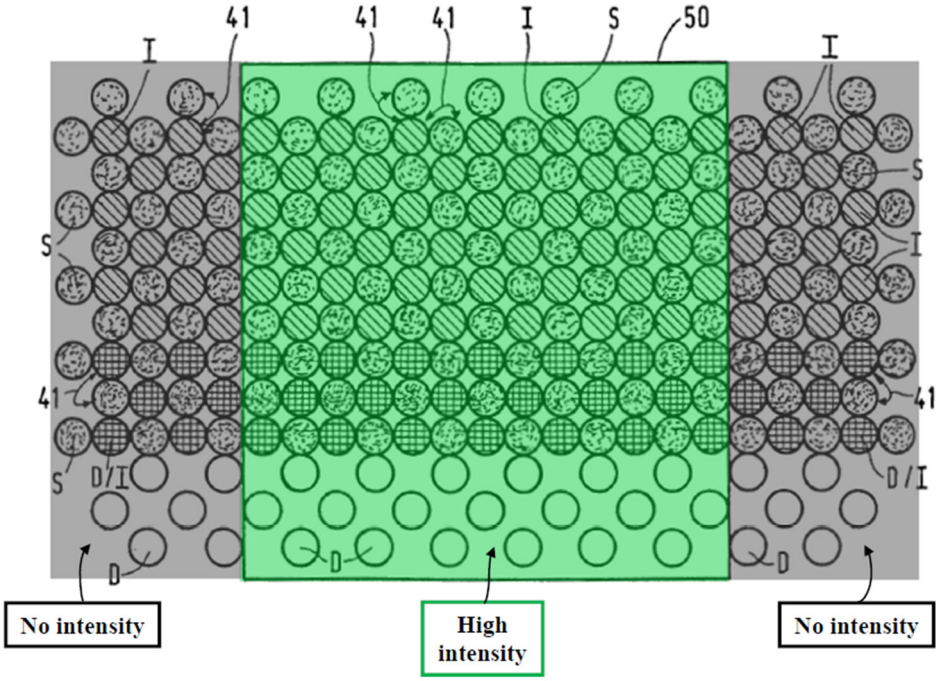
As discussed, Karlsson discloses [59.9]. *Supra* Section X; EX1003, ¶¶419-420; EX1010, 19:23-27 ("*dipped light function*"), 1:27-29 ("*low beams* or *dipped*

headlights"), 9:9-26, 2:7-9, 14:26-30, 5:16-32, 20:12-32, 21:36-22:4, Abstract, FIGS. 3, 14-15. Thus, a POSA would have understood that Karlsson's headlight includes a "predefined" illuminance, for example, a "dipped" illuminance. EX1003, ¶420.

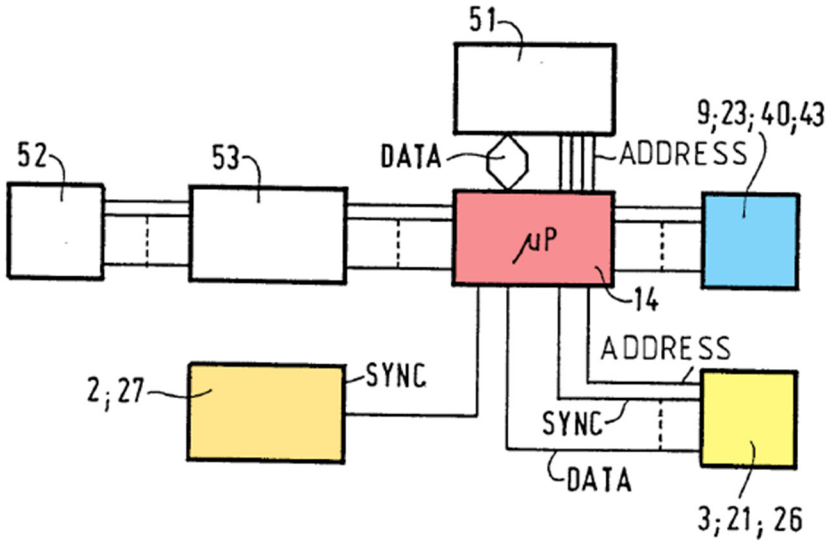
The first subsection (shaded area, e.g., outside emitted light beam 50) is illuminated "below a first predefined illuminance" because it receives "no light at all or light having a low intensity," which is *below* the dipped illuminance. *Id*., ¶¶421-422; EX1010, 9:18-26, FIG. 14.



EX1010, FIG. 14 (annotated).



EX1010, FIG. 14 (annotated).



EX1010, FIG. 15 (annotated).

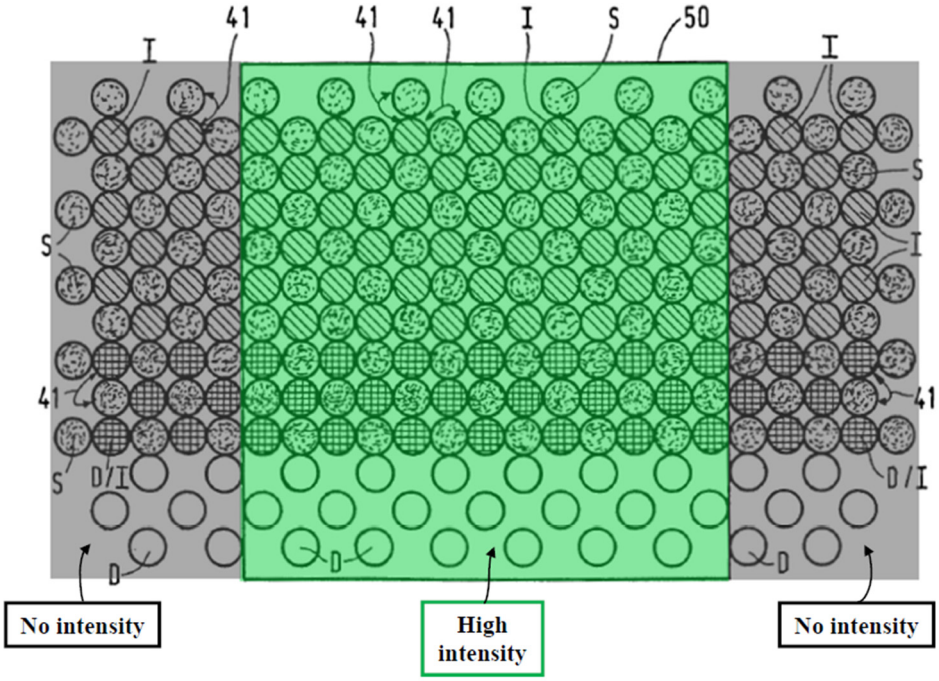
The ’503 patent does not disclose a predefined illuminance value, so a value is not required to satisfy [59.9]. EX1003, ¶423. Further, a POSA reading Karlsson would have understood Karlsson’s “dipped” illuminance, for example, teaches a

"predefined" illuminance, because Karlsson uses the dipped illuminance as a reference point below and above which to output illumination, preventing glare to other vehicles while increasing illumination to other areas. EX1003, ¶423; EX1010, 9:18-26.

Thus, Karlsson's system would illuminate the first subsection (shaded area) "below a first predefined illuminance." *Supra* Section X.A; EX1003, ¶¶423-424.

2. [59.10]

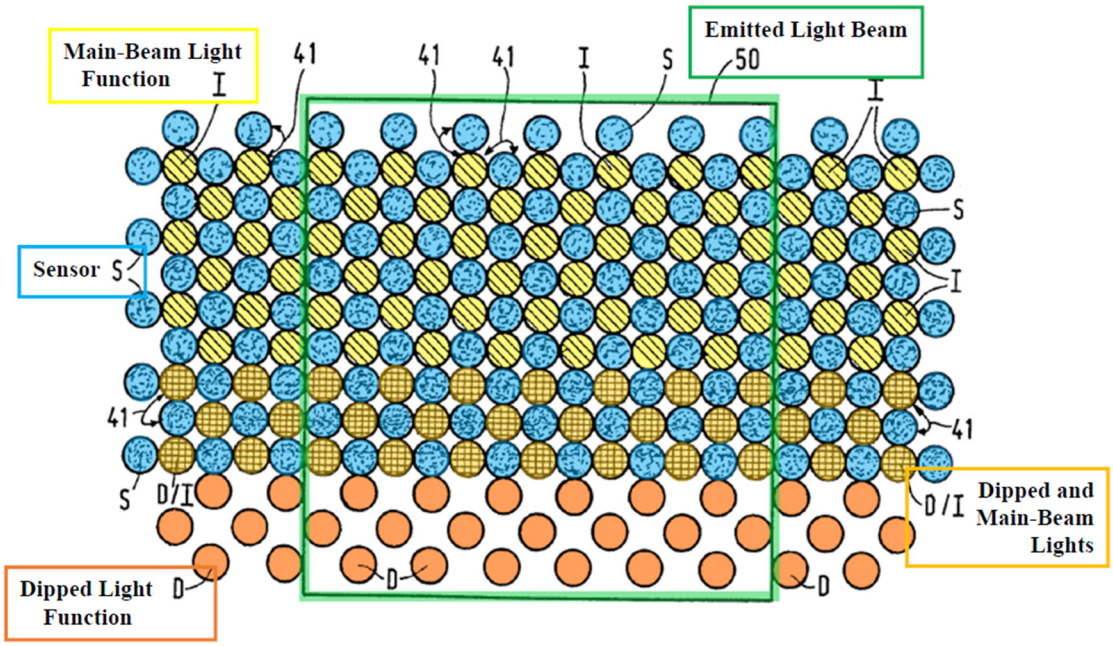
Karlsson discloses "the lighting *pattern* and the lighting *intensity* are *automatically adjusted*…permitting a light intensity which is generally *higher than that of conventional dipped headlights*." EX1010, Abstract, FIGS. 3, 14-15, 19:29-33 ("*emitted light beam 50*"), 2:7-9 ("*part of the light beam*…is automatically suppressed, whilst *retaining an optimum lighting* effect for the driver"), 19:26-27 ("*main-beam light function*"), 14:26-30, 5:16-32, 9:9-17; EX1003, ¶425. Karlsson thus "aims" the illumination at the different subsections, with a second subsection being to the side of the first subsection. EX1003, ¶¶425-426.



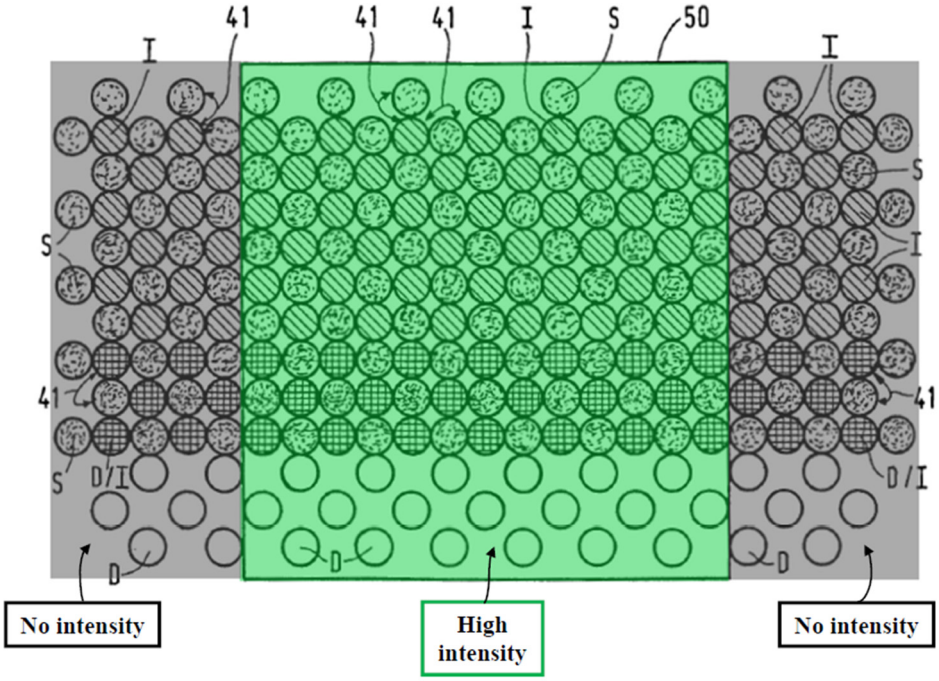
EX1010, FIG. 14 (annotated).

3. [59.11]

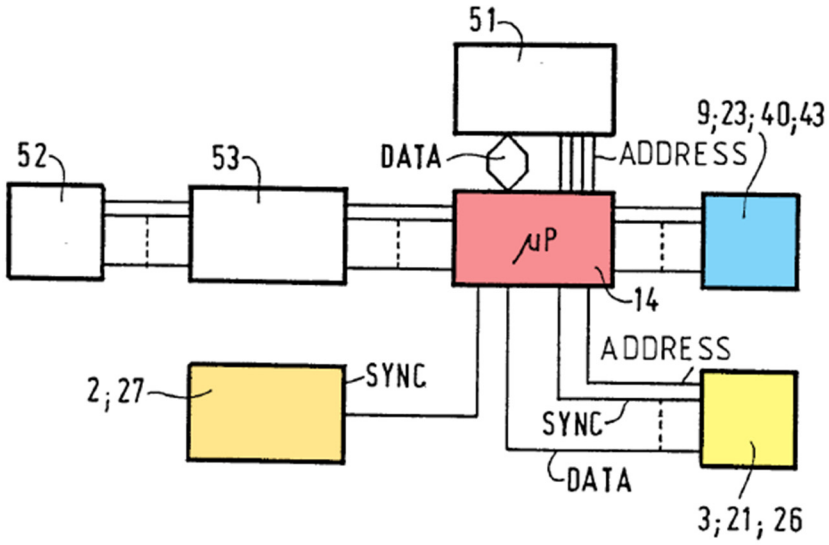
As discussed, Karlsson discloses [59.11]. *Supra* Section X; EX1003, ¶427; EX1010, 9:9-26, Abstract, 19:26-33, 2:7-9, 14:26-30, 5:16-32, FIGS. 3, 14-15. The second subsections (non-shaded areas, e.g., emitted light beam 50) are illuminated "above the first predefined illuminance" because the illuminance in those areas is "*higher* than that of conventional *dipped* headlights"—above a *dipped* illuminance. EX1003, ¶¶427-428; EX1010, Abstract, FIG. 14.



EX1010, FIG. 14 (annotated).



EX1010, FIG. 14 (annotated).



EX1010, FIG. 15 (annotated).

The '503 patent does not disclose a predefined illuminance value, so a value is not required to satisfy [59.11]. EX1003, ¶429. Further, a POSA reading Karlsson would have understood Karlsson's "dipped" illuminance, for example, teaches a "predefined" illuminance, because Karlsson uses the dipped illuminance as a reference point below and above which to output illumination, preventing glare to other vehicles while increasing illumination to other areas. EX1003, ¶429; EX1010, Abstract.

Thus, Karlsson's system would illuminate the second subsection (non-shaded area) "above the first predefined illuminance." *Supra* Section X.A; EX1003, ¶¶429-430.

D. Claims 24/63[11]

Karlsson discloses "*spotlight beam*…is understood to mean…a *light source of limited physical dimensions*, such as a *light-emitting diode*." EX1010, 4:32-35, FIGS. 6, 14, 5:4-15 ("*'Quantum Wells'* and the like"), 12:22 ("*photo diodes*"), 4:36-5:1 ("*pixel type light sources*"); EX1003, ¶¶431-432.

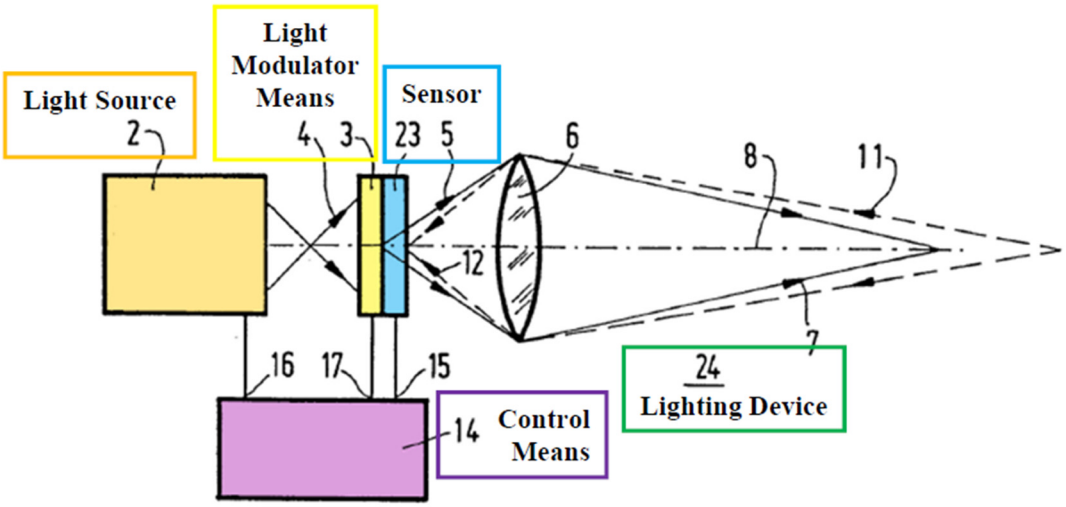
Further, laser diodes were well-known. EX1006, ¶28 ("*laser diodes*"); EX1003, ¶433. Indeed, the '503 patent admits laser diodes were known light sources. EX1001, 35:29-33; EX1037, Abstract ("*semiconductor laser*"); EX1003, ¶433. Thus, at a minimum, a laser diode would have been an obvious light source for Karlsson's controllable light source of "limited physical dimensions." EX1003, ¶433. And a POSA would have had a reasonable expectation of success, since a laser diode would have been just a simple substitution of one known prior art element for another. *KSR*, 550 U.S. at 416-418; EX1003, ¶¶433-434.

E. Claims 25/64[12]

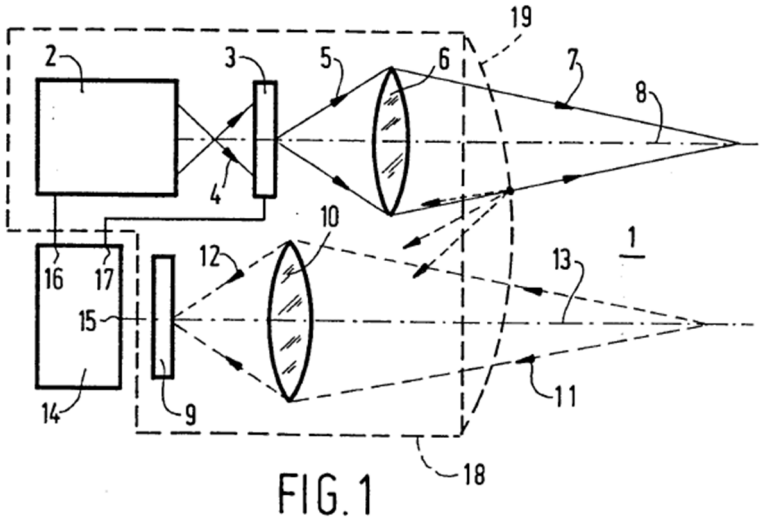
Karlsson discloses "light modulator means…of a type which *reflects light*…*'Micro Mirrors'*." EX1010, 5:7-15, FIGS. 1, 3, 8:15-17 ("a *lens 6*, which forms light 5 into a desired emitted light beam 7"), 8:27-35 ("*lenses 6, 10*"), Abstract, 5:11-15, 9:3-33, 10:32-11:1, 11:7-28; EX1003, ¶¶435-438.

[11] Claims 24 and 63 are identical. EX1003, ¶431.

[12] Claims 25 and 64 are patentably indistinct. EX1003, ¶435.



EX1010, FIG. 3 (annotated).



EX1010, FIG. 1.

XI. GROUND 6: THE COMBINATION OF KARLSSON, HARBERS, AND GOTOU RENDERS OBVIOUS CLAIMS 21-23 AND 60-62.

A. A POSA would have been motivated to combine Gotou with Karlsson-Harbers with a reasonable expectation of success.

As described in Section X.A, a POSA would have been motivated to combine Karlsson-Harbers. EX1003, ¶439. A POSA would have been further motivated to modify Karlsson-Harbers to adjust light based on map data including road curvature,

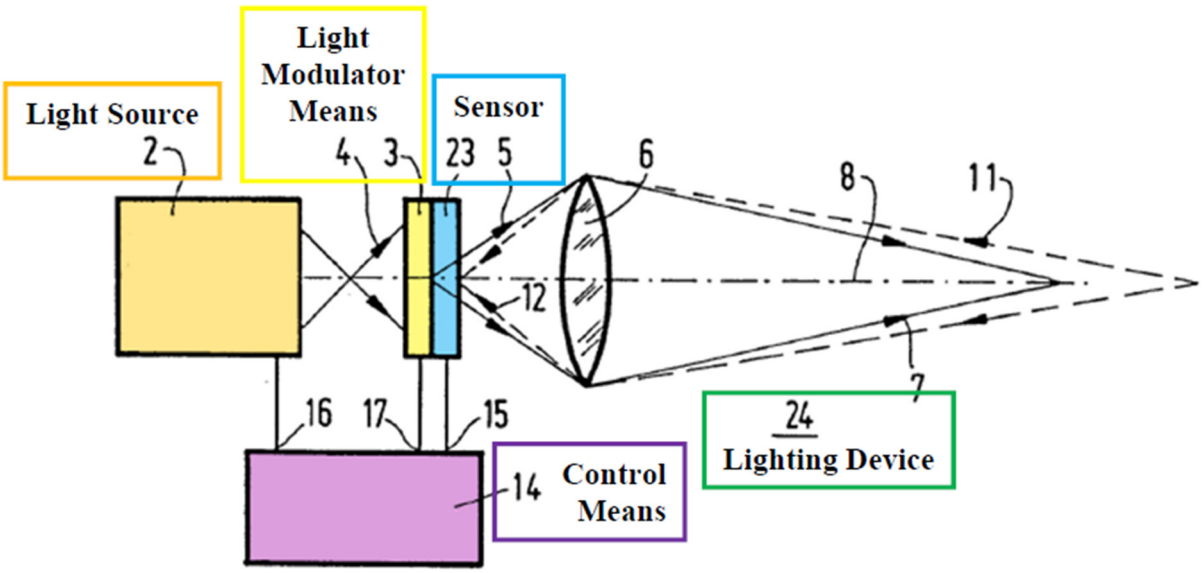
as in Gotou, to further control Karlsson-Harbers's directional spotlight beams to illuminate roadway curves, thereby improving driver safety—an express purpose of Karlsson. EX1003, ¶¶439, 446-448, 451; EX1010, 1:16-26, 4:17-21, 9:18-26.

Karlsson-Harbers and Gotou are from the same field—controllable headlamps with dynamic illumination—and include the same building blocks (light sources, sensors, controllers). Further, driver safety is paramount. EX1003, ¶450; EX1010, 1:21-26, 1:35-2:1, 9:18-26, 20:22-32; EX1012, 1:17-20, 2:19-26, 6:40-43.

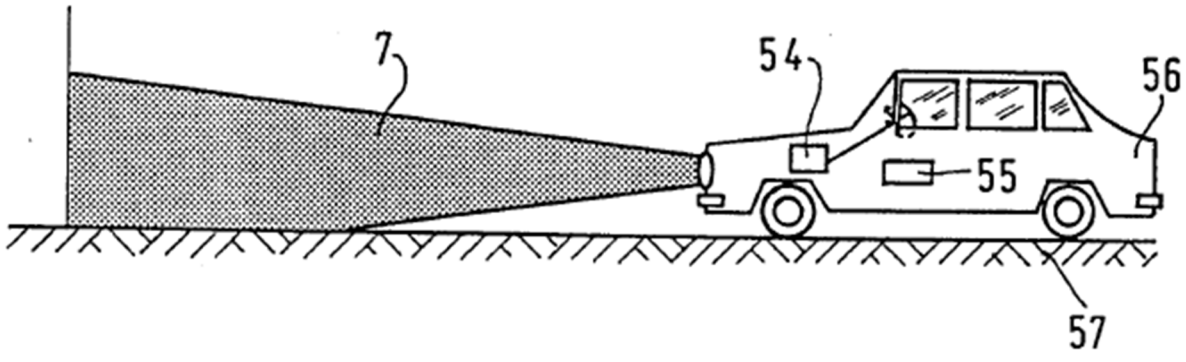
First, including an additional data source for Karlsson-Harbers's controller—Gotou's *known technique* of using map data including road curvature—would have enhanced Karlsson-Harbers by increasing/adjusting illumination based on the road curvature or a planned turn, improving driver safety by providing light to where it is needed. EX1003, ¶449. *Second*, a POSA would have easily incorporated *known components* of Gotou's navigation system 30 (including GPS receiver 34, *see* EX1012, Abstract, 1:35-40, 2:8-26, 3:24-55, 4:45-49, 6:4-61, 7:32-43, 8:28-35, FIGS. 1-3, 8-10) into Karlsson-Harbers. EX1003, ¶449. This would have, like Gotou, provided road curvature data for Karlsson-Harbers's detected field of view, allowing Karlsson-Harbers's system to increase increase/adjust illumination toward the road curvature, further improving visibility and safety. *Id.*

Karlsson "*selectively adjust[s]*…spotlight beam[s] 34, in response to a *control signal from sensor means 23*…provide a *desired lighting pattern*" in "given

directions." EX1010, 14:26-30, 11:25-28, FIGS. 3, 6, 14; EX1003, ¶452. Karlsson recognizes "[w]hen *taking a bend*…the road ahead…is *insufficiently lit*" and discloses using additional sensors, for example, "*direction sensor 54*…for determining when the car 56 is *taking a bend*, so that the light beam 7 can be *adapted*," and acknowledges the safety benefits of those systems. *Id*., 1:35-2:1; 20:22-32, FIG. 16, 6:26-33, 9:23-25; EX1003, ¶452.

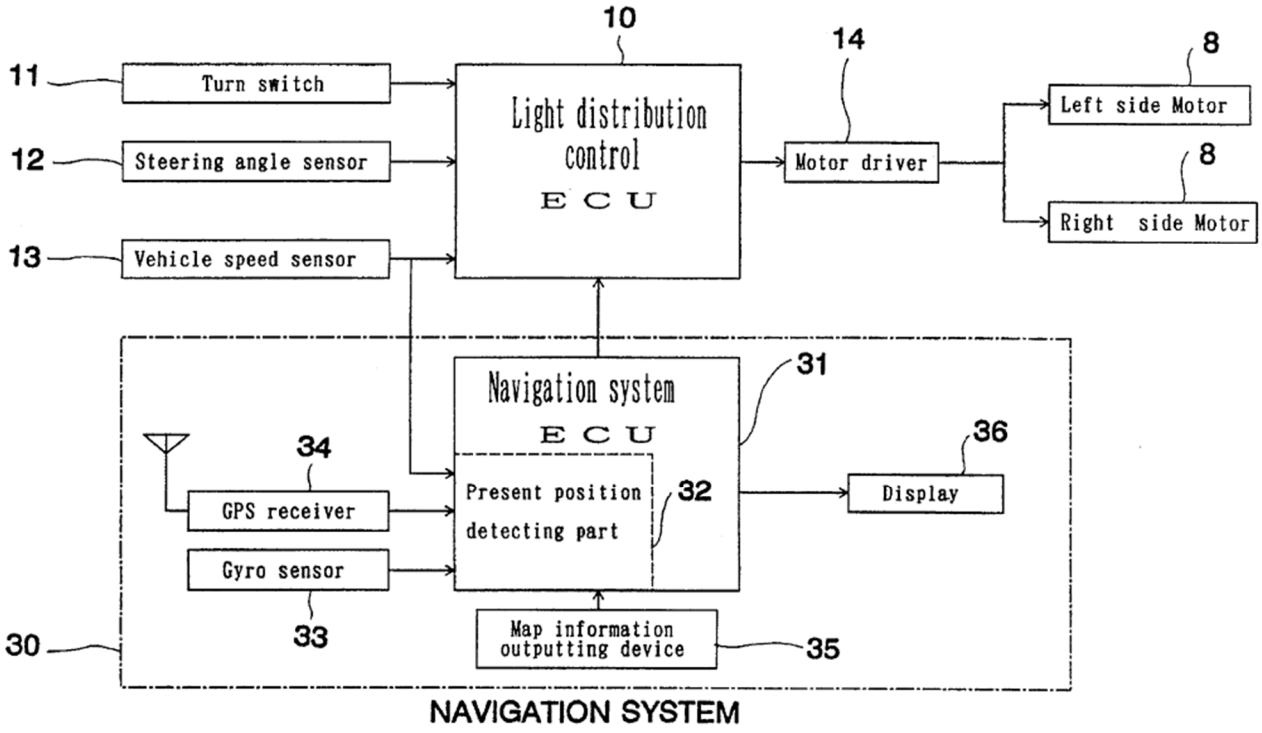


EX1010, FIG. 3 (annotated).



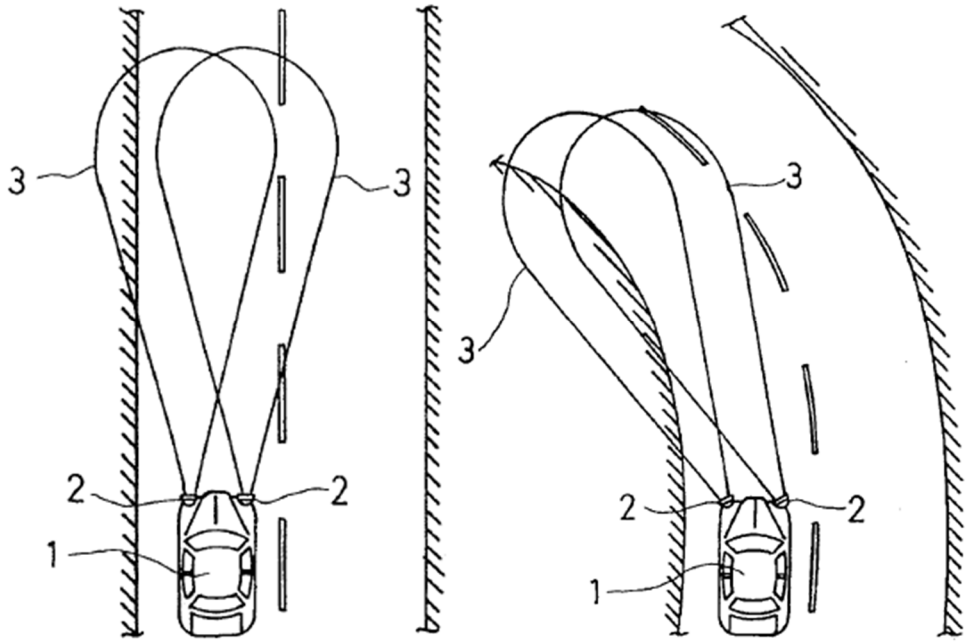
EX1010, FIG. 16.

If Patent Owner argues, incorrectly, that Karlsson-Harbers does not disclose details on how to detect curves, this was well-known in the art and would have been obvious in view of Gotou. EX1003, ¶453. This would have made Karlsson more active than prior systems, and further achieves Karlsson-Harbers's purpose of improving driver visibility and safety. EX1003, ¶453; EX1010, 1:35-2:1 ("[w]hen taking a bend"), 9:18-26, 20:22-32; EX1011, 5:14-26, 6:1-7, 6:27-7:19, 8:10-18. Gotou's active *techniques and system components*, like Karlsson-Harbers, seek to enhance driver safety—using map data-based control including road curvature. EX1012, 1:17-20, 2:19-26, 6:40-43; EX1003, ¶454. Gotou's navigation system 30 data is input to ECU 10, which alters the light direction from headlamp 2 in response to map data including road curvature input, directing light where it is needed at a given time, enhancing safety. EX1012, 4:30-49, 6:4-61, 8:28-35, FIGS. 1-3, 2:19-26 ("*superior visibility* can be attained"). Gotou's system responds to real-world conditions, multiple curves, and intersections. *Id*., 1:52-59, 2:19-26, 6:40-43, 8:28-35; EX1003, ¶454.



EX1012, FIG. 3.

Gotou's Figures 8-9 show that illumination control can be planned and controlled on roads with curves. EX1003, ¶455. When there is a leftward curve, the light distribution is adjusted leftward prior to reaching the curve. EX1012, 3:24-55, 7:32-43, 8:28-35, FIGS. 8-9; EX1003, ¶455.



EX1012, FIGS. 8-9.

Including an additional data source for Karlsson-Harbers's controller/processor—Gotou's map data including road curvature—would have enhanced Karlsson-Harbers by increasing/adjusting illumination of road curvatures, thereby improving driver safety. EX1003, ¶456. This would have merely been applying Gotou's known technique (using map data including road curvature from GPS to direct/redirect light) to Karlsson-Harbers's similar, known device (dynamic headlamp system with controllable spotlight beams), in the same way. EX1003, ¶456; *KSR*, 550 U.S. at 417. Gotou's known technique is fully described along with its benefits (improved visibility and safety); thus, a POSA would have readily applied it to similar systems, such as Karlsson-Harbers's, in the same way. EX1003, ¶456; *KSR*, 550 U.S. at 419-421.

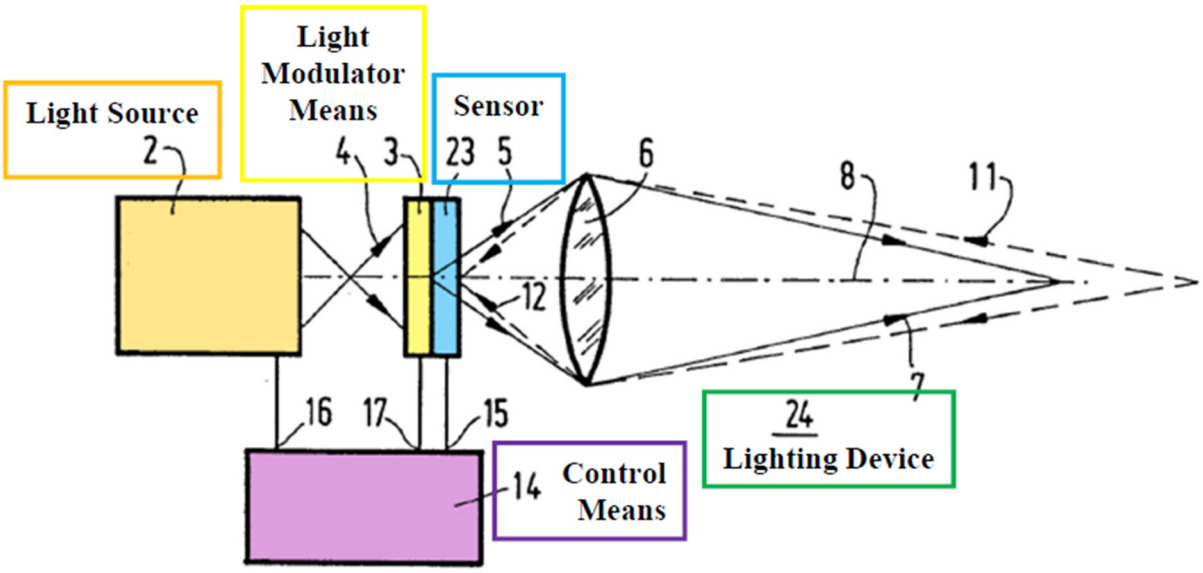
Additionally, or alternatively, this modification would have been simply combining known prior-art elements (Karlsson-Harbers's adaptive, direction-controllable headlamps with Gotou's directional control based on map data including road curvature) according to known methods (disclosed in Karlsson-Harbers and Gotou) to yield predictable results (illuminating curves, improving safety). EX1003, ¶457; *KSR*, 550 U.S. at 415-416.

A POSA would have had a reasonable expectation of success combining Gotou with Karlsson-Harbers, for example, by simply modifying software instructions stored in memory of Karlsson-Harbers's controller/processor (ECU) to adjust and direct light of the spotlight beams appropriately in view of Gotou's map data including road curvature. EX1003, ¶458. It also would have been a straightforward combination of prior-art elements: Gotou's navigation system 30 (including GPS receiver 34) with Karlsson-Harbers (in communication with Karlsson's controller). EX1003, ¶458.

This would have been routine and well within a POSA's skill due to the similarities in Karlsson-Harbers's and Gotou'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. EX1003, ¶459.

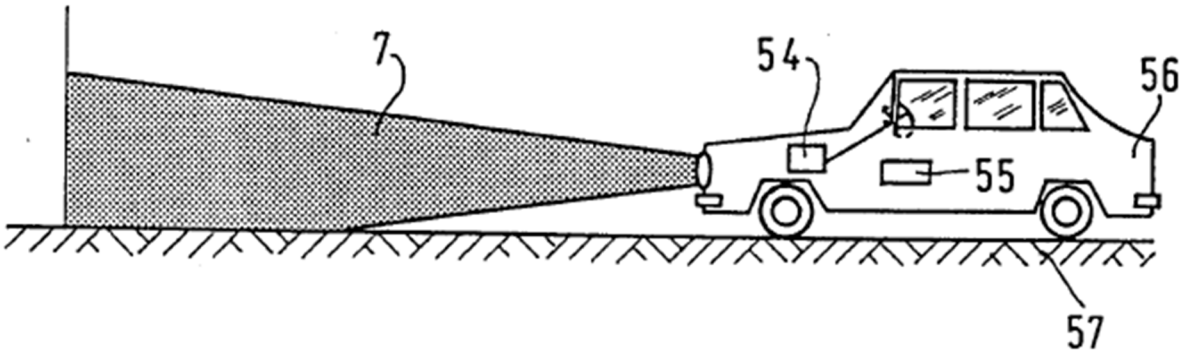
B. Claims 21/60[13]

Karlsson-Harbers discloses claims 21 and 60. EX1003, ¶¶440-441, 460. Karlsson discloses "a light-sensitive sensor, which detects…the area *ahead of a vehicle*" and "*direction sensors*, for detecting whether a vehicle is *taking a bend*." EX1010, 2:2-4, 6:26-33, FIGS. 3, 14-16, 20:29-32 ("*direction sensor 54*…determin[es] when the car 56 is *taking a bend*, so that the *light beam 7 can be adapted*"), 9:11-17; EX1003, ¶442.

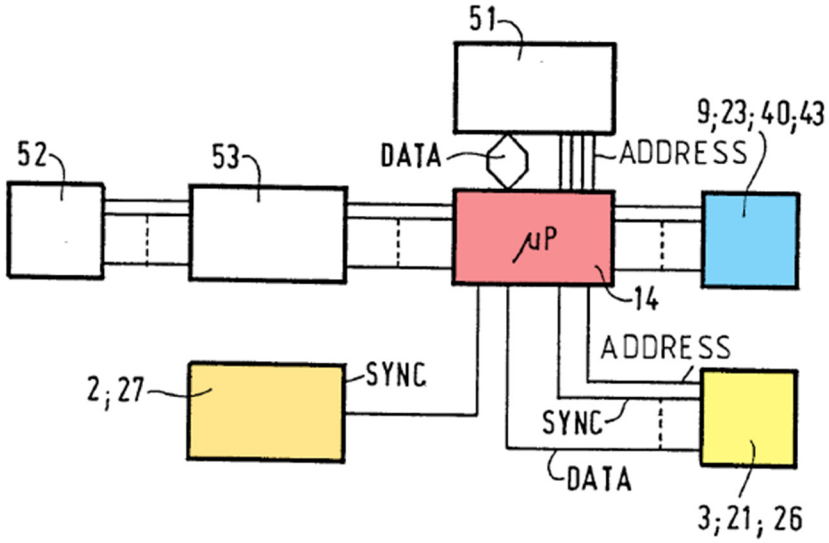


EX1010, FIG. 3 (annotated).

[13] Claims 21 and 60 are patentably indistinct. EX1003, ¶441.



EX1010, FIG. 16.

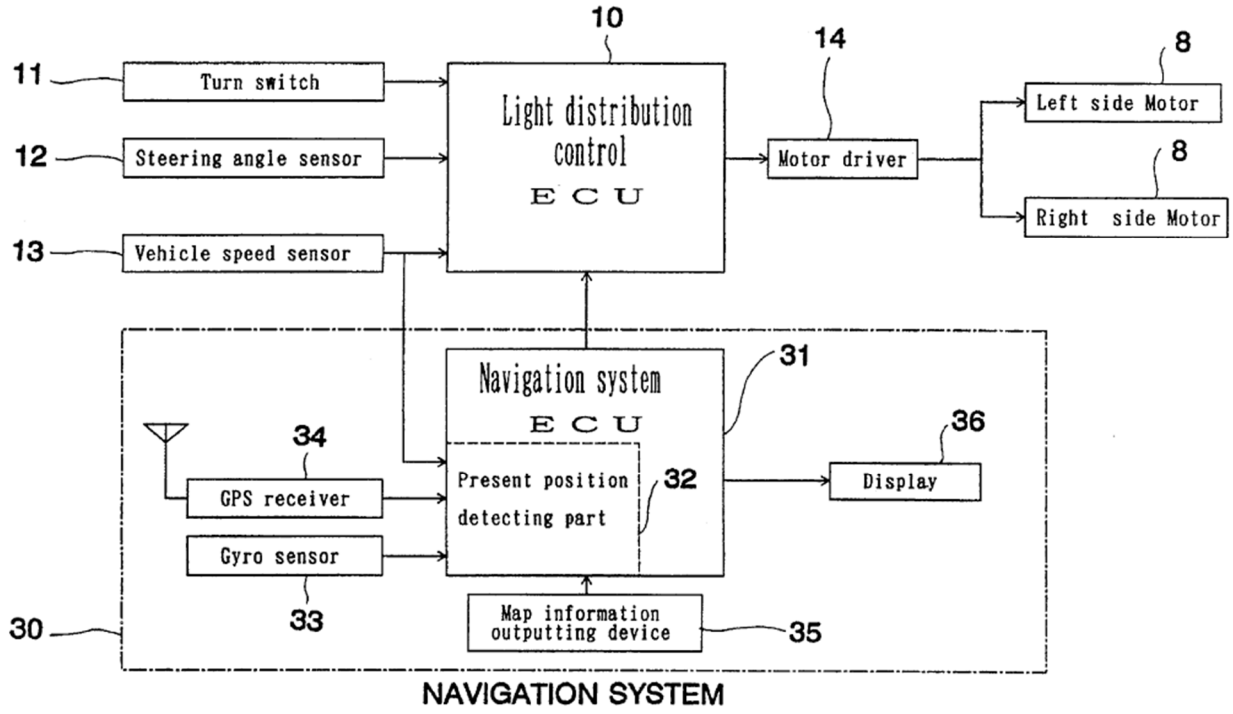


EX1010, FIG. 15 (annotated).

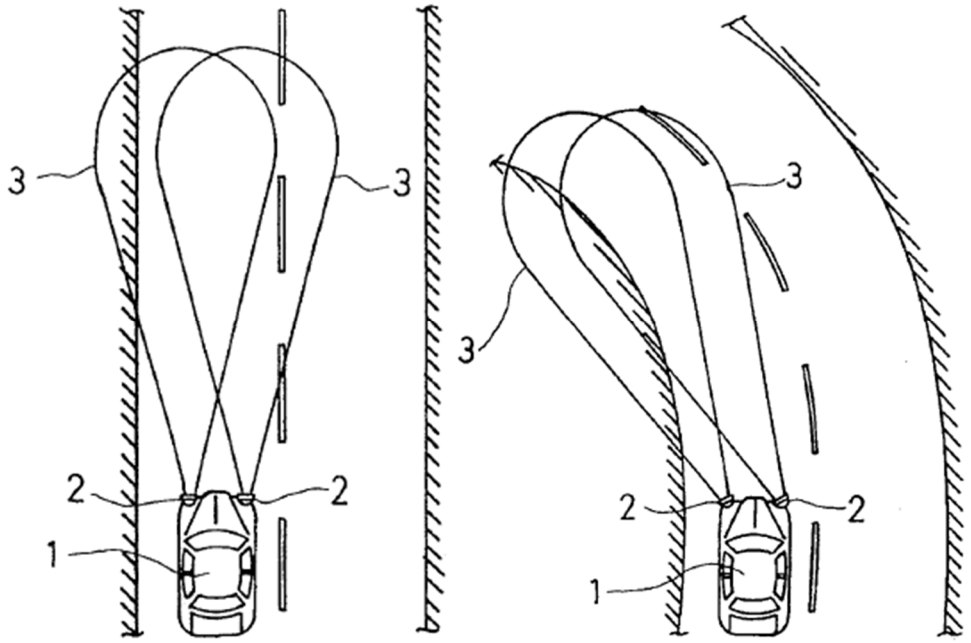
If Patent Owner argues, incorrectly, that Karlsson-Harbers does not disclose claims 21 and 60, Gotou does. EX1003, ¶443.

Gotou discloses "ECU 10 gets *map information*…from the navigation system 30…to *determine a requisite optical axis angle θ*" and "estimation of the *forward road shape*…[based] on the *road data* of the map information, so that the lighting region is changed early *in the turning direction* and the *visibility is improved*." EX1012, 3:52-63, 8:28-35, FIGS. 3, 8-9, 4:30-49 ("*map information*…such

as…*directions of the curves*"), 6:28-39 ("*analyz[ing]* whether the *forward curve* is…rightward or leftward"); EX1003, ¶444.



EX1012, FIG. 3.



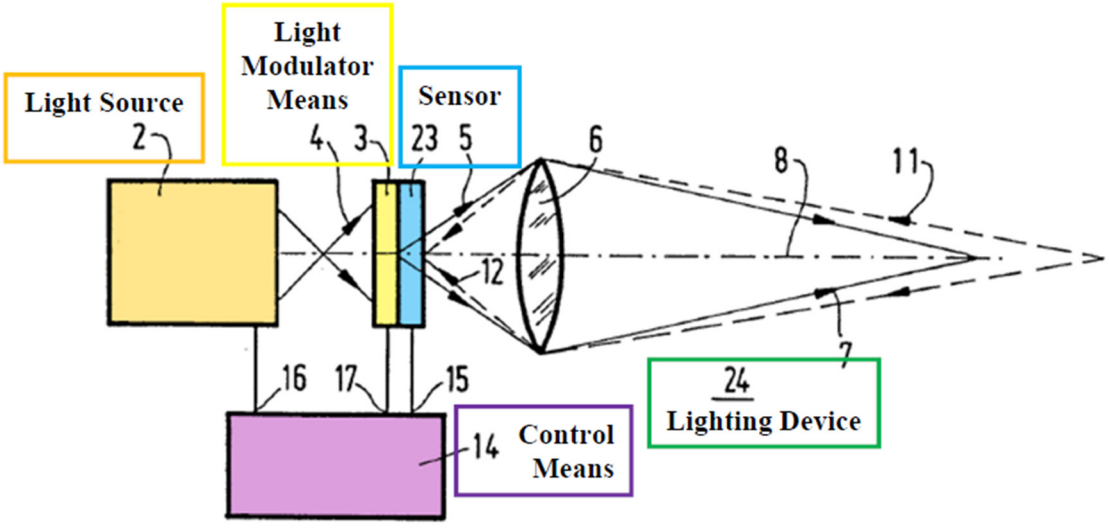
EX1012, FIGS. 8-9.

As discussed, a POSA would have been motivated to combine Gotou with Karlsson-Harbers with a reasonable expectation of success. *Supra* Section X.A; EX1003, ¶445.

Thus, Karlsson-Harbers, or combined with Gotou, renders obvious claims 21 and 60. EX1003, ¶460.

C. Claims 22/23[14]/61[15]/62[16]

Karlsson-Harbers discloses claims 22-23 and 61-62. Karlsson discloses "a light-sensitive sensor, which detects…the area *ahead of a vehicle*" and "*direction sensors*, for detecting whether a vehicle is *taking a bend*." EX1010, 2:2-4, 6:26-33, FIGS. 3, 14-16, 20:29-32 ("*direction sensor 54*…determin[es] when the car 56 is *taking a bend*, so that the light beam 7 can be adapted"), 9:9-17; EX1003, ¶464.

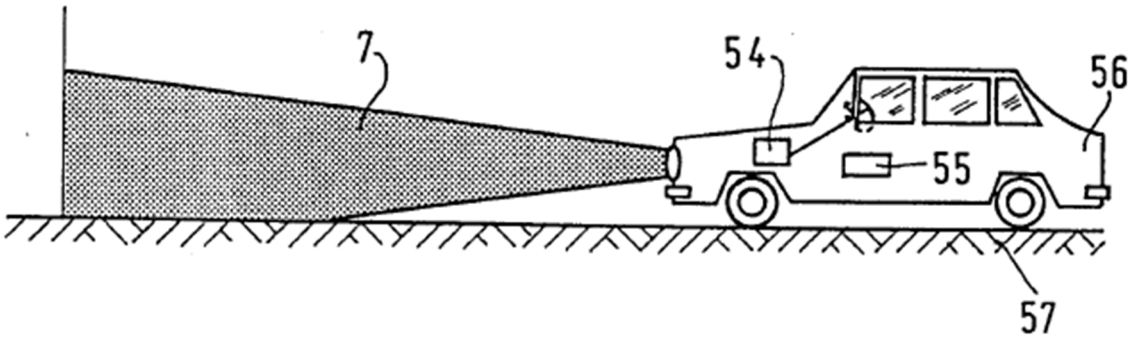


[14] Claims 22-23 are identical. EX1003, ¶461.

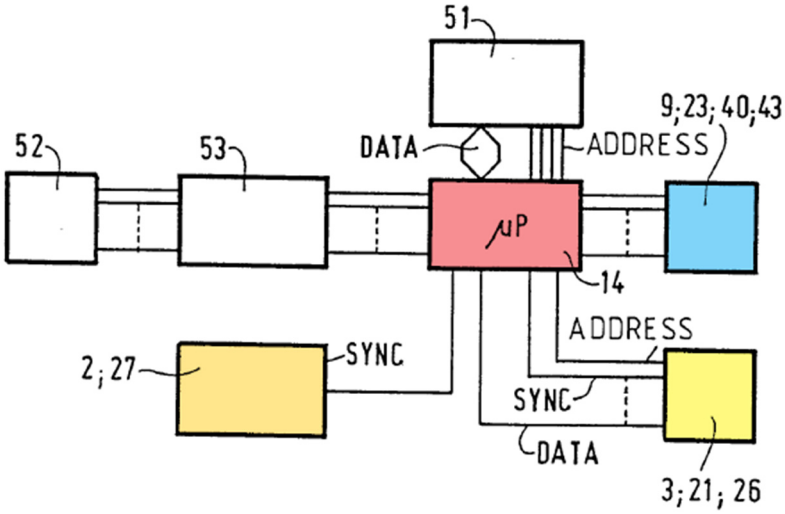
[15] Claims 22 and 61 are patentably indistinct. EX1003, ¶462.

[16] Claims 61-62 are identical. EX1003, ¶463.

EX1010, FIG. 3 (annotated).



EX1010, FIG. 16.

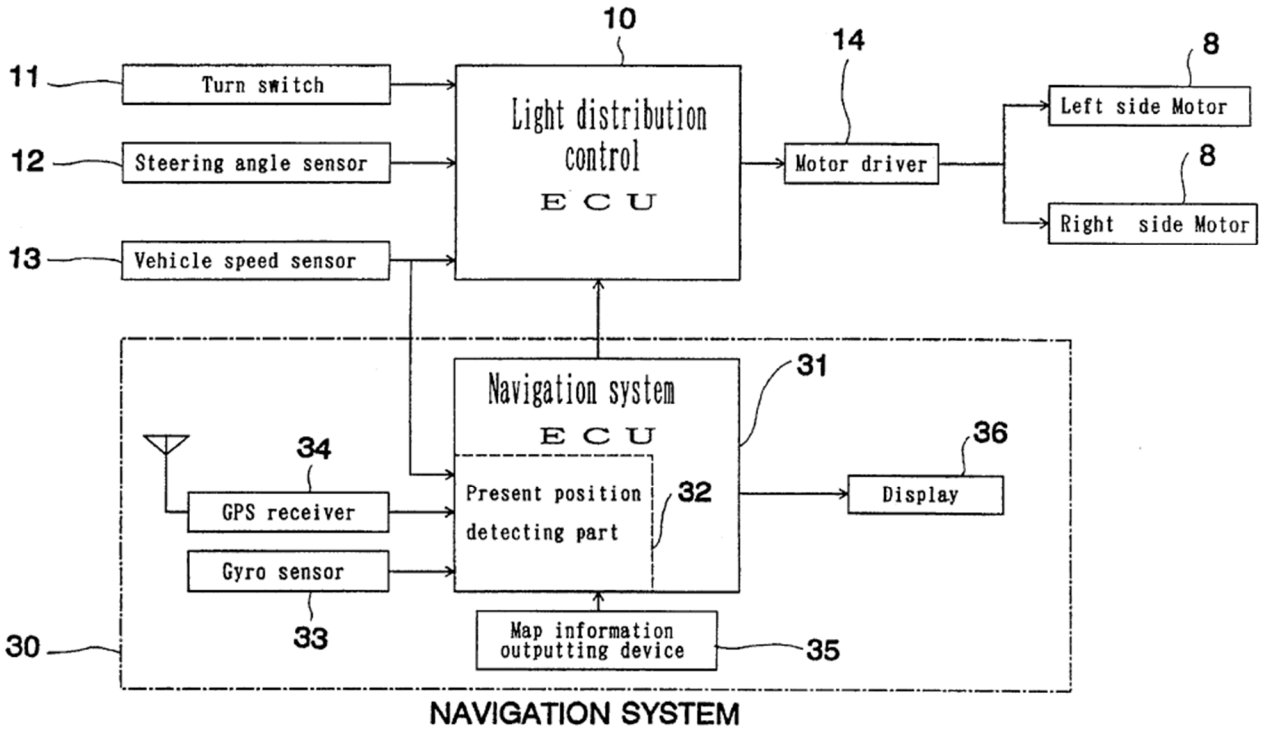


EX1010, FIG. 15 (annotated).

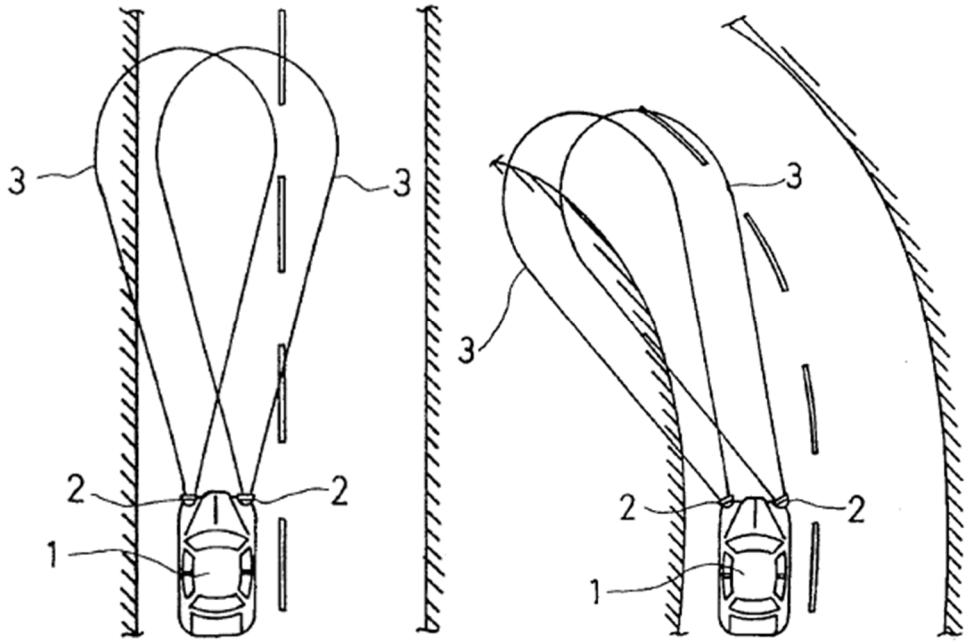
If Patent Owner argues, incorrectly, that Karlsson-Harbers does not disclose claims 22-23 and 61-62, Gotou does. EX1003, ¶465.

Gotou discloses "ECU 10 gets *map information*…from the navigation system 30…to *determine a requisite optical axis angle* θ" and "map information…*improves the visibility* by varying the optical axis toward the *planned running direction* at an early stage *before the steering wheel is actually turned*." EX1012, 3:52-67, 6:40-43,

FIGS. 3, 8-10, 6:8-17 ("the optical axis is swung…toward the *planned* running path"), 4:30-49 ("*map information*…such as…*directions of the curves*"), 6:28-39; EX1003, ¶466. A POSA would have understood that Gotou discloses a "planned upcoming turn" because the "planned running direction" includes an intended direction of a driver (e.g., left or right turn). EX1003, ¶466; EX1001, 54:1-15.



EX1012, FIG. 3.



EX1012, FIGS. 8-9.

As discussed, a POSA would have been motivated to combine Gotou with Karlsson-Harbers with a reasonable expectation of success. *Supra* Section X.A; EX1003, ¶467.

Thus, Karlsson-Harbers, or combined with Gotou, renders obvious claims 22-23 and 61-62. EX1003, ¶¶468-469.

XII. 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, ¶¶470-472. 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 '503 patent has different

claims, for which that evidence is inapplicable. Petitioner reserves the right to address any evidence Patent Owner presents.

XIII. DISCRETIONARY CONSIDERATIONS UNDER SECTIONS 314(A) AND 325(D) STRONGLY FAVOR INSTITUTION

A. The *Fintiv* factors strongly favor institution.

The *Fintiv* factors strongly favor institution. *Apple Inc. v. Fintiv, Inc.*, IPR2020-00019, Paper 11 (P.T.A.B. Mar. 20, 2020) (precedential); *see* June 21, 2022 Memorandum: Interim Procedure for Discretionary Denials in AIA Post Grant Proceedings with Parallel District Court Litigation ("June 2022 Memo").

Factor 1 is neutral or favors institution. No motion for stay has been filed and the court has not indicated whether it would grant any such motion. Because the Board typically "will not attempt to predict how the district court in the related district court litigation will proceed," *Sand Revolution II, LLC v. Continental Intermodal Group – Trucking LLC*, IPR2019-01393, Paper 24 at 7 (P.T.A.B. June 16, 2020) (informative), factor 1 carries little weight here.

Factor 2 strongly favors institution. The co-pending litigation in the DDE is in its early stages, no trial date has been set, and the median time to trial for civil actions in DDE is three years (36 months). EX1035, District Court Statistics, 14; *see* June 2022 Memo, 3. Thus, trial would likely occur (if at all) in mid-2025—over a year after the projected final decision here. *See Mylan Pharms. Inc. v. Bayer*

Pharma Aktiengesellschaft, IPR2022-00517, Paper 15 at 8-9 (P.T.A.B. Aug. 9, 2022) (evaluating median time to trial for factor 2).

Factor 3 strongly favors institution. By institution, neither the parties nor the DDE court will have invested significant resources in the litigation. The court has not issued a scheduling order, or any substantive rulings (e.g., claim construction, dispositive motion). Petitioner's diligence filing this Petition less than 6 months after the complaint, and long before Patent Owner's infringement contentions, confirm that factor 3 strongly favors institution.

Factors 4 and 5 strongly favor institution. Petitioner stipulates that, if the Board institutes this Petition, Petitioner will not raise at trial in parallel litigation any Ground raised here. Petitioner's stipulation mitigates concerns for duplicating efforts and inconsistent conclusions.

Factor 6 strongly favors institution. The Petition's merits are strong. *See* June 2022 Memo, 3-5. Additionally, under factor 6: (1) the Board is best suited to address the technical issues raised here; (2) a decision on the merits at institution may aid the parties in resolving their dispute; and (3) determining patentability will benefit the public, providing a complete record and rationale absent from a jury verdict form. Patent Owner has already sued at least 8 defendants and could potentially sue others in view of the accused technology.

Holistically, the *Fintiv* factors strongly favor institution.

B. *Advanced Bionics* strongly favors institution.

The two-part framework from *Advanced Bionics, LLC v. MED-EL Elektromedizinische Geräte GmbH*, IPR2019-01469, Paper 6 at 8-9 (P.T.A.B. Feb. 13, 2020) (precedential), demonstrates that denial under § 325(d) is not appropriate. Under Part 1, the same or substantially the same art or arguments were not previously presented to the Office, ending the inquiry in favor of institution. No references forming a Ground were applied or cited during the '503 patent's prosecution. The "new, noncumulative prior art" asserted here strongly favors institution. *Oticon Med. AB v. Cochlear Ltd.*, IPR2019-00975, Paper 15 at 20 (P.T.A.B. Oct. 16, 2019) (§§ II.B, II.C precedential). If Patent Owner attempts to analogize any previously considered art or arguments to those presented here, Petitioner reserves the right to respond.

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

A. Real Party In Interest (37 C.F.R. § 42.8(b)(1))

The real party-in-interest is Petitioner Volkswagen Group of America, Inc., which is a subsidiary of Volkswagen AG.

B. Related Matters (37 C.F.R. § 42.8(b)(2))

The '503 patent is the subject of the following pending civil action: *Torchlight Techs. LLC v. Daimler AG et al.*, Civil No. 1:22-cv-00751 (D. Del.), filed June 7, 2022. Petitioner, Volkswagen Group of America, Inc., was voluntarily dismissed without prejudice from this civil action on September 23, 2022.

The '503 patent claims the benefit of U.S. Patent Nos. 9,955,551 ("the '551 patent") and 8,100,552.

U.S. Patent No. 11,208,029 ("the '029 patent") claims the benefit of the '503 patent. On October 3, 2022, Petitioner filed a petition for *inter partes* review of the related '029 patent (IPR2022-01586).

C. Lead and Back-up Counsel (37 C.F.R. § 42.8(b)(3))

Pursuant to 37 C.F.R. §§ 42.8(b)(3) and 42.10(a), Petitioner appoints **Michael D. Specht** (Reg. No. 54,463) as lead counsel and **Jason A. Fitzsimmons** (Reg. No. 65,367) as first back-up counsel. Additionally, Petitioner appoints **Danny E. Yonan** (Reg. No. 53,812), **Brian G. Burke** (Reg. No. 75,349), and **Ian B. Soule** (Reg. No. 74,290) as additional back-up counsel, at the address: STERNE, KESSLER, GOLDSTEIN & FOX P.L.L.C., 1100 New York Avenue, N.W., Washington, D.C., 20005, phone (202) 371-2600, and facsimile (202) 371-2540.

D. Service Information (37 C.F.R. § 42.8(b)(4))

Petitioner consents to electronic service by email at the following addresses:

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XV. CONCLUSION

Petitioner requests institution and a final written decision finding claims 20-25 and 59-64 unpatentable.

Respectfully submitted,

STERNE, KESSLER, GOLDSTEIN & FOX P.L.L.C.

/Michael D. Specht/

Michael D. Specht (Reg. No. 54,463)
Attorney for Petitioner
Volkswagen Group of America, Inc.

Date: November 30, 2022

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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 13,762 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 2016 in 14 point Times New Roman.

Respectfully submitted,

STERNE, KESSLER, GOLDSTEIN & FOX P.L.L.C.

/Michael D. Specht/

Michael D. Specht (Reg. No. 54,463)
Attorney for Petitioner
Volkswagen Group of America, Inc.

Date: November 30, 2022

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

The undersigned hereby certifies that on November 30, 2022, true and correct copies of the foregoing **PETITION FOR INTER PARTES REVIEW OF U.S. PATENT NO. 10,894,503**, Petitioner's Power of Attorney, and all associated exhibits were served in their entireties on the following parties via FedEx Express®:

BROOKS KUSHMAN P.C.
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Southfield, Michigan 48075
PAIR Correspondence Address for U.S. Pat. No.: 10,894,503

Respectfully Submitted,

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Appendix A

Claim 20	Claim 59[17]
[20.P] A vehicle headlight system, comprising:	[59.P] identical to [20.P]
[20.1] one or more headlamps affixed to a vehicle,	[59.1] one or more headlamps affixed to a first vehicle,
[20.2] each headlamp including at least three directional light sources aimed at different angles relative to the vehicle,	[59.2] each headlamp including at least three directional light sources having different aimings relative to the first vehicle,
[20.3] the light sources configured to have one or more controllable light characteristics,	[59.3] the light sources having one or more controllable illumination characteristics;
[20.4] wherein a first light source of the more than one light sources at a first angle is less visually disturbing to traffic than a second light source of the more than one light sources aimed at a second angle, different from the first angle;	
[20.5] control circuitry configured to adjust the at least one light characteristic of at least one of the directional light sources;	
[20.6] one or more sensors configured to sense information,	[59.4] identical to [20.6]
[20.7] defined as pertinent to determining illumination output from the one or more headlamps and	[59.5] at least a portion of the sensed information indicating a second vehicle, and

[17] Petitioner demonstrates the unpatentability of elements [59.P]-[59.8] and [59.12] of claim 59 by showing that claim 20 is unpatentable.

Claim 20	Claim 59[17]
[20.8] communicating the sensed information to a processor as sensor data;	[59.6] communicate sensor data reflecting the sensed information to at least one processor,
[20.9] the processor, in communication with at least the sensors and the control circuitry, configured to: process the sensor data to determine, within a field-of-view, at least a first subsection including a detected vehicle and	[59.7] wherein the at least one processor is configured to: process the sensor data to identify a first subsection, of a field of view, that includes at least a portion of the second vehicle;
	[59.8] Language shown below with [20.12]
	[59.9] the illumination aimed at the first subsection substantially resulting in light below a first predefined illuminance in the first subsection, and
[20.10] at least a second subsection not including the detected vehicle,	
	[59.10] that aims illumination at one or more second subsections of the field of view to either side of the first subsection,
[20.11] determine optimal use of the differently aimed directional light sources to maximize vehicle operator visibility in at least the second subsection,	
	[59.11] the illumination aimed at the one or more second subsections substantially resulting in light above the first predefined illuminance in the one or more second subsections; and

Claim 20	Claim 59[17]
[20.12] while minimizing a disturbing effect, resulting from the illumination output, on the vision of other traffic in at least the first subsection, and	[59.8] determine light output for the headlight system that aims illumination at the first subsection,
[20.13] direct the control circuitry to adjust the directional light sources to achieve the determined optimal use.	[59.12] instruct adjustment of one or more of the light sources to achieve the determined output.

EX1001, 97:58-98:21, 102:14-40 (numbering and spacing added).

Appendix B

Claim listing:

Claim:	Element:	Claim Language:
Claim 20	[20.P]	A vehicle headlight system, comprising:
	[20.1]	one or more headlamps affixed to a vehicle,
	[20.2]	each headlamp including at least three directional light sources aimed at different angles relative to the vehicle,
	[20.3]	the light sources configured to have one or more controllable light characteristics,
	[20.4]	wherein a first light source of the more than one light sources at a first angle is less visually disturbing to traffic than a second light source of the more than one light sources aimed at a second angle, different from the first angle;
	[20.5]	control circuitry configured to adjust the at least one light characteristic of at least one of the directional light sources;
	[20.6]	one or more sensors configured to sense information
	[20.7]	defined as pertinent to determining illumination output from the one or more headlamps and
	[20.8]	communicating the sensed information to a processor as sensor data;
	[20.9]	the processor, in communication with at least the sensors and the control circuitry, configured to: process the sensor data to determine, within a field-of-view, at least a first subsection including a detected vehicle and
	[20.10]	at least a second subsection not including the detected vehicle,

	[20.11]	determine optimal use of the differently aimed directional light sources to maximize vehicle operator visibility in at least the second subsection,
	[20.12]	while minimizing a disturbing effect, resulting from the illumination output, on the vision of other traffic in at least the first subsection, and
	[20.13]	direct the control circuitry to adjust the directional light sources to achieve the determined optimal use.
Claim 21	-	The system of claim 20, wherein the processor is further configured to determine at least a road curvature, indicated by the sensor data, ahead of the vehicle and to direct the control circuitry to adjust the directional light sources to increase illumination in a direction of the road curvature.
Claim 22	-	The system of claim 21, wherein the processor is further configured to determine at least a planned upcoming turn, indicated by the sensor data, and to direct the control circuitry to increase illumination illuminating the turn.
Claim 23	-	The system of claim 20, wherein the processor is further configured to determine at least a planned upcoming turn, indicated by the sensor data, and to direct the control circuitry to increase illumination illuminating the turn.
Claim 24	-	The system of claim 20, wherein at least one light source provided to at least one of the one or more headlamps further includes a laser diode.
Claim 25	-	The system of claim 20, wherein at least one of the one or more headlamps further includes at least one of reflectors, refractors, or lenses usable to alter emitted light from at least one of the light sources.
Claim 59	[59.P]	A vehicle headlight system, comprising:

	[59.1]	one or more headlamps affixed to a first vehicle,
	[59.2]	each headlamp including at least three directional light sources having different aimings relative to the first vehicle,
	[59.3]	the light sources having one or more controllable illumination characteristics;
	[59.4]	one or more sensors configured to sense information,
	[59.5]	at least a portion of the sensed information indicating a second vehicle, and
	[59.6]	communicate sensor data reflecting the sensed information to at least one processor,
	[59.7]	wherein the at least one processor is configured to: process the sensor data to identify a first subsection, of a field of view, that includes at least a portion of the second vehicle;
	[59.8]	determine light output for the headlight system that aims illumination at the first subsection,
	[59.9]	the illumination aimed at the first subsection substantially resulting in light below a first predefined illuminance in the first subsection, and
	[59.10]	that aims illumination at one or more second subsections of the field of view to either side of the first subsection,
	[59.11]	the illumination aimed at the one or more second subsections substantially resulting in light above the first predefined illuminance in the one or more second subsections; and
	[59.12]	instruct adjustment of one or more of the light sources to achieve the determined output.

Claim 60	-	The system of claim 59, wherein at least one of the at least one processors is further configured to determine at least a road curvature, indicated by the sensor data, ahead of the first vehicle and to determine light output that aims illumination in a direction of the road curvature.
Claim 61	-	The system of claim 60, wherein at least one of the at least one processors is further configured to determine at least a planned upcoming turn, indicated by the sensor data, and to determine light output that illuminates the turn.
Claim 62	-	The system of claim 59, wherein at least one of the at least one processors is further configured to determine at least a planned upcoming turn, indicated by the sensor data, and to determine light output that illuminates the turn.
Claim 63	-	The system of claim 59, wherein at least one light source provided to at least one of the one or more headlamps further includes a laser diode.
Claim 64	-	The system of claim 59, wherein at least one of the one or more headlamps further includes at least one of reflectors, refractors, or lenses usable to alter the light emitted from at least one of the light sources as part of the instructed adjustment.