UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE PATENT TRIAL AND APPEAL BOARD

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PORSCHE CARS NORTH AMERICA, INC.,
Petitioner

v.

YECHEZKAL EVAN SPERO,
Patent Owner

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Case IPR2023-01321
U.S. Patent No. 10,894,503 B2

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# DECLARATION OF SCOTT ANDREWS, IN SUPPORT OF PETITION FOR *INTER PARTES* REVIEW OF U.S. PATENT NO. 10,894,503

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X. GROUND 1: THE COMBINATION OF BEAM AND THOMINET RENDERS OBVIOUS CLAIMS 1-5, 7-8, 10-14, AND 18-19. .....61

A. A POSA would have been motivated to combine Beam and Thominet with a reasonable expectation of success. .....65

B. Independent Claim 1 .....75

1. [1.P]: "A vehicle headlight system comprising:" .....75

2. [1.1]: "one or more headlamps and a vehicle structure, arranged for affixing components of the system to the vehicle;" .....76

3. [1.2]: "a plurality of light clusters, arranged in each of the one or more of the one or more headlamps," .....76

(a) Beam discloses this element. .....77

(b) Thominet also discloses this element. .....81

(c) A POSA would have been motivated to combine Beam and Thominet with a reasonable expectation of success. .82

4. [1.3]: "the headlamps capable of projecting light so as to illuminate a plurality of sub-sections of a field-of-view with different illumination characteristics," .....91

5. [1.4]: "the subsections determined in response to sensor data, wherein the light clusters operate to create a headlight beam;" .95

6. [1.5]: "electronic control circuitry configured to independently operate the light clusters;" .....97

7. [1.6]: "one or more sensors configured to obtain and provide the sensor data predefined as pertinent to illumination requirements for the field-of-view; and" .....100

8. [1.7]: "a logical controller including a processor, the processor in communication with a memory storing one or more algorithms, with the sensors, and with the control circuitry," .....102

9. [1.8]: "wherein the processor is configured to process the one or more algorithms and the sensor data to determine an illumination for at least two of the sub-sections," .....104

10. [1.9]: "that reduces illumination to reduce glare in at least a first of the at least two subsections and" .....107

11. [1.10]: "adapt the light emitted from one or more of the light-clusters so as to create the headlight beam that provides the determined illumination." .....109

C. Claim 2 .....112

1. [2.1]: "The headlight system of claim 1, wherein at least one of the light clusters comprises: a structure to position the light cluster, such that the projected light from the at least one cluster has an aiming direction in relation to a forward travel direction of the vehicle;" .....112

2. [2.2]: "one or more light emitting sources, each having a variable light-source characteristic dependent on power, and wherein the control circuitry is arranged to alter said light-source characteristic via power control; and" .....113

3. [2.3]: "one or more light modifying elements provided in the path of light emitted from at least one of the sources, further controlling the light-source characteristics;" .....115

4. [2.4]: "wherein the structure combined with control of the light sources and light modifying elements results in an emitted light-cluster light characteristic including at least one of direction, intensity, beam spread, spatial light distribution or spectral light distribution." .....118

D. Claim 3: "The headlight system of claim 2, wherein the one or more light modifying elements is at least one of a static light modifier or a variable light modifier, said light modifying element comprising at least one of reflectors or refractors, and wherein variable light modifier control circuitry is configured to control the light-cluster light characteristic by altering the light modifying elements in the path of the light emitted from the at least one of the light sources." .....120

E. Claim 4: "The headlight system of claim 2, wherein the light modifying element further comprises at least one of lenses, diffractors, optical devices, a light guide, filters, phosphors, optical coatings, prisms, controllable piezoelectric light guides, MEMS devices, light valves or optical switches. .....123

F. Claim 5: "The headlight system of claim 1, wherein at least one of the light-clusters includes: a plurality of light sources, wherein one or more of the plurality of light sources comprises at least one of multiple light-emitting-diodes (LEDs) or organic light emitting- diodes, each light source having a spectral power distribution characteristic and wherein the control circuitry is configured to alter the overall light-cluster spectral power distribution to illuminate at least one of the at least two subsections of the field-of-view with a different color of light from another of the at least two subsections." .....125

1. Beam's disclosure .....125

2. Thominet's disclosure .....127

3. A POSA would have been motivated to combine Beam and Thominet with a reasonable expectation of success. .....128

G. Claim 7: "The headlight system of claim 1, wherein at least one of the sensors is a camera-sensor configured to image at least lights indicative of oncoming vehicles having a driver whose vision could be disturbed by the headlight beam, and wherein the logical controller upon receiving data, indicating a position of the lights, from the camera-sensor, is configured to use one or more of the algorithms to determine a position of the oncoming vehicle, based on the position of the lights as indicated by the data, relative to the vehicle headlight system and responsively adapt the headlight beam to decrease at least one vision-disturbing characteristic to the oncoming vehicle driver." .....132

Claim 8: "The headlight system of claim 1, wherein at least one of the sensors is a camera-sensor configured to image at least lights indicative of preceding vehicles having a driver whose vision could be disturbed by the headlight beam reflected in a mirror, and where the logical controller upon receiving data, indicating a position of the lights, from the camera-sensor, is configured to use one or more of the algorithms to determine a position of the preceding vehicle, based on the position of the lights as indicated by the data, relative to the vehicle headlight system and responsively adapt the headlight beam to decrease at least one vision-disturbing characteristic to the driver of the preceding vehicle." .....133

H. Claim 10: "The headlight system of claim 1, wherein at least one of the sensors is configured to detect at least one of oncoming headlights or preceding taillights."....136

I. Claim 11: "The headlight system of claim 1, further including a computer vison processing unit configured to use the sensor data and one or more of the algorithms to identify entities including at least one of beings, vehicles, roadway, or street signs and wherein the logical controller is further configured to modify the headlight beam to change illumination of the identified entity."....137

J. Claim 12: "The headlight system of claim 1, where the determined illumination results in creation of a headlight beam providing a driver of the vehicle including said headlight system with higher visibility in at least a second of the at least two subsections relative to the first of the at least two subsections, while mitigating glaring illumination projected to reach the eyes of at least one of other drivers or pedestrians in the first of the at least two subsections, based on detected other vehicles or pedestrians in the first of the at least two subsections as indicated by the sensor data." ....141

K. Claim 13: "The headlight system of claim 1, wherein the required illumination continues to provide high-beam illumination in at least a second of the subsections different from the first of the subsections, without diminishing a range of the high-beam illumination." ....144

L. Claim 14: "The headlight system of claim 1, wherein the one or more sensors further includes at least one of a camera, a microphone, an ultrasonic transducer and receiver, or an electromagnetic radiation source and detector including any of IR, UV, laser, or light." ....145

M. Claim 18: "The system of claim 1, wherein at least one light source provided to at least one headlamp includes a laser diode."....147

1. Beam discloses this claim. ....147

2. Thominet also discloses this claim. ....147

3. A POSA would have been motivated to combine Beam and Thominet with a reasonable expectation of success. ....148

N. Claim 19: "The system of claim 1, 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 clusters." .....148

XI. GROUND 2: THE COMBINATION OF BEAM, THOMINET, AND STAM RENDERS OBVIOUS CLAIMS 37-45, 47-48, 50-53, AND 57-58. .....149

A. A POSA would have been motivated to combine Beam, Thominet, and Stam with a reasonable expectation of success. .....152

B. Independent Claim 37 .....155

1. [37.P]: "A vehicle headlight system comprising:" .....155

2. [37.1]: "one or more headlamps affixable to a first vehicle;" ..156

3. [37.2]: "a plurality of light clusters arranged in each of the one or more of the headlamps and" .....156

(a) Beam discloses this element. .....156

(b) Thominet also discloses this element. .....160

(c) A POSA would have been motivated to combine Beam and Thominet with a reasonable expectation of success. .....161

4. [37.3]: "capable of illuminating sub-sections of a field-of-view with different illumination characteristics," .....170

5. [37.4]: "wherein at least two of the light clusters operate to create a headlight beam;" .....171

6. [37.5]: "one or more sensors configured to obtain and provide sensor data," .....171

7. [37.6]: "at least a portion of the sensor data indicating a second vehicle within the field-of-view; and" .....171

8. [37.7]: "at least one processor configured to: receive the sensor data; process the sensor data to determine a light distribution pattern for an adaptive headlight beam," .....172

9. [37.8]: "such that a headlight beam adapted to the pattern substantially illuminates a first subsection of the field-of-view including at least a portion of the second vehicle with an illuminance below a predefined threshold value," .....172

(a) Beam discloses this element. .....172

(b) Stam also discloses this element. .....177

(c) A POSA would have been motivated to combine Beam, Thominet, and Stam with a reasonable expectation of success. .....179

10. [37.9]: "while the beam substantially illuminates at least the one or more second subsections of the field-of-view to either side of the first subsection with an illuminance above the predefined threshold value; and" .....184

(a) Beam discloses this element. .....184

(b) Stam also discloses this element. .....188

(c) A POSA would have been motivated to combine Beam, Thominet, and Stam with a reasonable expectation of success. .....190

11. [37.10]: "instruct operation of at least two of the light clusters to create the adapted headlight beam." .....195

C. Claim 38: "The headlight system of claim 37, wherein at least one of the at least one processors is further configured to process the sensor data to determine illumination for at least one first subsection of the field-of-view, determined to include at least a portion of the second vehicle, based on the sensor data, and for at least one second subsection determined not to include the second vehicle, based on the sensor data." .....195

D. Claim 39: "The headlight system of claim 37, wherein the plurality of light clusters are further capable of illuminating at least two of the sub-sections with different illumination characteristics based on the at least one processor determining specific, different illumination characteristics for each of the at least two sub-sections." .....198

E. Claim 40: "The headlight system of claim 37, wherein the light distribution pattern defines illumination for at least the first and the one or more second sub-sections of the field of view." .....201

F. Claim 41: "The headlight system of claim 37, wherein the light distribution patterns defines illumination for the first subsection designed to result in an illuminance below the predefined threshold value, and defines illumination for the one or more second subsections designed to result in an illuminance above the predefined threshold value." .....203

G. Claim 42: "The headlight system of claim 37, wherein at least one of the light clusters comprises: one or more light sources, each having a variable light-source light characteristic dependent on power and alterable, at least responsive to instructions from at least one of the at least one processors, via power control; and one or more light modifying elements provided in a path of light emitted from at least one of the light sources, further controlling at least one light characteristic of the at least one of the light source; wherein control of the light sources and light modifying elements results in a specified emitted light-source light characteristic, where said emitted light-source light characteristic includes at least one of direction, intensity, beam spread, spatial light distribution or spectral light distribution."....205

H. Claim 43: "The headlight system of claim 42, wherein the one or more light modifying elements comprises at least one of reflectors or refractors, and wherein at least one of the at least one processors is configured to instruct control of at least one light modifying element resulting in a change to the light-source light characteristic."....206

I. Claim 44: "The headlight system of claim 42, wherein the light modifying element further comprises at least one of lenses, diffractors, optical devices, a light guide, filters, phosphors, optical coatings, prisms, controllable piezoelectric light guides, MEMS devices, light valves or optical switches."....206

J. Claim 45: "The headlight system of claim 37, wherein at least one of the light-clusters includes: a plurality of light sources, wherein one or more light sources of the plurality of light sources comprise at least one of light-emitting-diodes (LEDs) or organic light-emitting-diodes, each light source having a spectral power distribution characteristic alterable, at least responsive to instructions from at least one of the at least one processors, by modifying power to the one or more light sources of the plurality of light sources, resulting in a color change to projected light from the at least one light-cluster illuminating at least one sub-section of the field-of-view." ....206

K. Claim 47: "The headlight system of claim 37, wherein at least one of the sensors is a camera-sensor configured to image at least lights indicative of an oncoming vehicle."....207

L. Claim 48: "The headlight system of claim 37, wherein at least one of the sensors is a camera-sensor configured to image at least lights indicative of a preceding vehicle." .....207

M. Claim 50: "The headlight system of claim 37, further including a computer vision processing unit configured to use the sensor data to identify entities including at least one of beings, vehicles, roadway, or street signs, and wherein the processor is further configured to determine modification of the headlight beam to change illumination of the identified entity." .....207

N. Claim 51: "The headlight system of claim 37, where the illumination created by the headlight beam results in illumination both providing a driver of the first vehicle with preserved illumination in the one or more second subsections and mitigating glare projected to reach the eyes of a driver of the second vehicle." .....208

O. Claim 52: "The headlight system of claim 37, wherein the adapted headlight beam continues to provide high-beam illumination in the one or more second of the subsections without diminishing a range of the high-beam illumination." .....210

P. Claim 53: "The headlight system of claim 37, wherein the one or more sensors further includes at least one of a camera, a microphone, an ultrasonic transducer and receiver, or an electromagnetic radiation source and detector including any of IR, UV, laser, or light." .....211

Q. Claim 57: "The headlight system of claim 37, wherein at least one light source provided to at least one headlamp includes a laser diode." .....211

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A. A POSA would have been motivated to combine Kobayashi with Beam-Thominet with a reasonable expectation of success. .....212

B. Claim 9: "The headlight system of claim 1, wherein the one or more sensors includes a GPS sensor." .....219

1. Beam-Thominet's disclosure .....219

2. Kobayashi's disclosure .....221

3. A POSA would have been motivated to combine Kobayashi with Beam-Thominet with a reasonable expectation of success. .....222

C. Claim 15: "The system of claim 1, wherein the logical controller is further configured to determine at least a road curvature, indicated by the sensor data, ahead of the vehicle and wherein the required illumination includes increasing illumination in a direction of the road curvature." .....229

1. Beam-Thominet's disclosure .....229

2. Kobayashi's disclosure .....233

3. A POSA would have been motivated to combine Kobayashi with Beam-Thominet with a reasonable expectation of success. .....234

D. Claim 16: "The system of claim 15, wherein the logical controller is further configured to determine at least a planned upcoming turn, indicated by the sensor data, and wherein the required illumination includes increasing illumination illuminating the turn." .....241

Claim 17: "The system of claim 1, wherein the logical controller is further configured to determine at least a planned upcoming turn, indicated by the sensor data, and wherein the required illumination includes increasing illumination illuminating the turn." .....241

1. Beam-Thominet's disclosure .....241

2. Kobayashi's disclosure .....245

3. A POSA would have been motivated to combine Kobayashi with Beam-Thominet with a reasonable expectation of success. .....247

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A. A POSA would have been motivated to combine Kobayashi with Beam-Thominet-Stam with a reasonable expectation of success. .....254

B. Claim 49: "The headlight system of claim 37, wherein the one or more sensors further includes a GPS sensor." .....254

C. Claim 54: "The headlight system of claim 37, 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 a second illumination pattern defining increased illumination in a direction of the road curvature." .....254

D. Claim 55: "The headlight system of claim 54, 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 a third illumination pattern defining increased illumination illuminating the turn." .....255

Claim 56: "The headlight system of claim 37, 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 a third illumination pattern defining increased illumination illuminating the turn." .....255

XIV. GROUND 5: THE COMBINATION OF BEAM, THOMINET, AND BRAUN RENDERS OBVIOUS CLAIM 6. .....256

A. A POSA would have been motivated to combine Braun with Beam-Thominet with a reasonable expectation of success. .....256

B. Claim 6: "The headlight system of claim 1, wherein the headlight beam further comprises light in at least one of infra-red (IR) or ultra-violet (UV) wavelengths." .....262

1. Beam-Thominet's disclosure .....262

2. Braun's disclosure .....264

3. A POSA would have been motivated to combine Braun with Beam-Thominet with a reasonable expectation of success. .....265

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A. A POSA would have been motivated to combine Braun with Beam-Thominet-Stam with a reasonable expectation of success. .....271

B. Claim 46: "The headlight system of claim 37, wherein the light output from at least one headlamp further comprises at least one of infrared or ultraviolet wavelengths." .....272

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A. A POSA would have been motivated to combine Karlsson and Harbers with a reasonable expectation of success. ....278

B. Claims 1 and 37 ....287

1. [1.P]: "A vehicle headlight system comprising:" ....287

[37.P]: "A vehicle headlight system comprising:" ....287

2. [1.1]: "one or more headlamps and a vehicle structure, arranged for affixing components of the system to the vehicle;" ....288

[37.1]: "one or more headlamps affixable to a first vehicle;" ..288

3. [1.2]: "a plurality of light clusters, arranged in each of the one or more of the one or more headlamps," ....290

[37.2]: "a plurality of light clusters arranged in each of the one or more of the headlamps and" ....290

(a) Karlsson discloses this element. ....290

(b) Harbers also discloses this element. ....295

(c) A POSA would have been motivated to combine Karlsson and Harbers with a reasonable expectation of success. ..297

4. [1.3]: "the headlamps capable of projecting light so as to illuminate a plurality of sub-sections of a field-of-view with different illumination characteristics," ....306

[37.3]: "capable of illuminating subsections of a field-of-view with different illumination characteristics," ....306

5. [1.4]: "the subsections determined in response to sensor data, wherein the light clusters operate to create a headlight beam;" ....308

[37.4]: "wherein at least two of the light clusters operate to create a headlight beam;" ....308

6. [1.5]: "electronic control circuitry configured to independently operate the light clusters;" .....311

7. [1.6]: "one or more sensors configured to obtain and provide the sensor data predefined as pertinent to illumination requirements for the field-of-view; and" .....314

[37.5]: "one or more sensors configured to obtain and provide sensor data," .....314

[37.6]: "at least a portion of the sensor data indicating a second vehicle within the field-of-view; and" .....314

8. [1.7]: "a logical controller including a processor, the processor in communication with a memory storing one or more algorithms, with the sensors, and with the control circuitry," .....316

9. [1.8]: "wherein the processor is configured to process the one or more algorithms and the sensor data to determine an illumination for at least two of the subsections," .....319

[37.7]: "at least one processor configured to: receive the sensor data; process the sensor data to determine a light distribution pattern for an adaptive headlight beam," .....319

10. [1.9]: "that reduces illumination to reduce glare in at least a first of the at least two subsections and" .....322

11. [1.10]: "adapt the light emitted from one or more of the light-clusters so as to create the headlight beam that provides the determined illumination." .....325

[37.10]: "instruct operation of at least two of the light clusters to create the adapted headlight beam." .....325

C. Additional Elements of Claim 37 .....328

1. [37.8]: "such that a headlight beam adapted to the pattern substantially illuminates a first subsection of the field-of-view including at least a portion of the second vehicle with an illuminance below a predefined threshold value," .....328

2. [37.9]: "while the beam substantially illuminates at least the one or more second subsections of the field-of-view to either side of the first subsection with an illuminance above the predefined threshold value; and" .....334

D. Claim 2/Claim 42 .....339

1. [2.1]: "The headlight system of claim 1, wherein at least one of the light clusters comprises: a structure to position the light cluster, such that the projected light from the at least one cluster has an aiming direction in relation to a forward travel direction of the vehicle;" .....340

[42.1]: "The headlight system of claim 37, wherein at least one of the light clusters comprises:" .....340

2. [2.2]: "one or more light emitting sources, each having a variable light-source characteristic dependent on power, and wherein the control circuitry is arranged to alter said light-source characteristic via power control; and" .....342

[42.2]: "one or more light sources, each having a variable light-source light characteristic dependent on power and alterable, at least responsive to instructions from at least one of the at least one processors, via power control; and" .....342

3. [2.3]: "one or more light modifying elements provided in the path of light emitted from at least one of the sources, further controlling the light-source characteristics;" .....344

[42.3]: "one or more light modifying elements provided in a path of light emitted from at least one of the light sources, further controlling at least one light characteristic of the at least one of the light source;" .....344

4. [2.4]: "wherein the structure combined with control of the light sources and light modifying elements results in an emitted light-cluster light characteristic including at least one of direction, intensity, beam spread, spatial light distribution or spectral light distribution." .....346

[42.4]: "wherein control of the light sources and light modifying elements results in a specified emitted light-source light characteristic, where said emitted light-source light characteristic includes at least one of direction, intensity, beam spread, spatial light distribution or spectral light distribution." .....346

E. Claim 3: "The headlight system of claim 2, wherein the one or more light modifying elements is at least one of a static light modifier or a variable light modifier, said light modifying element comprising at least one of reflectors or refractors, and wherein variable light modifier control circuitry is configured to

control the light-cluster light characteristic by altering the light modifying elements in the path of the light emitted from the at least one of the light sources." .....348

Claim 43: "The headlight system of claim 42, wherein the one or more light modifying elements comprises at least one of reflectors or refractors, and wherein at least one of the at least one processors is configured to instruct control of at least one light modifying element resulting in a change to the light-source light characteristic."....348

F. Claim 4: "The headlight system of claim 2, wherein the light modifying element further comprises at least one of lenses, diffractors, optical devices, a light guide, filters, phosphors, optical coatings, prisms, controllable piezoelectric light guides, MEMS devices, light valves or optical switches."....351

Claim 44: "The headlight system of claim 42, wherein the light modifying element further comprises at least one of lenses, diffractors, optical devices, a light guide, filters, phosphors, optical coatings, prisms, controllable piezoelectric light guides, MEMS devices, light valves or optical switches."....351

G. Claim 5: "The headlight system of claim 1, wherein at least one of the light-clusters includes: a plurality of light sources, wherein one or more of the plurality of light sources comprises at least one of multiple light-emitting-diodes (LEDs) or organic light-emitting-diodes, each light source having a spectral power distribution characteristic and wherein the control circuitry is configured to alter the overall light-cluster spectral power distribution to illuminate at least one of the at least two subsections of the field-of-view with a different color of light from another of the at least two subsections." .....352

Claim 45: "The headlight system of claim 37, wherein at least one of the light-clusters includes: a plurality of light sources, wherein one or more light sources of the plurality of light sources comprise at least one of light-emitting-diodes (LEDs) or organic light-emitting-diodes, each light source having a spectral power distribution characteristic alterable, at least responsive to instructions from at least one of the at least one processors, by modifying power to the one or more light sources of the plurality of light sources, resulting in a color change to projected light

from the at least one light-cluster illuminating at least one sub-section of the field-of-view.” .....353

1. Karlsson’s disclosure .....353

2. Harbers’s disclosure .....354

3. A POSA would have been motivated to combine Karlsson and Harbers with a reasonable expectation of success. .....357

H. Claim 7: “The headlight system of claim 1, wherein at least one of the sensors is a camera-sensor configured to image at least lights indicative of oncoming vehicles having a driver whose vision could be disturbed by the headlight beam, and wherein the logical controller upon receiving data, indicating a position of the lights, from the camera-sensor, is configured to use one or more of the algorithms to determine a position of the oncoming vehicle, based on the position of the lights as indicated by the data, relative to the vehicle headlight system and responsively adapt the headlight beam to decrease at least one vision-disturbing characteristic to the oncoming vehicle driver.” .....362

Claim 8: “The headlight system of claim 1, wherein at least one of the sensors is a camera-sensor configured to image at least lights indicative of preceding vehicles having a driver whose vision could be disturbed by the headlight beam reflected in a mirror, and where the logical controller upon receiving data, indicating a position of the lights, from the camera-sensor, is configured to use one or more of the algorithms to determine a position of the preceding vehicle, based on the position of the lights as indicated by the data, relative to the vehicle headlight system and responsively adapt the headlight beam to decrease at least one vision-disturbing characteristic to the driver of the preceding vehicle.” .....362

Claim 47: “The headlight system of claim 37, wherein at least one of the sensors is a camera-sensor configured to image at least lights indicative of an oncoming vehicle.” .....363

Claim 48: “The headlight system of claim 37, wherein at least one of the sensors is a camera-sensor configured to image at least lights indicative of a preceding vehicle.” .....363

I. Claim 10: "The headlight system of claim 1, wherein at least one of the sensors is configured to detect at least one of oncoming headlights or preceding taillights."....367

J. Claim 11: "The headlight system of claim 1, further including a computer vison processing unit configured to use the sensor data and one or more of the algorithms to identify entities including at least one of beings, vehicles, roadway, or street signs and wherein the logical controller is further configured to modify the headlight beam to change illumination of the identified entity."....367

Claim 50: "The headlight system of claim 37, further including a computer vision processing unit configured to use the sensor data to identify entities including at least one of beings, vehicles, roadway, or street signs, and wherein the processor is further configured to determine modification of the headlight beam to change illumination of the identified entity." ....368

K. Claim 12: "The headlight system of claim 1, where the determined illumination results in creation of a headlight beam providing a driver of the vehicle including said headlight system with higher visibility in at least a second of the at least two subsections relative to the first of the at least two subsections, while mitigating glaring illumination projected to reach the eyes of at least one of other drivers or pedestrians in the first of the at least two subsections, based on detected other vehicles or pedestrians in the first of the at least two subsections as indicated by the sensor data." ....371

L. Claim 13: "The headlight system of claim 1, wherein the required illumination continues to provide high-beam illumination in at least a second of the subsections different from the first of the subsections, without diminishing a range of the high-beam illumination." ....374

M. Claim 14: "The headlight system of claim 1, wherein the one or more sensors further includes at least one of a camera, a microphone, an ultrasonic transducer and receiver, or an electromagnetic radiation source and detector including any of IR, UV, laser, or light." ....376

Claim 53: "The headlight system of claim 37, wherein the one or more sensors further includes at least one of a camera, a microphone, an ultrasonic transducer and receiver, or an

electromagnetic radiation source and detector including any of IR, UV, laser, or light." .....376

N. Claim 18: "The system of claim 1, wherein at least one light source provided to at least one headlamp includes a laser diode." .....377

Claim 57: "The headlight system of claim 37, wherein at least one light source provided to at least one headlamp includes a laser diode." .....377

O. Claim 19: "The system of claim 1, 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 clusters." .....378

Claim 58: "The headlight system of claim 37, 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 clusters as part of the instructed operation." .....378

P. Claim 38: "The headlight system of claim 37, wherein at least one of the at least one processors is further configured to process the sensor data to determine illumination for at least one first subsection of the field-of-view, determined to include at least a portion of the second vehicle, based on the sensor data, and for at least one second subsection determined not to include the second vehicle, based on the sensor data." .....380

Q. Claim 39: "The headlight system of claim 37, wherein the plurality of light clusters are further capable of illuminating at least two of the sub-sections with different illumination characteristics based on the at least one processor determining specific, different illumination characteristics for each of the at least two sub-sections." .....382

R. Claim 40: "The headlight system of claim 37, wherein the light distribution pattern defines illumination for at least the first and the one or more second sub-sections of the field of view." .....385

S. Claim 41: "The headlight system of claim 37, wherein the light distribution patterns defines illumination for the first subsection designed to result in an illuminance below the predefined threshold value, and defines illumination for the one or more

second subsections designed to result in an illuminance above the predefined threshold value.”.....387

T. Claim 51: “The headlight system of claim 37, where the illumination created by the headlight beam results in illumination both providing a driver of the first vehicle with preserved illumination in the one or more second subsections and mitigating glare projected to reach the eyes of a driver of the second vehicle.”.....389

U. Claim 52: “The headlight system of claim 37, wherein the adapted headlight beam continues to provide high-beam illumination in the one or more second of the subsections without diminishing a range of the high-beam illumination.” .....391

XVII. GROUND 8: THE COMBINATION OF KARLSSON, HARBERS, AND GOTOU RENDERS OBVIOUS CLAIMS 9, 15-17, 49, AND 54-56. .....393

A. A POSA would have been motivated to combine Gotou with Karlsson-Harbers with a reasonable expectation of success.....393

B. Claim 9: “The headlight system of claim 1, wherein the one or more sensors includes a GPS sensor.” .....400

Claim 49: “The headlight system of claim 37, wherein the one or more sensors further includes a GPS sensor.” .....400

1. Karlsson-Harbers’s disclosure .....400

2. Gotou’s disclosure .....402

3. A POSA would have been motivated to combine Gotou with Karlsson-Harbers with a reasonable expectation of success. ...403

C. Claim 15: “The system of claim 1, wherein the logical controller is further configured to determine at least a road curvature, indicated by the sensor data, ahead of the vehicle and wherein the required illumination includes increasing illumination in a direction of the road curvature.” .....410

Claim 54: “The headlight system of claim 37, 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 a second illumination pattern defining increased illumination in a direction of the road curvature.” .....410

1. Karlsson-Harbers's disclosure .....410

2. Gotou's disclosure .....414

3. A POSA would have been motivated to combine Gotou with Karlsson-Harbers with a reasonable expectation of success. ...416

D. Claims 16: "The system of claim 15, wherein the logical controller is further configured to determine at least a planned upcoming turn, indicated by the sensor data, and wherein the required illumination includes increasing illumination illuminating the turn." .....423

Claim 17: "The system of claim 1, wherein the logical controller is further configured to determine at least a planned upcoming turn, indicated by the sensor data, and wherein the required illumination includes increasing illumination illuminating the turn." .....423

Claim 55: "The headlight system of claim 54, 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 a third illumination pattern defining increased illumination illuminating the turn." .....423

Claim 56: "The headlight system of claim 37, 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 a third illumination pattern defining increased illumination illuminating the turn." .....423

1. Karlsson-Harbers's disclosure .....424

2. Gotou's disclosure .....427

3. A POSA would have been motivated to combine Gotou with Karlsson-Harbers with a reasonable expectation of success. ...430

XVIII. GROUND 9: THE COMBINATION OF KARLSSON, HARBERS, AND BRAUN RENDERS OBVIOUS CLAIMS 6 AND 46...437

A. A POSA would have been motivated to combine Braun with Karlsson-Harbers with a reasonable expectation of success.....437

B. Claim 6: "The headlight system of claim 1, wherein the headlight beam further comprises light in at least one of infra-red (IR) or ultra-violet (UV) wavelengths." .....444

Claim 46: "The headlight system of claim 37, wherein the light output from at least one headlamp further comprises at least one of infrared or ultraviolet wavelengths." .....444

1. Karlsson-Harbers's disclosure .....444

2. Braun's disclosure.....445

3. A POSA would have been motivated to combine Braun with Karlsson-Harbers with a reasonable expectation of success. ...447

XIX. OBJECTIVE INDICIA DO NOT SUPPORT PATENTABILITY .....454

XX. CONCLUSION.....456

## I. INTRODUCTION

I, Scott Andrews, declare as follows:

1. I have been retained on behalf of Porsche Cars North America, Inc. ("Porsche" or "Petitioner") for the above-captioned *inter partes* review proceeding to provide my expert opinions and expert knowledge. I understand that this proceeding involves U.S. Patent No. 10,894,503 ("the '503 patent") titled "Detector Controlled Headlight[1] System," to Yechezkal Evan Spero, and that Torchlight Technologies, LLC has purported to be the exclusive licensee of the '503 patent. I understand that the Petition submitted by Petitioner challenges claims 1-19 and 37-58 of the '503 patent.

[1] The term "headlight," is generally used to describe the concept of the resultant beam of light emitted from "headlamp," (e.g., the hardware including emitters, lenses, housing, etc., packaged into a system on a vehicle). As shown in this declaration, the '503 patent (and prior art) sometimes equates the two, and thus disclosures of "headlamps" provide "headlights" and vice versa. And a POSA would have understood based on the context of the term whether any appreciable technical meaning was intended by the author of a document.

2. The ’503 patent describes, generally, adaptive headlamp systems and methods. I am familiar with the technology described in the ’503 patent as of its earliest possible priority date, July 12, 2002.

3. I have been asked to provide my independent technical review, analysis, insights, and opinions regarding the ’503 patent and the references that form the basis for the grounds of unpatentability set forth in the Petition for *inter partes* review of the ’503 patent filed by Petitioner.

4. In preparing this declaration, I have reviewed and am familiar with all the documents cited in this declaration. I have reviewed and am familiar with the ’503 patent and its file history. I confirm that to the best of my knowledge, the accompanying exhibits are true and accurate copies of what they purport to be, and that an expert in the field would reasonably rely on them to formulate opinions such as those set forth in this declaration.

5. I am being compensated at my customary rate of $500 per hour for my work on this case. My compensation is not dependent upon my opinions, my testimony, or the outcome of this case.

## II. SUMMARY OF GROUNDS

6. I understand that the Petition for *inter partes* review of the '503 patent filed by Petitioner asserts the following Grounds of unpatentability:

| Ground | References | Basis | Claims |
|---|---|---|---|
| 1 | Beam (EX1005), Thominet (EX1006) | §103 | 1-5, 7-8, 10-14, 18-19 |
| 2 | Beam, Thominet, Stam (EX1007) | §103 | 37-45, 47-48, 50-53, 57-58 |
| 3 | Beam, Thominet, Kobayashi (EX1008) | §103 | 9, 15-17 |
| 4 | Beam, Thominet, Stam, Kobayashi | §103 | 49, 54-56 |
| 5 | Beam, Thominet, Braun (EX1009) | §103 | 6 |
| 6 | Beam, Thominet, Stam, Braun | §103 | 46 |
| 7 | Karlsson (EX1010), Harbers (EX1011) | §103 | 1-5, 7-8, 10-14, 18-19, 37-45, 47-48, 50-53, 57-58 |
| 8 | Karlsson, Harbers, Gotou (EX1012) | §103 | 9, 15-17, 49, 54-56 |
| 9 | Karlsson, Harbers, Braun | §103 | 6, 46 |

## III. SUMMARY OF OPINIONS

7. In my opinion, the challenged claims of the '503 patent would have been obvious in view of the combinations of references Petitioner asserts in the context of common knowledge and industry practice at the time of its filing.

8. Therefore, it is my opinion that the challenged claims would have been obvious in view of the disclosures in the asserted prior art references, as described in detail below.

## IV. QUALIFICATIONS

9. My experience and education are detailed in my curriculum vitae ("CV"), a copy of which is provided as Exhibit1004.

10. I have over 30 years of experience in automotive systems technology. In various positions at Cogenia Partners, LLC, TRW, and Toyota, I have been responsible for research and development projects relating to automotive systems technology, including automotive control systems, automotive safety systems, vehicle navigation systems, connected vehicle systems, and various applications of location technologies such as map databases for curve speed warning, adaptive cruise control, collision warning/avoidance systems, and automated vehicles.

11. I received an undergraduate Bachelor of Science degree in Electrical Engineering from the University of California, Irvine in 1977, and received a Master of Science degree in Electronic Engineering from Stanford University in 1982.

12. From 1977 to 1983, I held engineering positions at Ford Aerospace and Teledyne Microwave where I worked on, among other things, transmitter-receiver systems for guided missiles and other related military electronics. From

1983 to 1993, I worked at TRW, Inc. ("TRW") in the Space & Electronics Group, where I served as a project manager, a department manager, and an assistant program manager on a variety of spacecraft communications systems projects. One exemplary project I worked on was an adaptive antenna array that used amplitude and phase modulation together with a digital filtering system to adaptively generate nulls in the antenna gain pattern in response to coherent radio signals. This system was intended to reduce the effect of narrow spectrum jamming signals on spread spectrum communications by dynamically adapting the antenna array based on radio illumination from external sources. My last position at TRW in the Space & Electronics Group was as the manager of the Monolithic Microwave Integrated Circuits ("MMIC") Products Organization. In that role, I developed TRW's commercial gallium arsenide (GaAs) MMIC business. During my time in the MMIC Products Organization, I helped produce one of the first cellular phone related RF integrated circuits. I also developed the first single chip 94 GHz radar, intended for use in automotive adaptive cruise control systems. While I was at TRW in the Space & Electronics Group, I received several awards for outstanding performance on independent research and development projects.

13. In 1993, while still at TRW, I moved to the Automotive Electronics Group and became the Director of Systems Engineering and Advanced Products. In this role, I was responsible for the overall management of TRW's advanced

development programs in the automotive electronics space. These programs included, among other things, wireless remote keyless entry systems, vehicle tracking and location systems (e.g., roadside assistance and emergency response systems, including those using global positioning system ("GPS") technology), emergency vehicle warning systems (e.g., transmitter-receiver systems that would provide a warning inside the user's vehicle when an active emergency vehicle was in the vicinity), automotive collision avoidance radar, and other types of vehicle information systems. I served in this role until 1996. While at TRW, I also led the development of an in-vehicle information system based on off-board map databases, wireless data communications, and radio-based location technologies, and developed business and product strategies related to various remotely connected information services.

14. From 1996 to 2000, I worked at Toyota Motor Corporation ("Toyota") at the Toyota Headquarters in Toyota City, Japan, as a Project General Manager in the R&D Management Division. My responsibilities included the conceptualization and development of multimedia systems and new technology products and services for Toyota's future generations of passenger vehicles. My work at Toyota included, among other things, automated vehicles, applications of digital map database, including automated braking systems, curve speed warning systems, and adaptive cruise control, as well as early work on various connected

vehicle technologies using on-board computing, map databases, and off-board communications to provide various services to the vehicle and the vehicle occupants.

15. While at Toyota, I also established the Automotive Multimedia Interface Collaboration ("AMI-C"), a partnership of carmakers to develop a uniform computing architecture for vehicle multimedia systems. AMI-C was primarily aimed at developing standards for the integration and use of consumer devices in vehicles, and for a common computing platform to facilitate the rapid introduction of new systems and software in the vehicle. For example, a typical AMI-C system might support the aftermarket integration of a cellular telephone subsystem and supporting software applications to provide location-based services such as off-board navigation and traffic information to support an in-vehicle navigation display system.

16. I founded Cogenia Partners, LLC as an independent consultant in the intelligent vehicles and mobile systems industry in January 2001. My primary clients have been various navigation and mobile device makers, automotive manufacturers, and the U.S. Department of Transportation. Since 2001 my work has focused on systems for delivery of services to vehicle occupants, either through personal devices, or through equipment embedded in the vehicle. These systems have included applications for vehicle and roadway safety, information and

entertainment, and operational concepts and system designs for various types of connected vehicle systems.

17. Between 2006 and 2011, I served as the Chief System Architect for a large Connected Vehicle test bed in the greater Detroit area. This project included extensive systems engineering work, and real-world test and evaluation of short range vehicle to roadside and vehicle to vehicle communications systems and applications, including various tolling applications. This work also included active involvement with various vehicle communications standards, including SAE J2735, SAE J2945, and a variety of IEEE standards associated with Dedicated Short Range Communications (DSRC) systems used, for example in vehicle management, traffic data collection and distribution, safety, tolling and other applications.

18. More recently I have served as a technical lead on a series of projects to support the National Highway Traffic Safety Administration (NHTSA) with the development of performance standards for connected vehicle equipment in vehicles, the development of a security credential management system, and the development and simulation of a sensor based system to detect and mitigate the introduction of erroneous and/or malevolent information into the connected vehicle network. I have also led the development of a variety of test and evaluation systems for the Federal Highway Administration to support the assessment of

connected vehicle systems in the roadway environment and developed security credential management systems in support of the connected vehicle effort.

19. In the various positions mentioned above, I was responsible for research and development projects relating to numerous vehicle information systems, user interface systems, sensory systems, control systems and safety systems, and also had the opportunity to collaborate with numerous researchers and suppliers to the auto industry. While at Toyota, I worked with a supplier on a concept for supplementing adaptive (steerable) headlights with navigational maps, so that the vehicle headlights would be controlled, at least in part by the curvature of the upcoming roadway based on the map data stored in the vehicle. This project also included warning systems to alert the driver if they were approaching a curve at excessive speed. Other related projects include alignment and control of radar beams for adaptive cruise control, including positioning the radar beam to adapt to curves in the forward vehicle trajectory, determination of roadway curves ahead using cameras, and a laser system for detecting the curvature of the road from reflective markers used to guide snowplows in winter conditions where the road edges cannot be otherwise detected.

20. I am a member of the Institute of Electrical and Electronics Engineers ("IEEE"), the IEEE Standards Association, the Institute of Navigation ("ION"), the International Council on Systems Engineering ("INCOSE"), and the Society of

Automotive Engineers ("SAE"). I am a named inventor on twenty-four U.S. patents, three Japanese patents, and one European patent. A list of my patents can be found in my curriculum vitae attached as Exhibit 1004. I have authored numerous technical papers, and have been invited to give professional talks at various conferences, including the World Congress on Intelligent Transportation Systems, the International Task Force on Vehicle Automation, the International Congress on Transportation Electronics (Convergence), and others. My curriculum vitae (Ex. 1004) includes a list of all publications I have authored in the last 10 years and provides further detail regarding my background and qualifications.

## V. MATERIALS CONSIDERED

21. In formulating my opinions, I have relied upon my training, knowledge, and experience that are relevant to the '503 patent. I have read and agree with the opinions offered by Dr. Jianzhong Jiao in his expert declaration in IPR2023-00335, and herein adopt those opinions as my own. Furthermore, I have specifically considered the following documents, in addition to other sources cited in this Declaration:

| 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") |
| **1004** | *Curriculum Vitae* of Scott Andrews |
| **1005** | U.S. Patent No. 6,144,158 to Beam |
| **1006** | U.S. Patent Publication No. 2001/0019486 to Thominet |

| Exhibit # | Description |
|---|---|
| **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** | English Translation of Japanese Unexamined Patent Application Publication H7-65603 to Nakamura *et al*. |
| **1014** | English Translation of Japanese Unexamined Patent Application Publication H7-101291 to Satonaka *et al*. |
| **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 |
| **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 |
| **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). |

| Exhibit # | Description |
|---|---|
| **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). |
| **1028** | Bernhard Wörner, Adaptive Frontlighting – Experimental System, Development and Functional Evaluation, Progress in Automotive Lighting Vol. 6, pp. 844-853 (1999). |
| **1030** | Assessment of Headlamp Glare and Potential Countermeasures, Survey of Advanced Front Lighting System (AFS) Research and Technology, National Highway Traffic Safety Administration (2005) |
| **1033** | File History of *Ex Parte* Reexamination of U.S. Patent No. 9,955,551, Control No. 90/014,815 |
| **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*. |

## VI. LEGAL STANDARDS

22. I have also relied upon various legal principles (as explained to me by Petitioner's counsel) in formulating my opinions. My understanding of these principles is summarized below.

23. I have been told the following legal principles apply to analysis of patentability. I also have been told that, in an *inter partes* review proceeding, a patent claim may be deemed unpatentable if it is shown by a preponderance of evidence that the claim is anticipated by one prior art reference under 35 U.S.C. § 102, or rendered obvious by one or more prior art references under 35 U.S.C. § 103.

24. I understand that documents and materials, such as printed publications or patents, that qualify as prior art can be used to render a patent claim as anticipated or as obvious.

25. I understand that once the claims of a patent have been properly construed, the second step in determining anticipation or obviousness of a patent claim requires a comparison of the properly construed claim language to the prior art on a limitation-by-limitation basis.

**A. My Understanding of Claim Construction**

26. I understand that during an *inter partes* review proceeding, claims are to be construed in light of the specification as would be read by a person of ordinary skill in the relevant art ("POSA") at the time of the purported priority date. I understand that claim terms are given their ordinary and customary meaning as would be understood by a POSA in the context of the entire disclosure. A claim term, however, will not receive its ordinary meaning if the patentee acted as his

own lexicographer and clearly set forth a definition of the claim term in the specification. In this case, the claim term will receive the definition set forth in the patent.

**B. A Person of Ordinary Skill in the Art**

27. I understand that a POSA is presumed to be aware of all pertinent art, thinks along conventional wisdom in the art, and is a person of ordinary creativity—not an automaton.

28. I have been asked to consider the level of ordinary skill in the field that someone would have had at the time the alleged invention was made. In deciding the level of ordinary skill, I considered the following:

- the levels of education and experience of persons working in the field;
- the types of problems encountered in the field; and
- the sophistication of the technology.

29. I understand that the relevant time for considering whether a claim would have been obvious to a POSA is at the time of the alleged invention, which I have been told to assume for this case is July 12, 2002.

30. Regardless of if I use "I" or "POSA" during my technical analysis below, all of my statements and opinions are to be understood to be based on how a POSA would have understood or read a document at the time of the alleged invention.

### C. My Understanding of Obviousness

31. I understand that a patent claim is unpatentable if the claimed invention would have been obvious to a POSA at the time of the alleged invention. I understand that this means that even if all of the elements of the claim cannot be found in a single prior art reference that would anticipate the claim, the claim can still be unpatentable.

32. It is my understanding that to obtain a patent, a claimed invention must have been, as of its earliest possible priority date, non-obvious in view of the prior art in the field. I understand that a patent claim is obvious when the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious to a POSA at the time the alleged invention was made.

33. When considering the issues of obviousness, I have been told that I am to do the following:

- Determine the scope and content of the prior art;
- Ascertain the differences between the prior art and the claims at issue;
- Resolve the level of ordinary skill in the pertinent art; and
- Consider evidence of secondary indicia of non-obviousness (if available).

34. With respect to determining the proper scope of prior art to examine, I understand that in order for a prior art reference to be properly used in an obviousness ground under 35 U.S.C. § 103, the prior art reference must be analogous art to the claimed invention. I have been told that a reference is analogous art to the claimed invention only if: (1) the reference is from the same field of endeavor as the claimed invention; or (2) the reference is reasonably pertinent to the particular problem solved by the inventor.

35. I understand that factors relevant to determining the proper field of endeavor include the inventor's explanations of the subject matter (including the patent specification), as well as the claimed invention's structure and function. And I further understand that to be reasonably pertinent to the particular problem solved by the inventor, a prior art reference must logically commend itself to the inventor's attention in considering his or her problem.

36. I have been told that an analogous reference may be modified or combined with other analogous references or with the POSA's own knowledge if the person would have found the modification or combination obvious. I have also been told that a POSA is presumed to know all relevant, analogous prior art, and that the obviousness analysis may take into account the inferences and creative steps that a POSA would employ.

37. In determining whether a prior art reference would have been combined with another prior art reference or other information known to a POSA, I have been told that the following principles may be considered:

- A combination of familiar elements according to known methods is likely to be obvious if it yields predictable results;
- The simple substitution of one known element for another is likely to be obvious if it yields predictable results;
- The use of a known technique to improve similar devices, products, or methods in the same way is likely to be obvious if it yields predictable results;
- The application of a known technique to a prior art reference that is ready for improvement is likely obvious if it yields predictable results;
- Any need or problem known in the field and addressed by the reference can provide a reason for combining the elements in the manner claimed;
- A skilled artisan often will be able to fit the teachings of multiple references together like a puzzle; and
- The proper analysis of obviousness requires a determination of whether a POSA would have a "reasonable expectation of success"—

not "absolute predictability" of success—in achieving the claimed invention by combining prior art references.

38. I understand that whether a prior art reference renders a claim unpatentable as obvious is determined from the perspective of a POSA. I have also been told that, while there is no requirement for the prior art to contain an express suggestion to combine known elements to achieve the claimed invention, a suggestion to combine known elements to achieve the claimed invention may come from the prior art as a whole or individually, as filtered through the knowledge of a POSA. In addition, I have been told the inferences and creative steps a POSA would employ are also relevant to the determination of obviousness.

39. I also understand that when a work is available in one field, design alternatives and other market forces can prompt variations of it, either in the same field or in another. I have also been told that if a POSA can implement a predictable variation and would see the benefit of doing so, that variation is likely to be obvious. I have been told that in many fields, there may be little discussion of obvious combinations, and in these fields market demand—not scientific literature—may drive design trends. I have been told that when there is a design need or market pressure and there are a finite number of predictable solutions, a POSA has good reason to pursue those known options.

40. I have been told there is no rigid rule prescribing a reference or combination of references must contain a "teaching, suggestion, or motivation" to combine references. But I also have been told that the "teaching, suggestion, or motivation" test can be a useful guide in establishing a rationale for combining elements of the prior art. I have been told this test poses the question as to whether there is an express or implied teaching, suggestion, or motivation to combine prior art elements in a way that realizes the claimed invention, and that it seeks to counter impermissible hindsight analysis.

41. Further, it is my understanding that a claim or claim element that has no patentable difference between another claim or claim element means that the same prior art references can be applied to those claims or claim elements. Additionally, it is my understanding that a claim or claim element that has no patentable difference between another claim or claim element means that there is no difference in what is required from a technical standpoint, and the same prior art citations disclose the respective features. In addition, it is my understanding that a claim or claim element that has no patentable difference between another claim or claim element means and that there are some individual features across the claim sets or claim element sets that are similar, but have no patentable difference between them, for the same reasons. I have identified a claim or claim element that has no patentable difference between another claim or claim element throughout

this declaration as appropriate, and the same prior art references are applied to those limitations as provided in the analysis.

## VII. LEVEL OF ORDINARY SKILL IN THE ART

42. In my opinion, a POSA in the context of the '503 patent as of July 12, 2002 (the earliest possible priority date of the '503 patent)[2] would have had a bachelor of science (B.S.) degree 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.

43. Experience could take the place of some formal training, as domain knowledge may be learned on the job. This description is approximate, and a higher level of education or skill might make up for less experience and vice versa.

44. Based on my education, training, and professional experience in the field of the claimed invention, I am familiar with the level and abilities of a person

[2] For this declaration, I have been asked to assume that July 12, 2002 is the earliest effective priority date, but the POSA definition would not change even if a later priority date is used.

of ordinary skill in the art at the time of the claimed invention. I also base this opinion on my experience hiring and managing approximately 20 engineers engaged in the development of advanced automotive electronics systems, and in leading engineering staff from approximately 30 different automotive manufacturers and suppliers as part of various research and development consortia. Additionally, I met at least these minimum qualifications to be a person having ordinary skill in the art at least as of July 12, 2002. Further, although my qualifications may exceed those of the hypothetical person having ordinary skill in the art defined above, my analysis and opinions regarding the '503 Patent have been rendered from the perspective of a person having ordinary skill in the art at the time of the invention.

## VIII. OVERVIEW OF THE '503 PATENT CLAIMS

### A. Technology Overview of the Patent Claims

45. The '503 patent claims relate to motor vehicle headlamps; however the specification of the '503 patent focuses primarily on *non-vehicle* applications. Of the approximately 100 columns of description, most all of the vehicular headlamp disclosure is centered around Figure 15.

46. Because the focus of the claims relates to motor vehicle headlamp systems and methods, I provide the following historical background related to automotive headlamps, the application of adaptive front lighting systems/beam

control, known glare-reduction techniques, anti-blinding systems, etc., including use of LEDs as light sources for headlamps.

47. By mid-2000 and several years before the earliest possible priority date, all the technologies claimed in the ’503 patent were well known by developers of automotive lighting systems, and specifically the adaptive automotive lighting systems. No individual elements of the ’503 patent claims were new, and there was nothing new about the manner in which those elements were combined in the claims. I know this because I had firsthand experience in automotive systems, including lighting control systems and related beam forming technologies.

48. Indeed, Grounds 1-2 and 7 demonstrate why it would have been obvious for an adaptive headlamp system to utilize well-known sensor inputs to output multiple beam regions and output light below and above a predefined threshold value. Grounds 3-4 and 8 demonstrate why it would have been obvious to include well-known sensor data and techniques to illuminate roadway curves. Grounds 5-6 and 9 demonstrate why it would have been obvious to implement well-known infrared (IR)/ultraviolet (UV) wavelengths to control illumination.

49. Adaptive lighting for headlamps to control one or more illumination characteristics was well known. As early as the 1940s and 1950s, vehicles such as the Tucker Torpedo and Citroen DS-19 included headlamps that swiveled with the

turning angle of the wheels via mechanical linkage. EX1030, NHTSA Survey, 3-4. Most notably with relation to the technology claimed in the '503 patent, from about 1992 to 1999, a global consortium of headlamp and automobile manufacturers participated in the EUREKA Project to advance development of adaptive front lighting systems (AFS). EX1015, Westermann, 3-6; EX1016, AFS Presentation, 1-19; EX1023, Manassero, 514-515; EX1024, Westermann, 819. The EUREKA Project was a well known consortium that a POSA would have been aware of. The EUREKA Project investigated, studied, and recommended AFS functions, including dynamic road illumination, glare control, explored reflectance of pedestrians and road signs, and other headlamp features. EX1015, 4.

50. By 1997, adaptive (dynamic) lighting's potential to increase road safety, driving safety, and drivers' visual comfort as an improvement over fixed (static) headlamps was well known. EX1017, Hogrefe, 3-10. Other background references support this finding. EX1018, Löwenau, 33-36 ("A new light concept called Adaptive Light Control (ALC) is developed with the aim to improve night time traffic safety."); EX1019, Manassero, 1-2 ("A major breakthrough in improving visibility, safety and comfort under all driving conditions is given by a headlamp with adjustable light intensity and beam pattern according to the vehicle speed, steering wheel angles and different driving conditions."); EX1020, Hamm, 368, 370, 374-378 ("The car's sensors analyze and evaluate the driving situation

and generate a light distribution that is adapted to that particular situation. In this process, not only the driver's comfort is increased but the visibility is improved also. This has a direct positive impact on traffic safety."); EX1024, Westermann, 819 ("The challenge of such a system approach and the necessary and not so easy change towards performance and system requirements was clearly seen - but also the prospects of possible safety improvement."); EX1025, Diem, 202 ("One explanation could be that because of the available luminous flux in direction of driving, the driver has the ability to recognize the subsequent direction peripherally and can fixate other interesting objects in the road area. With other words the driver has more time for driving and the tiredness of the eyes could be reduced."); EX1028, Wörner, 844 ("The driver's comfort and safety can be improved considerably by adaptive motor vehicle headlighting, with the today's technical means in lighting design and manufacturing, as well as sensors and communication systems in cars.").

51. 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 adaptive vehicle lighting applications. EX1005, Beam, 4:26-59 ("spatial light modulator"), 8:4-17 ("digital mirror devices"), FIGS. 1, 2, 4; EX1009, Braun, 21:13-16 ("digital mirror device, a 'DMD' device, and each luxel 76 comprises a

micromirror"), 14:12-33, FIGS. 2-5; EX1010, Karlsson, 5:11-15 ("Micro Mirrors"), 14:1-15, FIGS. 3, 6, 14; EX1038, Hornbeck, 1:12-10:3, FIGS. 1-3; EX1039, Hornbeck, 9:16-11:11, FIGS. 1-6; EX1040, Enomoto, 1:16-30, FIGS. 1, 2A-2C; EX1036, Nelson, 3:52-4:32, FIGS. 2-6.

52. Adaptive lighting commonly used multiple directional light sources (e.g., multiple directional beams, such as light modules or beam contributors) to produce an adaptive light pattern (angular light intensity distribution) by varying illumination characteristics including beam intensity, beam shape, beam color, beam direction around curved roads, and glare reduction. EX1017, 3-10 ("[A] curve or an intersection can be adaptively illuminated before reaching actually the point when the steering wheel is turned or the turn indicator is operated."); EX1018, 33-36 ("The advantage of using Adaptive Light Control is shown in Fig. 5, where one observes a country road lit correctly. Instead of illuminating some fields or trees, the available light is directed dynamically in the direction where it is actually needed, enhancing the visual information for the driver."); EX1019, 1-2 ("A major breakthrough in improving visibility, safety and comfort under all driving conditions is given by a headlamp with adjustable light intensity and beam pattern according to the vehicle speed, steering wheel angles and different driving conditions."); EX1020, 368, 370, 374-378 ("The results show, that significant

improvements can be proven by the adaptive headlamp system, without generating additional glare for oncoming traffic").

53. As an example, EX1017, Hogrefe shows how adapted light patterns can increase safety on curved roads, at high speeds, and within cities, for example, by varying improved lateral illuminance (shaping light around curves), increasing projection length of the beam to improve driver's visibility, and expanding the beam width to capture a wider angle, for example. And as Hogrefe's Figure 3 explains, "the individual light *pattern* of multiple sub-units sum up to the total adaptive light pattern." EX1017, FIG. 3 (emphasis in original).

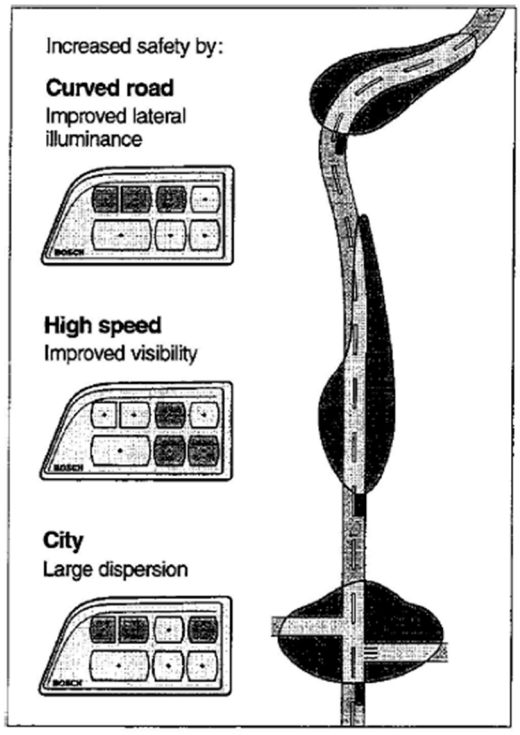



*Fig.1: Three standard driving situations with adapted light pattern seen from the bird eye's view.*

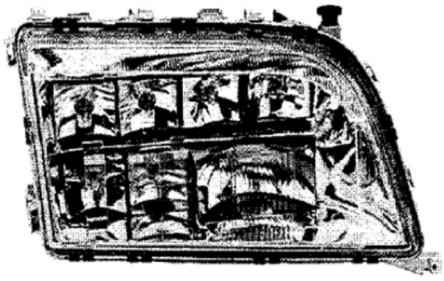
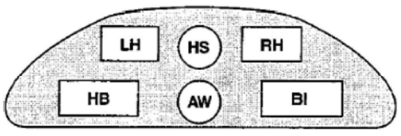


Fig 4: ALP *headlamp* sample




Single components:

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

Fig. 5 Advanced ALP sample layout

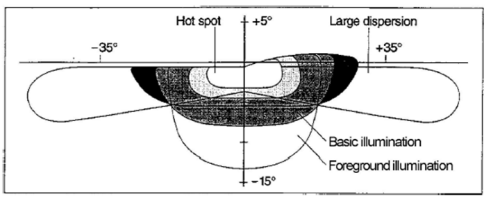



Fig. 3: Light pattern of multiple beam *headlamp (Isolux* curves in wall projection): The individual light *pattern* of multiple sub-units sum up to the total adaptive light pattern

EX1017, FIGS. 1 and 3-5.

54. Adaptive lighting to reduce glare in a portion of an oncoming or following driver's field-of-view was also well known. In 1999, the industry understood that the beam pattern in AFS systems could be adapted for different driving, weather, and environment conditions, and to keep glare at a lower level when meeting or following other vehicles on the road. EX1023, 514-515. AFS systems could use existing sensor signals on the vehicle to measure and collect ambient conditions, then to modify the lighting performance to the traffic conditions, and to prevent deteriorating glare effects for other road users. EX1024, 815-816.

55. By 2000, adaptive headlamp systems with multiple directional light beams were developed with various means of sensors to detect surroundings while driving and resulted in glare reduction for oncoming and preceding vehicle drivers. EX1005, 1:5-3:44, 4:9-59; EX1010, 1:10-26, 9:18-26, 20:29-32; *see also* EX1015, 6-18, 21; EX1016, 1-19 ("[A]ll GRE experts acknowledge the experience with the new technology of front lighting, designed to improve the illumination and to adapt it to various driving situations, whilst reducing glare."); EX1009, 6:4-7; 16:6-25, 20:15-33 ("According to an aspect of some embodiments of the present invention, the pattern recognition application identifies oncoming vehicles and automatically adjusts illumination provided by the luxels to prevent glare from light provided by the luxels from blinding a driver of the oncoming vehicle."). Further, arrays of

independently controlled narrow-beam directional light sources, for example, light-emitting diode (LED) arrays, were developed with sufficient illuminance, directionality, and dynamic control as an alternative to traditional incandescent and gas discharge bulbs to provide adaptive light patterns and real-time feedback. EX1005, 1:5-3:44, 4:9-59; EX1010, 1:10-26, 9:18-26, 20:29-32; EX1015, 6-18, 21; EX1009, 16:6-25, 20:15-33.

56. As I explain in this declaration, the ’503 patent claims are directed to systems and methods previously known in the art for adaptively controlling headlamp illumination characteristics. They recite known control schemes implemented by a known controller to control multiple light sources/clusters based on sensor data in a field-of-view. For example, light in a first subsection is provided below a predefined threshold to prevent glare, and light in a second subsection is provided above the predefined threshold to improve road illumination. Thus, a known control input (for providing a predefined threshold) is applied to a known way of controlling headlamp output light patterns and intensity.

57. As an example, independent claim 37 recites, in part, a system to:

*receive* the sensor data;

*process* the sensor data to determine a light distribution pattern for an adaptive headlight beam, such that

a headlight beam adapted to the pattern substantially illuminates a *first section* of the field-of-view including at least a portion of the *second vehicle* with an illuminance *below a predefined threshold value*,

while the beam substantially illuminates at least one or more *second subsections* of the field-of-view to either side of the first subsection with an illuminance *above the predefined threshold value*; and

*instruct* operation of at least two of the *light clusters* to create the adapted headlight beam.

EX1001, 100:3-28.[3] The dependent claims merely add known features: colored illumination; camera/GPS sensor; computer vision; illuminating road curvature/planned turn; reflectors/refractors/lenses; etc.

58. 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 one or more clusters 276 (290), 281 (282), 285 (286), 287 (288, 289) of differently aimed solid-state light sources (SLSs) such as light-emitting diodes (LEDs) 275, 277, 278, 283, 284, respectively. EX1001, 53:24-56:61, FIG. 15.

[3] Emphasis added throughout, unless noted.

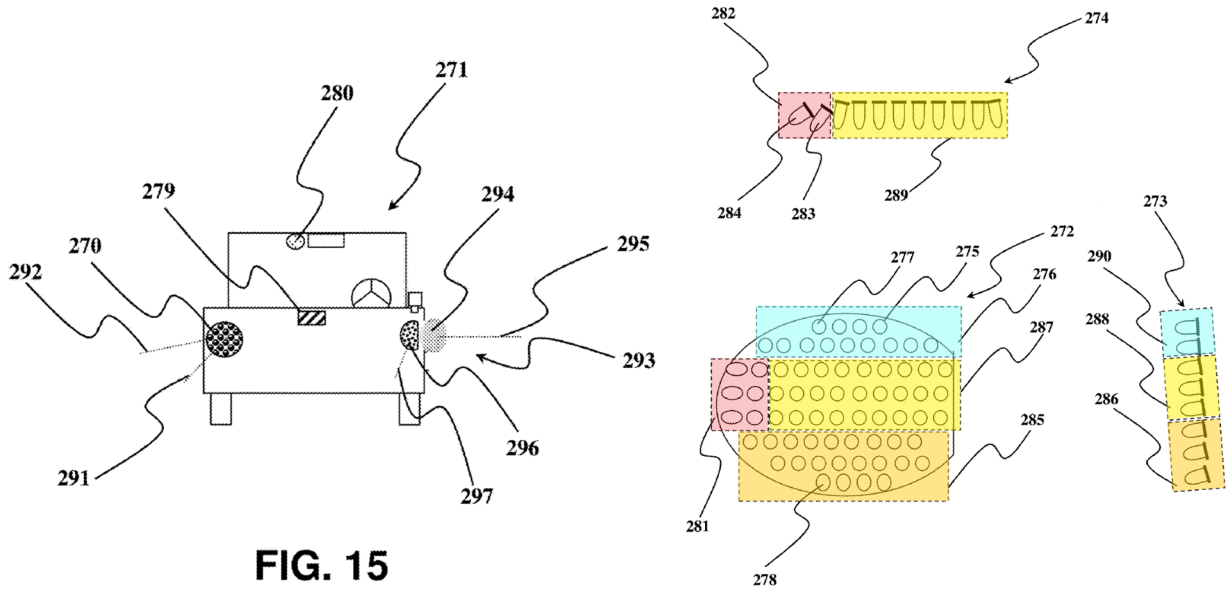



FIG. 15

EX1001, FIG. 15 (annotated).

59. The ’503 patent goes on and describes that 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. But unsurprisingly, the ’503 patent’s specification leaves it to a POSA to determine the illumination without describing an illuminance level, numerical value, algorithms, or control steps to achieve this. And a POSA would have readily incorporated multiple beam control and a predefined threshold in an adaptive headlamp system, as demonstrated by the applied prior art. Such element (predefined threshold) was well known and a POSA would have had no challenges in doing so.

### B. Independent Claims 1 and 37[4]

60. The independent claims recite a majority of patentably indistinct or substantively similar elements and concepts such that the same prior art disclosures are applicable to and map to those corresponding elements across the independent claims (e.g., claim elements [1.P]-[1.4]/[37.P]-[37.4], [1.6]/[37.5]-[37.6], [1.8]/[37.7], [1.10]/[37.10]). *See* Appendix A. That is, even if the words used in a corresponding claim or corresponding claim feature are not exactly the same, the concepts, functions, and scope, are the same. And so the same prior art applies.

61. For example, independent claims 1 and 37 recite a "vehicle headlight system" for controlling illumination characteristics of a headlamp beam with "a plurality of light clusters"; and independent claim 37 further recites a "predefined threshold value." *See* Appendix A.

62. The disclosures mapped below for the light clusters, sensor, processor, etc., of system claims 1-19, apply equally to and render obvious system claims 37-58. Minor phrasing differences do not affect the substantive application of the prior art. *See* Appendix A.

63. Substantively, the disclosures showing the obviousness of the claims apply no matter how the features are phrased within the different claim sets.

[4] Appendix A compares independent claims 1 and 37.

64. The table below highlights the overwhelming overlap between the independent claims, and shows why a POSA would have understood that the same disclosures in the applied references satisfy the corresponding claim elements:

**Table 1: Independent Claim Elements**

| Claim Element | Independent Claim 1 | Claim Element | Independent Claim 37 |
|---|---|---|---|
| [1.P] | A vehicle headlight system comprising: | [37.P] | Identical to [1.P] |
| [1.1] | one or more headlamps and a vehicle structure, arranged for affixing components of the system to the vehicle; | [37.1] | one or more headlamps affixable to a first vehicle; |
| [1.2] | a plurality of light clusters, arranged in each of the one or more of the one or more headlamps, | [37.2] | a plurality of light clusters arranged in each of the one or more of the headlamps and |
| [1.3] | the headlamps capable of projecting light so as to illuminate a plurality of sub-sections of a field-of-view with different illumination characteristics, | [37.3] | capable of illuminating sub-sections of a field-of-view with different illumination characteristics, |
| [1.4] | the subsections determined in response to sensor data, wherein the light clusters operate to create a headlight beam; | [37.4] | wherein at least two of the light clusters operate to create a headlight beam; |
| [1.5] | electronic control circuitry configured to independently operate the light clusters; | | |

| Claim Element | Independent Claim 1 | Claim Element | Independent Claim 37 |
|---|---|---|---|
| [1.6] | one or more sensors configured to obtain and provide the sensor data predefined as pertinent to illumination requirements for the field-of-view; and | [37.5] | one or more sensors configured to obtain and provide sensor data, |
| | | [37.6] | at least a portion of the sensor data indicating a second vehicle within the field-of-view; and |
| [1.7] | a logical controller including a processor, the processor in communication with a memory storing one or more algorithms, with the sensors, and with the control circuitry, | | |
| [1.8] | wherein the processor is configured to process the one or more algorithms and the sensor data to determine an illumination for at least two of the sub-sections, | [37.7] | at least one processor configured to: receive the sensor data; process the sensor data to determine a light distribution pattern for an adaptive headlight beam, |
| [1.9] | that reduces illumination to reduce glare in at least a first of the at least two subsections and | | |
| | | [37.8] | such that a headlight beam adapted to the pattern substantially illuminates a first subsection of the field-of-view including at least a portion of the second vehicle with an illuminance below a predefined threshold value, |

| Claim Element | Independent Claim 1 | Claim Element | Independent Claim 37 |
|---|---|---|---|
| | | [37.9] | while the beam substantially illuminates at least the one or more second subsections of the field-of-view to either side of the first subsection with an illuminance above the predefined threshold value; and |
| [1.10] | adapt the light emitted from one or more of the light-clusters so as to create the headlight beam that provides the determined illumination. | [37.10] | instruct operation of at least two of the light clusters to create the adapted headlight beam. |

### C. Prosecution History Summary

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

66. Additional non-art rejections were issued, and claims 1-70 issued without substantive, prior-art-based examination. The only art-based rejection was

overcome as allegedly not qualifying as prior art. Regardless, none of the prior art applied in the Petition or considered here was considered by the Office during prosecution.

### D. Claim Construction

67. As above, I understand that during an *inter partes* review proceeding, claims are to be construed in light of the specification as would be read by a POSA at the time of the purported priority date.

68. Under any reasonable construction or interpretation, it is my opinion that the challenged claims are unpatentable for the grounds presented, as I describe in this declaration. Should Patent Owner introduce any proposed claim construction(s), I reserve the right to review and revisit my opinions presented here.

**"light sources" (claims 2/42, 3/43, 5/45, 18/57)**

69. Counsel has informed me that Patent Owner submitted a proposed claim construction in a reexamination proceeding involving U.S. Patent No. 9,955,551 ("the '551 patent")—particularly a position that a POSA would understand the term "light source" in the '551 patent claims to mean an "individual LED"—but I understand that the Central Reexamination Unit did not address Patent Owner's proposed construction. EX1033, 15 ("a person of ordinary skill in the art (POSITA) would understand the term *light source* to mean individual

LED"), 19 ("[t]hus, pursuant to the broadest reasonable construction rubric, consistent with the teachings in the specification and the claim language, a person of ordinary skill in the art would construe the claim term *light source* to mean an individual LED").

70. The '503 patent, which shares the same specification as the '551 patent, 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] [i]ncandescent and discharge light sources." EX1001, 17:10-20. Therefore, in my opinion, a POSA would have understood that "light sources" include any known headlamp light sources, for example but not limited to, incandescent light sources, discharge light sources, laser diode (LD) light sources, and light emitting diode (LED) light sources that are electrically controllable, which also include the combination of light sources and spatial light modulators, for example, microbeam sources and spotlight beam sources. *See* EX1005, 8:4-17 ("microbeam sources"); EX1010, 4:32-5:10 ("spotlight beams"); EX1009, 14:16-20 ("luxels 26 may comprise one or a combination of light sources, such as for example semiconductor lasers, that provide light by emission, micro-

mirrors that provide light by reflection and/or liquid crystal cells that provide light by transmission").

71. Furthermore, in my opinion, the proposed construction of Patent Owner in the reexamination proceeding involving the '551 patent would not be applicable here at least because the '503 patent involves different claims than those claims involved in the reexamination proceeding of the '551 patent. Additionally, the claims here do not recite "LED light source," and therefore do not require the light source to be only an individual LED, and the specification and claims further explain what the term "light source" means in the context of the '503 patent.

72. In any event, the applied references cover the Patent Owner's proposed construction of a "light source" to mean an "individual LED." *See* EX1005, 8:4-17 ("light source includes an array of individual, independently controllable microbeam sources selected from the group consisting of *light emitting diodes*," which explains that the term microbeam source is a type of LED light source configuration); EX1010, 4:32-5:10 ("[t]he spotlight beams can be made up of separate, spatially distributed, pixel type light sources, for example a plurality of *light-emitting diodes*," which also explains that the term spotlight beam source is another example of a type of LED light source configuration). Thus, the challenged claims are unpatentable under any reasonable construction. Again, should any

proposed claim constructions be presented by Patent Owner, I reserve the right to provide an opinion thereon.

73. It is my opinion that none of the other claim terms require specific construction and should receive their plain and ordinary meaning in the context of the ’503 patent specification. And under any reasonable construction, the challenged claims are unpatentable.

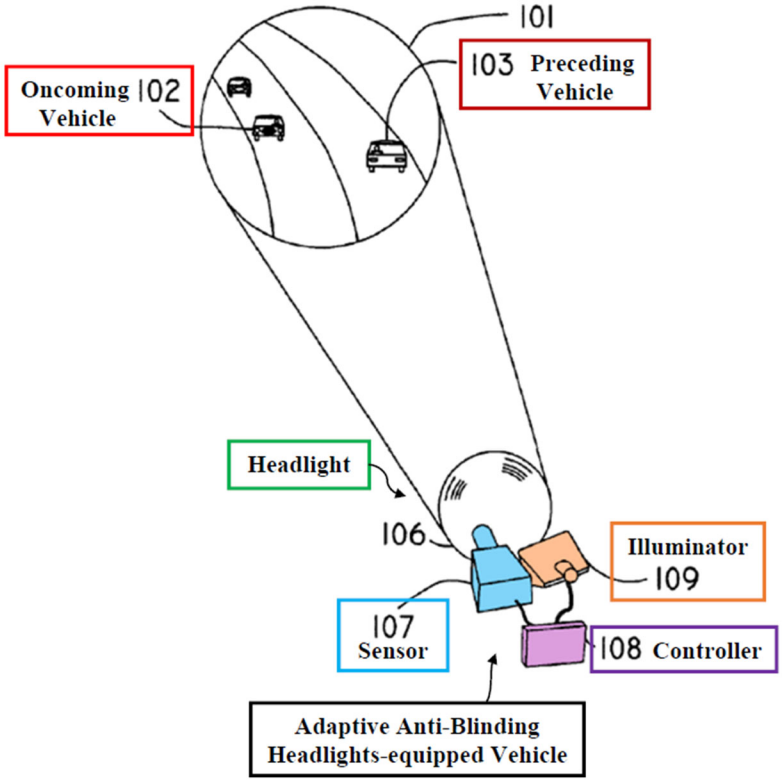
## IX. SUMMARY OF THE APPLIED REFERENCES

74. In my opinion, each applied reference discloses an adaptive automotive lighting system and, thus, is from the same field as the ’503 patent.

### A. Ground 1 – Beam and Thominet

#### 1. U.S. Patent No. 6,144,158 to Beam

75. Beam’s adaptive anti-blinding headlight/headlamp system (AABH) controls the intensity, shape, and/or angular position (direction) of one or more microbeam sources, such as individual, controllable, light-emitting diodes (LEDs). EX1005, Abstract, 8:4-17. 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.




EX1005, FIG. 1 (annotated).

76. Beam uses the term "microbeam" as light emitted from a "microbeam source," which includes "*individual, controllable, light-emitting diodes*" (LEDs). So, for clarity, when I refer to Beam's system and its LEDs, a POSA would have understood that all instances of "microbeam" in Beam's disclosure correlate with "*individual, controllable, light-emitting diodes (LEDs)*." Relatedly, as Beam uses the term "source," a POSA would have understood that the term "source" may include not only the *emitter* but also may include lenses/optics, packaging, etc.

77. Beam's LEDs are therefore controllable in direction, pattern, intensity, etc.—all with the purpose of providing enhanced safety to the driver and others.

EX1005, 3:8-44, 6:53-7:13. Because headlamps are critical safety features in the motor vehicle, the overarching purpose of providing enhanced safety to the driver and others (whether in other vehicles, or pedestrians, etc.) makes sense—any additional features or elements that improve safety would have been a focus of a POSA.

78. Beam's controller 108 uses imaged data from sensor 107 to determine a particular area (or section) of microbeams to reduce. EX1005, 4:26-59, FIGS. 2, 5. Rays from lamp 202 fall on and are reflected or blanked (attenuated) by spatial light modulator (SLM) 203 mounted on support 204 to produce an overall beam pattern comprising many individual, differently aimed microbeams. EX1005, 4:26-59, FIGS. 2, 5.

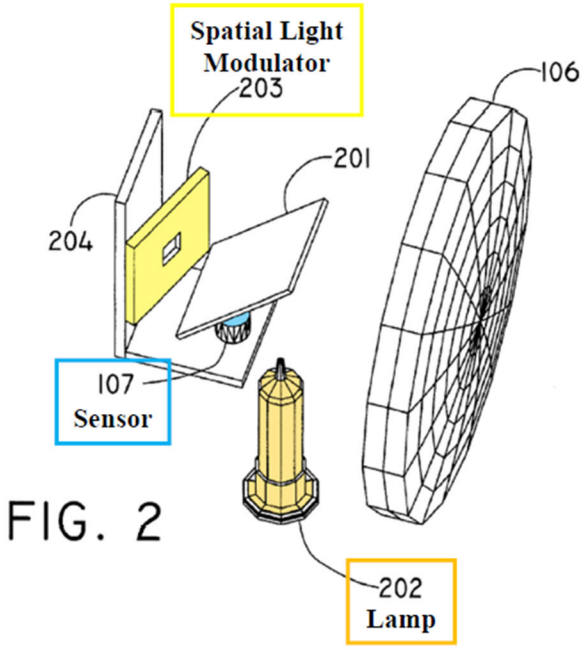



FIG. 2

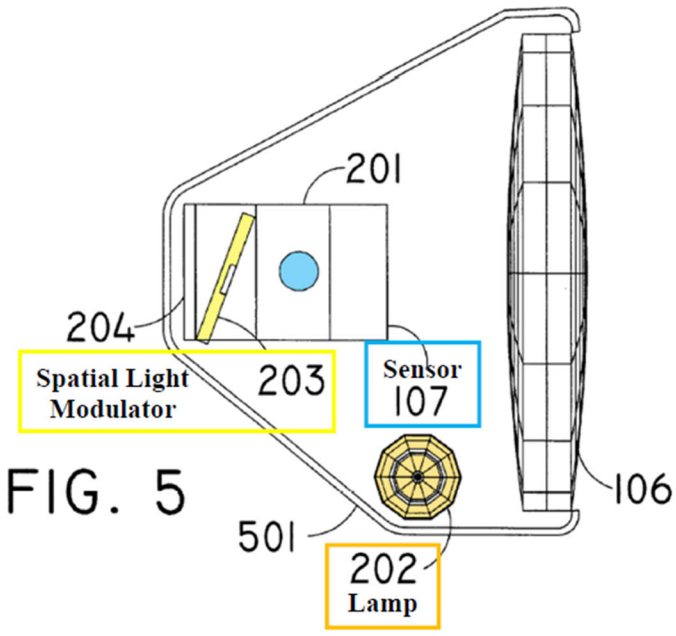



FIG. 5

EX1005, FIGS. 2, 5 (annotated).

79. As explained, Beam's microbeams are arranged in an X-Y matrix and the intensity and angular position of each microbeam is independently controlled. EX1005, 4:26-59, 8:4-17 ("digital mirror devices"), FIGS. 2, 5. 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.

80. Additionally, Beam discloses 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, 3:62-64, 5:3-16, 8:4-17 ("array of individual, independently controllable microbeam sources…light-emitting diodes…digital mirror devices"), FIGS. 4, 6.

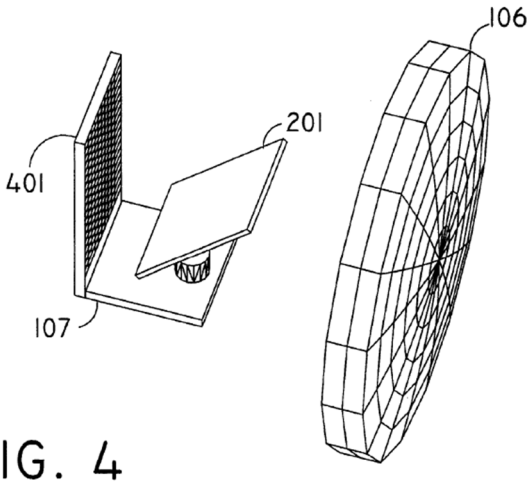



FIG. 4

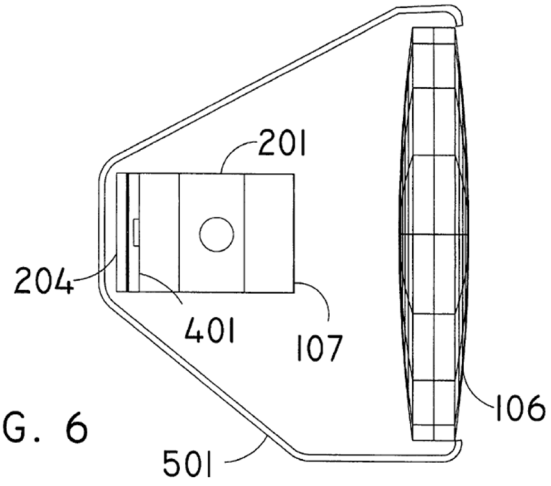
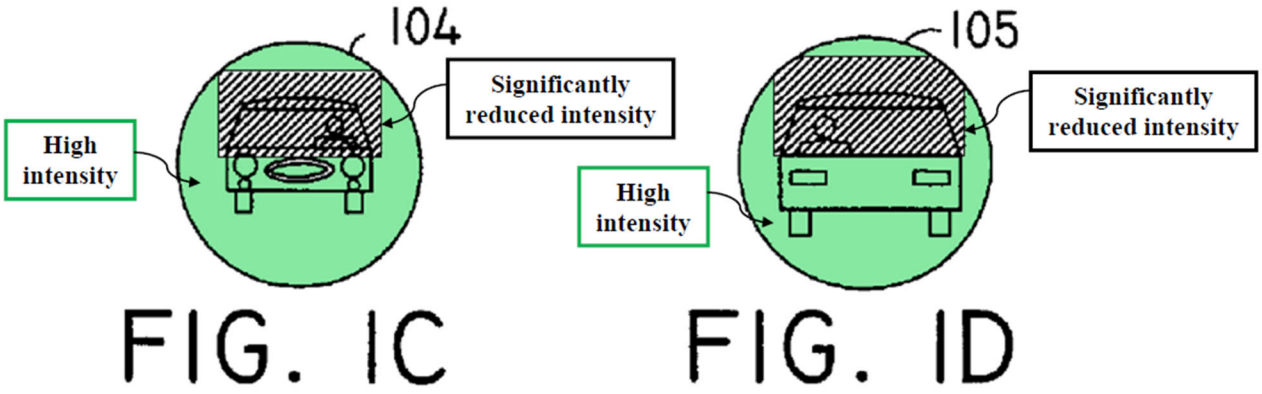



FIG. 6

EX1005, FIGS. 4, 6.

81. As shown in the annotated figures below, Beam's system automatically provides the illumination with significantly reduced intensity,

represented by shaded dark areas, to specific vehicle areas in circles 104, 105 where the light from the system is being projected to, for the purpose of *reducing blinding* of drivers of oncoming/preceding vehicles 102, 103—*while retaining high intensity illumination in unshaded areas*. EX1005, 2:53-3:3, 4:10-25, FIGS. 1C-1D.




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

82. Beam's AABH system does this via an optical system 106, sensor 107 (e.g., camera), controller 108, and illuminator 109. EX1005, 4:10-25. Data from sensor 107 are input to controller 108, thereby controlling illuminator 109 to illuminate an area 101. EX1005, 4:10-25.

83. Beam explains:

> *When an oncoming vehicle's headlights are detected* (whether or not it is equipped with the AABH system), *an area slightly wider than the headlight spacing and approximately six feet high, and whose bottom edge is centered on the oncoming headlights, is dimmed in the beam-bundle of the vehicle equipped with the AABH system*. As the positions

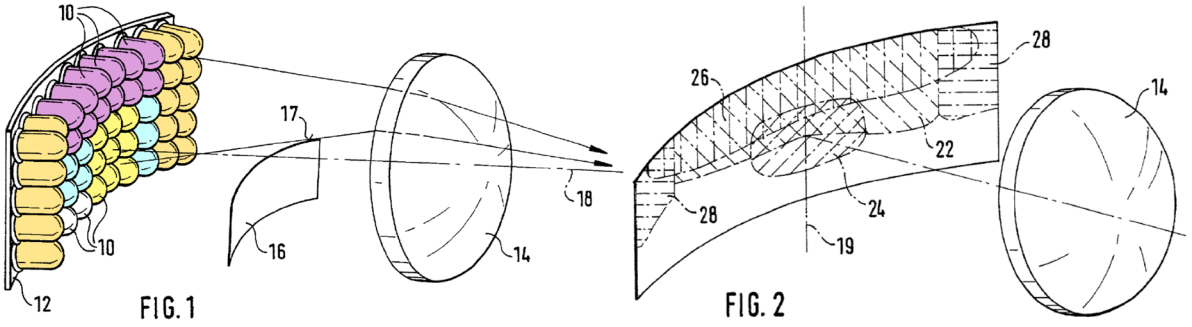
of both vehicles move, the *blanked area tracks the location of the oncoming vehicle, dynamically varying in position and in size*.

EX1005, 6:19-27, 5:46-54; *see also* EX1005, 2:59-3:3, 4:10-25.

84. And in the example with reference to Figures 2 and 5, controller 108 selectively commands reduction of illumination of microbeams falling on a particular object or objects, which commands spatial light modulator 203 in illuminator 109 to either divert or attenuate the selected microbeams. EX1005, 5:46-54; *see also* EX1005, 2:59-3:3, 4:10-25, 8:4-17 (explaining that the microbeams may be from LEDs).

**2. U.S. Patent Publication No. 2001/0019486 to Thominet**

85. Like Beam, Thominet discloses a headlight with independently controllable LEDs in an array. EX1006, ¶¶17-18, 21, 23-26, FIGS. 1-2, 5. Semiconductor light sources 10 (e.g., LEDs) arranged on a curved surface provide regions 22, 24, 26, 28 with different aimings, independently controllable to provide different illumination functions (e.g., low beam, high beam, low sight, large width). EX1006, ¶¶17-18, 21, 23-26, FIGS. 1-2, 5.




EX1006, FIGS. 1-2 (annotated).

86. Thominet describes that two "illumination devices can be arranged at the front end" of a vehicle as headlights. EX1006, ¶17. The semiconductor sources 10 (e.g., LEDs) are distributed in a matrix on support element 12. EX1006, ¶17. The semiconductor light sources 10 are held and electrically contacted on support element 12. Support element 12 arranges semiconductor light sources 10 "distributed over a concavely curved surface or a stepped surface." EX1006, ¶18.

87. Thominet discloses such an implementation to provide different spatial distributions for improved visibility in different driving situations (e.g., low visibility, low/high speeds, recognizing a counter traffic, curves, etc., *see* EX1006, ¶¶7-8, 23-26, FIGS. 1-2), thereby improving driver safety.

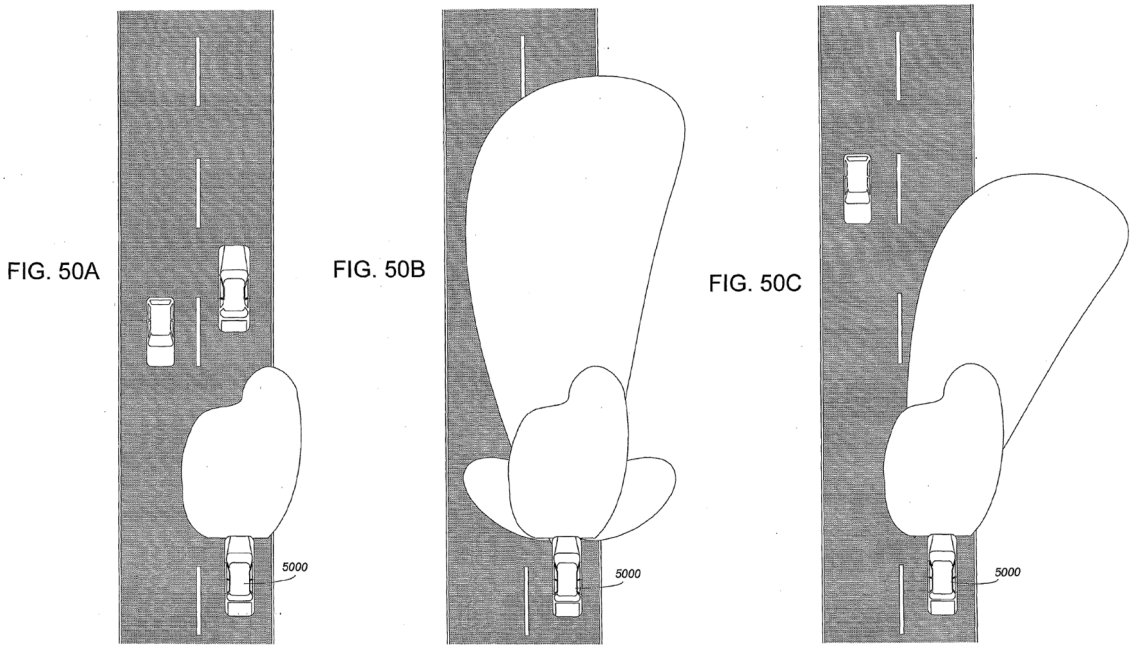
88. Thominet's technique (e.g., software implementation), seeks to enhance driver visibility, thereby increasing safety—using multiple beam regions (clusters) for different functions. EX1006, ¶¶17-18, 21, 23-26, FIGS. 1-2; EX1006, ¶4 ("*characteristic* of the light beam…can be used for *different functions*"), ¶¶5-8. Semiconductor light sources 10 provide beam regions 22, 24, 26, 28 with different angles/aimings for different driving situations. EX1006, ¶¶7-8, 17-18, 21, 23-26, FIGS. 1-2; EX1006, ¶7 ("*wider* illumination"), ¶23 ("*improving* the illumination…at high speeds").

89. Thominet's hardware makes this possible—Thominet's semiconductor light sources 10 on curved surface 12 (e.g., with differently

angled/aimed semiconductor light sources 10 relative to the vehicle, *see* EX1006, ¶¶17-20, 23-26, FIGS. 1-2, 5-7) results in different angles/aimings relative to the vehicle, provide beam regions 22, 24, 26, 28 (clusters) for different driving situations. EX1006, ¶¶7-8, 17-18, 21, 23-26, FIGS. 1-2.

### B. Ground 2 – WIPO Patent Publication No. 2001/070538 to Stam with Beam-Thominet

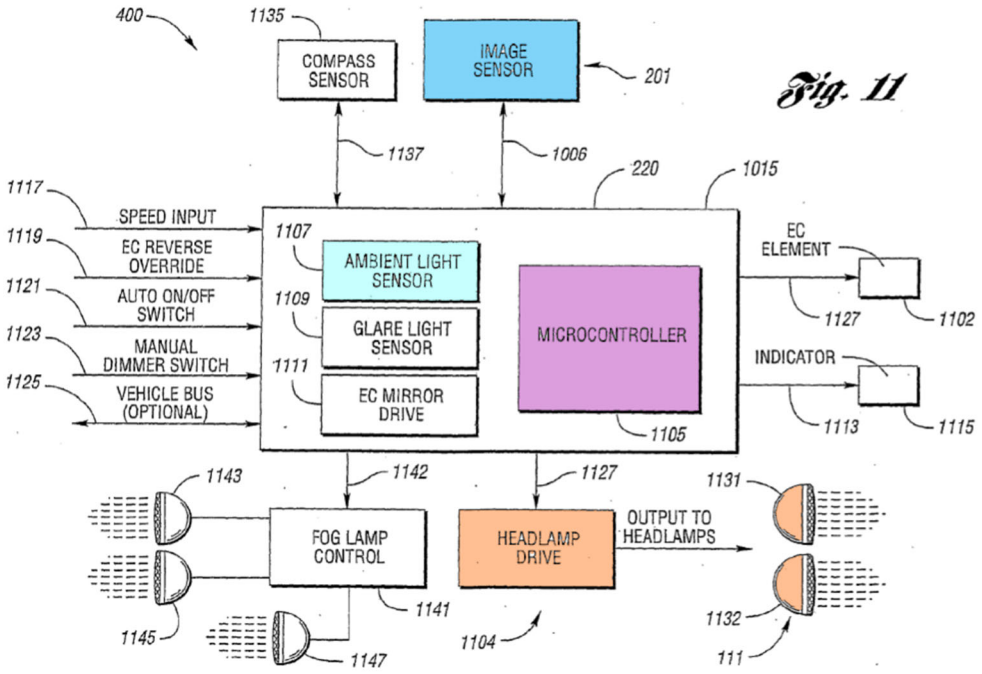
90. Like Beam, Stam discloses a headlight control system to automatically adjust beam patterns that maximize the illuminated area without causing excessive glare. EX1007, Abstract, 9:12-10:8, 77:30-78:17, FIGS. 11, 27-28, 33, 50A-50C.[5]




EX1007, FIGS. 50A-50C.

[5] In this declaration, for Stam, I use page:line citation format.

91. Stam's headlight control system uses an image sensor and controller to automatically adjust intensity, aim, and/or focus of exterior lights to generate beam patterns that maximize the illuminated area without excessive glare. EX1007, Abstract, 9:12-10:8, 73:13-16, 77:30-78:17, FIGS. 3, 11, 13, 14, 19, 20, 26a, 27, 28, 33, 50A-50C. Stam also discloses an ambient light sensor 1107 can have one or more predefined light level thresholds to vary the headlamps' beam pattern and intensity when the ambient light level is above or below a light level threshold. EX1007, 4:7-15, 30:12-31:16, 48:20-26, FIGS. 11, 14.




EX1007, FIG. 11 (annotated).

92. Further, Stam discloses laws and regulations governing the amount of glare experienced by drivers (e.g., a glare tolerance level or "perceived brightness") such that a predefined dimmed (low beam) illuminance of no greater

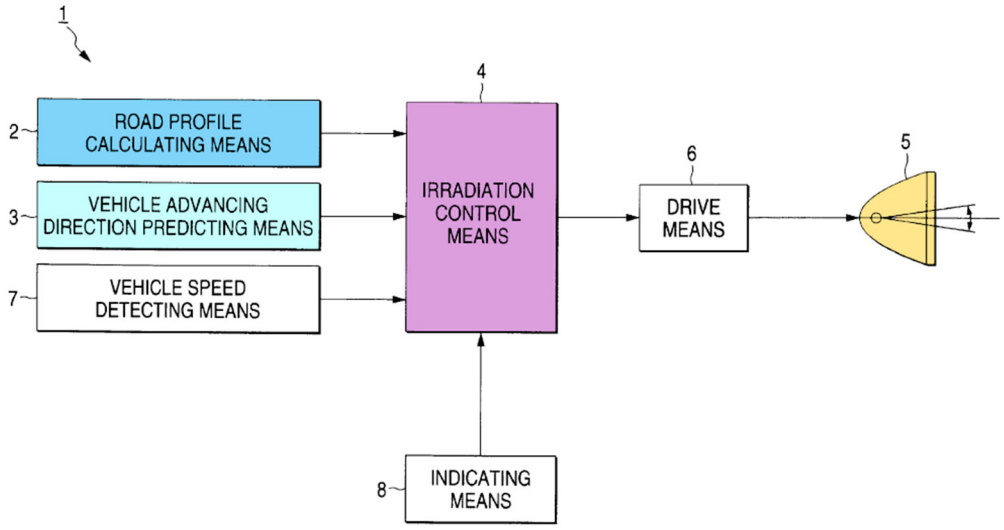
than 0.1 foot candles (fc) within 700 feet should be used to avoid glare to other drivers. EX1007, 1:14-31, 9:12-10:8.

93. Stam provides a specific "predefined threshold" value based on a dimmed illuminance to reduce glare, and indeed driver visibility and safety are paramount in Stam. EX1005, 3:8-45, 5:33-54, 6:53-7:13; EX1007, 1:14-31. In fact, Stam explains there are laws and regulations governing the amount of glare experienced by drivers and thus discloses techniques to further reduce glare. EX1007, 1:14-31, 9:12-10:8, Abstract, 58:11-33.

94. Stam's predefined dimmed illuminance (*see* EX1007, Abstract, 1:14-31, 9:12-10:8) is tied to particular glare reduction techniques and the relationship between such reduction and laws and regulations governing the amount of glare experienced by drivers.

### C. Grounds 3, 4 – U.S. Patent No. 6,049,749 to Kobayashi with Beam-Thominet/Beam-Thominet-Stam

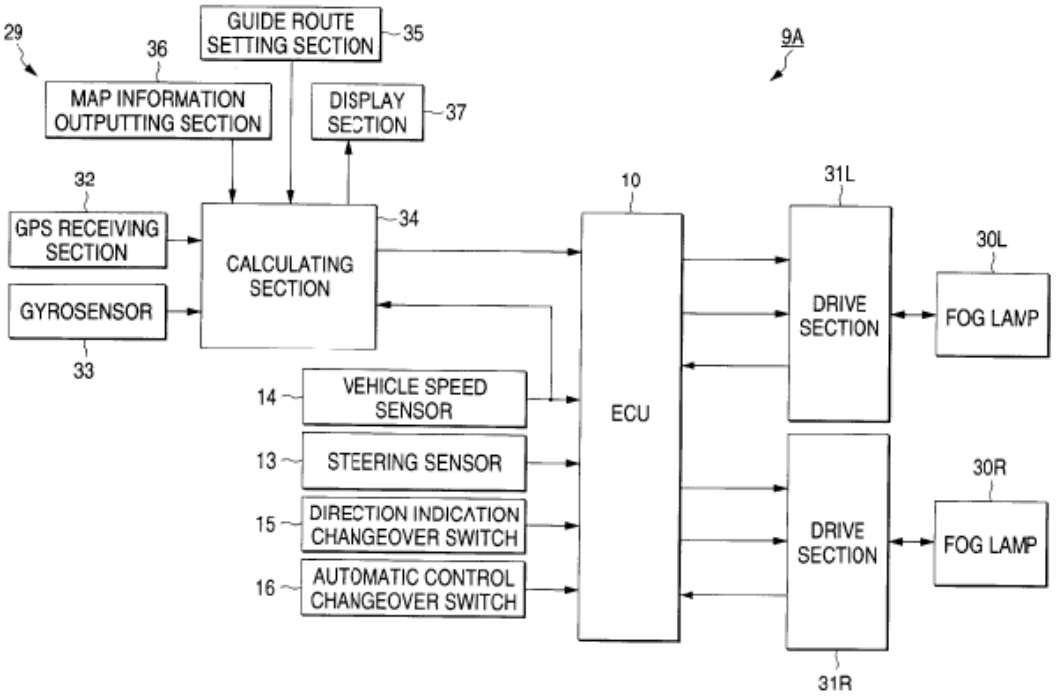
95. Like Beam, Kobayashi discloses an adaptive headlamp. EX1008, Abstract, 1:66-2:35, 4:60-64, FIGS. 1, 10. Kobayashi's adaptive lighting uses map data/information to predict and adjust illumination towards an advancing direction of the vehicle intended by the driver, for example, towards upcoming curves/turns. EX1008, Abstract, 1:66-2:35, 3:9-34, 4:60-64, FIGS. 1, 10.




EX1008, FIG. 1 (annotated).

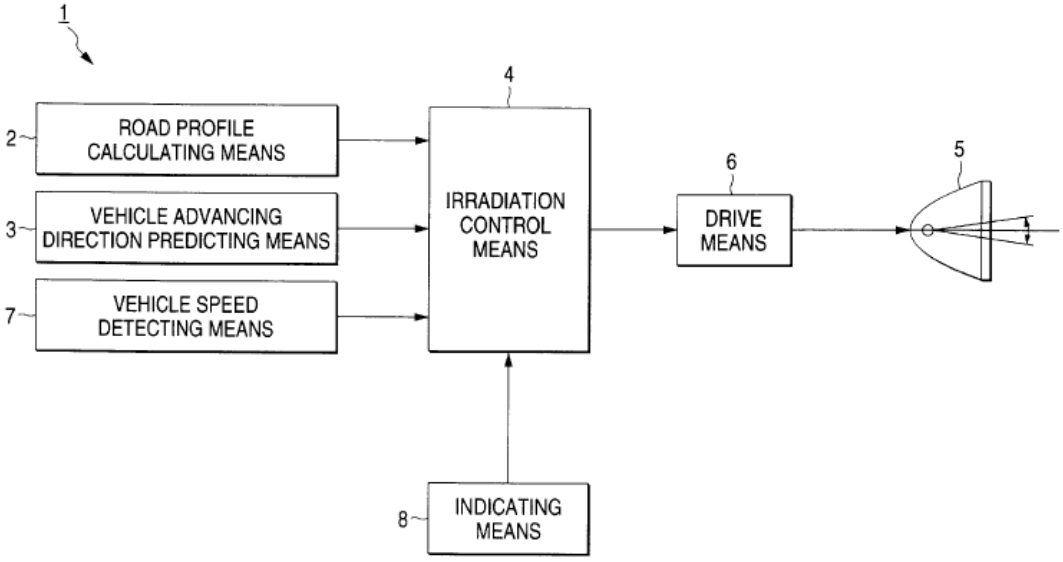
96. Kobayashi's ECU 10 receives input "from GPS navigation device 29, steering sensor 13, vehicle speed sensor 14, direction indicating switch 15 and automatic control changeover switch 16." EX1008, 17:8-15; *see also* EX1008, FIGS. 1, 6, 10:1-11:4. "GPS navigation device 29 corresponding to the road profile calculating means 2 includes: GPS receiving section 32, gyrosensor 33, calculating section 34, guide route setting section 35, map information output section 36, and display section 37." EX1008, 17:16-20.

FIG. 12



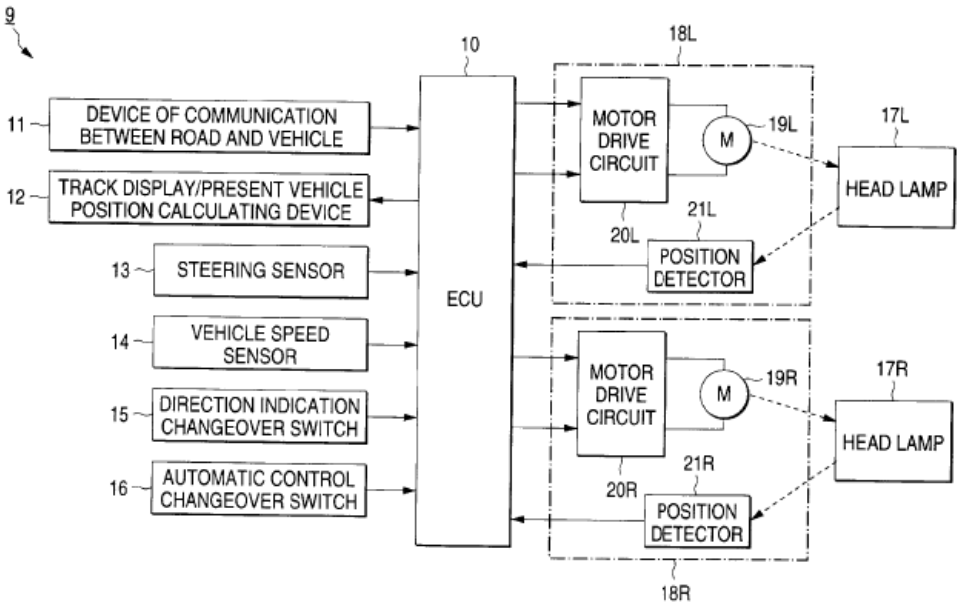

EX1008, FIG. 12.

FIG. 1




EX1008, FIG. 1.

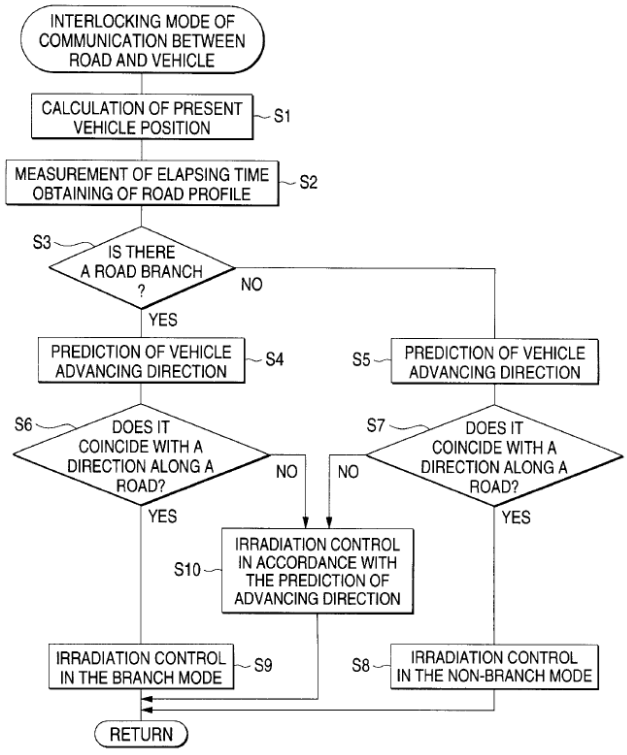
FIG. 6




EX1008, FIG. 6.

97. GPS navigation device 29 sends information about the road profile and the present vehicle position to ECU 10. EX1008, 17:39-40. In turn, output signals of ECU 10 are sent to drive sections 31L, 31R of the fog lamps 30L, 30R (which are head lamps) that are arranged at the left and right front portion of the vehicle, respectively. EX1008, 17:39-40, 3:9-19, FIGS. 1, 6, 12. ECU 10 processes information in Figure 12 in substantially the same way as that of Kobayashi's Figure 9 example. *See* EX1008, 11:34-14:52, including representative lookup tables; *see also* EX1008, 17:41-50, FIG. 9.

*FIG. 9*



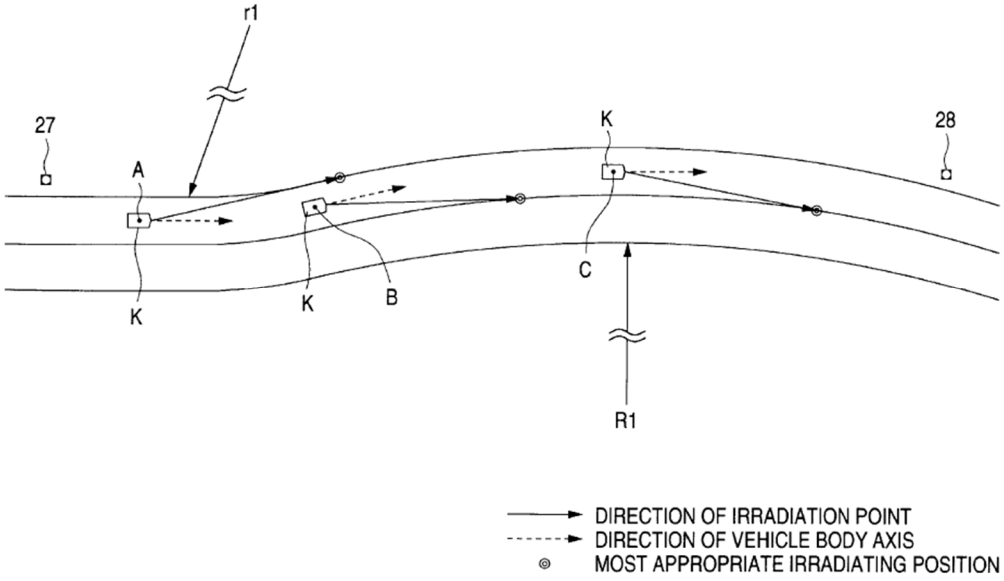

EX1008, FIG. 9.

98. Figure 12 uses map data including road curvature (e.g., by GPS navigation device 29) as the method of obtaining information, to implement the more general system diagram in Figure 1. EX1008, 17:44-50. And a scheduled course of the vehicle which is set by the guide route setting section 35 is fed to the prediction of the vehicle advancing direction in steps S4 and S5. EX1008, 17:44-50.

99. Kobayashi's road profile calculating means 2 (using map data such as GPS data including road curvature) and vehicle advancing direction predicting means 3 cooperate with control means 4 to alter the direction/shape/intensity of

headlamp 5. EX1008, 3:9-50, FIG. 1. Kobayashi discloses whole or partial directional control, including via portions of the lighting device or plurality of components composing the lighting device, e.g., reflecting mirrors, plurality of lighting devices, etc. *See generally* EX1008, 6:4-62.

100. Kobayashi's system responds to real-world conditions—multiple curves, intersections, etc. As an example, Figure 10 shows that the illumination control (including shaping/reshaping light and directionality) of vehicle K can be planned and controlled on curved roads r1 and R1 with the driver's line of sight to improve safety. For example, when vehicle K turns to the left (point A), the left shoulder is illuminated (the shape is adjusted towards the left shoulder), and when vehicle K turns to the right on a subsequent curve (point C), the right shoulder is illuminated (the light is reshaped towards the right shoulder). EX1008, 14:53-15:28. While Figure 10 is described in more detail relating to beacons 27 and 28, the GPS and other map data including road curvature are also accounted for in ECU 10. *See also* EX1008, FIG. 12, 17:3-18:67. Moreover, a POSA would have understood that the beacons 27 and 28 also convey map data, e.g., as road profile information including road curvature.




EX1008, FIG. 10.

### D. Grounds 5, 6 – WIPO Patent Publication No. 2002/004247 to Braun with Beam-Thominet/Beam-Thominet-Stam

101. Similar to Beam, Braun's headlight includes independently controllable light sources (e.g., LEDs) for adaptive illumination. EX1009, Abstract, 2:7-13, 9:29-10:4, 12:17-20, 14:12-20, 15:3-24, FIGS. 1, 5-6. Braun's controller 118 identifies and illuminates objects in a roadway scene by adapting colored luxels 26 (e.g., RGB) in illuminator 116. EX1009, 14:21-30, 23:28-24:27, FIGS. 5-6.

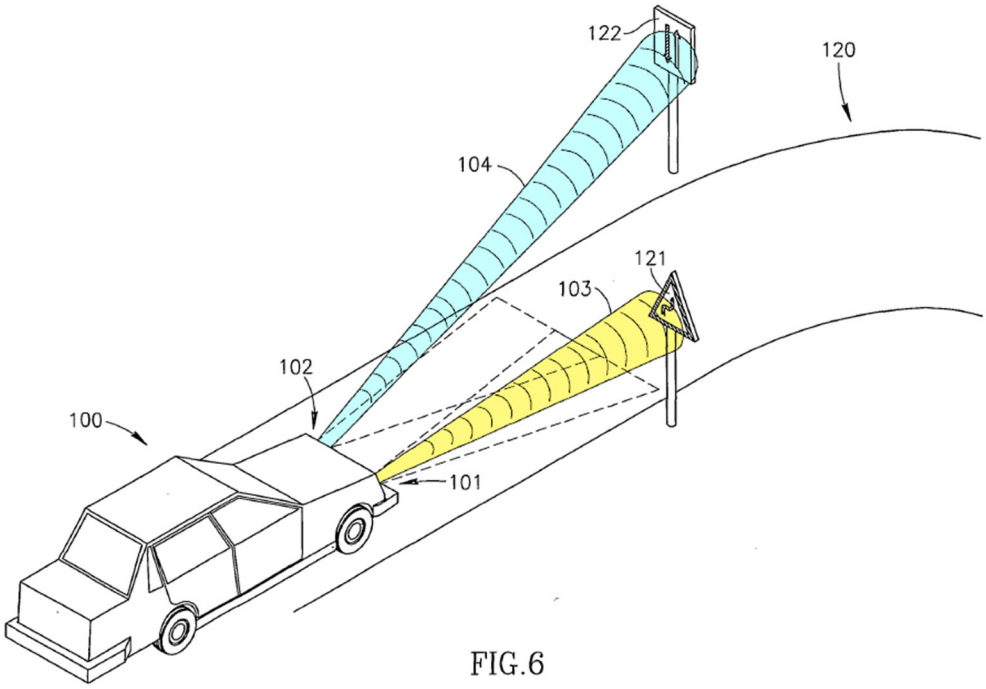
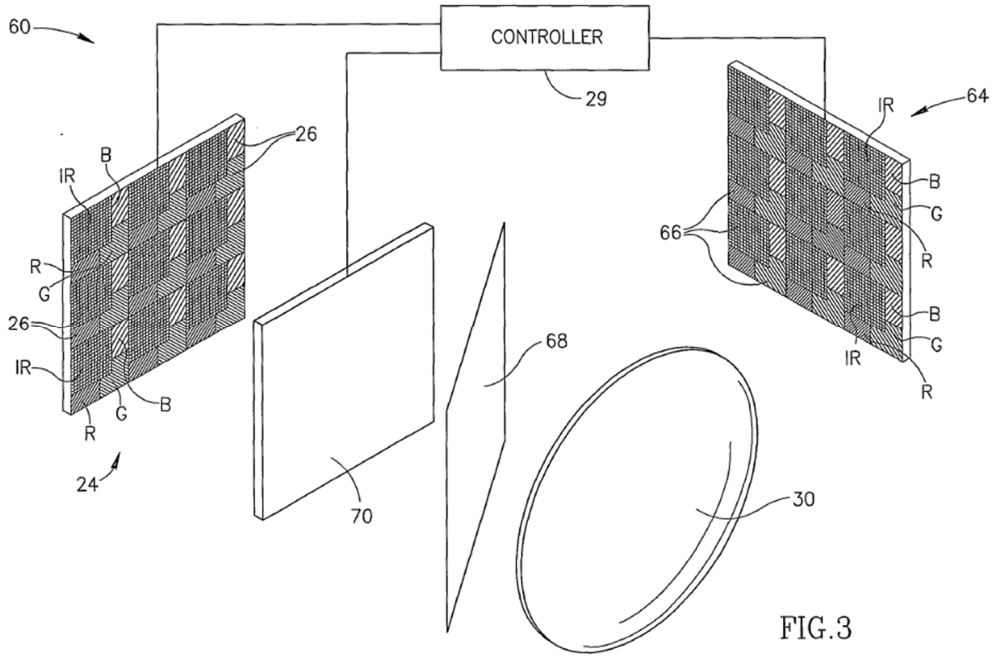



FIG.6

EX1009, FIG. 6 (annotated).

102. Further, Braun's colored luxels 26 provide "adaptive illumination of a *roadway* and *neighboring regions*" and "light provided by luxels 26 is not limited to the visible spectrum but may, for example, comprise *infrared* or *ultraviolet* light." EX1009, 14:21-30, 5:22-25, 14:21-25, FIGS. 2-3, 5-6; EX1009, 18:13-14 ("illuminator 24 provides *IR light*").



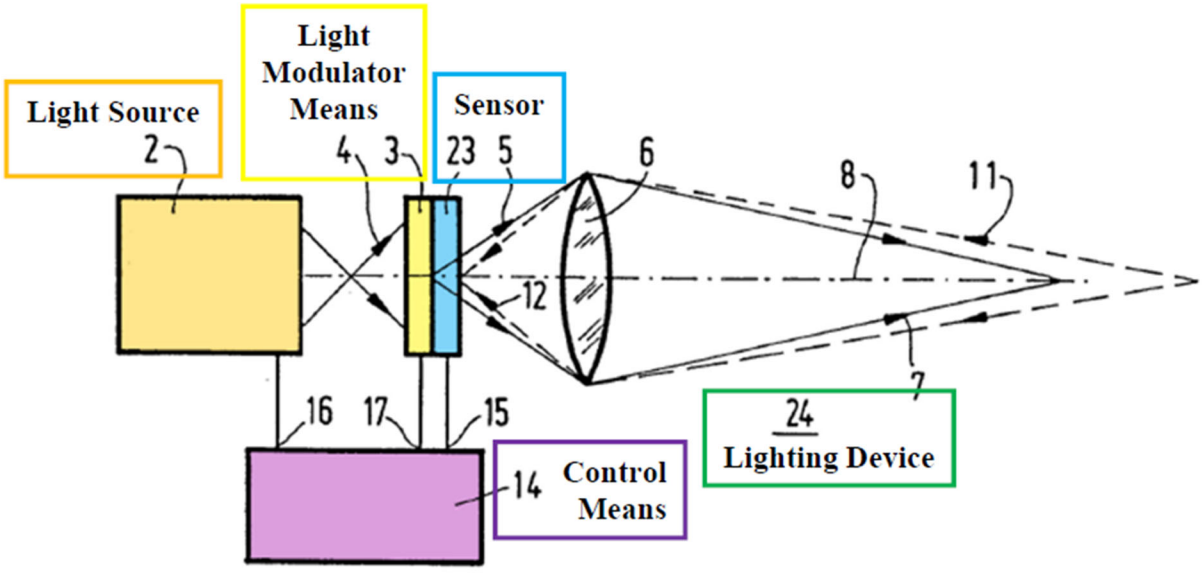

EX1009, FIG. 3.

### E. Ground 7 – Karlsson and Harbers

#### 1. WIPO Patent Publication No. 1998/054030 to Karlsson

103. Karlsson discloses a headlight having spotlight beams and sensors to detect coming traffic and automatically control a lighting pattern to reduce blinding of oncoming traffic. EX1010, Abstract, 2:30-35.[6] 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.

[6] In this declaration, for Karlsson, I use page:line citation format.




EX1010, FIG. 3 (annotated).

104. Lighting device 24 includes a plurality of controllable spotlight beams for 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. EX1010, 13:24-14:4, FIG. 6.

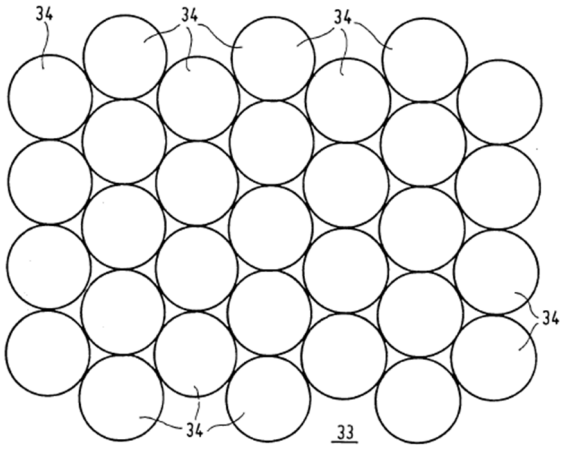



FIG. 6

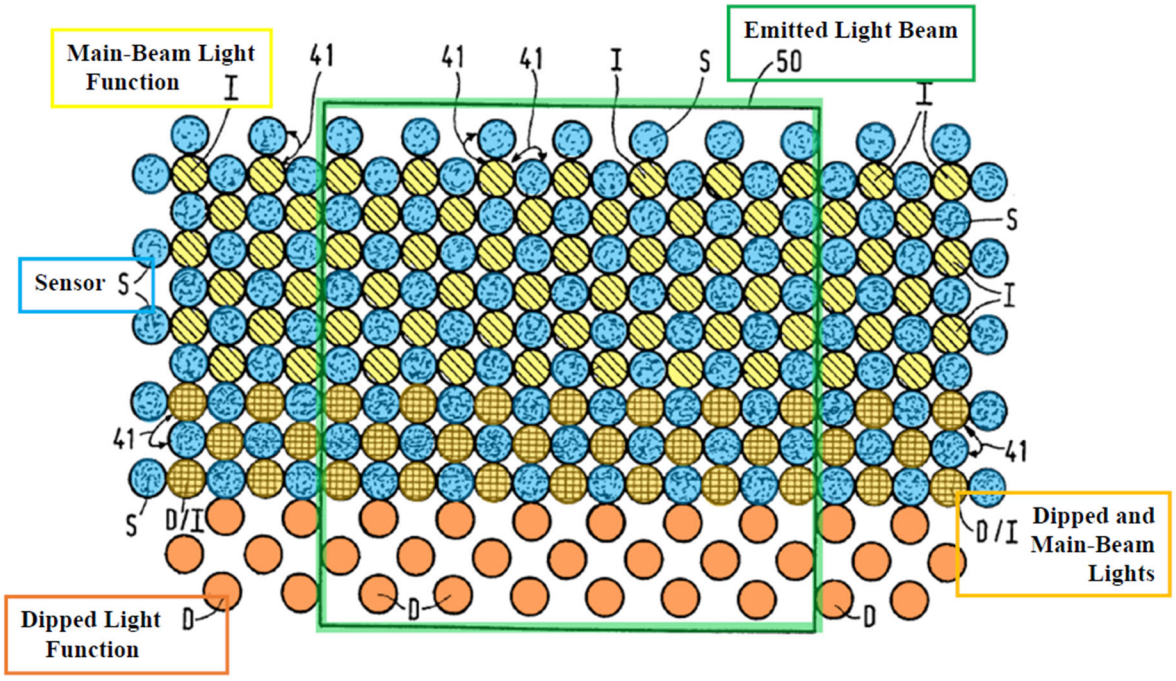
EX1010, FIG. 6.

105. Karlsson's automotive headlights (headlamps) include LEDs that are automatically controlled in direction and/or intensity. In an example, sensors detect oncoming traffic and a lighting pattern of the LEDs is automatically changed to reduce blinding of oncoming traffic. EX1010, Abstract. Karlsson's lighting device automatically varies an LED pattern in an efficient manner and with maximum sensitivity in response to control signals delivered by light-sensitive sensors. EX1010, 2:30-35, FIG. 3.

106. The spotlight beams (from LEDs) are controlled such that patterns of the emitted light beam are automatic and responsive to inputs. EX1010, 13:24-14:4. Switching one or more LEDs on or off or adjusting the intensity of the light emitted provides a desired pattern and intensity. EX1010, 13:24-14:4; *see also* EX1010, FIG. 3. Karlsson's spotlight beams 34 can be provided by a light source 2 composed of a grid of separate LEDs, which can be controlled individually or in groups. EX1010, 13:24-14:4; *see also* EX1010, FIG. 3. The headlight includes a spatial distribution of LEDs (D, I, and D/I) and spotlight sensors S. EX1010, 19:18-20:3, FIGS. 6, 14. The resulting emitted light beam 50 is represented as a window that can shift in the plane from left to right and from top to bottom and produced by LEDs based on the data from inputs, e.g., data sensed from spotlight sensors S. EX1010, 19:18-20:3, FIGS. 6, 14.

107. Emitted 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.

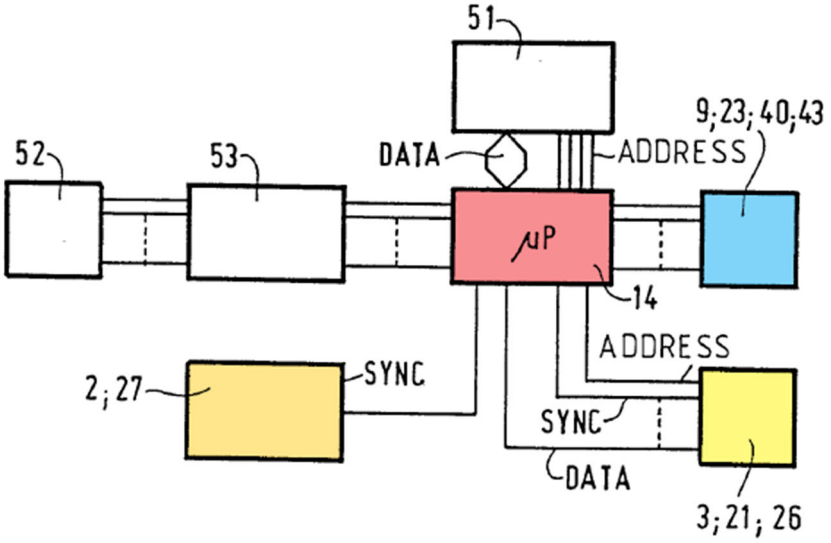
EX1010, 19:18-20:3, FIG. 14.




EX1010, FIG. 14 (annotated).

108. Processor-controlled 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.

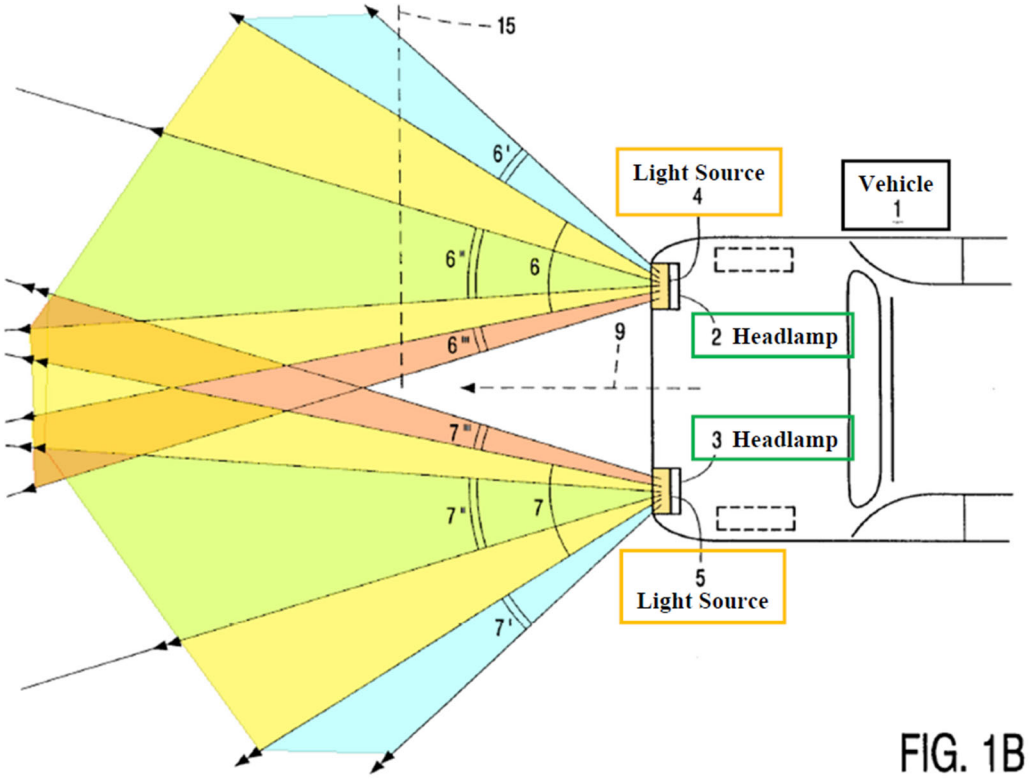



EX1010, FIG. 15 (annotated).

**2. WIPO Patent Publication No. 2001/001038 to Harbers**

109. Likewise, Harbers's headlamp includes independently controllable opto-electronic elements (e.g., LEDs) for adaptive colored illumination. EX1011, Abstract, 2:27-3:10, 5:14-26, 6:27-7:32, FIGS. 1B-2.[7] Colored light beam segments 6-6'-6"-6'", 7-7'-7"-7'" have different aimings (angles relative to longitudinal direction 9) and spectral characteristics to improve visibility, thereby increasing safety. EX1011, 5:14-26, 6:1-7, 6:27-7:32, 8:28-33, FIGS. 1B-2.

[7] In this declaration, for Harbers, I use page:line citation format.

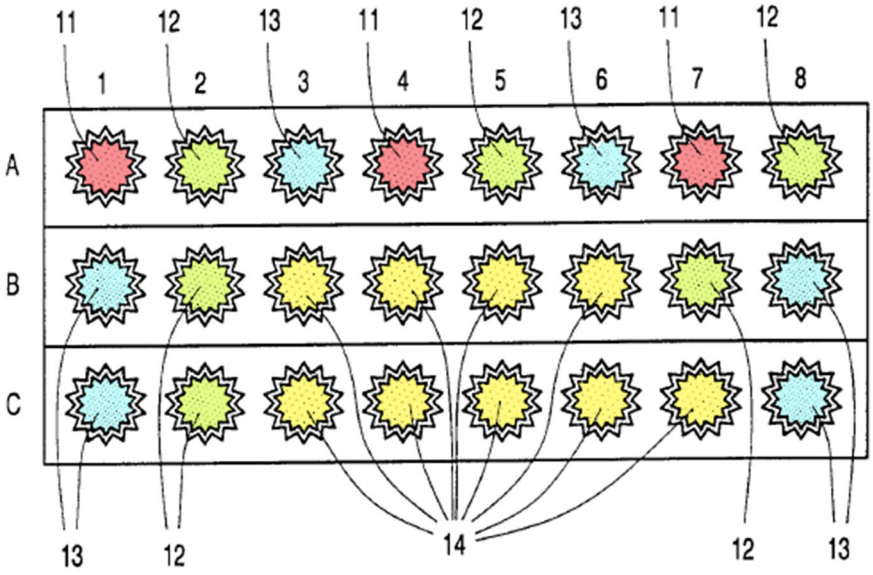



EX1011, FIG. 1B (annotated).

110. Harbers goes on to describe that first beam segment 6, 7 is "a kind of *passing* beam," second beam segment 6', 7' is "directed in particular towards the *edge of the road* (the shoulder of the road)," third beam segment 6", 7" is "directed particularly towards the *center of the road*," and fourth beam segment 6"', 7"' is "a kind of *main* beam." EX1011, 7:1-17.

111. Further, light source 4, 5 includes a plurality of opto-electronic elements 11-14 arranged on a curved substrate in a regular pattern to provide different colored illumination to different regions. EX1011, 7:20-32, 8:28-33, FIG. 2. For example, Harbers discloses "red LEDs are indicated by reference numeral

11, green LEDs by reference numeral 12, *blue LEDs* by reference *numeral 13*, and *yellow* or white LEDs by reference *numeral 14*." EX1011, 8:28-30.



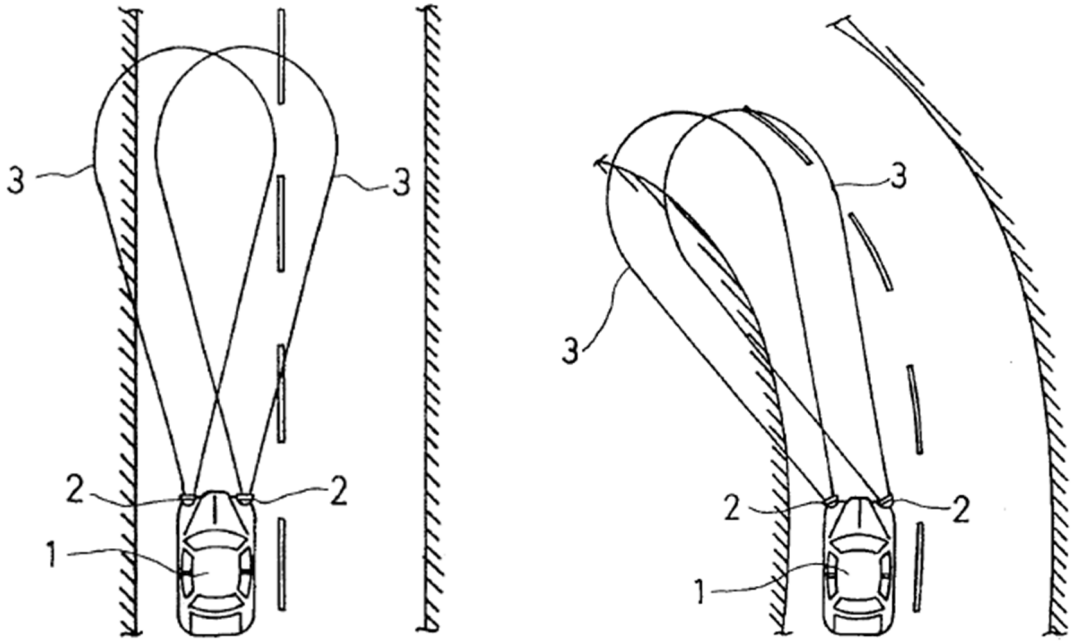

EX1011, FIG. 2 (annotated).

112. Additionally, Harbers discloses "a so-called *passing* beam and/or a so-called *main* beam…requires a luminous flux ranging *between 600 and 1000 lm*" and light source 4, 5 (e.g., LEDs) "meets the international *standard* ranging between *600 and 1000 lm*." EX1011, 2:8-10, 3:18-22, 8:13-18.

### F. Ground 8 – U.S. Patent No. 5,588,733 to Gotou with Karlsson-Harbers

113. 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. Gotou's adaptive lighting uses map data/information including road curvature to predict and adjust illumination towards upcoming curves/turns—for example,

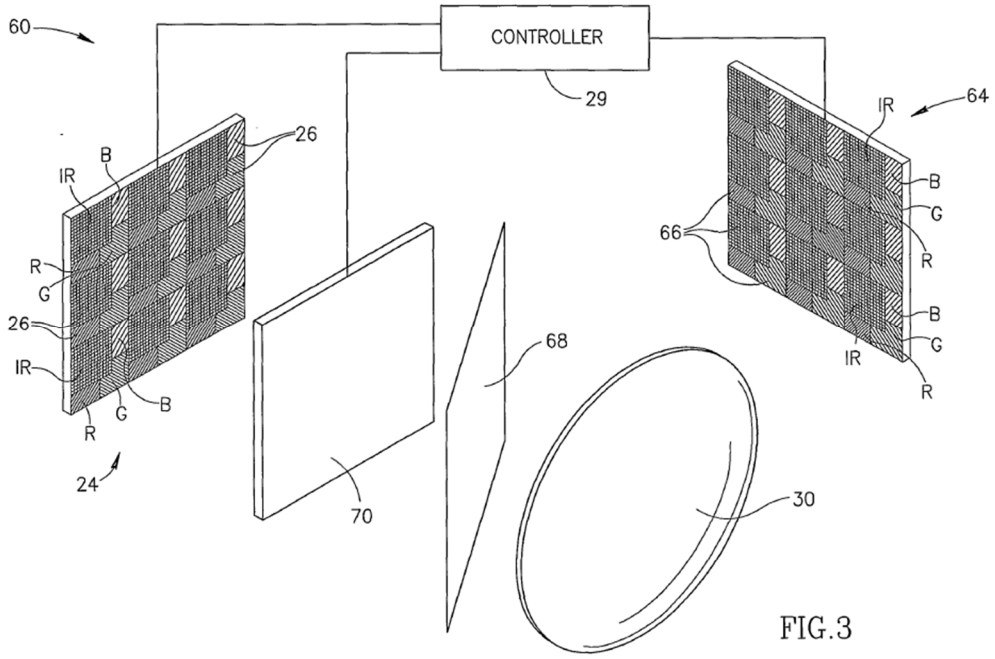
when there is a leftward curve, lighting regions 3 adjust leftward prior to the curve. EX1012, 3:24-55, 7:32-43, 8:28-35, FIGS. 8-9.




EX1012, FIGS. 8-9.

### G. Ground 9 – Braun with Karlsson-Harbers

114. Likewise, Braun's headlight includes independently controllable colored luxels 26 (e.g., LEDs) in illuminator 116 that provide infrared (IR) or ultraviolet (UV) light. *See supra* Section IX.D.




EX1009, FIG. 3.

## X. GROUND 1: THE COMBINATION OF BEAM AND THOMINET RENDERS OBVIOUS CLAIMS 1-5, 7-8, 10-14, AND 18-19.

115. It is my opinion that Beam explicitly or implicitly discloses every feature in claims 1-5, 7-8, 10-14, and 18-19. But to avoid doubt, Beam is combined with Thominet, for claim element [1.2] (and [37.2] in Ground 2), claim 5, and claim 18, which disclose a well-known implementation of adaptive headlamps—light clusters for different functions, a light cluster spectral power distribution (light color), and a laser diode as the light source, respectively—rendering the claims obvious. For dependent claims (e.g., claims 2-5 and 19) reciting "light clusters" or "light modifying elements," Beam, alone or in combination with Thominet, disclose or render obvious these claims.

116. Beam discloses "[t]he *angular* position or attenuation of *each of the microbeams* is *independently* set by the controller 108." EX1005, 4:46-48, Abstract, 7:25-29, 8:4-17, 8:23-34, FIGS. 1-2, 4. Each microbeam is a directional "cluster" or "source," having its own independent *angular* position, that combines to form the headlamp beam; so Beam's lamp 202 and SLM 203 (see Figure 2) is consistent of at least two light clusters/sources to provide illumination in desired subsections. EX1005, 7:25-29 ("*multiple* narrow angle microbeams"), 8:4-17 ("*array* of individual, independently controllable microbeam sources"), 8:23-34 ("area of illumination provided by *multiple* rays of light"), 4:26-59, 5:3-21, FIGS. 2, 4-6. Alternatively, if Patent Owner argues, incorrectly, that a "cluster" requires at least two (or more) microbeams, Beam also discloses this. EX1005, 4:26-59, 5:3-21, 4:46-48 ("[t]he *angular* position or attenuation of *each* of these microbeams is *independently* set by the controller 108"), FIGS. 2, 4-6.

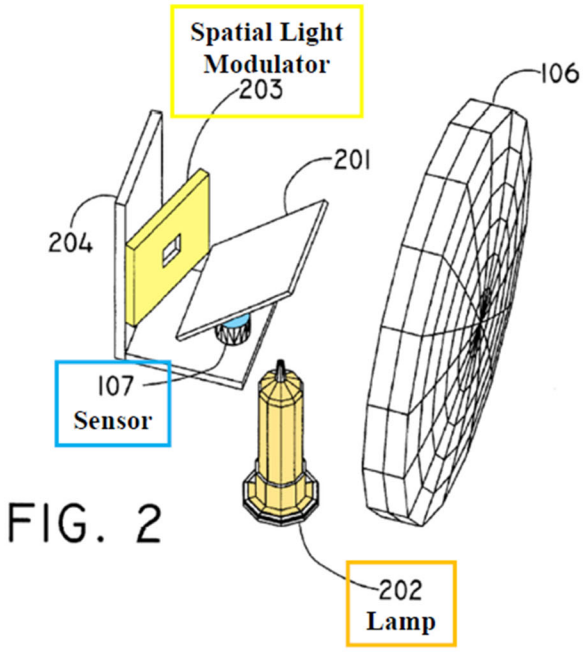



FIG. 2

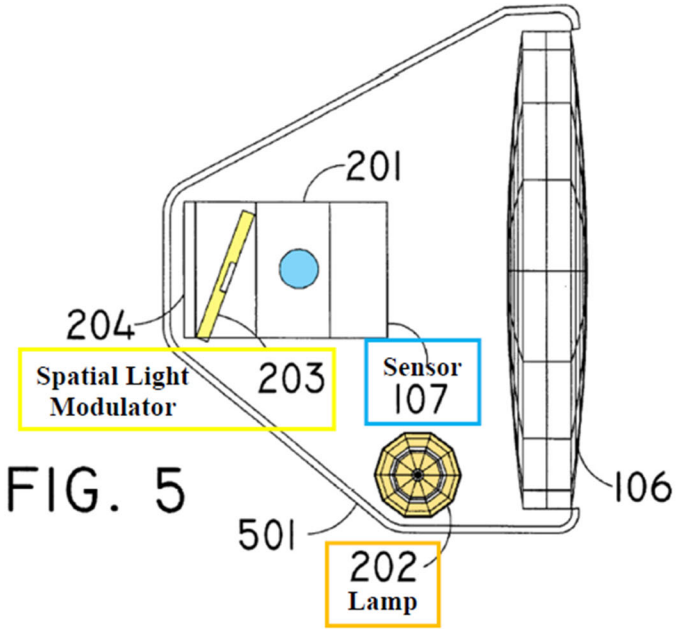
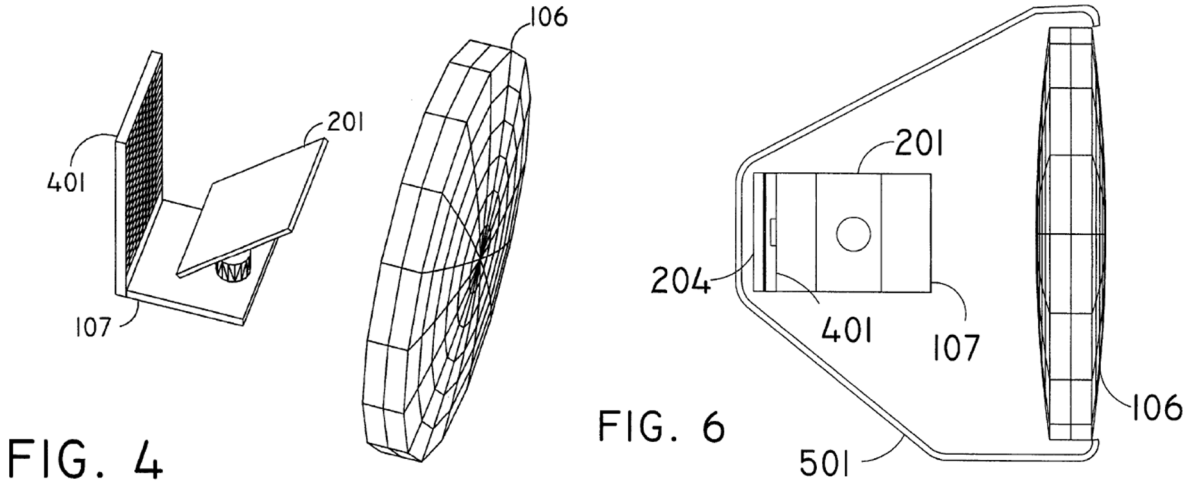



FIG. 5

EX1005, FIGS. 2, 5 (annotated).

117. 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 shown in Figure 2. EX1005, 3:62-64, 5:3-16, 8:4-17, FIGS. 4, 6. Each light source (cluster) of the array has its own independent *angular* position, that combines to form the headlamp beam, so Beam's array of light sources 401 of Figure 4 form many, and at least two light clusters/sources to provide illumination in desired subsections. EX1005, 3:62-64, 4:26-59, 5:3-16, 8:4-17, FIGS. 2, 4-6.



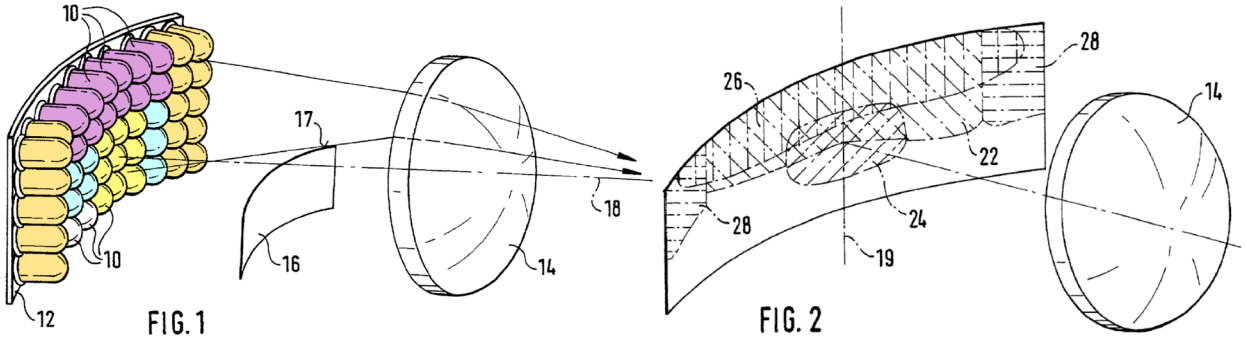

EX1005, FIGS. 4, 6.

118. Thus, Beam discloses "a plurality of light clusters"—independently controllable angular microbeam clusters/sources—that "create the headlight beam that provides the determined illumination" and "create the adapted headlight beam" as recited in claim element [1.2] (and [37.2] in Ground 2).

119. If Patent Owner argues, incorrectly, that Beam does not disclose claim element [1.2] (and [37.2] in Ground 2), Thominet does, and it would have been obvious to combine Thominet with Beam, as discussed below.

120. Specifically, while Beam discloses "[t]he *angular* position or attenuation of *each of these microbeams* is *independently* set by the controller 108," EX1005, 4:46-48, FIGS. 1, 2, and 4, Thominet expressly discloses "semiconductor light sources 10 *arranged in the different partial regions* [22, 24, 26, 28] are actuatable *independently*," EX1006, ¶20, FIGS. 1, 2, corresponding to

the "plurality of light clusters" recited in claim elements [1.2] (and [37.2] in Ground 2).




EX1006, FIGS. 1 and 2 (annotated).

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

121. As discussed, Beam discloses "light clusters" with independently controlled angular positions for reducing glare towards other drivers. Thominet provides further detail on implementing "light clusters" for different functions, conceptually and physically. So naturally, it would have been obvious to a POSA designing an adaptive headlamp to implement Thominet's multiple directional beam regions—through either software or hardware—for different functions in Beam's system. EX1005, 3:8-14, 3:37-45, 5:33-54, 7:1-13.

122. Indeed, Thominet discloses such an implementation to *automatically* provide different spatial distributions, improving visibility in different driving situations (low visibility, fog, low/high speeds, recognizing a counter traffic, curves, etc., *see* EX1006, ¶¶7-8, 23-26, FIGS. 1-2), thereby automating some of

Beam's *manual* control methods and improving driver safety—an express purpose of Beam. EX1005, 3:29-44 ("*manually* lower the beams for conditions like rain, snow, or fog"), 3:8-14, 5:33-54, 7:1-13; EX1006, ¶26 ("[b]y operation of the…corresponding partial region 22, 24, 26, 28…it is possible to switch over between the above mentioned *different light functions*…*automatically*").

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

124. *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, increasing safety. This is a simple software combination. 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; EX1005, Abstract, 8:4-17.

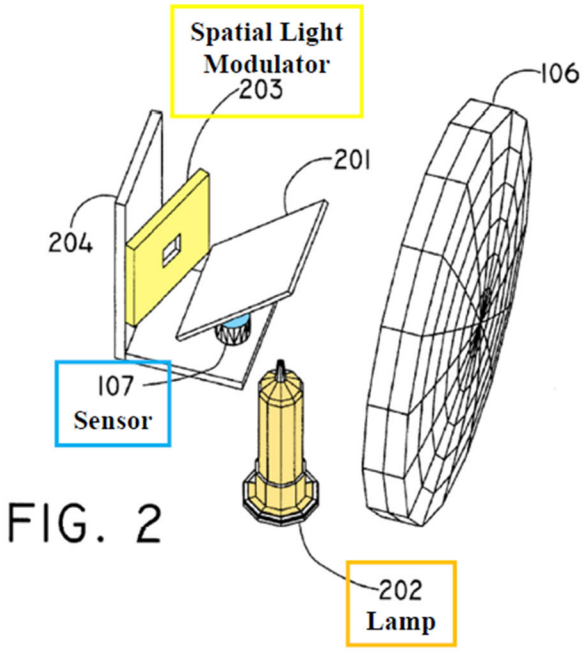



FIG. 2

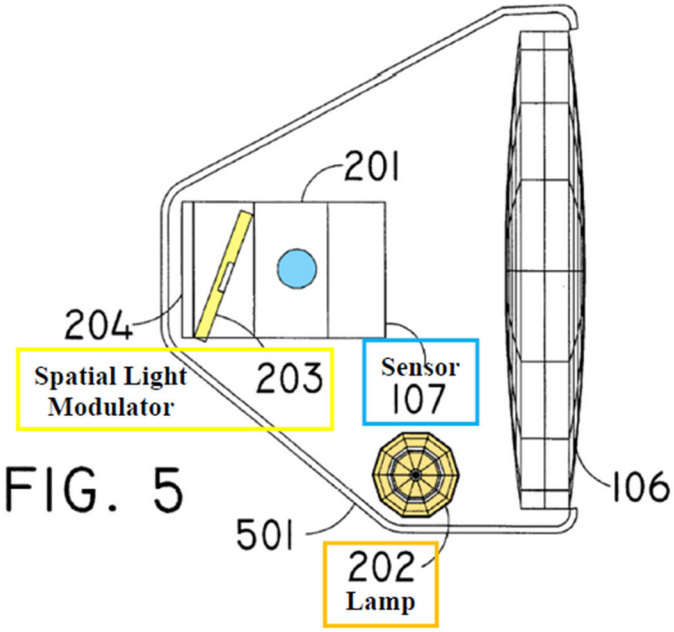
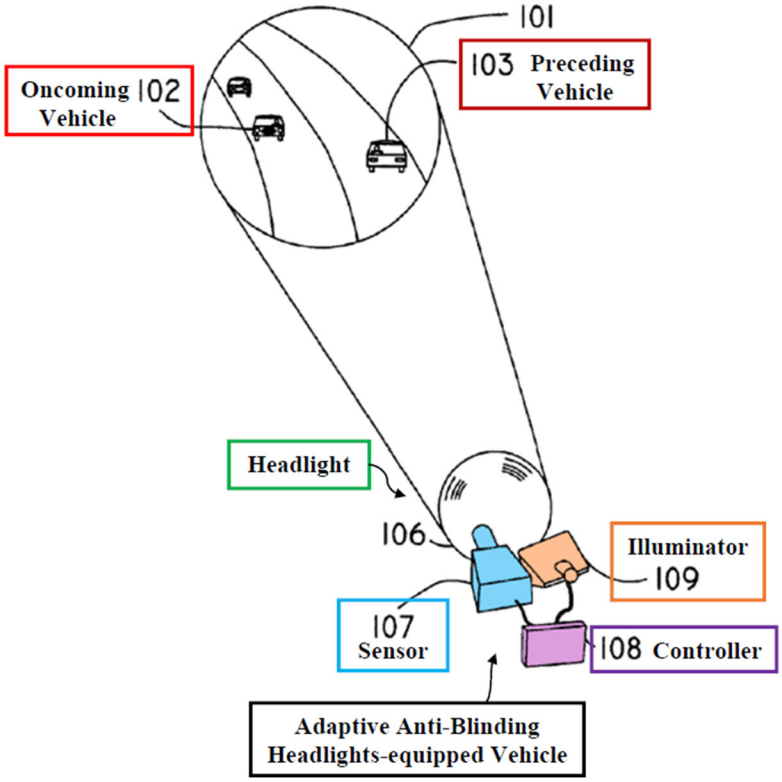



FIG. 5

EX1005, FIGS. 2, 5 (annotated).

125. 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. EX1005, 3:8-45. Beam enables "the driver to see more clearly at night," while protecting others from glare. EX1005, 3:8-45; EX1005, 4:10-25, 6:9-27.



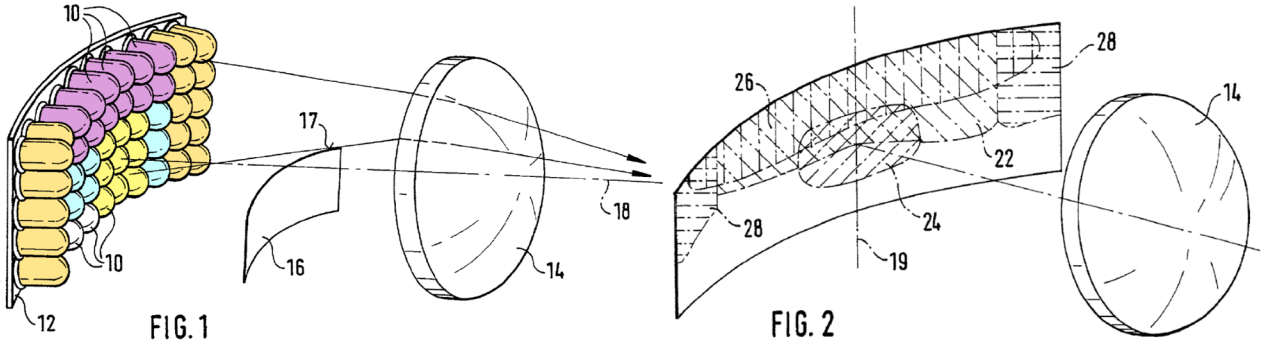

EX1005, FIG. 1 (annotated).

126. Beam's system "*determine[s] the location of light sources* forward of the apparatus and us[es] that information to *control the intensity, and/or the angular position*, of one or more" microbeams. EX1005, Abstract; EX1005, 4:10-59, 6:9-27, FIGS. 1, 1A-1D, 2. Beam recognizes the safety benefits of different spatial distributions "for conditions like rain, snow, or fog." EX1005, 3:29-36; EX1005, 1:54-59, 4:48-59. If Patent Owner argues, incorrectly, Beam does not expressly disclose "light clusters," even though Beam discloses different angular position control for different microbeams, it would have been obvious to a POSA to use such control for the feature of "light clusters." Combining Thominet with

Beam would have made Beam's system more direct, or active, or specifically aimed for different functions than prior systems, as Beam seeks to do (*see* EX1005, 2:15-22), and further achieves Beam's purpose of improving driver safety.

127. And Thominet's *technique* (software implementation), like Beam, enhances driver visibility, increasing safety—using multiple beam regions (clusters) for different functions. EX1006, ¶¶17-18, 21-26, FIGS. 1-3; EX1006, ¶3 ("*characteristic* of the light beam…can be used for *different functions*"), ¶20 ("partial *regions* are defined on the *matrix*"), ¶27 ("partial *regions* with partial quantities of the semiconductor sources 10 are defined on the *matrix*"), ¶¶5-8. Specifically, Thominet explains that the "characteristic" of the light beam, for example, color, direction, reaching distance, dispersion width, and/or intensity, "can be changed so that it can be used for *different functions*." EX1006, ¶¶3-4, FIGS. 1, 2; *see also* EX1006, ¶¶5-8.

128. Thominet's semiconductor light sources 10, arranged on curved surface 12, provide different beam regions 22, 24, 26, 28 for different driving situations including for recognizing a counter traffic, thereby improving road safety, including driver safety. EX1006, ¶¶7-8, 17-18, 21-27, FIGS. 1-3; EX1006, ¶7 ("*wider* illumination), ¶23 ("*improving* the illumination…at high speeds).




EX1006, FIGS. 1-2 (annotated).

129. The additional control (software implementation) of having multiple beam regions (clusters) 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.

130. A POSA would have understood that alternative or additional control for Beam's controller 108/illuminator 109 by using Thominet's different beam regions 22, 24, 26, 28, would have enhanced Beam's system, making it more direct, or active, or specifically aimed for different functions, by providing different spatial/angular distributions for different driving situations, thereby improving driver safety. Doing so would have merely been applying Thominet's known technique (software implementation: using multiple beam regions for different functions), to Beam's similar, known device (dynamic AAHB system with controllable microbeams), in the same way, would have been obvious. Thominet's known technique is fully described along with its benefits (improved

visibility for different functions in different driving situations, thereby increased safety); thus, a POSA would have readily applied it to similar systems, such as Beam's, in the same way.

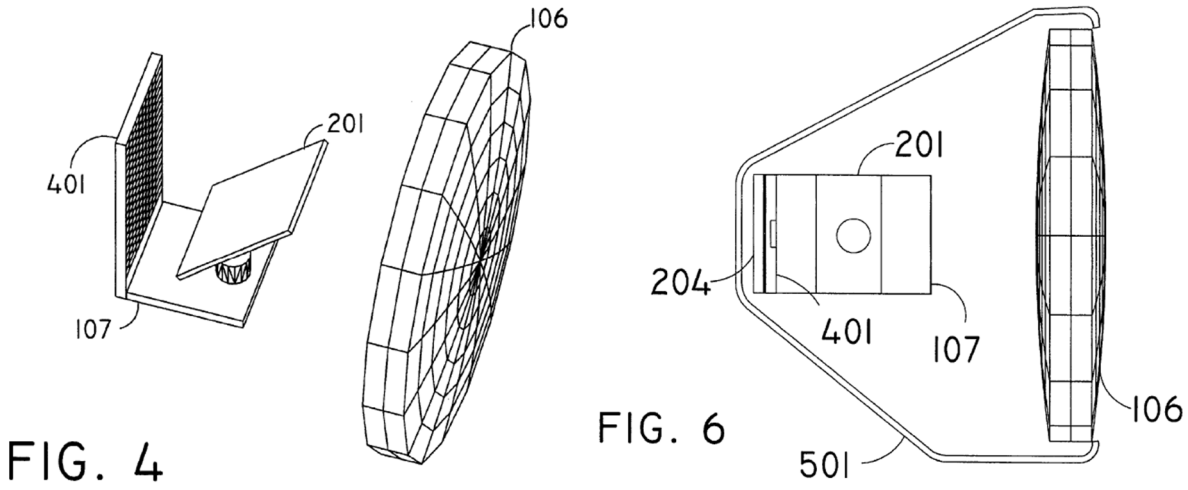
131. A POSA would have had a reasonable expectation of success combining Beam and Thominet, for example, by simply modifying software instructions in Beam's memory of its controller/processor to organize Beam's array of microbeams into multiple beam regions (clusters) for different functions. Overall, this is a simple software implementation.

132. Such modification 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. In applying Thominet's technique to Beam, a POSA would have simply been applying a known technique (software implementation) in a predictable way—controlling headlights in part based on multiple beam regions (clusters) for different functions—as already disclosed in the art.

133. *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 (arranged in different beam regions 22, 24, 26, 28, *see* EX1006, ¶¶17-20, 23-26, FIGS. 1-2, 5-7) into Beam's

system (with flat array of light sources 401). Again, this would have, like Thominet, provided different spatial distributions for different driving situations (e.g., low visibility, low/high speeds, traffic, curves, etc.), improving visibility and thereby safety. EX1006, ¶¶17-20, 23-26, FIGS. 1-2, 5-7. This is a simple hardware combination.

134. Beam discloses an array of light sources 401 (e.g., LEDs) that appears flat in Figures 4 and 6, and has the same functionality as lamp 202 and SLM 203 shown in Figure 2, and each light source is individually controlled. EX1005, 3:62-64, 5:3-16, FIGS. 4, 6; EX1005, 4:26-59 ("*angular* position"), 8:4-17.




EX1005, FIGS. 4, 6.

135. Through its *system components* (hardware implementation), Thominet, like Beam, seeks to enhance driver visibility and thereby increase safety. Indeed, semiconductor light sources 10 arranged on curved surface 12

provide beam regions 22, 24, 26, 28 (clusters) for different driving situations. EX1006, ¶¶7-8, 17-18, 21-26, FIGS. 1-2.

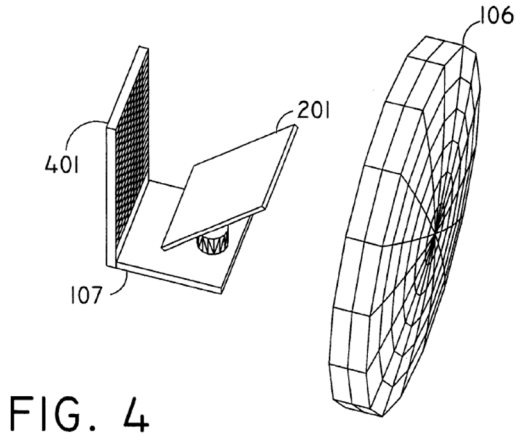



FIG. 4

EX1005, FIG. 4.

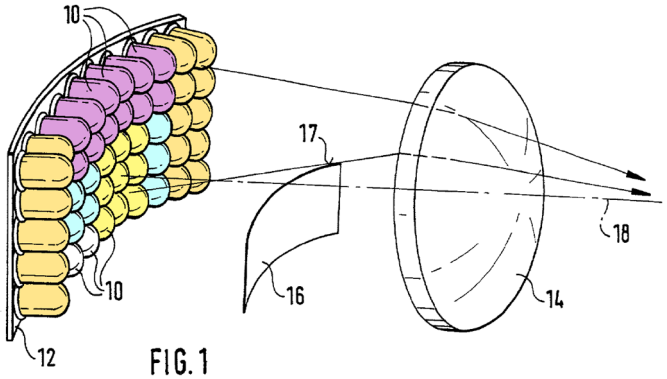



FIG.1

EX1006, FIG. 1 (annotated).

136. Like the software implementation above, this hardware combination—Beam's array of light sources 401 and Thominet's semiconductor sources 10 on curved surface 12 arranged in beam regions 22, 24, 26, 28—would have provided Beam's system with different spatial distributions for different driving situations, as in Thominet, thereby improving driver safety. EX1005, 3:62-64, 5:3-16, FIGS. 4, 6; EX1005, 4:26-59, 8:4-17. This would have been merely combining prior-art elements or a simple substitution of one known element for another (e.g., 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 (e.g., disclosed in Beam and Thominet) to yield predictable results (improved visibility and safety). Overall, this is a simple hardware implementation.

137. 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 clusters/sources (e.g., beam regions 22, 24, 26, 28) for different functions (hardware implementation).

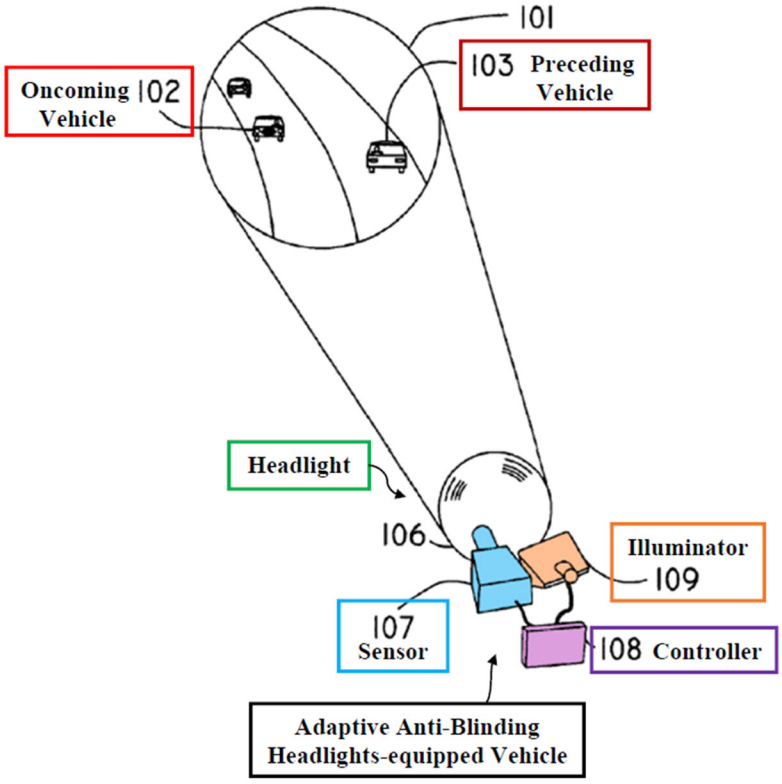
138. Such modification would have been routine and well within a POSA's skill due to the similarities in Beam's and Thominet's adaptive systems—their common components were well known and there would have been no limitations for a POSA to make such modifications. And in combining Beam with Thominet's array of semiconductor sources 10 (e.g., modifying an illuminator), a POSA would have simply been combining known elements according to known methods (disclosed in Thominet) to yield predictable results (light control for different functions, hardware implementation).

139. I lay out below the specific disclosures of Beam and Thominet, and expand on this combination and reasonable expectation of success analysis below, specifically with reference to claim element [1.2] (and [37.2] in Ground 2).

## B. Independent Claim 1[8]

### 1. [1.P]: "A vehicle headlight system comprising:"

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



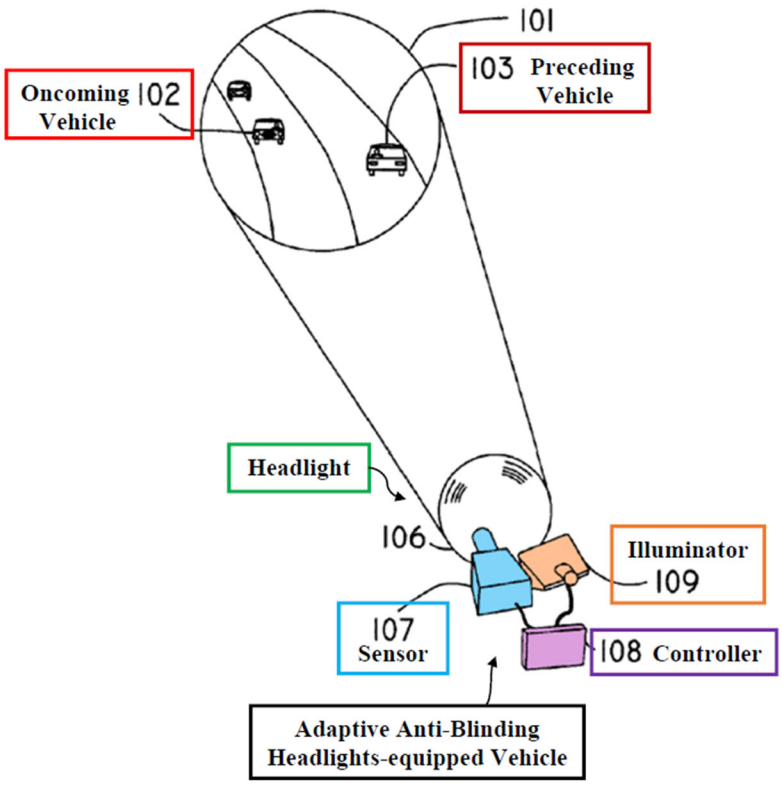

EX1005, FIG. 1 (annotated).

141. In view of the above, Beam discloses this element.

[8] All independent claim language is in Appendices A and B.

**2. [1.1]: "one or more headlamps and a vehicle structure, arranged for affixing components of the system to the vehicle;"**

142. Beam's "*AABH units* will be mounted on a *vehicle*." EX1005, 6:9-11, FIG. 1; EX1005, 6:33-34.




EX1005, FIG. 1 (annotated).

143. In view of the above, Beam discloses this element.

**3. [1.2]: "a plurality of light clusters, arranged in each of the one or more of the one or more headlamps,"**

144. In my opinion, claim elements [1.2]-[1.4] are part of the same clause but will be addressed separately for simplicity below.

**(a) Beam discloses this element.**

145. In my opinion, Beam discloses this claim element, [1.2]. *See supra* Sections X/X.A. Beam discloses "an *array* of *individual*, *independently* controllable *microbeam* sources" for example, "light-emitting diodes." EX1005, 8:5-12; EX1005, 8:4-17. Also, Beam discloses "*individually directed narrow-angle beams…microbeams*" and controlling "the intensity, and/or the *angular position*, of one or more narrow-angle *microbeams*." EX1005, 5:61-63, Abstract, FIGS. 2, 5. Each microbeam is a "cluster" that combines to form the headlamp beam, and the combination of Beam's lamp 202 and SLM 203 and/or array of light sources 401 form at least two directional light clusters. EX1005, 7:25-29 ("*multiple* narrow angle microbeams"), 8:4-17 ("*array* of individual, independently controllable microbeam sources"), 8:23-34 ("area of illumination provided by *multiple* rays of light"), 4:26-59, 5:3-21, FIGS. 2, 4-6.

146. Alternatively, if Patent Owner argues, incorrectly, that a "cluster" requires at least two (or more) microbeams, Beam also discloses this. 4:26-59, 5:3-21, FIGS. 2, 4-6; EX1005, 4:46-48 ("[t]he *angular* position or attenuation of *each* of these microbeams is *independently* set by the controller 108").

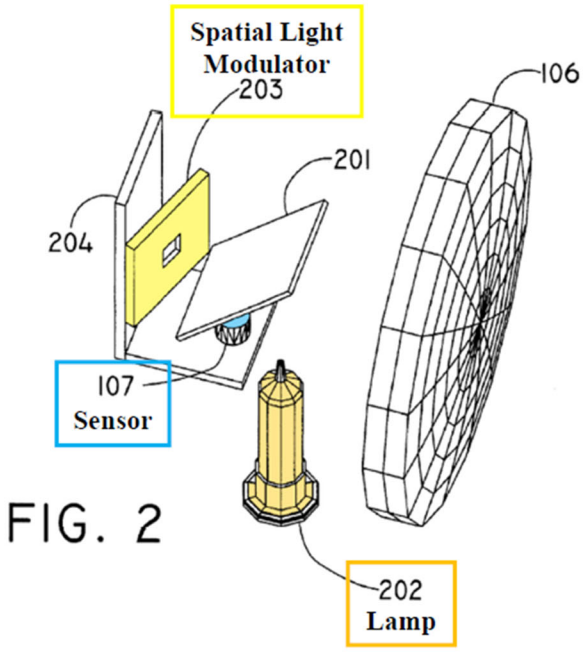



FIG. 2

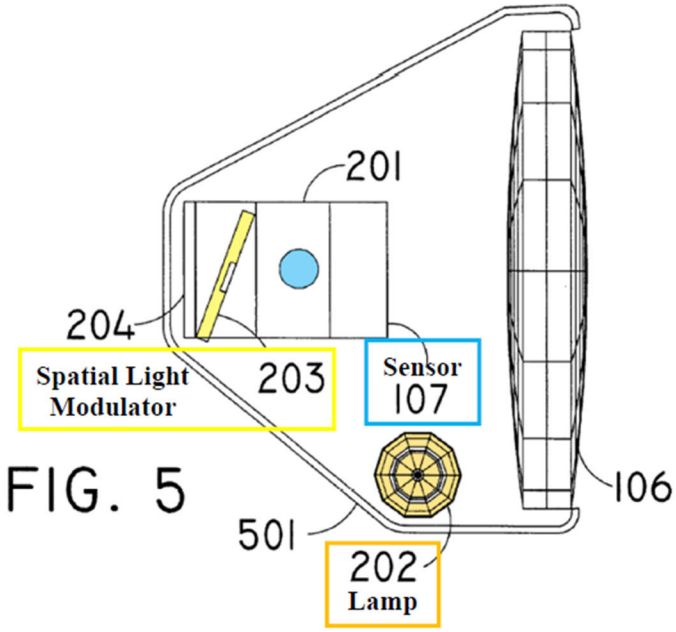



FIG. 5

EX1005, FIGS. 2 and 5 (annotated).

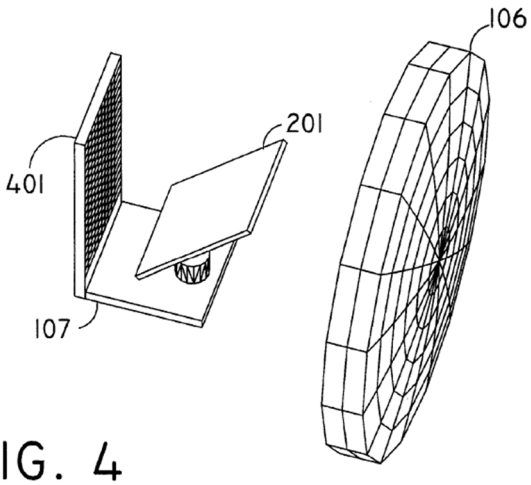



FIG. 4

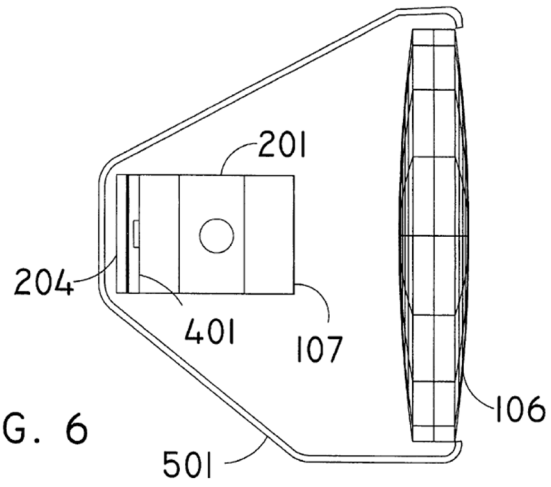



FIG. 6

EX1005, FIGS. 4 and 6.

147. Such directionality results in *directional light clusters* that by definition will have different angles, which result in different aimings in desired subsections. So disclosure that discusses adapting light emitted from light clusters to create a headlight beam for a plurality of subsections applies the same to

disclosure that discusses instructing operation of light clusters to create an adapted headlight beam for first and second subsections.

148. A POSA would have understood that controlling "intensity" and "angular position" of "one or more narrow-angle microbeams" is the same as controlling "one or more of the light-clusters…that provides the determined illumination," as the light output from a headlamp is all measured with its light intensity level in an angular distribution. *See* EX1017, 5 ("the adaptive light pattern should support to direct the concentration to the most important zone for the current driving situation"), FIGS. 1, 3-5; EX1018, 4 ("variable aiming"); EX1026, 451 ("[m]ore beams are necessary to match varied driving regions, traffic situations, and driving operations"), 456 ("beam axes of the lamps are aimed at the directions indicated"), FIGS. 1, 3-3; EX1038, 1:12-10:3, FIGS. 1-3; EX1039, 9:16-11:11, FIGS. 1-6; EX1040, 1:16-30, FIGS. 1, 2A-2C; EX1036, 3:52-4:32, FIGS. 2-6.

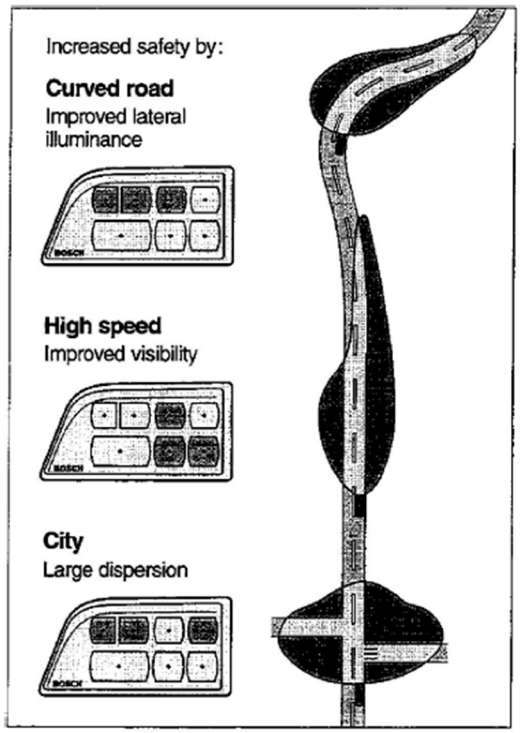



*Fig.1: Three standard driving situations with adapted light pattern seen from the bird eye's view.*

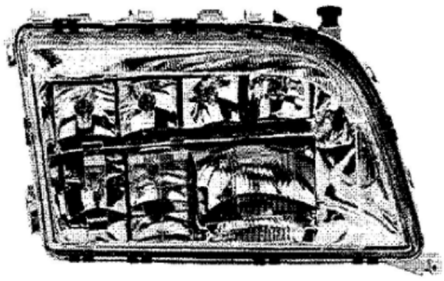
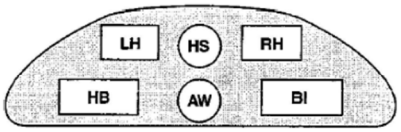


Fig 4: ALP *headlamp* sample




Single components:

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

Fig. 5 Advanced ALP sample layout

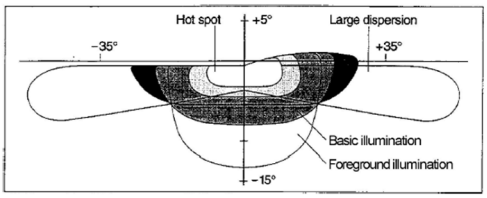



Fig. 3: Light pattern of multiple beam *headlamp* (*Isolux* curves in wall projection):
The individual light *pattern* of multiple sub-units sum up to the total adaptive light pattern

EX1017, FIGS. 1 and 3-5.

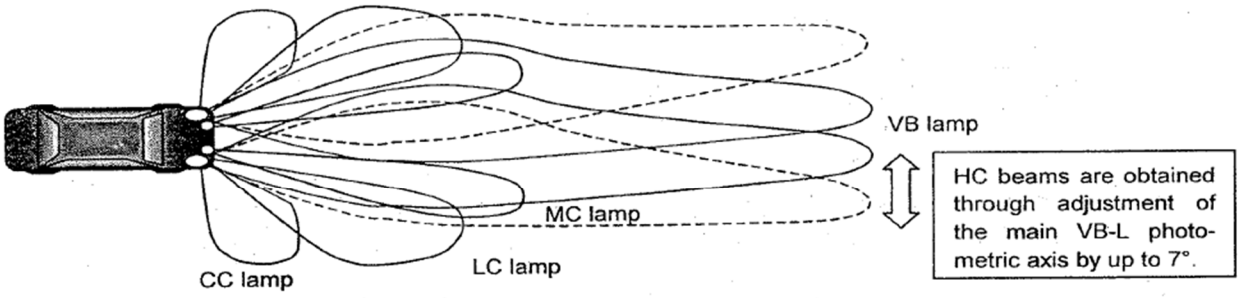
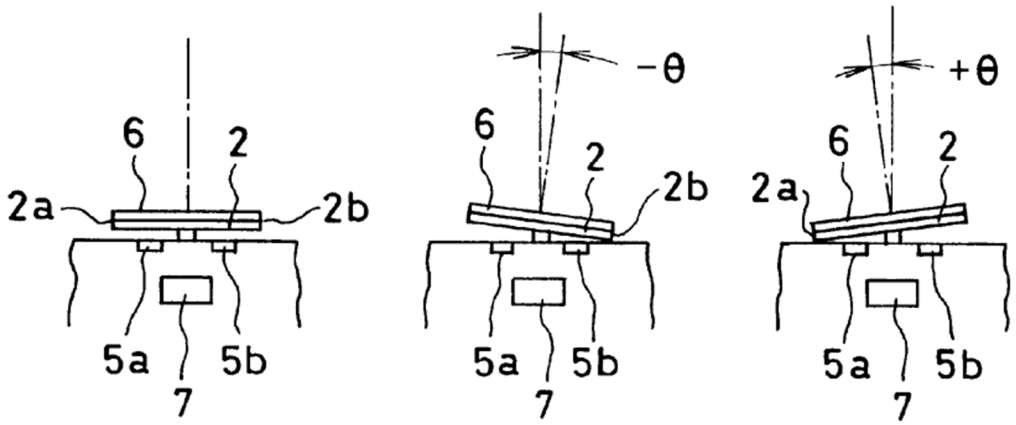



*Fig. 3-3: Imaged Illumination Configurations on Road Surface*

EX1026, FIG. 3-3.

FIG. 2A FIG. 2B FIG. 2C

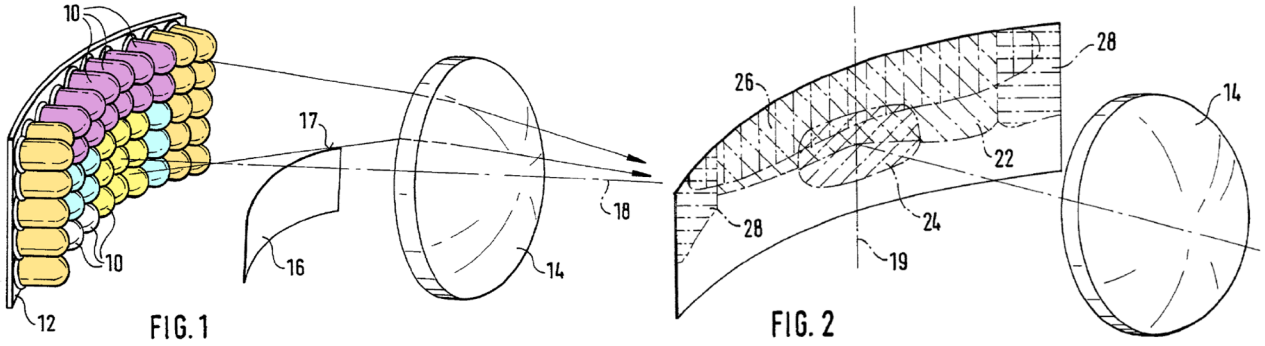



EX1040, FIGS. 2A-2C.

**(b) Thominet also discloses this element.**

149. If Patent Owner argues, incorrectly, that Beam does not disclose claim element [1.2], Thominet also discloses claim element [1.2], and it would have been obvious in view of Thominet. A POSA would have been motivated to combine Thominet with Beam with a reasonable expectation of success, providing predictable visibility and safety benefits. *See supra* Sections X/X.A.

150. As explained above (Section X.A), Thominet's headlights include independently controllable semiconductor light sources 10 (e.g., LEDs) arranged on curved surface 12 to provide multiple beam regions 22, 24, 26, 28 (light clusters) for different functions. EX1006, ¶¶17-18, 21-26, FIGS. 1-2. For example, Thominet's region 24 is "in the center" (first cluster) and regions 28 are "near the lateral edges" (second and third clusters). EX1006, ¶¶23, 25, FIGS. 1-2.




EX1006, FIGS. 1-2 (annotated).

151. A POSA would have been motivated to combine Thominet with Beam with a reasonable expectation of success, providing predictable visibility and safety benefits. I provide additional detail, evidence, and explanation of my conclusions below, showing that Beam, alone or combined with Thominet, discloses or renders obvious claim element [1.2].

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

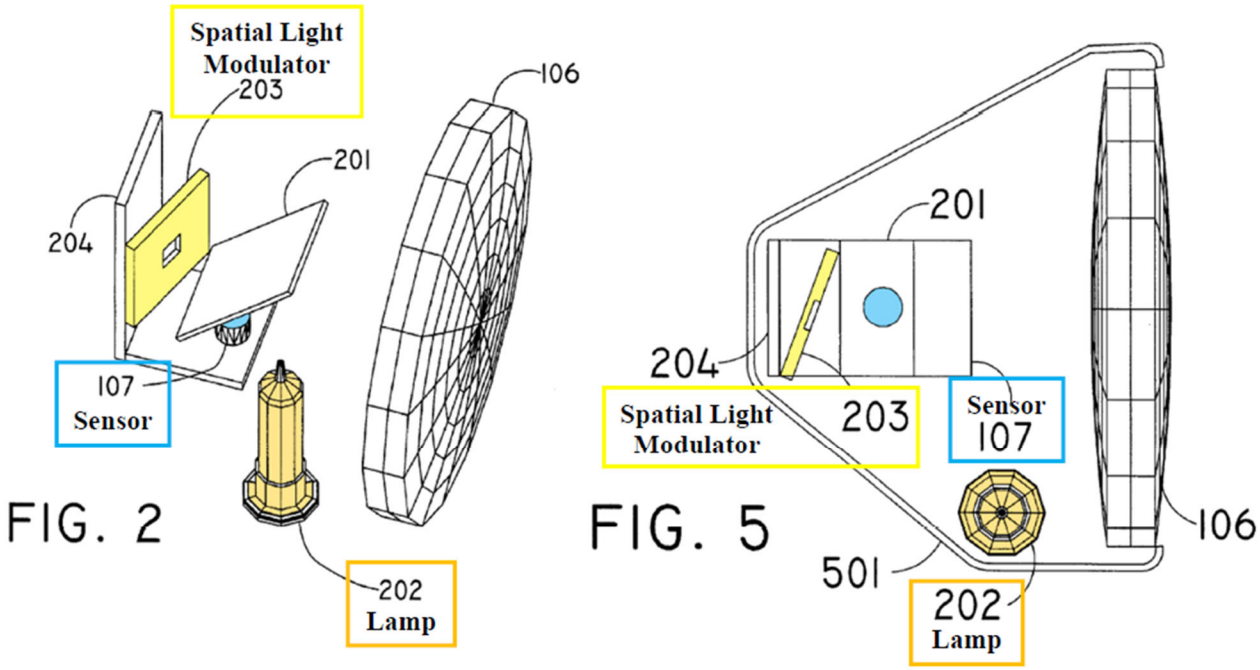
152. As discussed, Beam discloses "light clusters" with independently controlled angular positions for reducing glare towards other drivers. *Supra* Section X.A. Thominet provides further detail on implementing "light clusters" for different functions, conceptually and physically. So naturally, it would have been obvious to a POSA designing an adaptive headlamp to implement Thominet's multiple beam regions—through either software and/or hardware—for different functions in Beam's system. EX1005, 3:8-14, 3:37-45, 5:33-54, 7:1-13.

153. Indeed, Thominet discloses such an implementation to *automatically* provide different spatial distributions for improved visibility in different driving situations (low visibility, fog, low/high speeds, recognizing a counter traffic, curves, etc., *see* EX1006, ¶¶7-8, 23-26, FIGS. 1-2), thereby automating some of Beam's *manual* control methods and improving driver safety—an express purpose of Beam. EX1005, 3:29-44 ("*manually* lower the beams for conditions like rain, snow, or fog"), 3:8-14, 5:33-54, 7:1-13; EX1006, ¶26 ("[b]y operation of the…corresponding partial region 22, 24, 26, 28…it is possible to switch over between the above mentioned *different light functions…automatically*").

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

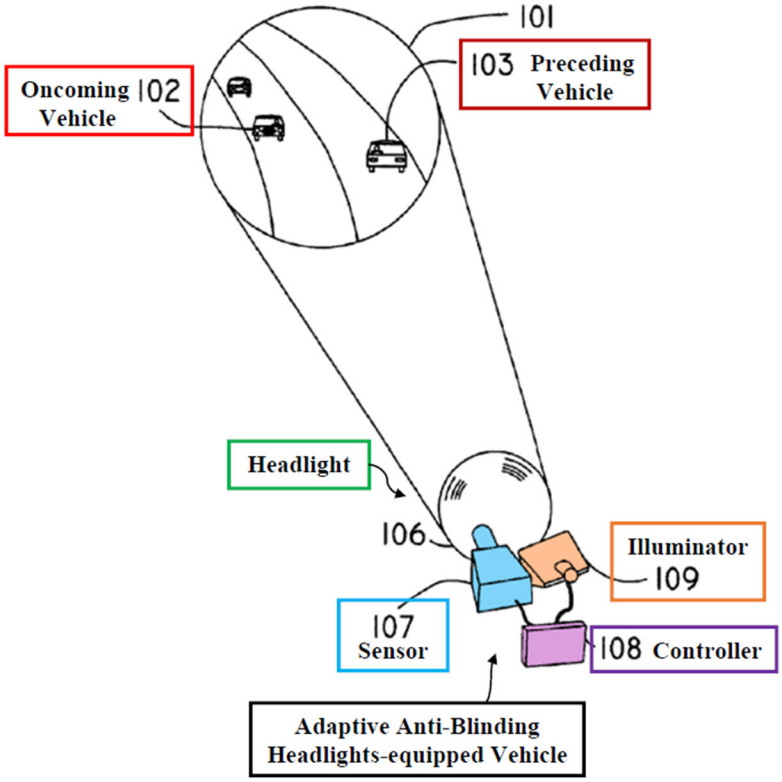
155. *First*, including an additional control technique (software implementation) for Beam—Thominet's *known technique* of using multiple beam regions (clusters) for different functions—would have added more control methods for different functions to Beam's visibility for different driving situations, increasing safety. This is a simple software combination. 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; EX1005, Abstract, 8:4-17.




EX1005, FIGS. 2, 5 (annotated).

156. 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. EX1005, 3:8-45. Beam enables "the driver to see more clearly at night," while protecting others from glare. EX1005, 3:8-45; EX1005, 4:10-25, 6:9-27.



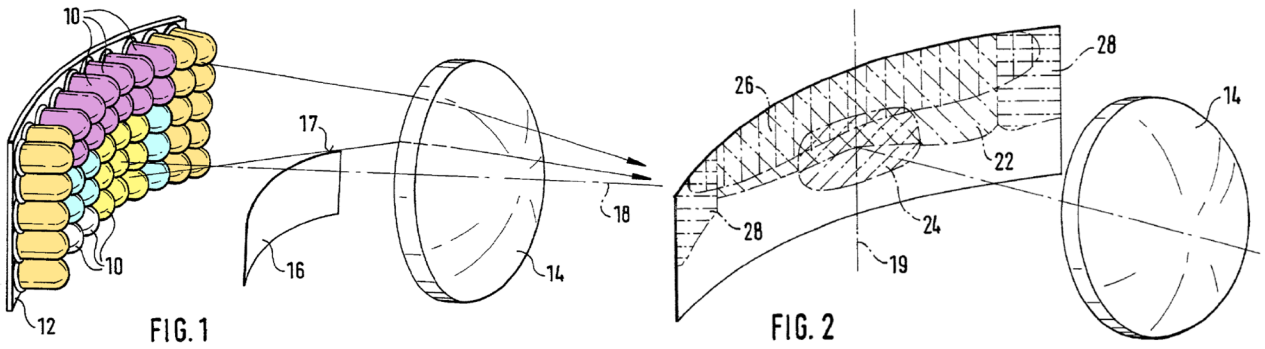

EX1005, FIG. 1 (annotated).

157. Beam's system "*determine[s] the location of light sources* forward of the apparatus and us[es] that information to *control the intensity, and/or the angular position*, of one or more" microbeams. EX1005, Abstract; EX1005, 4:10-59, 6:9-27, FIGS. 1, 1A-1D, 2. Beam recognizes the safety benefits of different spatial distributions "for conditions like rain, snow, or fog." EX1005, 3:29-36; EX1005, 1:54-59, 4:48-59. If Patent Owner argues, incorrectly, Beam does not expressly disclose "a plurality of light clusters," even though Beam discloses different angular position control for at least two different microbeams, it would have been obvious to a POSA to use such control for the feature of "light clusters."

Combining Thominet with Beam would have made Beam's system more direct, or active, or specifically aimed for different functions than prior systems, as Beam seeks to do (*see* EX1005, 2:15-22), and further achieves Beam's purpose of improving driver safety.

158. And Thominet's *technique* (software implementation), like Beam, enhances driver visibility, increasing safety—using multiple beam regions (clusters) for different functions. EX1006, ¶¶17-18, 21-26, FIGS. 1-3; EX1006, ¶3 ("*characteristic* of the light beam…can be used for *different functions*"), ¶20 ("partial *regions* are defined on the *matrix*"), ¶27 ("partial *regions* with partial quantities of the semiconductor sources 10 are defined on the *matrix*"), ¶¶5-8. Specifically, Thominet explains that the "characteristic" of the light beam, for example, color, direction, reaching distance, dispersion width, and/or intensity, "can be changed so that it can be used for *different functions*." EX1006, ¶¶3-4, FIGS. 1, 2; *see also* EX1006, ¶¶5-8.

159. Thominet's semiconductor light sources 10, arranged on curved surface 12, provide different beam regions 22, 24, 26, 28 (clusters) for different driving situations including for recognizing a counter traffic, thereby improving road safety, including driver safety. EX1006, ¶¶7-8, 17-18, 21-27, FIGS. 1-3; EX1006, ¶7 ("*wider* illumination), ¶23 ("*improving* the illumination…at high speeds).




EX1006, FIGS. 1-2 (annotated).

160. The additional control (software implementation) of having multiple beam regions (clusters) 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.

161. A POSA would have understood that alternative or additional control for Beam's controller 108/illuminator 109 by using Thominet's different beam regions 22, 24, 26, 28, would have enhanced Beam's system, making it more direct, or active, or specifically aimed for different functions, by providing different spatial/angular distributions for different driving situations, thereby improving driver safety. Doing so would have merely been applying Thominet's known technique (software implementation: using multiple beam regions for different functions), to Beam's similar, known device (dynamic AAHB system with controllable microbeams), in the same way. Thominet's known technique is fully described along with its benefits (improved visibility for different functions in

different driving situations, thereby increased safety); thus, a POSA would have readily applied it to similar systems, such as Beam's, in the same way.

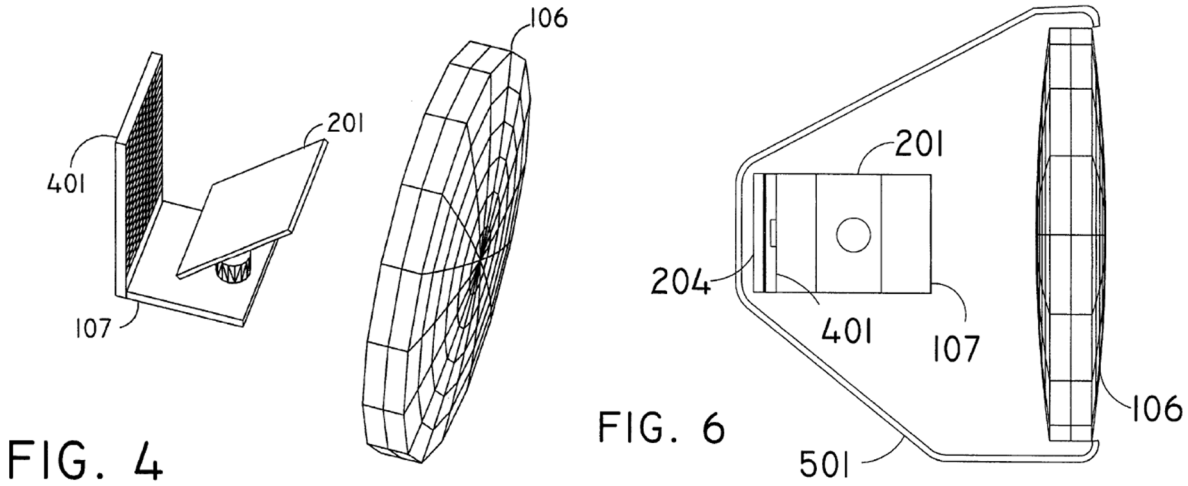
162. A POSA would have had a reasonable expectation of success combining Beam and Thominet, for example, by simply modifying software instructions in memory of Beam's controller/processor to organize Beam's array of microbeams into multiple beam regions (clusters) for different functions. Overall, this is a simple software implementation.

163. Such modification 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. In applying Thominet's technique to Beam, a POSA would have simply been applying a known technique (software implementation) in a predictable way—controlling headlights in part based on multiple directional beam regions for different functions—as already disclosed in the art.

164. *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 (arranged in different beam regions 22, 24, 26, 28, *see* EX1006, ¶¶17-20, 23-26, FIGS. 1-2, 5-7) into Beam's system (with flat array of light sources 401). Again, this would have, like

Thominet, provided different spatial distributions for different driving situations (e.g., low visibility, low/high speeds, traffic, curves, etc.), improving visibility and thereby safety. EX1006, ¶¶17-20, 23-26, FIGS. 1-2, 5-7. This is a simple hardware combination.

165. Beam discloses an array of light sources 401 (e.g., LEDs) that appears flat in Figures 4 and 6, and has the same functionality as lamp 202 and SLM 203 shown in Figure 2, and each light source is individually controlled. EX1005, 3:62-64, 5:3-16, FIGS. 4, 6; EX1005, 4:26-59 ("*angular* position"), 8:4-17.




EX1005, FIGS. 4, 6.

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

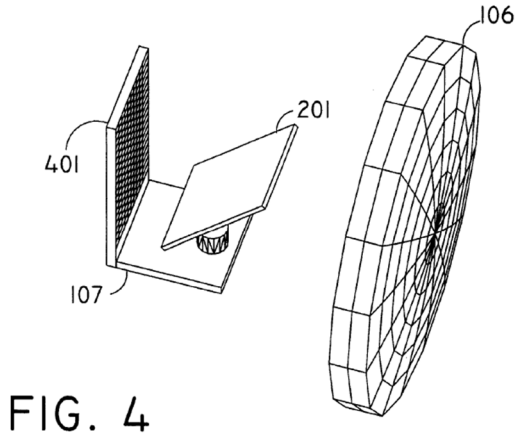



FIG. 4

EX1005, FIG. 4.

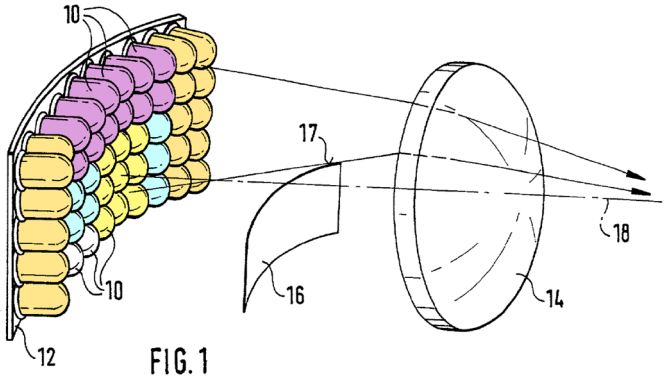



FIG.1

EX1006, FIG. 1 (annotated).

167. Like the software implementation above, this hardware combination—Beam's array of light sources 401 and Thominet's semiconductor sources 10 on curved surface 12 arranged in beam regions 22, 24, 26, 28—would have provided Beam's system with different spatial distributions for different driving situations, as in Thominet, thereby improving driver safety. This would have been merely combining prior-art elements or a simple substitution of one known element for another (e.g., 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 (e.g., disclosed in Beam and Thominet) to yield predictable results (improved visibility and safety). Overall, this is a simple hardware implementation.

168. 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 clusters (e.g., directional beam regions 22, 24, 26, 28) for different functions (hardware implementation).

169. Such modification 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. And in combining Beam with Thominet's array of semiconductor sources 10 (e.g., modifying an illuminator), a POSA would have simply been combining known elements according to known methods (disclosed in Thominet) to yield predictable results (light control for different functions, hardware implementation).

170. In view of the above, Beam, alone or in combination with Thominet, discloses or renders obvious this element.

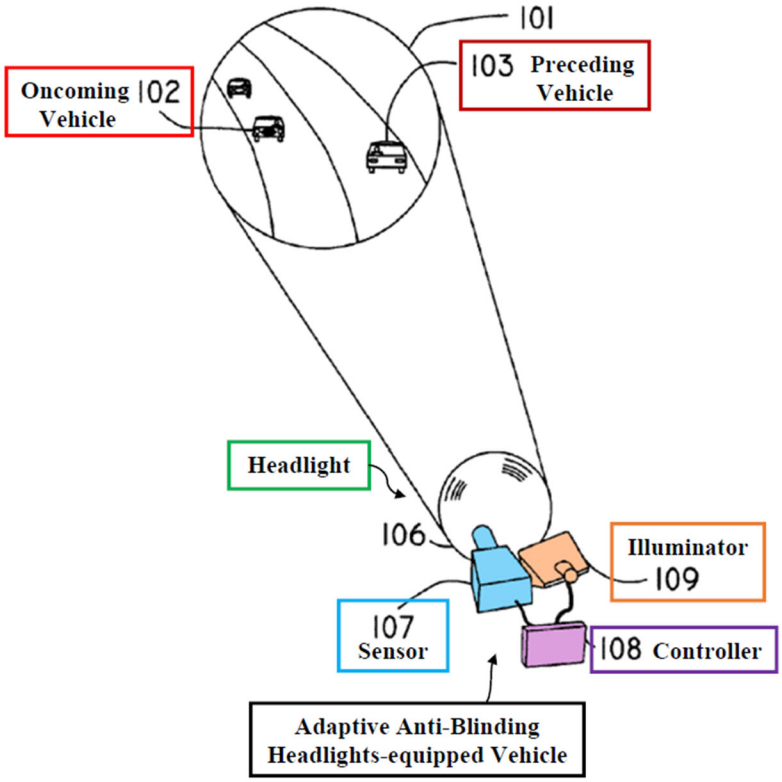
#### 4. [1.3]: "the headlamps capable of projecting light so as to illuminate a plurality of sub-sections of a field-of-view with different illumination characteristics,"

171. In my opinion, claim elements [1.2]-[1.4] are part of the same clause but will be addressed separately for simplicity below.

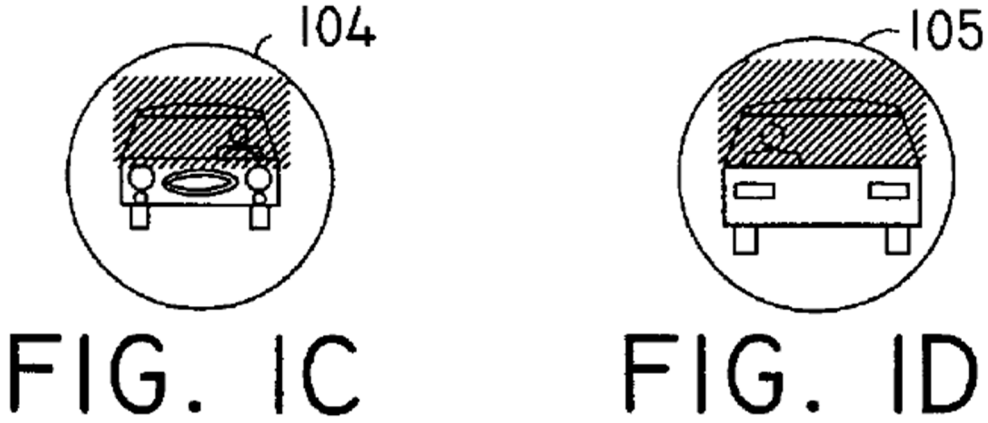
172. Beam discloses "*spatial scene data* from sensor 107…becomes the input to *a processor 1105*" and controlling "the *intensity*, and/or the *angular position*" of the microbeams. EX1005, 5:34-54, Abstract, FIGS. 1, 1C-1D, 2, 5, 7; EX1005, 6:14-16 ("headlight's *field-of-view*"), 5:65-6:2 ("a *dimmed area*…based

on input to the sensor"), 1:6-8 ("*reformatting the pattern*"), 1:13-18 ("*darken those microbeams*"), 4:26-59, 5:17-21. A POSA would have understood that "intensity" and "angular position" are "different illumination characteristics." EX1001, 16:43-50 ("the resultant light *characteristic*, be in its *intensity*, *spatial* intensity distribution"), 2:28-30 ("[e]ach fixture has its photometric distribution *characteristics*…how many *candela* at what *angle*").

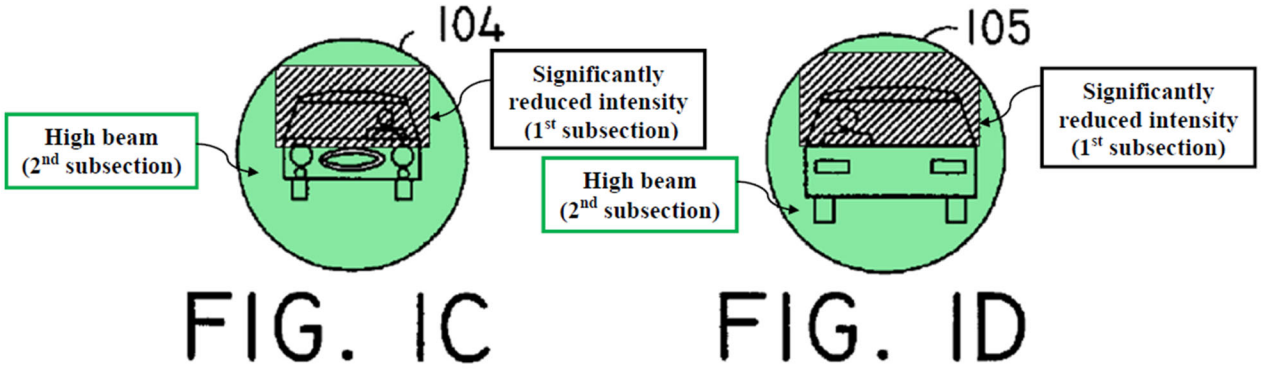
173. Beam also illuminates a plurality of subsections (shaded/non-shaded areas) of a field-of-view. EX1005, 5:33-54, 6:12-27, FIGS. 1C-1D.




EX1005, FIG. 1 (annotated).




EX1005, FIGS. 1C-1D.




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

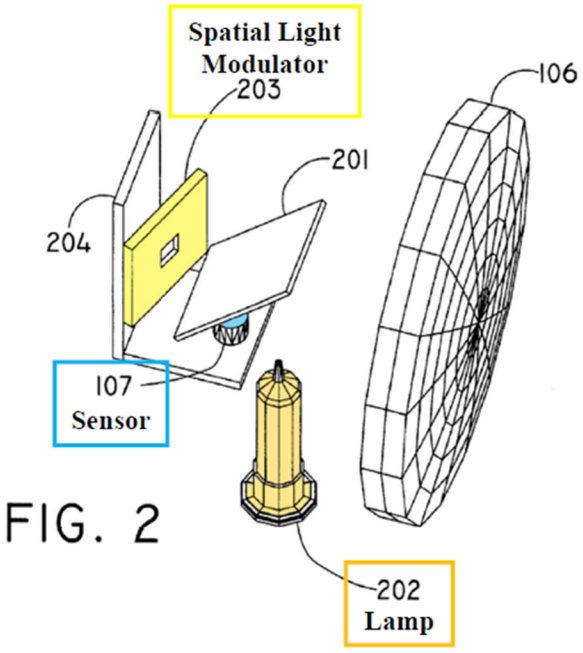



FIG. 2

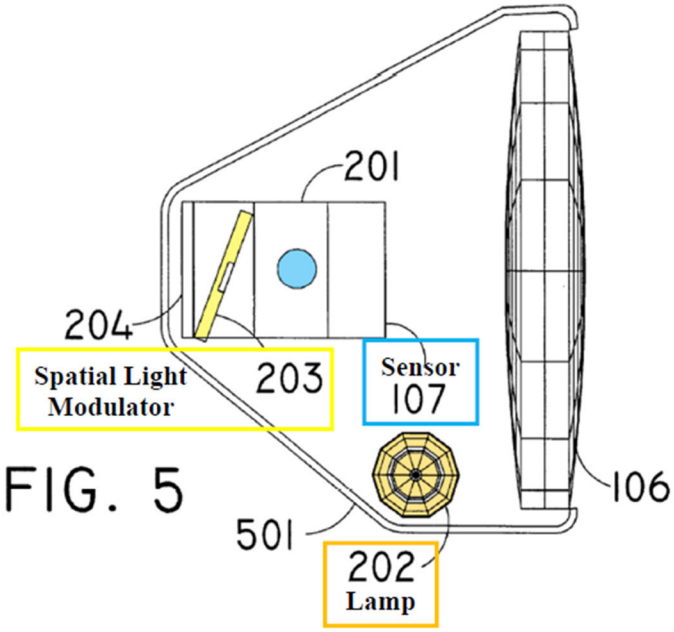



FIG. 5

EX1005, FIGS. 2 and 5 (annotated).

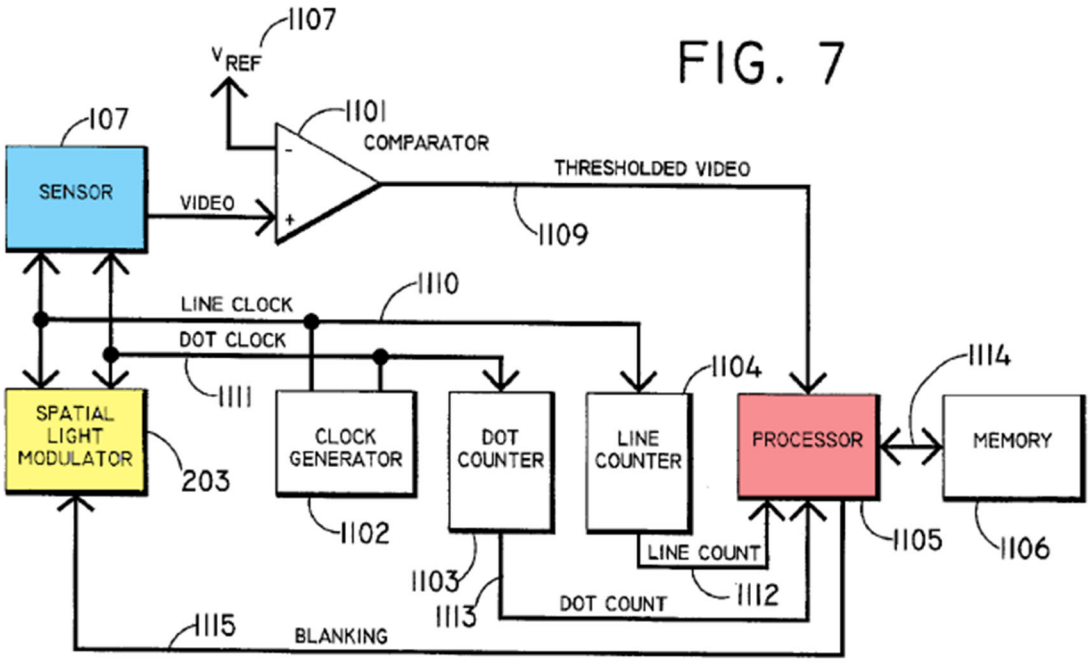



FIG. 7

EX1005, FIG. 7 (annotated).

174. In view of the above, Beam discloses this element.

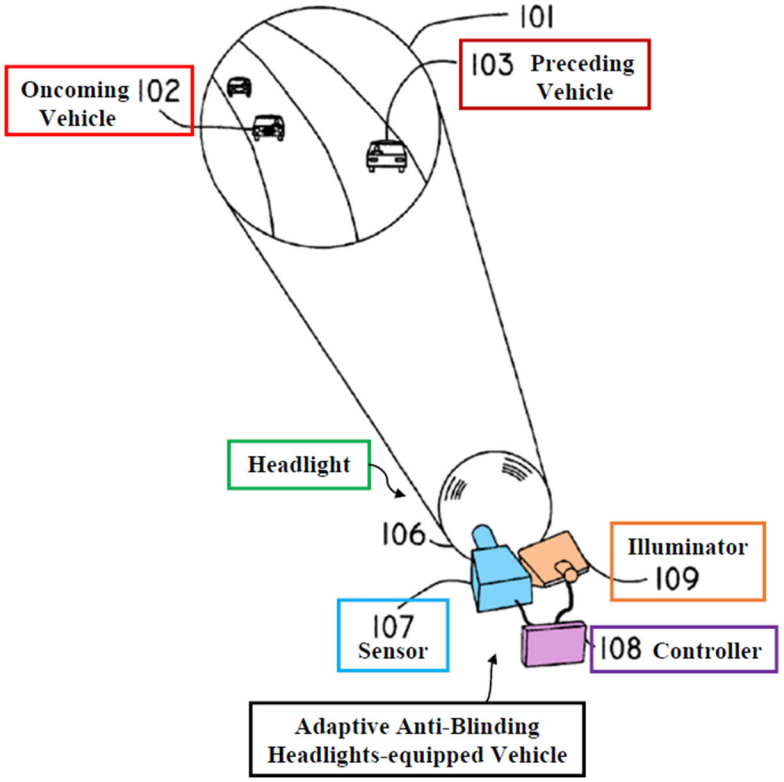
**5. [1.4]: "the subsections determined in response to sensor data, wherein the light clusters operate to create a headlight beam;"**

175. In my opinion, claim elements [1.2]-[1.4] are part of the same clause but will be addressed separately for simplicity below.

176. Beam detects headlights/taillights of an oncoming/preceding vehicle 102, 103 in a field-of-view 101 and Beam's "controller module uses the sensor spatial data (video)…to *control the Illuminator*," based on those subsections. EX1005, 4:10-25, 5:46-54, FIGS. 1, 1A-1D, 7; EX1005, 6:14-16 ("*determine[s]* whether there are *illumination sources* (headlights or tail lights) present"); 1:5-18 ("*reformatting* the *pattern*"), 4:10-25 ("*determine* which microbeams must be *reduced in intensity*").

177. As discussed, Beam, alone or in combination with Thominet, discloses or renders obvious one or more "light clusters." *Supra* Section X.B.3.

178. Thus, Beam, alone or in combination with Thominet, discloses or renders obvious "light clusters" and "at least two…light clusters" operate to create a headlight beam as in claim element [1.4] (and [37.4] in Ground 2).




EX1005, FIG. 1 (annotated).

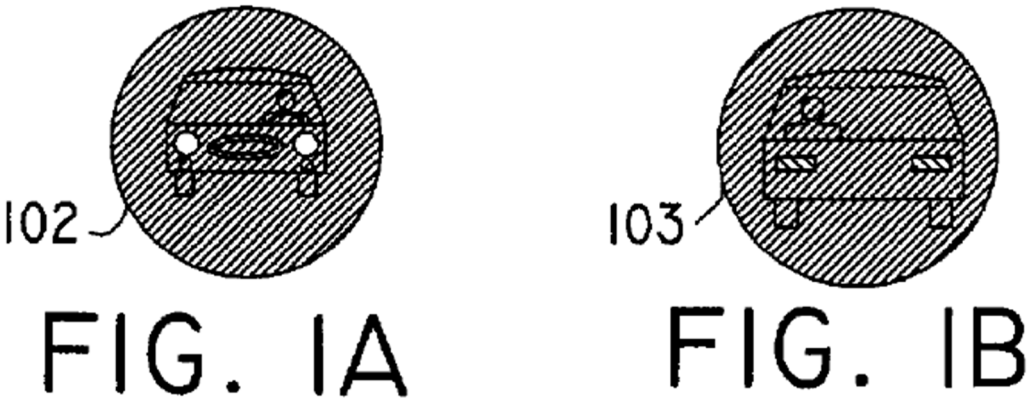



FIG. 1A FIG. 1B

EX1005, FIGS. 1A-1B.

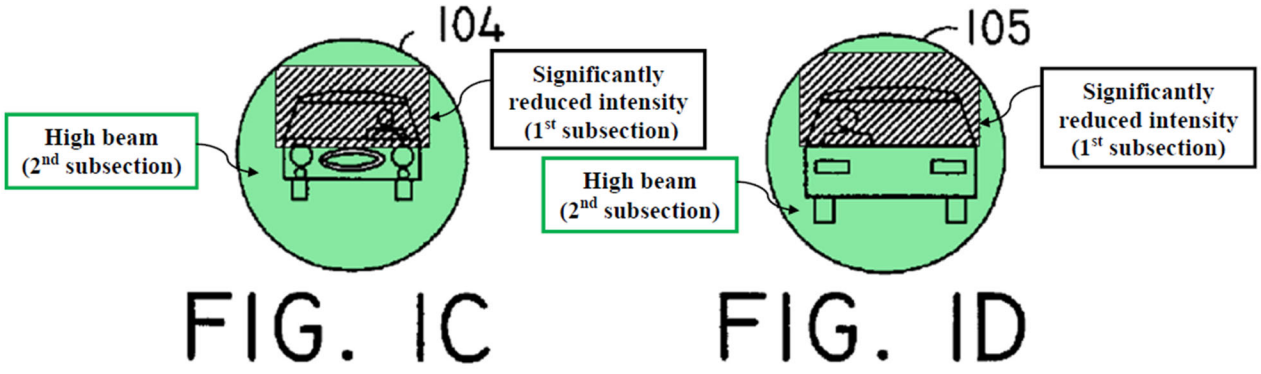
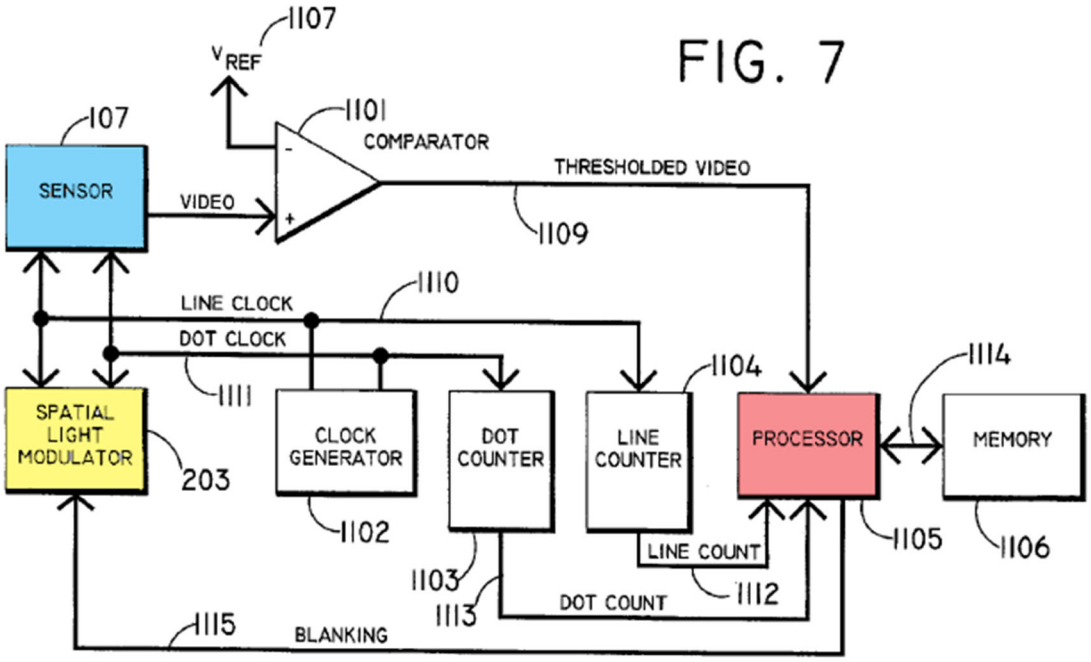



FIG. 1C FIG. 1D

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




EX1005, FIG. 7 (annotated).

179. In view of the above, Beam, alone or in combination with Thominet, discloses or renders obvious this element.

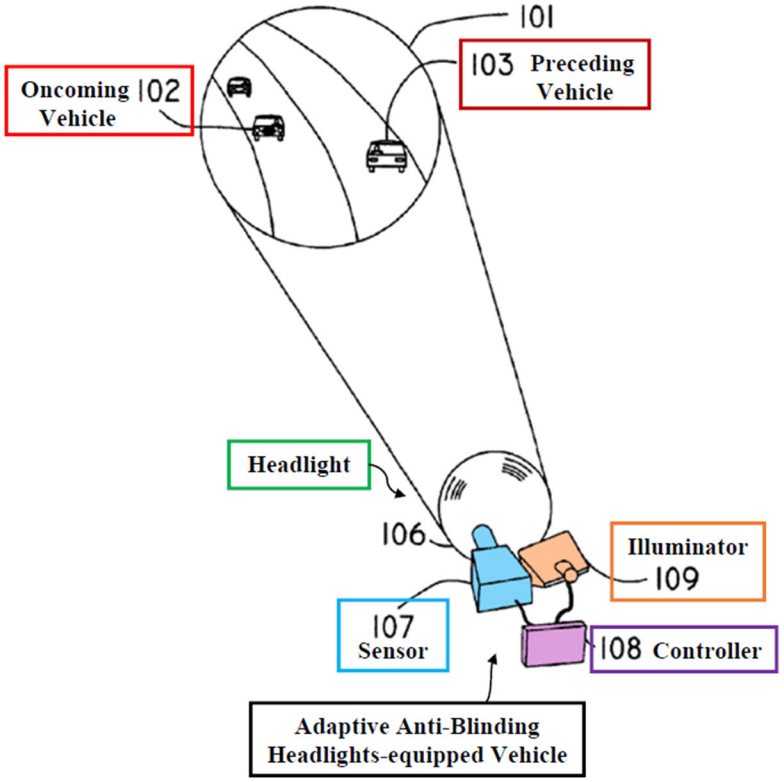
**6. [1.5]: "electronic control circuitry configured to independently operate the light clusters;"**

180. Beam's "controller module uses the *sensor spatial data (video)*…to *control the Illuminator*" and "*processor*…outputs *blanking*

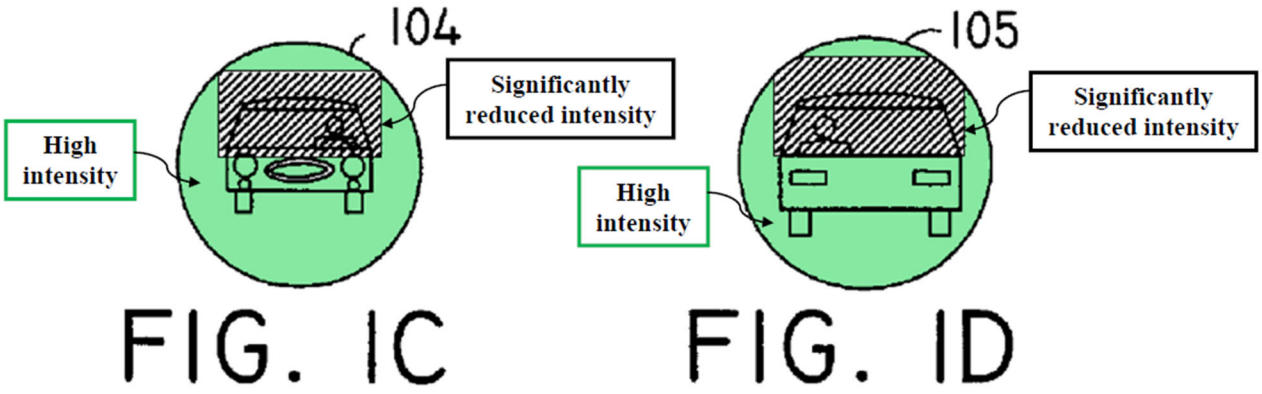
*signals…command[ing] the appropriate pixels to be reduced*." EX1005, 5:34-54, FIGS. 1, 1C-1D, 7; EX1005, 4:53-59 ("*controller…commands spatial light modulator 203* in illuminator 109 to either divert the selected microbeams or to attenuate them"), 8:35-38 ("*controlling individual rays*…producing a *desired output*"), 1:5-18 ("*reformatting* the *pattern*"), 4:10-25 ("*determine* which microbeams must be *reduced in intensity*"), 5:13-15 ("*controller*…uses the data to determine the size and position of the light emitters"), 5:61-65 ("*controlled by a processor*").

181. A POSA would have understood Beam's controller includes "electronic control circuitry" (blanking bus). EX1005, 5:33-54, 4:36-59, 8:4-17, FIGS. 1, 7. As discussed, Beam, alone or in combination with Thominet, discloses or renders obvious one or more "light clusters." *Supra* Section X.B.3.

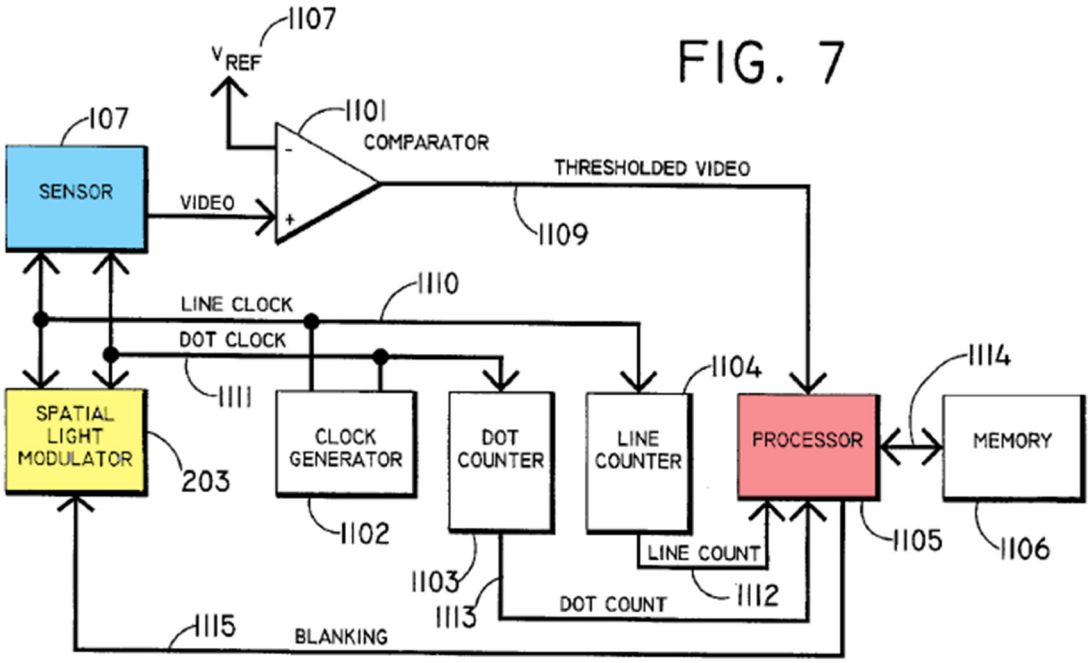
182. Thus, Beam's controller/processor sends control signals (blanking or non-blanking) to illuminator (SLM 203) to control microbeams in the array to "independently operate the light clusters." EX1005, 5:34-54, FIGS. 1, 1C-1D, 7.




EX1005, FIG. 1 (annotated).




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




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

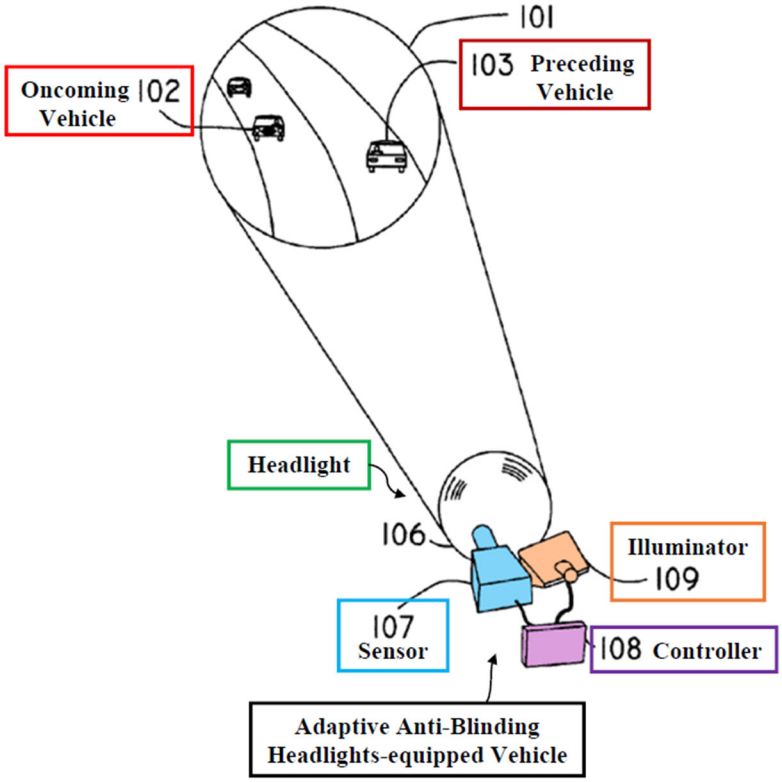
183. In view of the above, Beam, alone or in combination with Thominet, discloses or renders obvious this element.

**7. [1.6]: "one or more sensors configured to obtain and provide the sensor data predefined as pertinent to illumination requirements for the field-of-view; and"**

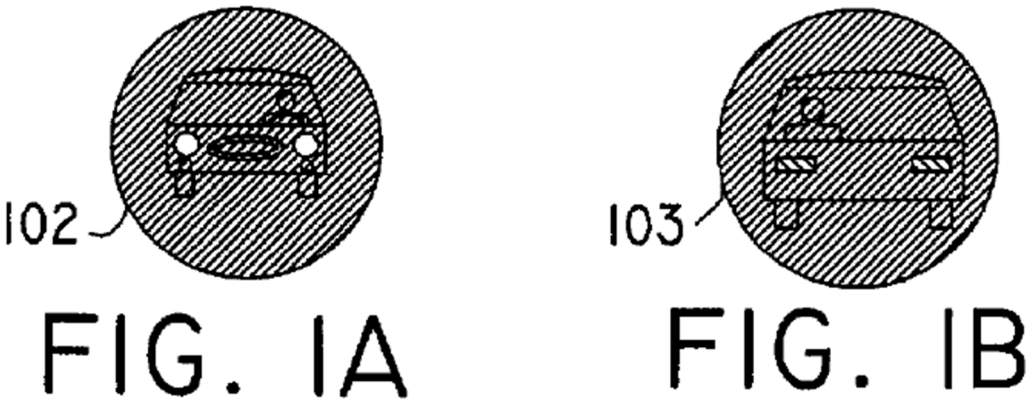
184. Beam's *sensor 107* detects headlights/taillights of an oncoming/preceding vehicle 102, 103 in a field-of-view 101. EX1005, 4:10-25, FIGS. 1, 1A-1B, 7; EX1005, 6:14-16 ("*determine[s]* whether there are *illumination sources* (headlights or tail lights) present"), 6:12-14 ("[a]n imaging *sensor*"), 4:26-36.

185. The sensor spatial data (oncoming/preceding traffic) is "predefined as pertinent to illumination" because Beam "tracks the location of the…vehicle" and

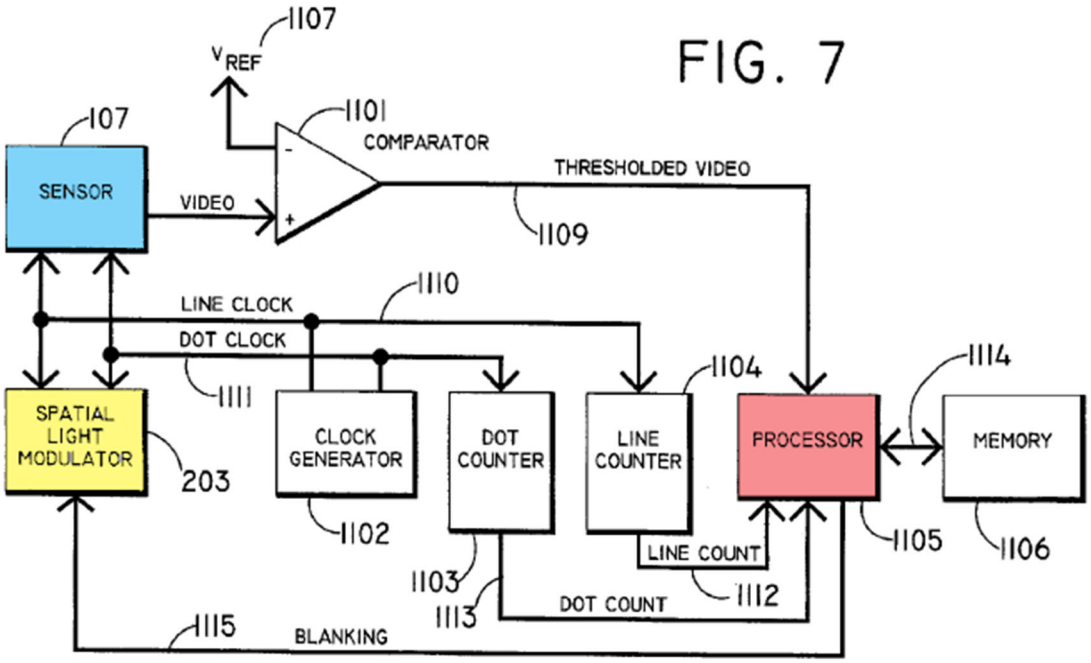
uses the sensor spatial data "to determine the locations to be blanked." EX1005, 5:46-54, 6:11-27, FIGS. 1, 1C-1D, 7.




EX1005, FIG. 1 (annotated).




EX1005, FIGS. 1A-1B.



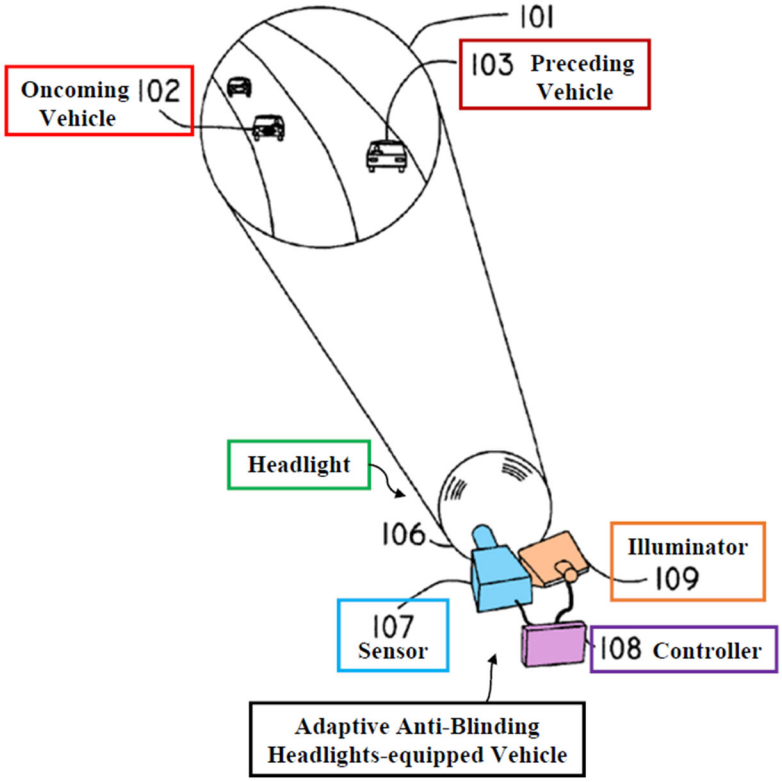

EX1005, FIG. 7 (annotated).

186. In view of the above, Beam discloses this element.

**8. [1.7]: "a logical controller including a processor, the processor in communication with a memory storing one or more algorithms, with the sensors, and with the control circuitry,"**

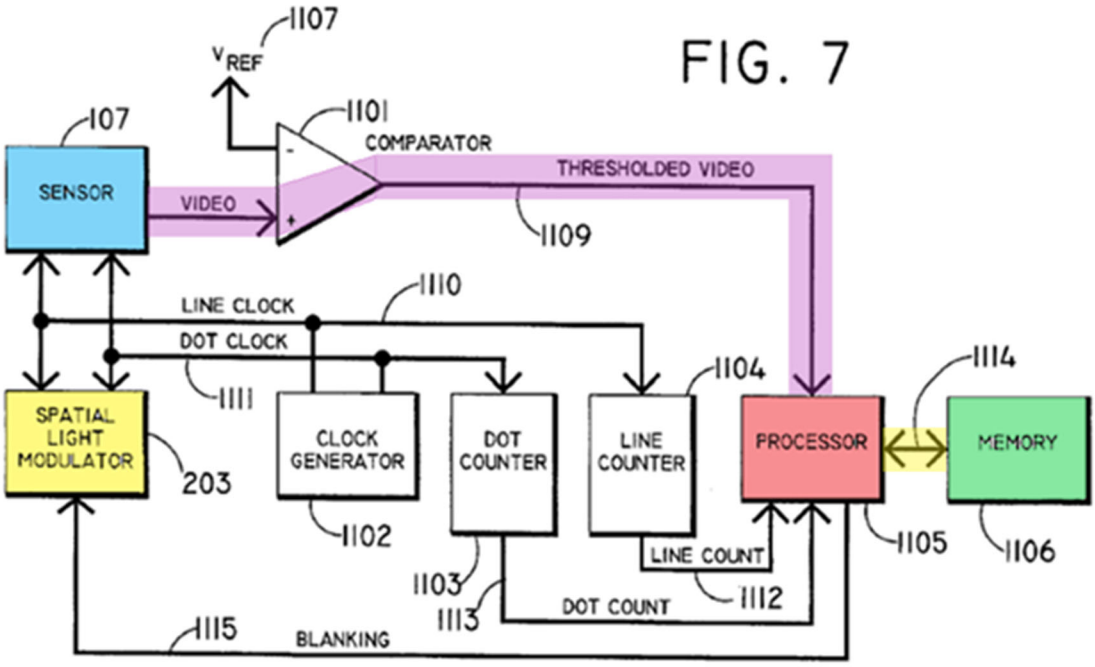
187. In my opinion, claim elements [1.7]-[1.10] are part of the same clause but will be addressed separately for simplicity below.

188. 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*," and "[p]rocessor 1105 uses appropriate *algorithms* on the incoming data…and stores them in *memory 1106*." EX1005, 4:10-25, 5:33-54, 5:61-65, FIGS. 1, 7; EX1005, 5:33-34 ("FIG. 7 is a *block diagram* of the *electronics portion of controller 108*"), 8:35-38, 5:13-15.




EX1005, FIG. 1 (annotated).

189. A POSA would have understood Beam's controller is "a logical controller including a processor" because Beam's "block diagram of the electronics portion of controller 108" (Figure 7) includes processor 1105 in communication with memory 1106, sensor 107, and SLM 203 (blanking bus). EX1005, 5:33-54, 4:36-59, 8:4-17, FIGS. 1, 7.




EX1005, FIG. 7 (logical controller with processor and control circuitry) (annotated).

190. In view of the above, Beam discloses this element.

**9. [1.8]: "wherein the processor is configured to process the one or more algorithms and the sensor data to determine an illumination for at least two of the sub-sections,"**

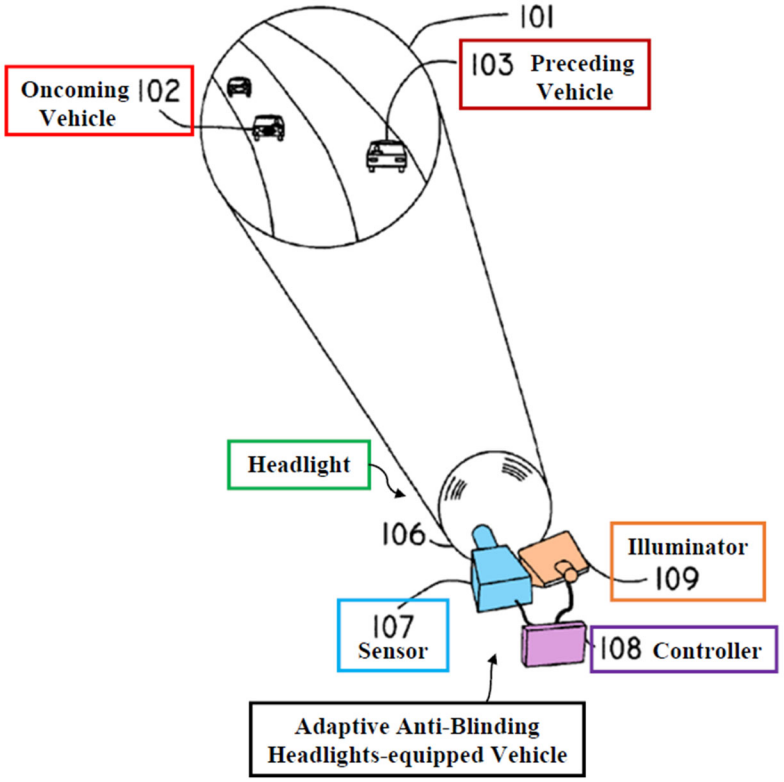
191. In my opinion, claim elements [1.7]-[1.10] are part of the same clause but will be addressed separately for simplicity below.

192. 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*…and outputs *blanking signals*…*commands* the appropriate pixels to be *reduced in intensity*." EX1005, 5:34-36, 5:46-54, FIGS. 1, 1C-1D, 7; EX1005, Abstract ("*determine* the location of light sources…using that information to *control the intensity*"), 6:14-16

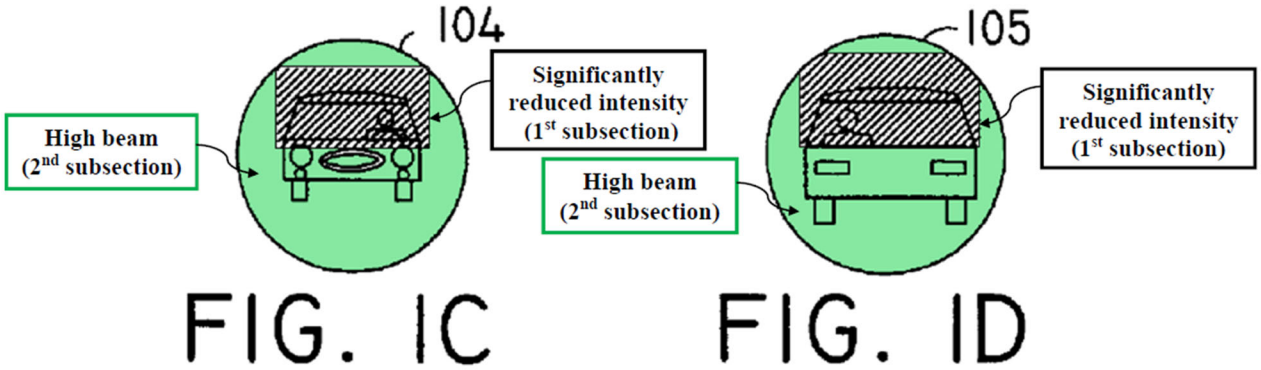
("headlight's *field-of-view*"), 5:65-6:2 ("a *dimmed area*…based on input to the sensor").

193. Beam also discloses "*determining*, from the *detected presence* of the oncoming or followed vehicle…*the shape, size and location of an area to be darkened*…[and] *determining* which of said multiple rays of light must be *extinguished*." EX1005, 8:29-34, FIGS. 1, 1C-1D, 7; EX1005, 1:5-18 ("*reformatting* the *pattern* of a beam…to *prevent* it from illuminating *certain areas*…thus eliminating the blinding of a driver in an *oncoming vehicle*, while continuing to provide *intense forward illumination*"), 2:59-3:3, 4:10-25, 5:13-15, 5:33-54, 8:23-38.

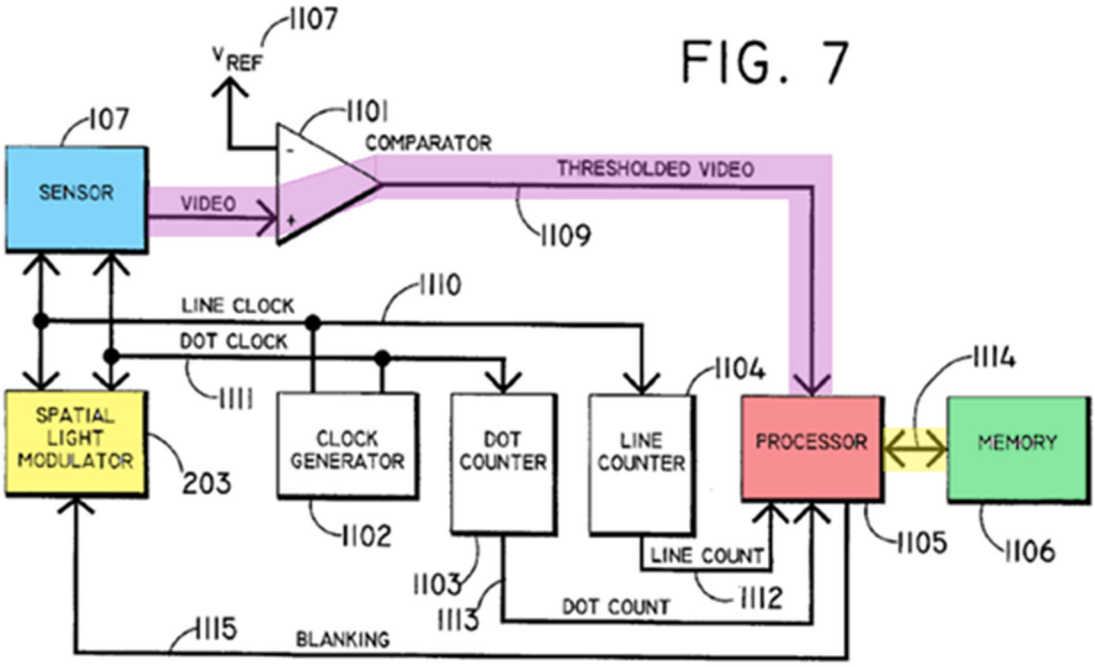
194. Thus, Beam's processor processes "algorithms" and the sensor data to "determine an illumination for at least two of the subsections" (shaded area of reduced intensity/non-shaded area of high intensity). Beam's processor processes the inputted spatial sensor data, indicates a vehicle within the headlight's field-of-view, and uses appropriate algorithms to determine an area to be dimmed within a first subsection of the field-of-view (e.g., shaded area of significantly reduced intensity) and an area to be illuminated within a second subsection of the field-of-view (e.g., non-shaded area of high intensity). EX1005, 5:33-54, 6:12-27, FIGS. 1C-1D; EX1005, 5:33-54 ("*blanking* signals"), 6:24-27 ("blanked area *tracks* the location of the *oncoming vehicle*").




EX1005, FIG. 1 (annotated).




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



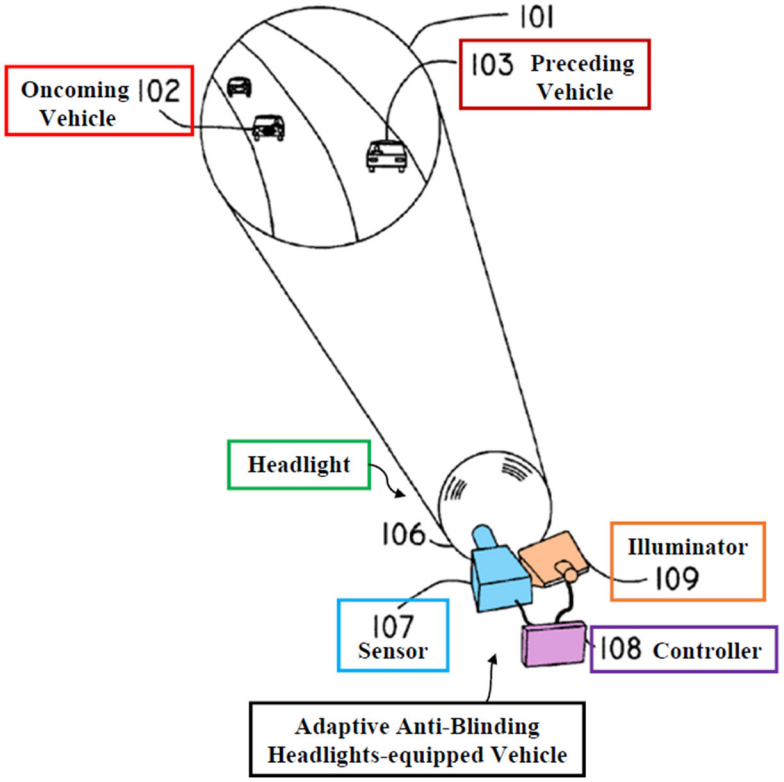

EX1005, FIG. 7 (annotated).

195. In view of the above, Beam discloses this element.

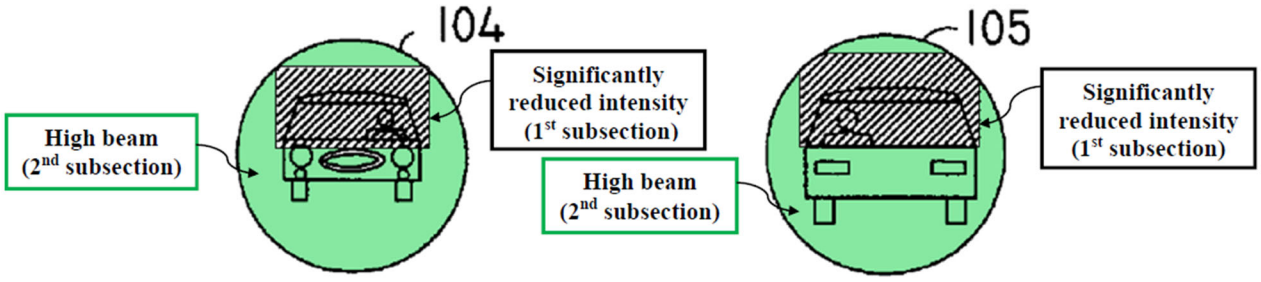
### 10. [1.9]: "that reduces illumination to reduce glare in at least a first of the at least two subsections and"

196. In my opinion, claim elements [1.7]-[1.10] are part of the same clause but will be addressed separately for simplicity below.

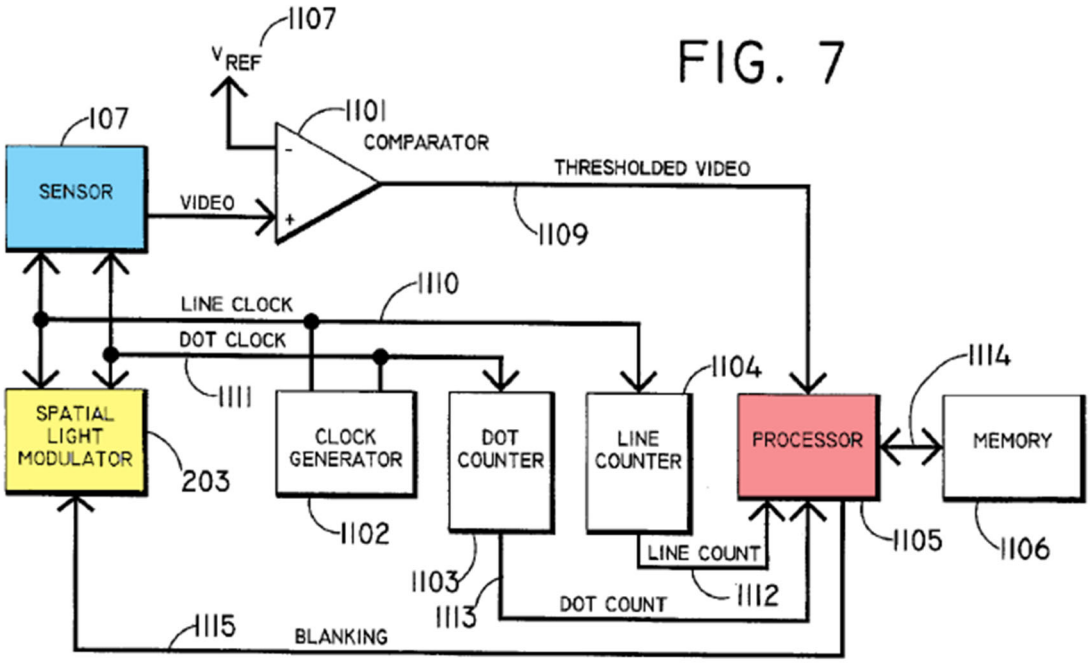
197. Beam's illumination in shaded areas is "*significantly less* than with current *low beams*" and "*reformatting* the *pattern*…to *prevent* it from illuminating *certain areas*…thus eliminating the *blinding* of a driver in an *oncoming vehicle*." EX1005, 1:5-18, FIGS. 1, 1C-1D, 7; EX1005, 2:59-3:3 ("area…*dazzl[ing]* the driver will be *darkened*"), 4:23-25 ("*shaded areas*"), 5:46-54 ("*blanked area*"), 5:65-6:2. This "reduce[s] glare" to other traffic.




EX1005, FIG. 1 (annotated).




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




EX1005, FIG. 7 (annotated).

198. In view of the above, Beam discloses this element.

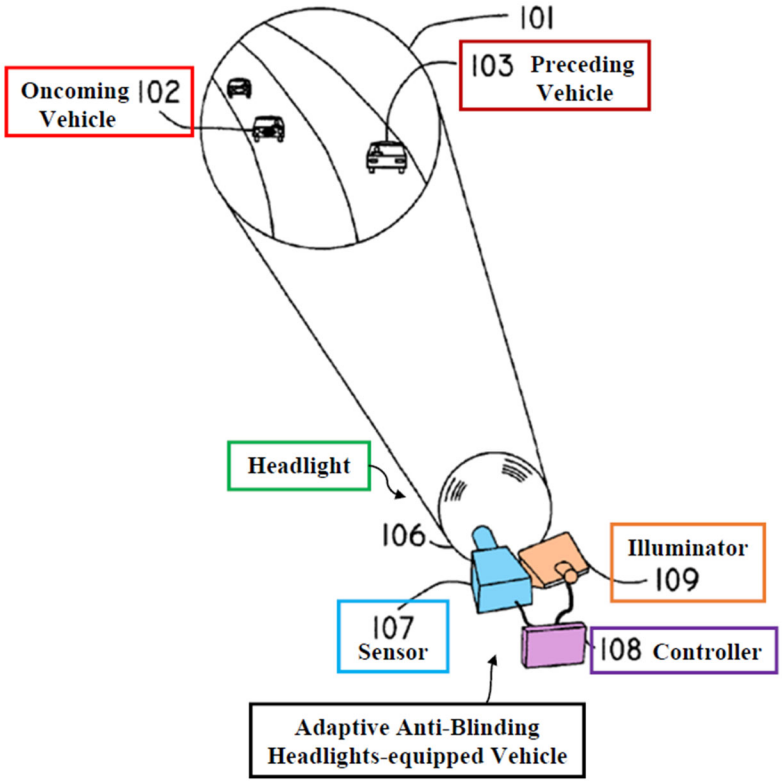
**11. [1.10]: "adapt the light emitted from one or more of the light-clusters so as to create the headlight beam that provides the determined illumination."**

199. In my opinion, claim elements [1.7]-[1.10] are part of the same clause but will be addressed separately for simplicity below.

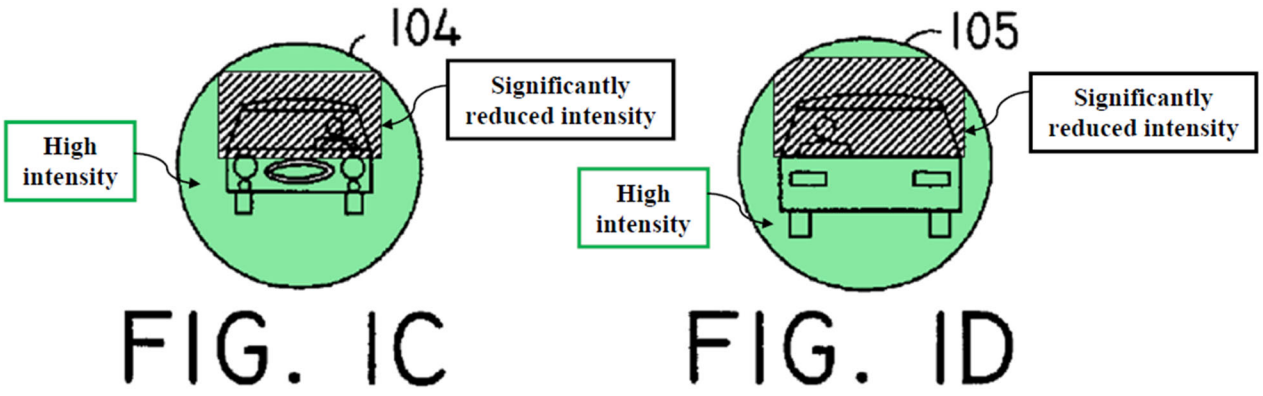
200. In my opinion, claim element [1.10] implements the steps of claim elements [1.8] and [1.9].

201. Beam's "controller module uses the *sensor spatial data (video)*…to *control the Illuminator*" and "*[p]rocessor…determine[s] the locations to be blanked*…outputs *blanking signals…command[ing]* the appropriate pixels." EX1005, 5:34-54, FIGS. 1, 1C-1D, 7; EX1005, 8:35-38 ("*controlling individual*

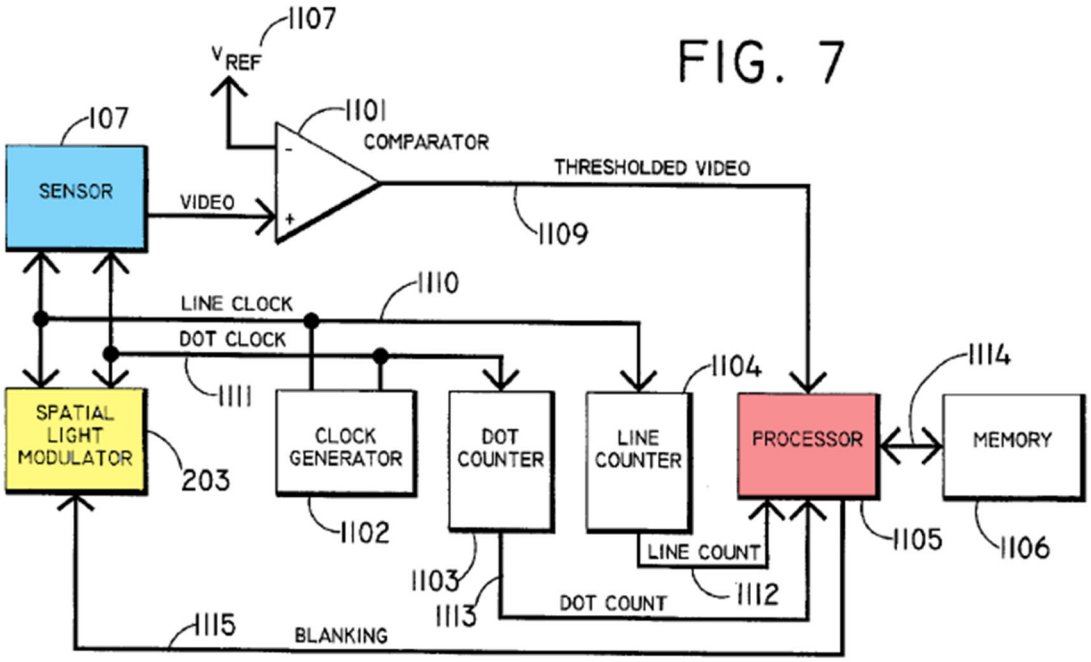
*rays*…producing a *desired output*"), 5:61-65 ("*controlled by a processor*"), 1:5-18 ("*reformatting the pattern*"), 4:10-25. As discussed, Beam, alone or in combination with Thominet, discloses or renders obvious one or more "light clusters." *Supra* Section X.B.3. Thus, Beam, alone or in combination with Thominet, discloses or renders obvious "adapt[ing]…light-clusters" and "instruct[ing] operation of at least two…light clusters" to create the headlight beam as in claim element [1.10] (and [37.10] in Ground 2).




EX1005, FIG. 1 (annotated).




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




EX1005, FIG. 7 (annotated).

202. In view of the above, Beam, alone or in combination with Thominet, discloses or renders obvious this element.

### C. Claim 2

#### 1. [2.1]: "The headlight system of claim 1, wherein at least one of the light clusters comprises: a structure to position the light cluster, such that the projected light from the at least one cluster has an aiming direction in relation to a forward travel direction of the vehicle;"

203. Beam's "spatial light modulator 203…[is] mounted on a *support 204*" and "*unitized housing* [501]…provide[s]…mechanical support…to maintain optical *alignment*." EX1005, 4:36-40, 5:17-28, FIGS. 2, 5; EX1005, 8:4-17, 5:61-63, Abstract, 4:26-59, 5:3-21, 1:5-18, FIGS. 2, 4-6. Beam's "AABH units will be mounted on a vehicle, *facing forward*, just as are conventional headlights." EX1005, 6:9-11. As discussed, Beam, alone or in combination with Thominet, discloses or renders obvious one or more "light clusters." *Supra* Section X.B.3. Thus, a POSA would have understood that Beam's support 204 and/or housing 501 provides "at least one cluster [having] an aiming direction in relation to a forward travel direction." EX1005, 4:36-40, 5:17-28, 6:9-11, FIGS. 2, 5. Simply, to be used as headlights, Beam's clusters aim forward.

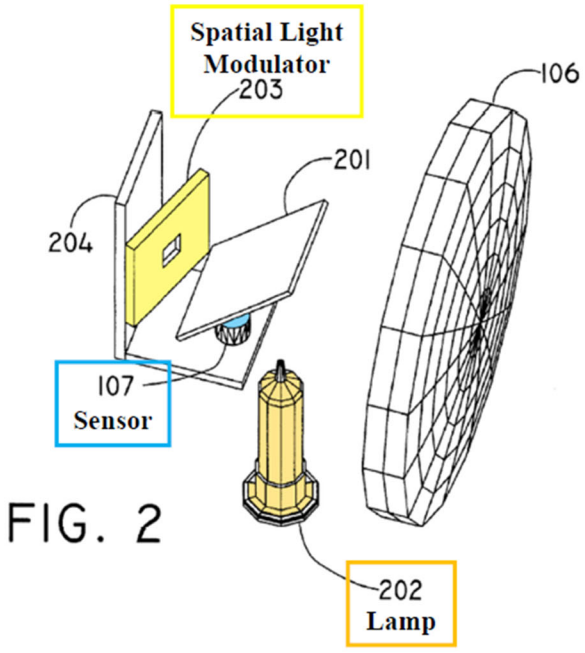



FIG. 2

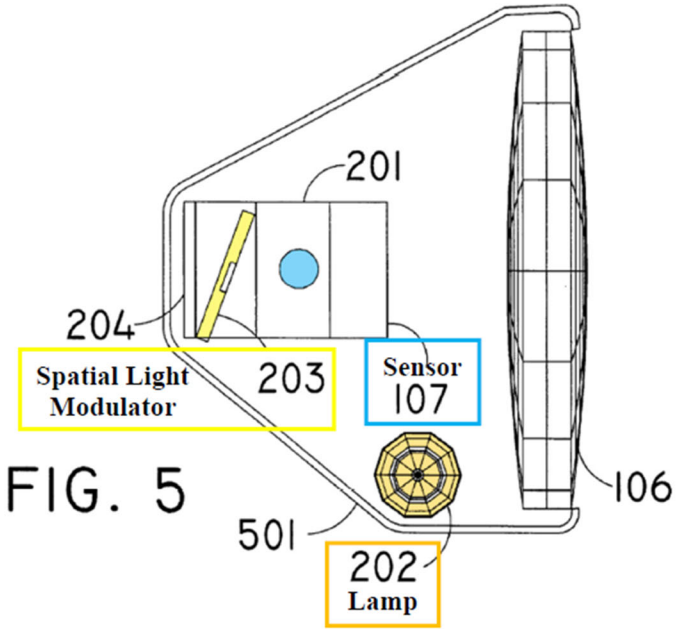



FIG. 5

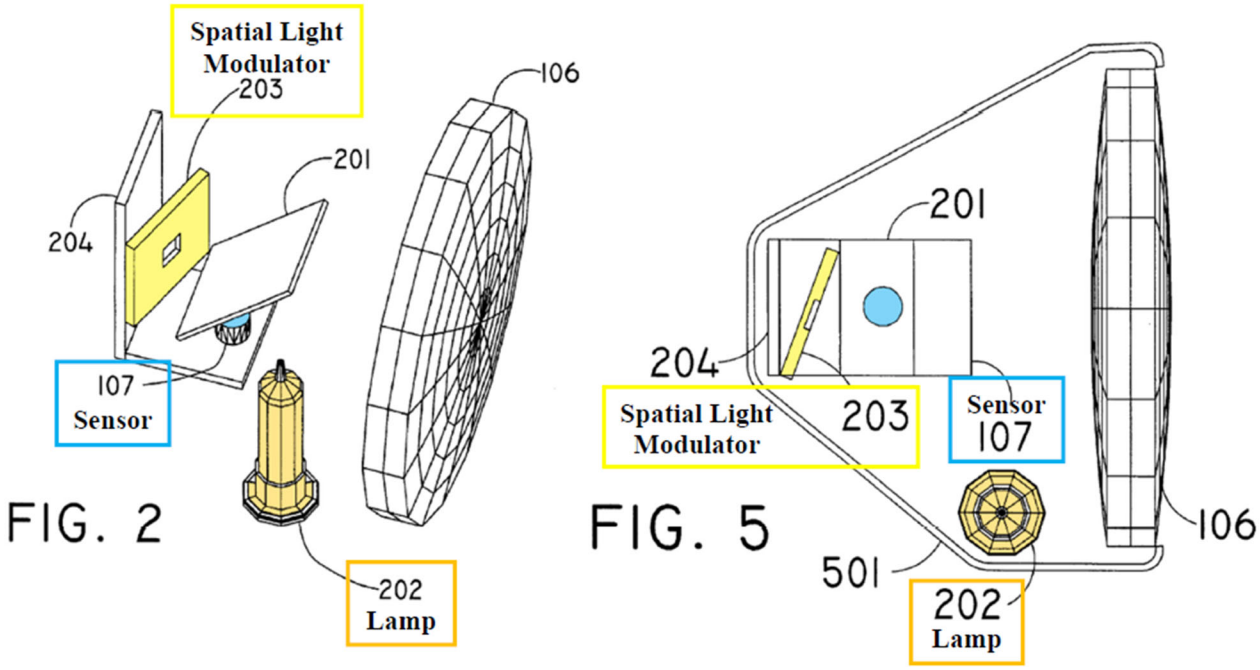
EX1005, FIGS. 2 and 5 (annotated).

204. In view of the above, Beam, alone or in combination with Thominet, discloses or renders obvious this element.

**2. [2.2]: "one or more light emitting sources, each having a variable light-source characteristic dependent on power, and wherein the control circuitry is arranged to alter said light-source characteristic via power control; and"**

205. Beam discloses "[r]ays from a *lamp 202* fall on…spatial light modulator 203, mounted on a support 204, where they are either *reflected* or *blanked*" and "[c]ontroller 108 selectively commands *reduction of the energy* of the microbeams." EX1005, 4:26-52, FIGS. 2, 5; EX1005, Abstract, 7:25-29, 8:4-34. A POSA would have understood that "intensity" is one of a "variable light-source characteristic." EX1001, 16:43-50, 2:28-30. A POSA would have

understood that lamp 202 (see Figure 2) is a "light emitting source[]…dependent on power" since an intensity (brightness) of a lamp (e.g., incandescent) can be altered based on the amount of power (current) applied. EX1005, 5:3-21, 8:4-18.




EX1005, FIGS. 2, 5 (annotated).

206. 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, 3:62-64, 5:3-16, FIGS. 4, 6; EX1005, 8:4-17. A POSA would have understood that Beam's array of light sources 401 (e.g., LEDs, see Figure 4) is a "light emitting source…dependent on power" since an intensity (brightness) of an LED can be altered based on the amount of power (current) applied. EX1005, 5:3-21, 8:4-18.

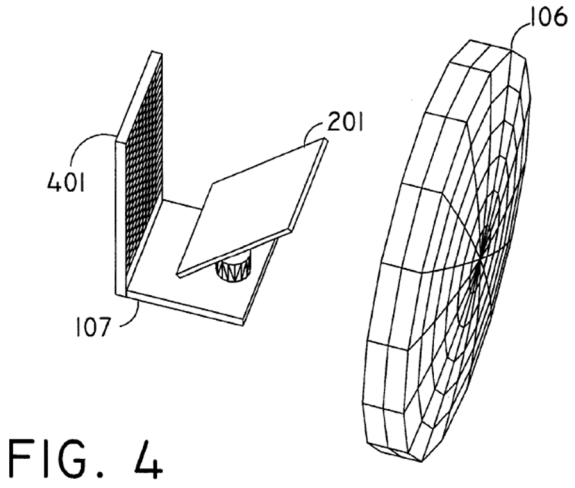



FIG. 4

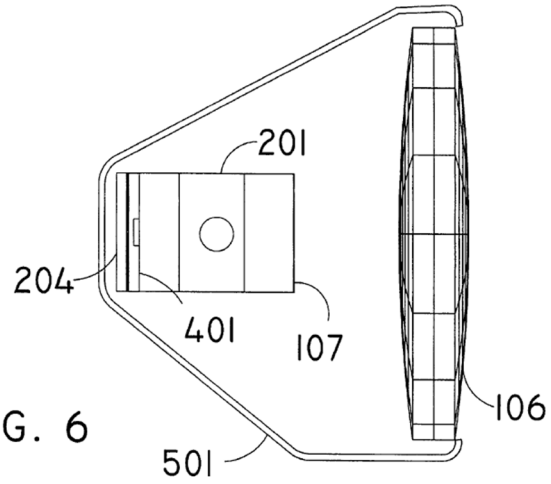



FIG. 6

EX1005, FIGS. 4, 6.

207. In view of the above, Beam discloses this element.

**3. [2.3]: "one or more light modifying elements provided in the path of light emitted from at least one of the sources, further controlling the light-source characteristics;"**

208. Beam discloses "[r]ays from a lamp 202 fall on…*spatial light modulator 203*…where they are either *reflected* or *blanked*" and "the *angular* position or *attenuation* of each…microbeam[] is independently set by the controller 108." EX1005, 4:26-52, FIGS. 2, 5; EX1005, Abstract, 7:25-29, 8:4-34. A POSA would have understood that Beam's SLM 203 (see Figure 2) is a "light modifying element[]" that further controls light from lamp 202. EX1005, 5:3-21, 8:4-18.

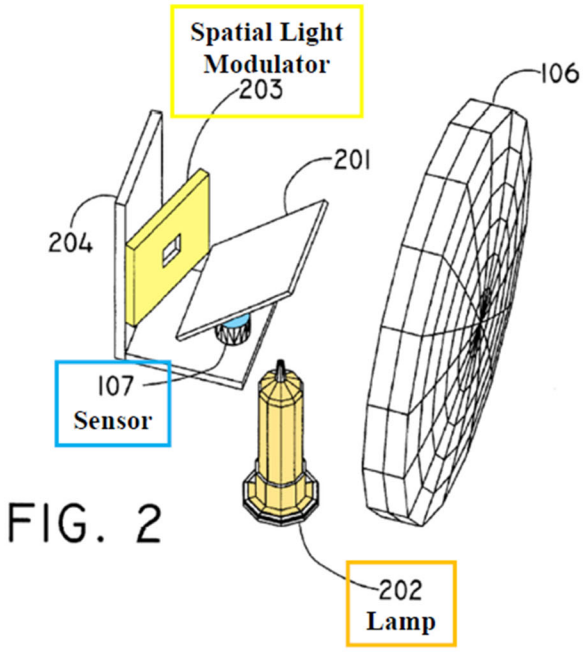



FIG. 2

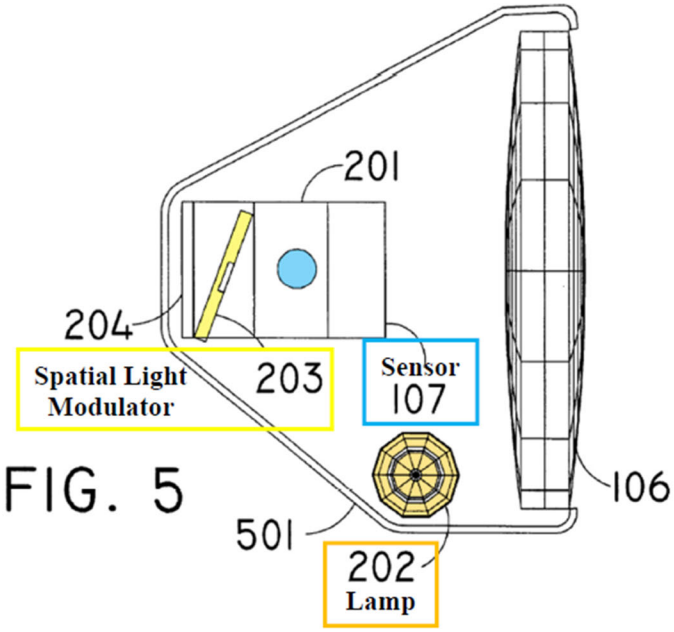



FIG. 5

EX1005, FIGS. 2, 5 (annotated).

209. 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, 3:62-64, 5:3-16, FIGS. 4, 6; EX1005, 8:4-17. A POSA would have understood that Beam's array of light sources 401 (see Figure 4, with spatial light modulator) is a "light modifying element[]" that further controls light from light sources (e.g., LEDs). EX1005, 5:3-21, 8:4-18.

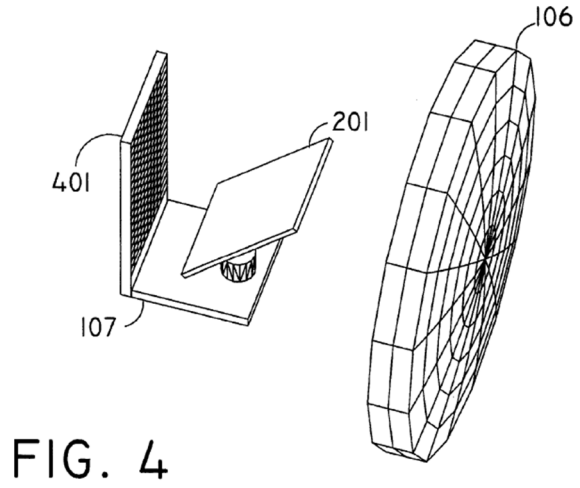



FIG. 4

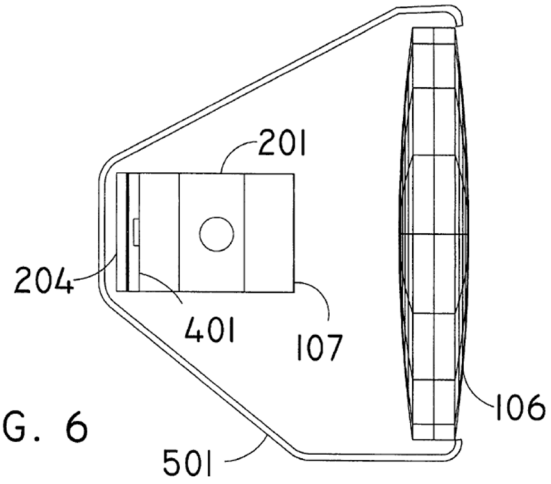



FIG. 6

EX1005, FIGS. 4, 6.

210. Additionally, Beam's optical system 106 (bi-convex lens) and/or Beam-Thominet's lens 43, 46 of semiconductor source 10 (LED) is a "light modifying element[]." EX1005, 1:63-65, 4:10-59, 5:3-21, FIGS. 2-6; EX1006, ¶¶19, 29-31, FIGS. 1, 5-7.

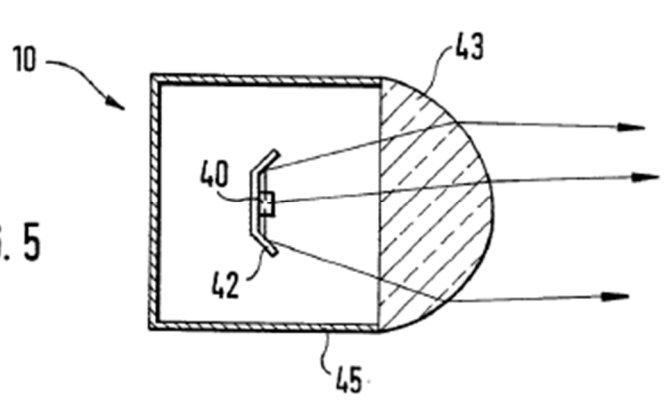



FIG. 5

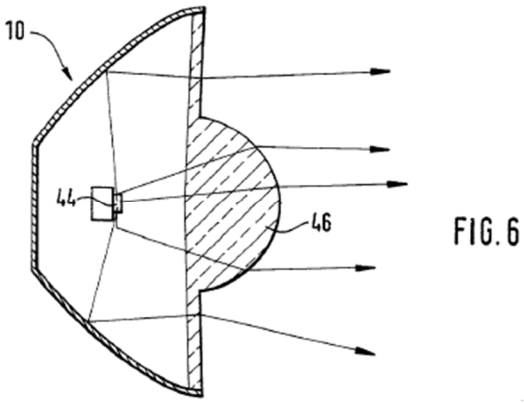



FIG. 6

EX1006, FIGS. 5-6.

211. In view of the above, Beam, alone or in combination with Thominet, discloses or renders obvious this element.

**4. [2.4]: "wherein the structure combined with control of the light sources and light modifying elements results in an emitted light-cluster light characteristic including at least one of direction, intensity, beam spread, spatial light distribution or spectral light distribution."**

212. Beam discloses "[r]ays from a lamp 202 fall on…spatial light modulator 203, mounted on a support 104" and "the *angular* position or *attenuation* of each…microbeam[] is independently set by the controller 108." EX1005, 4:26-52, FIGS. 2, 5; EX1005, Abstract, 7:25-29, 8:4-34. Also, Beam discloses controlling "*individually directed narrow-angle beams…microbeams*" and "the *intensity*, and/or the *angular position*, of one or more narrow-angle *microbeams*." EX1005, 5:61-63, Abstract, FIGS. 2, 5. 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, 3:62-64, 5:3-16, FIGS. 4, 6; EX1005, 8:4-17. As discussed, Beam, alone or in combination with Thominet, discloses or renders obvious one or more "light clusters." *Supra* Section X.B.3. A POSA would have understood that Beam's system provides "an emitted light-cluster light characteristic," for example, "direction," "intensity," or "spatial light distribution." EX1005, 5:3-21, 8:4-18, FIGS. 1C-1D.

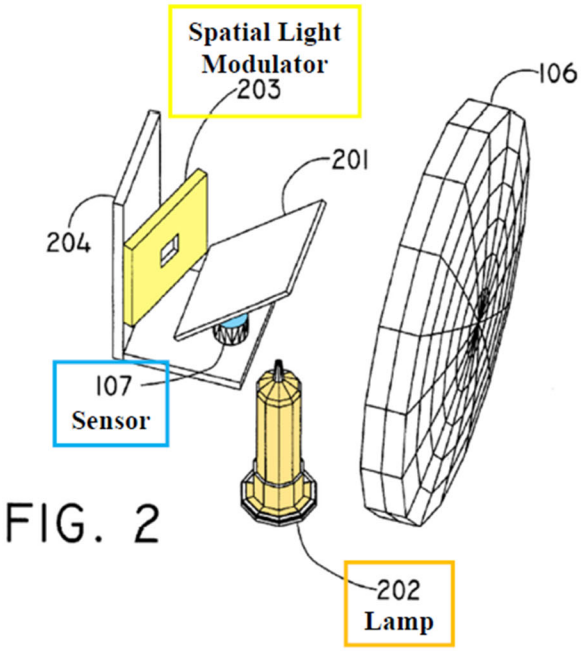



FIG. 2

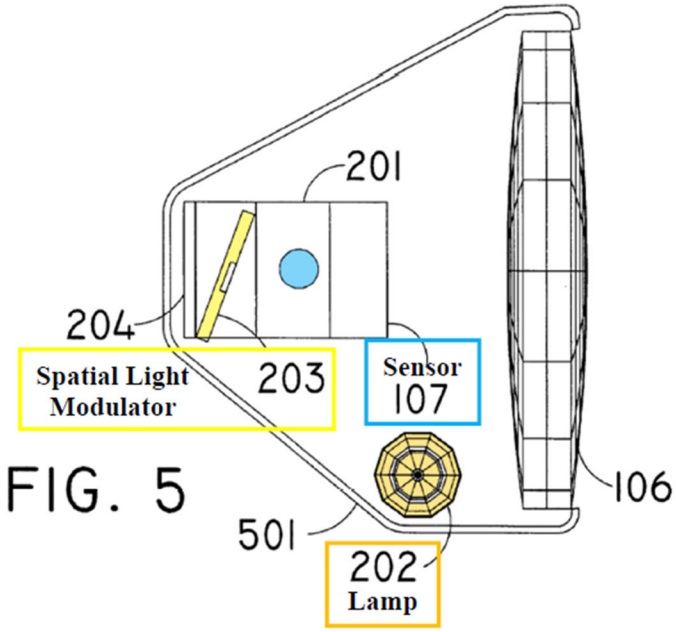



FIG. 5

EX1005, FIGS. 2, 5 (annotated).

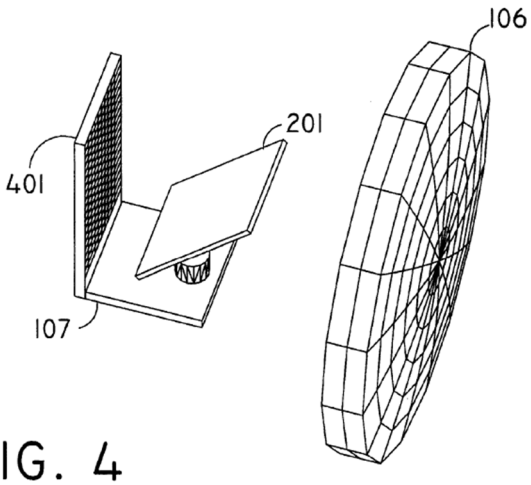



FIG. 4

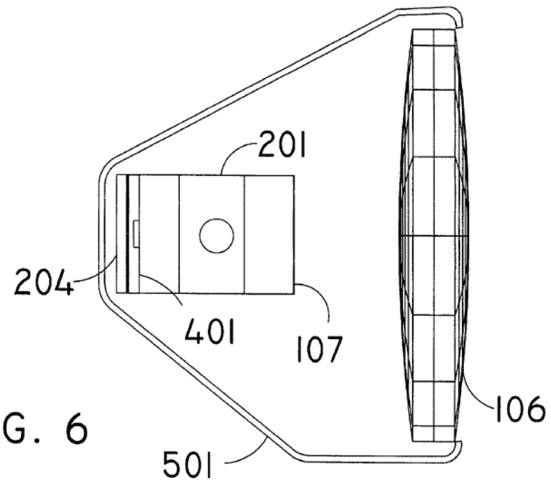
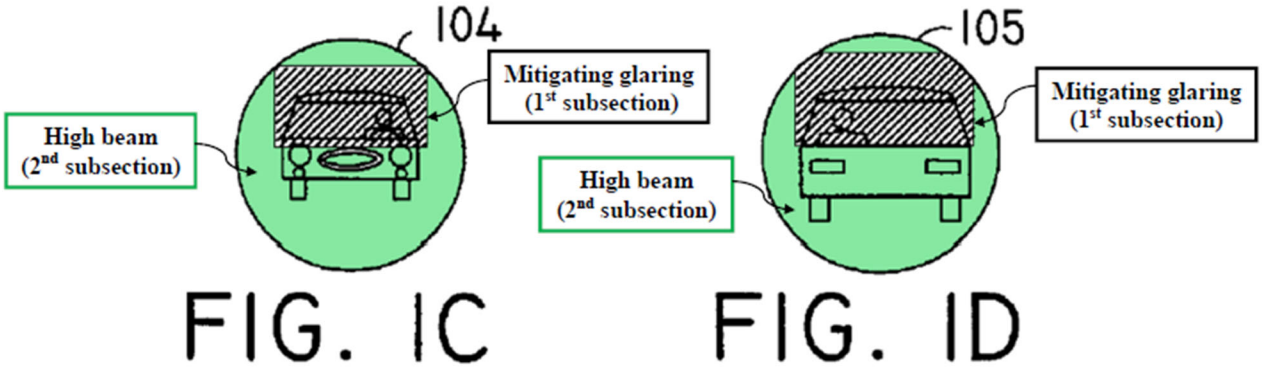



FIG. 6

EX1005, FIGS. 4, 6.




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

213. In view of the above, Beam, alone or in combination with Thominet, discloses or renders obvious this element.

214. Thus, Beam, alone or in combination with Thominet, discloses or renders obvious this claim.

**D. Claim 3: "The headlight system of claim 2, wherein the one or more light modifying elements is at least one of a static light modifier or a variable light modifier, said light modifying element comprising at least one of reflectors or refractors, and wherein variable light modifier control circuitry is configured to control the light-cluster light characteristic by altering the light modifying elements in the path of the light emitted from the at least one of the light sources."**

215. Beam discloses "[r]ays from…lamp 202 fall on…*spatial light modulator 203*…where they are…*reflected* through or blanked" and "*angular* position or *attenuation* of each…microbeam[] is independently set by the controller 108." EX1005, 4:26-52, FIGS. 2, 5; EX1005, 8:4-12 ("*spatial light modulator*…*digital mirror devices*, liquid crystal devices, and grating light valves

for selectively controlling the intensity of individual microbeam sources in said array"), Abstract, 5:61-63, 7:25-29, 8:4-34, 3:62-64, 5:3-16, 8:4-17, FIGS. 4, 6.

216. A POSA would have understood that Beam's SLM 203 is "a variable light modifier" with "reflectors" that control the "light-cluster light characteristic," for example, "direction," "intensity," or "spatial light distribution." EX1005, 5:3-21, 8:4-18, FIGS. 1C-1D. A POSA would have understood Beam's SLM 203 (digital mirror device) includes "variable light modifier control circuitry" to adjust the angular position/intensity of each modulator (mirror) in the array. EX1005, 5:33-54, 4:36-59, 8:4-17, FIGS. 1, 2, 4-7.

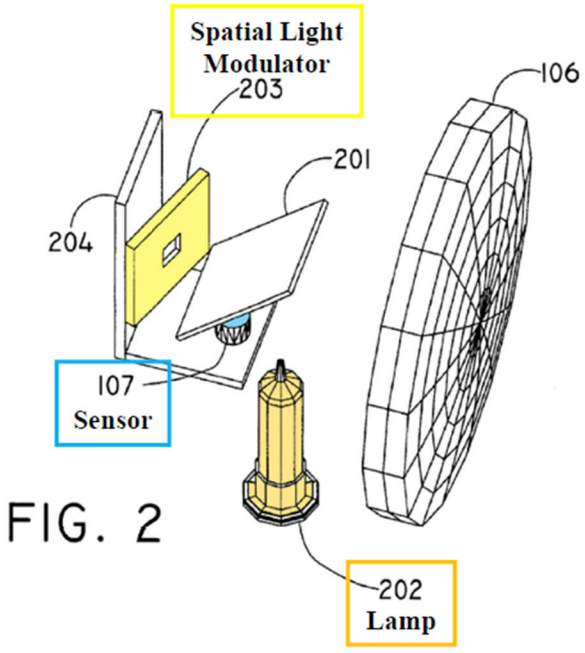



FIG. 2

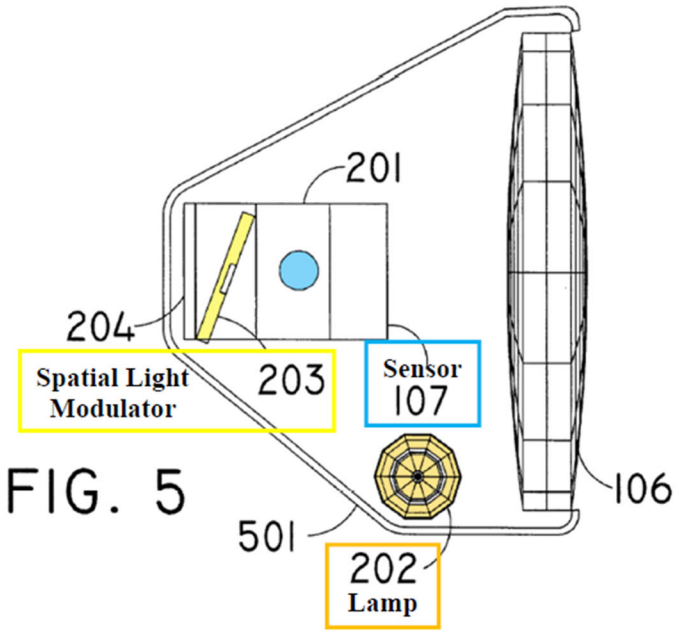



FIG. 5

EX1005, FIGS. 2, 5 (annotated).

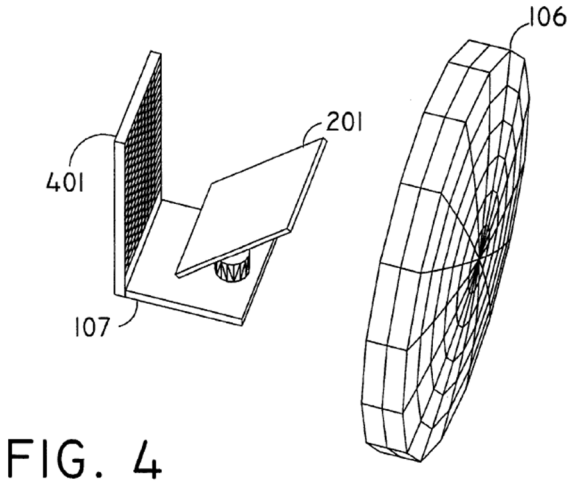



FIG. 4

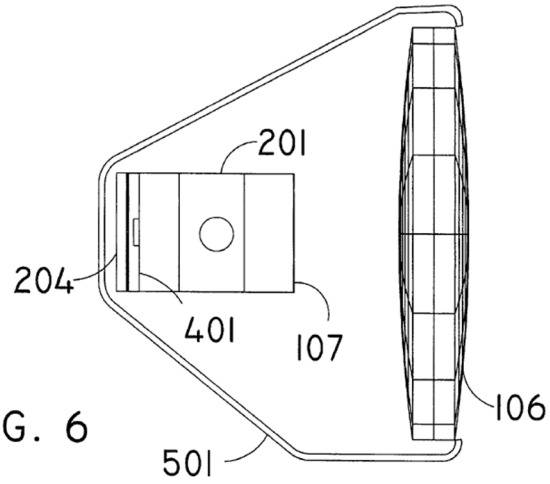



FIG. 6

EX1005, FIGS. 4, 6.

217. Additionally, Beam's optical system 106 (bi-convex lens) and/or Beam-Thominet's lens 43, 46 of semiconductor source 10 (LED) is "a static light modifier" with "refractors." EX1005, 1:63-65, 4:10-59, 5:3-21, FIGS. 2-6; EX1006, ¶¶19, 29-31, FIGS. 1, 5-7.

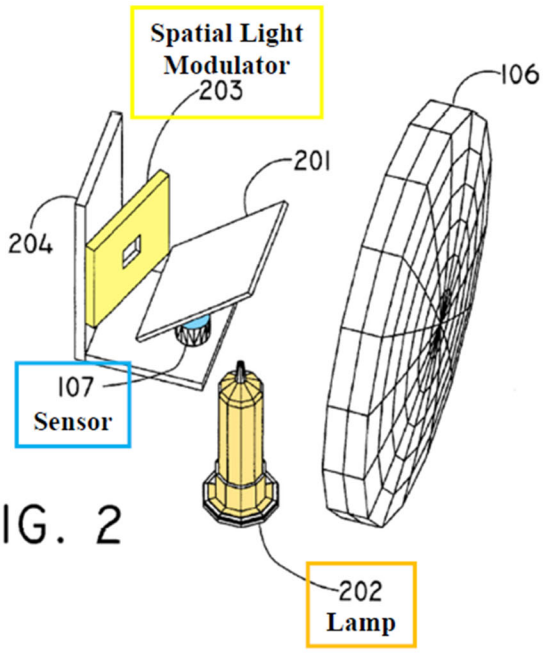



FIG. 2

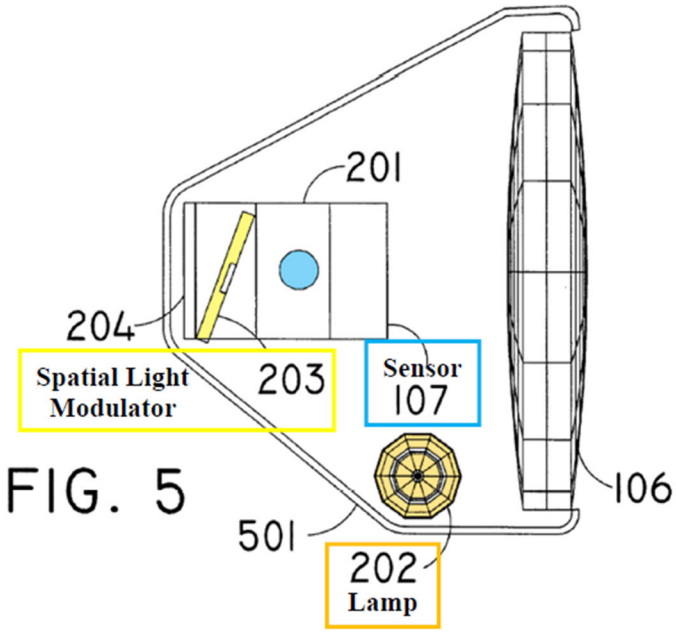



FIG. 5

EX1005, FIGS. 2, 5 (annotated).

218. In view of the above, Beam, alone or in combination with Thominet, discloses or renders obvious this claim.

**E. Claim 4: "The headlight system of claim 2, wherein the light modifying element further comprises at least one of lenses, diffractors, optical devices, a light guide, filters, phosphors, optical coatings, prisms, controllable piezoelectric light guides, MEMS devices, light valves or optical switches.**

219. Beam discloses "*spatial light modulator*…[includes] *digital mirror devices*, liquid crystal devices, and grating *light valves*." EX1005, 8:4-12, FIGS. 2, 4-6; EX1005, 4:26-52, Abstract, 5:61-63, 7:25-29, 8:4-34, 3:62-64, 5:3-16, FIGS. 4, 6. Thus, Beam's SLM 203 includes "optical devices." EX1005, 8:4-18.

220. Additionally, a POSA would have understood that "digital mirror devices" include "MEMS devices." EX1005, 8:4-18.

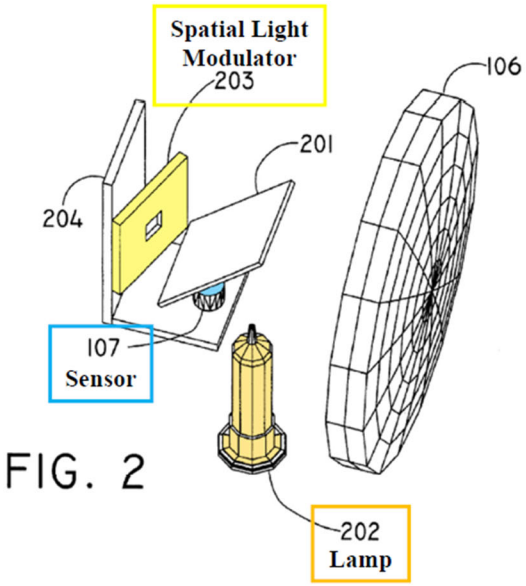



FIG. 2

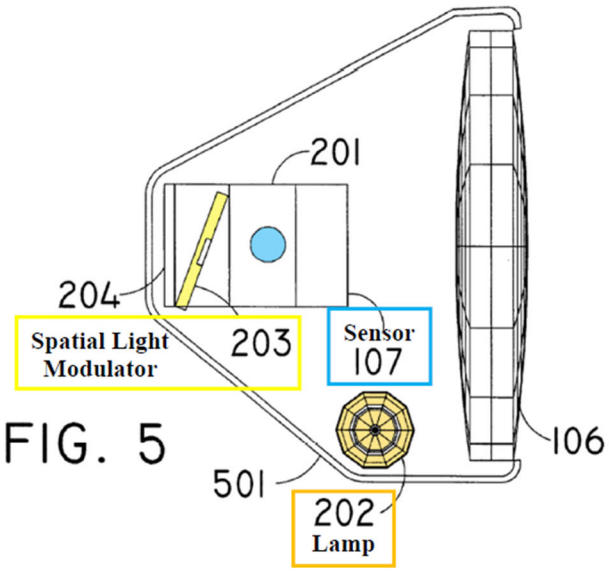
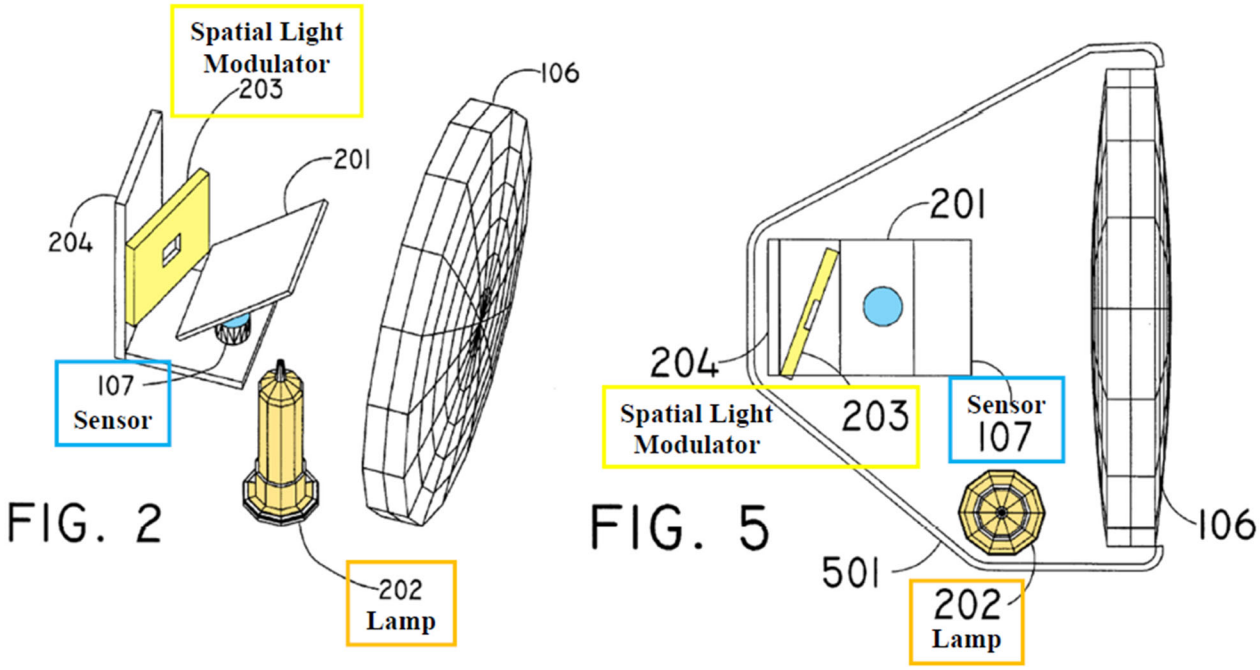


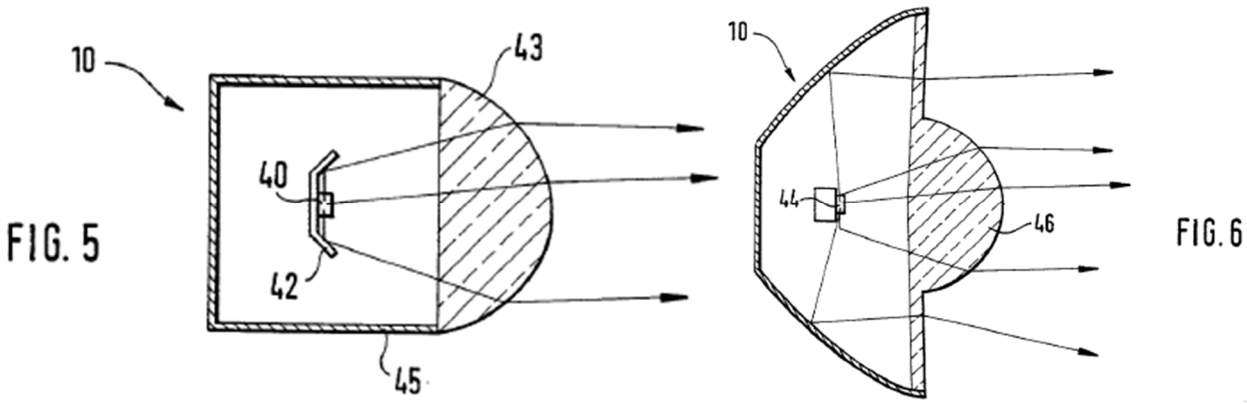

FIG. 5

EX1005, FIGS. 2, 5 (annotated).

221. Additionally, Beam's optical system 106 (bi-convex lens) and/or Beam-Thominet's lens 43, 46 is a "lens" or an "optical device." EX1005, 1:63-65, 4:10-59, 5:3-21, FIGS. 2-6; EX1006, ¶¶19, 29-31, FIGS. 1, 5-7.




EX1005, FIGS. 2, 5 (annotated).




EX1006, FIGS. 5-6.

222. In view of the above, Beam, alone or in combination with Thominet, discloses or renders obvious this claim.

**F. Claim 5: "The headlight system of claim 1, wherein at least one of the light-clusters includes: a plurality of light sources, wherein one or more of the plurality of light sources comprises at least one of multiple light-emitting-diodes (LEDs) or organic light emitting-diodes, each light source having a spectral power distribution characteristic and wherein the control circuitry is configured to alter the overall light-cluster spectral power distribution to illuminate at least one of the at least two subsections of the field-of-view with a different color of light from another of the at least two subsections."**

**1. Beam's disclosure**

223. Beam discloses "[r]ays from a lamp 202 fall on…spatial light modulator 203" and "*angular* position or *attenuation* of each…microbeam[] is independently set by the controller 108." EX1005, 4:26-52, FIGS. 2, 5; EX1005, Abstract, 5:61-63, 7:25-29, 8:4-34. 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, 3:62-64, 5:3-16, FIGS. 4, 6; EX1005, 8:4-17 ("*light-emitting diodes*").

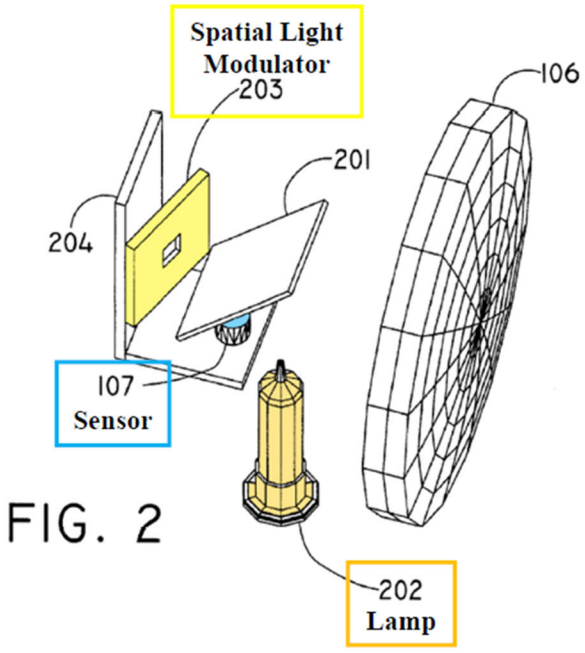



FIG. 2

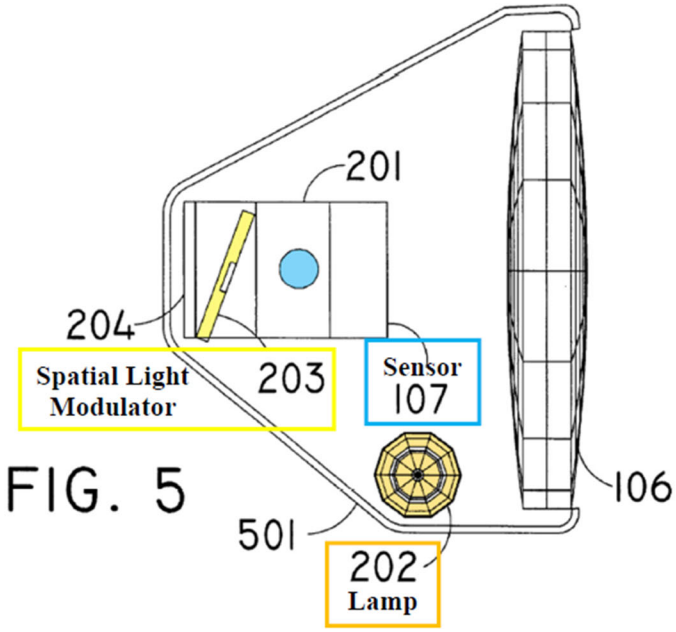



FIG. 5

EX1005, FIGS. 2, 5 (annotated).

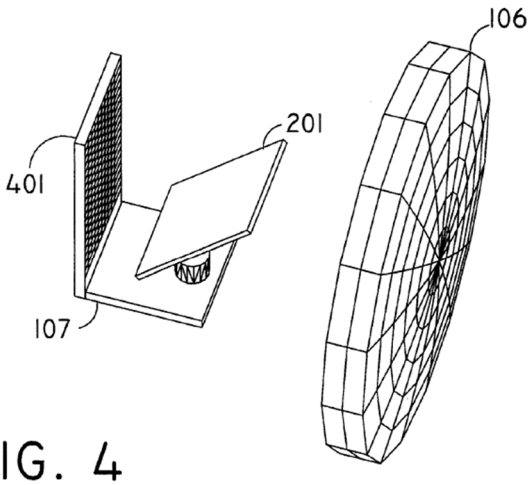



FIG. 4

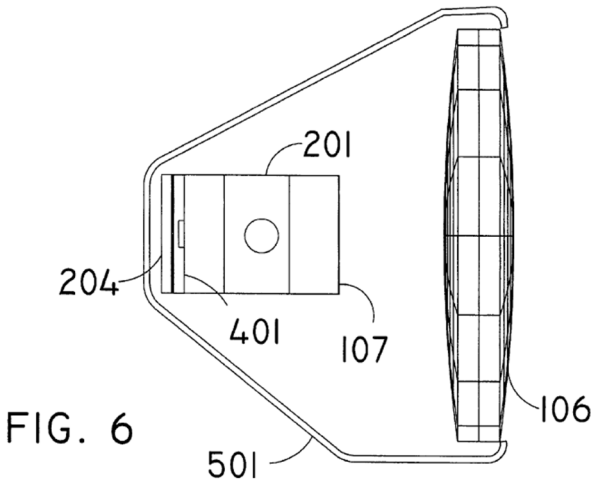



FIG. 6

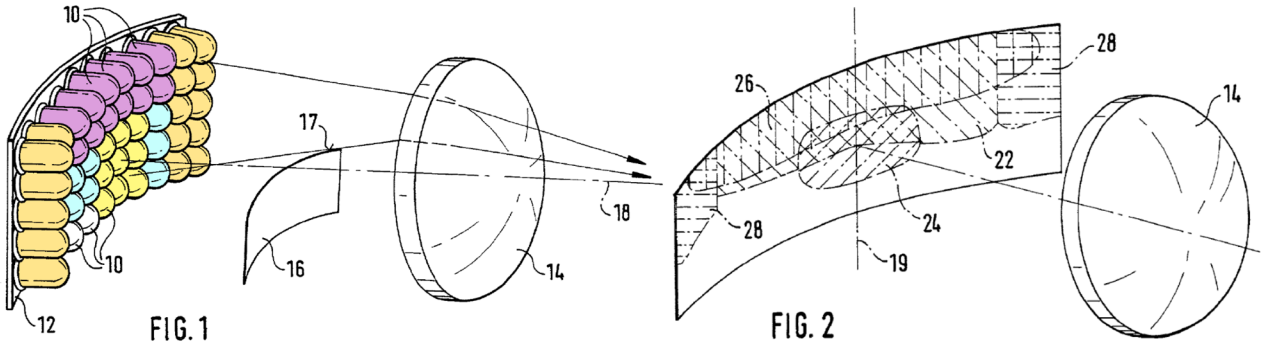
EX1005, FIGS. 4, 6.

224. Beam does not disclose illuminating a subsection with a different color of light, but this feature was well known in the prior art, e.g., as explicitly disclosed by Thominet.

**2. Thominet's disclosure**

225. Thominet's semiconductor light sources 10 are arranged in different beam regions 22, 24, 26, 28 (clusters) for different driving situations. EX1006, ¶¶7-8, 17-18, 21-29, FIGS. 1-3; EX1006, ¶7, ¶23. Further, Thominet discloses "light beams of *different light colors* is possible…for different signal functions" and "different partial regions [22, 24, 26, 28] emit light of *different colors*" and/or "a *mixture of the colors*." EX1006, ¶¶5, 27-29, claim 3, FIGS. 1B-2.

226. A POSA would have understood Beam-Thominet's LEDs each have "a spectral power distribution characteristic" (color) and that Beam-Thominet's controller provides different colors to different subsections. EX1006, ¶¶2-5, 26-29, FIGS. 1B-2; EX1005, 3:62-64, 5:3-16, FIGS. 2, 4-6. A spectral power distribution (SPD) is a pictorial representation of the radiant power emitted by a light source at each wavelength expressed in units of W/nm. Thus, different colors (e.g., red, green, blue) have different SPDs (as a function of wavelength) and a mixture of colors alters the overall SPD of the illumination.




EX1006, FIGS. 1-2 (annotated).

227. As discussed, a POSA would have been motivated to combine Thominet with Beam with a reasonable expectation of success. *Supra* Section X.A.

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

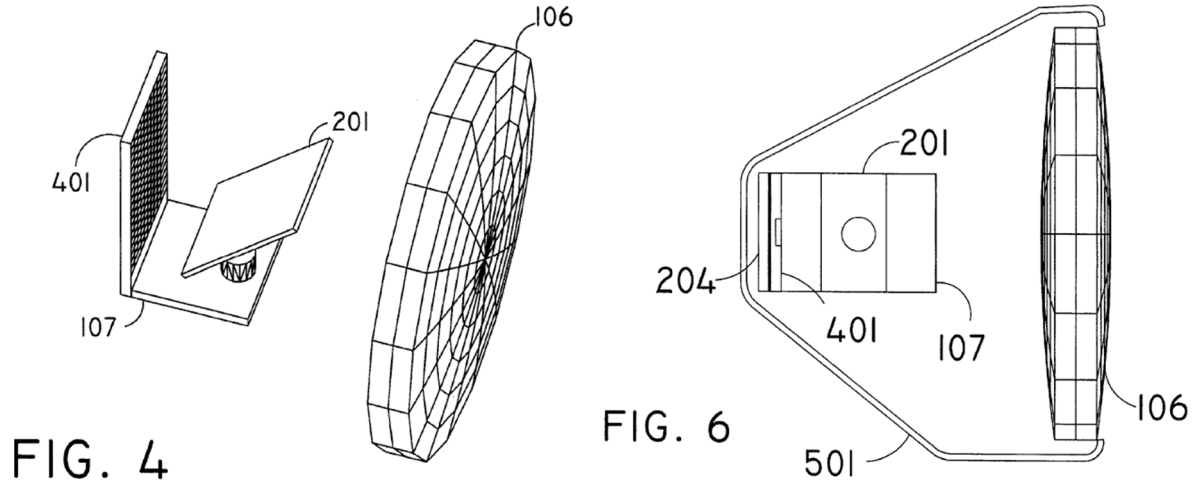
228. As discussed, Beam discloses "light clusters" with independently controlled angular positions for reducing glare towards other drivers. *Supra* Section X.A. Thominet provides further detail on implementing multiple colored "light clusters" for different functions. So naturally, it would have been obvious to a POSA designing an adaptive headlamp to implement Thominet's multiple colored beam regions for different functions in Beam's system. EX1005, 3:8-14, 3:37-45, 5:33-54, 7:1-13.

229. Indeed, Thominet discloses such an implementation to *automatically* provide different colored spatial distributions for improved visibility in different driving situations (low visibility, fog, low/high speeds, recognizing a counter traffic, curves, etc., *see* EX1006, ¶¶7-8, 23-26, FIGS. 1-2), thereby automating some of Beam's *manual* control methods and improving driver safety—an express purpose of Beam. EX1005, 3:29-44 ("*manually* lower the beams for conditions like rain, snow, or fog"), 3:8-14, 5:33-54, 7:1-13; EX1006, ¶26 ("[b]y operation of the…corresponding partial region 22, 24, 26, 28…it is possible to switch over between the above mentioned *different light functions…automatically*").

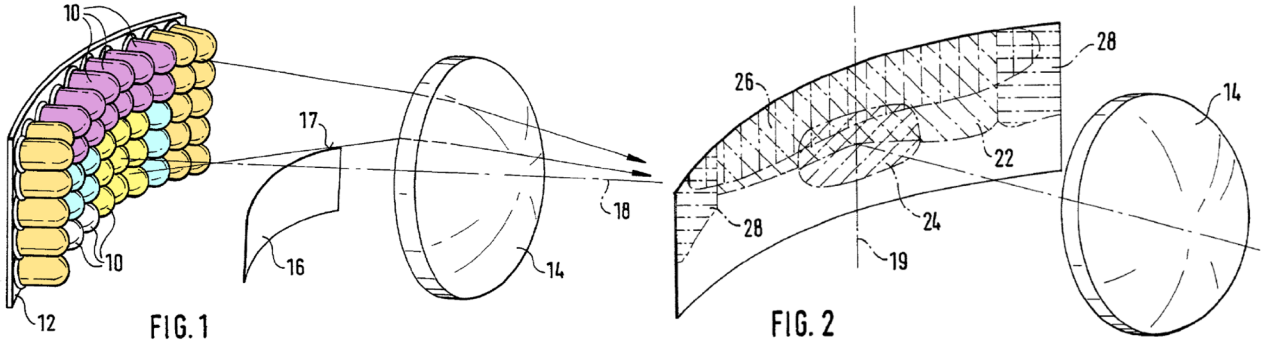
230. Beam and Thominet are from the same field—controllable headlamps with dynamic illumination—and include the same building blocks (light sources, sensors, controllers). Further, improved visibility, thereby increasing safety, is paramount in both. EX1005, 1:54-59, 3:8-45, 4:48-59, 6:53-7:13; EX1006,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

231. A POSA would have sought to incorporate *known components* (hardware implementation) of Thominet's colored semiconductor light sources 10 on curved surface 12 (arranged in different beam regions 22, 24, 26, 28, *see* EX1006, ¶¶17-20, 23-26, FIGS. 1-2, 5-7) into Beam's system (with flat array of light sources 401). This would have, like Thominet, provided different colored spatial and spectral distributions for different driving situations (e.g., low visibility, low/high speeds, traffic, curves, etc.), improving visibility and thereby safety. EX1006, ¶¶17-20, 23-26, FIGS. 1-2, 5-7. This is a simple hardware combination.

232. Beam discloses 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, 3:62-64, 5:3-16, FIGS. 2, 4-6; EX1005, 4:26-59 ("*angular* position"), 8:4-17. Further, Thominet discloses "light beams of *different light colors* is possible…for different signal functions" and "different partial regions [22, 24, 26, 28] emit light of *different colors*." EX1006, ¶¶5, 27, 28 ("emit…light of *different colors*…providing a *mixture of the colors*"), FIGS. 1B-2.




EX1005, FIGS. 4, 6.




EX1006, FIGS. 1-2 (annotated).

233. Indeed, Beam's techniques and system enable "the driver to see more clearly at night," while protecting others from glare. EX1005, 3:8-45; EX1005, 4:10-25, 6:9-27. Beam recognizes the safety benefits of different colored spatial distributions "for conditions like…*fog*." EX1005, 3:29-36; EX1005, 1:54-59, 4:48-59; EX1006, ¶¶5 ("*different light colors*"), 7 ("*wider* illumination…in *fog*").

234. And through its *system components* (hardware implementation), Thominet, like Beam, seeks to enhance driver visibility and thereby increase safety. EX1006, ¶¶3-5, 7, 17-18, 21-26. Thominet's colored semiconductor light

sources 10 arranged on curved surface 12 provide colored beam regions 22, 24, 26, 28 (clusters) for different driving situations. EX1006, ¶¶7-8, 17-18, 21-26, FIGS. 1-2.

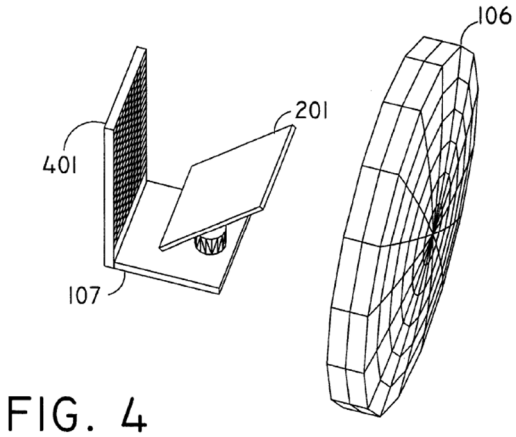



FIG. 4

EX1005, FIG. 4.

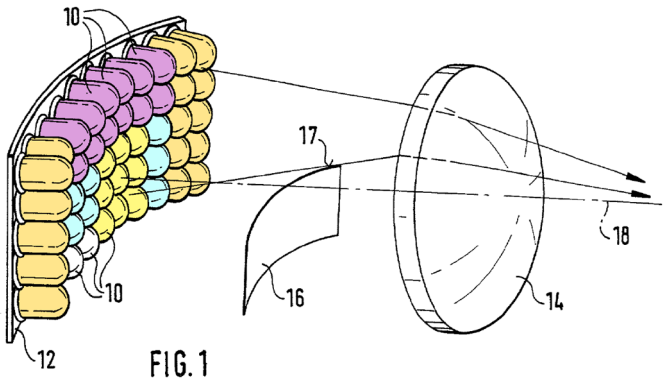



FIG. 1

EX1006, FIG. 1 (annotated).

235. This hardware combination—Beam's array of light sources 401 and Thominet's colored semiconductor sources 10 on curved surface 12 arranged in beam regions 22, 24, 26, 28—would have provided Beam's system with different colored spatial and spectral distributions for different driving situations, as in Thominet, thereby improving driver safety. This would have been merely combining prior-art elements or a simple substitution of one known element for another (e.g., Beam's array of light sources 401 and Thominet's colored semiconductor sources 10 on a curved surface 12) according to known methods (e.g., disclosed in Beam and Thominet) to yield predictable results (improved visibility and safety). Overall, this is a simple hardware implementation.

236. A POSA would have had a reasonable expectation of success combining Beam and Thominet, for example, by simply modifying Beam's array of light sources 401 (e.g., LEDs) with Thominet's array of colored semiconductor sources 10 (e.g., colored LEDs) to provide multiple colored light clusters (e.g., colored beam regions 22, 24, 26, 28) for different functions (hardware implementation).

237. Such modification 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. And in combining Beam with Thominet's array of semiconductor sources 10 (e.g., modifying an illuminator), a POSA would have simply been combining known elements according to known methods (disclosed in Thominet) to yield predictable results (light control for different functions, hardware implementation).

238. In view of the above, Beam in combination with Thominet renders obvious this claim.

**G. Claim 7: "The headlight system of claim 1, wherein at least one of the sensors is a camera-sensor configured to image at least lights indicative of oncoming vehicles having a driver whose vision could be disturbed by the headlight beam, and wherein the logical controller upon receiving data, indicating a position of the lights, from the camera-sensor, is configured to use one or more of the algorithms to determine a position of the oncoming vehicle, based on the position of the lights as indicated by the data, relative to the**

**vehicle headlight system and responsively adapt the headlight beam to decrease at least one vision-disturbing characteristic to the oncoming vehicle driver."**

**Claim 8: "The headlight system of claim 1, wherein at least one of the sensors is a camera-sensor configured to image at least lights indicative of preceding vehicles having a driver whose vision could be disturbed by the headlight beam reflected in a mirror, and where the logical controller upon receiving data, indicating a position of the lights, from the camera-sensor, is configured to use one or more of the algorithms to determine a position of the preceding vehicle, based on the position of the lights as indicated by the data, relative to the vehicle headlight system and responsively adapt the headlight beam to decrease at least one vision-disturbing characteristic to the driver of the preceding vehicle."**

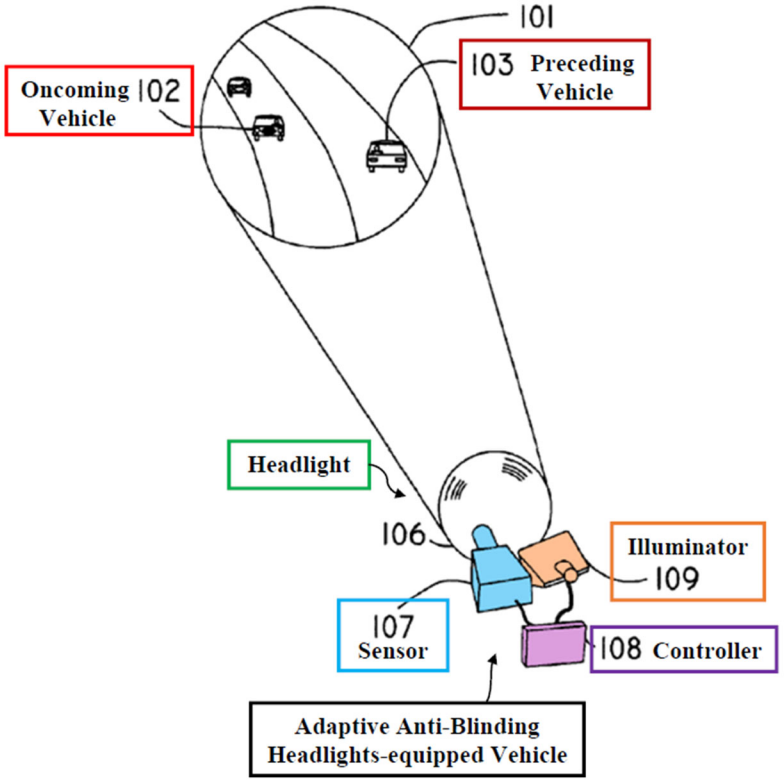
239. In my opinion, claims 7-8 recite language having no patentable difference, relating to identifying a vehicle (oncoming/preceding) with a camera-sensor, determining a position of the identified vehicle, and adapting the headlight beam to decrease a vision-disturbing characteristic (e.g., glare) to the identified vehicle: an "oncoming vehicle[]" (claim 7) and a "preceding vehicle[]" (claim 8).

240. In my opinion, there is no patentable difference between the language of claim 7 and claim 8 as shown above. *See also* Appendices A and B. The same disclosures below address each feature.

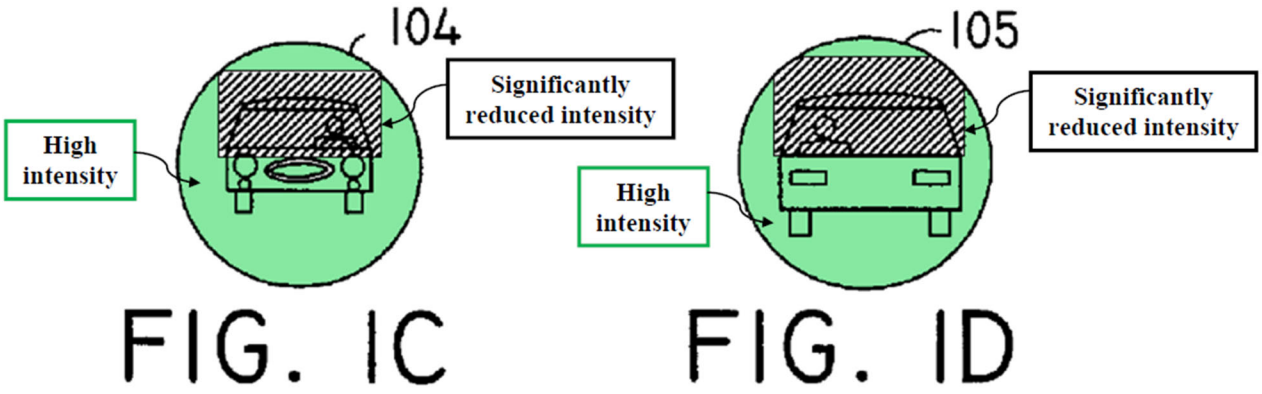
241. Beam's controller is "a logical controller." *Supra* Section X.B.8. Beam's *sensor 107* detects oncoming headlights/preceding taillights of an oncoming/preceding vehicle 102, 103 and "*spatial scene data* from sensor 107…[is] *input* to a processor 1105." EX1005, 4:10-25, 5:33-35, FIGS. 1-2, 5;

EX1005, 4:26-36 ("a *camera*"), 6:12-14 ("imaging *sensor*…such as a *video camera*"), 7:37-40 ("*video cameras*"), 8:23-27. Beam's "*[p]rocessor 1105* uses appropriate *algorithms* on the incoming data to *determine the locations to be blanked*…outputs *blanking signals*…[and] *commands* the appropriate pixels to be *reduced in intensity*." EX1005, 5:34-36, 5:46-54, FIGS. 1, 1C-1D, 7; EX1005, Abstract, 6:14-16 ("headlight's *field-of-view*"), 5:65-6:2 ("a *dimmed area*…based on input to the sensor").

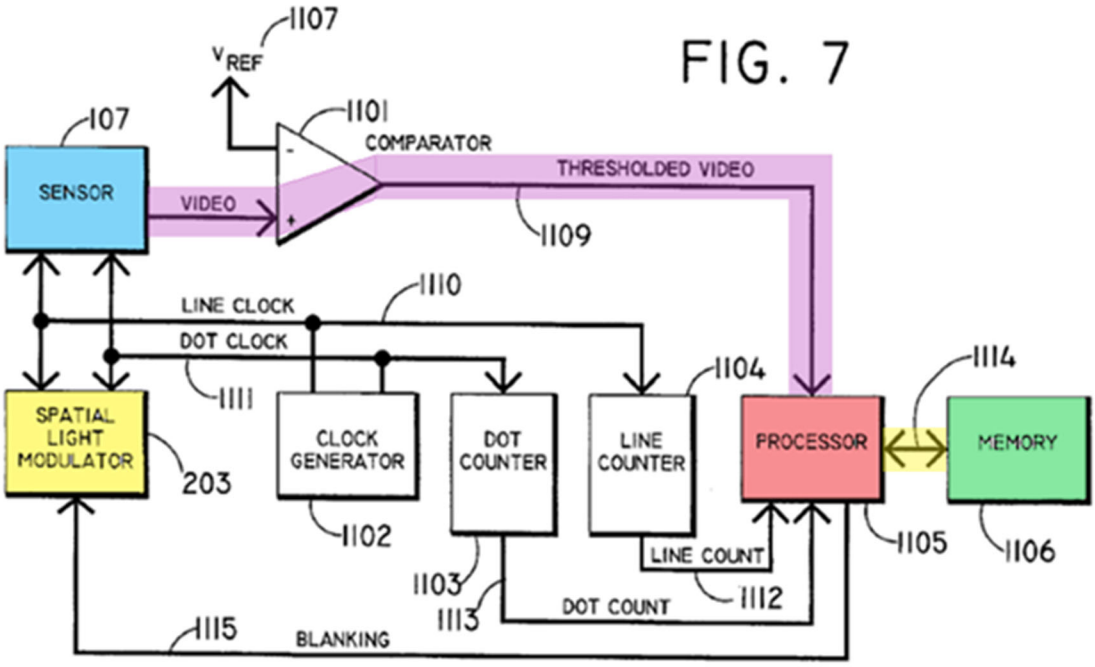
242. Thus, Beam's processor processes the data (from camera-sensor), indicates a vehicle (oncoming/preceding) within the headlight's field-of-view, and uses appropriate algorithms to determine/track an area to be dimmed within a first subsection of the field-of-view (e.g., shaded area of significantly reduced intensity) to "decrease at least one vision-disturbing characteristic," for example, glare or blinding. EX1005, 5:33-54, 6:12-27, FIGS. 1C-1D; EX1005, 5:33-54 ("*blanking* signals"), 6:24-27 ("blanked area *tracks* the location of the *oncoming vehicle*").




EX1005, FIG. 1 (annotated).




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

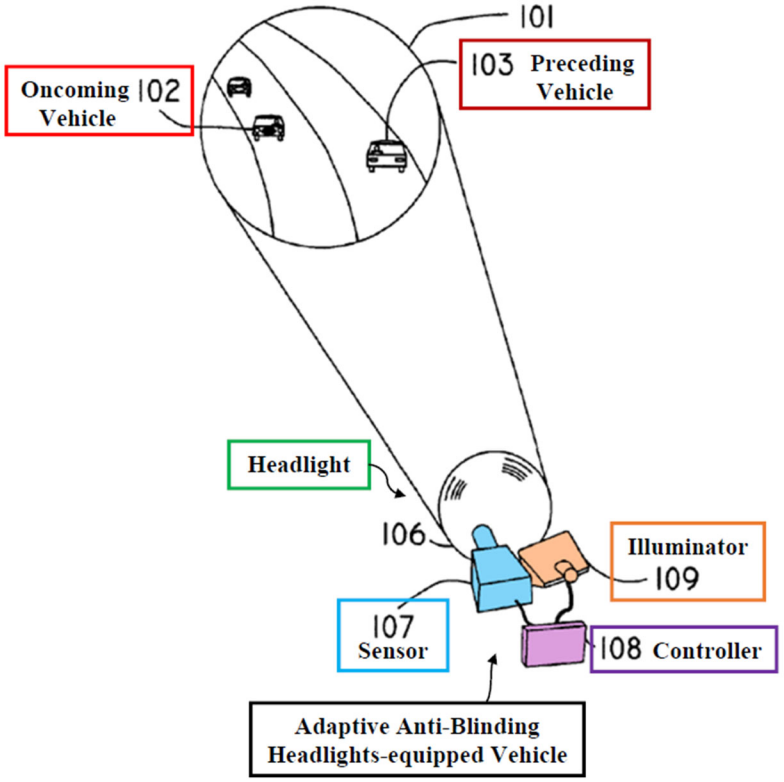



EX1005, FIG. 7 (annotated).

243. In view of the above, Beam discloses these claims.

**H. Claim 10: "The headlight system of claim 1, wherein at least one of the sensors is configured to detect at least one of oncoming headlights or preceding taillights."**

244. Beam's *sensor 107* detects oncoming headlights/preceding taillights of an oncoming/preceding vehicle 102, 103 and "*spatial scene data* from sensor 107…[is] *input* to a processor 1105." EX1005, 4:10-25, 5:33-35, FIGS. 1, 1A-1B, 2, 5; EX1005, 6:12-14 ("imaging *sensor*"), 4:26-36 ("incoming rays are imaged by the sensor 107"), 8:23-27.




EX1005, FIG. 1 (annotated).

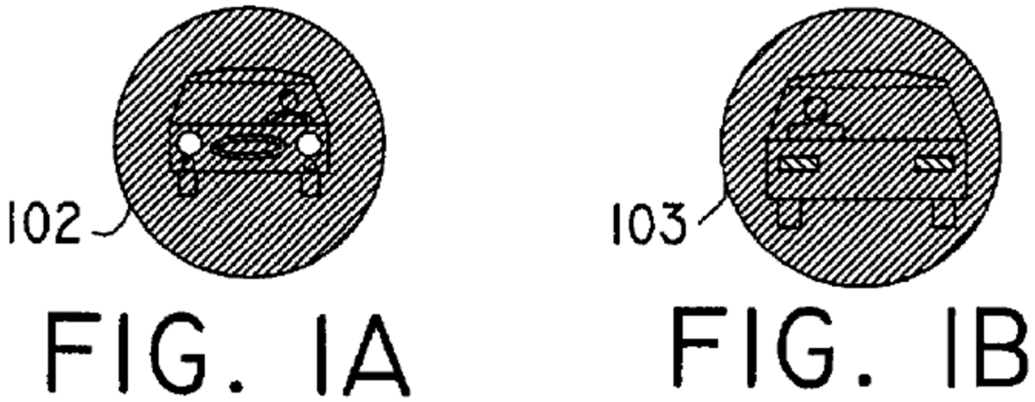



FIG. 1A FIG. 1B

EX1005, FIGS. 1A-1B.

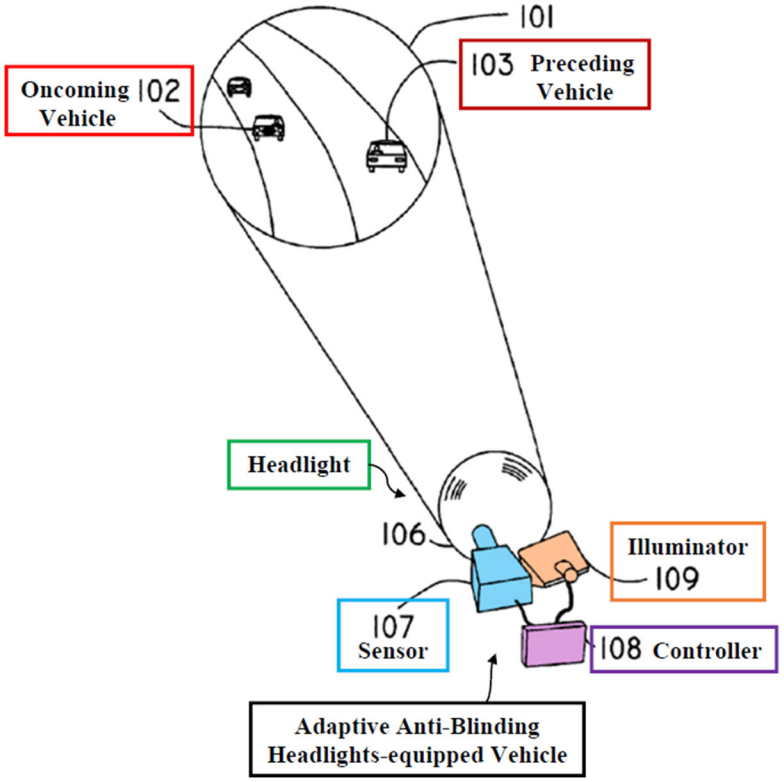
245. In view of the above, Beam discloses this claim.

**I. Claim 11: "The headlight system of claim 1, further including a computer vison processing unit configured to use the sensor data and one or more of the algorithms to identify entities including at least one of beings, vehicles, roadway, or street signs and wherein**

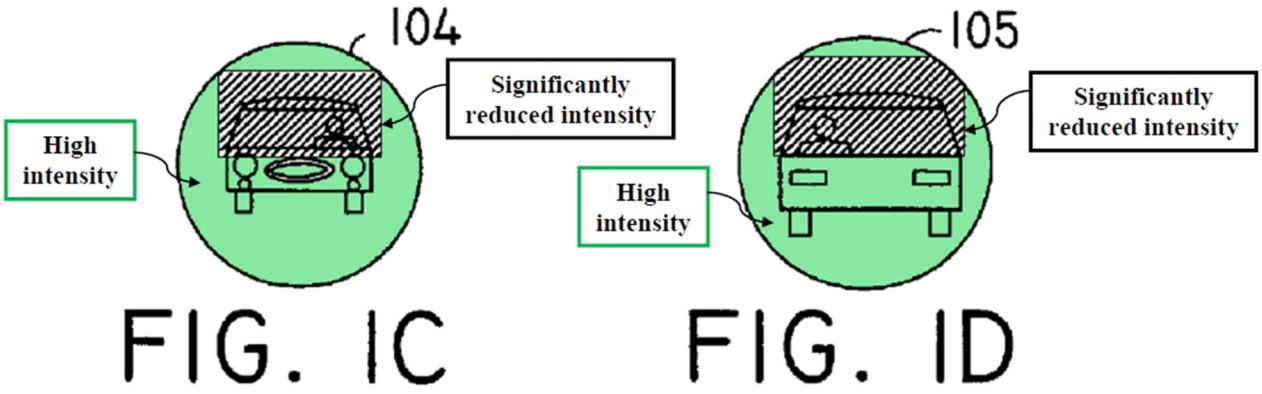
**the logical controller is further configured to modify the headlight beam to change illumination of the identified entity."**

246. Beam's controller is "a logical controller." *Supra* Section X.B.8. Beam's *sensor 107* detects headlights/taillights of an oncoming/preceding *vehicle* 102, 103 and "*[p]rocessor 1105* uses appropriate *algorithms* on the incoming data to *determine the locations to be blanked*." EX1005, 4:10-25, 5:33-54, FIGS. 1, 1C-1D, 7; EX1005, Abstract, 6:14-16 ("headlight's *field-of-view*"), 5:65-6:2 ("a *dimmed area*…based on input to the sensor").

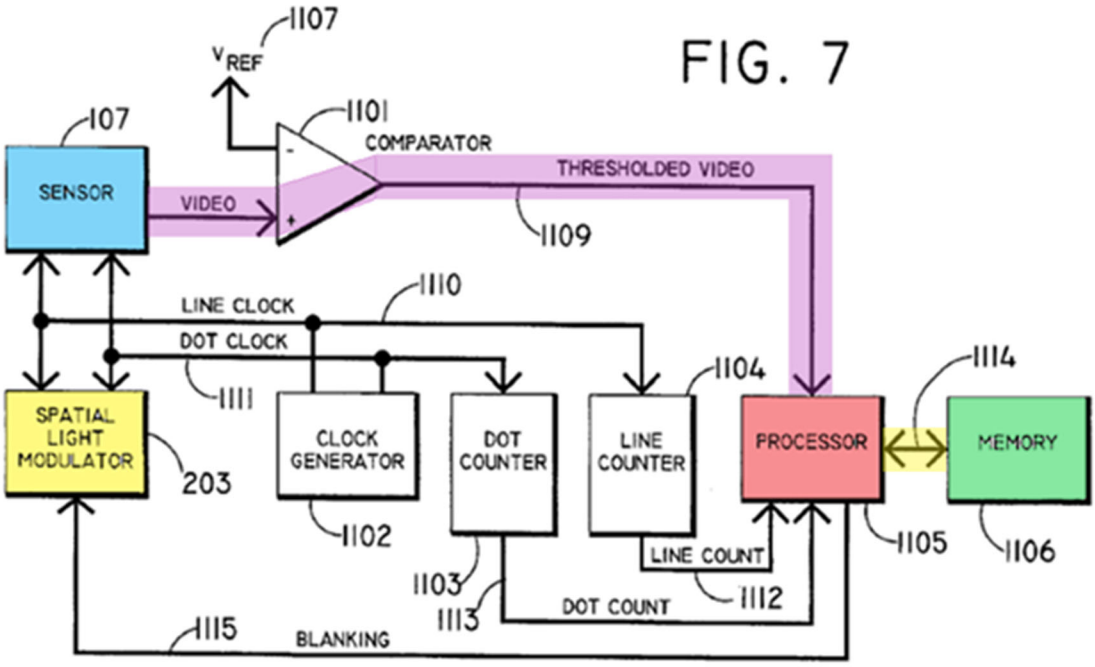
247. In my opinion, Beam's processor qualifies as/includes "a computer vis[i]on processing unit" because Beam's processor uses spatial scene data from sensor 107 and appropriate algorithms to identify vehicles (oncoming/preceding). EX1005, 4:10-25, 5:33-54, 6:12-27, FIGS. 1C-1D; EX1005, 5:33-54 ("*blanking* signals"), 6:24-27 ("blanked area *tracks* the location of the *oncoming vehicle*").




EX1005, FIG. 1 (annotated).




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




EX1005, FIG. 7 (computer vision) (annotated).

248. Further, computer vision was well-known. EX1009, 22:17-23 ("[t]he *pattern recognition* application processes, using algorithms and *methods known in the art*, images of a scene…to *identify features and/or objects in the scene*"), 24:4-7 ("*pattern recognition* application processes the *images*…and *identifies roadway signs 121 and 122*"), 26:31-27:1 ("'pattern recognize[s]' presence of *people*…and *spotlight[s] the people* to alert the driver"), FIGS. 5-6; EX1013, Nakamura, ¶¶34-46, FIGS. 10(2), 10(6); EX1014, Satonaka, ¶¶7-11, 16-17, 21-22, 25-38, FIGS. 4(2), 4(6), 6.

249. Indeed, the '503 patent admits that "computer vision methodologies…[were] *known in the art*." EX1001, 63:37-45; *see also* EX1009, 22:17-23, 24:4-7, 26:31-27:1, FIGS. 5-6; EX1013, Nakamura, ¶¶34-46, FIGS.

10(2), 10(6); EX1014, Satonaka, ¶¶7-11, 16-17, 21-22, 25-38, FIGS. 4(2), 4(6), 6. Thus, at a minimum, a computer vision processing unit would have been an obvious addition to Beam's controller/processor. And a POSA would have had a reasonable expectation of success, since a computer vision processing unit would have been just a simple substitution of one known prior art element for another.

250. In view of the above, Beam discloses this claim.

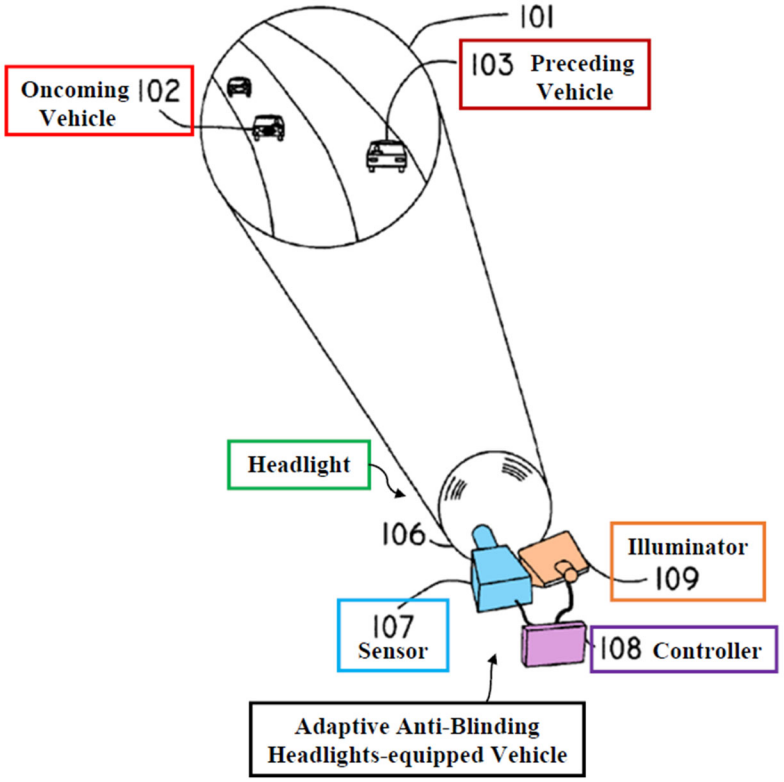
**J. Claim 12: "The headlight system of claim 1, where the determined illumination results in creation of a headlight beam providing a driver of the vehicle including said headlight system with higher visibility in at least a second of the at least two subsections relative to the first of the at least two subsections, while mitigating glaring illumination projected to reach the eyes of at least one of other drivers or pedestrians in the first of the at least two subsections, based on detected other vehicles or pedestrians in the first of the at least two subsections as indicated by the sensor data."**

251. Beam's processor "determine[s] an illumination for at least two of the sub-sections." *Supra* Section X.B.9. 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; EX1005, 5:34-54 ("*spatial scene data* from sensor 107…[is] input to *a processor 1105*…uses appropriate algorithms on the incoming data to…*command[]* the appropriate pixels to be *reduced in intensity*"), Abstract ("*determine* the location of light sources…using that information to

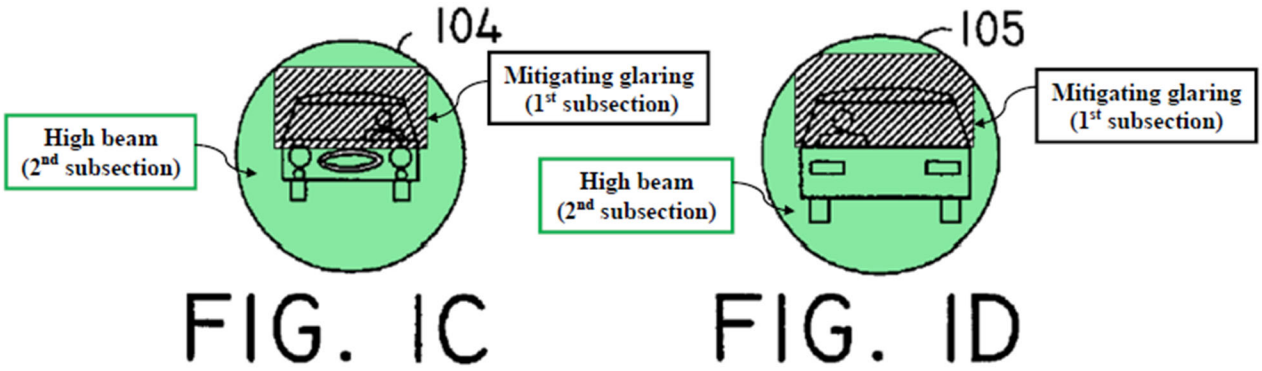
*control the intensity*"), 6:14-16 ("headlight's *field-of-view*"), 5:65-6:2 ("a *dimmed area*…based on input to the sensor").

252. Beam also discloses "*determining*, from the *detected presence* of the oncoming or followed vehicle…*the shape, size and location of an area to be darkened*…[and] *determining* which of said multiple rays of light must be *extinguished*." EX1005, 8:29-34, FIGS. 1, 1C-1D, 7; EX1005, 1:5-18 ("*reformatting* the *pattern* of a beam…to *prevent* it from illuminating *certain areas*…thus eliminating the blinding of a driver in an *oncoming vehicle*, while continuing to provide *intense forward illumination*"), 2:59-3:3, 4:10-25, 5:13-15, 5:33-54, 8:23-38.

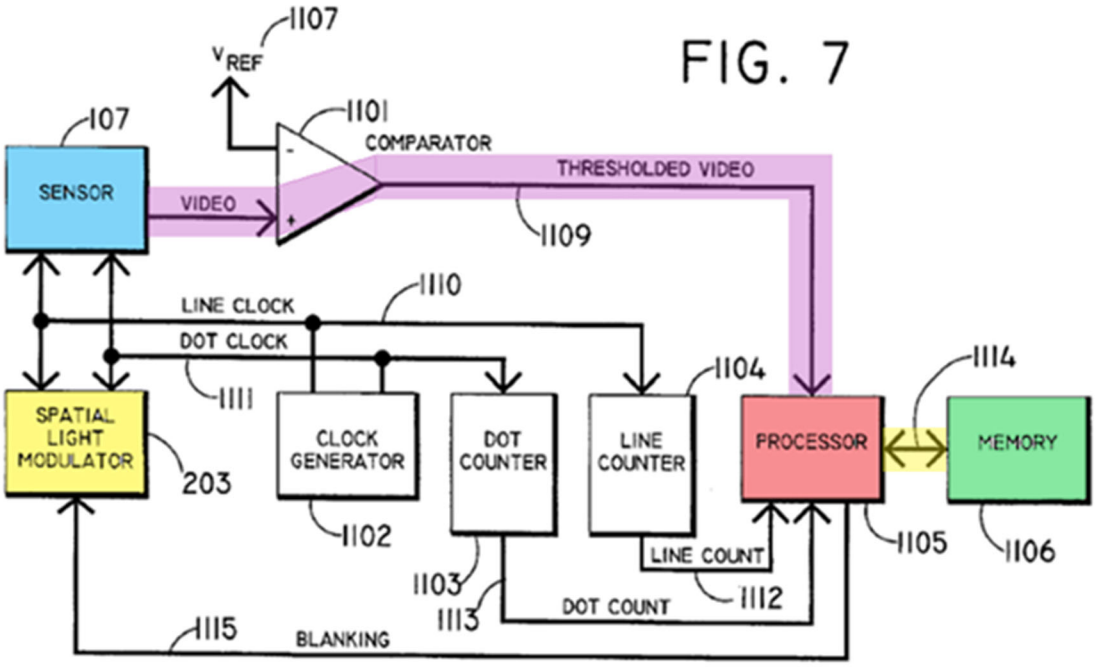
253. This results in dimmed light within a first subsection (e.g., shaded area of significantly reduced intensity) to "mitigat[e] glaring," and illumination with "higher visibility" within a second subsection. EX1005, 5:33-54, 6:12-27, FIGS. 1C-1D.




EX1005, FIG. 1 (annotated).




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

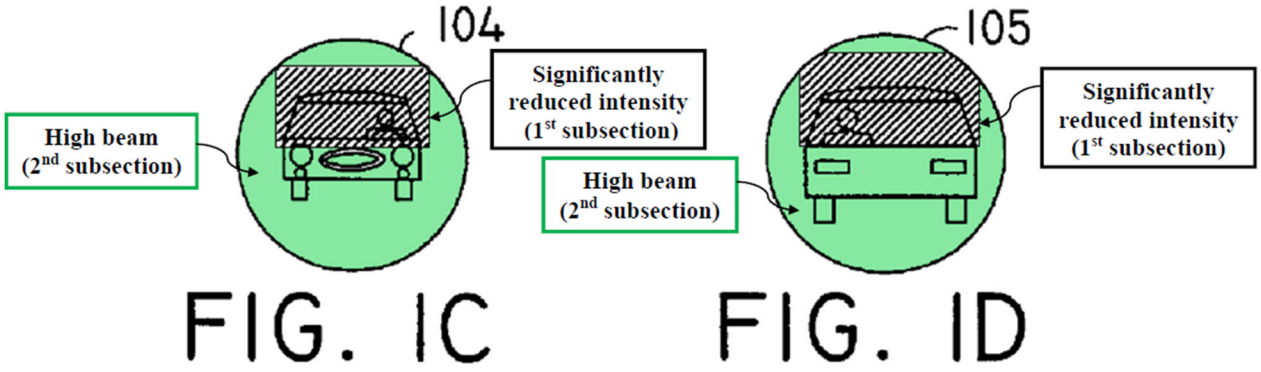



EX1005, FIG. 7 (annotated).

254. In view of the above, Beam discloses this claim.

**K. Claim 13: "The headlight system of claim 1, wherein the required illumination continues to provide high-beam illumination in at least a second of the subsections different from the first of the subsections, without diminishing a range of the high-beam illumination."**

255. Beam's illumination in non-shaded areas is "a *much higher brightness beam*" and "the area of the beam 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; EX1005, 6:40-44 ("*bright high beams*"), 6:11-12 ("*maximum intensity*"), 1:5-18 ("*intense forward illumination*"). This "provide[s] high-beam illumination" in the second subsection "without diminishing a range of the high-beam illumination."



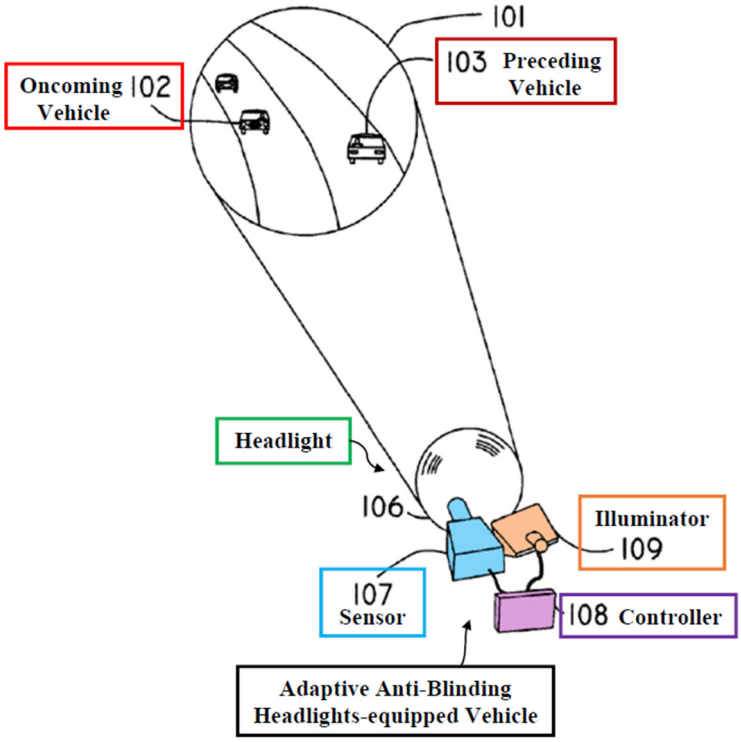

EX1005, FIGS. 1C-1D (annotated).

256. In view of the above, Beam discloses this claim.

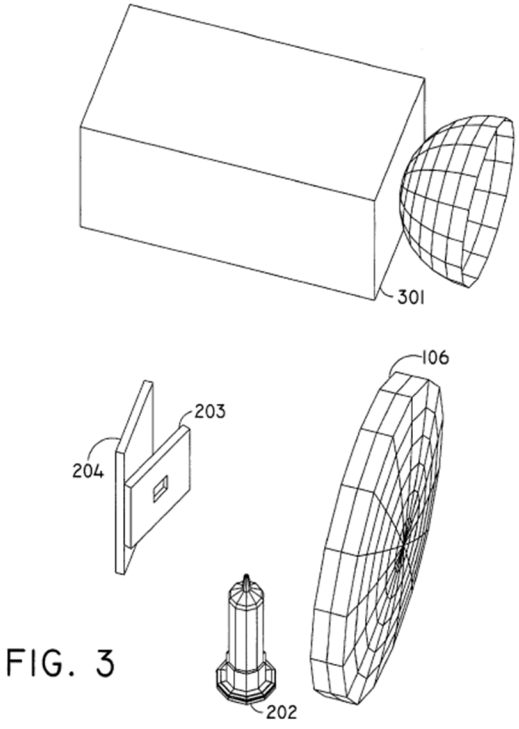
**L. Claim 14: "The headlight system of claim 1, wherein the one or more sensors further includes at least one of a camera, a microphone, an ultrasonic transducer and receiver, or an electromagnetic radiation source and detector including any of IR, UV, laser, or light."**

257. Beam's *sensor 107* can include "a camera." EX1005, 4:10-36, 5:33-35, FIGS. 1-3, 5; EX1005, 6:9-14 ("imaging *sensor*…such as a *video camera*"), 7:37-40 ("*video cameras*"), 4:60-5:2, 8:23-27.

258. Additionally, Beam's *radar sensor 301* constitutes "an electromagnetic radiation source and detector including…light." EX1005, 4:60-5:2 ("radar sensor 301 of either optical or radio frequency type…[t]he output and reflected wavefronts are used to determine range and angular position of the vehicles ahead"), 4:10-5:16, 8:4-17, FIGS. 1-7.




EX1005, FIG. 1 (annotated).



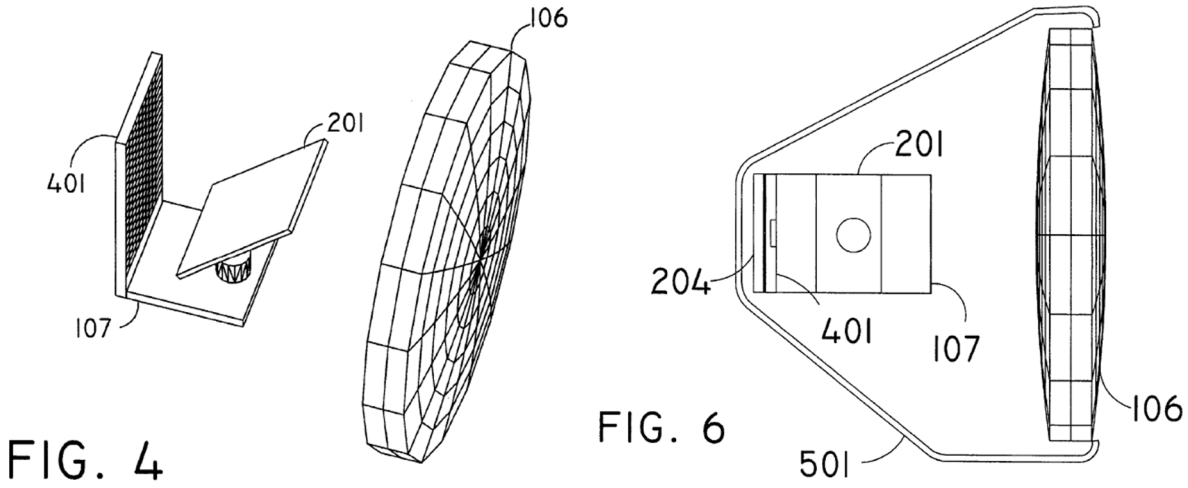

EX1005, FIG. 3.

259. In view of the above, Beam discloses this claim.

### M. Claim 18: "The system of claim 1, wherein at least one light source provided to at least one headlamp includes a laser diode."

#### 1. Beam discloses this claim.

260. In my opinion, Beam discloses this claim, claim 24. Specifically, Beam discloses the light source can include "light-emitting *diodes*" and "*lasers*." EX1005, 8:14-18; EX1005, 5:3-16 ("*matrix of lasers*"). Thus, a POSA would have understood that Beam discloses "a laser diode" in the system.




EX1005, FIGS. 4 and 6.

#### 2. Thominet also discloses this claim.

261. If Patent Owner argues, incorrectly, that Beam does not expressly disclose claim 24, Thominet also discloses claim 24, and it would have been obvious to incorporate Thominet's disclosure into Beam.

262. Thominet expressly discloses "*laser diodes* can be also utilized." EX1006, ¶28, FIGS. 1-2.

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

263. As discussed, 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. *See supra* Section X.A.

264. In view of the above, Beam, alone or in combination with Thominet, discloses or renders obvious this claim.

**N. Claim 19: "The system of claim 1, 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 clusters."**

265. 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; EX1005, 1:63-65 ("a *reflector* or *lens*"), 4:26-41 ("*reflected* by a *beamsplitter 201*"), 4:10-59, 5:17-21. And these optical elements discloses by Beam are all "usable to alter emitted light from at least one of the light clusters."

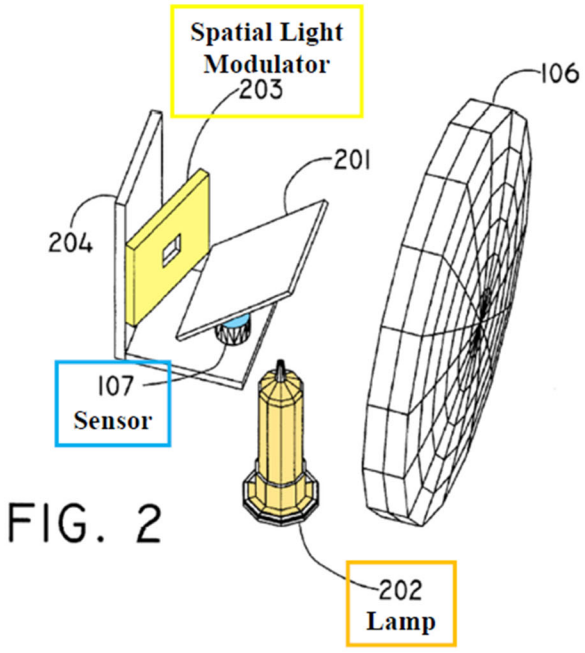



FIG. 2

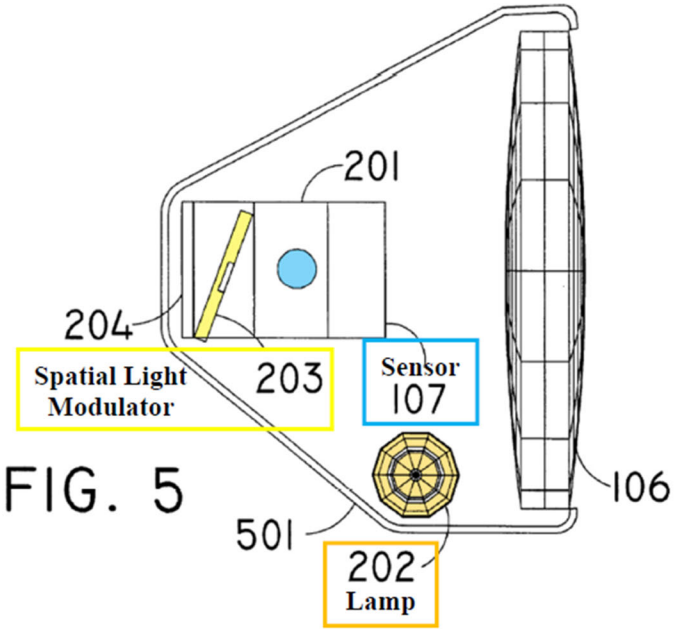



FIG. 5

EX1005, FIGS. 2 and 5 (annotated).

266. In view of the above, Beam discloses this claim.

267. Thus, Beam, alone or in combination with Thominet, discloses or renders obvious claims 1-5, 7-8, 10-14, and 18-19 of the '503 patent.

## XI. GROUND 2: THE COMBINATION OF BEAM, THOMINET, AND STAM RENDERS OBVIOUS CLAIMS 37-45, 47-48, 50-53, AND 57-58.

268. In my opinion, Beam/Beam-Thominet explicitly or implicitly discloses every feature in claims 37-45, 47-48, 50-53, and 57-58. As discussed, Beam is combined with Thominet, for claim element [37.2] and claim 45, which disclose a well-known implementation of adaptive headlamps—light clusters for different functions and a light cluster spectral power distribution (light color), respectively—rendering the claims obvious. *See supra* Sections X.A/X.B.3. But to

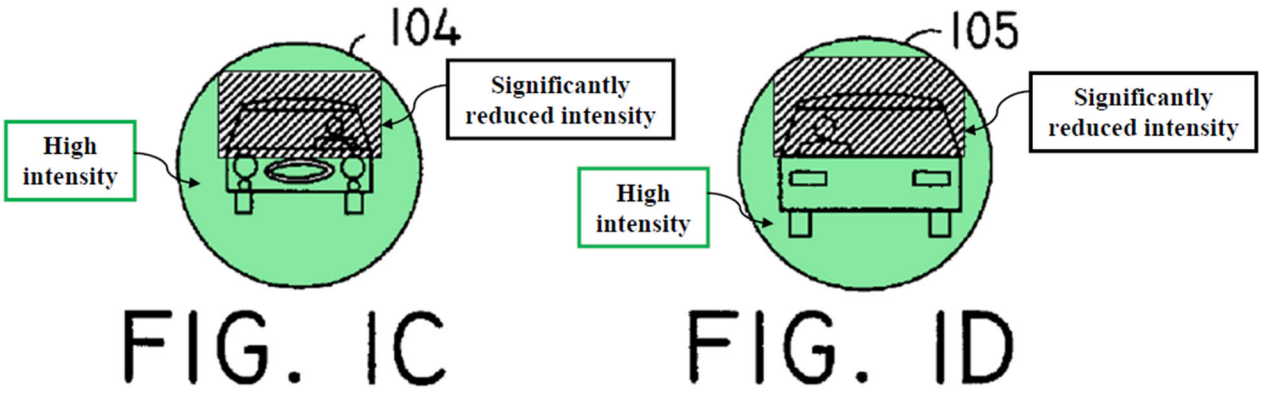
avoid doubt, Beam-Thominet is combined with Stam, for claim elements [37.8] and [37.9], and claim 41, which disclose a well-known feature of adaptive headlamps—outputting light above or below a predefined threshold depending on the driving situation—rendering the claims obvious.

269. Beam discloses a "*default* illumination level will be the equivalent of today's *low beams*." EX1005, 6:30-33. The concept of a "default illumination level" or a low beam illumination level would have been known to a POSA. Because all automotive exterior lighting devices (headlamps, tailing lamps, and other road illumination devices and signaling and marking devices) are highly regulated in the U.S. as well as in the rest of world, all lighting products installed on a vehicle must comply with these regulations. *See* EX1030, 62-69; EX1016, 4-11. As such, common practice in the automotive lighting industry is to set up the performance level including light output for a product, such as a headlamp, to produce predefined illumination values (in angular light intensity distribution) either per the regulations, or in a higher performance level set by automakers.

270. Such default illumination level for driver's visibility and glare light control is defined in all regulations, standards, and automaker's specifications, which is predefined as the illumination level in terms of the light intensity distribution in the low beam illuminating area or low beam projected angular section. *See* EX1030, 3-8, 21-41, 62-69; EX1016, 4-11. Therefore, Beam's

"default illumination level" is an example of a "predefined" threshold level, for example, equivalent to a "low beam" illuminance.

271. Further, Beam discloses 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, 2:60-3:3, 6:11-12, 6:40-44, FIGS. 1, 1C-1D.




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

272. Thus, Beam discloses a "predefined" (e.g., low beam) threshold value and outputting illumination "below…[the] predefined threshold value" and "above…[the] predefined threshold value" (e.g., shaded < low beam < non-shaded) recited in claim elements [37.8] and [37.9].

273. However, if Patent Owner argues the claims require a concrete threshold value, even though the '503 patent does not disclose such value, Stam discloses: "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, corresponding to the "predefined threshold value" recited in claim elements [37.8] and [37.9].

274. As explained, Stam discloses a predefined dimmed illuminance of 0.1 fc within 700 feet, which is equal to about 1.1 lux within 700 feet. Note, the definition of 1 lux (SI unit) is 1 lumen of luminous flux being intersected by 1 square meter surface, or 1 lux = 1 $lm/m^2$. The definition of 1 foot-candle (fc) (non-SI unit) is 1 lumen of luminous flux being intersected by 1 square foot surface, or 1 fc = 1 $lm/ft^2$. The conversion from fc to lux ($lm/ft^2$ to $lm/m^2$) is 1 fc = 10.7639 lux. Thus, 0.1 fc is about 1.1 lux. Therefore, Stam provides another example of a quantitative (e.g., 0.1 fc) glare prevention level.

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

275. As described in Section X.A, a POSA would have been motivated to combine Beam-Thominet. As discussed, Beam discloses a "predefined threshold" based on a low beam illuminance. Stam provides a specific "predefined threshold" value based on a dimmed illuminance to reduce glare. Naturally, it would have been obvious to a POSA designing an adaptive headlamp to implement Stam's

predefined (dimmed) threshold 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. EX1005, 3:8-14, 3:37-45, 5:33-54, 7:1-13.

276. Stam is from the same field—controllable headlamps with dynamic illumination—and includes the same building blocks (light sources, sensors, controllers). Like Beam-Thominet, driver visibility and safety is paramount in Stam. 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.

277. *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. *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). This would have, like Stam, provided a specific "predefined" threshold, below and above which to adjust illumination for desired areas, further improving safety. EX1007, Abstract, 1:14-31, 9:12-10:8.

278. 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 feet), would have provided greater illumination control *referenced to* a predefined value to prevent glare and increase illumination to other areas, thereby improving driver safety. 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. 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.

279. 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).

280. 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 feet) in memory of Beam-Thominet's controller/processor to output Beam's headlamp illumination below and above that value for respective illumination areas. 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.

281. I lay out below the specific disclosures of Beam, Thominet, and Stam, and expand on this combination and reasonable expectation of success analysis below specifically with reference to claim elements [37.2], [37.8], and [37.9].

### B. Independent Claim 37[9]

#### 1. [37.P]: "A vehicle headlight system comprising:"

282. Claim element [37.P] is identical to claim element [1.P]. *Supra* Section X.B.1; *see also* Appendix A.

283. In view of the above, Beam discloses this element.

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[9] Claim 37 and claim 1 recite many identical elements or elements that are so technically similar that, in my opinion, there is no patentable difference between corresponding elements, even where the claim elements may be worded slightly different. (*See* Appendix A.) That is, there is no difference in what is required from a technical standpoint, and so the same prior art citations disclose the respective features. To avoid undue repetition, I have identified these elements throughout my declaration as appropriate, and the same prior art citations are applicable to those elements as provided in the referenced analysis.

**2. [37.1]: "one or more headlamps affixable to a first vehicle;"**

284. In my opinion, there is no patentable difference between claim elements [37.1] and [1.1]. *Supra* Section X.B.2; *see also* Appendix A. Therefore, my above analysis in Section X.B.2 applies.

285. In view of the above, Beam discloses this element.

**3. [37.2]: "a plurality of light clusters arranged in each of the one or more of the headlamps and"**

286. In my opinion, claim elements [37.2]-[37.4] are part of the same clause but will be addressed separately for simplicity below.

287. In my opinion, there is no patentable difference between claim elements [37.2] and [1.2]. *Supra* Section X.B.3; *see also* Appendix A. Therefore, my above analysis in Section X.B.3 applies.

**(a) Beam discloses this element.**

288. In my opinion, Beam discloses this claim element, [37.2]. *See supra* Sections X/X.A/X.B.3. Beam discloses "an *array* of *individual*, *independently* controllable *microbeam* sources" for example, "light-emitting diodes." EX1005, 8:5-12; EX1005, 8:4-17. Also, Beam discloses "*individually directed narrow-angle beams…microbeams*" and controlling "the intensity, and/or the *angular position*, of one or more narrow-angle *microbeams*." EX1005, 5:61-63, Abstract, FIGS. 2, 5. Each microbeam is a "cluster" that combines to form the headlamp beam, and the combination of Beam's lamp 202 and SLM 203 and/or array of light sources 401

form at least two light clusters. EX1005, 7:25-29 ("*multiple* narrow angle microbeams"), 8:4-17 ("*array* of individual, independently controllable microbeam sources"), 8:23-34 ("area of illumination provided by *multiple* rays of light"), 4:26-59, 5:3-21, FIGS. 2, 4-6.

289. Alternatively, if Patent Owner argues, incorrectly, that a "cluster" requires at least two (or more) microbeams, Beam also discloses this. 4:26-59, 5:3-21, FIGS. 2, 4-6; EX1005, 4:46-48 ("[t]he *angular* position or attenuation of *each* of these microbeams is *independently* set by the controller 108").

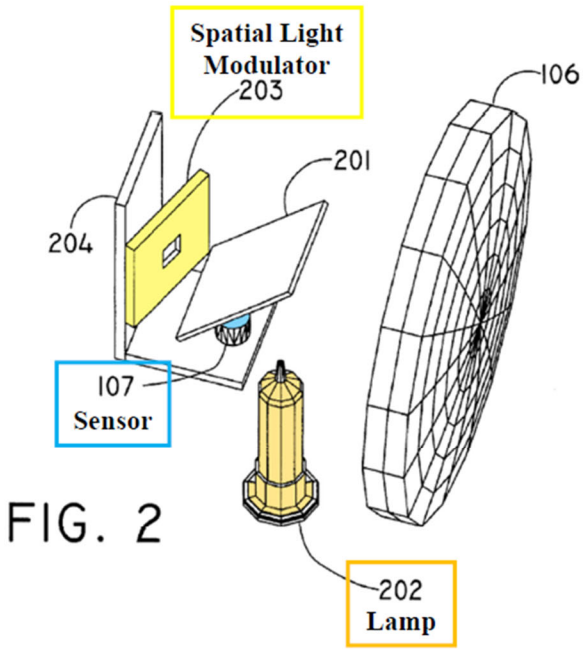



FIG. 2

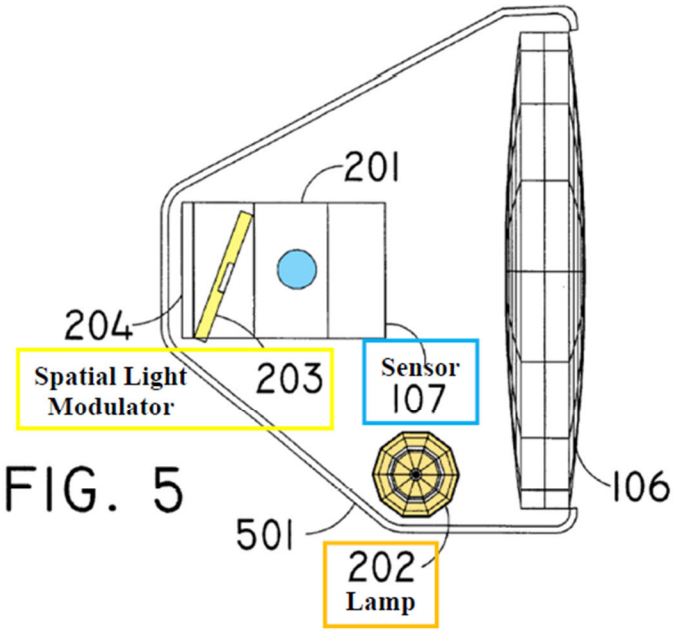



FIG. 5

EX1005, FIGS. 2 and 5 (annotated).

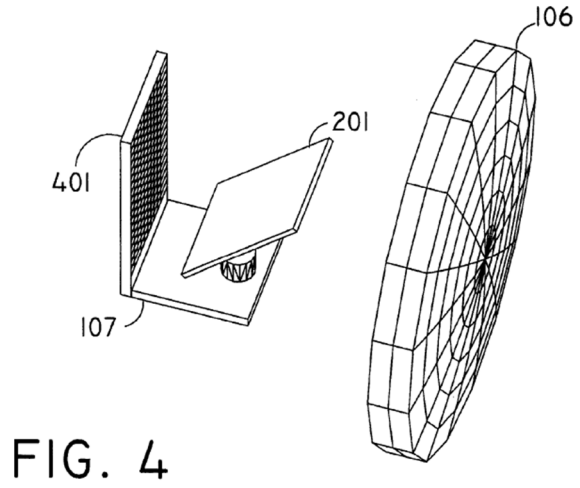



FIG. 4

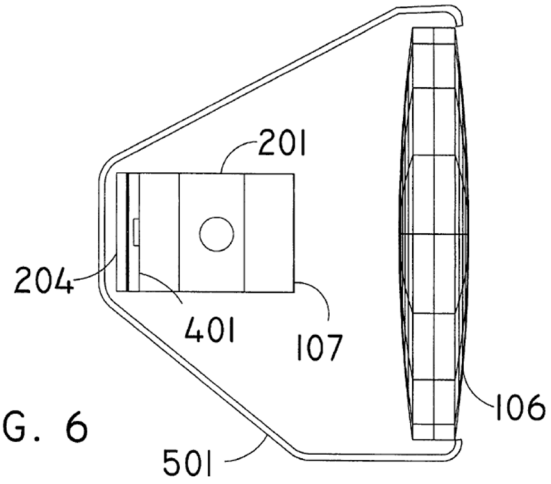



FIG. 6

EX1005, FIGS. 4 and 6.

290. Such directionality results in *directional light clusters* that by definition will have different angles, which result in different aimings in desired subsections. So disclosure that discusses adapting light emitted from light clusters to create a headlight beam for a plurality of subsections applies the same to disclosure that discusses instructing operation of light clusters to create an adapted headlight beam for first and second subsections.

291. A POSA would have understood that controlling "intensity" and "angular position" of "one or more narrow-angle microbeams" is the same as controlling "at least two of the light clusters to create the adapted headlight beam," as the light output from a headlamp is all measured with its light intensity level in an angular distribution. *See* EX1017, 5 ("the adaptive light pattern should support to direct the concentration to the most important zone for the current driving situation"), FIGS. 1, 3-5; EX1018, 4 ("variable aiming"); EX1026, 451 ("[m]ore

beams are necessary to match varied driving regions, traffic situations, and driving operations"), 456 ("beam axes of the lamps are aimed at the directions indicated"), FIGS. 1, 3-3; EX1038, 1:12-10:3, FIGS. 1-3; EX1039, 9:16-11:11, FIGS. 1-6; EX1040, 1:16-30, FIGS. 1, 2A-2C; EX1036, 3:52-4:32, FIGS. 2-6.

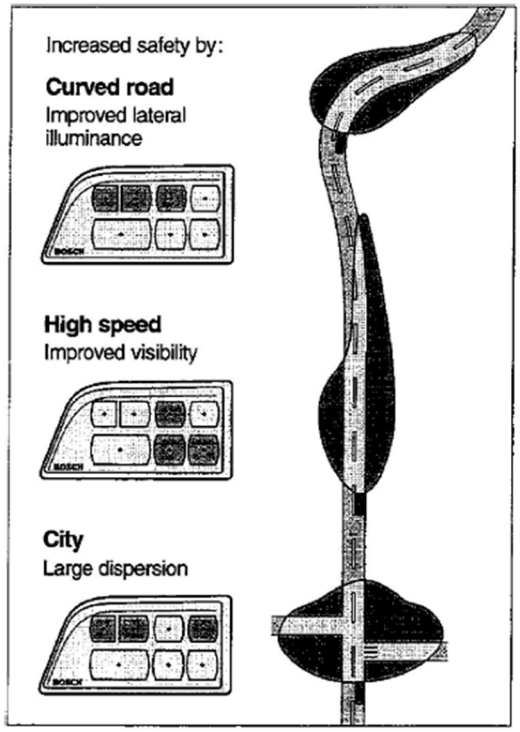



*Fig.1: Three standard driving situations with adapted light pattern seen from the bird eye's view.*

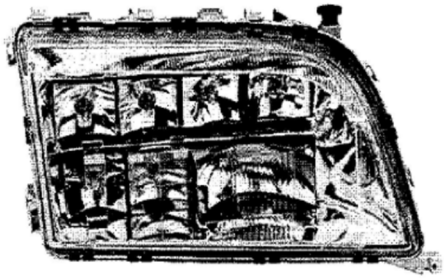
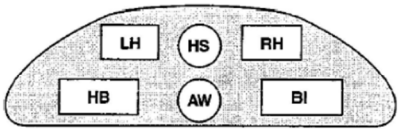


Fig 4: ALP *headlamp* sample




Single components:

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

Fig. 5 Advanced ALP sample layout

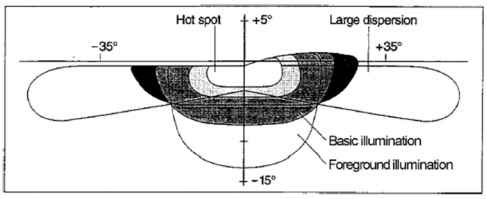



Fig. 3: Light pattern of multiple beam *headlamp (Isolux* curves in wall projection):
The individual light *pattern* of multiple sub-units sum up to the total adaptive light pattern

EX1017, FIGS. 1 and 3-5.

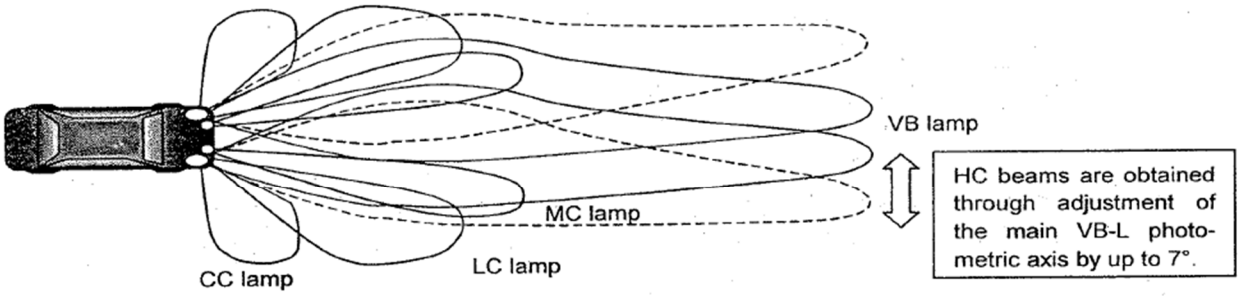
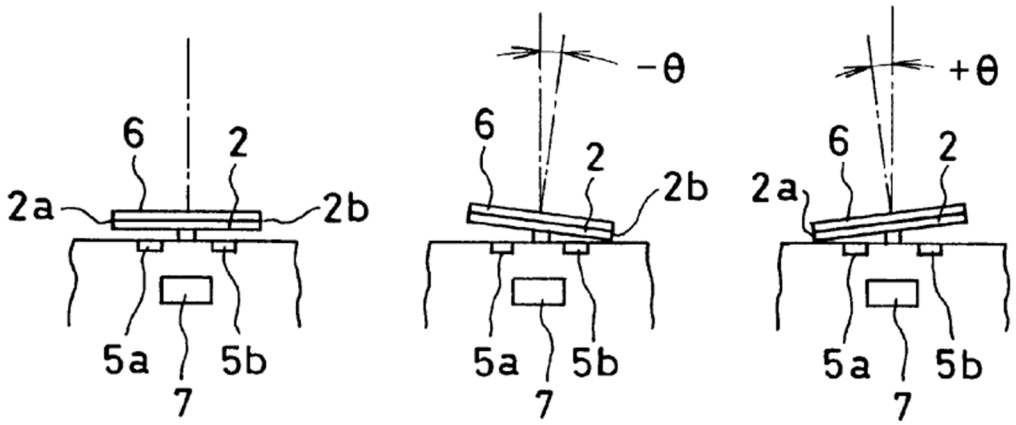



*Fig. 3-3: Imaged Illumination Configurations on Road Surface*

EX1026, FIG. 3-3.

FIG. 2A FIG. 2B FIG. 2C

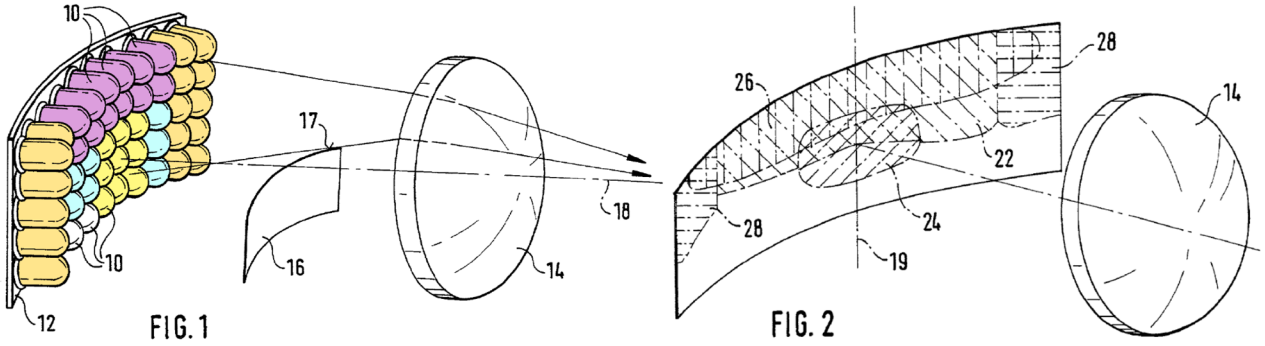



EX1040, FIGS. 2A-2C.

**(b) Thominet also discloses this element.**

292. If Patent Owner argues, incorrectly, that Beam does not disclose claim element [37.2], Thominet also discloses claim element [37.2], and it would have been obvious in view of Thominet. A POSA would have been motivated to combine Thominet with Beam with a reasonable expectation of success, providing predictable visibility and safety benefits. *See supra* Sections X/X.A.

293. As explained above (Section X.A), Thominet's headlights include independently controllable semiconductor light sources 10 (e.g., LEDs) arranged on curved surface 12 to provide multiple beam regions 22, 24, 26, 28 (light clusters) for different functions. EX1006, ¶¶17-18, 21-26, FIGS. 1-2. For example, Thominet's region 24 is "in the center" (first cluster) and regions 28 are "near the lateral edges" (second and third clusters). EX1006, ¶¶23, 25, FIGS. 1-2.




EX1006, FIGS. 1-2 (annotated).

294. A POSA would have been motivated to combine Thominet with Beam with a reasonable expectation of success, providing predictable visibility and safety benefits. I provide additional detail, evidence, and explanation of my conclusions below, showing that Beam, alone or combined with Thominet, discloses or renders obvious claim element [37.2].

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

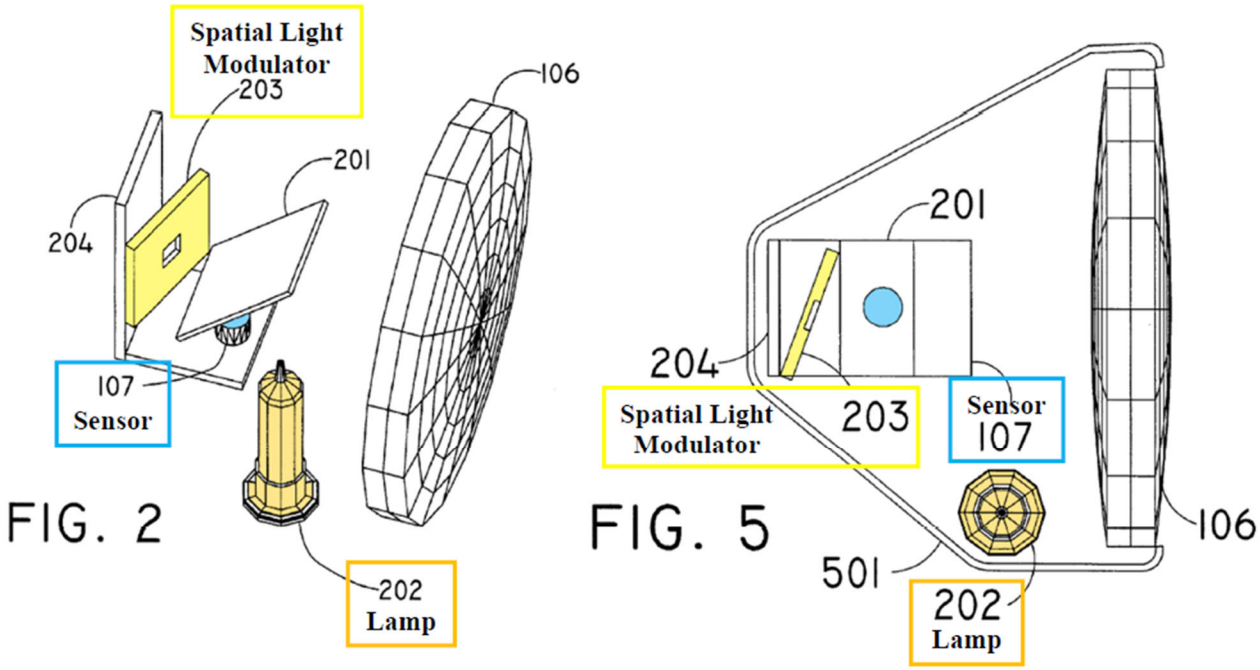
295. As discussed, Beam discloses "light clusters" with independently controlled angular positions for reducing glare towards other drivers. *Supra* Sections X.A/X.B.3. Thominet provides further detail on implementing "light clusters" for different functions, conceptually and physically. So naturally, it would have been obvious to a POSA designing an adaptive headlamp to implement Thominet's multiple beam regions—through either software and/or hardware—for different functions in Beam's system. EX1005, 3:8-14, 3:37-45, 5:33-54, 7:1-13.

296. Indeed, Thominet discloses such an implementation to *automatically* provide different spatial distributions for improved visibility in different driving situations (low visibility, fog, low/high speeds, recognizing a counter traffic, curves, etc., *see* EX1006, ¶¶7-8, 23-26, FIGS. 1-2), thereby automating some of Beam's *manual* control methods and improving driver safety—an express purpose of Beam. EX1005, 3:29-44 ("*manually* lower the beams for conditions like rain, snow, or fog"), 3:8-14, 5:33-54, 7:1-13; EX1006, ¶26 ("[b]y operation of the…corresponding partial region 22, 24, 26, 28…it is possible to switch over between the above mentioned *different light functions…automatically*").

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

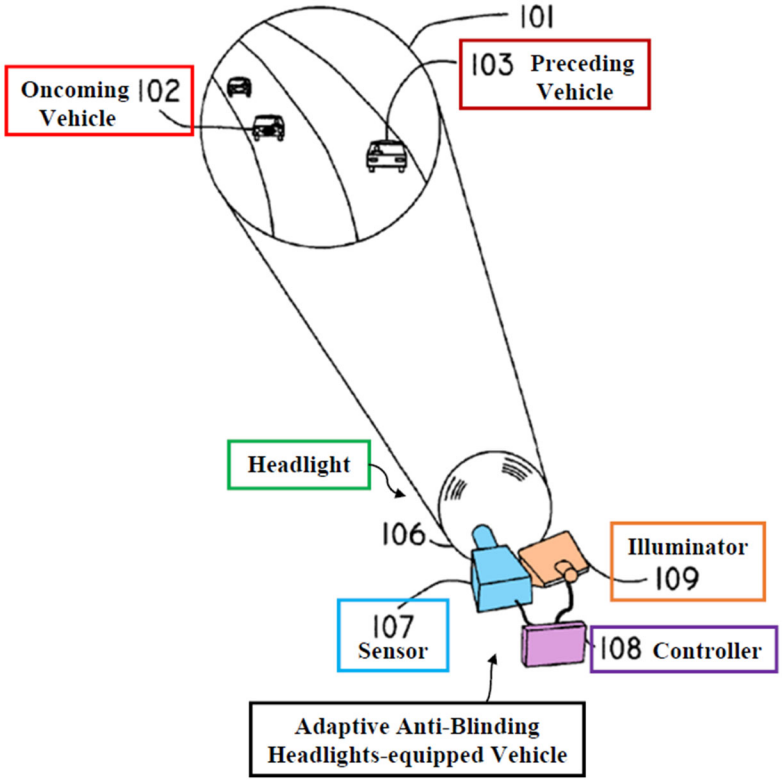
298. *First*, including an additional control technique (software implementation) for Beam—Thominet's *known technique* of using multiple beam regions (clusters) for different functions—would have added more control methods for different functions to Beam's visibility for different driving situations, increasing safety. This is a simple software combination. 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; EX1005, Abstract, 8:4-17.




EX1005, FIGS. 2, 5 (annotated).

299. 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. EX1005, 3:8-45. Beam enables "the driver to see more clearly at night," while protecting others from glare. EX1005, 3:8-45; EX1005, 4:10-25, 6:9-27.



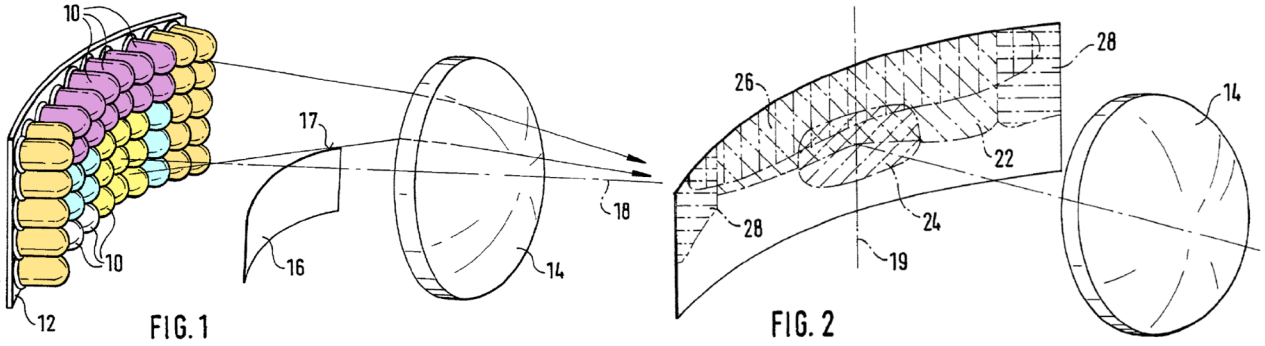

EX1005, FIG. 1 (annotated).

300. Beam's system "*determine[s] the location of light sources* forward of the apparatus and us[es] that information to *control the intensity, and/or the angular position*, of one or more" microbeams. EX1005, Abstract; EX1005, 4:10-59, 6:9-27, FIGS. 1, 1A-1D, 2. Beam recognizes the safety benefits of different spatial distributions "for conditions like rain, snow, or fog." EX1005, 3:29-36; EX1005, 1:54-59, 4:48-59. If Patent Owner argues, incorrectly, Beam does not expressly disclose "a plurality of light clusters," even though Beam discloses different angular position control for different microbeams, it would have been obvious to a POSA to use such control for the feature of "light clusters."

Combining Thominet with Beam would have made Beam's system more direct, or active, or specifically aimed for different functions than prior systems, as Beam seeks to do (*see* EX1005, 2:15-22), and further achieves Beam's purpose of improving driver safety.

301. And Thominet's *technique* (software implementation), like Beam, enhances driver visibility, increasing safety—using multiple beam regions (clusters) for different functions. EX1006, ¶¶17-18, 21-26, FIGS. 1-3; EX1006, ¶3 ("*characteristic* of the light beam…can be used for *different functions*"), ¶20 ("partial *regions* are defined on the *matrix*"), ¶27 ("partial *regions* with partial quantities of the semiconductor sources 10 are defined on the *matrix*"), ¶¶5-8. Specifically, Thominet explains that the "characteristic" of the light beam, for example, color, direction, reaching distance, dispersion width, and/or intensity, "can be changed so that it can be used for *different functions*." EX1006, ¶¶3-4, FIGS. 1, 2; *see also* EX1006, ¶¶5-8.

302. Thominet's semiconductor light sources 10, arranged on curved surface 12, provide different beam regions 22, 24, 26, 28 (clusters) for different driving situations including for recognizing a counter traffic, thereby improving road safety, including driver safety. EX1006, ¶¶7-8, 17-18, 21-27, FIGS. 1-3; EX1006, ¶7 ("*wider* illumination), ¶23 ("*improving* the illumination…at high speeds).




EX1006, FIGS. 1-2 (annotated).

303. The additional control (software implementation) of having multiple beam regions (clusters) 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.

304. A POSA would have understood that alternative or additional control for Beam's controller 108/illuminator 109 by using Thominet's different beam regions 22, 24, 26, 28, would have enhanced Beam's system, making it more direct, or active, or specifically aimed for different functions, by providing different spatial/angular distributions for different driving situations, thereby improving driver safety. Doing so would have merely been applying Thominet's known technique (software implementation: using multiple beam regions for different functions), to Beam's similar, known device (dynamic AAHB system with controllable microbeams), in the same way. Thominet's known technique is fully described along with its benefits (improved visibility for different functions in

different driving situations, thereby increased safety); thus, a POSA would have readily applied it to similar systems, such as Beam's, in the same way.

305. 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 beam regions (clusters) for different functions. Overall, this is a simple software implementation.

306. Such modification 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. In applying Thominet's technique to Beam, a POSA would have simply been applying a known technique (software implementation) in a predictable way—controlling headlights in part based on multiple directional beam regions for different functions—as already disclosed in the art.

307. *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 (arranged in different beam regions 22, 24, 26, 28, *see* EX1006, ¶¶17-20, 23-26, FIGS. 1-2, 5-7) into Beam's system (with flat array of light sources 401). Again, this would have, like

Thominet, provided different spatial distributions for different driving situations (e.g., low visibility, low/high speeds, traffic, curves, etc.), improving visibility and thereby safety. EX1006, ¶¶17-20, 23-26, FIGS. 1-2, 5-7. This is a simple hardware combination.

308. Beam discloses an array of light sources 401 (e.g., LEDs) that appears flat in Figures 4 and 6, and has the same functionality as lamp 202 and SLM 203 shown in Figure 2, and each light source is individually controlled. EX1005, 3:62-64, 5:3-16, FIGS. 4, 6; EX1005, 4:26-59 ("*angular* position"), 8:4-17.

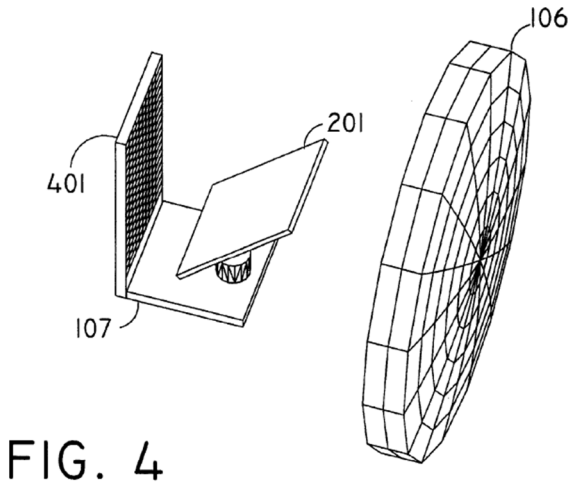



FIG. 4

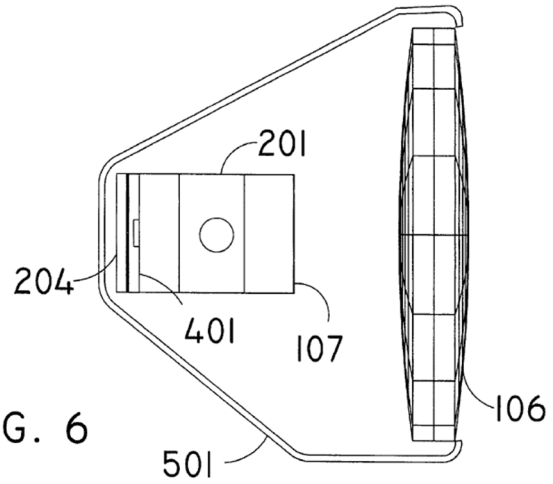



FIG. 6

EX1005, FIGS. 4, 6.

309. Through its *system components* (hardware implementation), Thominet, like Beam, seeks to enhance driver visibility and thereby increase safety. Indeed, semiconductor light sources 10 arranged on curved surface 12 provide beam regions 22, 24, 26, 28 (clusters) for different driving situations. EX1006, ¶¶7-8, 17-18, 21-26, FIGS. 1-2.

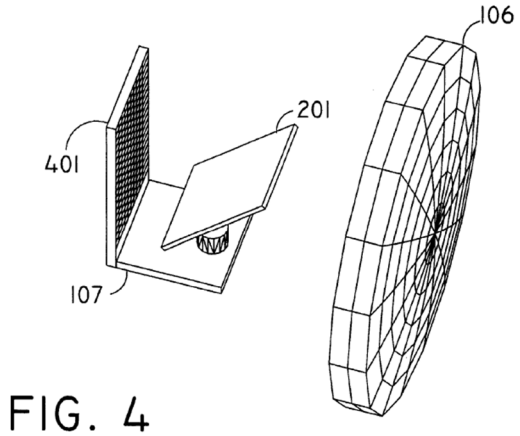



FIG. 4

EX1005, FIG. 4.

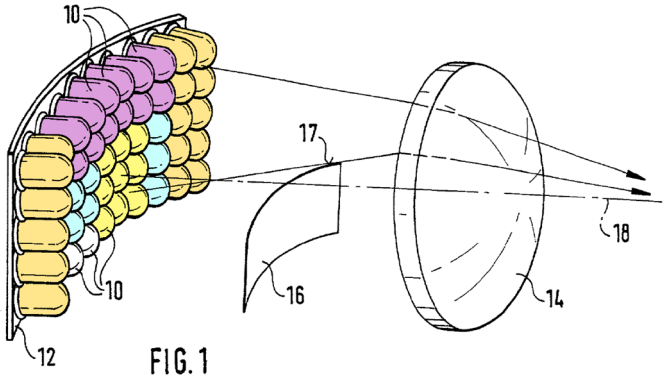



FIG.1

EX1006, FIG. 1 (annotated).

310. Like the software implementation above, this hardware combination—Beam's array of light sources 401 and Thominet's semiconductor sources 10 on curved surface 12 arranged in beam regions 22, 24, 26, 28—would have provided Beam's system with different spatial distributions for different driving situations, as in Thominet, thereby improving driver safety. This would have been merely combining prior-art elements or a simple substitution of one known element for another (e.g., 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 (e.g., disclosed in Beam and Thominet) to yield predictable results (improved visibility and safety). Overall, this is a simple hardware implementation.

311. 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 clusters (e.g., directional beam regions 22, 24, 26, 28) for different functions (hardware implementation).

312. Such modification 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. And in combining Beam with Thominet's array of semiconductor sources 10 (e.g., modifying an illuminator), a POSA would have simply been combining known elements according to known methods (disclosed in Thominet) to yield predictable results (light control for different functions, hardware implementation).

313. In view of the above, Beam, alone or in combination with Thominet, discloses or renders obvious this element.

#### 4. [37.3]: "capable of illuminating sub-sections of a field-of-view with different illumination characteristics,"

314. In my opinion, claim elements [37.2]-[37.4] are part of the same clause but will be addressed separately for simplicity below.

315. In my opinion, there is no patentable difference between claim elements [37.3] and [1.3]. *Supra* Section X.B.4; *see also* Appendix A. Therefore, my above analysis in Section X.B.4 applies.

316. In view of the above, Beam discloses this element.

**5. [37.4]: "wherein at least two of the light clusters operate to create a headlight beam;"**

317. In my opinion, claim elements [37.2]-[37.4] are part of the same clause but will be addressed separately for simplicity below.

318. In my opinion, there is no patentable difference between claim elements [37.4] and [1.4]. *Supra* Section X.B.5; *see also* Appendix A. Therefore, my above analysis in Section X.B.5 applies.

319. In view of the above, Beam, alone or in combination with Thominet, discloses or renders obvious this element.

**6. [37.5]: "one or more sensors configured to obtain and provide sensor data,"**

320. In my opinion, claim elements [37.5] and [37.6] are part of the same clause but will be addressed separately for simplicity below.

321. In my opinion, there is no patentable difference between claim elements [37.5] and [1.6]. *Supra* Section X.B.7; *see also* Appendix A. Therefore, my above analysis in Section X.B.7 applies.

322. In view of the above, Beam discloses this element.

**7. [37.6]: "at least a portion of the sensor data indicating a second vehicle within the field-of-view; and"**

323. In my opinion, claim elements [37.5] and [37.6] are part of the same clause but will be addressed separately for simplicity below.

324. In my opinion, there is no patentable difference between claim elements [37.6] and [1.6]. *Supra* Section X.B.7; *see also* Appendix A. Therefore, my above analysis in Section X.B.7 applies.

325. In view of the above, Beam discloses this element.

**8. [37.7]: "at least one processor configured to: receive the sensor data; process the sensor data to determine a light distribution pattern for an adaptive headlight beam,"**

326. In my opinion, claim elements [37.7]-[37.10] are part of the same clause but will be addressed separately for simplicity below.

327. In my opinion, there is no patentable difference between claim elements [37.7] and [1.8]. *Supra* Section X.B.9; *see also* Appendix A. Therefore, my above analysis in Section X.B.9 applies.

328. In view of the above, Beam discloses this element.

**9. [37.8]: "such that a headlight beam adapted to the pattern substantially illuminates a first subsection of the field-of-view including at least a portion of the second vehicle with an illuminance below a predefined threshold value,"**

329. In my opinion, claim elements [37.7]-[37.10] are part of the same clause but will be addressed separately for simplicity below.

**(a) Beam discloses this element.**

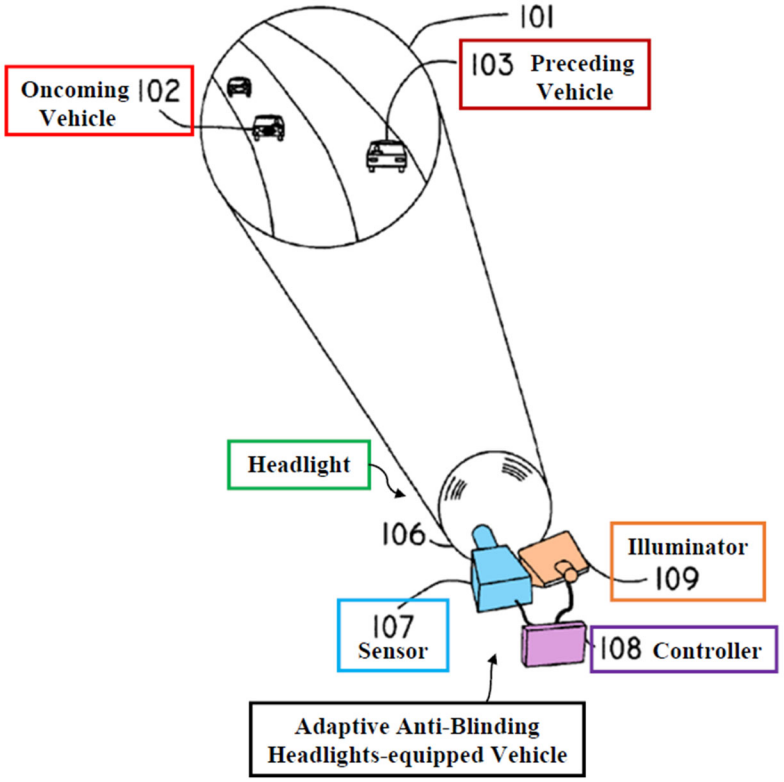
330. In my opinion, Beam discloses this claim element, [37.8]. *Supra* Section XI; EX1005, 1:5-18 ("*reformatting* the *pattern*…to *prevent* it from illuminating *certain areas*…thus *eliminating the blinding* of a driver in an

*oncoming vehicle*"), 6:30-33 ("*default* illumination level"), 2:59-3:3 (controlling an area *determined* by analyzing the position of the lights…the area of the beam…*dazzl[ing]* the driver will be *darkened*), Abstract ("*determine* the location of light sources…using that information to *control the intensity*"), 4:10-25 (*determine* which microbeams must be reduced in intensity…*shaded areas*), 5:13-15 ("uses the data to *determine* the size and position of the light emitters to be dimmed"), 5:46-54 ("*blanked area*"), 8:23-38 ("*determining*…an area to be darkened within said area of illumination…*producing* a desired output pattern"), 5:33-54, 5:65-6:2, FIGS. 1, 1C-1D, 7.

331. Specifically, Beam discloses a "*default* illumination level will be the equivalent of today's *low beams*" and that illumination in *shaded* areas is "*significantly less* than with current *low beams*" (e.g., below the default low beam threshold level). EX1005, 6:30-33, 2:59-3:3, FIGS. 1, 1C-1D, 7; EX1005, Abstract, 4:21-25 ("illumination in the *shaded areas* being *reduced significantly*"). The first subsection (shaded area) is thus illuminated "below a predefined threshold" (below a *low beam* illuminance). A POSA would have understood that Beam's "default illumination level…equivalent of today's low beams" is a "predefined threshold."

332. As discussed in Section XI.A, the concept of a "default illumination level" or a low beam illumination level would have been known to a POSA. Such

default illumination level for driver's visibility and glare light control is defined in all regulations, standards, and automaker's specifications, which is a predefined illumination level in terms of the light intensity distribution in the low beam illuminating area or low beam projected angular section. Therefore, Beam's "default illumination level" is an example of a predefined threshold level. *See also* EX1015, 6 ("discomfort glare…disability glare…to what extent the eye adaptation and therewith the threshold sensitivity is at a given adaptation luminance"), 18 ("glare reduction and visibility improvement"), FIGS. 2.1, 2.8; EX1017, 5 ("the adaptive light pattern should support to direct the concentration to the most important zone for the current driving situation"), FIGS. 1, 3-5; EX1026, 451, 456, FIGS. 1, 3-3; EX1030, 3-8, 21-41, 49, 62-69, Table 5.5.




EX1005, FIG. 1 (annotated).

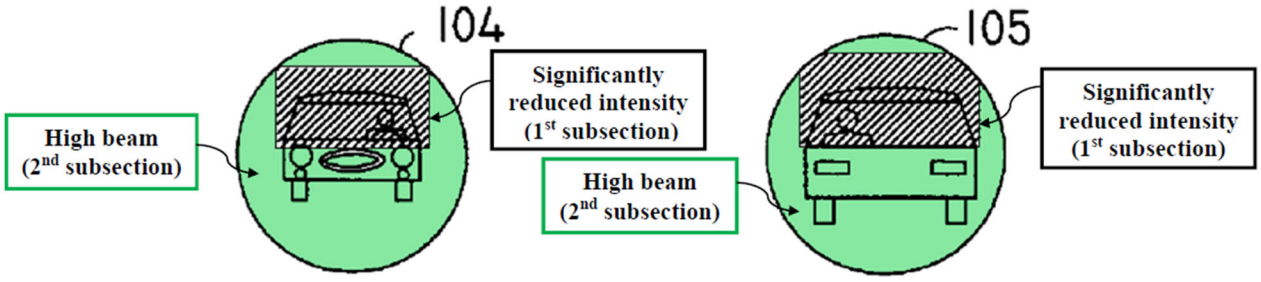
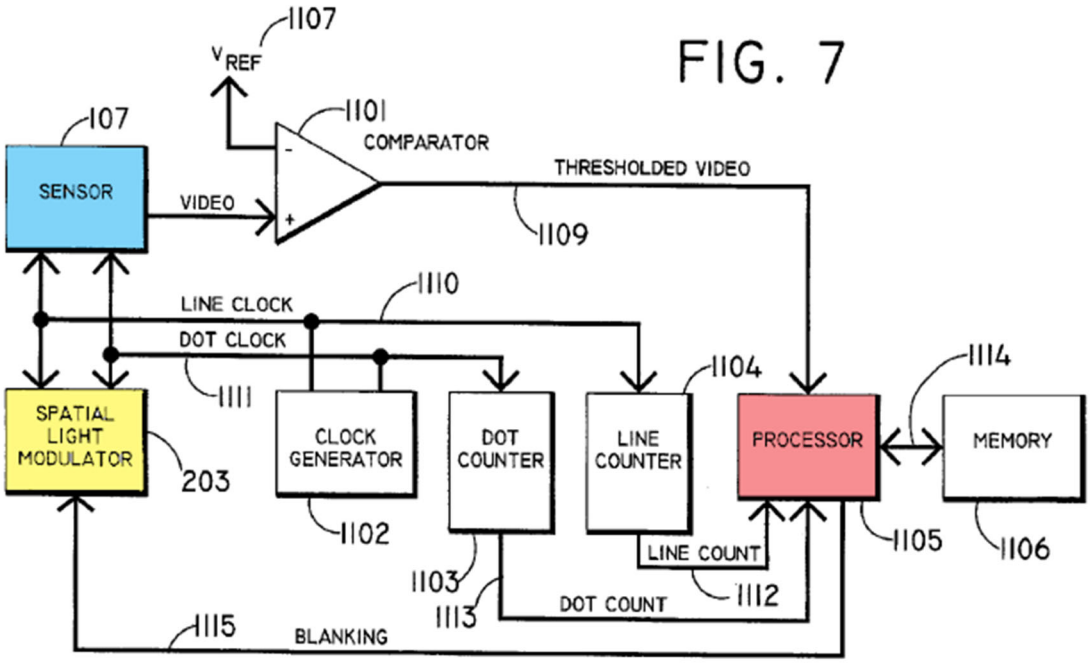
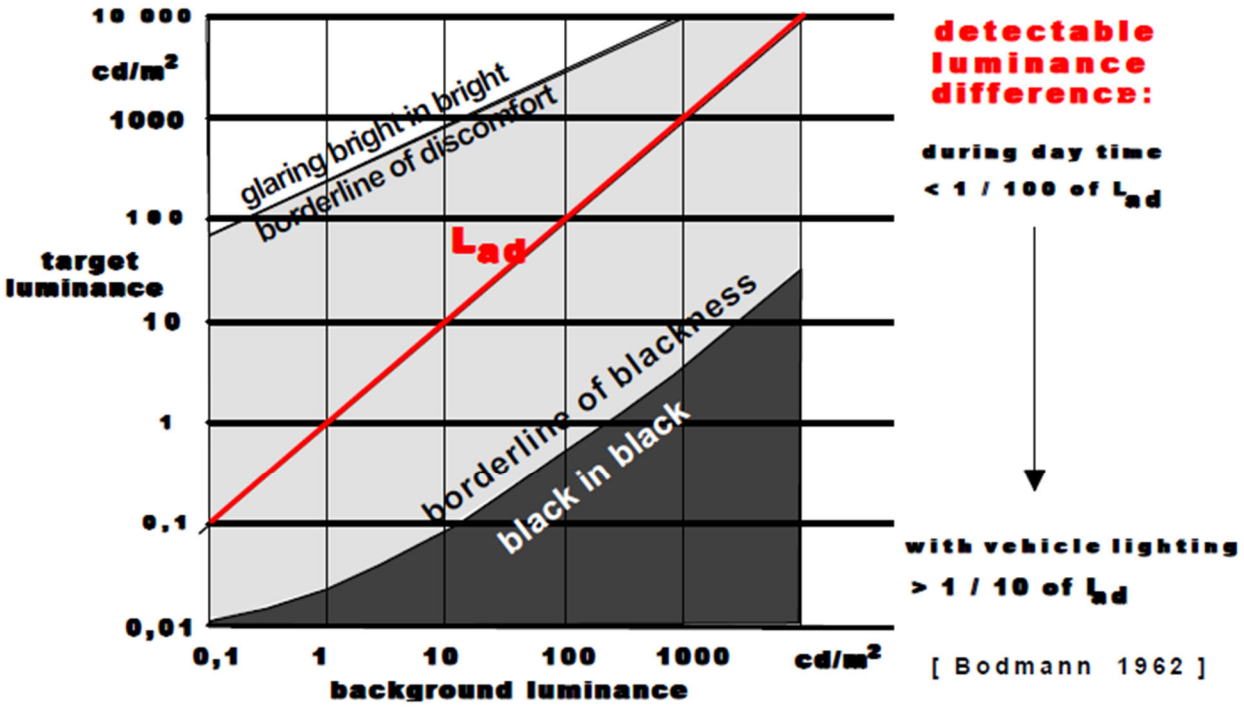



FIG. 1C FIG. 1D

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




EX1005, FIG. 7 (annotated).




EX1015, FIG. 2.1.

**Table 5.5.** Road illumination requirements for an adaptive lighting system.

| Devices | Beam patterns | Visibility on straight (m) | Visibility on curve r=150m (m) | Illuminance (lx) | Angular window for specified visibility (deg.) |
|---|---|---|---|---|---|
| Conventional beam | Low beam | 58 | 30 | 40 | -- |
| | High beam | 140 | -- | 120 | -- |
| AFS | Country | 80 | -- | 20 | Hor.: -1° to 1°<br>Ver.: -0.75° to 0.3° |
| | Bending | -- | 76 | 6 | Hor.: -4° to 35°<br>Ver.: -1° to -0.5° |
| | **High speed** | **200** | -- | **3** | Hor.: -1° to 1°<br>Ver.: -0.3° to 0° |

EX1030, Table 5.5.

**(b) Stam also discloses this element.**

333. If Patent Owner argues, incorrectly, that Beam-Thominet does not disclose claim element [37.8], Stam also discloses claim element [37.8], and it would have been obvious to incorporate Stam's disclosure into Beam-Thominet.

334. As explained above (Section XI.A), Stam discloses laws and regulations limit the amount of glare experienced by drivers (e.g., 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; EX1007, Abstract, 1:14-31, 9:12-10:8, FIG. 11. Thus, Stam defines a "predefined" (e.g., dimmed) threshold value

equal to 0.1 fc (about 1.1 lux[10]) within 700 feet (or 213 meter), corresponding to the "predefined threshold" recited in claim element [37.8].

335. Stam provides a specific "predefined threshold" value based on a dimmed illuminance to reduce glare, and indeed driver visibility and safety are paramount in Stam. EX1005, 3:8-44, 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.

336. Stam's predefined dimmed illuminance (*see* EX1007, Abstract, 1:14-31, 9:12-10:8) is tied to particular glare reduction techniques and the relationship between such reduction and laws and regulations governing the amount of glare experienced by drivers.

337. Stam further discloses the "predefined threshold" quantitatively (even though this claim element does not), based on regulation requirements. As I previously explained throughout this declaration, a POSA would have understood that the headlamp beam patterns would have a quantitatively defined illuminance level either based on regulations or based on automaker's specifications that often

[10] 1 foot-candle (fc) is equal to 10.7639 lux.

are above the regulations (with higher illuminance level for visibility and lower illuminance level for glare light control, comparing to the regulations).

338. A POSA would have been motivated to combine Stam with Beam-Thominet with a reasonable expectation of success, providing predictable visibility and safety benefits. I provide additional detail, evidence, and explanation of my conclusions below, showing that Beam (with Thominet), or combined with Stam, discloses claim element [37.8].

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

339. As described in Section X.A, a POSA would have been motivated to combine Beam-Thominet. As discussed, Beam discloses a "predefined threshold" based on a low beam illuminance. Stam provides a specific "predefined threshold" value based on a dimmed illuminance to reduce glare. 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. EX1005, 3:8-14, 3:37-45, 5:33-54, 7:1-13.

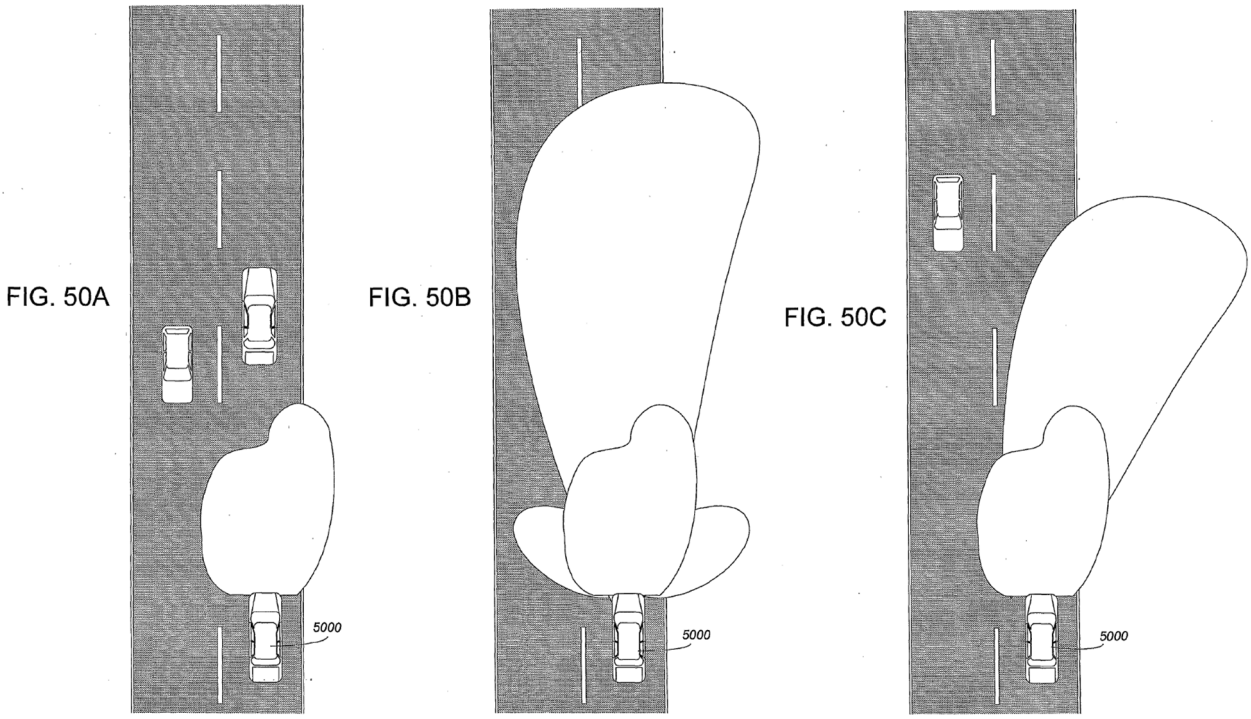
340. Stam is from the same field—controllable headlamps with dynamic illumination—and includes the same building blocks (light sources, sensors, controllers). Like Beam-Thominet, driver visibility and safety is paramount in

Stam. 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.

341. *First*, including a predefined value for Beam-Thominet's controller—Stam's *known 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. *Second*, a POSA would have sought to incorporate this *known feature* of Stam (e.g., a predefined dimmed illuminance, *see* EX1007, Abstract, 1:14-31, 4:7-15, 9:12-10:8, FIGS. 11, 50A-50C) into Beam's system (with controller 108 and/or illuminator 109). This would have, like Stam, provided a specific "predefined" threshold, below and above which to adjust illumination for desired areas, further improving safety. EX1007, Abstract, 1:14-31, 9:12-10:8.

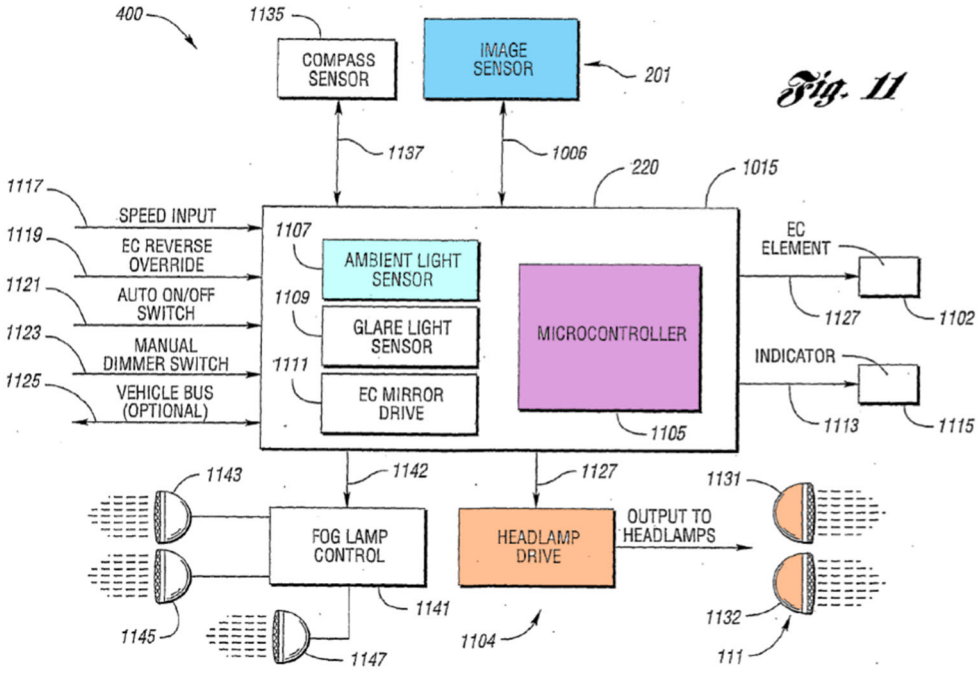
342. Stam's *technique*, like Beam-Thominet, seeks to enhance driver comfort and safety—using a predefined dimmed illuminance to reduce glare. EX1007, Abstract, 1:14-31, 9:12-10:8, FIGS. 50A-50C. Stam discloses "to *avoid an illuminance of 0.1 foot candles (fc)* incident on another vehicle…headlamps

should be *dimmed within 700 feet* of another vehicle." EX1007, 1:25-27, 1:14-31 ("control the amount of *glare*"), 9:12-10:8, 58:11-33, FIG. 11.




EX1007, FIGS. 50A-50C.

343. Stam's headlight control system uses an image sensor and controller to automatically adjust intensity, aim, and/or focus of exterior lights to generate beam patterns that maximize the illuminated area without excessive glare. EX1007, Abstract, 9:12-10:8, 73:13-16, 77:30-78:17, FIGS. 3, 11, 13, 14, 19, 20, 26a, 27, 28, 33, 50A-50C. Stam also discloses an ambient light sensor 1107 can have one or more predefined light level thresholds to vary the headlamps' beam pattern and intensity when the ambient light level is above or below a light level threshold. EX1007, 4:7-15, 30:12-31:16, 48:20-26, FIGS. 11, 14.




EX1007, FIG. 11 (annotated).

344. 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 feet), would have provided greater illumination control *referenced to* a predefined value to prevent glare and increase illumination to other areas, thereby improving driver safety. 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. Stam's known technique is fully described along with its benefits (e.g., improved safety); thus, a POSA would have readily applied it to similar systems, such as Beam-Thominet's, in the same way.

345. Additionally, or alternatively, this modification would have been simply combining prior-art elements (e.g., 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 (e.g., reduced glare, improving safety).

346. A POSA would have had a reasonable expectation of success combining Beam-Thominet and Stam. A POSA would have understood *how* to combine their disclosures, for example, by simply storing a specific dimmed threshold value (e.g., 0.1 fc within 700 feet) in memory of Beam-Thominet's controller/processor in order for the controller/processor to output Beam's headlamp illumination below and above that value (e.g., glare threshold level) for respective illumination areas.

347. Such modification 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. In applying Stam's technique to Beam-Thominet, a POSA would have simply been applying a known technique in a predictable way—controlling headlights in part based on a predefined dimmed illuminance—as already disclosed in the art.

348. Thus, the combined Beam-Thominet-Stam system would illuminate the first subsection (e.g., shaded area) "below a predefined threshold value." *Supra* Section XI.A.

349. In view of the above, Beam (with Thominet), or in combination with Stam, discloses or renders obvious this element.

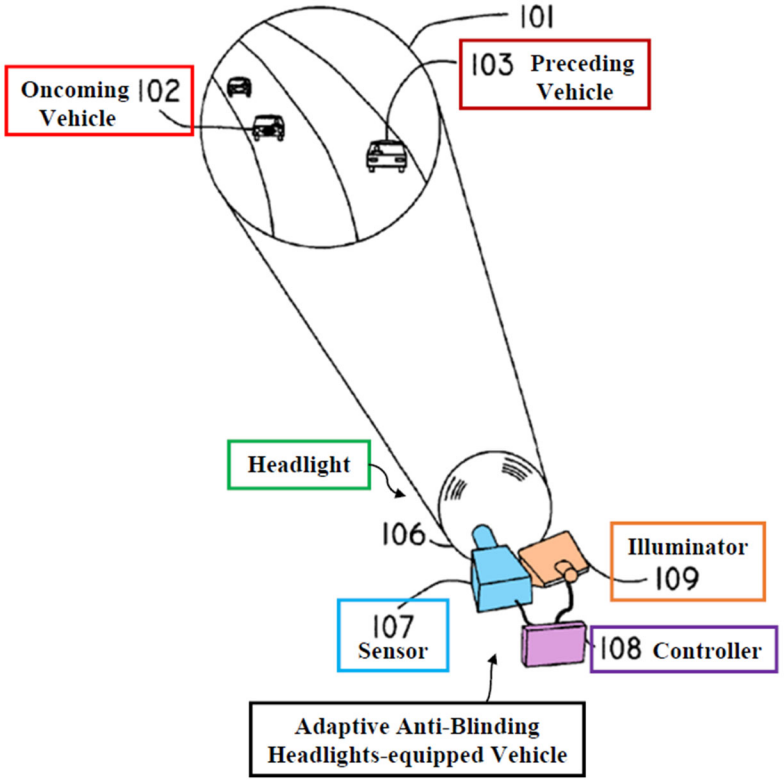
**10. [37.9]: "while the beam substantially illuminates at least the one or more second subsections of the field-of-view to either side of the first subsection with an illuminance above the predefined threshold value; and"**

350. In my opinion, claim elements [37.7]-[37.10] are part of the same clause but will be addressed separately for simplicity below.

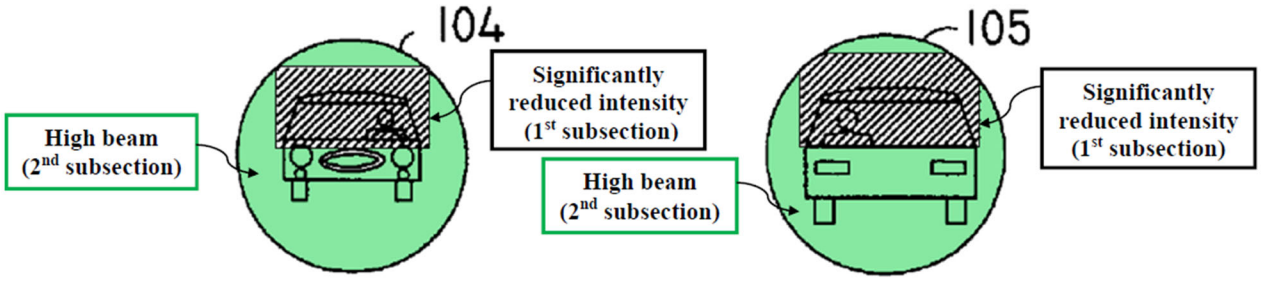
**(a) Beam discloses this element.**

351. In my opinion, Beam discloses this element, [37.9]. *Supra* Section XI; EX1005, 1:5-18 ("*reformatting* the *pattern*…to *prevent* it from illuminating *certain areas*…thus *eliminating the blinding* of a driver in an *oncoming vehicle*"), 6:11-55 ("*default* illumination level"), 2:59-3:3 (controlling an area *determined* by analyzing the position of the lights), Abstract ("*determine* the location of light sources…using that information to *control the intensity*"), 7:30-36 ("controller providing feedback to cause…a *high level of illumination*"), 8:23-38 ("*determining*…an area to be darkened within said area of illumination…*producing* a desired output pattern"), 4:10-25, 5:33-54, 5:65-6:2, FIGS. 1, 1C-1D, 7.

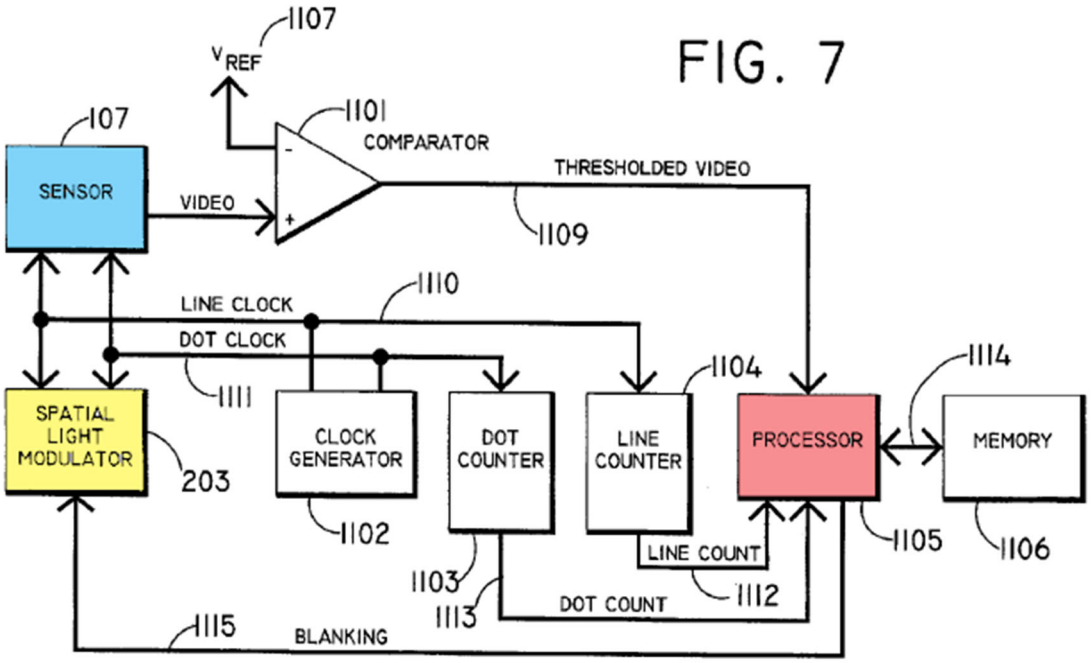
352. Specifically, Beam discloses a "*default* illumination level will be the equivalent of today's *low beams*" and that illumination in *non-shaded* areas is "at *maximum* intensity" and "like having bright *high beams*" (e.g., above the default low beam threshold level). EX1005, 6:30-33, 6:11-12, 6:40-44, FIGS. 1, 1C-1D, 7; EX1005, 2:59-3:3 ("*maintaining f[u]ll intensity elsewhere*"), 6:53-56 ("*high beam headlights or brighter*"). The second subsections (non-shaded areas) are thus illuminated "above the predefined threshold" (above a *low beam* illuminance). A POSA would have understood that Beam's "default illumination level…equivalent of today's low beams" is a "predefined threshold." *See also* EX1015, 6 ("discomfort glare…disability glare…to what extent the eye adaptation and therewith the threshold sensitivity is at a given adaptation luminance"), 18 ("glare reduction and visibility improvement"), FIGS. 2.1, 2.8; EX1017, 5 ("the adaptive light pattern should support to direct the concentration to the most important zone for the current driving situation"), FIGS. 1, 3-5; EX1026, 451, 456, FIGS. 1, 3-3; EX1030, 3-8, 21-41, 49, 62-69, Table 5.5.



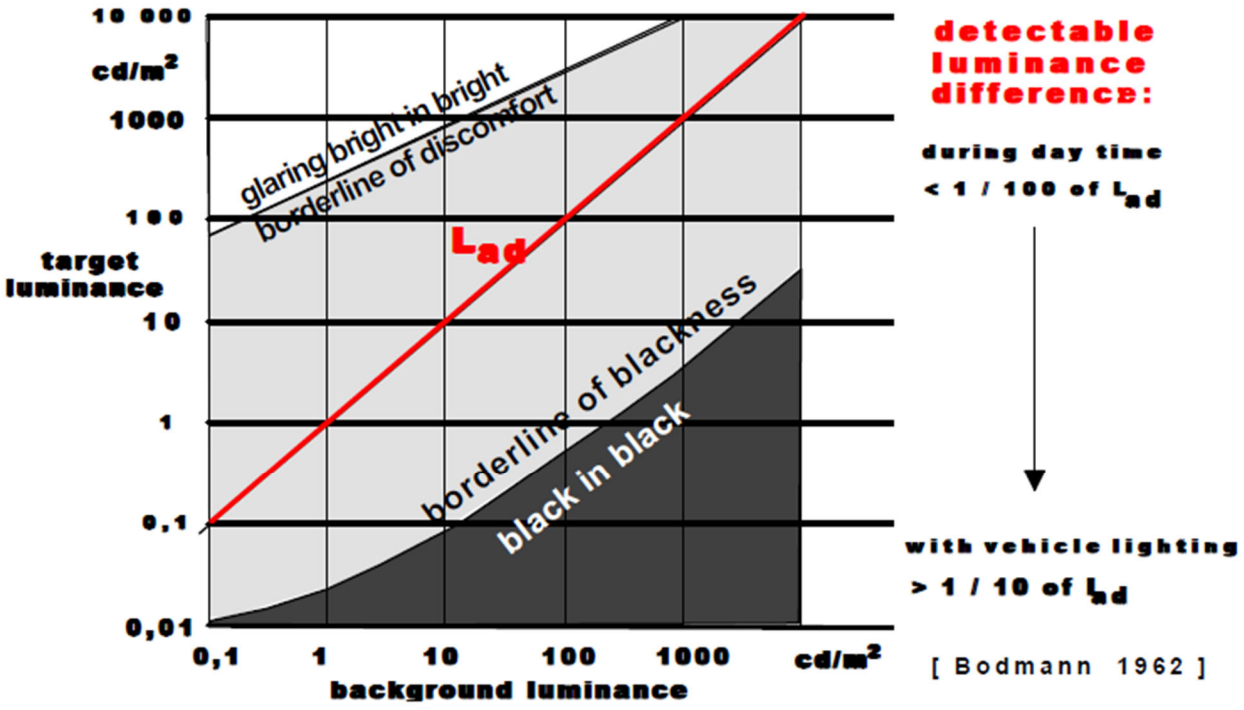

EX1005, FIG. 1 (annotated).




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




EX1005, FIG. 7 (annotated).




EX1015, FIG. 2.1.

**Table 5.5.** Road illumination requirements for an adaptive lighting system.

| Devices | Beam patterns | Visibility on straight (m) | Visibility on curve r=150m (m) | Illuminance (lx) | Angular window for specified visibility (deg.) |
|---|---|---|---|---|---|
| Conventional beam | Low beam | 58 | 30 | 40 | -- |
| | High beam | 140 | -- | 120 | -- |
| AFS | Country | 80 | -- | 20 | Hor.: -1° to 1°<br>Ver.: -0.75° to 0.3° |
| | Bending | -- | 76 | 6 | Hor.: -4° to 35°<br>Ver.: -1° to -0.5° |
| | **High speed** | **200** | -- | **3** | Hor.: -1° to 1°<br>Ver.: -0.3° to 0° |

EX1030, Table 5.5.

**(b) Stam also discloses this element.**

353. If Patent Owner alleges, incorrectly, that Beam-Thominet does not expressly disclose claim element [37.9], Stam also discloses claim element [37.9], and it would have been obvious to incorporate Stam's disclosure into Beam-Thominet.

354. As explained above (Section XI.A), Stam discloses laws and regulations limit the amount of glare experienced by drivers (e.g., 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; EX1007, Abstract, 1:14-31, 9:12-10:8, FIG. 11. Thus, Stam defines a "predefined" (dimmed) threshold value equal

to 0.1 fc (about 1.1 lux[11]) within 700 feet, corresponding to the "predefined threshold" recited in claim element [37.9].

355. Stam provides a specific "predefined threshold" value based on a dimmed illuminance to reduce glare, and indeed driver visibility and safety are paramount in Stam. EX1005, 3:8-44, 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.

356. Stam's predefined dimmed illuminance (see EX1007, Abstract, 1:14-31, 9:12-10:8) is tied to particular glare reduction techniques and the relationship between such reduction and laws and regulations governing the amount of glare experienced by drivers.

357. Stam further discloses the "predefined threshold" quantitatively (even though this claim element does not), based on regulation requirements. As I previously explained throughout this declaration, a POSA would have understood that the headlamp beam patterns would have a quantitatively defined threshold level either based on regulations or based on automaker's specifications that often

[11] 1 foot candle (fc) is equal to 10.7639 lux.

are above the regulations (with higher illuminance level for visibility and lower illuminance level for glare light control comparing to the regulations).

358. A POSA would have been motivated to combine Stam with Beam-Thominet with a reasonable expectation of success, providing predictable visibility and safety benefits. I provide additional detail, evidence, and explanation of my conclusions below, showing that Beam (with Thominet), or combined with Stam, discloses claim element [37.9].

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

359. As described in Section X.A, a POSA would have been motivated to combine Beam-Thominet. As discussed, Beam discloses a "predefined threshold" based on a low beam illuminance. Stam provides a specific "predefined threshold" value based on a dimmed illuminance to reduce glare. Naturally, it would have been obvious to a POSA designing an adaptive headlamp to implement Stam's predefined (dimmed) threshold 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. EX1005, 3:8-14, 3:37-45, 5:33-54, 7:1-13.

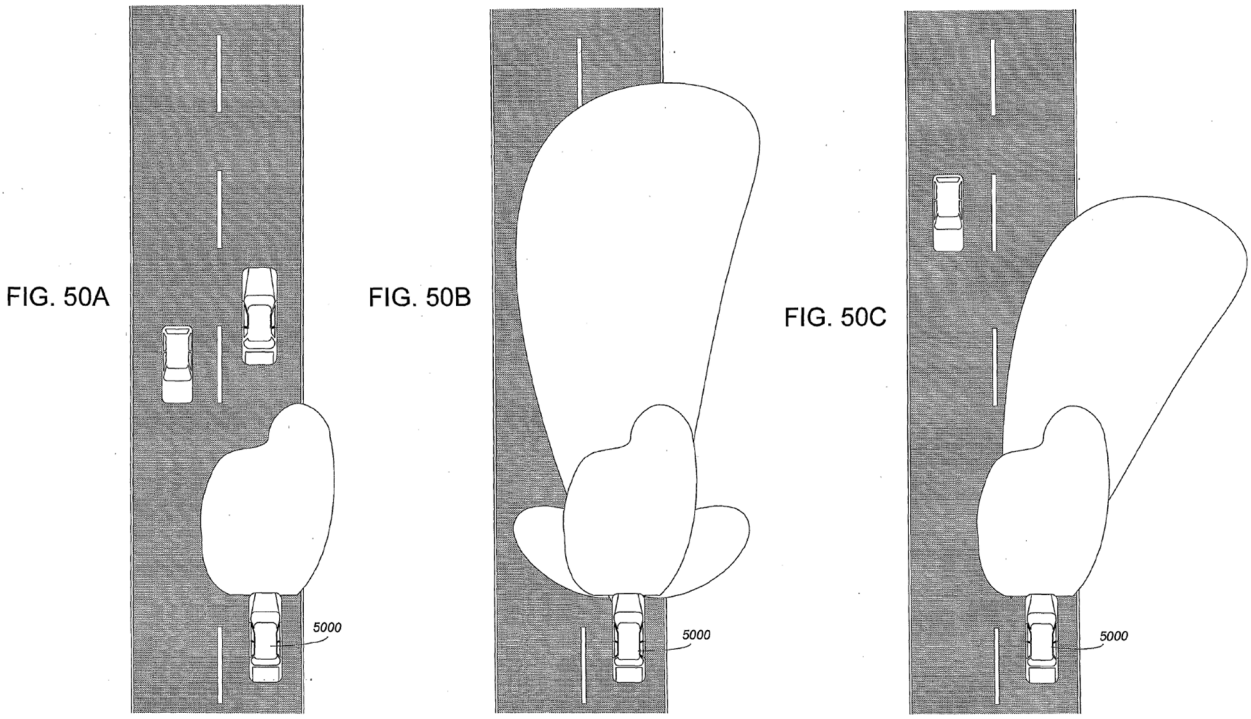
360. Stam is from the same field—controllable headlamps with dynamic illumination—and includes the same building blocks (light sources, sensors, controllers). Like Beam-Thominet, driver visibility and safety is paramount in

Stam. 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.

361. *First*, including a predefined value for Beam-Thominet's controller—Stam's *known 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. *Second*, a POSA would have sought to incorporate this *known feature* of Stam (e.g., a predefined dimmed illuminance, *see* EX1007, Abstract, 1:14-31, 4:7-15, 9:12-10:8, FIGS. 11, 50A-50C) into Beam's system (with controller 108 and/or illuminator 109). This would have, like Stam, provided a specific "predefined" threshold, below and above which to adjust illumination for desired areas, further improving safety. EX1007, Abstract, 1:14-31, 9:12-10:8.

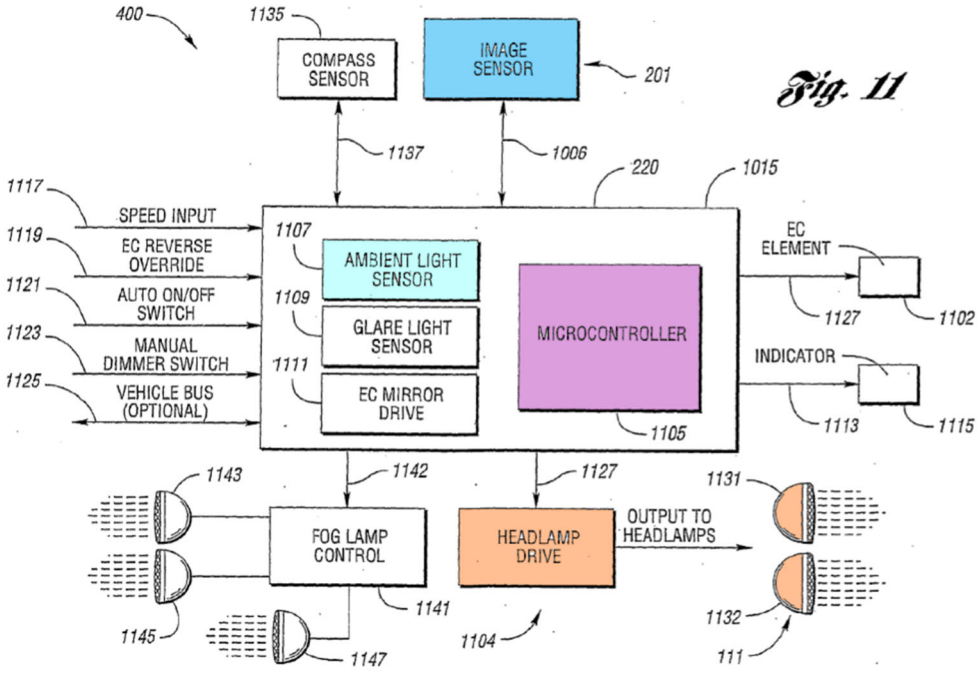
362. Stam's *technique*, like Beam-Thominet, seeks to enhance driver comfort and safety—using a predefined dimmed illuminance to reduce glare. EX1007, Abstract, 1:14-31, 9:12-10:8, FIGS. 50A-50C. Stam discloses "to *avoid an illuminance of 0.1 foot candles (fc)* incident on another vehicle…headlamps

should be *dimmed within 700 feet* of another vehicle." EX1007, 1:25-27, 1:14-31 ("control the amount of *glare*"), 9:12-10:8, 58:11-33, FIG. 11.




EX1007, FIGS. 50A-50C.

363. Stam's headlight control system uses an image sensor and controller to automatically adjust intensity, aim, and/or focus of exterior lights to generate beam patterns that maximize the illuminated area without excessive glare. EX1007, Abstract, 9:12-10:8, 73:13-16, 77:30-78:17, FIGS. 3, 11, 13, 14, 19, 20, 26a, 27, 28, 33, 50A-50C. Stam also discloses an ambient light sensor 1107 can have one or more predefined light level thresholds to vary the headlamps' beam pattern and intensity when the ambient light level is above or below a light level threshold. EX1007, 4:7-15, 30:12-31:16, 48:20-26, FIGS. 11, 14.




EX1007, FIG. 11 (annotated).

364. 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 feet), would have provided greater illumination control *referenced to* a predefined value to prevent glare and increase illumination to other areas, thereby improving driver safety. 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. Stam's known technique is fully described along with its benefits (e.g., improved safety); thus, a POSA would have readily applied it to similar systems, such as Beam-Thominet's, in the same way.

365. Additionally, or alternatively, this modification would have been simply combining prior-art elements (e.g., 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 (e.g., reduced glare, improving safety).

366. A POSA would have had a reasonable expectation of success combining Beam-Thominet and Stam. A POSA would have understood *how* to combine their disclosures, for example, by simply storing a specific dimmed threshold value (e.g., 0.1 fc within 700 feet) in memory of Beam-Thominet's controller/processor in order for the controller/processor to output Beam's headlamp illumination below and above that value (e.g., glare threshold level) for respective illumination areas.

367. Such modification 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. In applying Stam's technique to Beam-Thominet, a POSA would have simply been applying a known technique in a predictable way—controlling headlights in part based on a predefined dimmed illuminance—as already disclosed in the art.

368. Thus, the combined Beam-Thominet-Stam system would illuminate the second subsection (non-shaded area) "above the predefined threshold value." *Supra* Sections XI.A/XI.B.9.

369. In view of the above, Beam (with Thominet), or in combination with Stam, discloses or renders obvious this element.

**11. [37.10]: "instruct operation of at least two of the light clusters to create the adapted headlight beam."**

370. In my opinion, claim elements [37.7]-[37.10] are part of the same clause but will be addressed separately for simplicity below.

371. In my opinion, there is no patentable difference between claim elements [37.10] and [1.10]. *Supra* Section X.B.11; *see also* Appendix A. Therefore, my above analysis in Section X.B.11 applies.

372. In view of the above, Beam, alone or in combination with Thominet, discloses or renders obvious this element.

**C. Claim 38: "The headlight system of claim 37, wherein at least one of the at least one processors is further configured to process the sensor data to determine illumination for at least one first subsection of the field-of-view, determined to include at least a portion of the second vehicle, based on the sensor data, and for at least one second subsection determined not to include the second vehicle, based on the sensor data."**

373. Beam discloses "*spatial scene data* from sensor 107…becomes the input to *a processor 1105*" and "*[p]rocessor 1105* uses…incoming data to *determine the locations to be blanked*." EX1005, 5:34-36, 5:46-54, FIGS. 1, 1C-

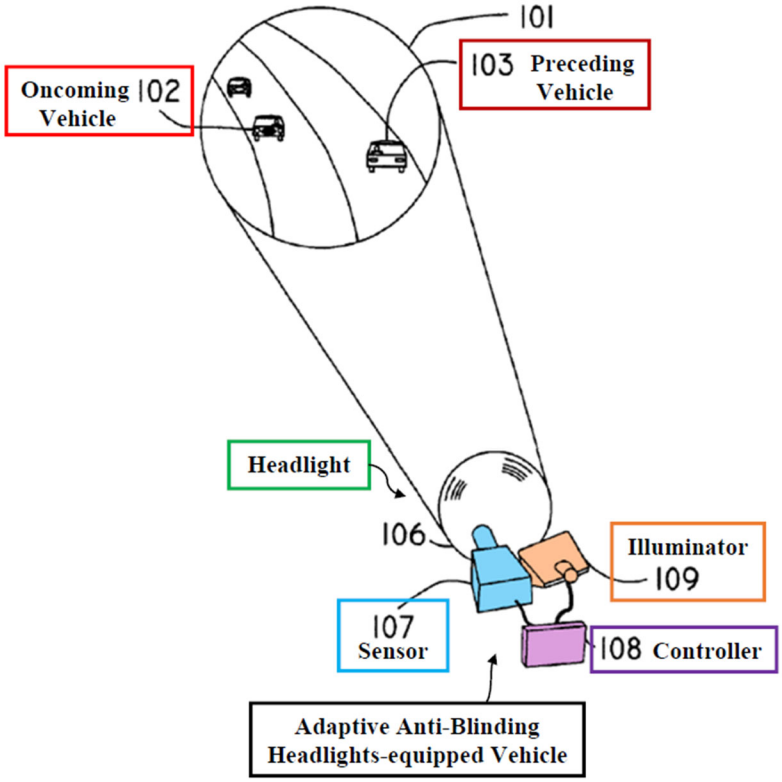
1D, 7; EX1005, Abstract ("*determine* the location of light sources…using that information to *control the intensity*"), 6:14-19 ("headlight's *field-of-view*"), 5:65-6:2 ("a *dimmed area*…based on input to the sensor").

374. Beam also discloses "*determining*, from the *detected presence* of the oncoming or followed vehicle…*the shape, size and location of an area to be darkened*…[and] *determining* which of said multiple rays of light must be *extinguished*." EX1005, 8:29-34, FIGS. 1, 1C-1D, 7; EX1005, 1:5-18 ("*reformatting* the *pattern* of a beam…to *prevent* it from illuminating *certain areas*…thus eliminating the blinding of a driver in an *oncoming vehicle*, while continuing to provide *intense forward illumination*"), 2:59-3:3, 4:10-25, 5:13-15, 5:33-54, 8:23-38.

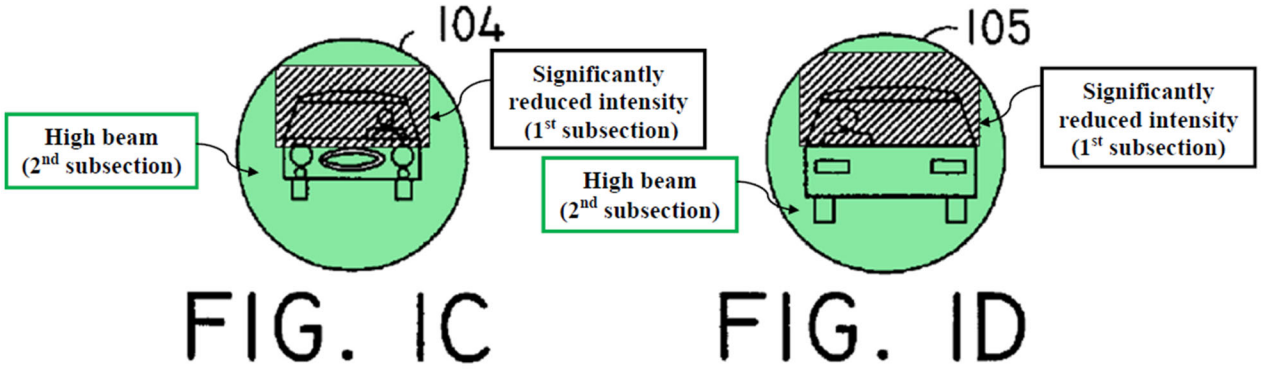
375. Thus, Beam's processor processes the sensor data and determines an area to be dimmed within a first subsection of the field-of-view (e.g., that includes a portion of the second vehicle that a driver is in) and an area to be illuminated within a second subsection of the field-of-view (e.g., non-shaded area of high intensity, including non-vehicle portions of the field-of-view). EX1005, 5:33-54, 6:12-27, FIGS. 1C-1D.

376. A POSA would have understood that Beam's first subsection can be adjusted such that the "second subsection…[does] not include the second vehicle"

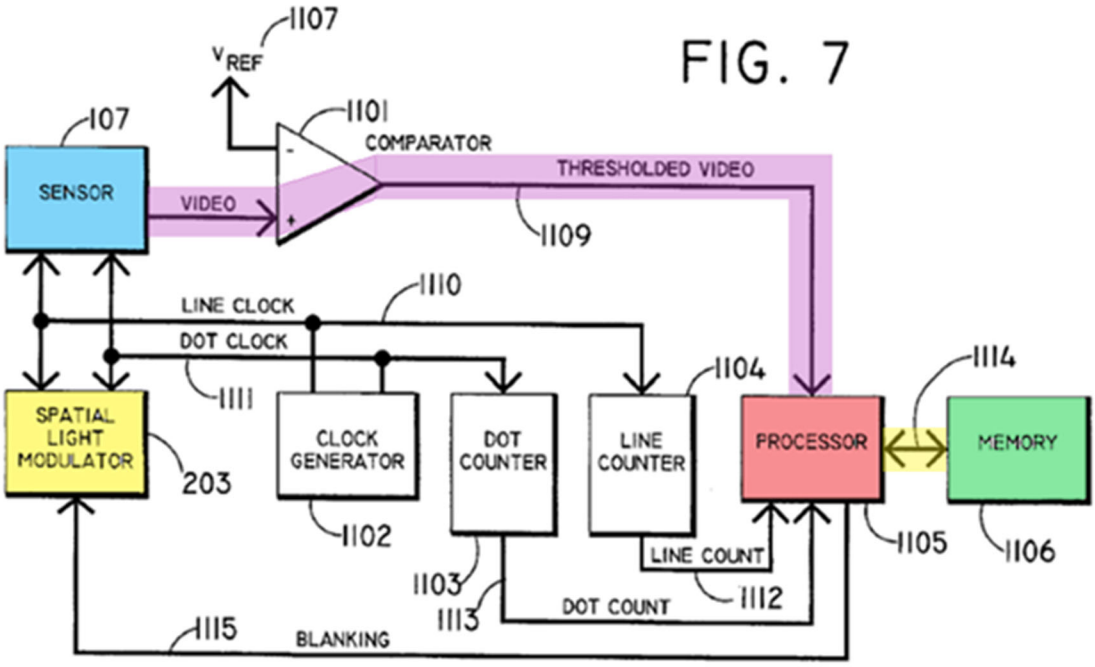
because Beam's system "tracks the location of the…vehicle" and "the blanked area…var[ies] in *position* and in *size*." EX1005, 6:9-27, FIGS. 1C-1D.




EX1005, FIG. 1 (annotated).




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




EX1005, FIG. 7 (annotated).

377. In view of the above, Beam discloses this claim.

**D. Claim 39: "The headlight system of claim 37, wherein the plurality of light clusters are further capable of illuminating at least two of the sub-sections with different illumination characteristics based on the at least one processor determining specific, different illumination characteristics for each of the at least two sub-sections."**

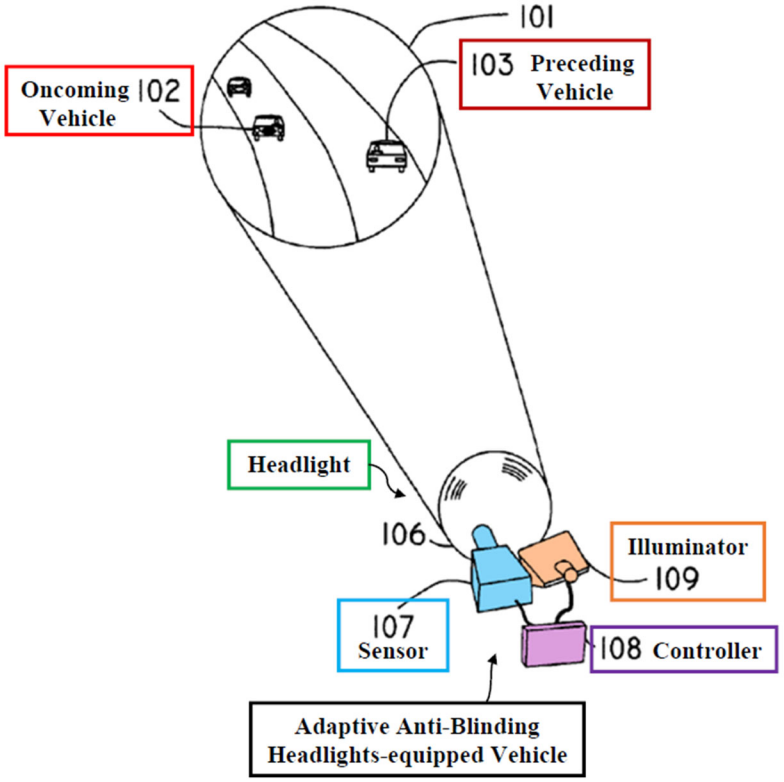
378. Beam discloses illuminating "with different illumination characteristics." *Supra* Sections X.B.4/XI.B.4.

379. Beam's illumination in shaded areas (first subsection) is "*significantly less* than with current *low beams*" and "*reformatting* the *pattern*…to *prevent* it from illuminating *certain areas*…thus eliminating the *blinding* of a driver in an *oncoming vehicle*." EX1005, 1:5-18, FIGS. 1, 1C-1D, 7; EX1005, 2:59-3:3

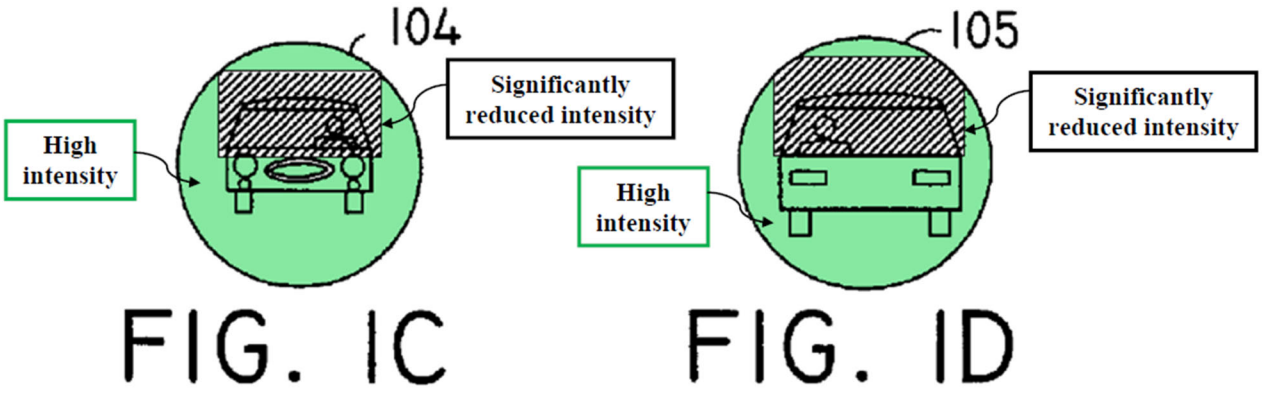
("area…*dazzl[ing]* the driver will be *darkened*"), 4:23-25 ("illumination in the *shaded areas* being *reduced significantly*"), 5:46-54 ("*blanked area*"), 5:65-6:2.

380. Beam's illumination in non-shaded areas (second subsection) is "at *maximum* intensity" and "like having bright *high beams* on at all times." EX1005, 6:30-33, 6:11-12, 6:40-44, FIGS. 1, 1C-1D, 7; EX1005, 2:59-3:3 ("*maintaining f[u]ll intensity elsewhere*"), 6:53-55 ("*high beam headlights or brighter*").

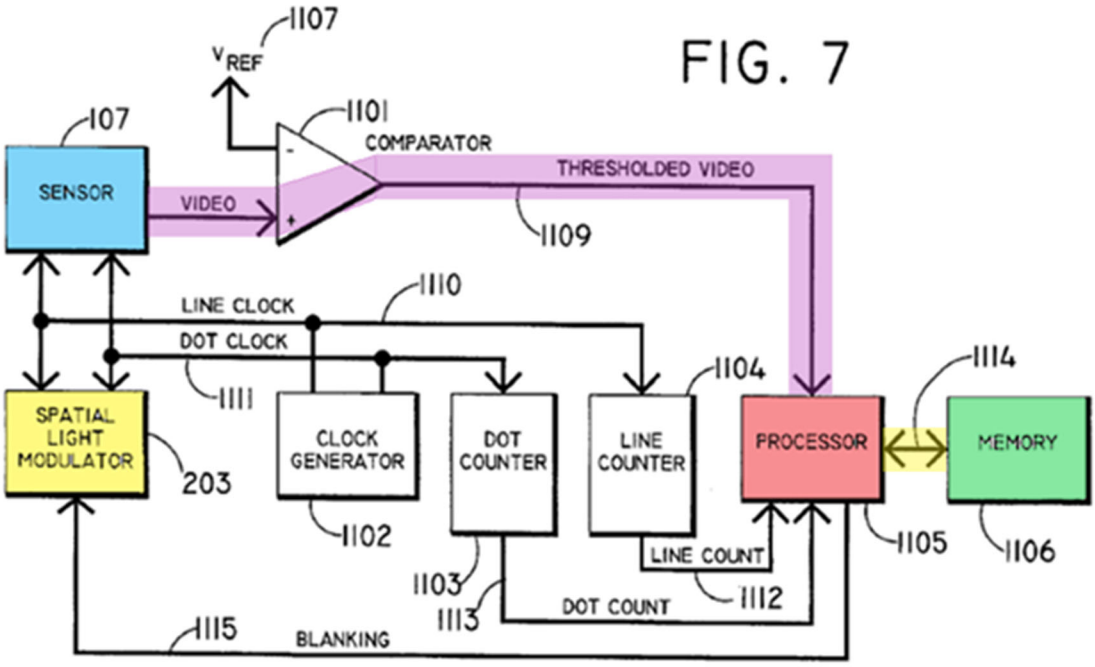
381. A POSA would have understood that "intensity" and "angular position" are "different illumination characteristics." *See also* EX1001, 16:43-50, 2:28-30. As discussed, Beam, alone or in combination with Thominet, discloses or renders obvious one or more "light clusters." *Supra* Section X.B.3. Thus, Beam's processor controls illuminator to dim a first subsection and illuminate a second subsection based on "different illumination characteristics for each of the at least two sub-sections." EX1005, 5:33-54, 6:12-27, FIGS. 1C-1D.




EX1005, FIG. 1 (annotated).




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




EX1005, FIG. 7 (annotated).

382. In view of the above, Beam, alone or in combination with Thominet, discloses or renders obvious this claim.

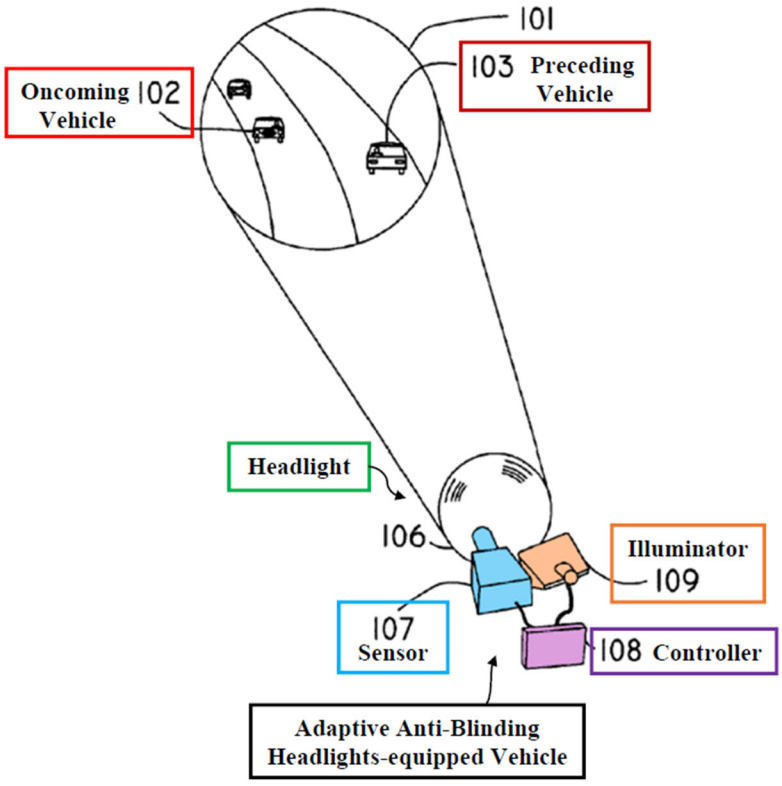
**E. Claim 40: "The headlight system of claim 37, wherein the light distribution pattern defines illumination for at least the first and the one or more second sub-sections of the field of view."**

383. Beam's processor "determine[s] a light distribution pattern." *Supra* Sections X.B.9/XI.B.8.

384. Beam's illumination in shaded areas (first subsection) is "*significantly less* than with current *low beams*" and "*reformatting* the *pattern*…to *prevent* it from illuminating *certain areas*…thus eliminating the *blinding* of a driver in an *oncoming vehicle*." EX1005, 1:5-18, FIGS. 1, 1C-1D, 7; EX1005, 2:59-3:3, 4:23-25, 5:46-54, 5:65-6:2. Beam's illumination in non-shaded areas (second

subsection) is "at *maximum* intensity" and "like having bright *high beams* on at all times." EX1005, 6:30-33, 6:11-12, 6:40-44, FIGS. 1, 1C-1D, 7; EX1005, 2:59-3:3, 6:53-55.

385. Thus, Beam's light distribution pattern defines illumination for first and second subsections of the field-of-view. EX1005, 5:33-54, 6:12-27, FIGS. 1C-1D.




EX1005, FIG. 1 (annotated).

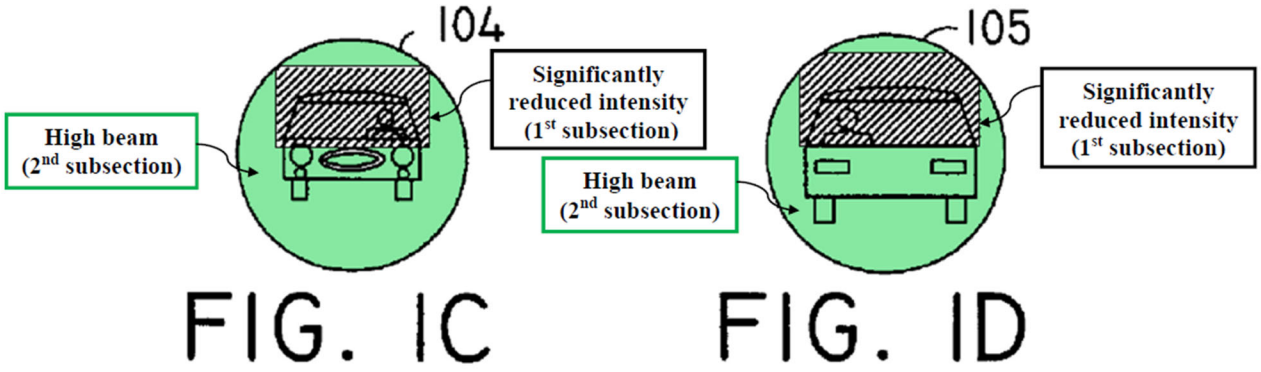



FIG. 1C FIG. 1D

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

386. In view of the above, Beam discloses this claim.

**F. Claim 41: "The headlight system of claim 37, wherein the light distribution patterns defines illumination for the first subsection designed to result in an illuminance below the predefined threshold value, and defines illumination for the one or more second subsections designed to result in an illuminance above the predefined threshold value."**

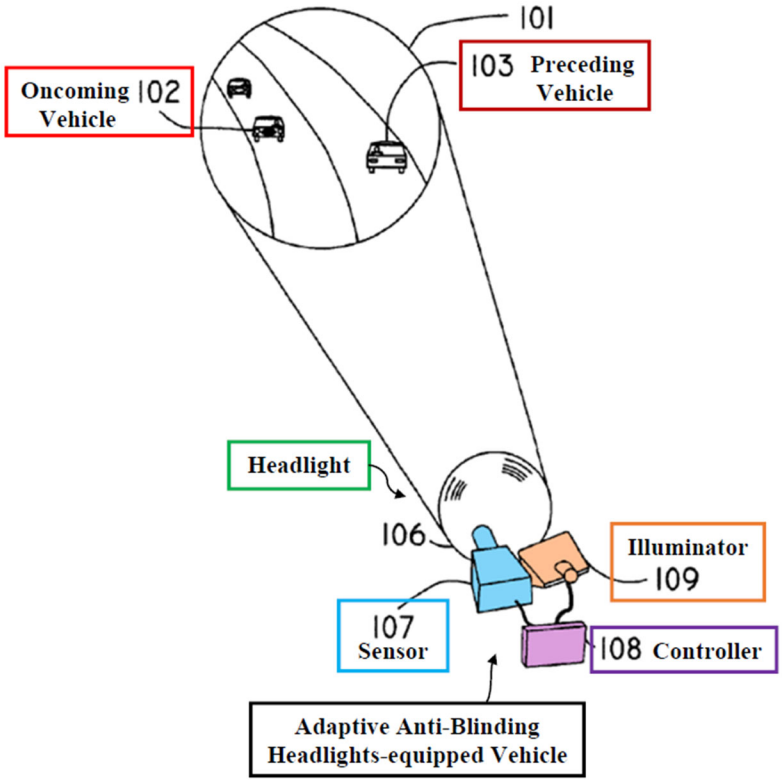
387. Beam's processor "determine[s] a light distribution pattern." *Supra* Sections X.B.9/XI.B.8.

388. Further, Beam discloses the first subsection (shaded area) is illuminated "below a predefined threshold" (below a predefined *low beam* threshold) and the second subsection (non-shaded area) is illuminated "above the predefined threshold" (above a predefined *low beam* threshold). *Supra* Sections XI.A/XI.B.9/XI.B.10.

389. Beam's illumination in shaded areas (first subsection) is "*significantly less* than with current *low beams*" and "*reformatting* the *pattern*…to *prevent* it from illuminating *certain areas*…thus eliminating the *blinding* of a driver in an

*oncoming vehicle*." EX1005, 1:5-18, FIGS. 1, 1C-1D, 7; EX1005, 2:59-3:3, 4:23-25, 5:46-54, 5:65-6:2. Beam's illumination in non-shaded areas (second subsection) is "at *maximum* intensity" and "like having bright *high beams* on at all times." EX1005, 6:30-33, 6:11-12, 6:40-44, FIGS. 1, 1C-1D, 7; EX1005, 2:59-3:3, 6:53-55.

390. Thus, Beam's light distribution pattern illuminates a first subsection "below the predefined threshold" and illuminates a second subsection "above the predefined threshold." EX1005, 5:33-54, 6:12-27, FIGS. 1C-1D.




EX1005, FIG. 1 (annotated).

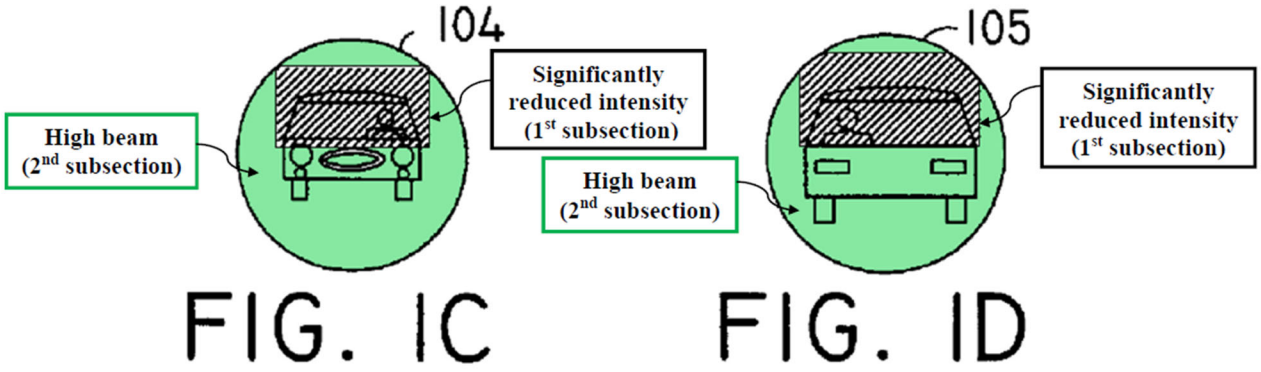



FIG. 1C FIG. 1D

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

391. In view of the above, Beam (with Thominet), or in combination with Stam, discloses or renders obvious this claim.

**G. Claim 42: "The headlight system of claim 37, wherein at least one of the light clusters comprises: one or more light sources, each having a variable light-source light characteristic dependent on power and alterable, at least responsive to instructions from at least one of the at least one processors, via power control; and one or more light modifying elements provided in a path of light emitted from at least one of the light sources, further controlling at least one light characteristic of the at least one of the light source; wherein control of the light sources and light modifying elements results in a specified emitted light-source light characteristic, where said emitted light-source light characteristic includes at least one of direction, intensity, beam spread, spatial light distribution or spectral light distribution."**

392. In my opinion, there is no patentable difference between the language of claim 42 and claim 2. *Supra* Section X.C; *see also* Appendix A. Therefore, my above analysis in Section X.C applies.

393. In view of the above, Beam, alone or in combination with Thominet, discloses or renders obvious this claim.

**H. Claim 43: "The headlight system of claim 42, wherein the one or more light modifying elements comprises at least one of reflectors or refractors, and wherein at least one of the at least one processors is configured to instruct control of at least one light modifying element resulting in a change to the light-source light characteristic."**

394. In my opinion, there is no patentable difference between the language of claim 43 and claim 3. *Supra* Section X.D; *see also* Appendix A. Therefore, my above analysis in Section X.D applies.

395. In view of the above, Beam, alone or in combination with Thominet, discloses or renders obvious this claim.

**I. Claim 44: "The headlight system of claim 42, wherein the light modifying element further comprises at least one of lenses, diffractors, optical devices, a light guide, filters, phosphors, optical coatings, prisms, controllable piezoelectric light guides, MEMS devices, light valves or optical switches."**

396. The language of claim 44 is identical to the language of claim 4 as shown above. *Supra* Section X.E; *see also* Appendix A. Therefore, my above analysis in Section X.E applies.

397. In view of the above, Beam, alone or in combination with Thominet, discloses or renders obvious this claim.

**J. Claim 45: "The headlight system of claim 37, wherein at least one of the light-clusters includes: a plurality of light sources, wherein one or more light sources of the plurality of light sources comprise at least one of light-emitting-diodes (LEDs) or organic light-emitting-diodes, each light source having a spectral power distribution characteristic alterable, at least responsive to instructions from at least one of the at least one processors, by**

**modifying power to the one or more light sources of the plurality of light sources, resulting in a color change to projected light from the at least one light-cluster illuminating at least one sub-section of the field-of-view."**

398. In my opinion, there is no patentable difference between the language of claim 45 and claim 5. *Supra* Section X.F; *see also* Appendix A. Therefore, my above analysis in Section X.F applies.

399. In view of the above, Beam, alone or in combination with Thominet, discloses or renders obvious this claim.

**K. Claim 47: "The headlight system of claim 37, wherein at least one of the sensors is a camera-sensor configured to image at least lights indicative of an oncoming vehicle."**

400. In my opinion, there is no patentable difference between the language of claim 47 and claim 7. *Supra* Section X.G; *see also* Appendix A. Therefore, my above analysis in Section X.G applies.

401. In view of the above, Beam discloses this claim.

**L. Claim 48: "The headlight system of claim 37, wherein at least one of the sensors is a camera-sensor configured to image at least lights indicative of a preceding vehicle."**

402. In my opinion, there is no patentable difference between the language of claim 48 and claim 8. *Supra* Section X.G; *see also* Appendix A. Therefore, my above analysis in Section X.G applies.

403. In view of the above, Beam discloses this claim.

**M. Claim 50: "The headlight system of claim 37, further including a computer vision processing unit configured to use the sensor data**

**to identify entities including at least one of beings, vehicles, roadway, or street signs, and wherein the processor is further configured to determine modification of the headlight beam to change illumination of the identified entity."**

404. In my opinion, there is no patentable difference between the language of claim 50 and claim 11. *Supra* Section X.I; *see also* Appendix A. Therefore, my above analysis in Section X.I applies.

405. In view of the above, Beam discloses this claim.

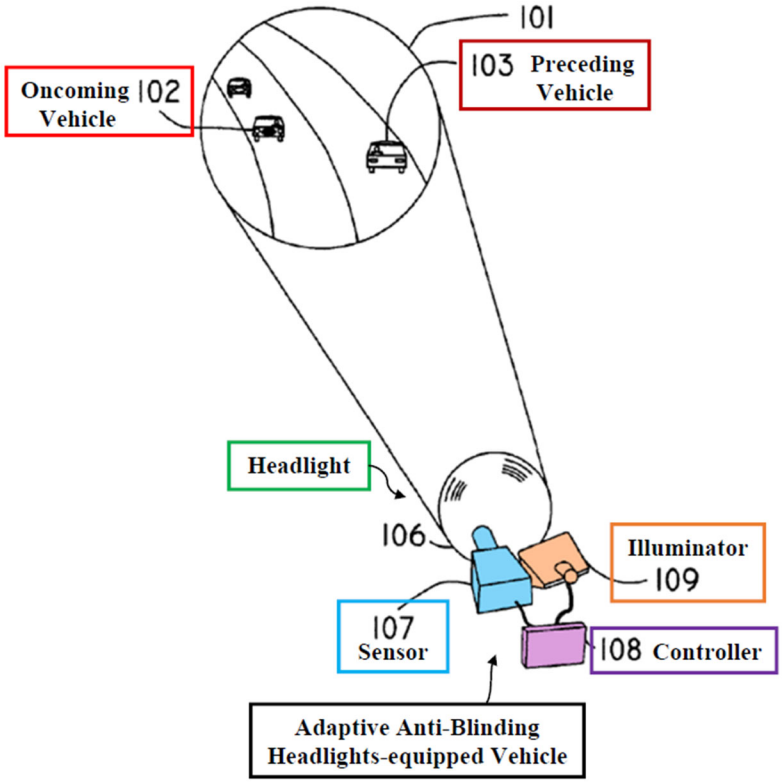
**N. Claim 51: "The headlight system of claim 37, where the illumination created by the headlight beam results in illumination both providing a driver of the first vehicle with preserved illumination in the one or more second subsections and mitigating glare projected to reach the eyes of a driver of the second vehicle."**

406. 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; EX1005, 5:34-54 ("*spatial scene data* from sensor 107…[is] input to *a processor 1105*…uses appropriate algorithms on the incoming data to…*command[]* the appropriate pixels to be *reduced in intensity*"), Abstract ("*determine* the location of light sources…using that information to *control the intensity*"), 6:14-16 ("headlight's *field-of-view*"), 5:65-6:2 ("a *dimmed area*…based on input to the sensor").

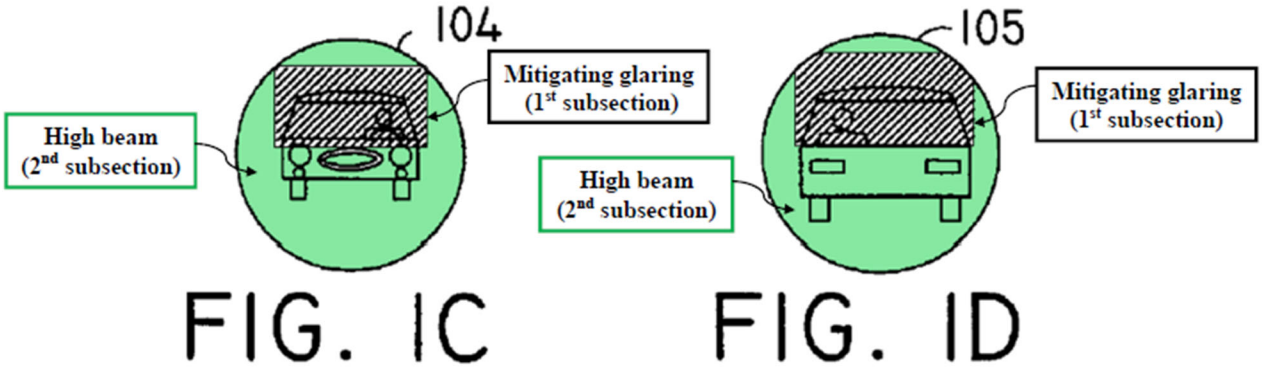
407. Beam also discloses "*determining*, from the *detected presence* of the oncoming or followed vehicle…*the shape, size and location of an area to be*

*darkened*…[and] *determining* which of said multiple rays of light must be *extinguished*." EX1005, 8:29-34, FIGS. 1, 1C-1D, 7; EX1005, 1:5-18 ("*reformatting* the *pattern* of a beam…to *prevent* it from illuminating *certain areas*…thus eliminating the blinding of a driver in an *oncoming vehicle*, while continuing to provide *intense forward illumination*"), 2:59-3:3, 4:10-25, 5:13-15, 5:33-54, 8:23-38.

408. Thus, Beam's light distribution pattern dims a first subsection to "mitigat[e] glare" and illuminates a second subsection to provide "preserved illumination." EX1005, 5:33-54, 6:12-27, FIGS. 1C-1D.




EX1005, FIG. 1 (annotated).




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

409. In view of the above, Beam discloses this claim.

**O. Claim 52: "The headlight system of claim 37, wherein the adapted headlight beam continues to provide high-beam illumination in the one or more second of the subsections without diminishing a range of the high-beam illumination."**

410. Beam's second subsection illumination is "a *much higher brightness beam*" and "the area of the beam 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; EX1005, 6:40-44 ("*bright high beams*"), 6:11-12 ("*maximum intensity*"), 1:5-18 ("*intense forward illumination*"). This "provide[s] high-beam illumination" in the second subsection "without diminishing a range of the high-beam illumination." EX1005, 2:59-3:3. *Supra* Section X.K.

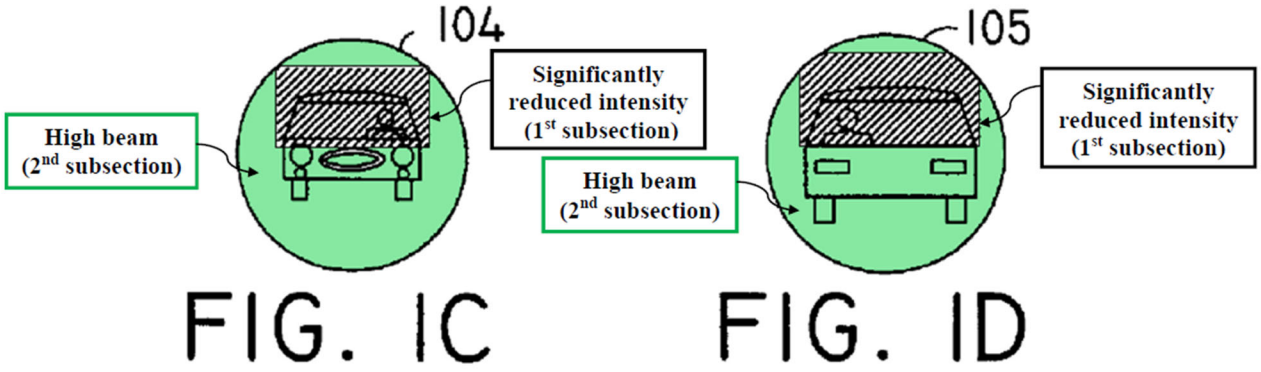



FIG. 1C FIG. 1D

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

411. In view of the above, Beam discloses this claim.

**P. Claim 53: "The headlight system of claim 37, wherein the one or more sensors further includes at least one of a camera, a microphone, an ultrasonic transducer and receiver, or an electromagnetic radiation source and detector including any of IR, UV, laser, or light."**

412. The language of claim 53 is identical to the language of claim 14 as shown above. *Supra* Section X.L; *see also* Appendix A. Therefore, my above analysis in Section X.L applies.

413. In view of the above, Beam discloses this claim.

**Q. Claim 57: "The headlight system of claim 37, wherein at least one light source provided to at least one headlamp includes a laser diode."**

414. The language of claim 57 is identical to the language of claim 18 as shown above. *Supra* Section X.M; *see also* Appendix A. Therefore, my above analysis in Section X.M applies.

415. In view of the above, Beam, alone or in combination with Thominet, discloses or renders obvious this claim.

**R. Claim 58: "The headlight system of claim 37, 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 clusters as part of the instructed operation."**

416. In my opinion, there is no patentable difference between the language of claim 58 and claim 19. *Supra* Section X.N; *see also* Appendix A. Therefore, my above analysis in Section X.N applies.

417. In view of the above, Beam discloses this claim.

418. Thus, Beam (with Thominet), or in combination with Stam, discloses or renders obvious claims 37-45, 47-48, 50-53, and 57-58 of the '503 patent.

## XII. GROUND 3: THE COMBINATION OF BEAM, THOMINET, AND KOBAYASHI RENDERS OBVIOUS CLAIMS 9 AND 15-17.

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

419. As described in Section X.A, a POSA would have been motivated to combine Beam-Thominet. A POSA would have been further motivated to modify Beam-Thominet to adjust light based on sensed data, such as map data from a GPS sensor (including road curvature/planned upcoming turns), as in Kobayashi, to further control Beam's system to illuminate curves/turns, thereby improving visibility and driver safety—an express purpose of Beam-Thominet. EX1005, 3:8-14, 3:37-45, 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.

420. Although live data could be used by vehicle sensors, it was well known that GPS navigation system gave additional advantages by providing more accurate information on driving regions. EX1026, 461-462 ("To obtain more accurate information on driving regions, it is advantageous to use data from a GPS navigation system.").

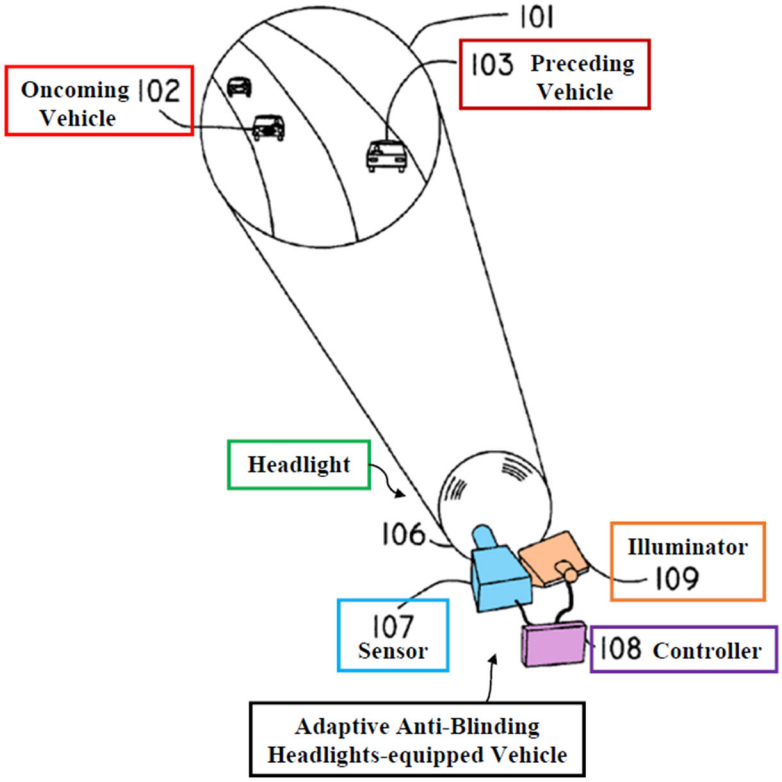
421. Further, conventional headlamps, with static high and low beams did not respond to changing driving conditions, and multiple beams were needed to provide "bending beams" for different types of road curvatures ("high speed," "middle speed," "low speed," "cross-roads"). EX1026, 451-452.

422. Beam-Thominet and Kobayashi 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. EX1005, 5:33-54, 3:8-45, 6:53-7:13; EX1008, 15:6-28.

423. *First*, including an additional data source for Beam-Thominet's controller—Kobayashi's *known technique* of using GPS data—would have enhanced Beam-Thominet by increasing/adjusting illumination based on a road curvature/planned upcoming 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*

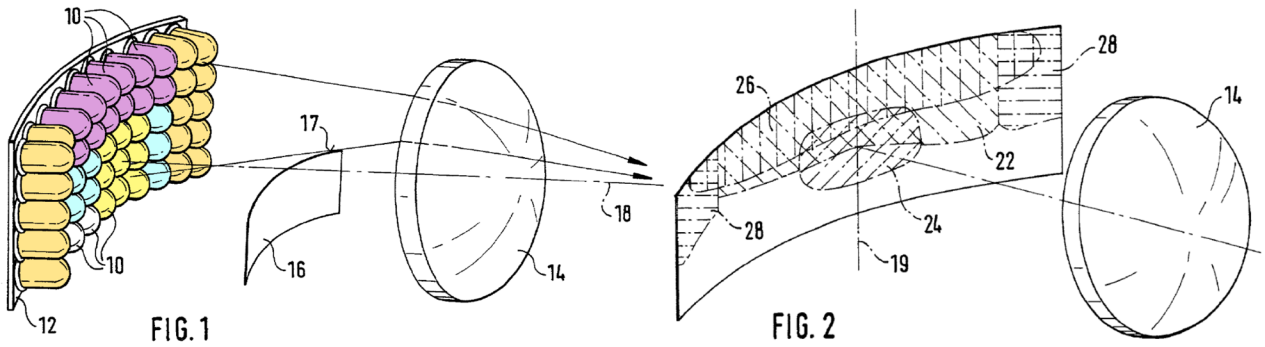
EX1008, Abstract, 1:10-2:35, 4:60-64, FIGS. 1, 10, 12) into Beam-Thominet. This would have, like Kobayashi, provided road curvature data for Beam's detected scene 101, allowing Beam-Thominet's system to increase illumination toward the road curvature/planned upcoming turn, further improving safety.

424. 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; EX1005, 4:16-19. Control is "*dynamically varying* in position and in size," in response to the input. EX1005, 6:24-27, 5:46-54. Beam acknowledges the beneifts of prior systems that control headlamps in response to changes in the vehicle's position (tilt on a hill) and steering mechanism (along a curve) and acknowledges those systems' safety benefits—noting that more active systems decrease the compromise between "reducing glare and providing enough light to the driver for adequate visibility." EX1005, 2:1-6, 2:15-22.




EX1005, FIG. 1 (annotated).

425. 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.



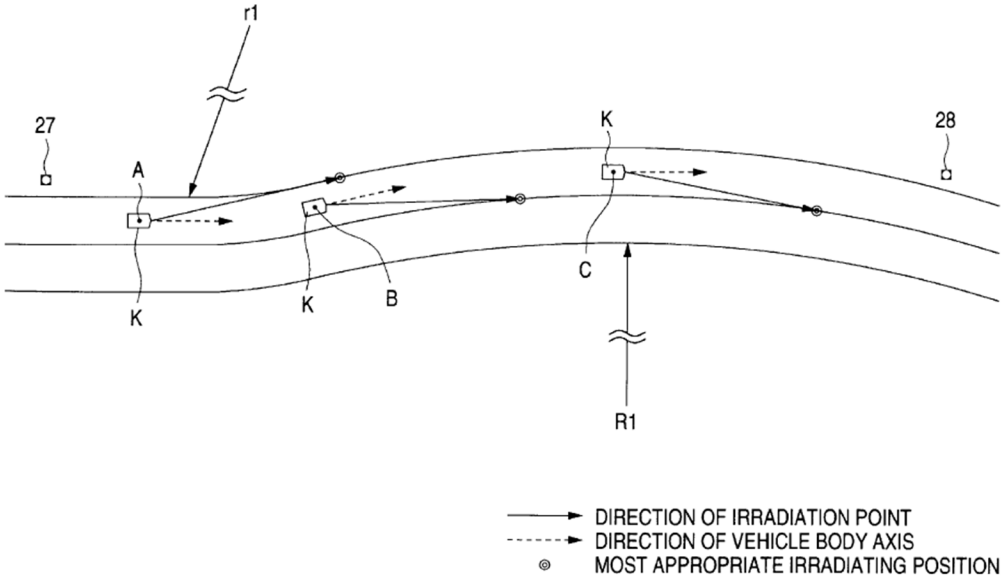

EX1006, FIGS. 1-2 (annotated).

426. Beam-Thominet does not disclose details on how to detect upcoming curves/turns, such as from GPS or navigation beacons, as an input to control the intensity, shape, and/or angular position of the microbeams, but this was well known in the art and it would have been obvious to a POSA to do so. 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 safety. EX1005, 3:8-45, 6:53-7:13. Kobayashi provides additional active techniques, specifically GPS sensor data-based control (including road curvature/planned upcoming turns).

427. Kobayashi's active *techniques and system components*, like Beam-Thominet, seek to enhance driver safety—using GPS sensor data-based control. EX1008, 15:6-28. Kobayashi's GPS data are inputs to control means 4, which alters the light direction from its headlamp 5 in response to road curvature/planned upcoming turn data, enhancing safety. EX1008, 3:9-50, 6:4-62, FIG. 1, 15:6-28 ("safety of driving can be enhanced"). Kobayashi's system responds to real-world conditions, multiple curves, and intersections. EX1008, 11:34-14:52, 17:41-50.

428. Kobayashi's Figure 10 shows illumination control is planned and controlled for multiple curves/turns. 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.




EX1008, FIG. 10.

429. A POSA would have understood that including an additional data source for Beam-Thominet's controller/processor—Kobayashi's GPS sensor data—would have enhanced Beam-Thominet by increasing illumination of a road curvature/upcoming turn, thereby improving safety. This would have merely been applying Kobayashi's known technique (using GPS sensor data to shape/reshape light) to Beam-Thominet's similar, known device (dynamic headlamp system with controllable beams), in the same way. 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.

430. 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 GPS data) according to known methods (disclosed in Beam-Thominet and Kobayashi) to yield predictable results (illuminating curves/turns, improving safety).

431. A POSA would have had a reasonable expectation of success combining Kobayashi with Beam-Thominet. A POSA would have understood *how* to combine their disclosures, for example, by simply modifying software instructions stored in memory of Beam-Thominet's controller/processor (e.g., ECU) to adjust and direct light of the microbeams appropriately in view of Kobayashi's GPS data. It also would have been straightforward combination of prior-art elements: Kobayashi's GPS sensor (e.g., GPS navigation device 29) with Beam-Thominet (in communication with Beam's controller).

432. Such modifications 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. In applying Kobayashi's technique to Beam-Thominet, a POSA would have simply been applying a known technique in a predictable way—controlling headlights in

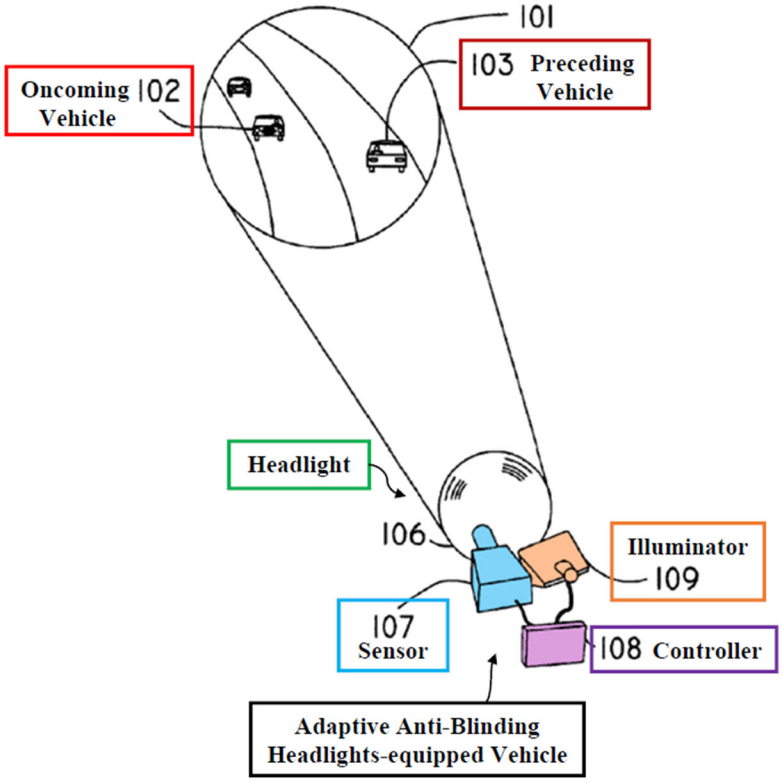
part based on GPS data (including road curvature/planned upcoming turns)—as already disclosed in the art. And in combining Beam-Thominet with Kobayashi's road profile calculating means 2 and/or vehicle advancing direction prediction means 3 (e.g., revising control input/output on an ECU), a POSA would have simply been combining known elements according to known methods (disclosed in Kobayashi) to yield predictable results (additional light control).

433. I lay out below the specific disclosures of Beam-Thominet and Kobayashi, and expand on this combination and reasonable expectation of success analysis below.

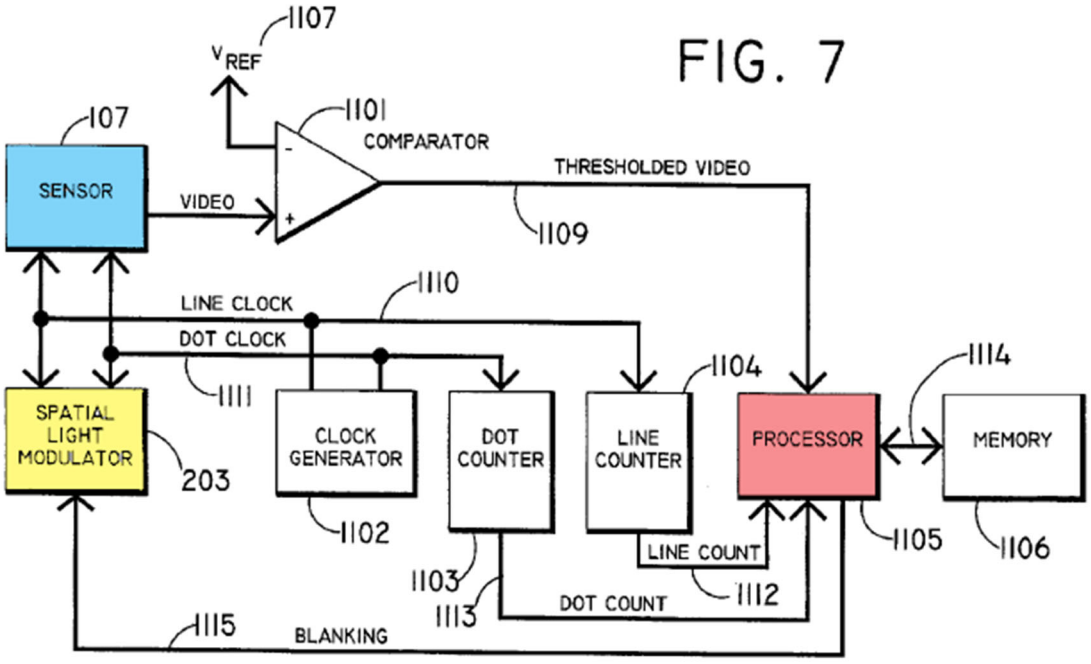
### B. Claim 9: "The headlight system of claim 1, wherein the one or more sensors includes a GPS sensor."

#### 1. Beam-Thominet's disclosure

434. Beam's "controller module uses the *sensor spatial data (video)*…to *control the Illuminator*" and "*[p]rocessor…commands* the appropriate pixels." EX1005, 6:14-17, 5:46-54, FIGS. 1, 7; EX1005, 6:12-14 ("[a]n imaging *sensor*"), 5:33-54 ("*spatial scene data [101]* from sensor 107…becomes the input to a processor 1105"), 4:10-25, 4:53-59, 2:35-38, Abstract.




EX1005, FIG. 1 (annotated).

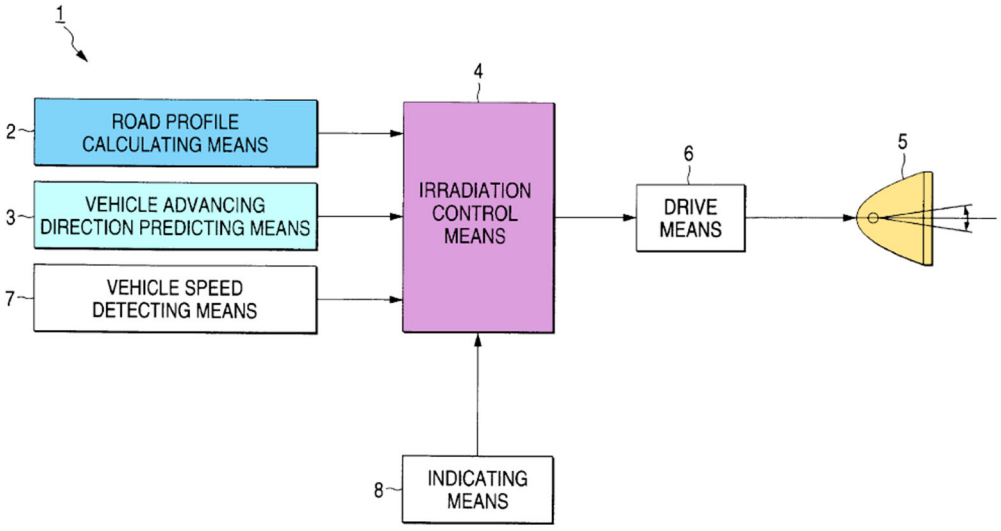



EX1005, FIG. 7 (annotated).

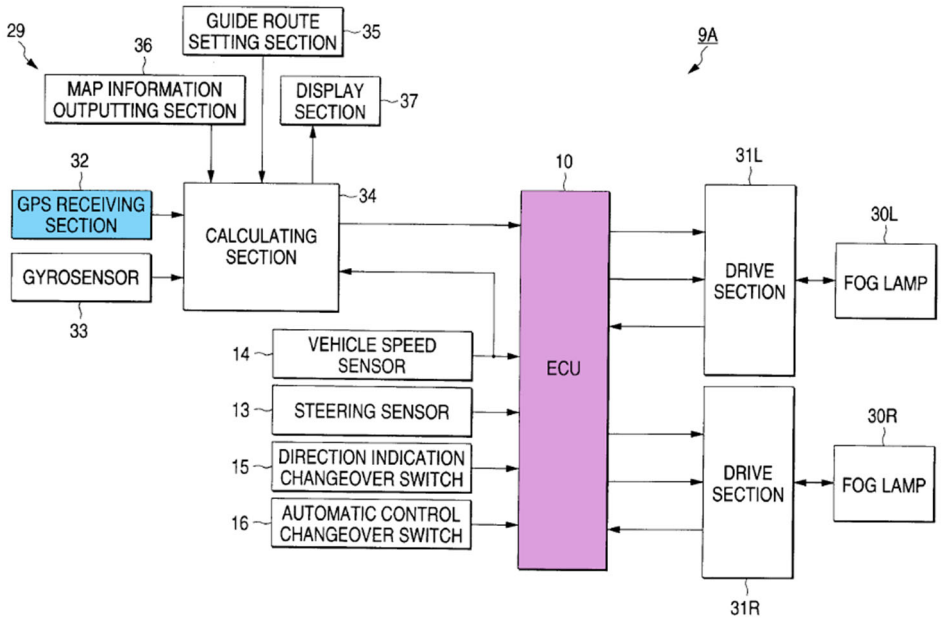
435. Beam-Thominet does not disclose a GPS sensor, but this feature was well known in the prior art, e.g., as explicitly disclosed by Kobayashi. *See also* EX1024, 815-816 ("digital *GPS information* on actual road curvature, information on distance of preceding or following vehicles etc"); EX1026, 461-462 ("[t]o obtain more accurate information on driving regions, it is advantageous to use data from a *GPS navigation system*").

### 2. Kobayashi's disclosure

436. Kobayashi discloses "*GPS navigation device 29* corresponding to the road profile calculating means 2 includes…*GPS receiving section 32*" and "GPS navigation device 29 sends information about the road profile…to ECU 10." EX1008, 17:3-47, 9:39-41, FIGS. 1, 9, 10, 12; EX1008, 3:9-50, 14:53-15:28.




EX1008, FIG. 1 (annotated).




EX1008, FIG. 12 (annotated).

437. As discussed, a POSA would have been motivated to combine Kobayashi with Beam-Thominet with a reasonable expectation of success. *Supra* Section XII.A.

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

438. As described in Section X.A, a POSA would have been motivated to combine Beam-Thominet. A POSA would have been further motivated to modify Beam-Thominet to adjust light based on sensed data, such as map data from a GPS sensor (including road curvature/planned upcoming turns), as in Kobayashi, to further control Beam's system to illuminate curves/turns, thereby improving visibility and driver safety—an express purpose of Beam-Thominet. EX1005, 3:8-

14, 3:37-45, 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.

439. Although live data could be used by vehicle sensors, it was well known that GPS navigation system gave additional advantages by providing more accurate information on driving regions. EX1026, 461-462 ("To obtain more accurate information on driving regions, it is advantageous to use data from a GPS navigation system.").

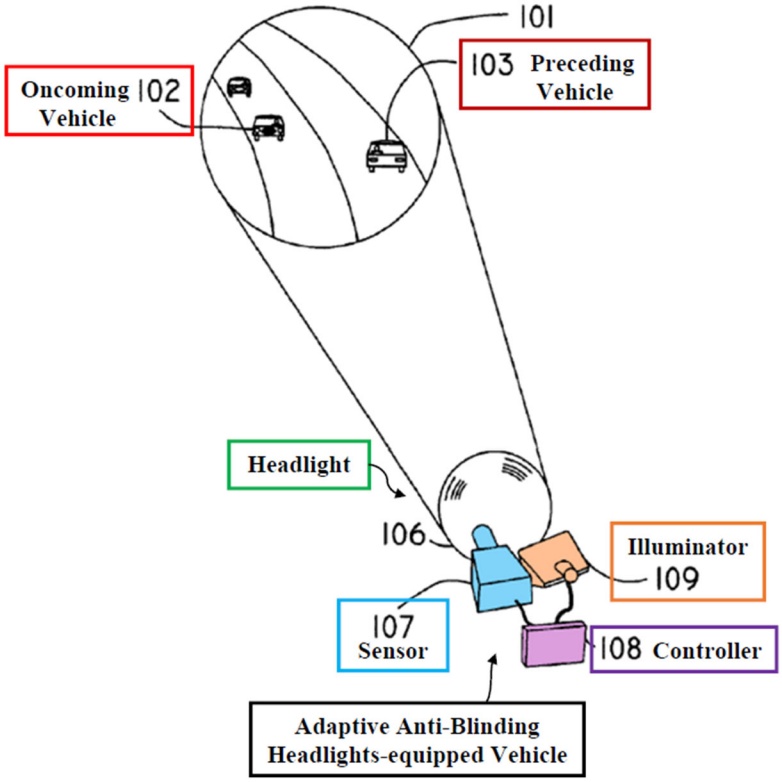
440. Further, conventional headlamps, with static high and low beams did not respond to changing driving conditions, and multiple beams were needed to provide "bending beams" for different types of road curvatures ("high speed," "middle speed," "low speed," "cross-roads"). EX1026, 451-452.

441. Beam-Thominet and Kobayashi 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. EX1005, 5:33-54, 3:8-45, 6:53-7:13; EX1008, 15:6-28.

442. *First*, including an additional data source for Beam-Thominet's controller—Kobayashi's *known technique* of using GPS data—would have enhanced Beam-Thominet by increasing/adjusting illumination based on a road curvature/planned upcoming turn, improving driver safety by providing light to where it is needed. *Second*, a POSA would have easily incorporated *known*

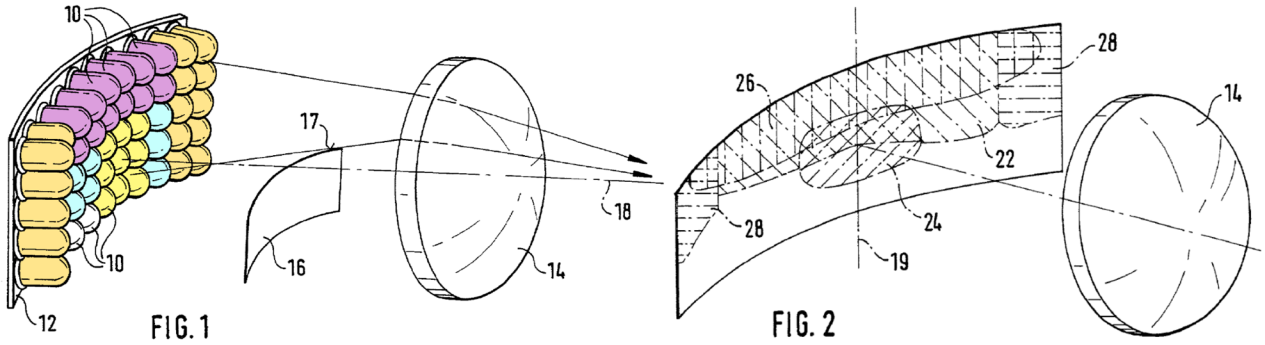
*components* of Kobayashi's road profile calculating means 2 and/or vehicle advancing direction prediction means 3 (including *GPS navigation device 29*, *see* EX1008, Abstract, 1:10-2:35, 4:60-64, FIGS. 1, 10, 12) into Beam-Thominet. This would have, like Kobayashi, provided road curvature data for Beam's detected scene 101, allowing Beam-Thominet's system to increase illumination toward the road curvature/planned upcoming turn, further improving safety.

443. 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; EX1005, 4:16-19. Control is "*dynamically varying* in position and in size," in response to the input. EX1005, 6:24-27, 5:46-54. Beam acknowledges the benefits of prior systems that control headlamps in response to changes in the vehicle's position (tilt on a hill) and steering mechanism (along a curve) and acknowledges those systems' safety benefits—noting that more active systems decrease the compromise between "reducing glare and providing enough light to the driver for adequate visibility." EX1005, 2:1-6, 2:15-22.




EX1005, FIG. 1 (annotated).

444. 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.

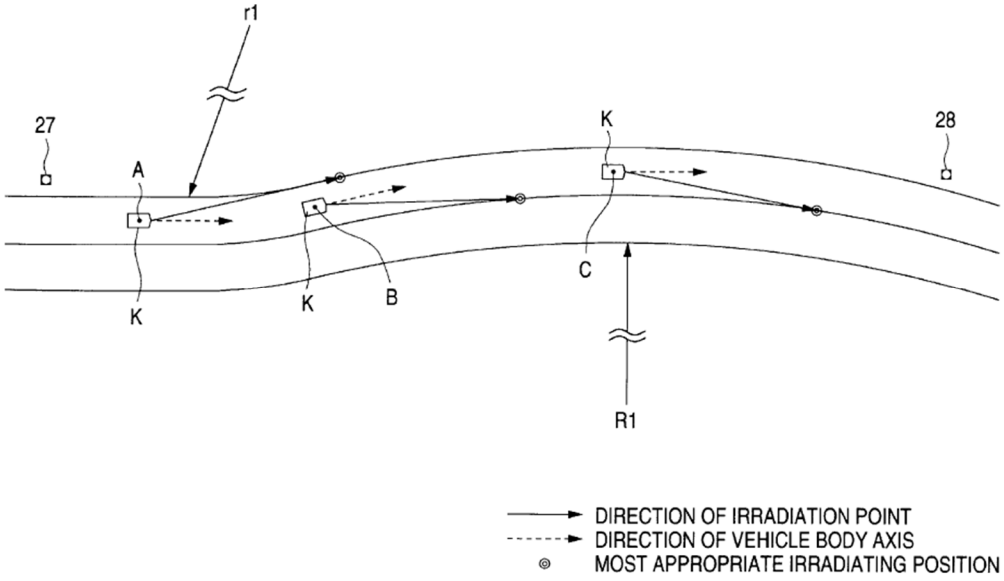



EX1006, FIGS. 1-2 (annotated).

445. Beam-Thominet does not disclose a GPS sensor, but this was well known in the art and it would have been obvious to a POSA to do so. 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 safety. EX1005, 3:8-45, 6:53-7:13. Kobayashi provides additional active techniques, specifically GPS sensor data-based control (including road curvature/planned upcoming turns).

446. Kobayashi's active *techniques and system components*, like Beam-Thominet, seek to enhance driver safety—using GPS sensor data-based control. EX1008, 15:6-28. Kobayashi's GPS data (from *GPS navigation device 29*) are inputs to control means 4, which alters the light direction from its headlamp 5 in response to road curvature/planned upcoming turn data, enhancing safety. EX1008, 3:9-50, 6:4-62, FIG. 1, 15:6-28 ("safety of driving can be enhanced"). Kobayashi's system responds to real-world conditions, multiple curves, and intersections. EX1008, 11:34-14:52, 17:41-50.

447. Kobayashi's Figure 10 shows illumination control is planned and controlled for multiple curves. 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.




EX1008, FIG. 10.

448. A POSA would have understood that including an additional data source for Beam-Thominet's controller/processor—Kobayashi's GPS sensor data—would have enhanced Beam-Thominet by increasing illumination of a road curvature/upcoming turn, thereby improving safety. This would have merely been applying Kobayashi's known technique (using GPS sensor data to shape/reshape light) to Beam-Thominet's similar, known device (dynamic headlamp system with controllable beams), in the same way. 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.

449. 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

GPS data) according to known methods (disclosed in Beam-Thominet and Kobayashi) to yield predictable results (illuminating curves/turns, improving safety).

450. A POSA would have had a reasonable expectation of success combining Kobayashi with Beam-Thominet. A POSA would have understood *how* to combine their disclosures, for example, by simply modifying software instructions stored in memory of Beam-Thominet's controller/processor (e.g., ECU) to adjust and direct light of the microbeams appropriately in view of Kobayashi's GPS data. It also would have been straightforward combination of prior-art elements: Kobayashi's GPS sensor (e.g., *GPS navigation device 29*) with Beam-Thominet (in communication with Beam's controller).

451. Such modifications 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. In applying Kobayashi's technique to Beam-Thominet, a POSA would have simply been applying a known technique in a predictable way—controlling headlights in part based on GPS data (including road curvature/planned upcoming turns)—as already disclosed in the art. And in combining Beam-Thominet with Kobayashi's road profile calculating means 2 and/or vehicle advancing direction prediction

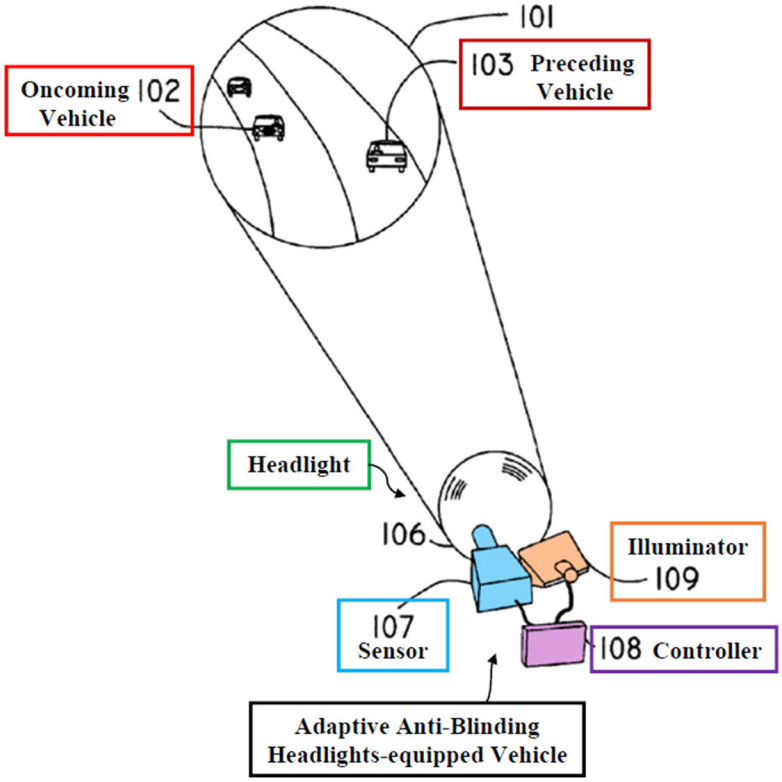
means 3 (e.g., revising control input/output on an ECU), a POSA would have simply been combining known elements according to known methods (disclosed in Kobayashi) to yield predictable results (additional light control).

452. In view of the above, Beam-Thominet in combination with Kobayashi renders obvious this claim.

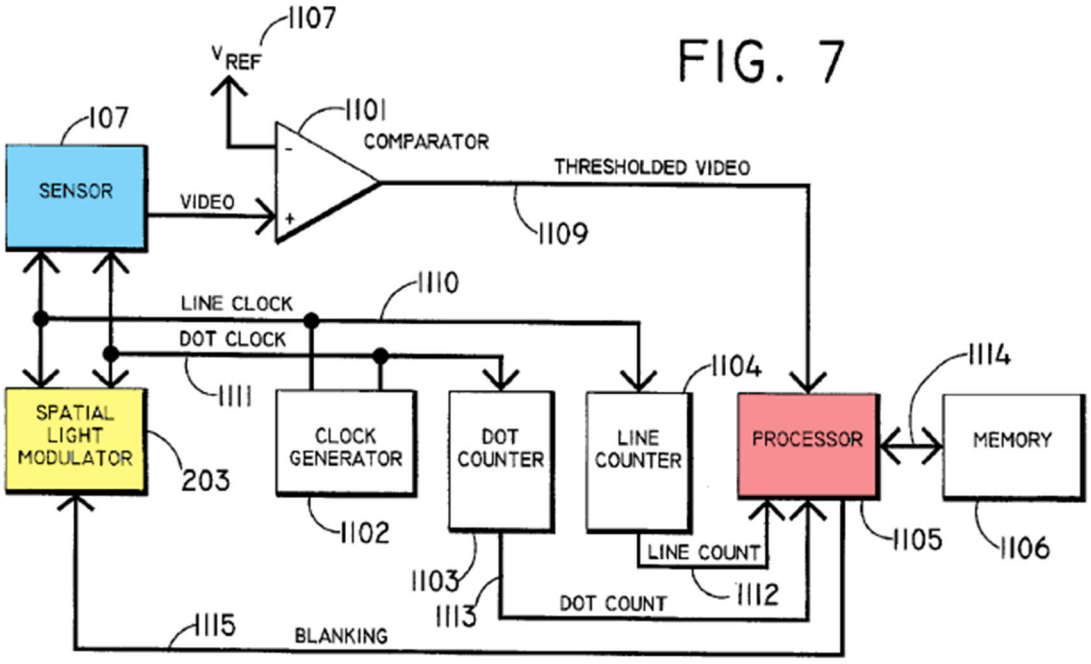
### C. Claim 15: "The system of claim 1, wherein the logical controller is further configured to determine at least a road curvature, indicated by the sensor data, ahead of the vehicle and wherein the required illumination includes increasing illumination in a direction of the road curvature."

#### 1. Beam-Thominet's disclosure

453. Beam's "controller module uses the *sensor spatial data (video)*…to *control the Illuminator*" and "*[p]rocessor*…*commands* the appropriate pixels." EX1005, 6:14-27, 5:46-54, FIGS. 1, 7; EX1005, 5:33-54 ("*spatial scene data [101]* from sensor 107…becomes the input to a processor"), 4:53-59, 2:35-38, Abstract.

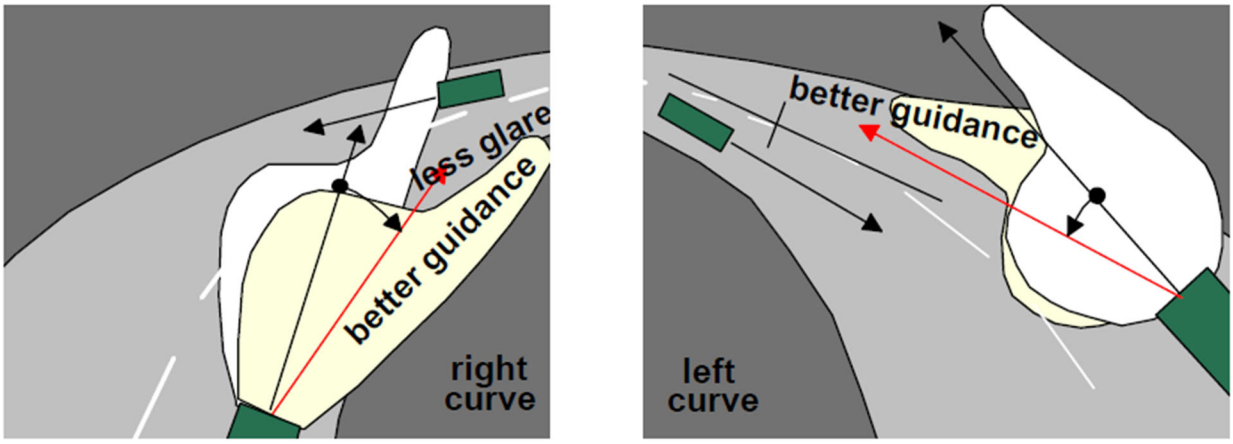



EX1005, FIG. 1 (annotated).




EX1005, FIG. 7 (annotated).

454. Beam-Thominet does not disclose determining a road curvature (even though the spatial data disclosed by Beam should normally include the road curvature information) and increasing illumination in a direction of the road curvature, but this feature was well known in the prior art, e.g., as explicitly disclosed by Kobayashi. *See also* EX1015, 18 ("glare reduction and visibility improvement in curves"), FIG. 2.8; EX1017, 5, 8 ("in a narrow bend a special curve illumination makes pedestrians or obstacles visible for the driver which normally will be hidden"), FIGS. 1, 3-5, 7; EX1020, 376 ("curve lighting"), 378 ("turns/crossings lighting"), FIGS. 10-11.




EX1015, FIG. 2.8.

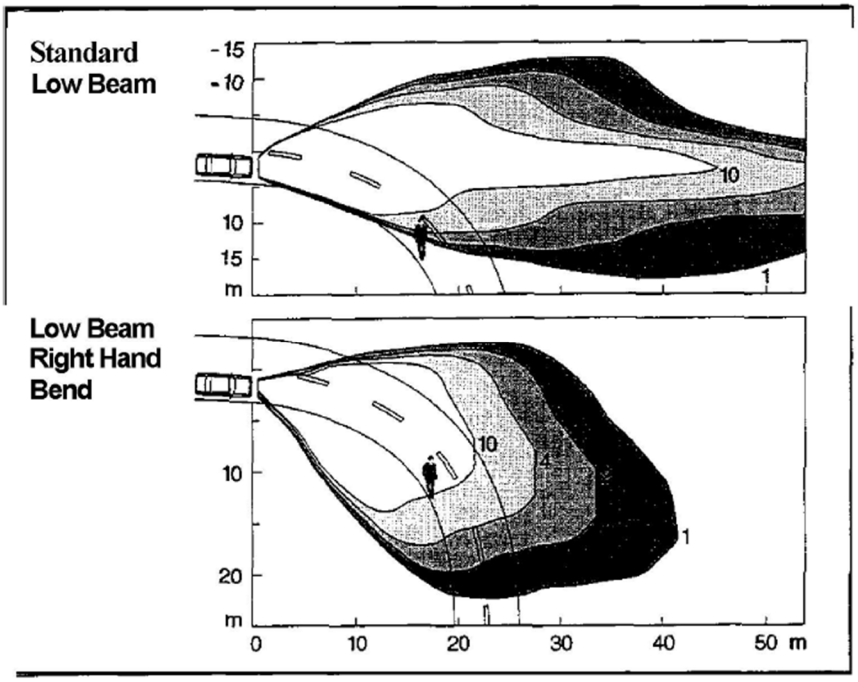



Fig. 7: comparison between basic low beam and right curve illumination, Isolux curves from bird eye's view

EX1017, FIG. 7.

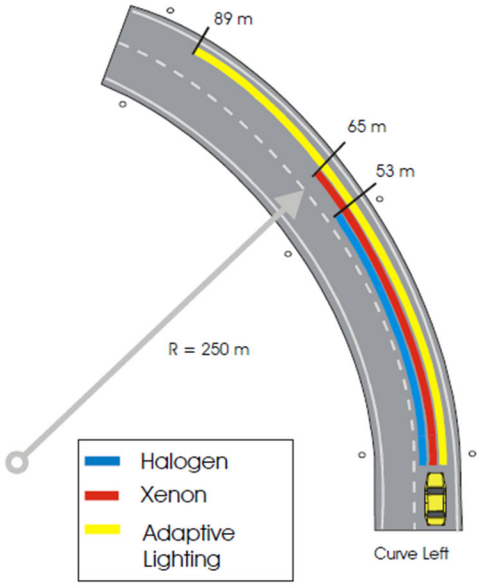
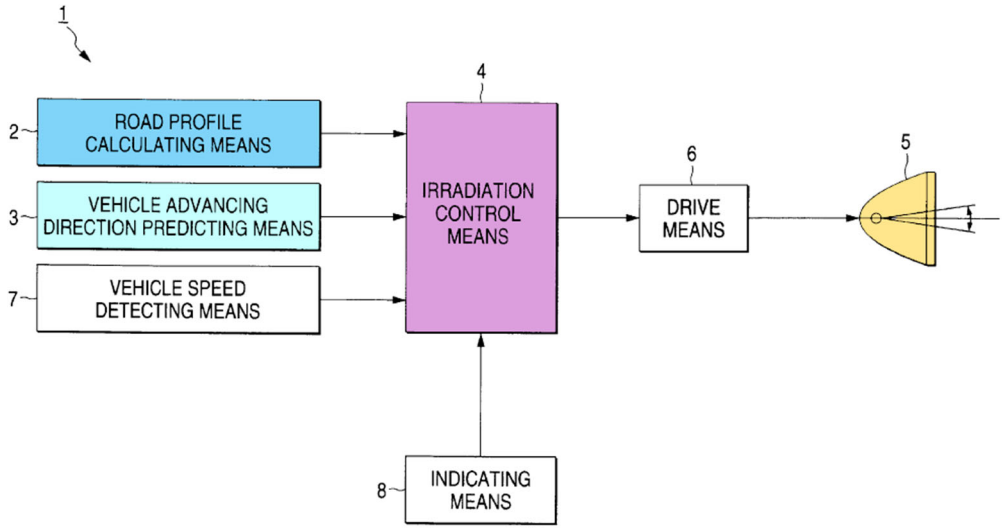



*Figure 10: Static test: Results of the investigations about visibility distances obtained with halogen-, HID- and adaptive headlamps.*

EX1020, FIG. 10.

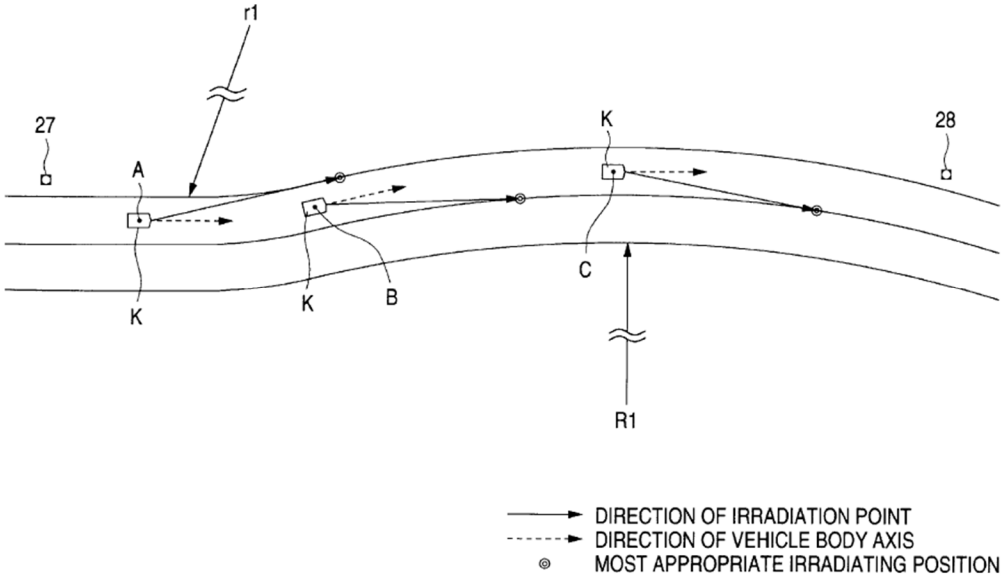
### 2. Kobayashi's disclosure

455. 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; EX1008, 4:60-64 ("irradiation control means 4 conducts irradiation control…with the *road profile*"), 3:9-50, 14:53-15:28.




EX1008, FIG. 1 (annotated).

456. For example, Kobayashi discloses irradiation control of vehicle K can be planned and controlled on curved roads r1, R1 to improve safety such that when vehicle K turns left (point A), the left shoulder is irradiated, and when vehicle K turns right (point C), the right shoulder is irradiated. EX1008, 14:53-15:28, FIG. 10.




EX1008, FIG. 10.

457. As discussed, a POSA would have been motivated to combine Kobayashi with Beam-Thominet with a reasonable expectation of success. *Supra* Section XII.A.

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

458. As described in Section X.A, a POSA would have been motivated to combine Beam-Thominet. A POSA would have been further motivated to modify Beam-Thominet to adjust light based on sensed data, such as map data from a GPS sensor (including road curvature), as in Kobayashi, to further control Beam's system to illuminate curves, thereby improving visibility and driver safety—an express purpose of Beam-Thominet. EX1005, 3:8-14, 3:37-45, 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.

459. Although live data could be used by vehicle sensors, it was well known that GPS navigation system gave additional advantages by providing more accurate information on driving regions. EX1026, 461-462 ("To obtain more accurate information on driving regions, it is advantageous to use data from a GPS navigation system.").

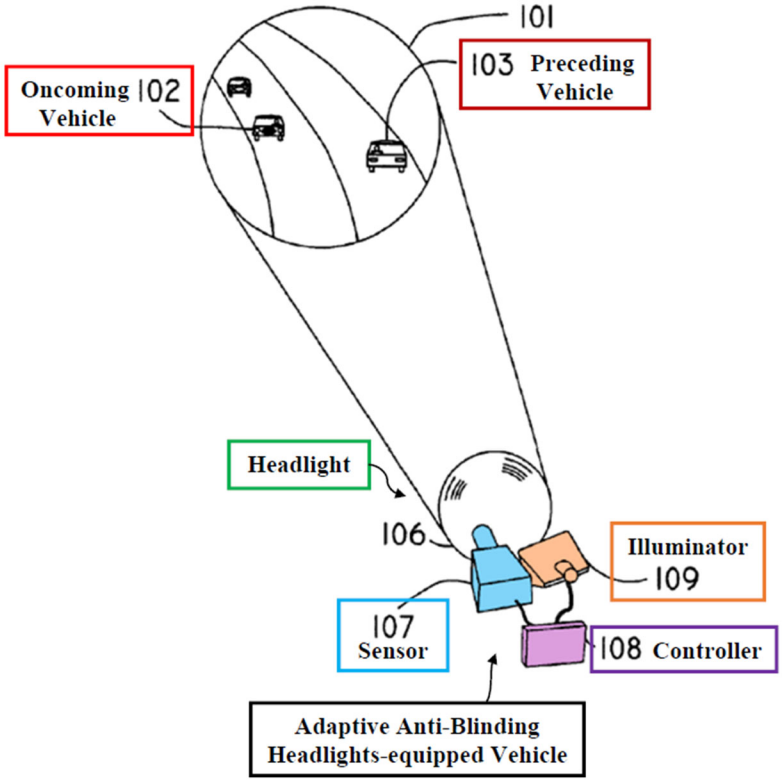
460. Further, conventional headlamps, with static high and low beams did not respond to changing driving conditions, and multiple beams were needed to provide "bending beams" for different types of road curvatures ("high speed," "middle speed," "low speed," "cross-roads"). EX1026, 451-452.

461. Beam-Thominet and Kobayashi 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. EX1005, 5:33-54, 3:8-45, 6:53-7:13; EX1008, 15:6-28.

462. *First*, including an additional data source for Beam-Thominet's controller—Kobayashi's *known technique* of using GPS data—would have enhanced Beam-Thominet by increasing/adjusting illumination based on a road curvature, improving driver safety by providing light to where it is needed. *Second*, a POSA would have easily incorporated *known components* of Kobayashi's road

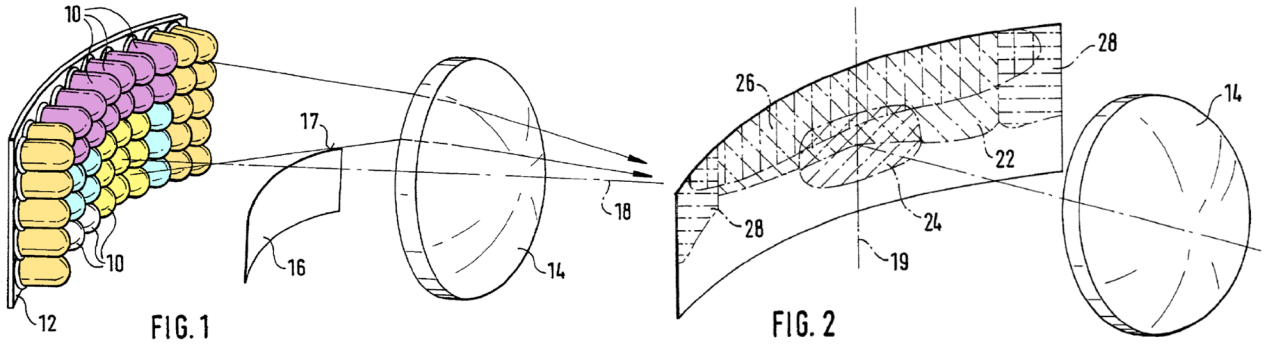
profile calculating means 2 and/or vehicle advancing direction prediction means 3 (including GPS navigation device 29, *see* EX1008, Abstract, 1:10-2:35, 4:60-64, FIGS. 1, 10, 12) into Beam-Thominet. This would have, like Kobayashi, provided road curvature data for Beam's detected scene 101, allowing Beam-Thominet's system to increase illumination toward the road curvature, further improving safety.

463. 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; EX1005, 4:16-19. Control is "*dynamically varying* in position and in size," in response to the input. EX1005, 6:24-27, 5:46-54. Beam acknowledges the beneifts of prior systems that control headlamps in response to changes in the vehicle's position (tilt on a hill) and steering mechanism (along a curve) and acknowledges those systems' safety benefits—noting that more active systems decrease the compromise between "reducing glare and providing enough light to the driver for adequate visibility." EX1005, 2:1-6, 2:15-22.




EX1005, FIG. 1 (annotated).

464. 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.



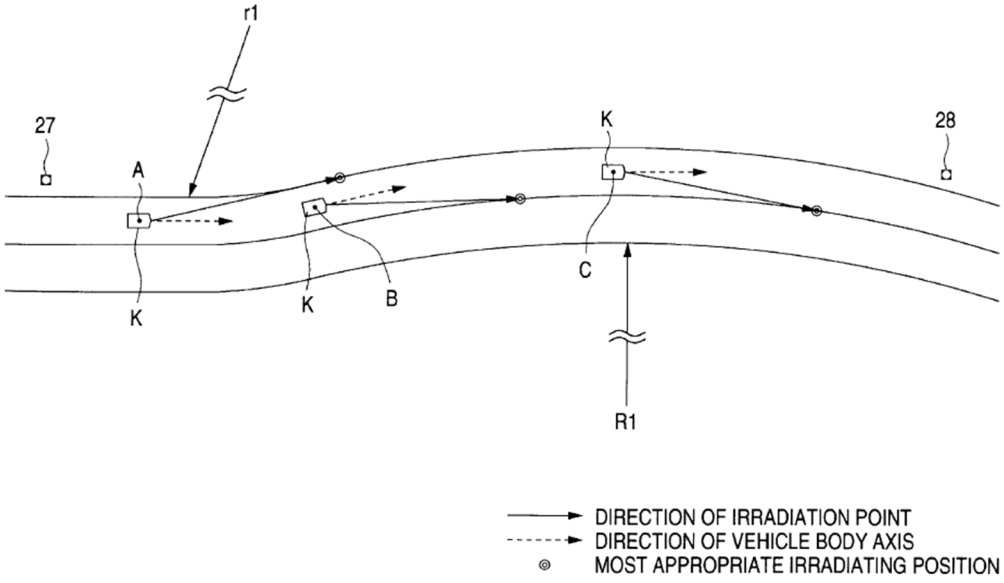

EX1006, FIGS. 1-2 (annotated).

465. Beam-Thominet does not disclose details on how to detect a road curvature, such as from GPS or navigation beacons, as an input to control the intensity, shape, and/or angular position of the microbeams, but this was well known in the art and it would have been obvious to a POSA to do so. 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 safety. EX1005, 3:8-45, 6:53-7:13. Kobayashi provides additional active techniques, specifically GPS sensor data-based control (including road curvature).

466. Kobayashi's active *techniques and system components*, like Beam-Thominet, seek to enhance driver safety—using GPS sensor data-based control including road curvature. EX1008, 15:6-28. 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 its headlamp 5 in response to road curvature data, enhancing safety. EX1008, 3:9-50, 6:4-62, FIG. 1, 15:6-28 ("safety of driving can be enhanced"). Kobayashi's system responds to real-world conditions, multiple curves, and intersections. EX1008, 11:34-14:52, 17:41-50.

467. Kobayashi's Figure 10 shows illumination control is planned and controlled for multiple curves. 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.




EX1008, FIG. 10.

468. A POSA would have understood that including an additional data source for Beam-Thominet's controller/processor—Kobayashi's GPS sensor data—would have enhanced Beam-Thominet by increasing illumination of a road curvature, thereby improving safety. This would have merely been applying Kobayashi's known technique (using GPS sensor data including road curvature to shape/reshape light) to Beam-Thominet's similar, known device (dynamic headlamp system with controllable beams), in the same way. 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.

469. 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 GPS data) according to known methods (disclosed in Beam-Thominet and Kobayashi) to yield predictable results (illuminating the road curvature, improving safety).

470. A POSA would have had a reasonable expectation of success combining Kobayashi with Beam-Thominet. A POSA would have understood *how* to combine their disclosures, for example, by simply modifying software instructions stored in memory of Beam-Thominet's controller/processor (e.g., ECU) to adjust and direct light of the microbeams appropriately in view of Kobayashi's GPS data. It also would have been straightforward combination of prior-art elements: Kobayashi's road profile calculating means 2 and/or vehicle advancing direction prediction means 3 (e.g., including GPS navigation device 29) with Beam-Thominet (in communication with Beam's controller).

471. Such modifications 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. In applying Kobayashi's technique to Beam-Thominet, a POSA would have simply

been applying a known technique in a predictable way—controlling headlights in part based on GPS data (including road curvature)—as already disclosed in the art. And in combining Beam-Thominet with Kobayashi's road profile calculating means 2 and/or vehicle advancing direction prediction means 3 (e.g., revising control input/output on an ECU), a POSA would have simply been combining known elements according to known methods (disclosed in Kobayashi) to yield predictable results (additional light control).

472. In view of the above, Beam-Thominet in combination with Kobayashi renders obvious this claim.

**D. Claim 16: "The system of claim 15, wherein the logical controller is further configured to determine at least a planned upcoming turn, indicated by the sensor data, and wherein the required illumination includes increasing illumination illuminating the turn."**

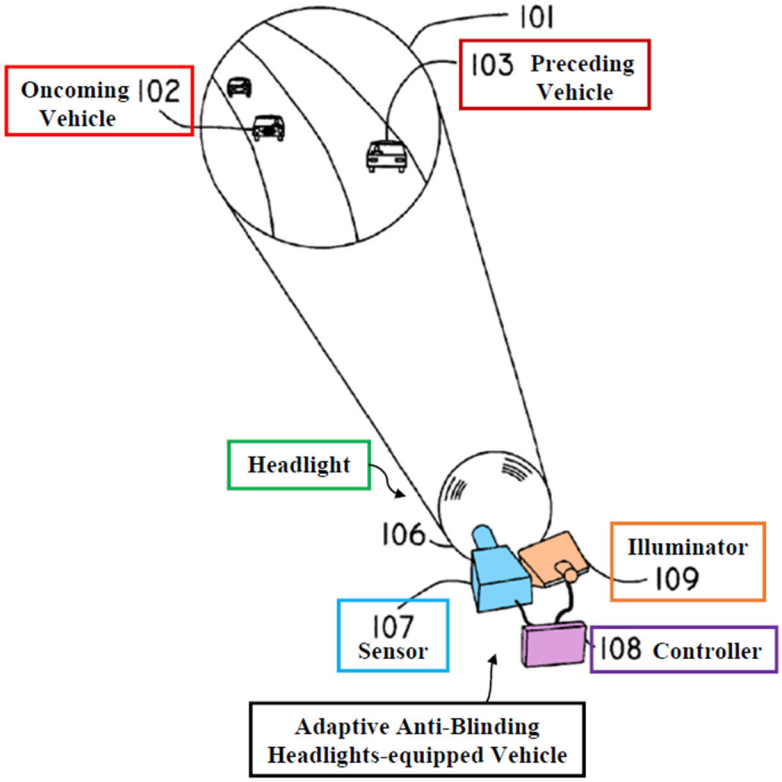
**Claim 17: "The system of claim 1, wherein the logical controller is further configured to determine at least a planned upcoming turn, indicated by the sensor data, and wherein the required illumination includes increasing illumination illuminating the turn."**

473. The language of claim 17 is identical to the language of claim 16 as shown above. *See also* Appendix A and Appendix B.

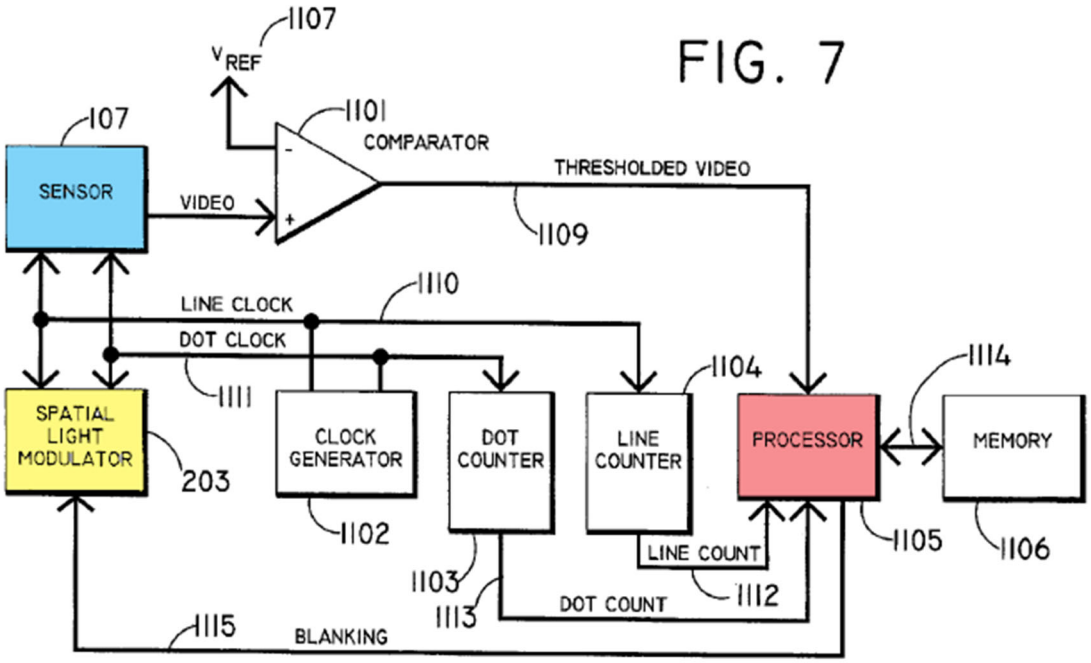
**1. Beam-Thominet's disclosure**

474. Beam's "controller module uses the *sensor spatial data (video)*…to *control the Illuminator*" and "*[p]rocessor*…*commands* the appropriate pixels." EX1005, 6:14-27, 5:46-54, FIGS. 1, 7; EX1005, 5:33-54 ("*spatial scene data*

*[101]* from sensor 107…becomes the input to a processor"), 4:53-59, 2:35-38, Abstract.

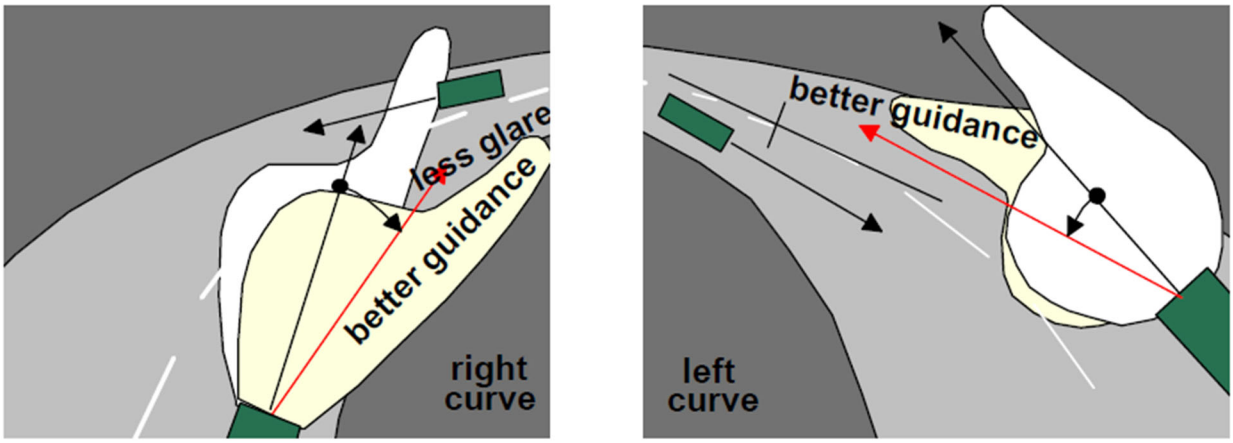



EX1005, FIG. 1 (annotated).




EX1005, FIG. 7 (annotated).

475. Beam-Thominet does not disclose determining a planned upcoming turn (even though the spatial data disclosed by Beam should normally include the upcoming turn information) and increasing illumination to illuminate the turn, but this feature was well known in the prior art, e.g., as explicitly disclosed by Kobayashi. *See also* EX1015, 18 ("glare reduction and visibility improvement in curves"), FIG. 2.8; EX1017, 5, 8 ("in a narrow bend a special curve illumination makes pedestrians or obstacles visible for the driver which normally will be hidden"), FIGS. 1, 3-5, 7; EX1020, 376 ("curve lighting"), 378 ("turns/crossings lighting"), FIGS. 10-11.




EX1015, FIG. 2.8.

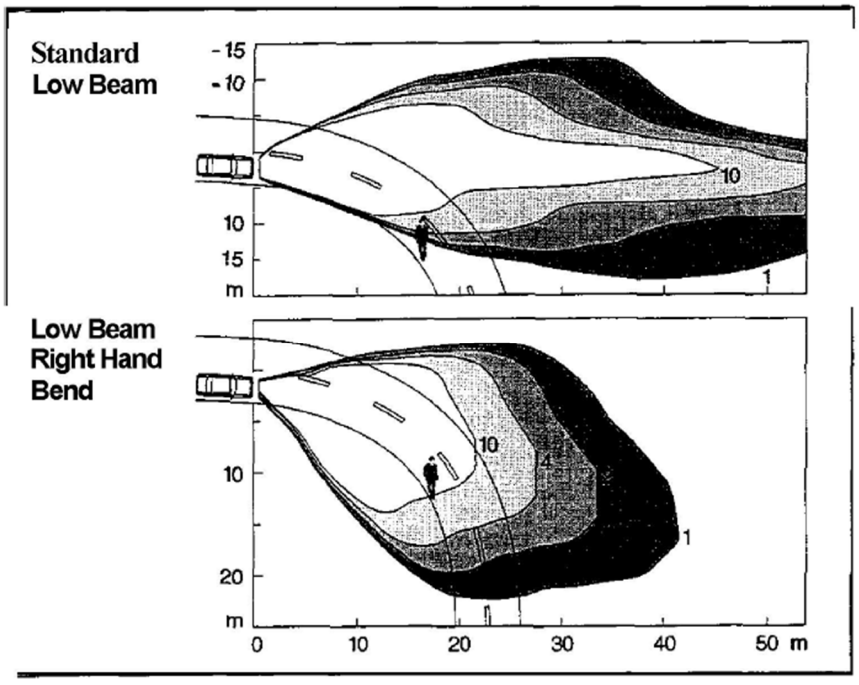



Fig. 7: comparison between basic low beam and right curve illumination, Isolux curves from bird eye's view

EX1017, FIG. 7.

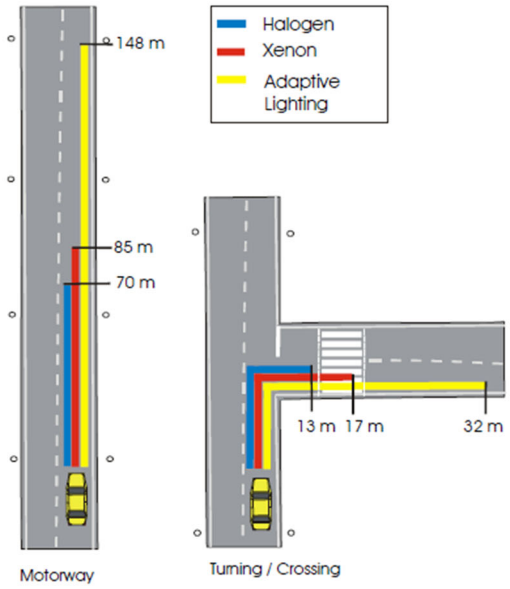


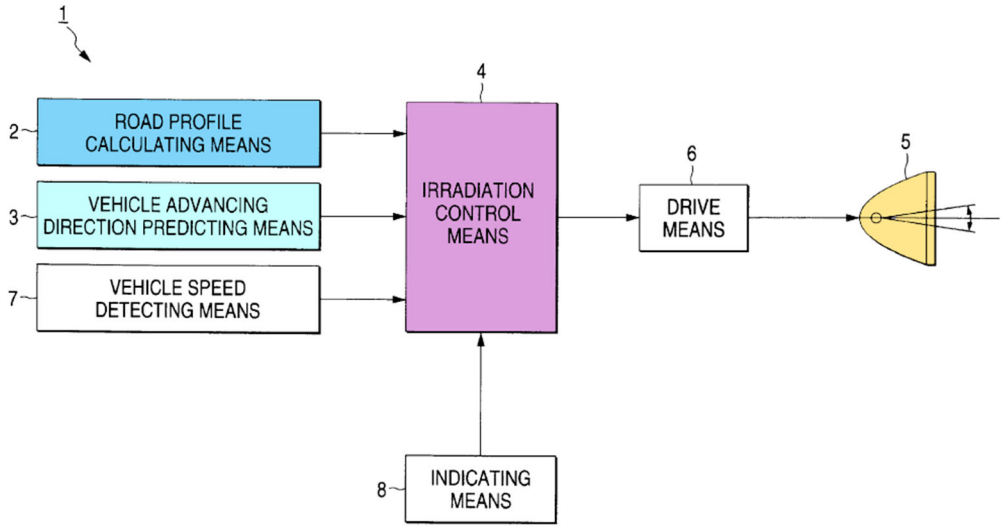

*Figure 11: Static test: Results of the investigations about visibility distances obtained with halogen-, HID- and adaptive headlamps*

EX1020, FIG. 11.

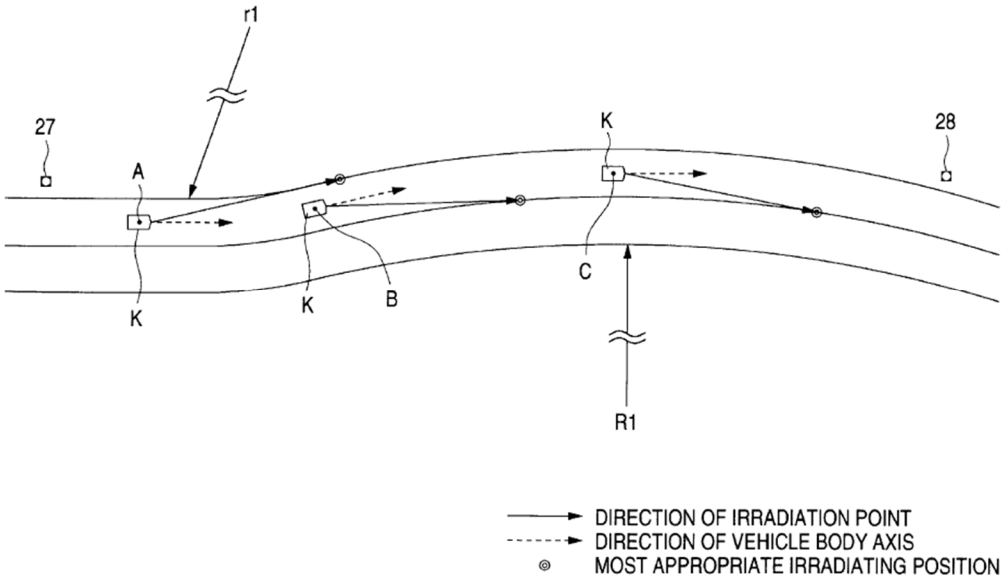
**2. Kobayashi's disclosure**

476. 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; EX1008, 4:6-8 ("*predicts a vehicle advancing direction* at which the driver aims"), 3:9-50, 11:34-14:52.

477. A POSA would have understood that Kobayashi discloses illumination for "a planned upcoming turn" recited in claims 16-17 because illumination is controlled along the "scheduled course" that includes an intended direction of a driver (e.g., left or right turn). *See* EX1008, 9:38-41; EX1001, 54:1-15 ("[a] driver can't make a 90-degree turn traveling 90 km/h but from a stop, the turn may be around a corner…the more angled SLS 284, closer in for illuminating [a] sharp turn, than that of the less angled SLS 283 for a shallow curve"), 56:33-54.




EX1008, FIG. 1 (annotated).




EX1008, FIG. 10.

478. As discussed, a POSA would have been motivated to combine Kobayashi with Beam-Thominet with a reasonable expectation of success. *Supra* Section XII.A.

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

479. As described in Section X.A, a POSA would have been motivated to combine Beam-Thominet. A POSA would have been further motivated to modify Beam-Thominet to adjust light based on sensed data, such as map data from a GPS sensor (including planned upcoming turns), as in Kobayashi, to further control Beam's system to illuminate turns, thereby improving visibility and driver safety—an express purpose of Beam-Thominet. EX1005, 3:8-14, 3:37-45, 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.

480. Although live data could be used by vehicle sensors, it was well known that GPS navigation system gave additional advantages by providing more accurate information on driving regions. EX1026, 461-462 ("To obtain more accurate information on driving regions, it is advantageous to use data from a GPS navigation system.").

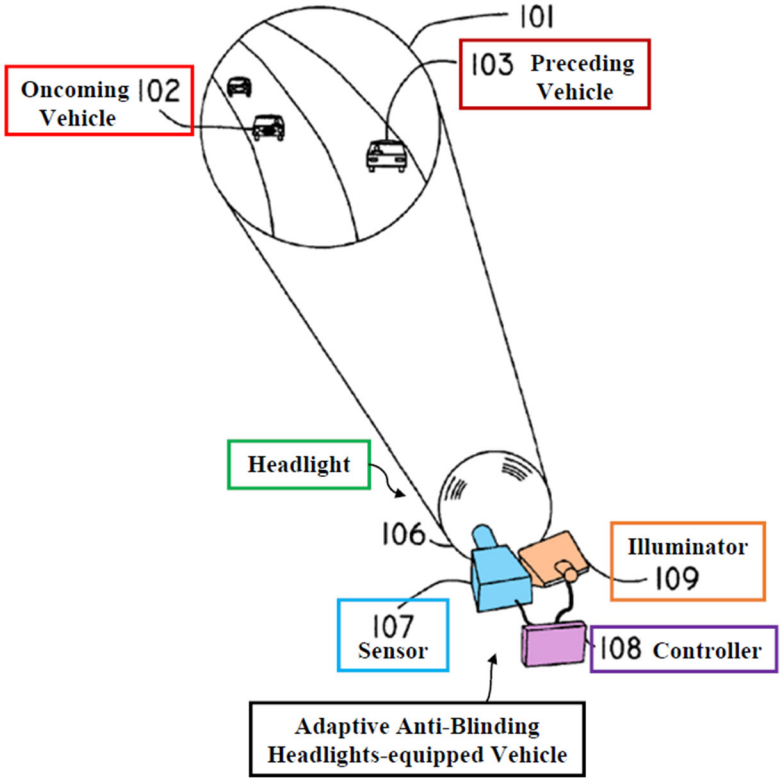
481. Further, conventional headlamps, with static high and low beams did not respond to changing driving conditions, and multiple beams were needed to provide "bending beams" for different types of road curvatures ("high speed," "middle speed," "low speed," "cross-roads"). EX1026, 451-452.

482. Beam-Thominet and Kobayashi 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. EX1005, 5:33-54, 3:8-45, 6:53-7:13; EX1008, 15:6-28.

483. *First*, including an additional data source for Beam-Thominet's controller—Kobayashi's *known technique* of using GPS data—would have enhanced Beam-Thominet by increasing/adjusting illumination based on an upcoming 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. 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 upcoming turn, further improving safety.

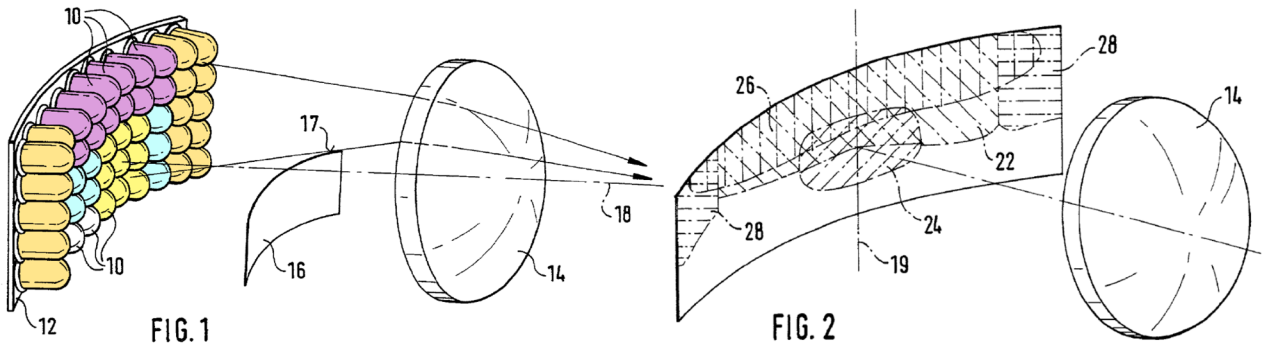
484. Beam "*determine[s] the location of light sources* forward of the apparatus and us[es] that information to *control the intensity, and/or the angular position*, of one or more" microbeams. EX1005, Abstract; EX1005, 4:16-19. Control is "*dynamically varying* in position and in size," in response to the input. EX1005, 6:24-27, 5:46-54. Beam acknowledges the benefits of prior systems that

control headlamps in response to changes in the vehicle's position (tilt on a hill) and steering mechanism (along a curve) and acknowledges those systems' safety benefits—noting that more active systems decrease the compromise between "reducing glare and providing enough light to the driver for adequate visibility." EX1005, 2:1-6, 2:15-22.




EX1005, FIG. 1 (annotated).

485. 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.



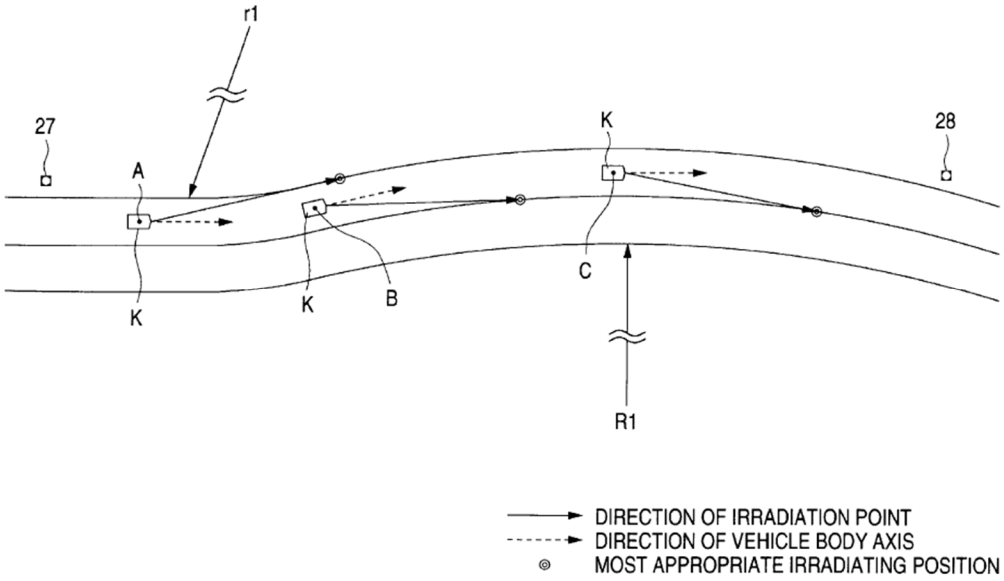

EX1006, FIGS. 1-2 (annotated).

486. Beam-Thominet does not disclose details on how to detect an upcoming turn, such as from GPS or navigation beacons, as an input to control the intensity, shape, and/or angular position of the microbeams, but this was well known in the art and it would have been obvious to a POSA to do so. 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. EX1005, 3:8-45, 6:53-7:13. Kobayashi provides additional active techniques, specifically GPS sensor data-based control (including planned upcoming turns).

487. Kobayashi's active *techniques and system components*, like Beam-Thominet, seek to enhance driver safety—using GPS sensor data-based control. EX1008, 15:6-28. 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 planned upcoming turn data, enhancing safety. EX1008, 3:9-50, 6:4-62, FIG. 1, 15:6-28

("safety of driving can be enhanced"). Kobayashi's system responds to real-world conditions, multiple curves, and intersections. EX1008, 11:34-14:52, 17:41-50.

488. Kobayashi's Figure 10 shows illumination control is planned and controlled for multiple turns. 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.




EX1008, FIG. 10.

489. A POSA would have understood that including an additional data source for Beam-Thominet's controller/processor—Kobayashi's GPS sensor data—would have enhanced Beam-Thominet by increasing illumination of an upcoming turn, thereby improving safety. This would have merely been applying Kobayashi's known technique (using GPS sensor data to shape/reshape light) to

Beam-Thominet's similar, known device (dynamic headlamp system with controllable beams), in the same way. 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.

490. 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 GPS data) according to known methods (disclosed in Beam-Thominet and Kobayashi) to yield predictable results (illuminating upcoming turns, improving safety).

491. A POSA would have had a reasonable expectation of success combining Kobayashi with Beam-Thominet. A POSA would have understood *how* to combine their disclosures, for example, by simply modifying software instructions stored in memory of Beam-Thominet's controller/processor (e.g., ECU) to adjust and direct light of the microbeams appropriately in view of Kobayashi's GPS data. It also would have been straightforward combination of prior-art elements: Kobayashi's road profile calculating means 2 and/or vehicle advancing direction prediction means 3 (e.g., including GPS navigation device 29) with Beam-Thominet (in communication with Beam's controller).

492. Such modifications 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. In applying Kobayashi's technique to Beam-Thominet, a POSA would have simply been applying a known technique in a predictable way—controlling headlights in part based on GPS data (including planned upcoming turns)—as already disclosed in the art. And in combining Beam-Thominet with Kobayashi's road profile calculating means 2 and/or vehicle advancing direction prediction means 3 (e.g., revising control input/output on an ECU), a POSA would have simply been combining known elements according to known methods (disclosed in Kobayashi) to yield predictable results (additional light control).

493. In view of the above, Beam-Thominet in combination with Kobayashi renders obvious these claims.

494. Thus, Beam-Thominet in combination with Kobayashi renders obvious claims 9 and 15-17 of the '503 patent.

# XIII. GROUND 4: THE COMBINATION OF BEAM, THOMINET, STAM, AND KOBAYASHI RENDERS OBVIOUS CLAIMS 49 AND 54-56.

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

495. As described in Sections X.A/XI.A, a POSA would have been motivated to combine Beam-Thominet-Stam. For the same reasons described in Section XII.A, a POSA would have been further motivated to combine Kobayashi with Beam-Thominet-Stam. The addition of Stam to Beam-Thominet would not change the inclusion of Kobayashi.

## B. Claim 49: "The headlight system of claim 37, wherein the one or more sensors further includes a GPS sensor."

496. In my opinion, there is no patentable difference between the language of claim 49 and claim 9. *Supra* Section XII.B; *see also* Appendix A. Therefore, my above analysis in Section XII.B applies.

497. In view of the above, Beam-Thominet-Stam in combination with Kobayashi renders obvious this claim.

## C. Claim 54: "The headlight system of claim 37, 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 a second illumination pattern defining increased illumination in a direction of the road curvature."

498. In my opinion, there is no patentable difference between the language of claim 54 and claim 15. *Supra* Section XII.C; *see also* Appendix A. Therefore, my above analysis in Section XII.C applies.

499. A POSA would have understood that Kobayashi's system "determine[s] a second illumination pattern" recited in claim 54 because illumination is adjusted according to the "road profile" (e.g., left or right curve) and applied to a "specific direction." EX1008, 14:59-66, 9:38-41, FIGS. 1, 10; EX1008, 4:60-64 ("irradiation control means 4 conducts irradiation control…with the *road profile*"), 3:9-50, 14:53-15:28.

500. In view of the above, Beam-Thominet-Stam in combination with Kobayashi renders obvious this claim.

**D. Claim 55: "The headlight system of claim 54, 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 a third illumination pattern defining increased illumination illuminating the turn."**

**Claim 56: "The headlight system of claim 37, 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 a third illumination pattern defining increased illumination illuminating the turn."**

501. The language of claim 56 is identical to the language of claim 55 as shown above. *See also* Appendix A and Appendix B.

502. In my opinion, there is no patentable difference between the language of claims 55-56 and claims 16-17. *Supra* Section XII.D; *see also* Appendix A and Appendix B. Therefore, my above analysis in Section XII.D applies.

503. A POSA would have understood that Kobayashi's system "determine[s] a third illumination pattern" recited in claims 55-56 because illumination is adjusted along the "scheduled course" (e.g., left or right turn) and applied to a "specific direction." EX1008, 9:38-41, 18:53-57, FIGS. 1, 9, 10; EX1008, 4:6-8 ("*predicts a vehicle advancing direction* at which the driver aims"), 3:9-50, 11:34-14:52.

504. In view of the above, Beam-Thominet-Stam in combination with Kobayashi renders obvious these claims.

505. Thus, Beam-Thominet-Stam in combination with Kobayashi renders obvious claims 49 and 54-56 of the '503 patent.

## XIV. GROUND 5: THE COMBINATION OF BEAM, THOMINET, AND BRAUN RENDERS OBVIOUS CLAIM 6.

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

506. As described in Section X.A, a POSA would have been motivated to combine Beam-Thominet. A POSA would have been further motivated to modify Beam-Thominet to include infrared (IR)/ultraviolet (UV) wavelengths, as in Braun (EX1009, 3:4-8, 3:26-27, 8:4-5, 9:23-28, 14:21-30, 18:13-14, 19:9-21, 20:25-21:16, FIGS. 3-6), to further control Beam-Thominet's adaptive headlamps to illuminate a roadway, thereby improving visibility and driver safety—an express purpose of Beam-Thominet. EX1005, 3:29-45 ("lower the beams for conditions

like rain, snow, or fog"), 3:8-14, 5:33-54, 7:1-13; EX1006, ¶¶5 ("light beams of *different light colors*"), 7 ("*wider* illumination…in fog"), 17-18, 21-26.

507. Beam-Thominet and Braun are from the same field—controllable headlamps with dynamic illumination—and include the same building blocks (e.g., light sources, sensors, controllers). Improved visibility and driver safety is paramount. EX1005, 3:8-45, 6:53-7:13, 1:54-59, 4:48-59; EX1009, 21:1-4 ("*IR light*…to provide *desired illumination* of scene"), 21:9-12 ("*IR light* for determining *distances* to a scene"), 22:19-23 ("*identify features and/or objects* in the scene"), 6:4-51 ("*prevent glare*"), 5:27-31 ("*improve…readability*"), 11:26-30 ("*maximize visibility*"), 26:29-27:4, 22:24-25, FIGS. 3-6.

508. A POSA would have sought to incorporate *known components* (hardware implementation) of Braun's colored luxels 26 (with IR/UV wavelengths, *see* EX1009, 3:4-8, 3:26-27, 8:4-5, 9:23-28, 14:21-30, 18:13-14, 19:9-21, 20:25-21:16, FIGS. 3-6) into Beam-Thominet's system (illuminator). This would have, like Braun, provided different colored spatial distributions for different situations, improving visibility and thereby safety.

509. Additionally, this would have provided increased illumination of certain surfaces (e.g., fluorescent surfaces), for example, road signs, road markers, etc. via UV luminescence. Luminescence occurs when light of a shorter wavelength (e.g., UV light) is absorbed by a material, and light of a longer

wavelength (e.g., visible light) is reemitted from the material. UV light is absorbed by the luminescent objects/surfaces that reemit visible light, which increases drivers' visibility for the road signs, road markers, and other objects with the luminescent surfaces. It can improve road safety at night.

510. Further, IR sensing would have provided longer distance detection of objects (e.g., vehicles, road signs, road curvature, etc.). Indeed, as Braun details "illuminator 24…provides *IR light* for *determining distances* to a scene." EX1009, 21:9-12, 20:25-21:8, 23:28-24:27, FIGS. 5-6.

511. Beam's array of light sources 401 (e.g., LEDs) modified by Thominet recognizes that "light beams of *different light colors* is possible…for different signal functions" and "different partial regions [22, 24, 26, 28] emit light of *different colors*." EX1006, ¶¶5, 27, FIGS. 1B-2; EX1005, 3:62-64, 5:3-16, FIGS. 2, 4-6; EX1005, 4:26-59 ("*angular* position"), 8:4-17.

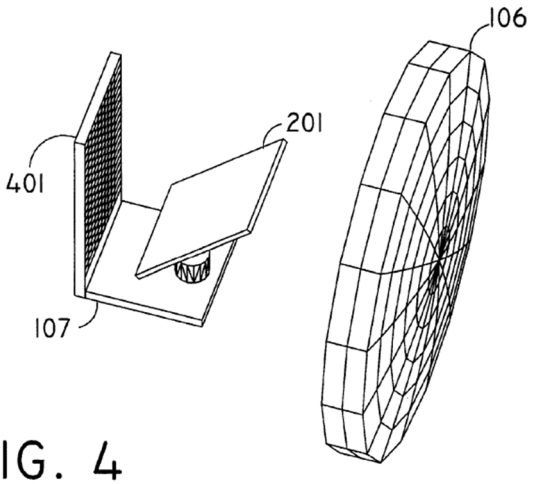



FIG. 4

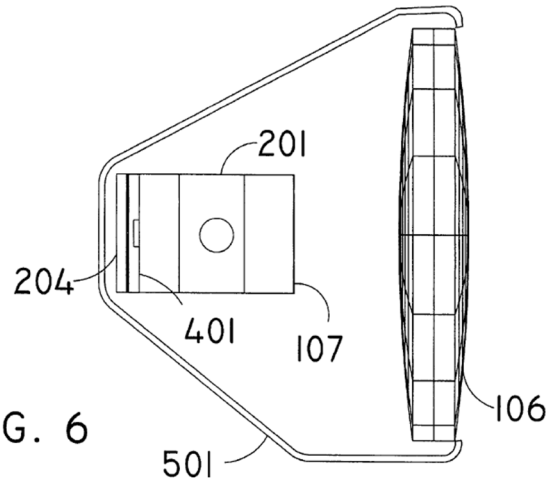
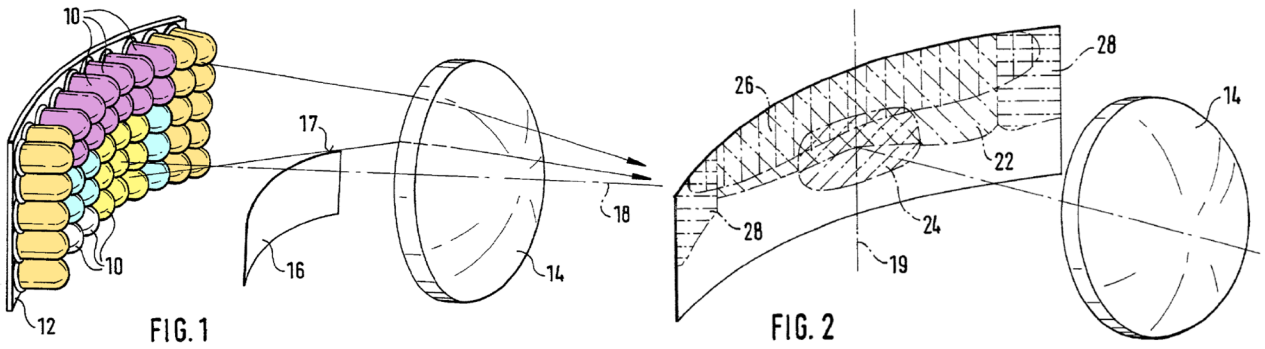



FIG. 6

EX1005, FIGS. 4, 6.

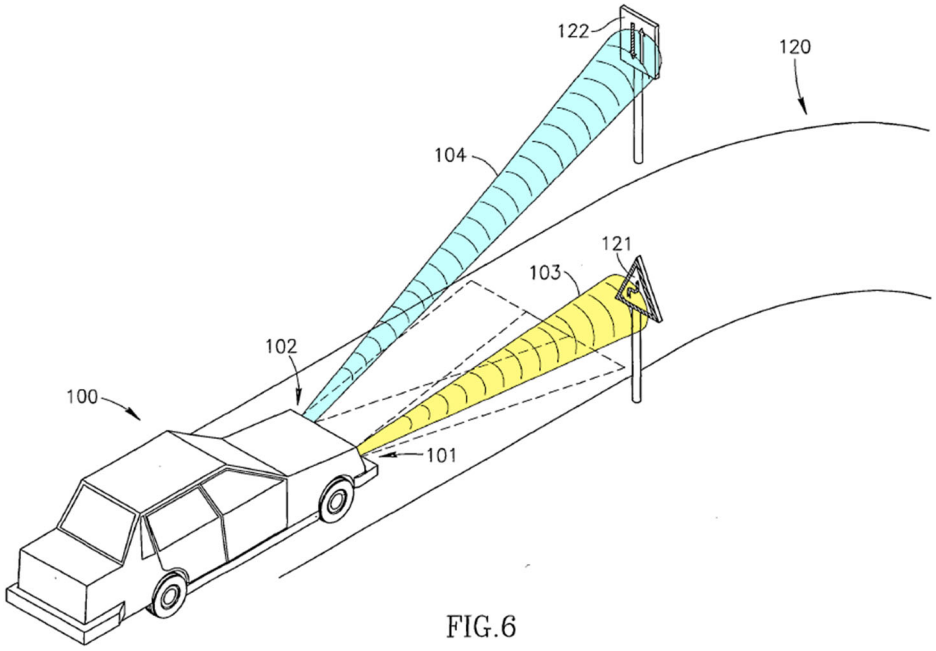



EX1006, FIGS. 1-2 (annotated).

512. Indeed, Beam's techniques and system enable "the driver to see more clearly at night," while protecting others from glare. EX1005, 3:8-45; EX1005, 4:10-25, 6:9-27. Beam recognizes the safety benefits of different spatial distributions "for conditions like…*fog*." EX1005, 3:29-36; EX1005, 1:54-59, 4:48-59; EX1006, ¶¶5 ("*different light colors*"), 7 ("*wider* illumination…in *fog*").

513. And through its *system components*, Braun, like Beam-Thominet, seeks to enhance driver visibility and thereby increase safety. EX1009, 3:4-8, 3:26-27, 8:4-5, 9:23-28, 14:21-30, 18:13-14, 19:9-21, 20:25-21:16, FIGS. 3-6. Braun's colored luxels 26 provide "adaptive illumination of a *roadway* and *neighboring regions*" (e.g., road signs 121, 122) and "luxels 26 [are] not limited to the visible spectrum but may, for example, comprise *infrared* or *ultraviolet* light." EX1009, 14:21-30, 5:22-25, FIGS. 2-3, 5-6; EX1009, 21:1-4 ("*IR light*…to provide *desired illumination* of scene"), 21:9-12 ("*IR light* for determining *distances* to a scene"), 18:13-14 ("illuminator 24 provides *IR light*"), 23:28-24:27. And like Beam, Braun's system "identifies *oncoming vehicles* and automatically adjusts

illumination…to *prevent glare*…[and] *blinding* a driver of the oncoming vehicle," so Braun's colored luxels 26 (hardware implementation) would have been a natural extension and improvement on Beam's AABH system and would have been obvious to a POSA.




EX1009, FIG. 6 (annotated).

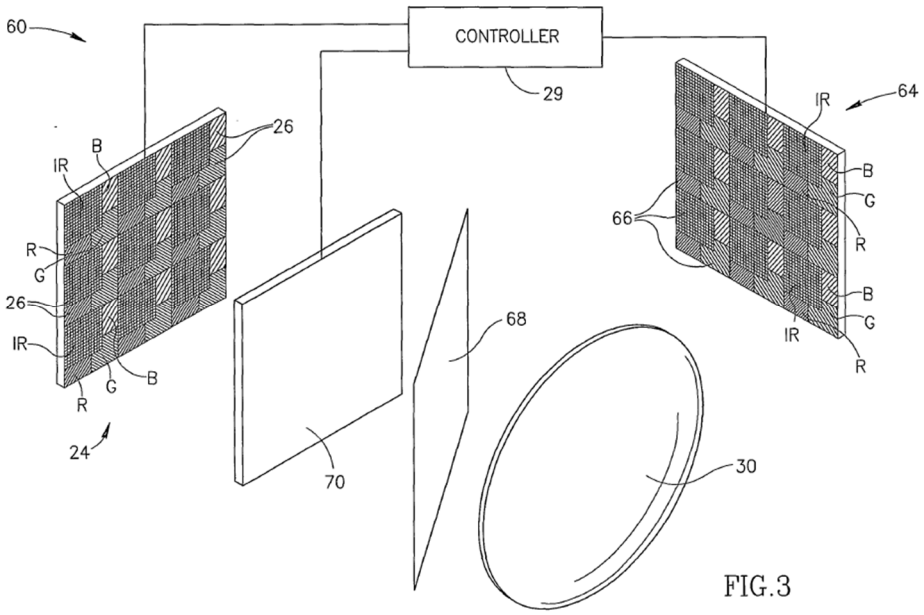



FIG.3

EX1009, FIG. 3.

514. This hardware combination—Beam's array of light sources 401 (LEDs) and Braun's differently colored luxels 26 including IR/UV wavelengths—would have provided Beam-Thominet's system with different colored spatial distributions for different situations, as in Braun, thereby improving driver safety. 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 and Braun's array of colored luxels 26) according to known methods (disclosed in Beam-Thominet and Braun) to yield predictable results (improved visibility and safety).

515. A POSA would have had a reasonable expectation of success combining Beam-Thominet and Braun, for example, by simply modifying Beam's array of light sources 401 (e.g., LEDs) with Braun's array of colored luxels 26

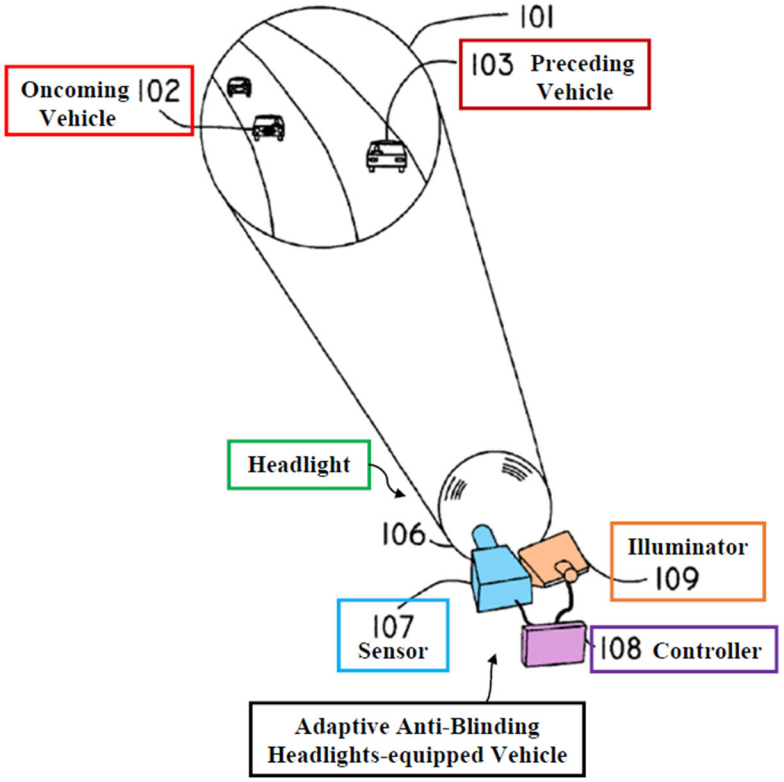
(e.g., colored LEDs) to provide colored light sources (e.g., colored luxels 26 with IR/UV wavelengths) for different functions. This would have been routine and well within a POSA's skill due to the similarities in Beam-Thominet's and Braun's adaptive systems—their common components were well-known and there would have been no limitations for a POSA to make such modifications.

516. I lay out below the specific disclosures of Beam-Thominet and Braun, and expand on this combination and reasonable expectation of success analysis below.

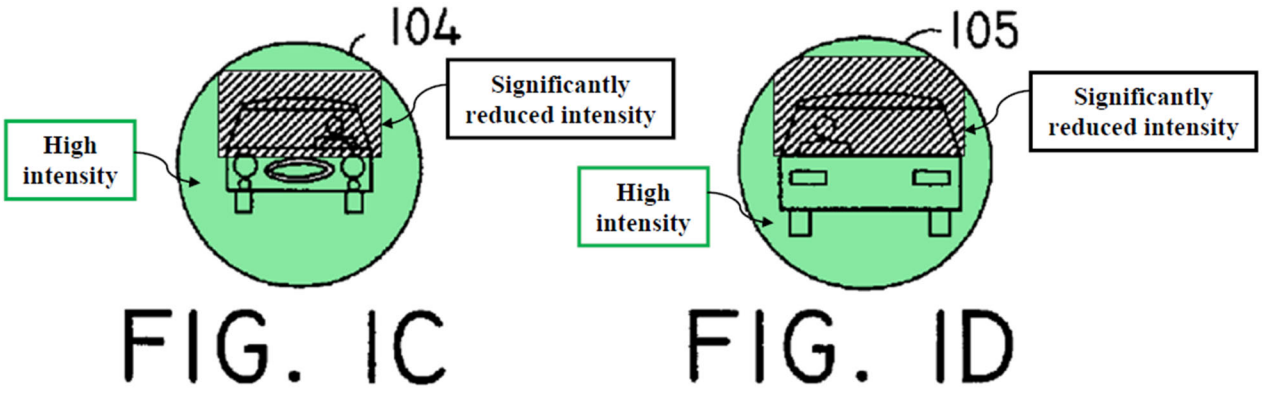
### B. Claim 6: "The headlight system of claim 1, wherein the headlight beam further comprises light in at least one of infra-red (IR) or ultra-violet (UV) wavelengths."

#### 1. Beam-Thominet's disclosure

517. Beam discloses the headlight system, "*spatial scene data [101]* from sensor 107…becomes the input to a processor 1105" and recognizes the problem of illuminating "terrain features, obstructions or potholes in the road" with just low beam illumination. EX1005, 5:33-36, 1:54-59, FIGS. 1, 1C-1D, 7; EX1005, 3:37-45 ("to see more clearly *at night*"), 4:53-59, 5:33-54.




EX1005, FIG. 1 (annotated).

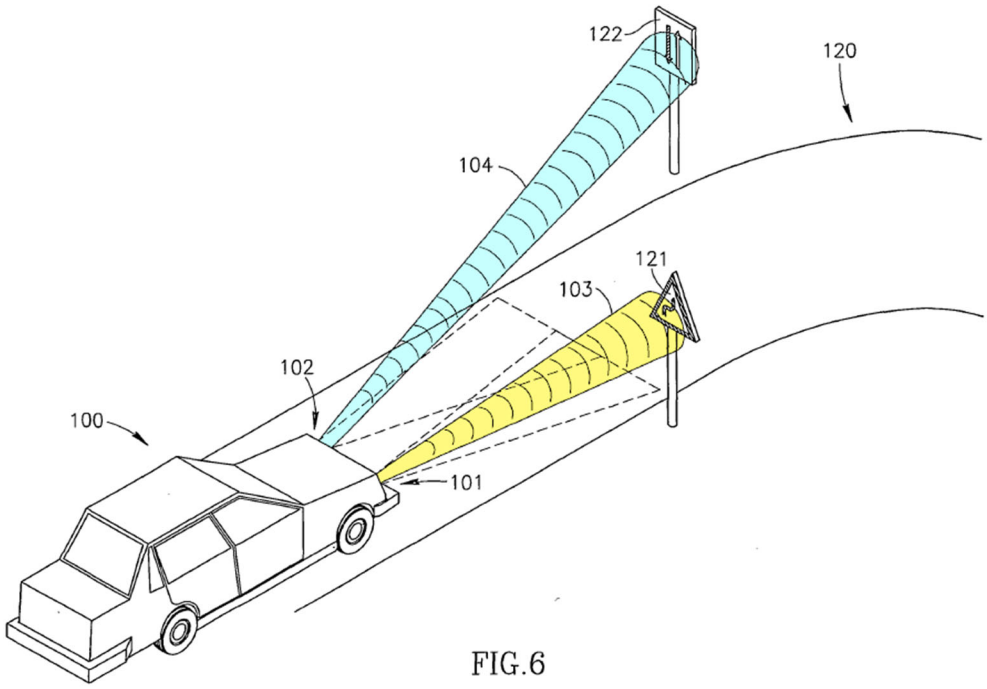



EX1005, FIGS. 1C-1D (annotated).

518. Beam-Thominet does not disclose IR or UV illumination, but this feature was well-known in the prior art, e.g., as explicitly disclosed by Braun.

### 2. Braun's disclosure

519. Braun's colored luxels 26 provide "adaptive illumination of a *roadway* and *neighboring regions*" and "light provided by luxels 26 is not limited to the visible spectrum but may, for example, comprise *infrared* or *ultraviolet* light." EX1009, 14:21-30, 5:22-25, 14:21-25, FIGS. 2-3, 5-6; EX1009, 18:13-14 ("illuminator 24 provides *IR light*").




EX1009, FIG. 6 (annotated).

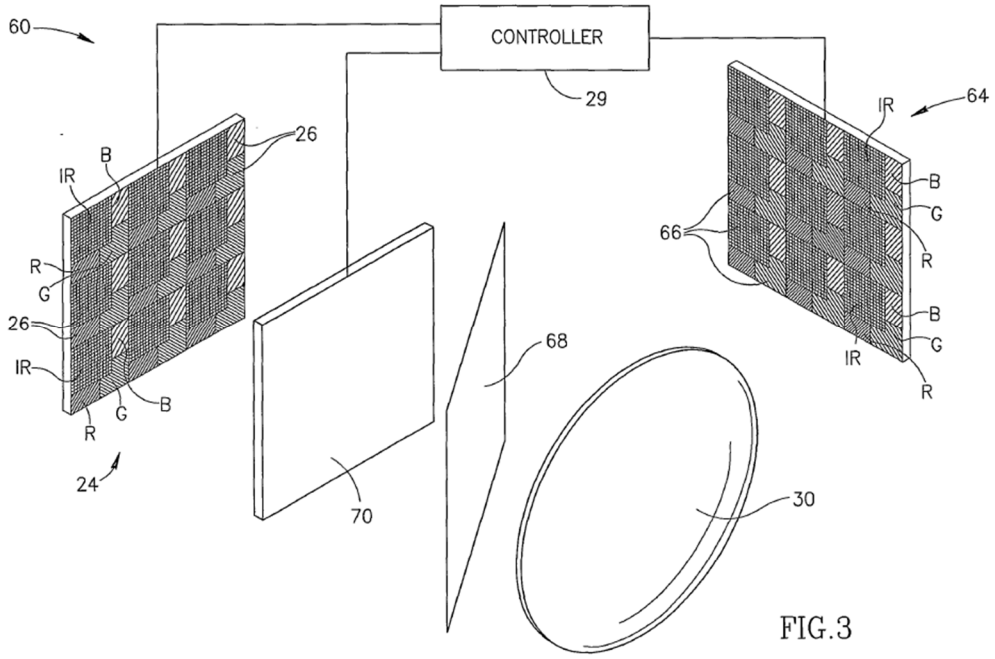



FIG.3

EX1009, FIG. 3.

520. As discussed, a POSA would have been motivated to combine Braun with Beam-Thominet with a reasonable expectation of success. *Supra* Section XIV.A.

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

521. As described in Section X.A, a POSA would have been motivated to combine Beam-Thominet. A POSA would have been further motivated to modify Beam-Thominet to include infrared (IR)/ultraviolet (UV) wavelengths, as in Braun (EX1009, 3:4-8, 3:26-27, 8:4-5, 9:23-28, 14:21-30, 18:13-14, 19:9-21, 20:25-21:16, FIGS. 3-6), to further control Beam-Thominet's adaptive headlamps to illuminate a roadway, thereby improving visibility and driver safety—an express purpose of Beam-Thominet. EX1005, 3:29-44 ("lower the beams for conditions

like rain, snow, or fog"), 3:8-14, 5:33-54, 7:1-13; EX1006, ¶¶5 ("light beams of *different light colors*"), 7 ("*wider* illumination…in fog"), 17-18, 21-26.

522. Beam-Thominet and Braun are from the same field—controllable headlamps with dynamic illumination—and include the same building blocks (e.g., light sources, sensors, controllers). Improved visibility and driver safety is paramount. EX1005, 3:8-45, 6:53-7:13, 1:54-59, 4:48-59; EX1009, 21:1-4 ("*IR light*…to provide *desired illumination* of scene"), 21:9-12 ("*IR light* for determining *distances* to a scene"), 22:19-23 ("*identify features and/or objects* in the scene"), 6:4-51 ("*prevent glare*"), 5:27-31 ("*improve…readability*"), 11:26-30 ("*maximize visibility*"), 26:29-27:4, 22:24-25, FIGS. 3-6.

523. A POSA would have sought to incorporate *known components* (hardware implementation) of Braun's colored luxels 26 (with IR/UV wavelengths, *see* EX1009, 3:4-8, 3:26-27, 8:4-5, 9:23-28, 14:21-30, 18:13-14, 19:9-21, 20:25-21:16, FIGS. 3-6) into Beam-Thominet's system (illuminator). This would have, like Braun, provided different colored spatial distributions for different situations, improving visibility and thereby safety.

524. Additionally, this would have provided increased illumination of certain surfaces (e.g., fluorescent surfaces), for example, road signs, road markers, etc. via UV luminescence. Luminescence occurs when light of a shorter wavelength (e.g., UV light), is absorbed by a material, and light of a longer

wavelength (e.g., visible light) is reemitted from the material. UV light is absorbed by the luminescent objects/surfaces that reemit light in the visible light, which increases drivers'visibility for the road signs, road markers, and other objects with the luminescent surfaces. It can improve road safety at night.

525. Further, IR sensing would have provided longer distance detection of objects (e.g., vehicles, road signs, road curvature, etc.). Indeed, as Braun details "illuminator 24…provides *IR light* for *determining distances* to a scene." EX1009, 21:9-12, 20:25-21:8, 23:28-24:27, FIGS. 5-6. Moreover,

526. Beam's array of light sources 401 (e.g., LEDs) modified by Thominet recognizes that "light beams of *different light colors* is possible…for different signal functions" and "different partial regions [22, 24, 26, 28] emit light of *different colors*." EX1006, ¶¶5, 27, FIGS. 1B-2; EX1005, 3:62-64, 5:3-16, FIGS. 2, 4-6; EX1005, 4:26-59 ("*angular* position"), 8:4-17.

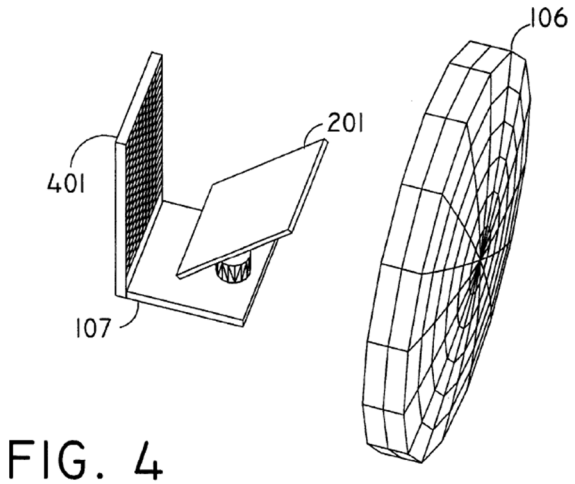



FIG. 4

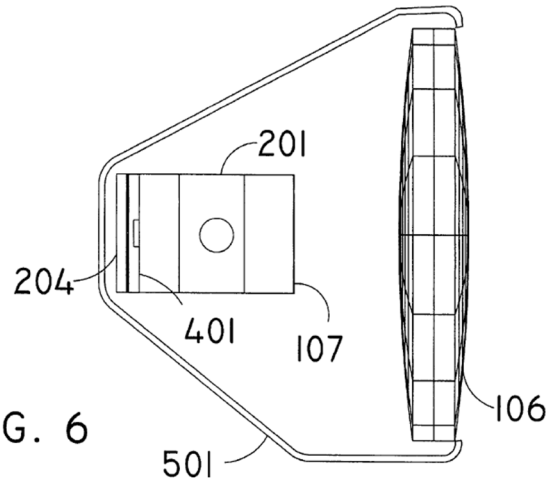
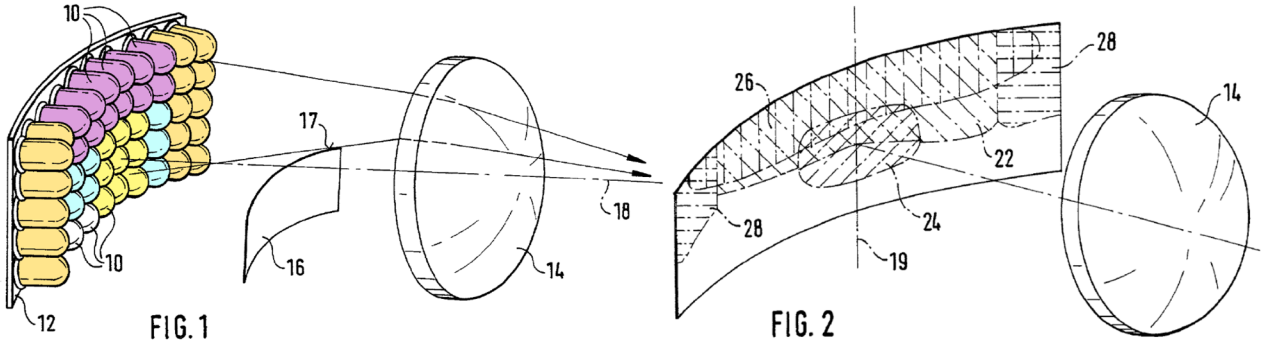



FIG. 6

EX1005, FIGS. 4, 6.




EX1006, FIGS. 1-2 (annotated).

527. Indeed, Beam's techniques and system enable "the driver to see more clearly at night," while protecting others from glare. EX1005, 3:8-45; EX1005, 4:10-25, 6:9-27. Beam recognizes the safety benefits of different spatial distributions "for conditions like…*fog*." EX1005, 3:29-36; EX1005, 1:54-59, 4:48-59; EX1006, ¶¶5 ("*different light colors*"), 7 ("*wider* illumination…in *fog*").

528. And through its *system components*, Braun, like Beam-Thominet, seeks to enhance driver visibility and thereby increase safety. EX1009, 3:4-8, 3:26-27, 8:4-5, 9:23-28, 14:21-30, 18:13-14, 19:9-21, 20:25-21:16, FIGS. 3-6. Braun's colored luxels 26 provide "adaptive illumination of a *roadway* and *neighboring regions*" (e.g., road signs 121, 122) and "luxels 26 [are] not limited to the visible spectrum but may, for example, comprise *infrared* or *ultraviolet* light." EX1009, 14:21-30, 5:22-25, FIGS. 2-3, 5-6; EX1009, 21:1-4 ("*IR light*…to provide *desired illumination* of scene"), 21:9-12 ("*IR light* for determining *distances* to a scene"), 18:13-14 ("illuminator 24 provides *IR light*"), 23:28-24:27. And like Beam, Braun's system "identifies *oncoming vehicles* and automatically adjusts

illumination…to *prevent glare*…[and] *blinding* a driver of the oncoming vehicle," so Braun's colored luxels 26 (hardware implementation) would have been a natural extension and improvement on Beam's AABH system and would have been obvious to a POSA.

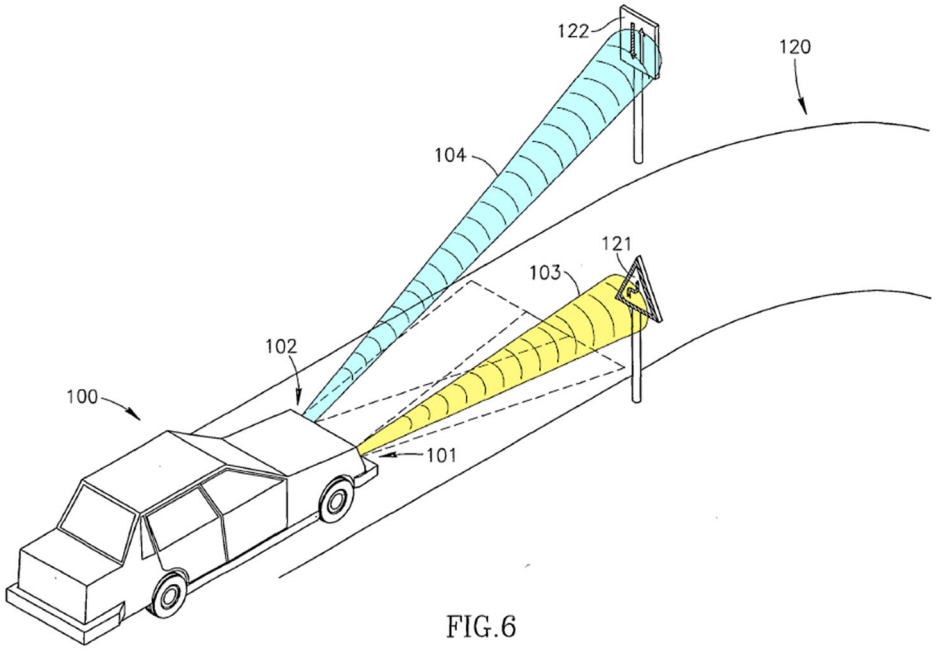



FIG.6

EX1009, FIG. 6 (annotated).

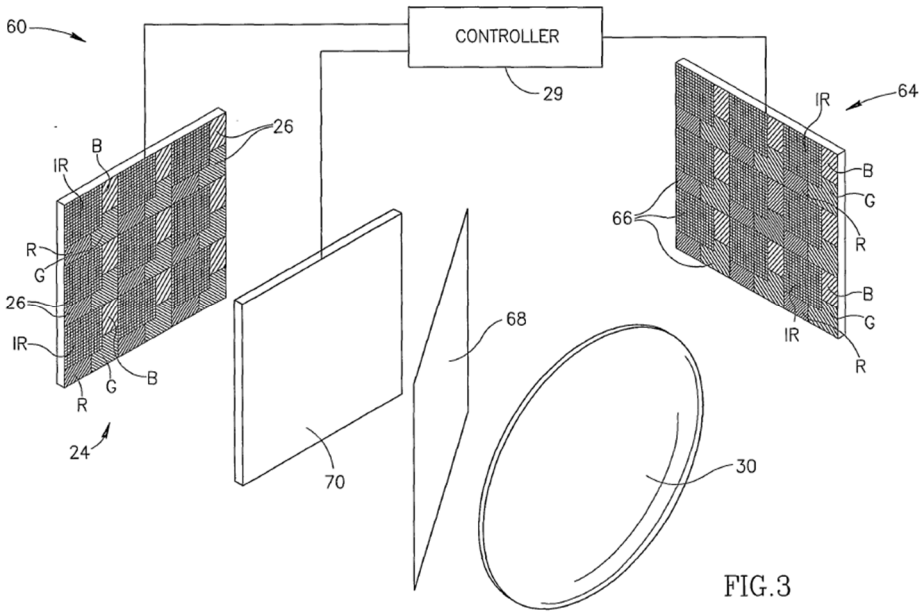



FIG.3

EX1009, FIG. 3.

529. This hardware combination—Beam's array of light sources 401 (LEDs) and Braun's differently colored luxels 26 including IR/UV wavelengths—would have provided Beam-Thominet's system with different colored spatial distributions for different driving situations, as in Braun, thereby improving driver safety. 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 and Braun's array of colored luxels 26) according to known methods (disclosed in Beam-Thominet and Braun) to yield predictable results (improved visibility and safety).

530. A POSA would have had a reasonable expectation of success combining Beam-Thominet and Braun, for example, by simply modifying Beam's

array of light sources 401 (e.g., LEDs) with Braun's array of colored luxels 26 (e.g., colored LEDs) to provide colored light sources (e.g., colored luxels 26 with IR/UV wavelengths) for different functions. This would have been routine and well within a POSA's skill due to the similarities in Beam-Thominet's and Braun's adaptive systems—their common components were well-known and there would have been no limitations for a POSA to make such modifications.

531. In view of the above, Beam-Thominet in combination with Braun renders obvious this claim

532. Thus, Beam-Thominet in combination with Braun renders obvious claim 6 of the '503 patent.

## XV. GROUND 6: THE COMBINATION OF BEAM, THOMINET, STAM, AND BRAUN RENDERS OBVIOUS CLAIM 46.

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

533. As described in Sections X.A/XI.A, a POSA would have been motivated to combine Beam-Thominet-Stam. For the same reasons described in Section XIV.A, a POSA would have been further motivated to combine Braun with Beam-Thominet-Stam. The addition of Stam to Beam-Thominet would not change the inclusion of Braun.

### B. Claim 46: "The headlight system of claim 37, wherein the light output from at least one headlamp further comprises at least one of infrared or ultraviolet wavelengths."

534. In my opinion, there is no patentable difference between the language of claim 46 and claim 6. *Supra* Section XIV.B; *see also* Appendix A. Therefore, my above analysis in Section XIV.B applies.

535. In view of the above, Beam-Thominet-Stam in combination with Braun renders obvious this claim.

536. Thus, Beam-Thominet-Stam in combination with Braun renders obvious claim 46 of the '503 patent.

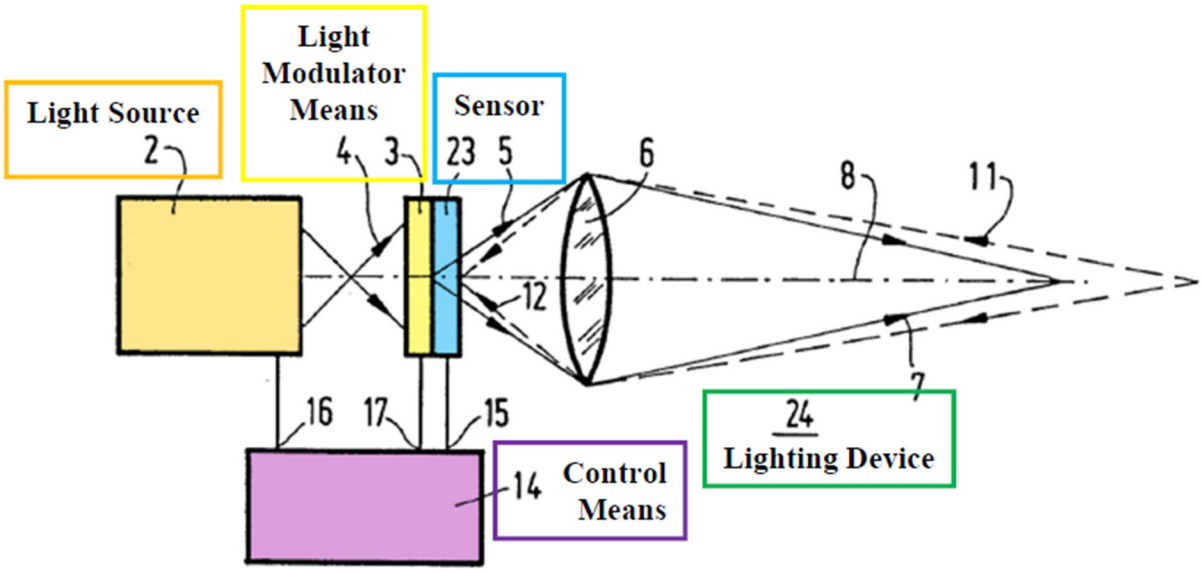
## XVI. GROUND 7: THE COMBINATION OF KARLSSON AND HARBERS RENDERS OBVIOUS CLAIMS 1-5, 7-8, 10-14, 18-19, 37-45, 47-48, 50-53, AND 57-58.

537. In my opinion, Karlsson explicitly or implicitly discloses every feature recited in claims 1-5, 7-8, 10-14, 18-19, 37-45, 47-48, 50-53, and 57-58. But to avoid doubt, Karlsson is combined with Harbers, for claim elements [1.2] and [37.2], claim 5, and claim 45, which disclose well-known features of adaptive headlamps—light clusters for different functions and a light cluster spectral power distribution (light color), respectively—rendering the claims obvious.

**"light clusters" claim elements [1.2]/[37.2]**

538. Karlsson's "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*

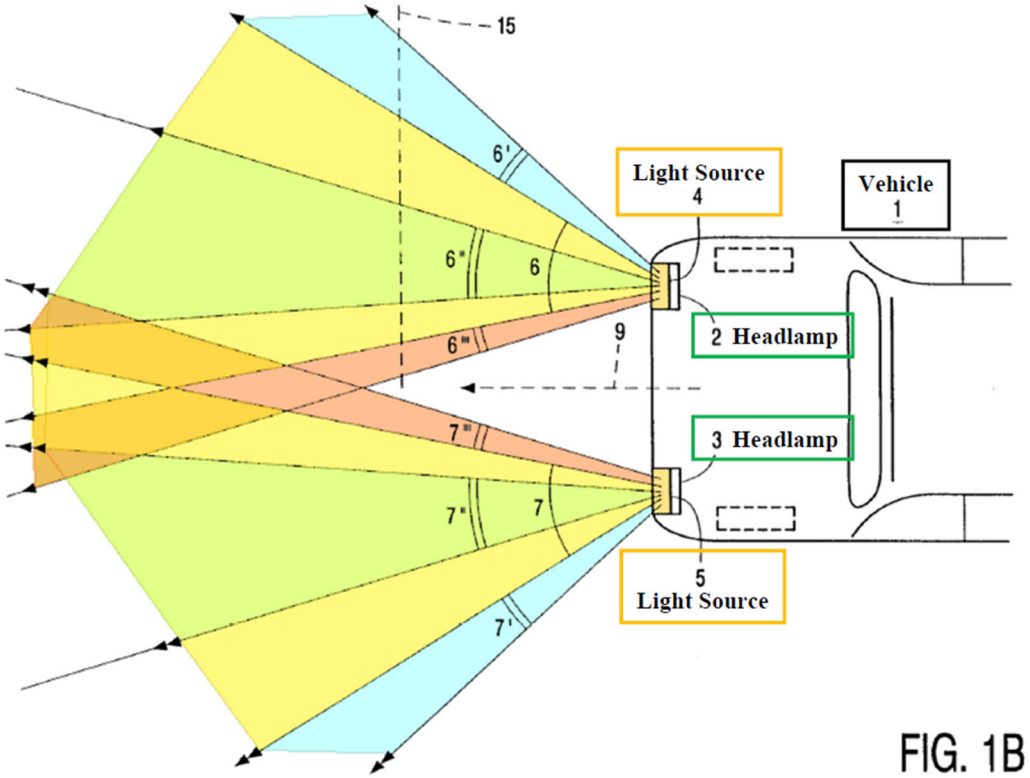
advantageously can be switched to…*given directions*." EX1010, 11:25-28, 14:1-9, FIGS. 3, 6, 14. Each spotlight beam is a directional "cluster" or "source," having its own independent *direction* (aiming), that combines to form the headlamp beam; so the combination of Karlsson's spotlight beams form at least two light clusters/sources to provide illumination in desired subsections. EX1010, 4:25-31, 14:1-15, FIGS. 6, 14. Alternatively, if Patent Owner argues, incorrectly, that a "cluster" requires at least two (or more) spotlight beams, Karlsson also discloses this. EX1010, 14:1-9 ("spotlight beams 34 can…be controlled either individually or in *groups*"), 14:12-15 ("a desired light *intensity* can be adjusted for…a *group* of spotlight beams"), 14:26-30, FIGS. 6, 14.




EX1010, FIG. 3 (annotated).

539. Thus, Karlsson discloses "a plurality of light clusters"—independently controllable directional spotlight beam clusters/sources—as in claim elements [1.2]/[37.2].

540. Harbers expressly discloses "*array of opto-electronic elements 11; 12; 13; 14…determined* to a substantial degree by the *desired direction* of the light beams emitted," EX1011, 7:27-32, FIGS. 1B, 2, corresponding to the "plurality of light clusters" recited in claim elements [1.2]/[37.2].




EX1011, FIG. 1B (annotated).

541. If Patent Owner argues, incorrectly, that Karlsson does not disclose [1.2]/[37.2], Harbers does; and it would have been obvious to combine Harbers with Karlsson, as discussed below.

**"predefined threshold" claim elements [37.8]/[37.9]**

542. Karlsson discloses "accurate measurement of ambient light (11), which is not disturbed by the lighting device's own lighting means (27), is provided, for example for detecting light from oncoming traffic…[a]s a result, the lighting pattern and the *lighting intensity are automatically adjusted*, in such a manner that oncoming traffic *will not be blinded*, thus permitting a light intensity which is generally *higher than that of conventional dipped headlights*, for example." EX1010, Abstract.

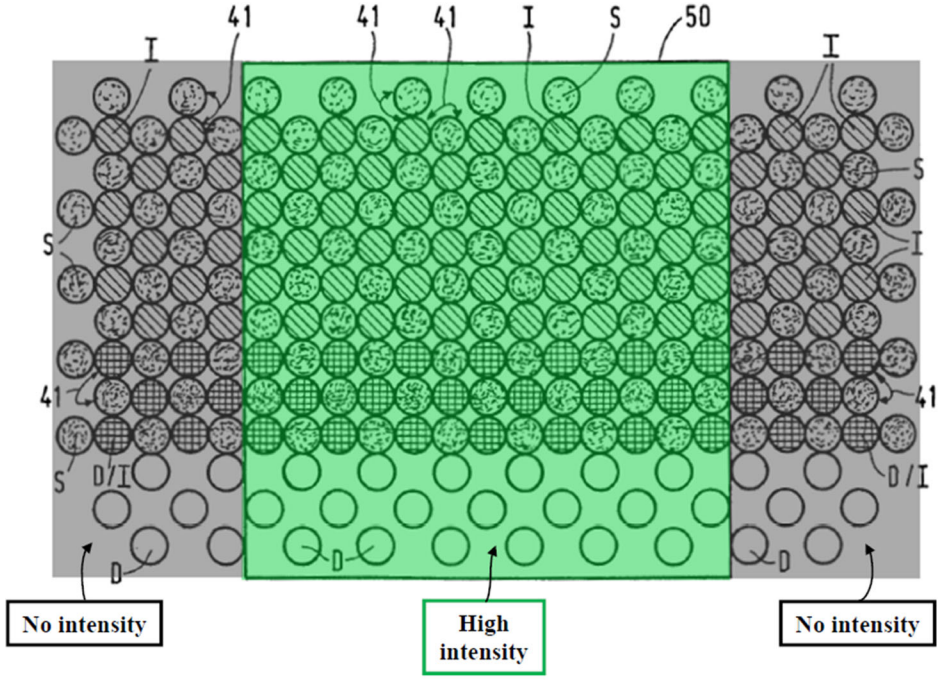
543. Further, Karlsson discloses "spotlight sources indicated at D provide the *dipped light function*." EX1010, 19:23-27, FIGS. 14-15, 1:27-30 ("*low beams* or *dipped* headlights"), Abstract, 1:16-18. The concept of a "dipped light function" or a low beam illumination level would have been known to a POSA. As discussed, because all automotive exterior lighting devices (headlamps, tailing lamps, and other road illumination devices and signaling and marking devices) are highly regulated in the U.S. as well as in the rest of world, all lighting products installed on a vehicle must comply with these regulations. *See* EX1030, 62-69; EX1016, 4-11. As such, common practice in the automotive lighting industry is to

set up the performance level including light output for a product, such as a headlamp, to produce predefined illumination values (in angular light intensity distribution) either per the regulations, or in a higher performance level set by automakers. *See* EX1030, 62-69; EX1016, 4-11.

544. Such low beam (dipped headlights) illumination level for driver's visibility and glare light control is defined in all regulations, standards, and automaker's specifications, which is predefined as the illumination level in terms of the light intensity distribution in the low beam illuminating area or low beam projected angular section. *See* EX1030, 3-8, 21-41, 62-69; EX1016, 4-11. Therefore, Karlsson's "dipped light function" is an example of a "predefined" threshold level, for example, equivalent to a "dipped headlights" illuminance.

545. Further, Karlsson discloses illumination directed to the shaded areas (e.g., 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," (e.g., no intensity in shaded area is *below* Karlsson's predefined *dipped* headlights illuminance: shaded illuminance < dipped headlights illuminance), and illumination directed to the non-shaded areas (e.g., within emitted light beam 50) is "a light intensity which is generally *higher* than that of conventional *dipped headlights*" and "longer-range *main-beam*" (e.g., high intensity in non-shaded area is *above* Karlsson's predefined *dipped headlights* illuminance: non-shaded

illuminance > dipped headlights illuminance). EX1010, Abstract, 1:18-24, 9:18-22, 19:23-27, FIGS. 3, 14-15.




EX1010, FIG. 14 (annotated).

546. Therefore, Karlsson discloses a "predefined" (e.g., dipped headlights) threshold and outputting illumination "below…[the] predefined threshold" and "above…[the] predefined threshold" (e.g., shaded < dipped headlights < non-shaded) as in claim elements [37.8] and [37.9].

547. The '503 patent does not disclose a predefined threshold value, so a value is not required to satisfy claim elements [37.8] and [37.9]. Further, a POSA reading Karlsson would have understood Karlsson's "dipped headlights" illuminance, for example, teaches a "predefined" threshold, because Karlsson uses the dipped headlights illuminance as a reference point below and above which to

output illumination, preventing glare to other vehicles while increasing illumination to other areas. EX1010, 9:18-26 ("the pattern and the intensity of the light beam 7 are, for example, controlled in such a manner that *no light at all* or light having a low intensity is emitted…[i]n this manner *glaring or blinding* of oncoming traffic is *effectively prevented*"), Abstract ("the lighting pattern and the lighting intensity are automatically adjusted…thus *permitting a light intensity* which is generally *higher than that of conventional dipped headlights*"), 1:18-24, 19:23-27, FIGS. 3, 6, 14-15.

548. Therefore, a POSA would have understood that Karlsson discloses or renders obvious a "predefined threshold" recited in claim elements [37.8] and [37.9].

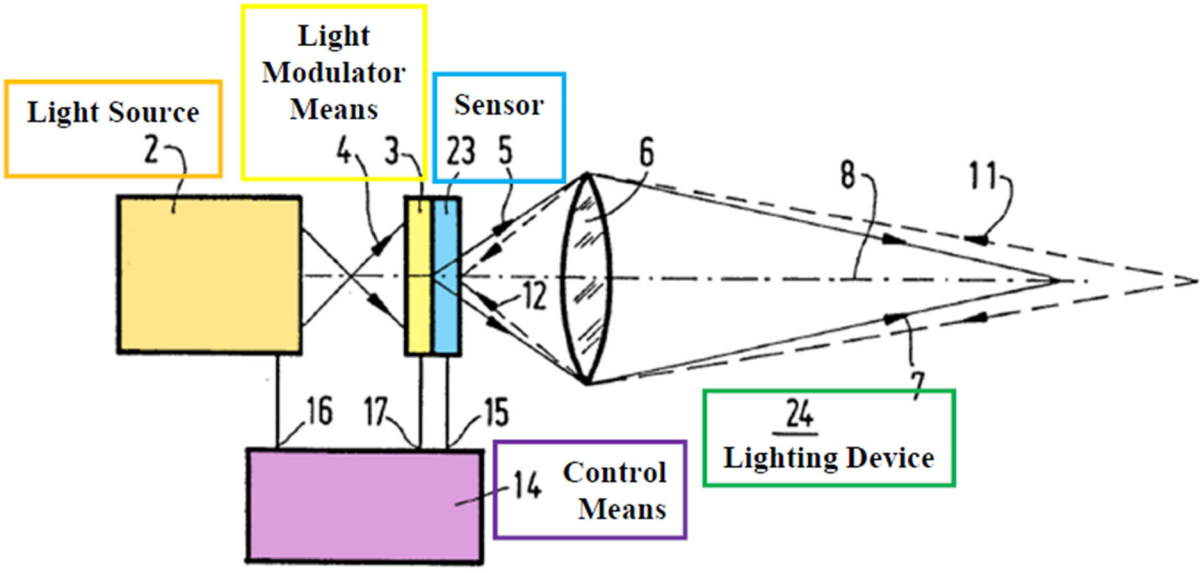
### A. A POSA would have been motivated to combine Karlsson and Harbers with a reasonable expectation of success.

549. As discussed, Karlsson discloses "light clusters" with independently controlled angular positions for reducing glare towards other drivers. *Supra* Section XVI. Harbers provides further detail on implementing "light clusters" for different functions, conceptually and physically. So naturally, it would have been obvious to a POSA designing an adaptive headlamp to implement Harbers's multiple directional beam segments—through either software or hardware—for different functions in Karlsson's system. 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. EX1010, 1:10-13, 1:16-26, 4:17-21, 9:18-26.

550. Karlsson and Harbers are from the same field—controllable headlamps with dynamic illumination—and include the same building blocks (light sources, sensors, controllers). EX1010, Abstract, 2:30-35, 9:18-26, 13:24-14:4, 19:18-20:3, FIGS. 3, 6, 14-15; EX1011, Abstract, 2:27-3:10, 5:14-26, 6:27-7:19, 7:27-32, FIGS. 1B, 2. Further, improved visibility, thereby increasing safety is paramount in both. EX1010, 1:10-26, 4:17-21, 9:18-26; EX1011, 5:1-26, 7:1-14, 9:1-32.

551. *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 more control methods for different functions to Karlsson's system for different driving situations, thereby increasing safety. This is a simple software combination. 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.




EX1010, FIG. 3 (annotated).

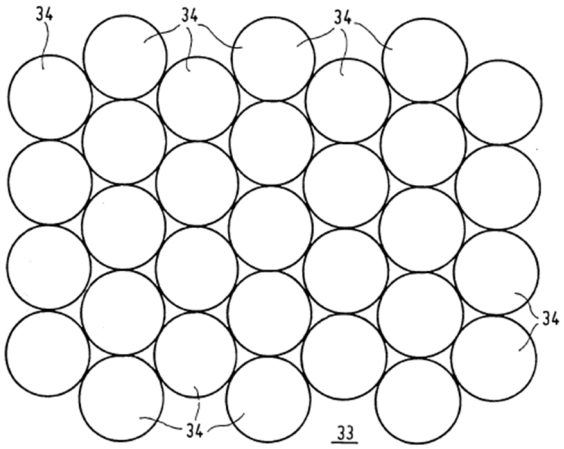



FIG. 6

EX1010, FIG. 6.

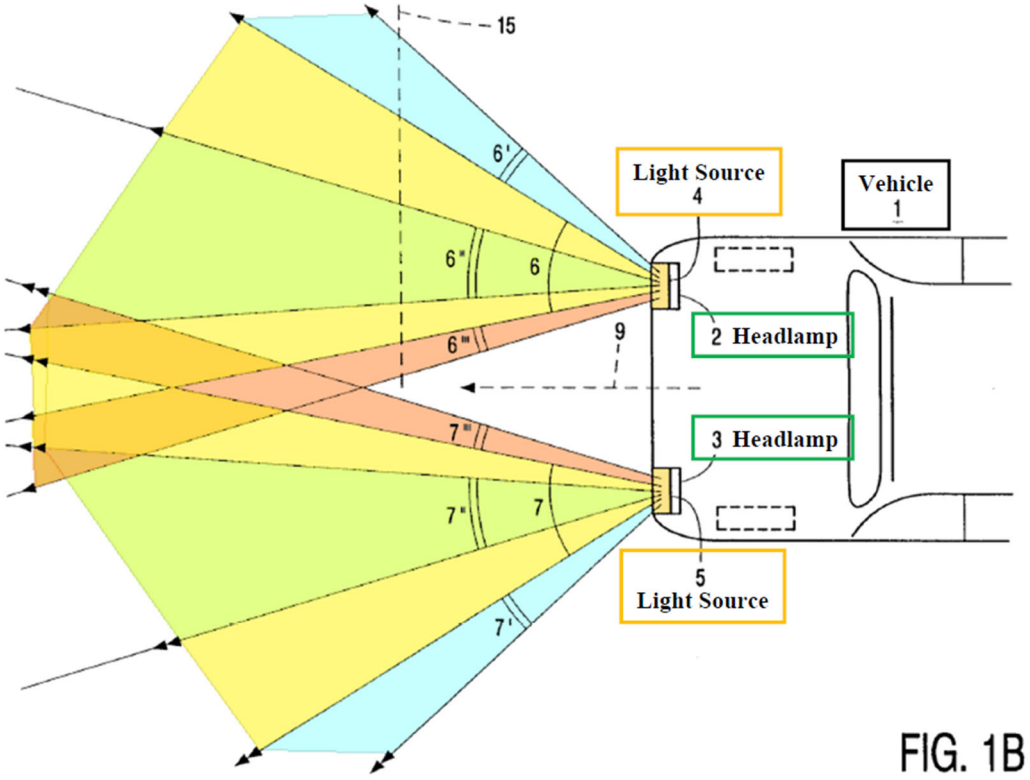
552. Indeed, Karlsson's techniques and system of controlling individual spotlight beams emphasize safety of all drivers. EX1010, 1:16-26, 4:17-21, 9:18-26. Controllable headlamps "significantly increase the driving comfort and the road safety," and "glaring or blinding of oncoming traffic is effectively 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. EX1010, 1:21-26, 1:10-13 ("comply with…regulations…preventing the *blinding* or *glare*").

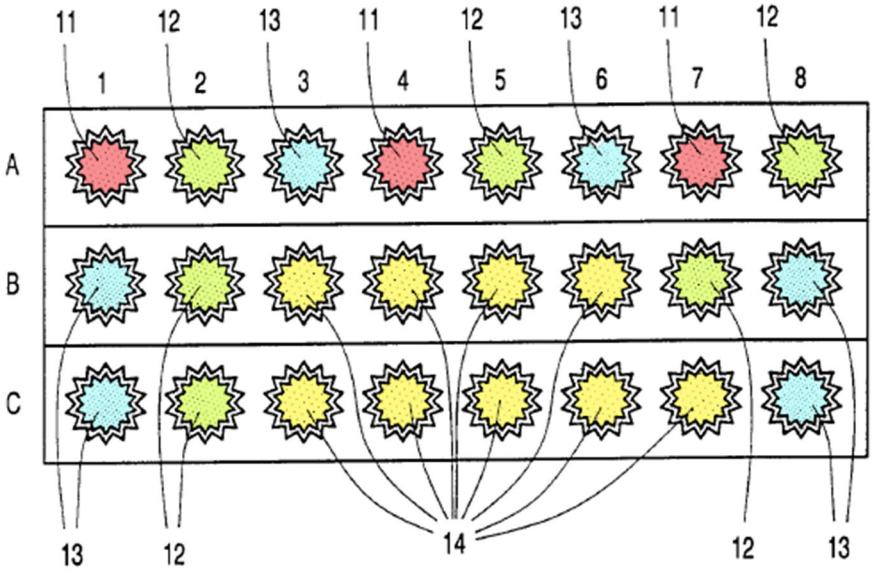
553. Karlsson's system "*selectively adjust[s]*…spotlight beam[s] 34, in response to a *control signal from sensor means 23*…to provide a *desired lighting pattern*" in "given *directions*." EX1010, 14:26-30, 11:25-28, FIGS. 3, 6, 14. Karlsson recognizes the safety benefits of identifying "oncoming traffic" 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. If Patent Owner argues, incorrectly, Karlsson does not expressly disclose light clusters, even though Karlsson discloses different angular positions control for different spotlight beams, it would have been obvious to a POSA to use such control to "create the headlight beam that provides the determined illumination" and "create the adapted headlight beam." Combining Harbers with Karlsson would have made Karlsson's system more direct or active for different functions, and further achieves Karlsson's purpose of improving driver safety.

554. And Harbers's *technique* (software implementation), like Karlsson, seeks to enhance driver visibility, thereby increasing safety—using multiple directional beam segments (clusters) for different functions. EX1011, 5:14-26, 6:1-7, 6:27-7:19, 8:10-18, FIGS. 1B-2. Specifically, Harbers's explains opto-electronic

elements 11-14 provide differently aimed beam segments 6-6'-6"-6'", 7-7'-7"-7'" to form different spatial distributions, improving visibility of the road and/or road surrounding, thereby increasing safety. EX1011, 5:14-26, 6:1-7, 6:27-7:19, FIGS. 1B-2; EX1011, 7:27-32 ("*curved* substrate"), 7:1-17, 9:28-10:5, 13:5-7.




EX1011, FIG. 1B (annotated).




EX1011, FIG. 2 (annotated).

555. The additional control (software implementation) of having multiple directional beam segments (clusters) 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.

556. This would have merely been applying Harbers's known techniques (software implementation: using multiple directional beam segments for different functions) to Karlsson's similar, known device (adaptive system with controllable spotlight beams), in the same way. 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 way.

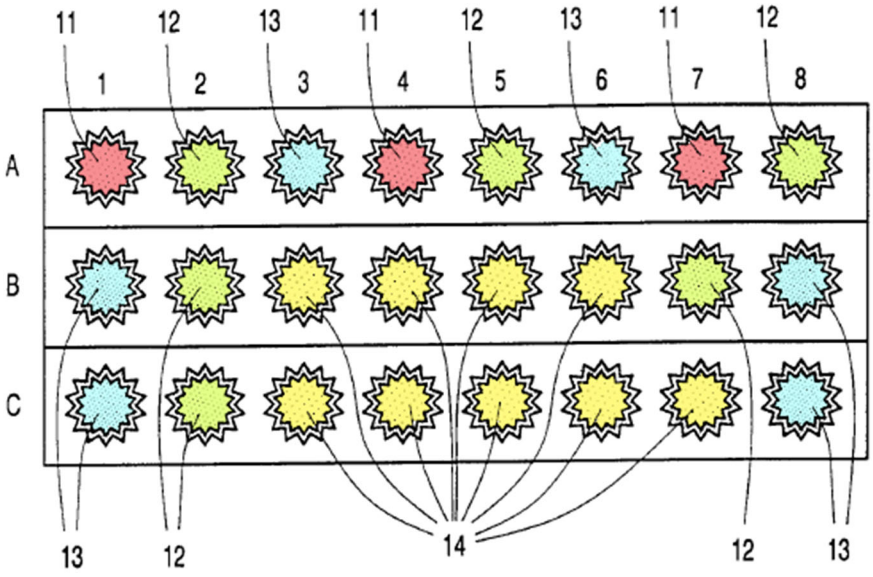
557. A POSA would have had a reasonable expectation of success combining Harbers with Karlsson, for example, by simply modifying software instructions stored in Karlsson's controller/processor-memory to organize Karlsson's spotlight beams into multiple beam segments (clusters) for different functions. Overall, this is a simple software implementation.

558. Such modification 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. In applying Harbers's technique to Karlsson, a POSA would have simply been applying a known technique (software implementation) in a predictable way—controlling headlights in part based on multiple beam segments (clusters) for different functions—as already disclosed in the art.

559. *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 aimed opto-electronic elements 11-14, *see* EX1011, 5:14-26, 6:1-7, 6:27-7:32, FIGS. 1B-2) into Karlsson's system (with lighting means 2, 3). Again, this would have, like Harbers, provided different spatial distributions for different driving situations

(e.g., off-axis viewing, bends, narrow roads, motorways, etc.), improving visibility and thereby safety. This is a simple hardware implementation.

560. Through its *system components* (hardware implementation), 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. Indeed, opto-electronic elements 11-14 arranged on a "curved substrate," with different aimings relative to the vehicle, provide beam segments 6-6'-6"-6'", 7-7'-7"-7'" (clusters) for different driving situations. EX1011, 5:14-26, 6:1-7, 6:27-7:19, FIGS. 1B-2; EX1011, 7:27-32 ("*curved* substrate"), 7:1-17, 9:28-10:5, 13:5-7.




EX1011, FIG. 2 (annotated).

561. Like the software implementation above, this hardware combination of Karlsson's lighting means 2, 3 and Harbers's differently 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. 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). Overall, this is a simple hardware implementation.

562. 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 clusters/sources (e.g., beam segments 6-6'-6"-6"', 7-7'-7"-7"') for different functions (hardware implementation).

563. Such modification 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. And in combining Karlsson with Harbers's array of opto-electronic elements 11-14 (e.g., modifying an illuminator), a POSA would have simply been combining known elements according to known methods (disclosed in Harbers) to yield predictable results (light control for different functions, hardware implementation).

564. I lay out below the specific disclosures of Karlsson and Harbers, and expand on this combination and reasonable expectation of success analysis below, specifically with reference to claim elements [1.2] and [37.2].

### B. Claims 1 and 37

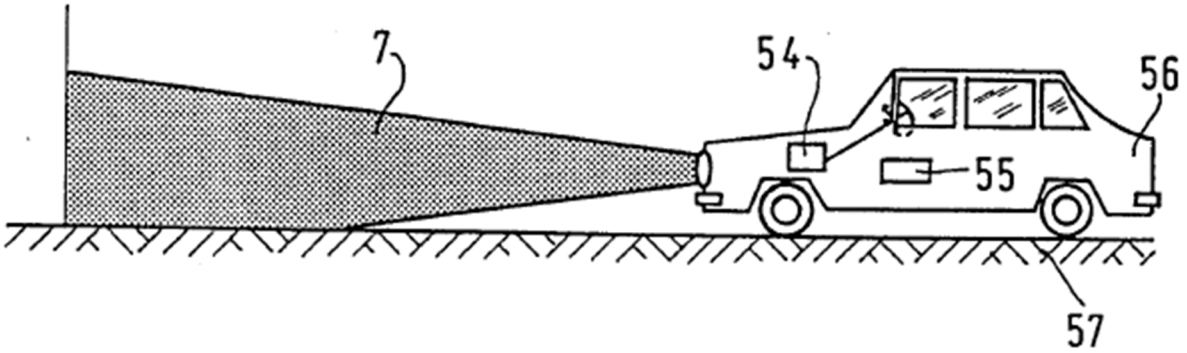
565. Karlsson, alone or in combination with Harbers, renders independent claims 1 and 37 obvious.

#### 1. [1.P]: "A vehicle headlight system comprising:"

#### [37.P]: "A vehicle headlight system comprising:"

566. Claim element [37.P] is identical to claim element [1.P]. *See also* Appendix A.

567. Karlsson's headlight system for a car 56 provides an adaptive light beam 7. EX1010, 20:16-32, Abstract, FIG. 16.




EX1010, FIG. 16.

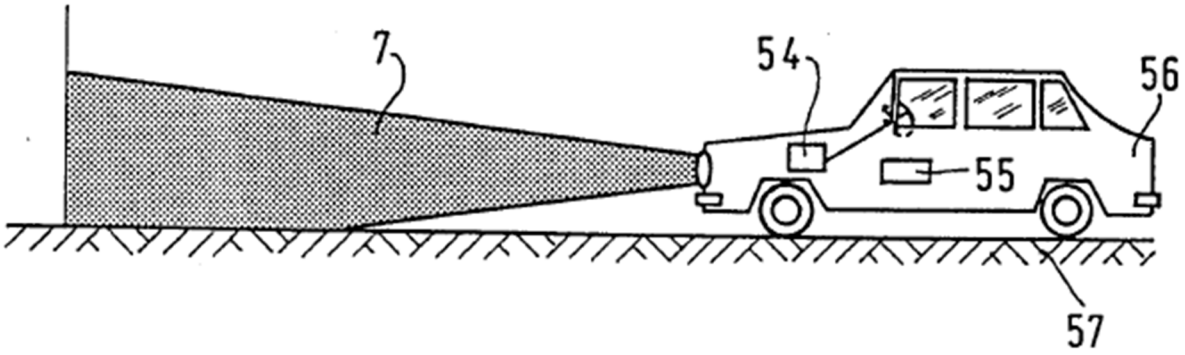
568. In view of the above, Karlsson discloses these elements.

**2. [1.1]: "one or more headlamps and a vehicle structure, arranged for affixing components of the system to the vehicle;"**

**[37.1]: "one or more headlamps affixable to a first vehicle;"**

569. In my opinion, there is no patentable difference between claim elements [37.1] and [1.1]. *See also* Appendix A. The same disclosures below address each feature.

570. 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; EX1010, Abstract, 9:18-22.




EX1010, FIG. 16.

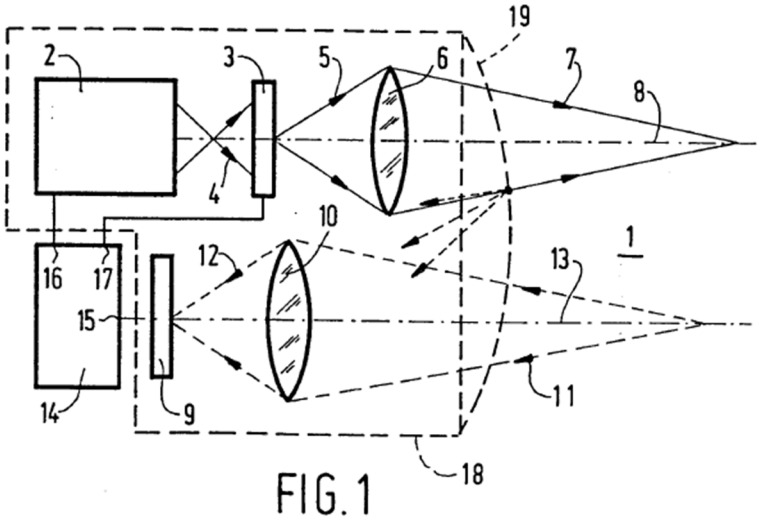
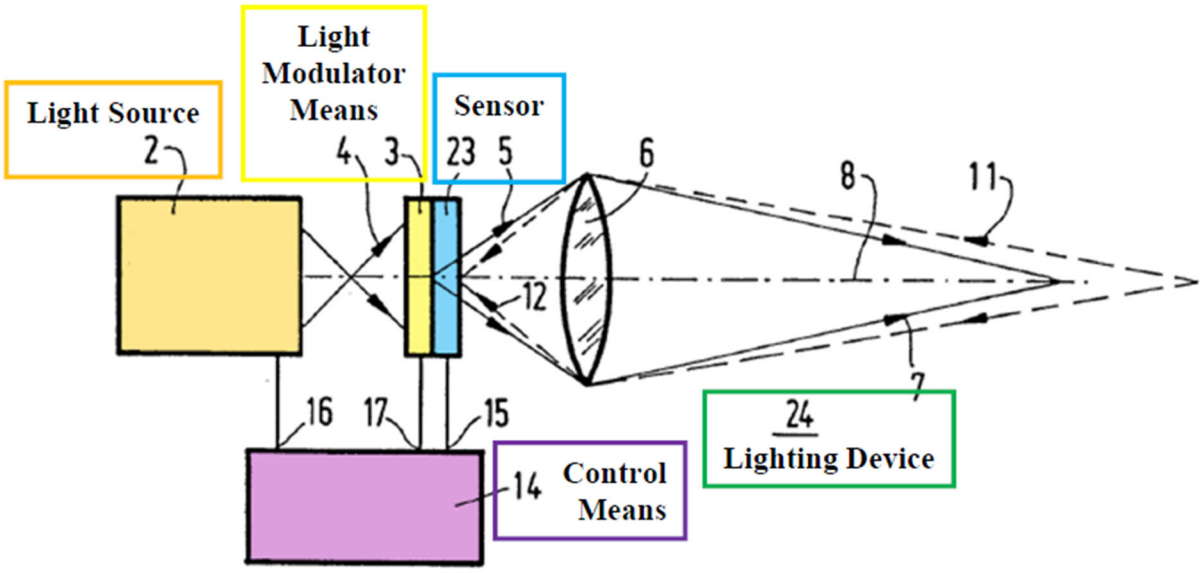



FIG. 1

EX1010, FIG. 1.




EX1010, FIG. 3 (annotated).

571. In view of the above, Karlsson discloses these elements.

### 3. [1.2]: "a plurality of light clusters, arranged in each of the one or more of the one or more headlamps,"

**[37.2]: "a plurality of light clusters arranged in each of the one or more of the headlamps and"**

572. In my opinion, claim elements [1.2]-[1.4] are part of the same clause but will be addressed separately for simplicity below.

573. In my opinion, claim elements [37.2]-[37.4] are part of the same clause but will be addressed separately for simplicity below.

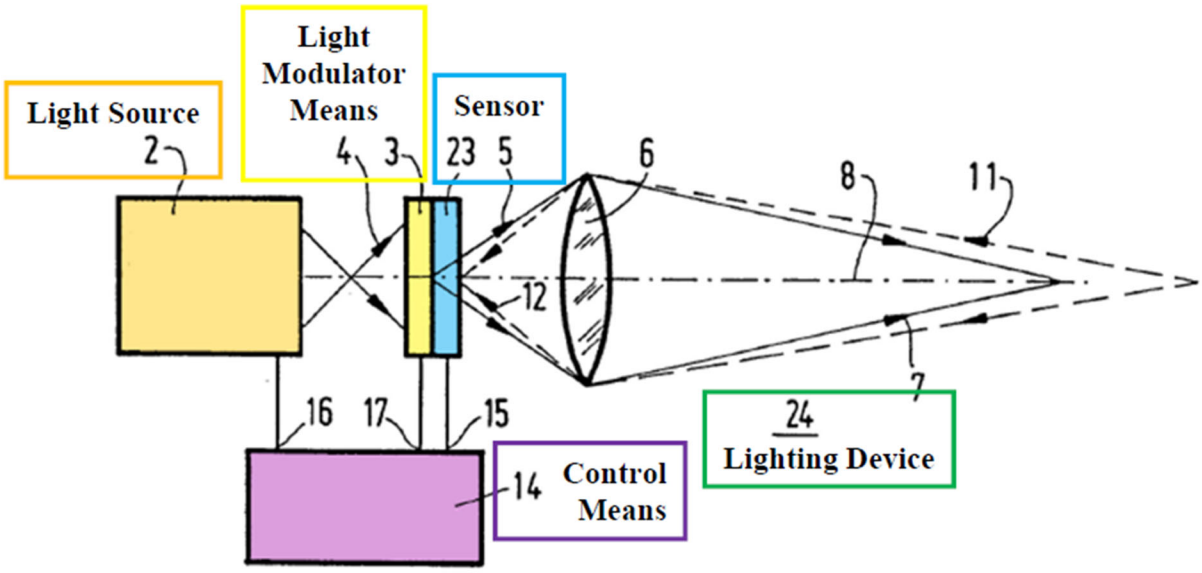
574. In my opinion, there is no patentable difference between claim elements [37.2] and [1.2]. *See also* Appendix A. The same disclosures below address each feature.

#### (a) Karlsson discloses this element.

575. In my opinion, Karlsson discloses these claim elements, [1.2]/[37.2]. *See supra* Sections XVI/XVI.A. Karlsson discloses "a plurality of *controllable spotlight beams*" and "*spotlight beams 34* may also be made up of…*light modulators* which can be controlled to transmit light *to a specified degree*…for each *individual* spotlight beam 34 or for a *group* of spotlight beams." EX1010, 4:25-31, 14:5-15, FIGS. 3, 6; EX1010, 11:25-28 ("*given directions*"), 14:1-4 ("spotlight beams 34 can be…a *grid of separate light sources*"), 19:29-33 ("desired pattern and *direction of the beam*"), FIG. 14. Each spotlight beam is a "cluster" that combines to form the headlamp beam, and the combination of

Karlsson's spotlight beams form at least two light clusters. EX1010, 4:25-31, 14:1-15, FIGS. 6, 14.

576. Alternatively, if Patent Owner argues, incorrectly, that a "cluster" requires at least two (or more) spotlight beams, Karlsson also discloses this. EX1010, 14:1-9 ("spotlight beams 34 can…be controlled either individually or in *groups*"), 14:12-15 ("a desired light *intensity* can be adjusted for…a *group* of spotlight beams"), 14:26-30, FIGS. 6, 14.




EX1010, FIG. 3 (annotated).

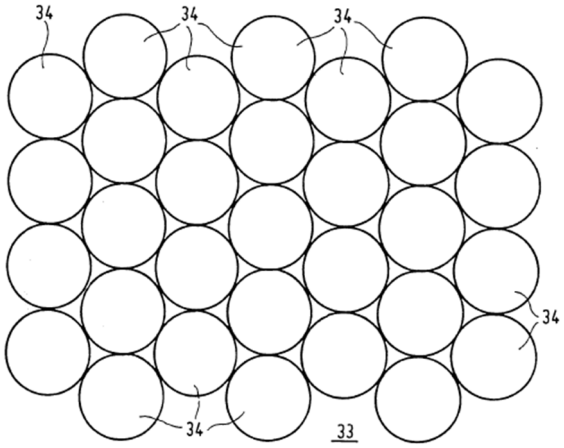
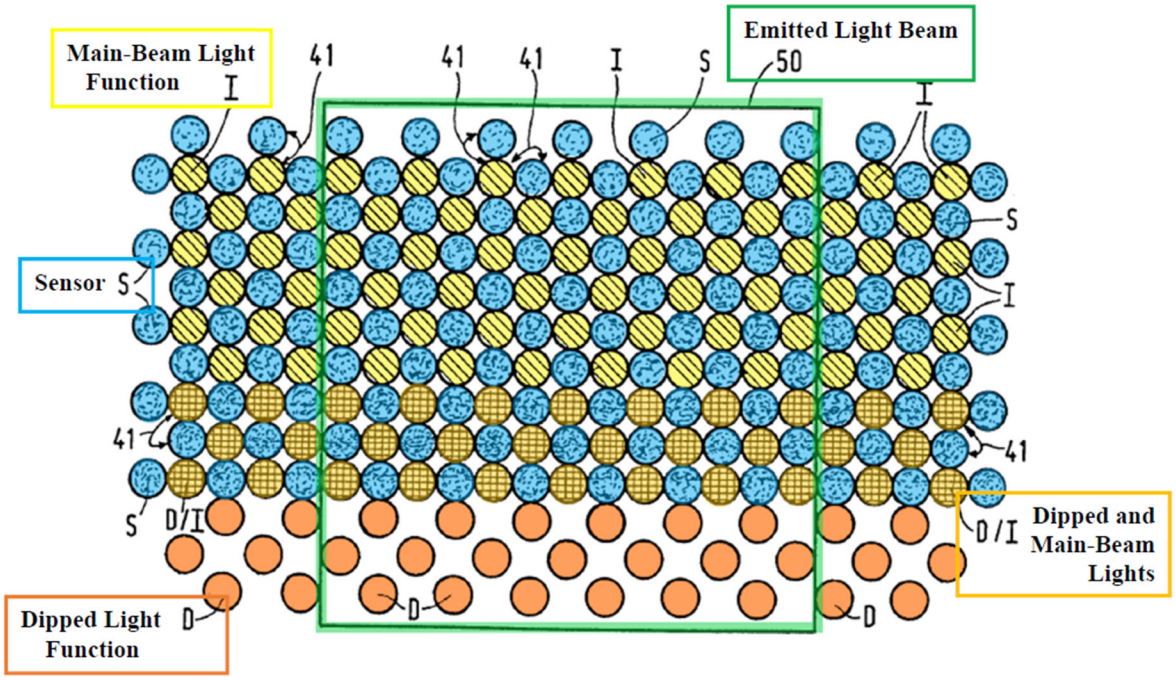



FIG. 6

EX1010, FIG. 6.




EX1010, FIG. 14 (annotated).

577. Such directionality results in *directional light clusters* that by definition will have different angles, which result in different aimings in desired subsections. So disclosure that discusses adapting light emitted from light clusters

to create a headlight beam for a plurality of subsections applies the same to disclosure that discusses instructing operation of light clusters to create an adapted headlight beam for first and second subsections.

578. A POSA would have understood that controlling "intensity" and "directions" of "spotlight beams 34…controlled either individually or in *groups*" is the same as controlling "at least two of the light clusters to create the adapted headlight beam," as the light output from a headlamp is all measured with its light intensity level in an angular distribution. EX1010, 14:1-15 ("a desired light *intensity* can be adjusted…for a *group* of spotlight beams"); *see also* EX1017, 5 ("the adaptive light pattern should support to direct the concentration to the most important zone for the current driving situation"), FIGS. 1, 3-5; EX1018, 4 ("variable aiming"); EX1026, 451 ("[m]ore beams are necessary to match varied driving regions, traffic situations, and driving operations"), 456 ("beam axes of the lamps are aimed at the directions indicated"), FIGS. 1, 3-3; EX1038, 1:12-10:3, FIGS. 1-3; EX1039, 9:16-11:11, FIGS. 1-6; EX1040, 1:16-30, FIGS. 1, 2A-2C; EX1036, 3:52-4:32, FIGS. 2-6.

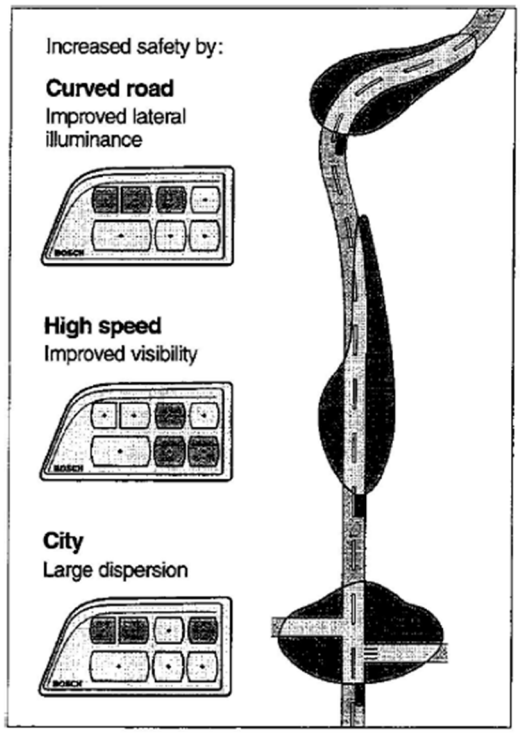



*Fig.1: Three standard driving situations with adapted light pattern seen from the bird eye's view.*

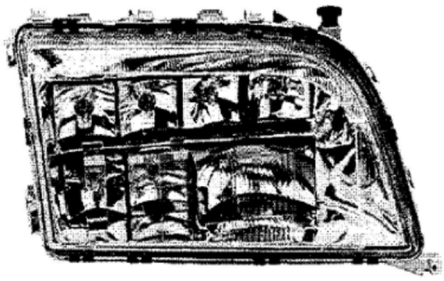
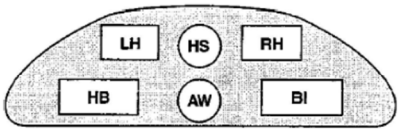


Fig 4: ALP *headlamp* sample




Single components:

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

Fig. 5 Advanced ALP sample layout

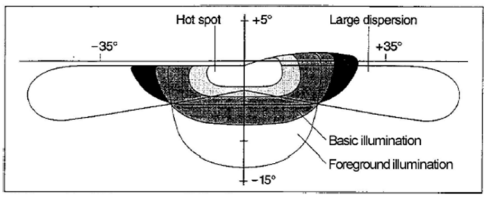



Fig. 3: Light pattern of multiple beam *headlamp* (*Isolux* curves in wall projection):
The individual light *pattern* of multiple sub-units sum up to the total adaptive light pattern

EX1017, FIGS. 1 and 3-5.

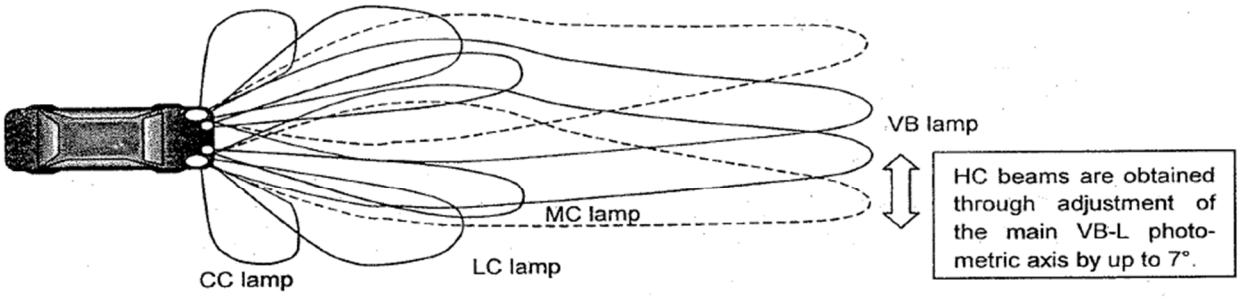
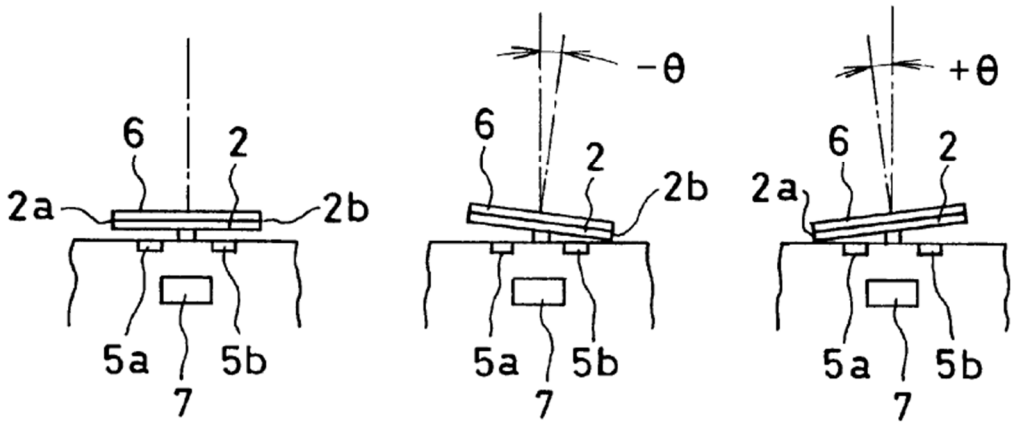



*Fig. 3-3: Imaged Illumination Configurations on Road Surface*

EX1026, FIG. 3-3.

FIG. 2A FIG. 2B FIG. 2C



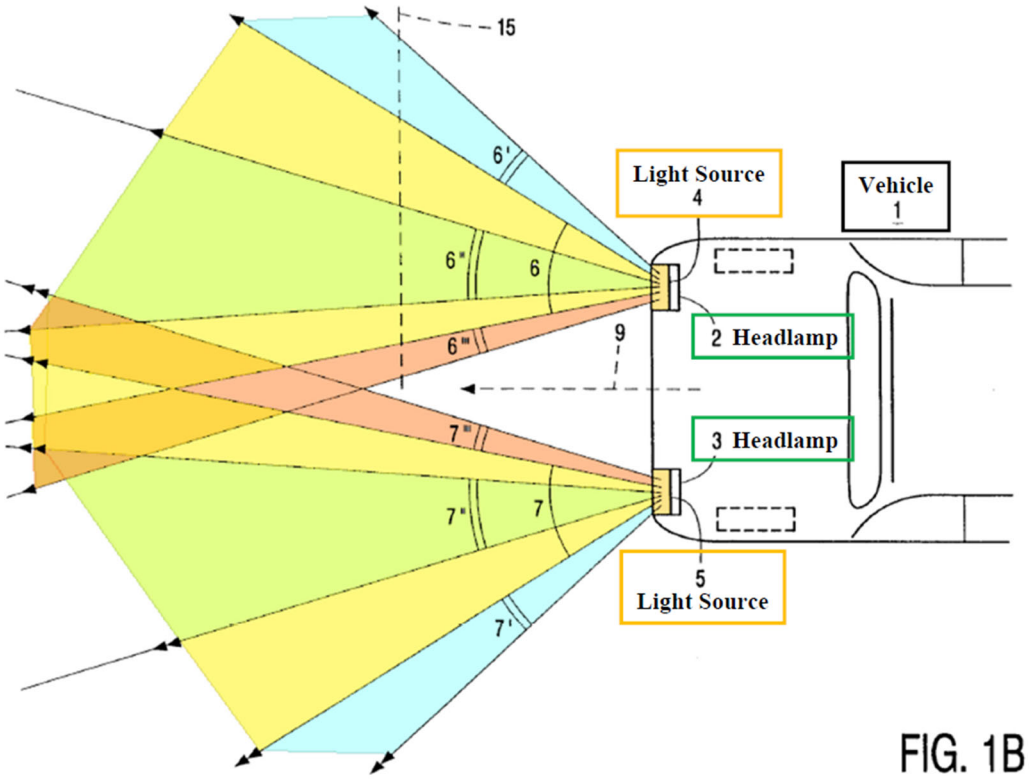

EX1040, FIGS. 2A-2C.

**(b) Harbers also discloses this element.**

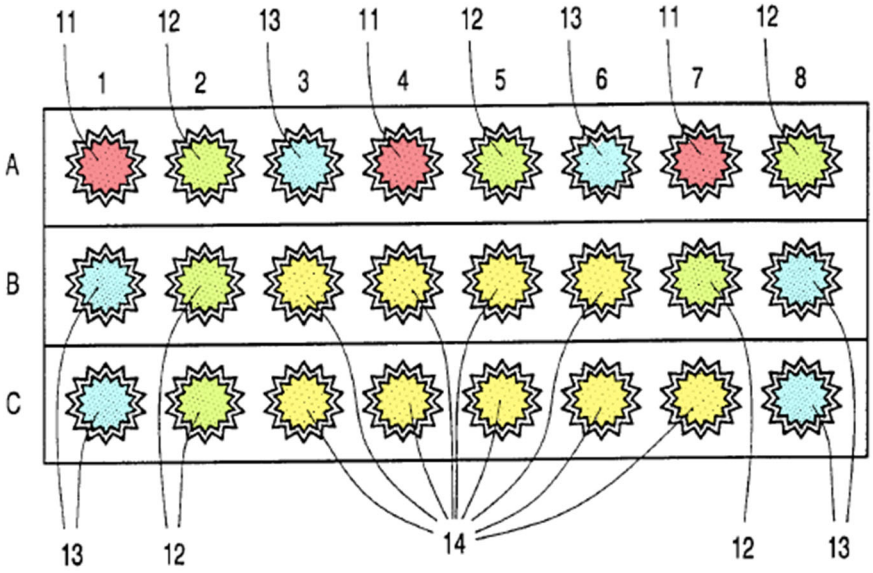
579. If Patent Owner argues, incorrectly, that Karlsson does not disclose claim elements [1.2]/[37.2], Harbers also discloses claim elements [1.2]/[37.2], and it would have been obvious in view of Harbers. A POSA would have been motivated to combine Harbers with Karlsson with a reasonable expectation of success, providing predictable visibility and safety benefits. *See supra* Sections XVI/XVI.A.

580. As explained above (Section XVI.A), 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'" (clusters) 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. For example, Harbers's beam segment 6, 7 is a "wide…passing beam" (first

cluster), beam segment 6', 7' illuminates "the shoulder of the road" (second cluster), and beam segment 6", 7" illuminates "the center of the road" (third cluster). EX1011, 7:1-17, FIG. 1B.




EX1011, FIG. 1B (annotated).




EX1011, FIG. 2 (annotated).

581. A POSA would have been motivated to combine Harbers with Karlsson with a reasonable expectation of success, providing predictable visibility and safety benefits. I provide additional detail, evidence, and explanation of my conclusions below, showing that Karlsson, alone or combined with Harbers, discloses or renders obvious claim elements [1.2]/[37.2].

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

582. As discussed, Karlsson discloses "light clusters" with independently controlled angular positions for reducing glare towards other drivers. *Supra* Section XVI.A. Harbers provides further detail on implementing "light clusters" for different functions, conceptually and physically. So naturally, it would have been obvious to a POSA designing an adaptive headlamp to implement Harbers's

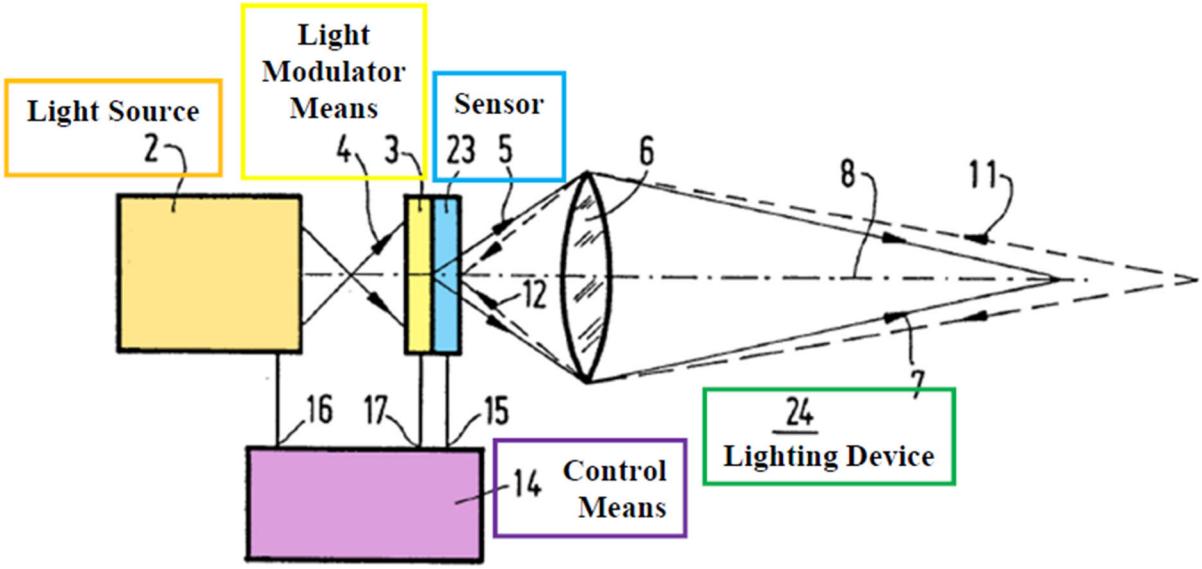
multiple beam segments—through either software or hardware—for different functions in Karlsson's system.

583. 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. EX1010, 1:10-13, 1:16-26, 4:17-21, 9:18-26.

584. Karlsson and Harbers are from the same field—controllable headlamps with dynamic illumination—and include the same building blocks (light sources, sensors, controllers). EX1010, Abstract, 2:30-35, 9:18-26, 13:24-14:4, 19:18-20:3, FIGS. 3, 6, 14-15; EX1011, Abstract, 2:27-3:10, 5:14-26, 6:27-7:19, 7:27-32, FIGS. 1B, 2. Further, improved visibility, thereby increasing safety is paramount in both. EX1010, 1:10-26, 4:17-21, 9:18-26; EX1011, 5:1-26, 7:1-14, 9:1-32.

585. *First*, including an additional control technique (software implementation) for Karlsson—Harbers's *known technique* of using multiple beam segments (clusters) for different functions—would have added more control methods for different functions to Karlsson's system for different driving situations, thereby increasing safety. This is a simple software combination. 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.




EX1010, FIG. 3 (annotated).

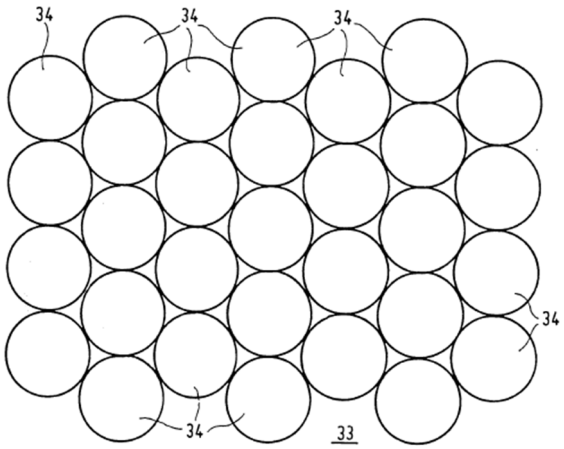



FIG. 6

EX1010, FIG. 6.

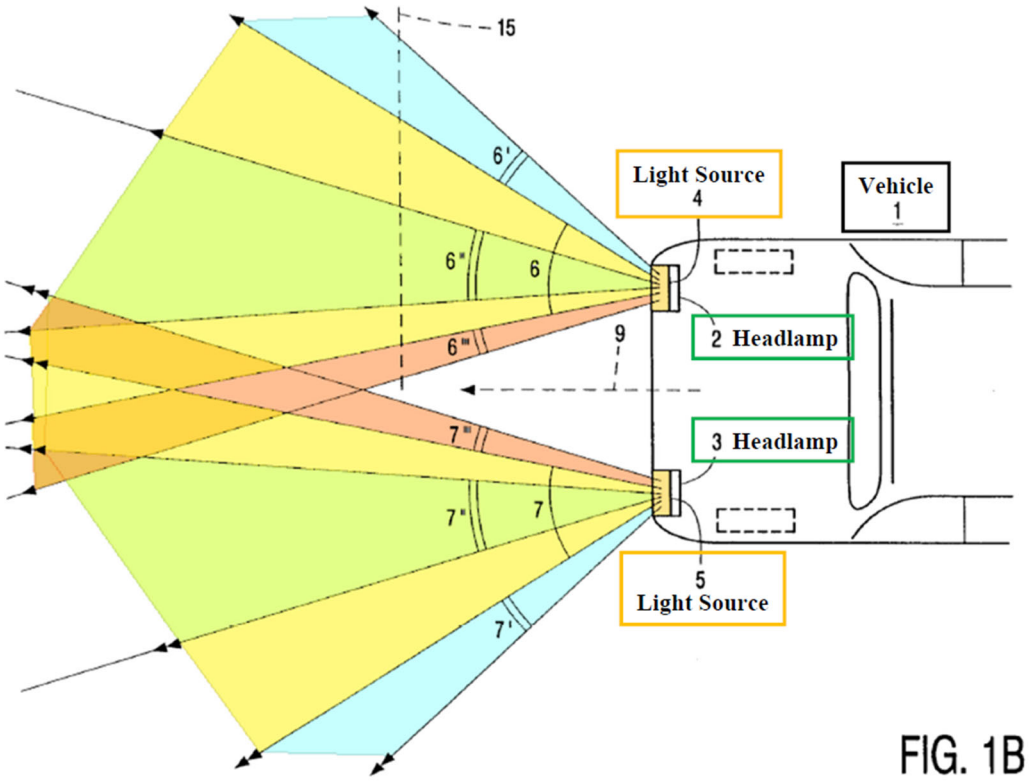
586. Indeed, Karlsson's techniques and system of controlling individual spotlight beams emphasize safety of all drivers. EX1010, 1:16-26, 4:17-21, 9:18-26. Controllable headlamps "significantly increase the driving comfort and the

road safety," and "glaring or 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. EX1010, 1:21-26, 1:10-13 ("comply with…regulations…preventing the *blinding* or *glare*").

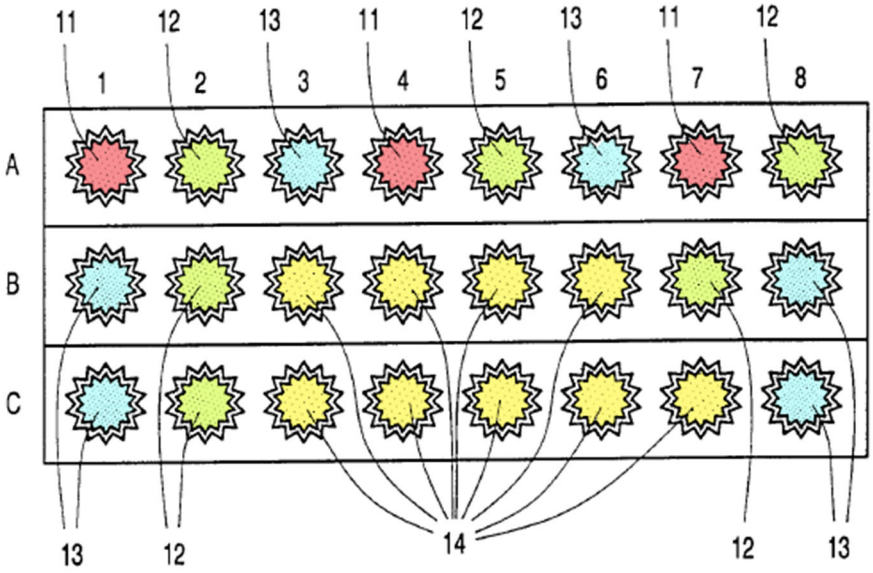
587. Karlsson's system "*selectively adjust[s]*…spotlight beam[s] 34, in response to a *control signal from sensor means 23*…to provide a *desired lighting pattern*" in "given *directions*." EX1010, 14:26-30, 11:25-28, FIGS. 3, 6, 14. Karlsson recognizes the safety benefits of identifying "oncoming traffic" 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. If Patent Owner argues, incorrectly, Karlsson does not expressly disclose "a plurality of light clusters," even though Karlsson discloses different angular positions control for at least two different spotlight beams, it would have been obvious to a POSA to use such control for the feature of "light clusters." Combining Harbers with Karlsson would have made Karlsson's system more direct or active for different functions, and further achieves Karlsson's purpose of improving driver safety.

588. And Harbers's *technique* (software implementation), like Karlsson, seeks to enhance driver visibility, thereby increasing safety—using multiple beam

segments (clusters) for different functions. EX1011, 5:14-26, 6:1-7, 6:27-7:19, 8:10-18, FIGS. 1B-2. Specifically, Harbers's explains opto-electronic elements 11-14 provide differently aimed beam segments 6-6'-6"-6"', 7-7'-7"-7"' (clusters) to form different spatial distributions, improving visibility of the road and/or road surrounding, thereby increasing safety. EX1011, 5:14-26, 6:1-7, 6:27-7:19, FIGS. 1B-2; EX1011, 7:27-32 ("*curved* substrate"), 7:1-17, 9:28-10:5, 13:5-7.




EX1011, FIG. 1B (annotated).




EX1011, FIG. 2 (annotated).

589. The additional control (software implementation) of having multiple beam segments (clusters) 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.

590. This would have merely been applying Harbers's known techniques (software implementation: using multiple directional beam segments for different functions) to Karlsson's similar, known device (adaptive system with controllable spotlight beams), in the same way. 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 way.

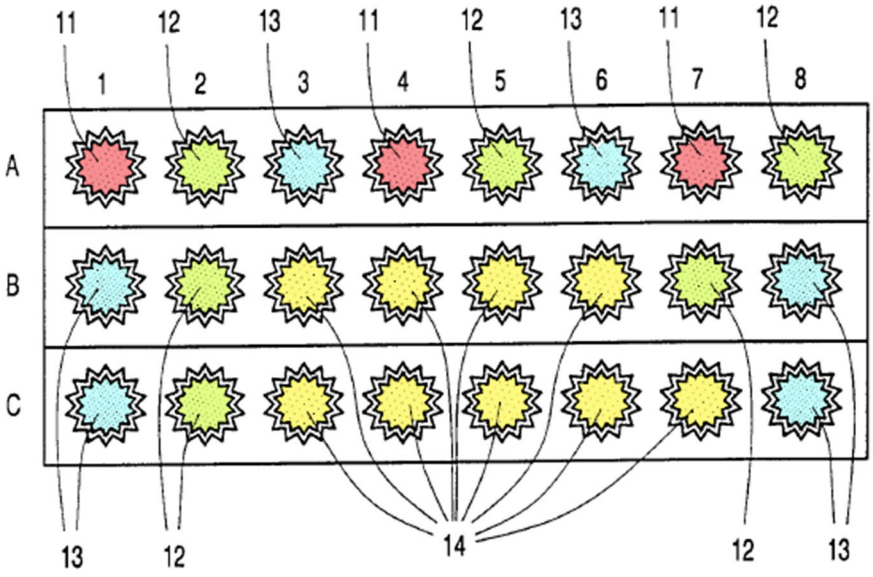
591. A POSA would have had a reasonable expectation of success combining Harbers with Karlsson, for example, by simply modifying software instructions stored in memory of Karlsson's controller/processor to organize Karlsson's spotlight beams into multiple beam segments (clusters) for different functions. Overall, this is a simple software implementation.

592. Such modification 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. In applying Harbers's technique to Karlsson, a POSA would have simply been applying a known technique (software implementation) in a predictable way—controlling headlights in part based on multiple directional beam segments for different functions—as already disclosed in the art.

593. *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 aimed opto-electronic elements 11-14, *see* EX1011, 5:14-26, 6:1-7, 6:27-7:32, FIGS. 1B-2) into Karlsson's system (with lighting means 2, 3). Again, this would have, like Harbers, provided different spatial distributions for different driving situations

(e.g., off-axis viewing, bends, narrow roads, motorways, etc.), improving visibility and thereby safety. This is a simple hardware implementation.

594. Through its *system components* (hardware implementation), 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. Indeed, opto-electronic elements 11-14 arranged on a "curved substrate," with different aimings relative to the vehicle, provide beam segments 6-6'-6"-6'", 7-7'-7"-7'" (clusters) for different driving situations. EX1011, 5:14-26, 6:1-7, 6:27-7:19, FIGS. 1B-2; EX1011, 7:27-32 ("*curved* substrate"), 7:1-17, 9:28-10:5, 13:5-7.




EX1011, FIG. 2 (annotated).

595. Like the software implementation above, this hardware combination of Karlsson's lighting means 2, 3 and Harbers's differently 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. 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). Overall, this is a simple hardware implementation.

596. 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 clusters (e.g., directional beam segments 6-6'-6"-6"', 7-7'-7"-7"') for different functions (hardware implementation).

597. Such modification 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. And in combining Karlsson with Harbers's array of opto-electronic elements 11-14 (e.g., modifying an illuminator), a POSA would have simply been combining known elements according to known methods (disclosed in Harbers) to yield predictable results (light control for different functions, hardware implementation).

598. In view of the above, Karlsson, alone or in combination with Harbers, discloses or renders obvious these elements.

**4. [1.3]: "the headlamps capable of projecting light so as to illuminate a plurality of sub-sections of a field-of-view with different illumination characteristics,"**

**[37.3]: "capable of illuminating subsections of a field-of-view with different illumination characteristics,"**

599. In my opinion, claim elements [1.2]-[1.4] are part of the same clause but will be addressed separately for simplicity below.

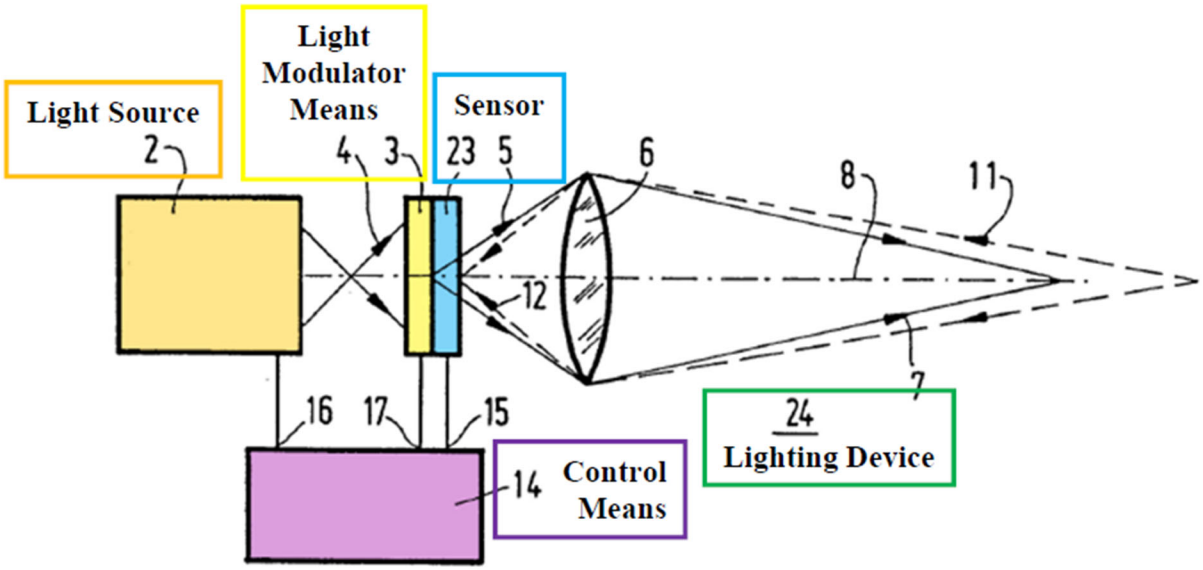
600. In my opinion, claim elements [37.2]-[37.4] are part of the same clause but will be addressed separately for simplicity below.

601. In my opinion, there is no patentable difference between claim elements [37.3] and [1.3] as shown above. *See also* Appendix A. The same disclosures below address each feature.

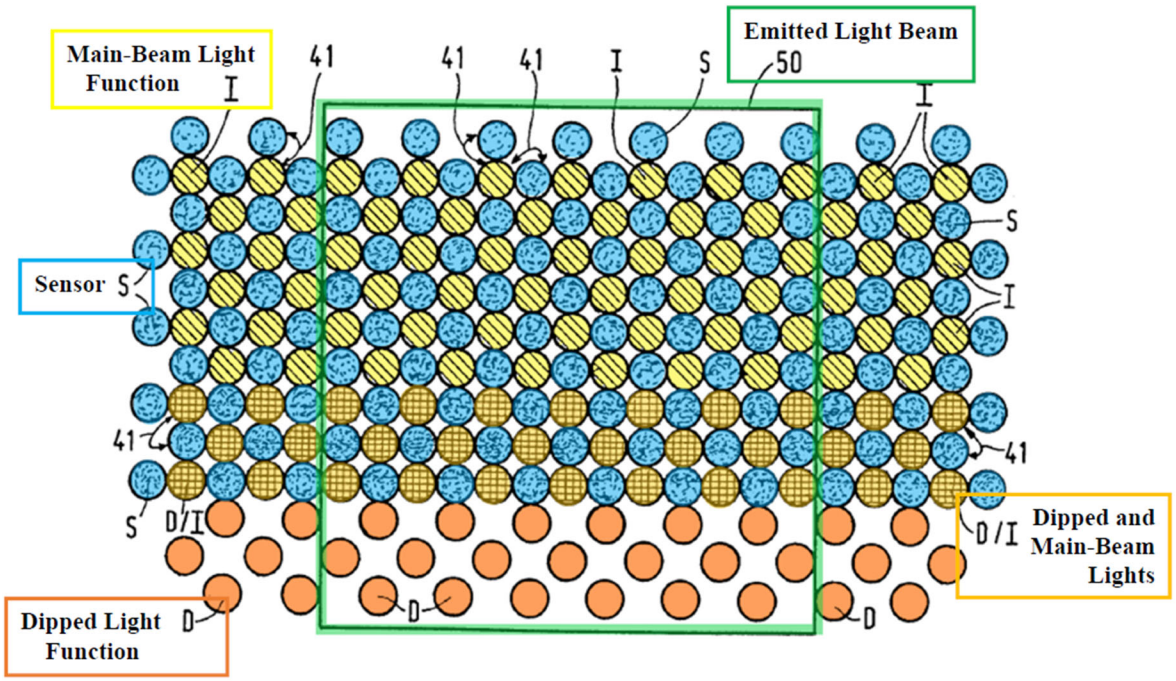
602. Karlsson's control means 14 controls "light beam 7 having a *desired pattern* and a *desired intensity* is emitted." EX1010, 9:9-17, FIGS. 3, 6, 14-15; EX1010, 3:27-31 ("*field of view*"), 4:26-29 ("*desired pattern*"), 5:16-23 ("*detecting*…*oncoming traffic* as a *parameter*"), 2:7-9 ("*part of the light beam*…is automatically suppressed"), 19:29-33 ("*vary* as regards its *shape* and *dimension*"), 9:19-22.

603. A POSA would have understood that "intensity" and "pattern" are "different illumination characteristics." EX1001, 16:43-50 ("the resultant light

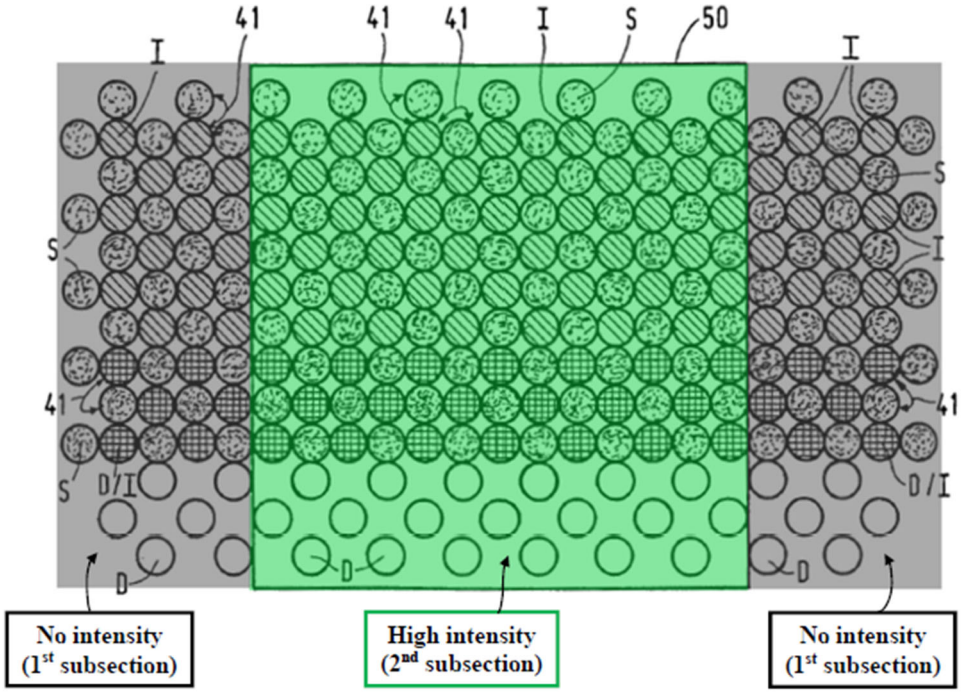
*characteristic*, be in its *intensity*, *spatial* intensity distribution"), 2:28-30 ("[e]ach fixture has its photometric distribution *characteristics*…how many *candela* at what *angle*").




EX1010, FIG. 3 (annotated).



EX1010, FIG. 14 (annotated).




EX1010, FIG. 14 (annotated).

604. In view of the above, Karlsson discloses these elements.

**5. [1.4]: "the subsections determined in response to sensor data, wherein the light clusters operate to create a headlight beam;"**

**[37.4]: "wherein at least two of the light clusters operate to create a headlight beam;"**

605. In my opinion, claim elements [1.2]-[1.4] are part of the same clause but will be addressed separately for simplicity below.

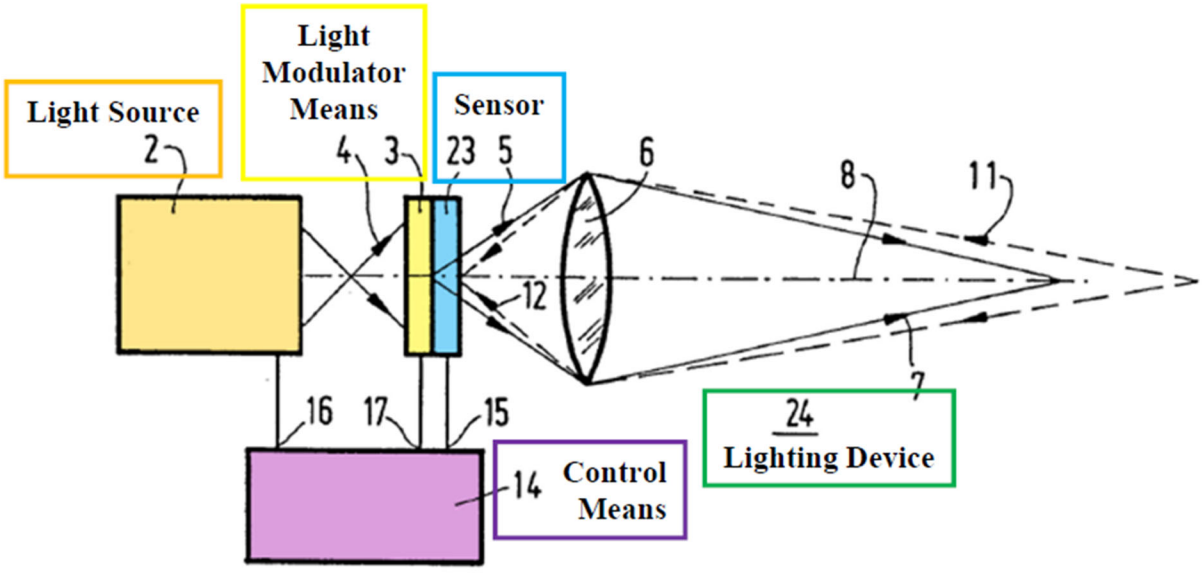
606. In my opinion, claim elements [37.2]-[37.4] are part of the same clause but will be addressed separately for simplicity below.

607. In my opinion, there is no patentable difference between claim elements [37.4] and [1.4] as shown above. *See also* Appendix A. The same disclosures below address each feature.

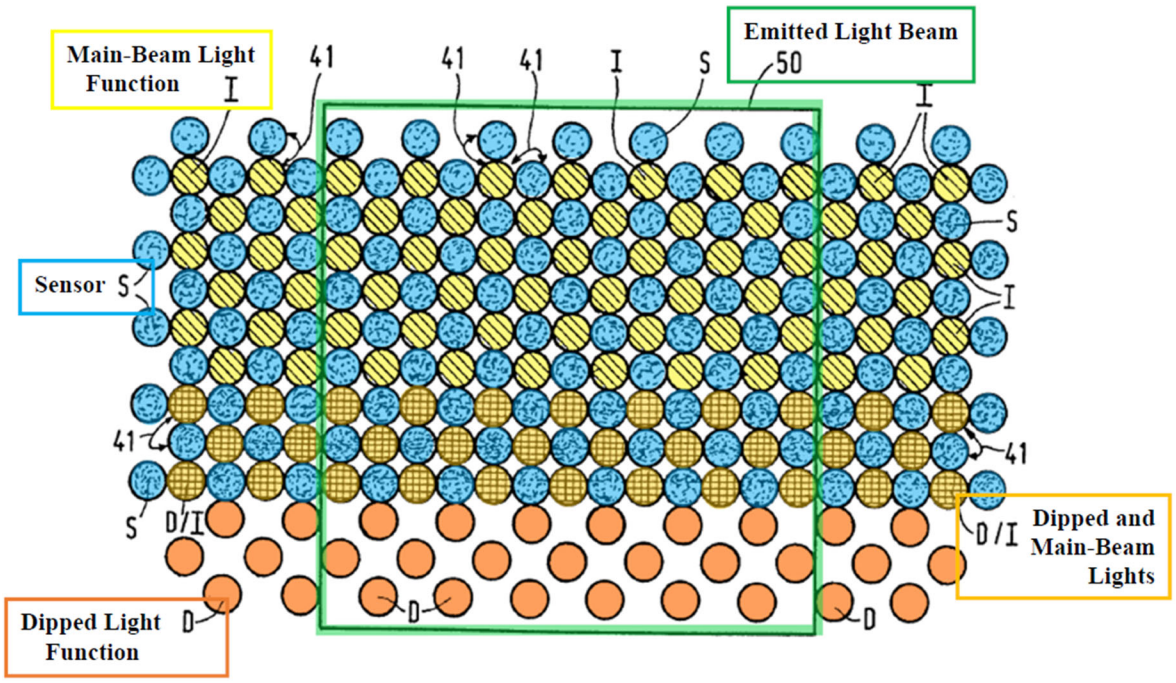
608. Karlsson's "light-sensitive sensor…*detects* the distribution and the intensity of light in the *area ahead of a vehicle*" for "*detecting* light from *oncoming traffic*" and "*control means 14...control the lighting means 2, 3* in such a manner that a *light beam 7* having a *desired pattern* and a *desired intensity* is emitted." EX1010, 2:2-4, Abstract, 9:9-17, FIGS. 3, 14-15; EX1010, 3:17-21 ("*light of oncoming traffic*"), 12:19-24 ("precisely determining the *direction* and the *intensity* of the *detected light 11*"), 5:16-32, 3:27-31.

609. As discussed, Karlsson, alone or in combination with Harbers, discloses one or more "light clusters." *Supra* Section XVI.B.3.

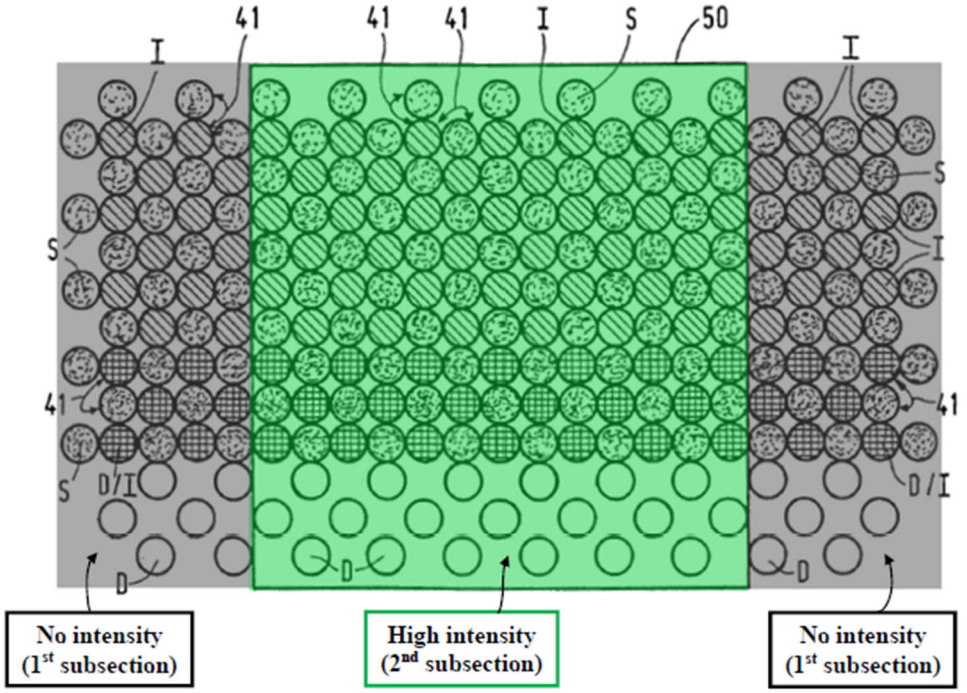
610. Thus, Karlsson, alone or in combination with Harbers, discloses or renders obvious "light clusters" and "at least two…light clusters" operate to create a headlight beam as in claim elements [1.4] and [37.4].




EX1010, FIG. 3 (annotated).




EX1010, FIG. 14 (annotated).

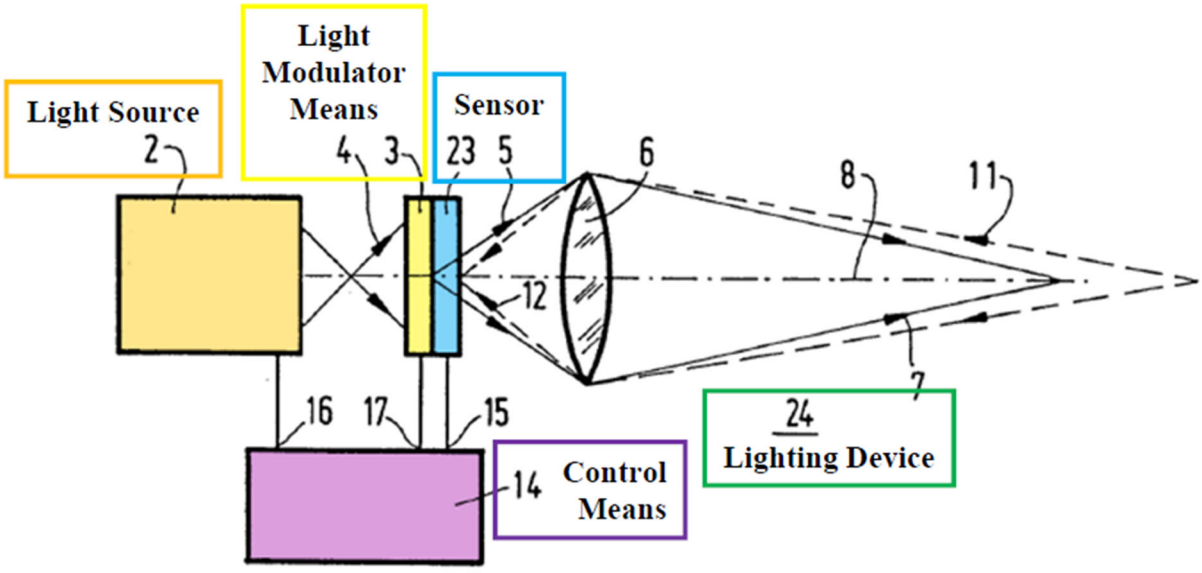



EX1010, FIG. 14 (annotated).

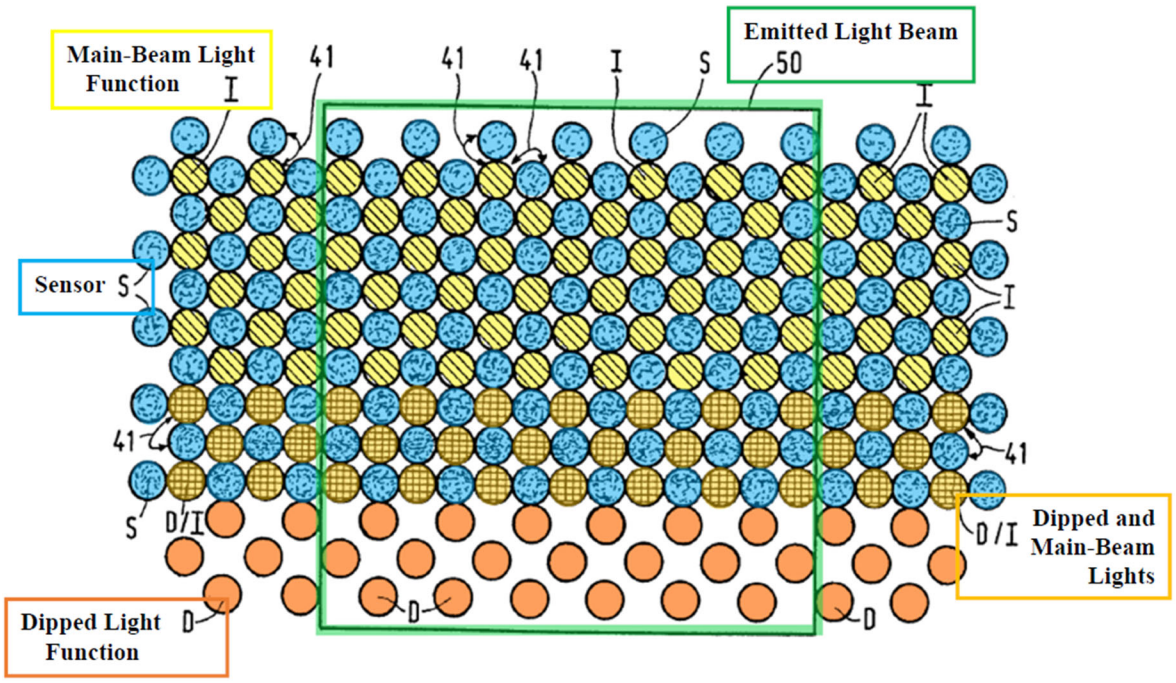
611. In view of the above, Karlsson, alone or in combination with Harbers, discloses or renders obvious these elements.

### 6. [1.5]: "electronic control circuitry configured to independently operate the light clusters;"

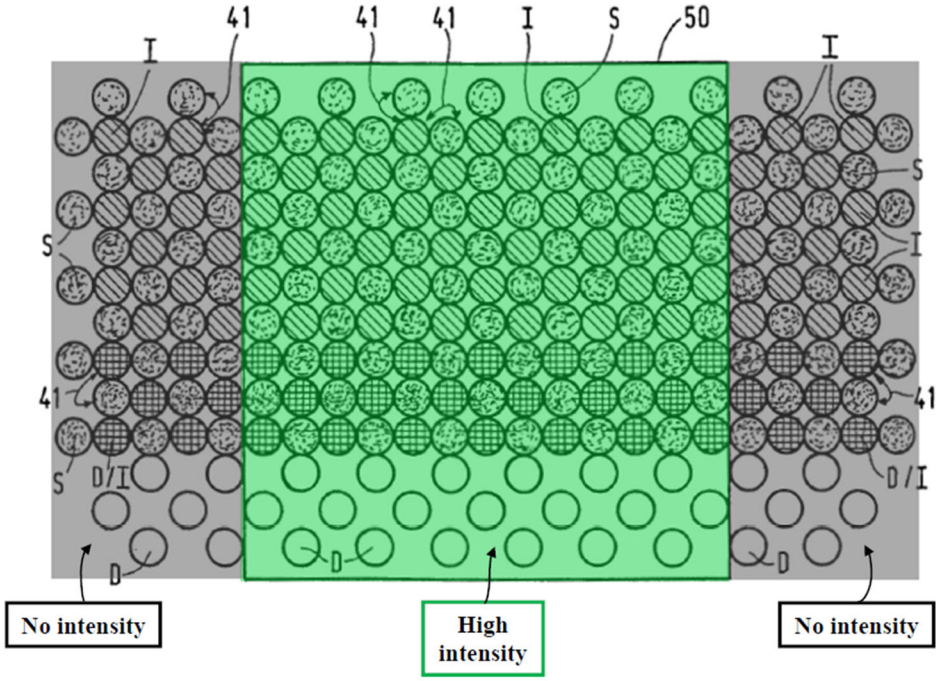
612. Karlsson's "lighting means 2, 3…[are] controlled by control means 14, such that the incident light 11 on the light-sensitive sensor 9…is processed into an electric control signal…[and] processed by the control means 14 into output signals…to control…light beam 7 having a desired pattern and a desired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




EX1010, FIG. 3 (annotated).

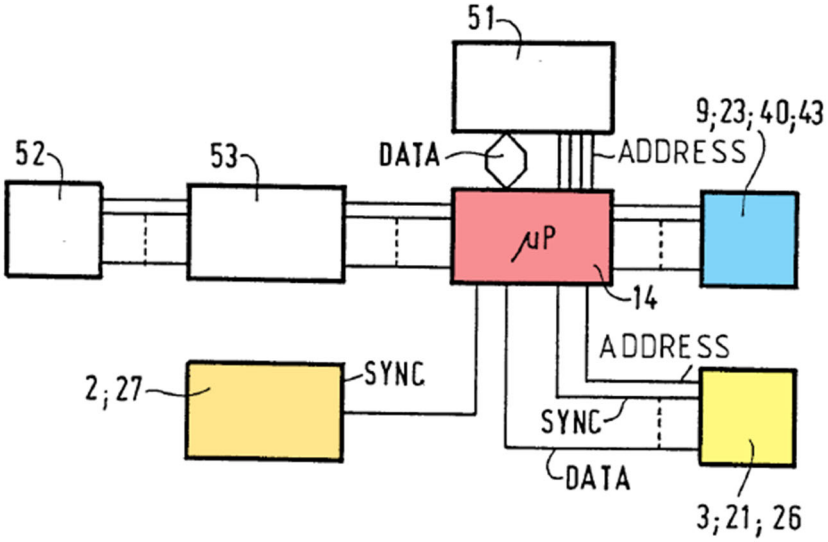



EX1010, FIG. 14 (annotated).




EX1010, FIG. 14 (annotated).

613. A POSA would have understood Karlsson's controller includes "electronic control circuitry" (control electronics/signaling links). EX1010, 19:34-20:15, 21:36-22:4, FIGS. 14-15. As discussed, Karlsson, alone or in combination with Harbers, discloses one or more "light clusters." *Supra* Section XVI.B.3.



EX1010, FIG. 15 (control circuitry) (annotated).

614. Thus, Karlsson's controller/processor sends control signals to illuminator (light modulator means) to control spotlight beams in the array to "independently operate the light clusters." EX1010, 5:4-15, 9:9-17, 19:34-20:5; FIGS. 3, 14-15.

615. In view of the above, Karlsson, alone or in combination with Harbers, discloses or renders obvious this element.

**7. [1.6]: "one or more sensors configured to obtain and provide the sensor data predefined as pertinent to illumination requirements for the field-of-view; and"**

**[37.5]: "one or more sensors configured to obtain and provide sensor data,"**

**[37.6]: "at least a portion of the sensor data indicating a second vehicle within the field-of-view; and"**

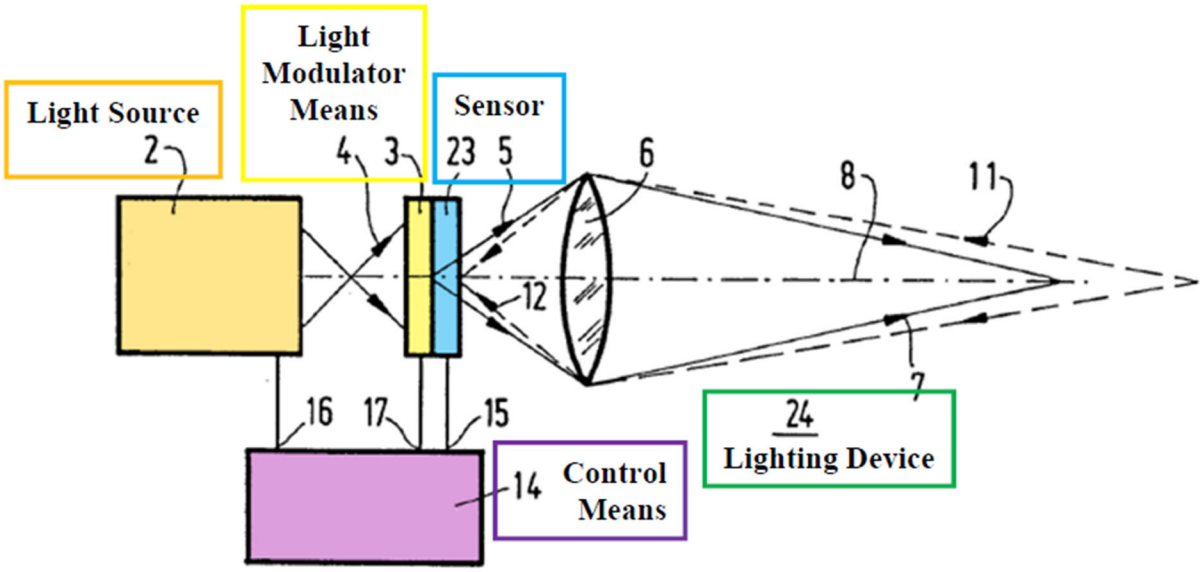
616. In my opinion, claim elements [37.5] and [37.6] are part of the same clause and will be addressed together for simplicity below.

617. In my opinion, there is no patentable difference between claim elements [37.5] and [1.6] as shown above. *See also* Appendix A. The same disclosures below address each feature.

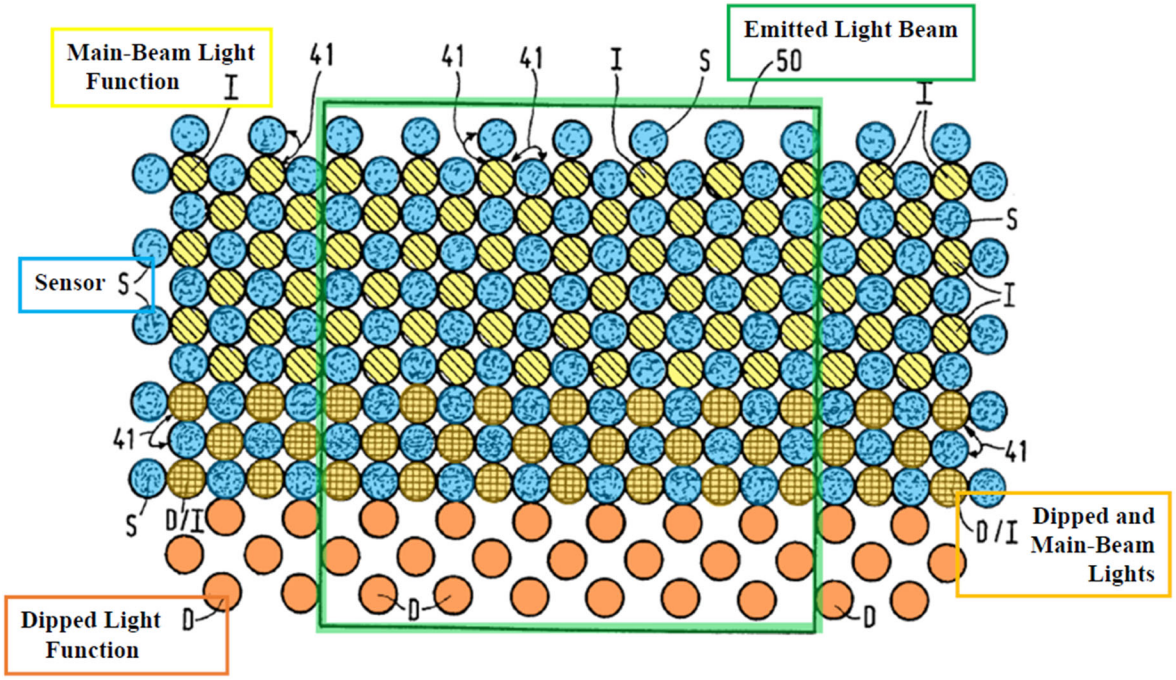
618. In my opinion, there is no patentable difference between claim elements [37.6] and [1.6] as shown above. *See also* Appendix A. The same disclosures below address each feature.

619. Karlsson's "*light-sensitive sensors* 9 and 23…*determin[e]* the direction and the intensity of the *detected light 11*" and "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, 12:19-24, 2:2-4, Abstract, FIGS. 3, 14-15; EX1010, 3:27-31 ("*field of view*"), 19:18-21 ("*spotlight sensors S*"), 5:16-23 ("*sensor means*…comprises *spotlight sensors*"), 3:17-21 ("*light of oncoming traffic*"), 9:6-8, 5:28-32.

620. The detected light data (oncoming traffic) is "predefined as pertinent to illumination" because Karlsson uses "light from oncoming traffic as a parameter to which the pattern…is to be adjusted." EX1010, 5:16-23, FIGS. 3, 14-15.




EX1010, FIG. 3 (annotated).




EX1010, FIG. 14 (annotated).

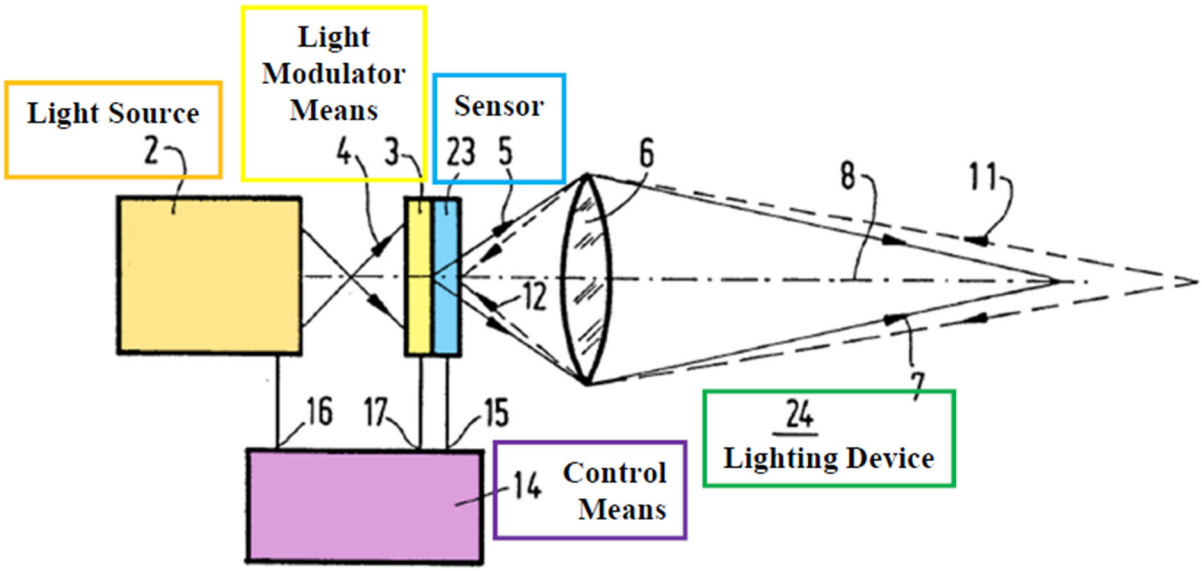
621. In view of the above, Karlsson discloses these elements.

**8. [1.7]: "a logical controller including a processor, the processor in communication with a memory storing one or more algorithms, with the sensors, and with the control circuitry,"**

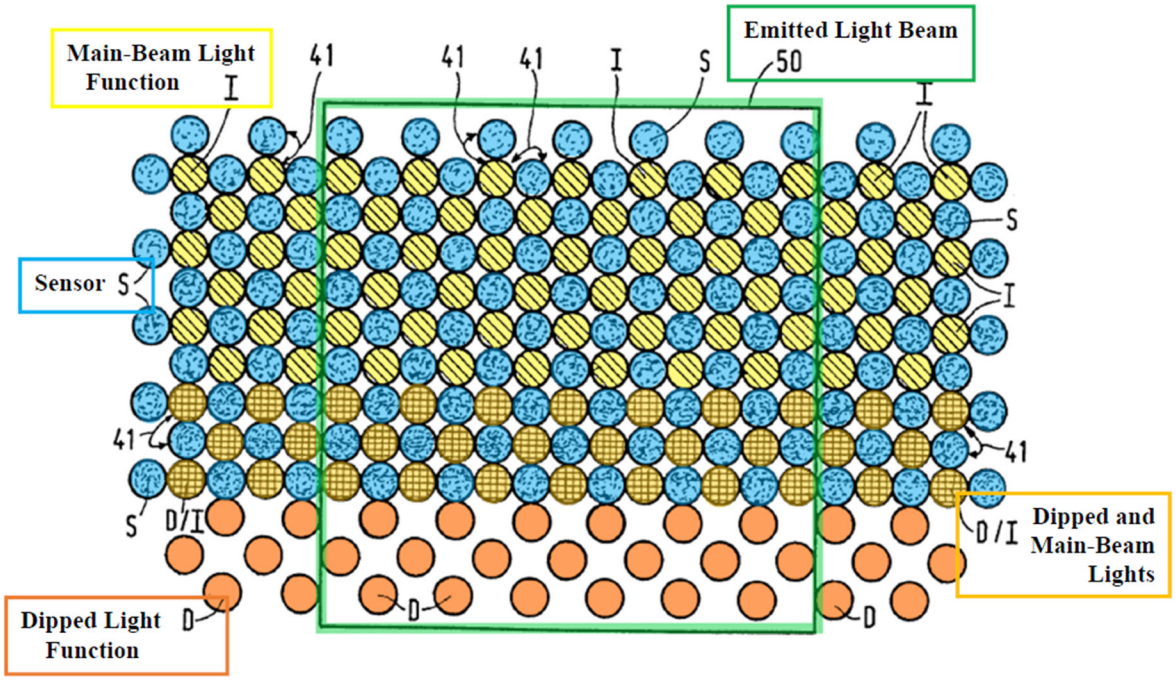
622. In my opinion, claim elements [1.7]-[1.10] are part of the same clause but will be addressed separately for simplicity below.

623. 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*" and "*memory 51*…may be used for *storing* and recording the *various adjustments*." EX1010, 9:9-17, 21:36-22:4, FIGS. 3, 14-15; EX1010, 21:36-22:1

("*microprocessor*"), 20:12-32 ("*memory means 51*"), 20:1-3 ("*control electronics 41*"), 21:36-22:4.

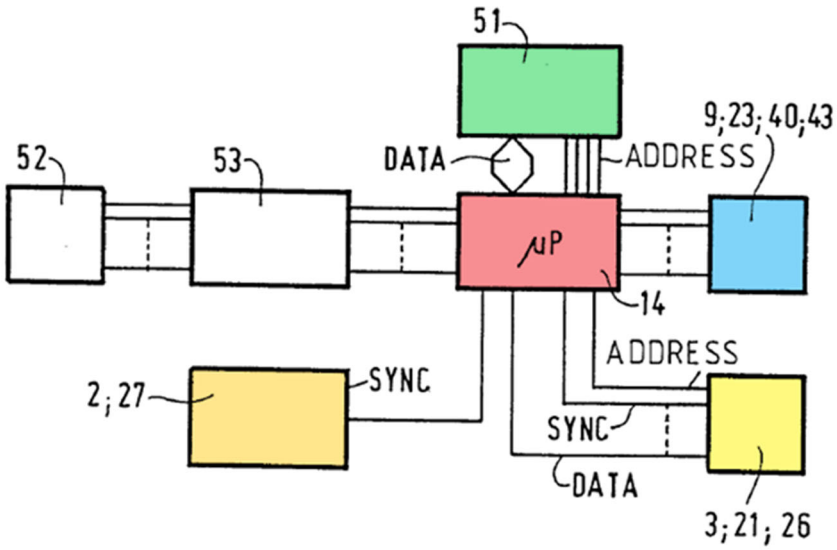



EX1010, FIG. 3 (annotated).




EX1010, FIG. 14 (annotated).

624. A POSA would have understood Karlsson's controller is "a logical controller including a processor" because Karlsson's "electric diagram…[of] processor-controlled control means 14" (Figure 15) includes processor/microprocessor 14 in communication with memory 51, sensor 9/23, and light modulator 3 (control electronics/signaling links). EX1010, 19:34-20:15, 21:36-22:4, FIGS. 14-15.




EX1010, FIG. 15 (controller with processor/control circuitry) (annotated).

625. A POSA would have understood that Karlsson's memory 51 stores "one or more algorithms" in communication with "processor-controlled control means 14" to determine adaptive light beam 7. EX1010, 9:9-17, 12:19-24, 20:12-15, FIG. 15.

626. In view of the above, Karlsson discloses or renders obvious this element.

**9. [1.8]: "wherein the processor is configured to process the one or more algorithms and the sensor data to determine an illumination for at least two of the subsections,"**

**[37.7]: "at least one processor configured to: receive the sensor data; process the sensor data to determine a light distribution pattern for an adaptive headlight beam,"**

627. In my opinion, claim elements [1.7]-[1.10] are part of the same clause but will be addressed separately for simplicity below.

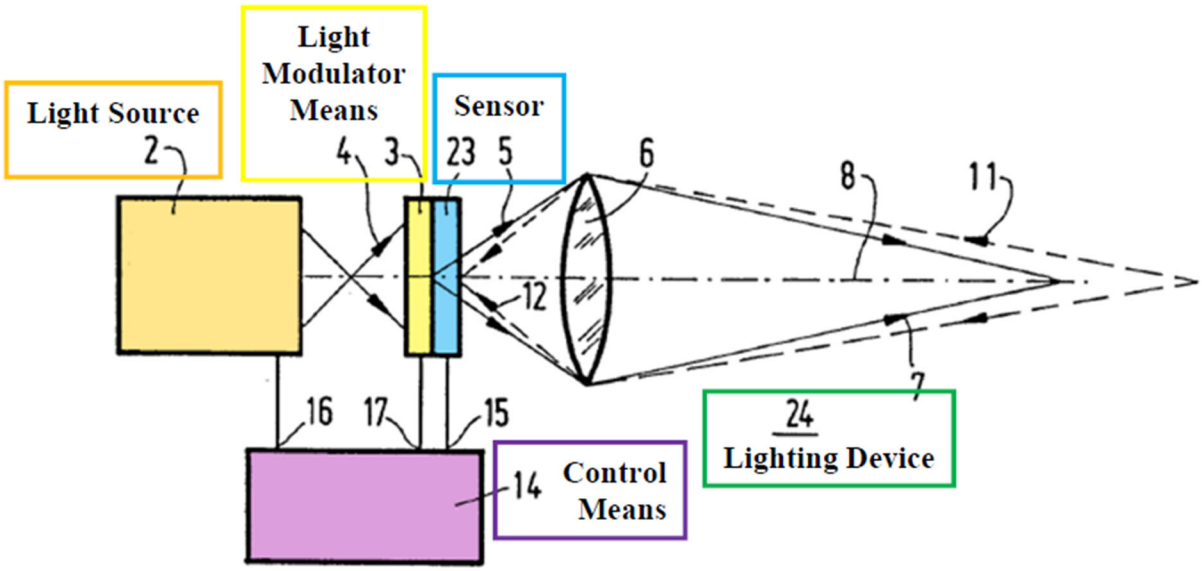
628. In my opinion, claim elements [37.7]-[37.10] are part of the same clause but will be addressed separately for simplicity below.

629. In my opinion, there is no patentable difference between claim elements [37.7] and [1.8]. *See also* Appendix A. The same disclosures below address each feature.

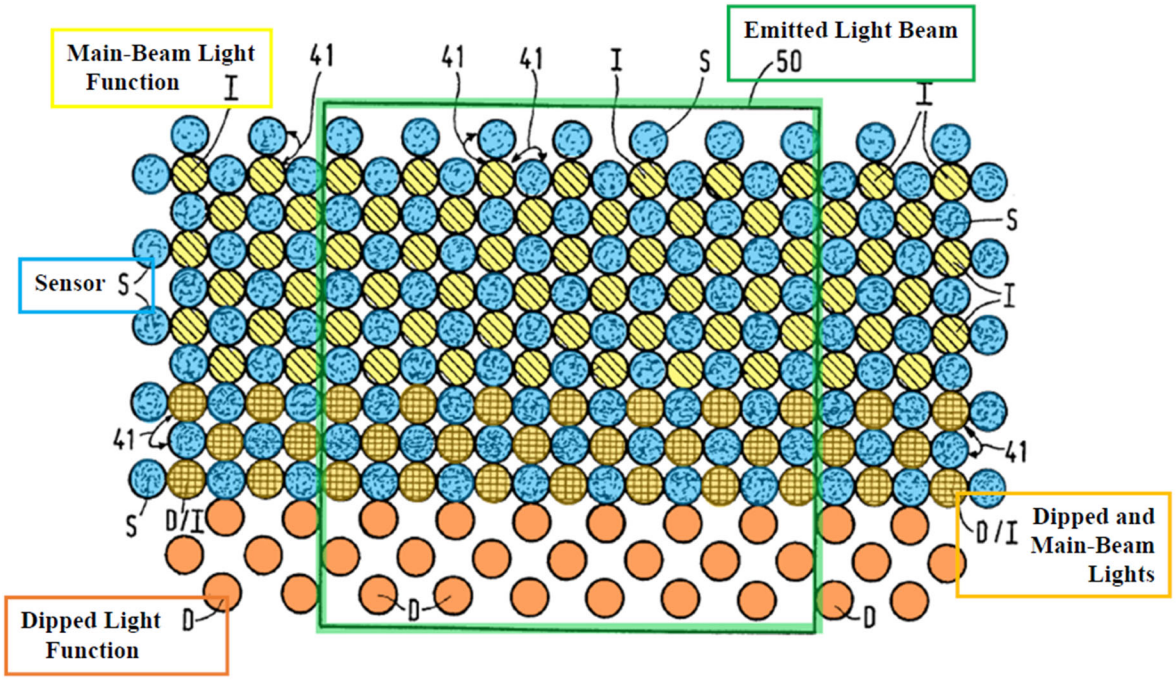
630. Karlsson discloses "incident light 11 on the light-sensitive sensor 9…is processed into an electric control signal on input 15 of the control means 14." EX1010, 9:9-17, FIGS. 3, 14-15; EX1010, 5:16-23 ("detecting…oncoming traffic as a parameter"), 2:7-9 ("part of the light beam…is automatically suppressed"), 3:27-31 ("field of view"), 5:28-32, 9:18-26, 20:12-32, 21:36-22:4, 14:26-30.

631. Thus, Karlsson's processor processes the inputted incident light data and uses memory (with algorithms) to "determine an illumination for at least two

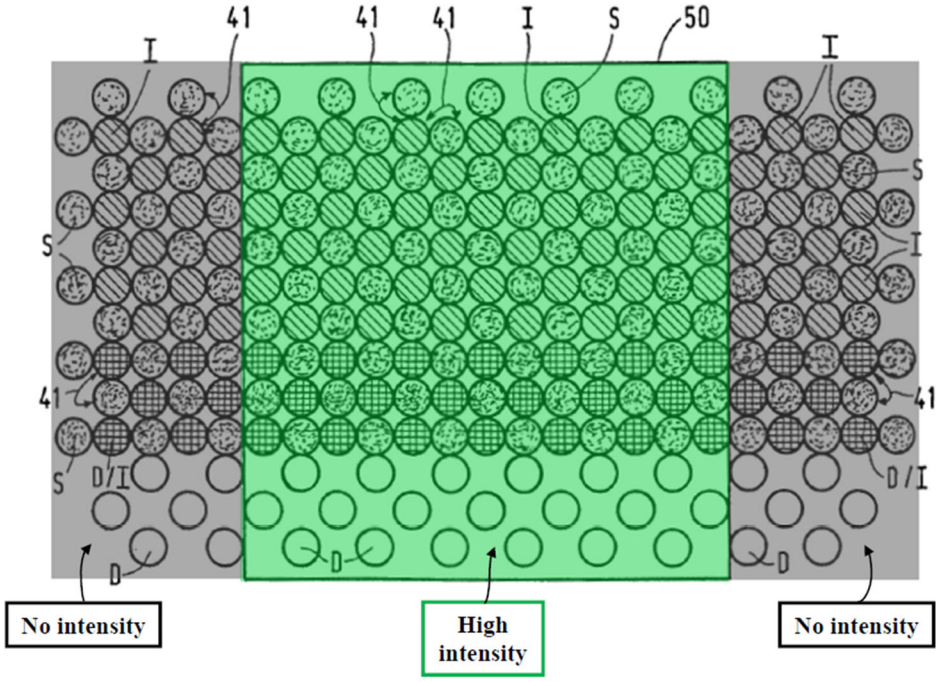
of the subsections" (shaded area of no intensity and non-shaded area of high intensity). EX1010, 9:9-17, 12:19-24, FIGS. 14-15.



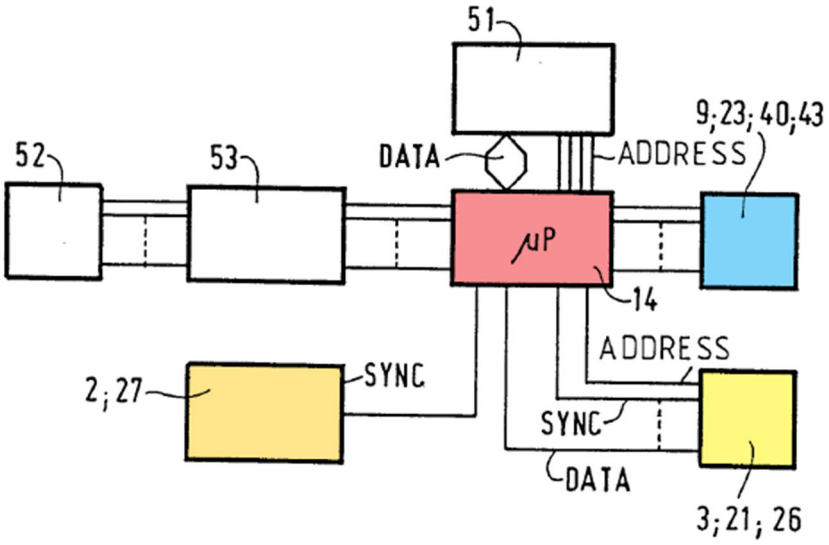

EX1010, FIG. 3 (annotated).




EX1010, FIG. 14 (annotated).




EX1010, FIG. 14 (annotated).




EX1010, FIG. 15 (annotated).

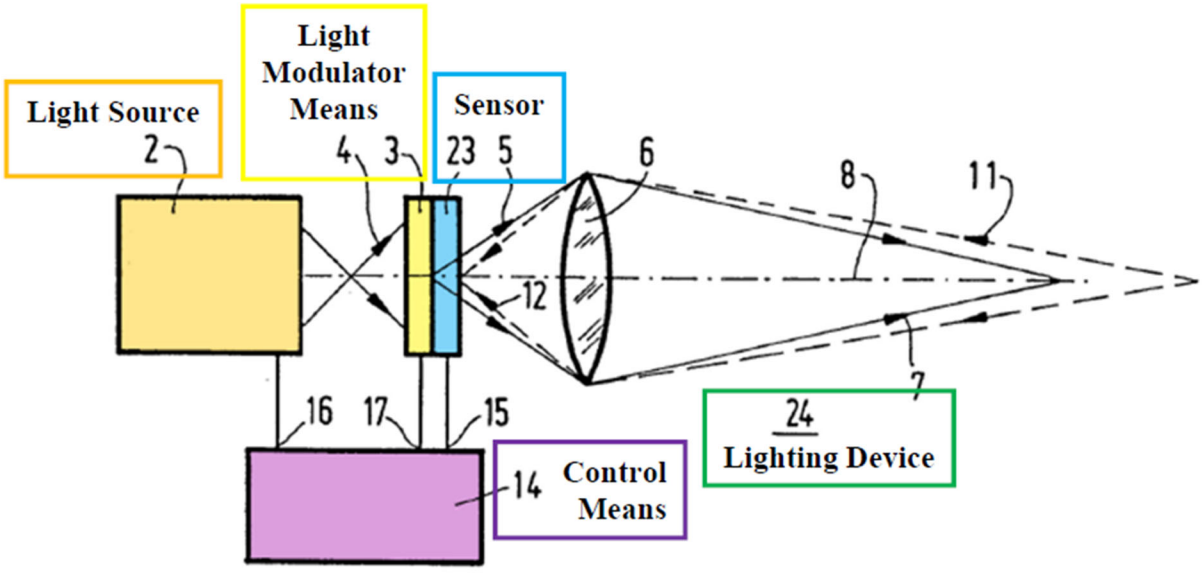
632. In view of the above, Karlsson discloses or renders obvious these elements.

**10. [1.9]: "that reduces illumination to reduce glare in at least a first of the at least two subsections and"**

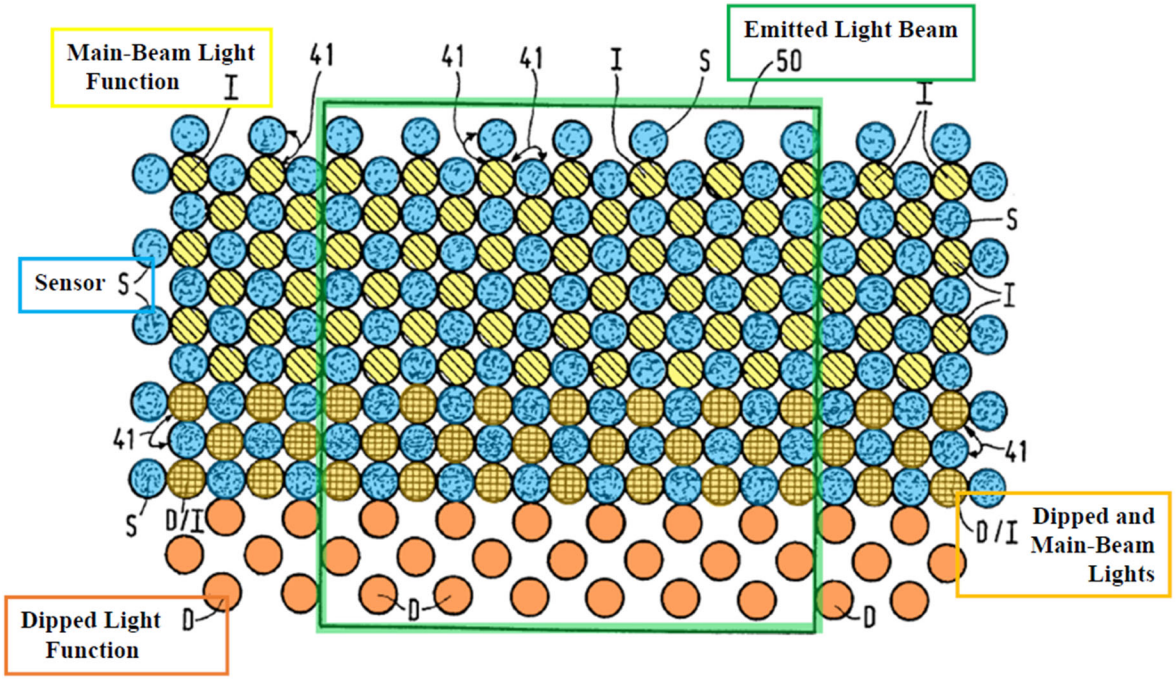
633. In my opinion, claim elements [1.7]-[1.10] are part of the same clause but will be addressed separately for simplicity below.

634. 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; EX1010, 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.

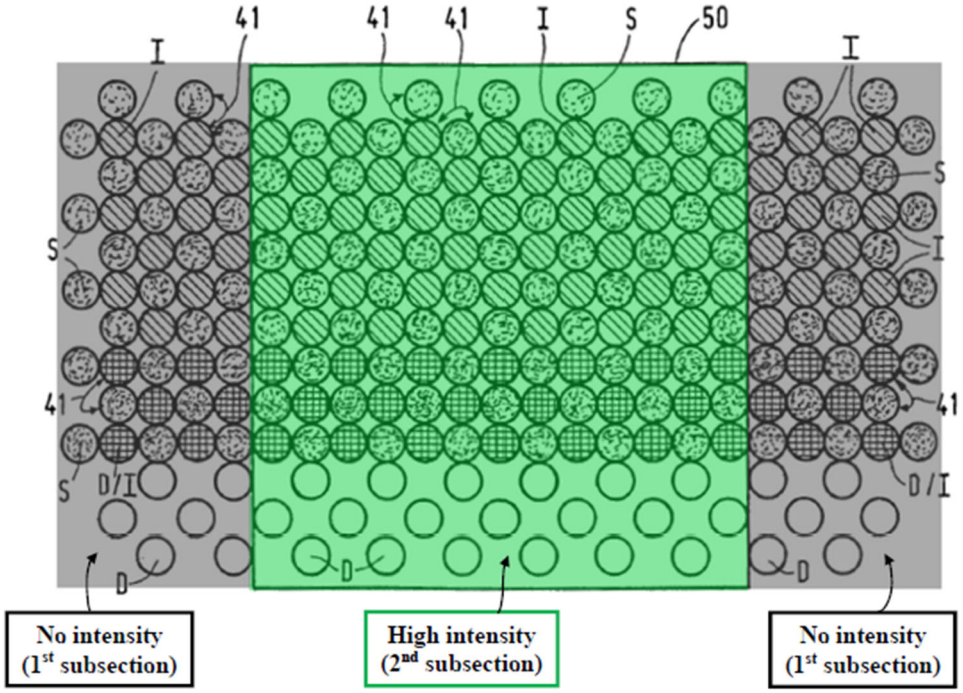
635. Karlsson thus suppresses illumination at the identified vehicle area, which "reduce[s] glare." EX1010, 9:11-26, 2:7-9, 5:28-32.



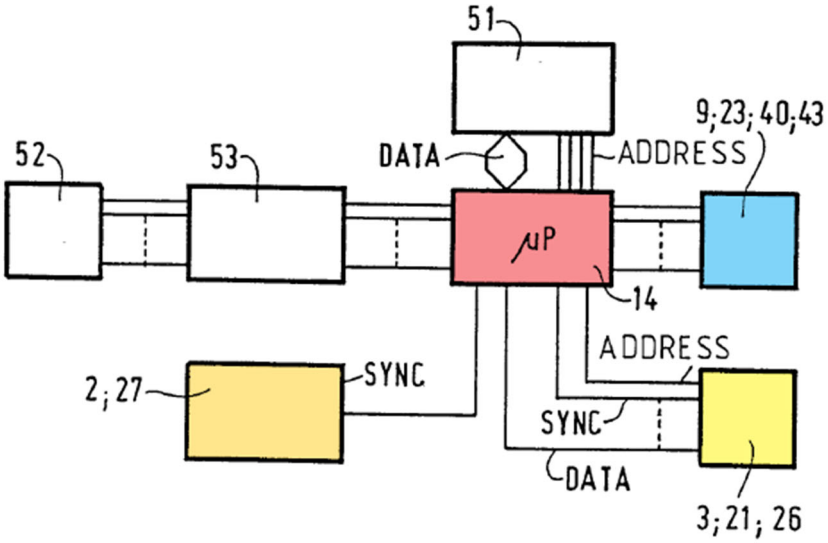

EX1010, FIG. 3 (annotated).




EX1010, FIG. 14 (annotated).




EX1010, FIG. 14 (annotated).




EX1010, FIG. 15 (annotated).

636. In view of the above, Karlsson discloses this element.

**11. [1.10]: "adapt the light emitted from one or more of the light-clusters so as to create the headlight beam that provides the determined illumination."**

**[37.10][12]: "instruct operation of at least two of the light clusters to create the adapted headlight beam."**

637. In my opinion, claim elements [1.7]-[1.10] are part of the same clause but will be addressed separately for simplicity below.

638. In my opinion, claim elements [37.7]-[37.10] are part of the same clause but will be addressed separately for simplicity below.

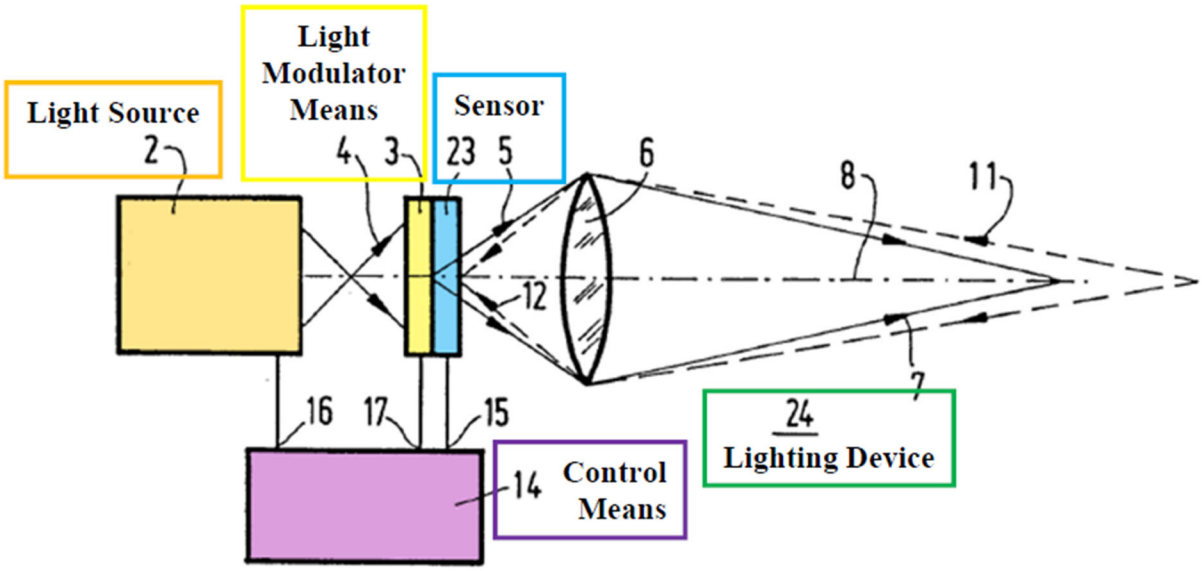
639. In my opinion, there is no patentable difference between claim elements [37.10] and [1.10] as shown above. *See also* Appendix A. The same disclosures below address each feature.

640. Karlsson's "lighting means 2, 3…[are] 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; EX1010, 20:12-32, 21:36-22:4.

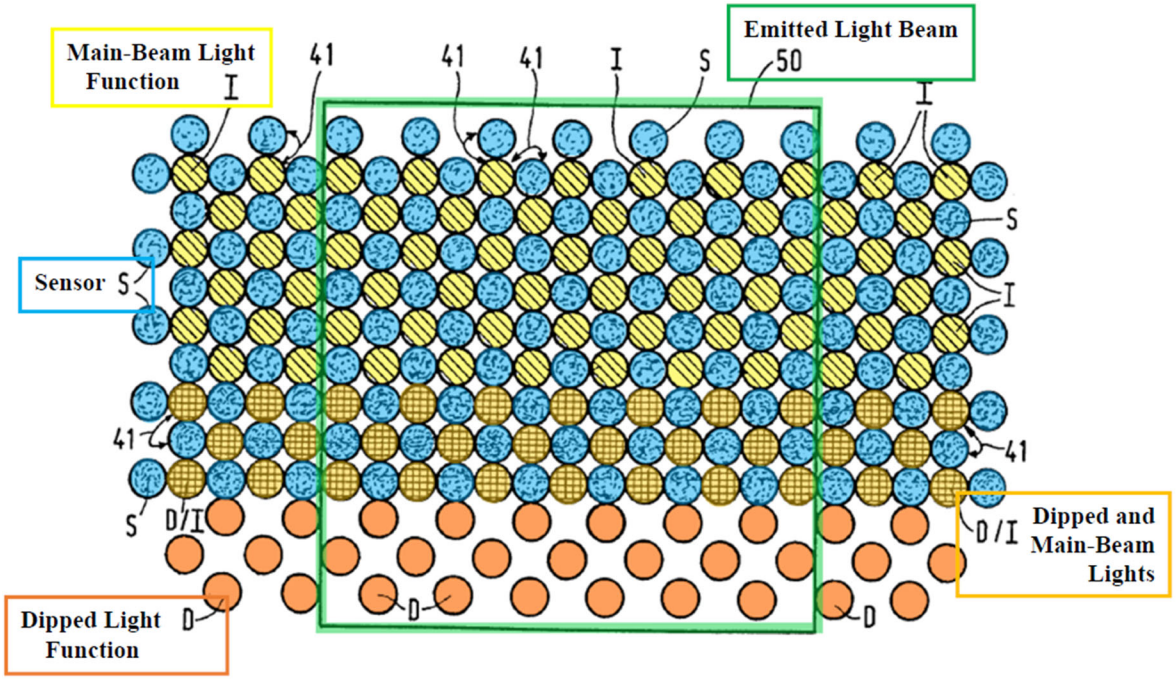
[12] Claim elements [37.8]-[37.9] will be addressed in Section XVI.C below with claim 37.

641. As discussed, Karlsson, alone or in combination with Harbers, discloses one or more "light clusters." *Supra* Section XVI.B.3.

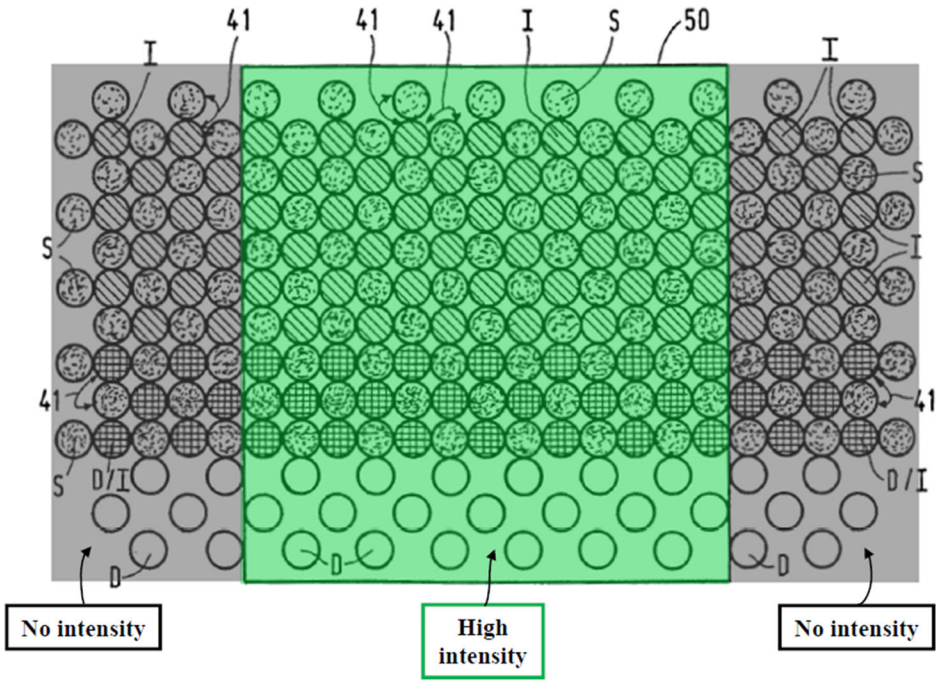
642. Thus, Karlsson, alone or in combination with Harbers, discloses "adapt[ing]…light-clusters" and "instruct[ing] operation of at least two…light clusters" to create a headlight beam as in [1.10] and [37.10].



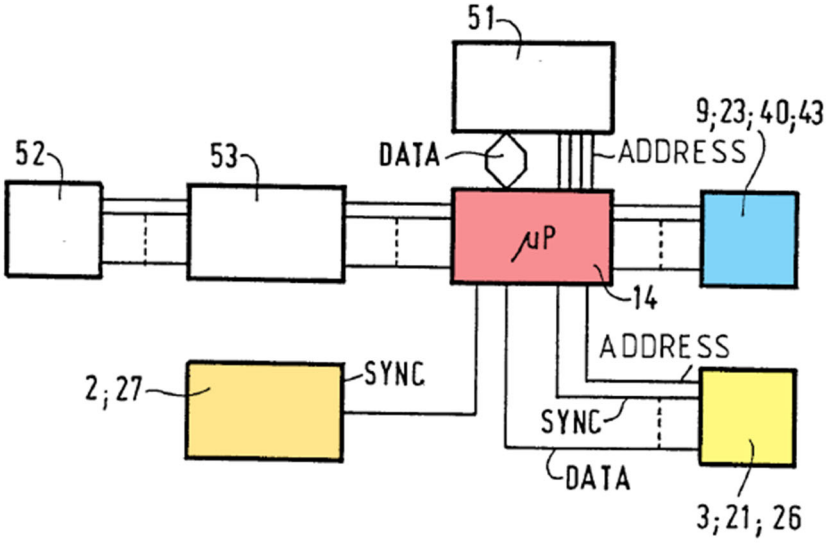

EX1010, FIG. 3 (annotated).




EX1010, FIG. 14 (annotated).




EX1010, FIG. 14 (annotated).




EX1010, FIG. 15 (annotated).

643. In view of the above, Karlsson, alone or in combination with Harbers, discloses or renders obvious these elements.

### C. Additional Elements of Claim 37

644. Claim elements [37.P]-[37.7] and [37.10] are addressed above in Section XVI.B.

#### 1. [37.8]: "such that a headlight beam adapted to the pattern substantially illuminates a first subsection of the field-of-view including at least a portion of the second vehicle with an illuminance below a predefined threshold value,"

645. In my opinion, claim elements [37.7]-[37.10] are part of the same clause but will be addressed separately for simplicity below.

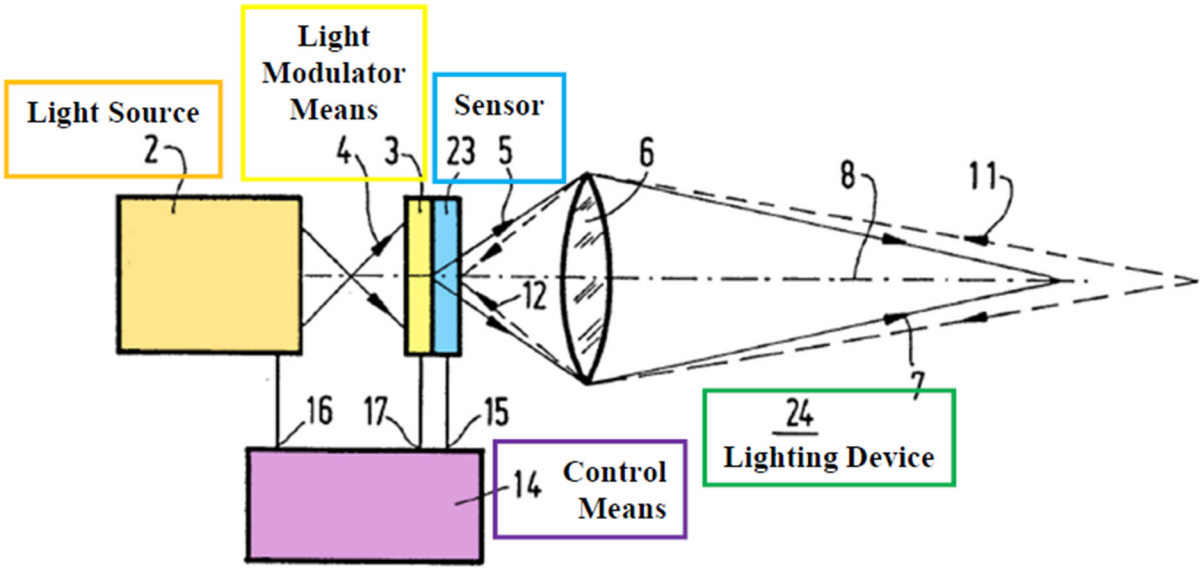
646. As discussed (Sections XVI/XVI.A), in my opinion, Karlsson discloses this element, [37.8]. Specifically, Karlsson discloses "spotlight sources indicated at D provide the *dipped light function*." EX1010, 19:23-27, FIGS. 14-15;

EX1010, 1:27-30 ("*low beams* or *dipped* headlights"), Abstract, 1:16-18. Thus, a POSA would have understood that Karlsson's headlight includes a "predefined" threshold, for example, a "dipped headlights" illuminance.

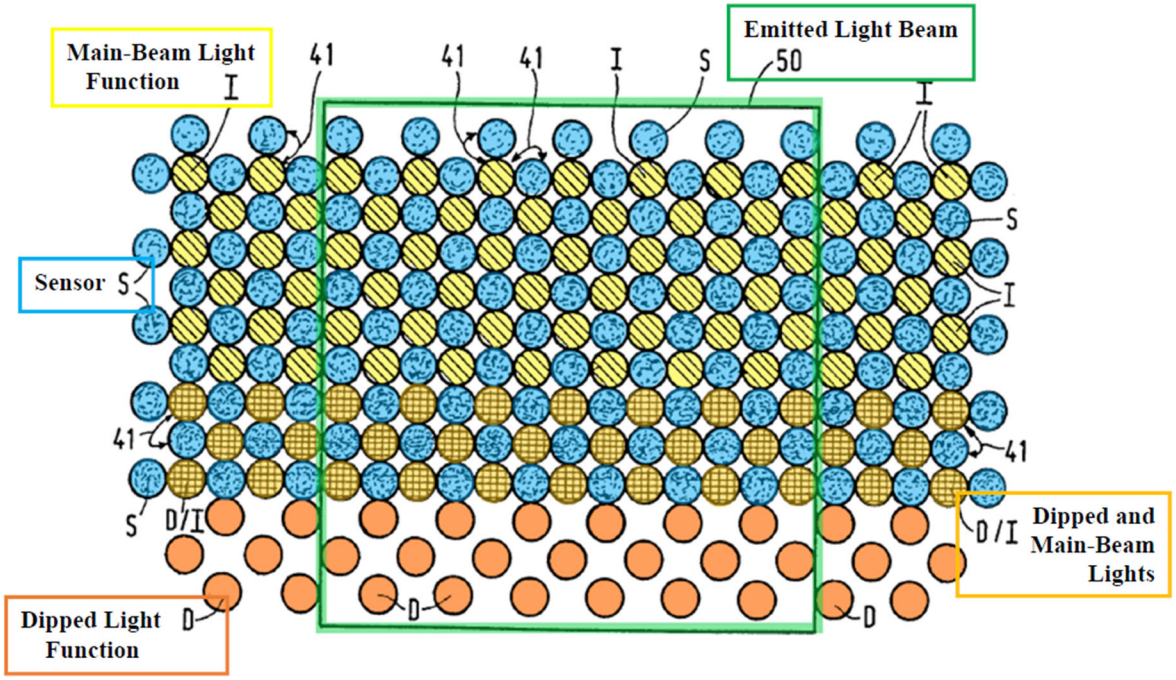
647. Further, Karlsson discloses "light beam 7…controlled in such a manner that *no light at all* or *light having a low intensity* is emitted in those directions from which light is detected…[thus] *glaring or blinding of oncoming traffic* is effectively *prevented*." EX1010, 9:18-26, FIGS. 3, 14, 15; EX1010, 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 ("precise adjustment…so as *not to emit light* in the direction of the detected light"), 14:26-30, 9:9-26, 5:16-32, 20:12-32, 21:36-22:4. The first subsection (shaded area, e.g., outside emitted light beam 50) is thus illuminated "below a predefined threshold" (e.g., below a *dipped* headlights illuminance) because "no light at all or light having a *low intensity*" is *below* a dipped headlights illuminance.

648. As discussed in Section XVI.A, the concept of a "dipped light function" or a low beam illumination level would have been known to a POSA. Such low beam (dipped headlights) illumination level for driver's visibility and glare light control is defined in all regulations, standards, and automaker's specifications, which is a predefined illumination level in terms of the light intensity distribution in the low beam illuminating area or low beam projected

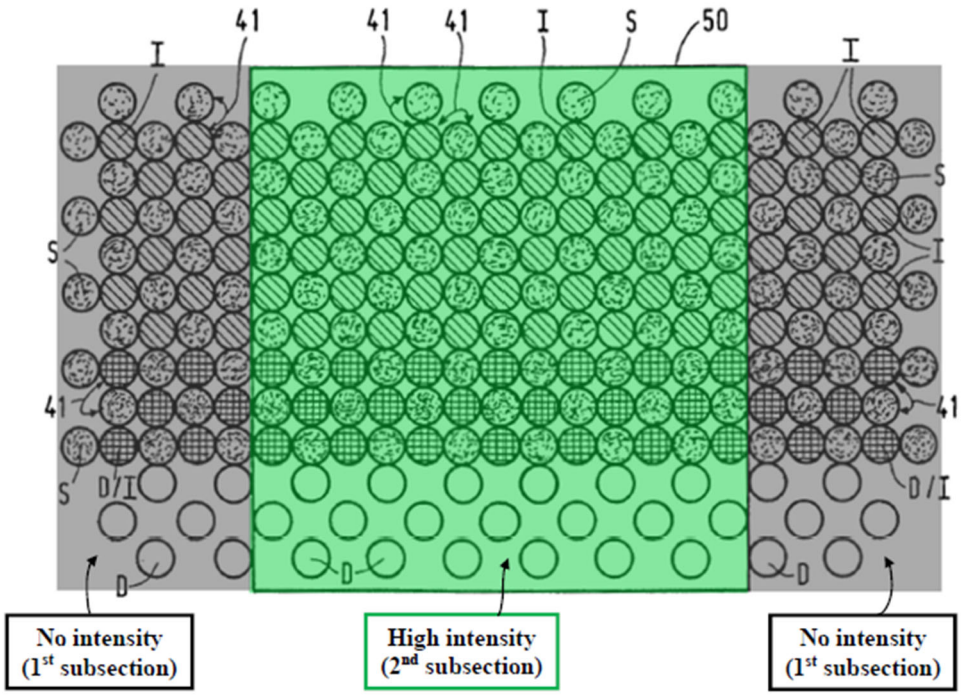
angular section. *See* EX1030, 3-8, 21-41, 62-69; EX1016, 4-11. Therefore, Karlsson's "dipped light function" is an example of a "predefined" threshold level, for example, equivalent to a "dipped headlights" illuminance. *See also* EX1015, 6 ("discomfort glare…disability glare…to what extent the eye adaptation and therewith the threshold sensitivity is at a given adaptation luminance"), 18 ("[g]lare reduction and visibility improvement"), FIGS. 2.1, 2.8; EX1017, 5 ("the adaptive light pattern should support to direct the concentration to the most important zone for the current driving situation"), FIGS. 1, 3-5; EX1026, 451, 456, FIGS. 1, 3-3; EX1030, 3-8, 21-41, 49, 62-69, Table 5.5.



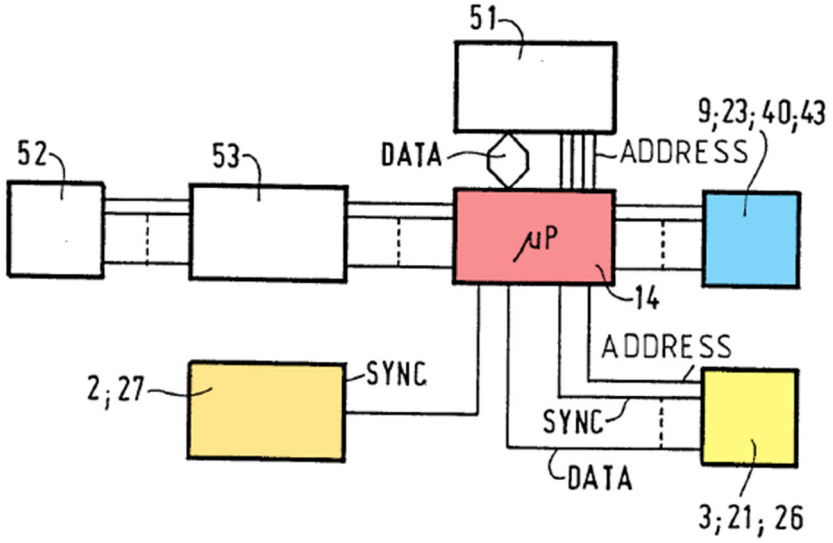

EX1010, FIG. 3 (annotated).



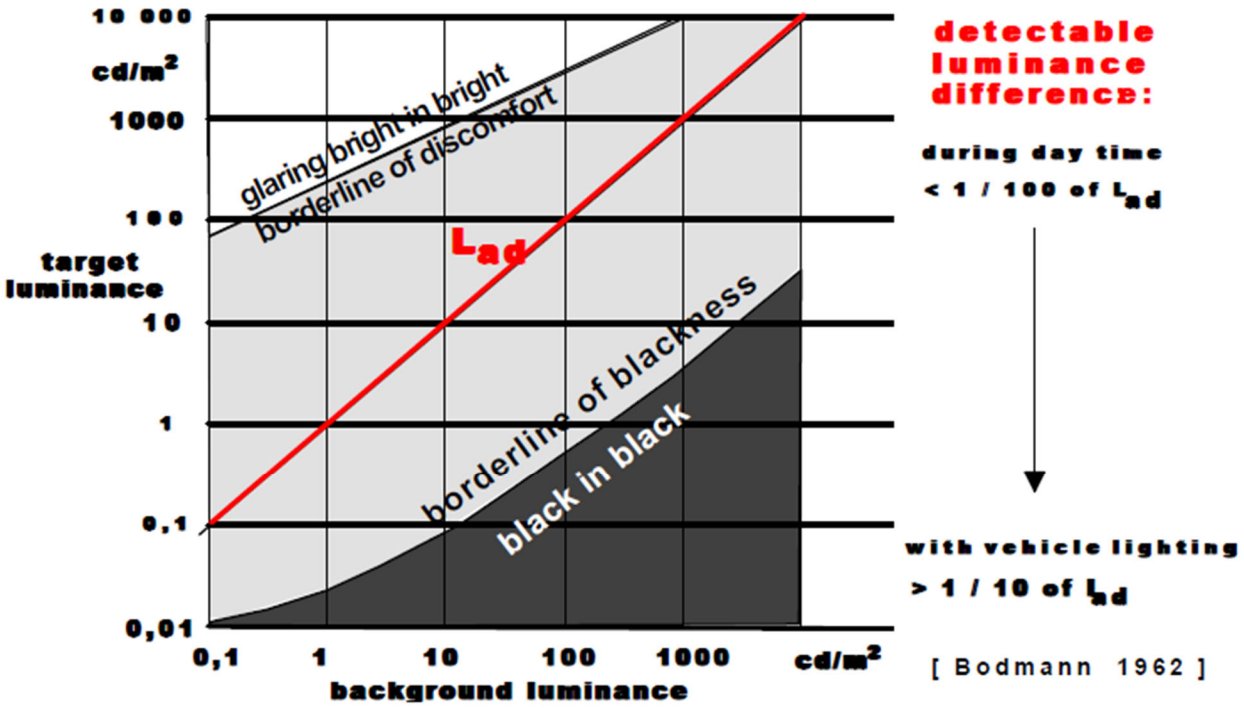

EX1010, FIG. 14 (annotated).




EX1010, FIG. 14 (annotated).




EX1010, FIG. 15 (annotated).




EX1015, FIG. 2.1.

**Table 5.5.** Road illumination requirements for an adaptive lighting system.

| Devices | Beam patterns | Visibility on straight (m) | Visibility on curve r=150m (m) | Illuminance (lx) | Angular window for specified visibility (deg.) |
|---|---|---|---|---|---|
| Conventional beam | Low beam | 58 | 30 | 40 | -- |
| | High beam | 140 | -- | 120 | -- |
| AFS | Country | 80 | -- | 20 | Hor.: -1° to 1°<br>Ver.: -0.75° to 0.3° |
| | Bending | -- | 76 | 6 | Hor.: -4° to 35°<br>Ver.: -1° to -0.5° |
| | **High speed** | **200** | -- | **3** | Hor.: -1° to 1°<br>Ver.: -0.3° to 0° |

EX1030, Table 5.5.

649. The '503 patent does not disclose a predefined threshold value, so such value is not needed to satisfy claim element [37.8]. As discussed, the '503 patent's specification leaves it to a POSA to determine the "predefined threshold," without describing an illuminance level, numerical value, algorithms, or any control steps to achieve this. In any case, a POSA reading the disclosure of Karlsson would have understood that Karlsson teaches a predefined threshold, for example, a "dipped headlights" illuminance, because Karlsson uses the dipped headlights illuminance as a reference point to output illuminance below that value, preventing glare to other vehicles. EX1010, 9:18-26 ("the pattern and the intensity of the light beam 7 are, for example, controlled in such a manner that *no light at all* or light having a *low intensity* is emitted…[i]n this manner *glaring or blinding* of oncoming traffic is *effectively prevented*"), Abstract, 1:18-24, 19:23-27, FIGS. 3, 6, 14-15.

650. Thus, Karlsson's system would illuminate the first subsection (shaded area) "below a predefined threshold." *Supra* Section XVI.A.

651. In view of the above, Karlsson discloses or renders obvious this element.

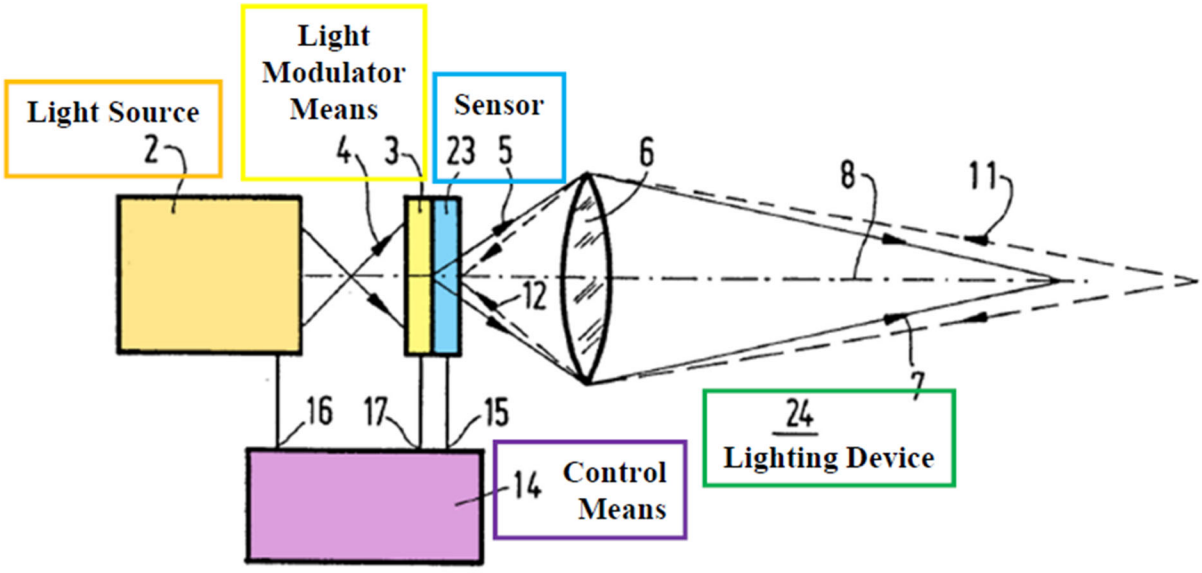
**2. [37.9]: "while the beam substantially illuminates at least the one or more second subsections of the field-of-view to either side of the first subsection with an illuminance above the predefined threshold value; and"**

652. In my opinion, claim elements [37.7]-[37.10] are part of the same clause but will be addressed separately for simplicity below.

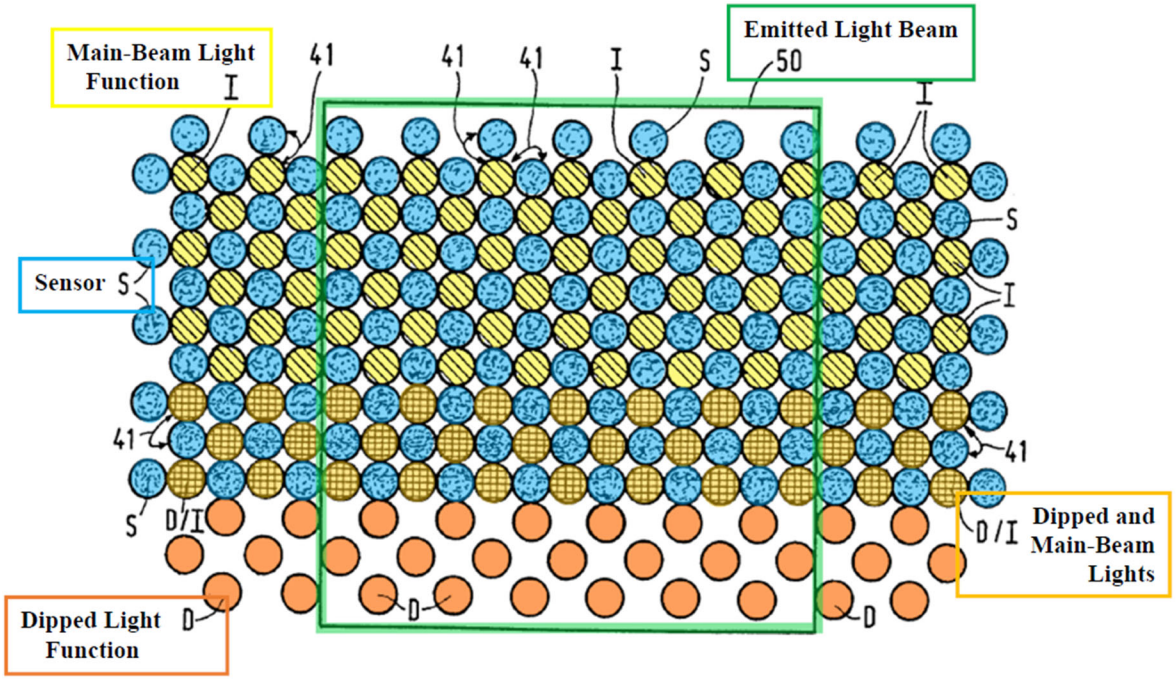
653. As discussed (Sections XVI/XVI.A), in my opinion, Karlsson discloses this element, claim element [37.9]. Specifically, Karlsson discloses "light beam 7…*optimally adapted* to the road and to the ambient light" and "permitting a light intensity which is generally *higher than that of conventional dipped headlights*." EX1010, 9:18-26, Abstract, FIGS. 3, 14, 15; EX1010, 19:23-27 ("*main-beam light function*"), 19:29-33 ("*emitted light beam 50*"), 2:7-9 ("*part of the light beam*…is automatically suppressed, whilst *retaining an optimum lighting* effect"), 14:26-30, 5:16-32, 9:9-17. The second subsections (non-shaded areas, e.g., emitted light beam 50) are thus illuminated "above the predefined threshold" (e.g., above a *dipped* headlights illuminance) because the illuminance in those areas is "*higher* than that of conventional *dipped headlights*," so it is above a

*dipped* headlights illuminance. Thus, a POSA would have understood that Karlsson's "dipped light function" is a "predefined threshold."

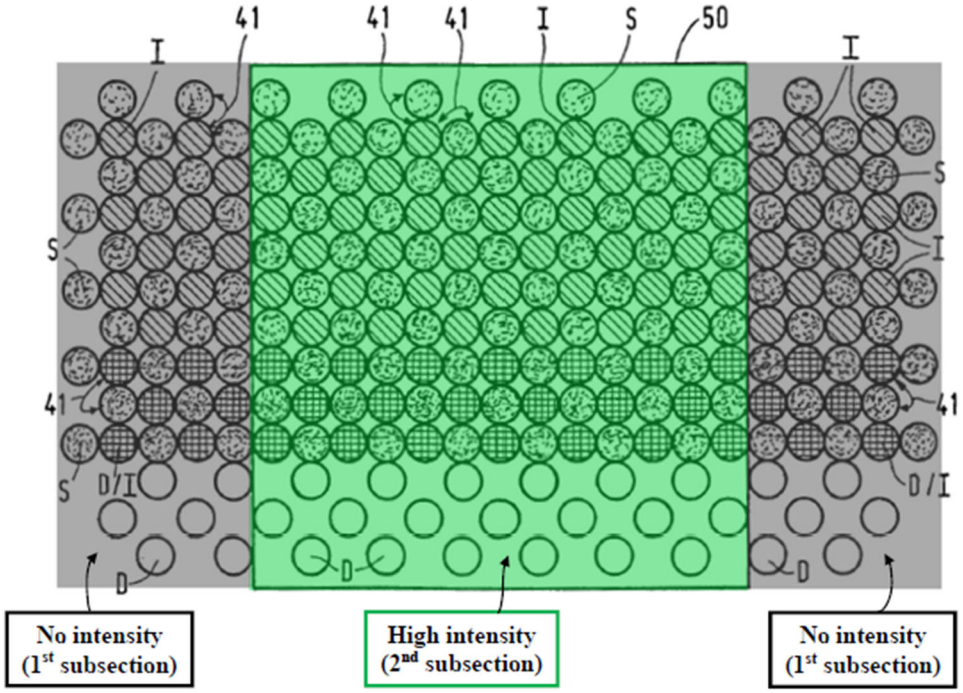
654. As discussed in Section XVII.A, the concept of a "dipped light function" or a low beam illumination level would have been known to a POSA. Such low beam (dipped headlights) illumination level for driver's visibility and glare light control is defined in all regulations, standards, and automaker's specifications, which is a predefined illumination level in terms of the light intensity distribution in the low beam illuminating area or low beam projected angular section. *See* EX1030, 3-8, 21-41, 62-69; EX1016, 4-11. Therefore, Karlsson's "dipped light function" is an example of a "predefined" threshold level, for example, equivalent to a "dipped headlights" illuminance. *See also* EX1015, 6 ("discomfort glare…disability glare…to what extent the eye adaptation and therewith the threshold sensitivity is at a given adaptation luminance"), 18 ("[g]lare reduction and visibility improvement"), FIGS. 2.1, 2.8; EX1017, 5 ("the adaptive light pattern should support to direct the concentration to the most important zone for the current driving situation"), FIGS. 1, 3-5; EX1026, 451, 456, FIGS. 1, 3-3; EX1030, 3-8, 21-41, 49, 62-69, Table 5.5.



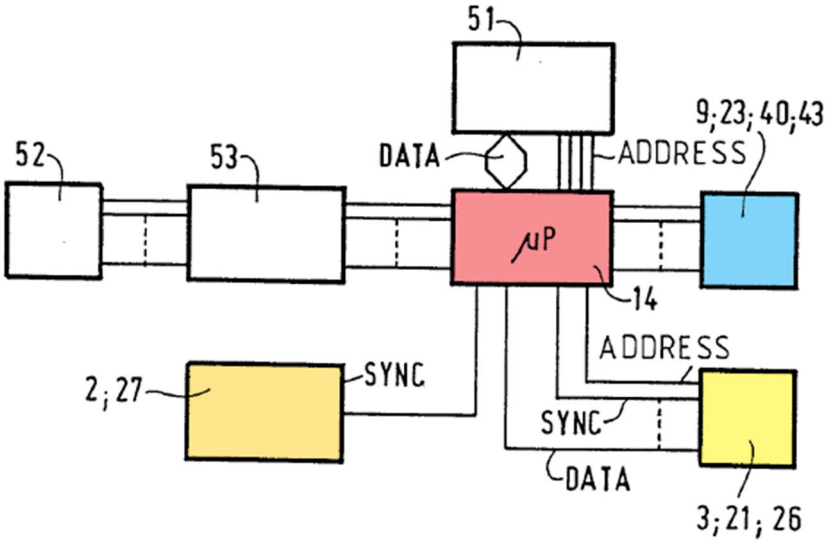

EX1010, FIG. 3 (annotated).



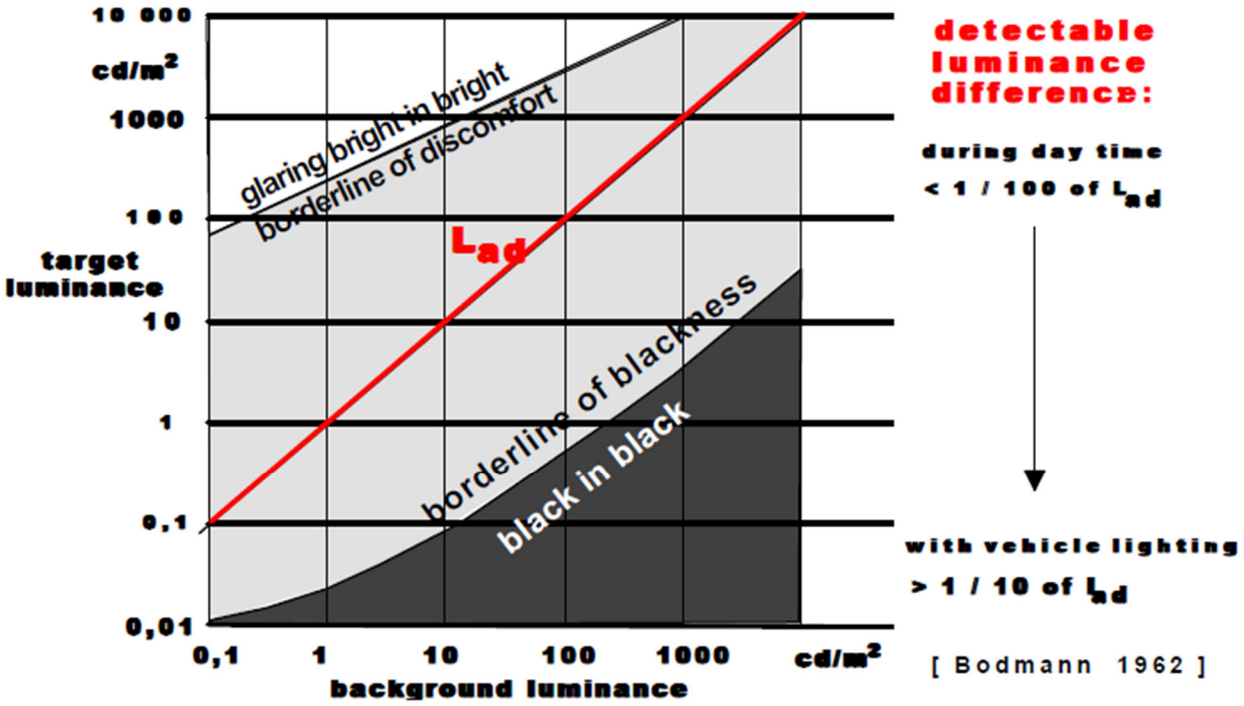

EX1010, FIG. 14 (annotated).




EX1010, FIG. 14 (annotated).




EX1010, FIG. 15 (annotated).




EX1015, FIG. 2.1.

**Table 5.5.** Road illumination requirements for an adaptive lighting system.

| Devices | Beam patterns | Visibility on straight (m) | Visibility on curve r=150m (m) | Illuminance (lx) | Angular window for specified visibility (deg.) |
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| Conventional beam | Low beam | 58 | 30 | 40 | -- |
| | High beam | 140 | -- | 120 | -- |
| AFS | Country | 80 | -- | 20 | Hor.: -1° to 1°<br>Ver.: -0.75° to 0.3° |
| | Bending | -- | 76 | 6 | Hor.: -4° to 35°<br>Ver.: -1° to -0.5° |
| | **High speed** | **200** | -- | **3** | Hor.: -1° to 1°<br>Ver.: -0.3° to 0° |

EX1030, Table 5.5.

655. The ’503 patent does not disclose the predefined threshold value, so such value is not needed to satisfy claim element [37.9]. As discussed, the ’503 patent’s specification leaves it to a POSA to determine the “predefined threshold,”

without describing an illuminance level, numerical value, algorithms, or any control steps to achieve this. In any case, a POSA reading the disclosure of Karlsson would have understood that Karlsson teaches a predefined threshold, for example, a "dipped headlights" illuminance, because Karlsson uses the dipped headlights illuminance as a reference point to output illuminance above that value, increasing illumination to other areas. EX1010, Abstract ("the lighting pattern and the lighting intensity are automatically adjusted…thus *permitting a light intensity* which is generally *higher than that of conventional dipped headlights*"), 9:18-26, 1:18-24, 19:23-27, FIGS. 3, 6, 14-15.

656. Thus, Karlsson's system would illuminate the second subsection (non-shaded area) "above the predefined threshold." *Supra* Section XVI.A.

657. In view of the above, Karlsson discloses or renders obvious this element.

**D. Claim 2/Claim 42**

658. In my opinion, there is no patentable difference between the language of claim 42 and claim 2. *See also* Appendix A. The same disclosures below address each feature.

**1. [2.1]: "The headlight system of claim 1, wherein at least one of the light clusters comprises: a structure to position the light cluster, such that the projected light from the at least one cluster has an aiming direction in relation to a forward travel direction of the vehicle;"**

**[42.1]: "The headlight system of claim 37, wherein at least one of the light clusters comprises:"**

659. In my opinion, there is no patentable difference between claim elements [42.1] and [2.1]. *See also* Appendix A. The same disclosures below address each feature.

660. Karlsson's "light source 2…light modulator means 3…can be arranged…in a *housing* 18…[and] control means 14 can be arranged therein." EX1010, 8:31-35, FIG. 1; EX1010, 4:25-31, 14:1-15, 11:25-28, 19:29-33, FIGS. 3, 6, 14. Karlsson's lighting device 1, 24 is affixed to car 56 provides light aimed in a forward travel direction. EX1010, 20:16-32, FIGS. 1, 3, 16; EX1010, Abstract, 9:18-22.

661. Thus, a POSA would have understood that Karlsson's housing 18 provides "at least one cluster [having] an aiming direction in relation to a forward travel direction." EX1010, 8:31-35, 20:16-32, FIGS. 1, 16.

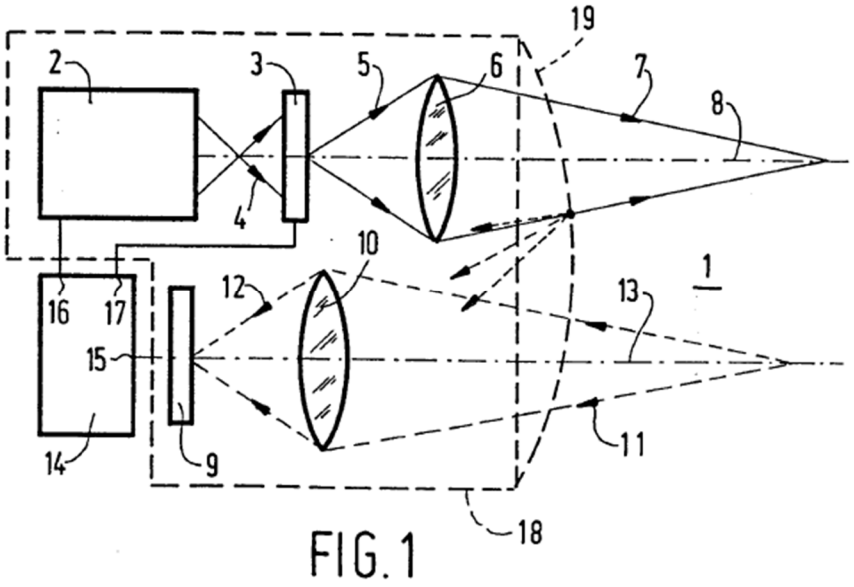
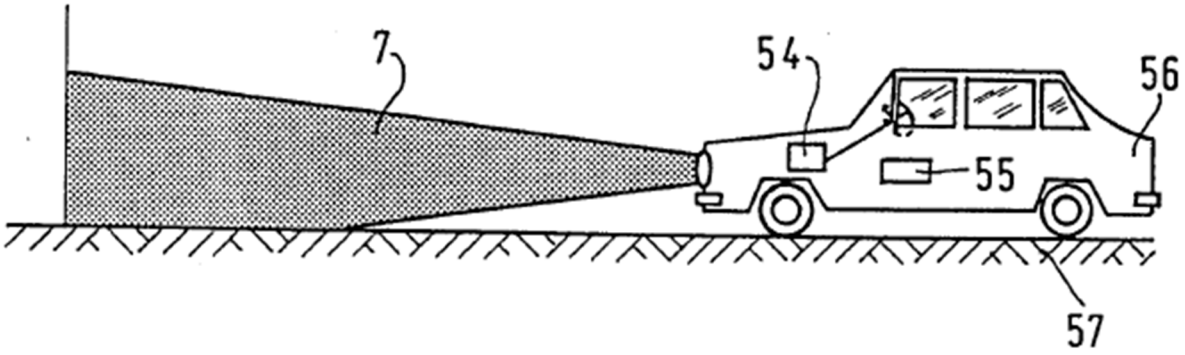



FIG. 1

EX1010, FIG. 1.




EX1010, FIG. 16.

662. In view of the above, Karlsson discloses these elements.

**2. [2.2]: "one or more light emitting sources, each having a variable light-source characteristic dependent on power, and wherein the control circuitry is arranged to alter said light-source characteristic via power control; and"**

**[42.2]: "one or more light sources, each having a variable light-source light characteristic dependent on power and alterable, at least responsive to instructions from at least one of the at least one processors, via power control; and"**

663. In my opinion, there is no patentable difference between claim elements [42.2] and [2.2]. *See also* Appendix A. The same disclosures below address each feature.

664. Karlsson's system includes a light source power/energy supply. EX1010, 8:31-9:1 (*electric energy source* or…*power supply source* for the light source 2), FIGS. 1, 16; EX1010, 8:27-31 ("*controlling* the *light source 2* or the light modulator 3"), 10:18-25 ("*controlling* the *intensity* of the light source 2 and/or…light modulator means 3"), 13:5-8 ("lamp 30"), 18:35-19:3 ("Xenon lamp").

665. Additionally, Karlsson's "light source 2…is composed of a grid of separate light sources, such as *LEDs*…controlled either individually or in groups." EX1010, 14:1-15, FIG. 1; EX1010, 18:2-7, 20:16-32, FIGS. 1, 3, 16; EX1010, Abstract, 9:18-22.

666. A POSA would have understood that light source 2 is a "light emitting source[]…dependent on power" since an intensity (brightness) of a lamp (e.g.,

incandescent) or an LED can be altered based on the amount of power (current) applied. EX1010, 8:31-9:1, 8:27-31, 10:18-25, 14:1-15.

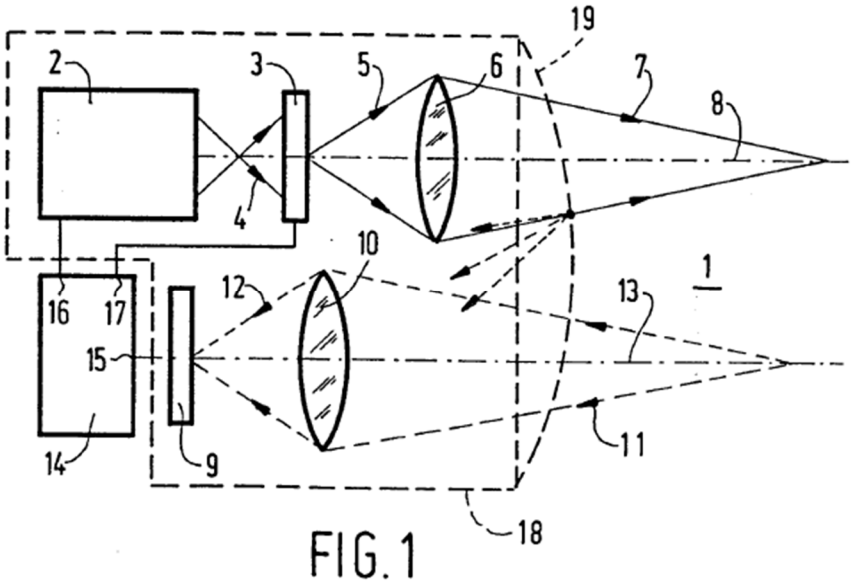
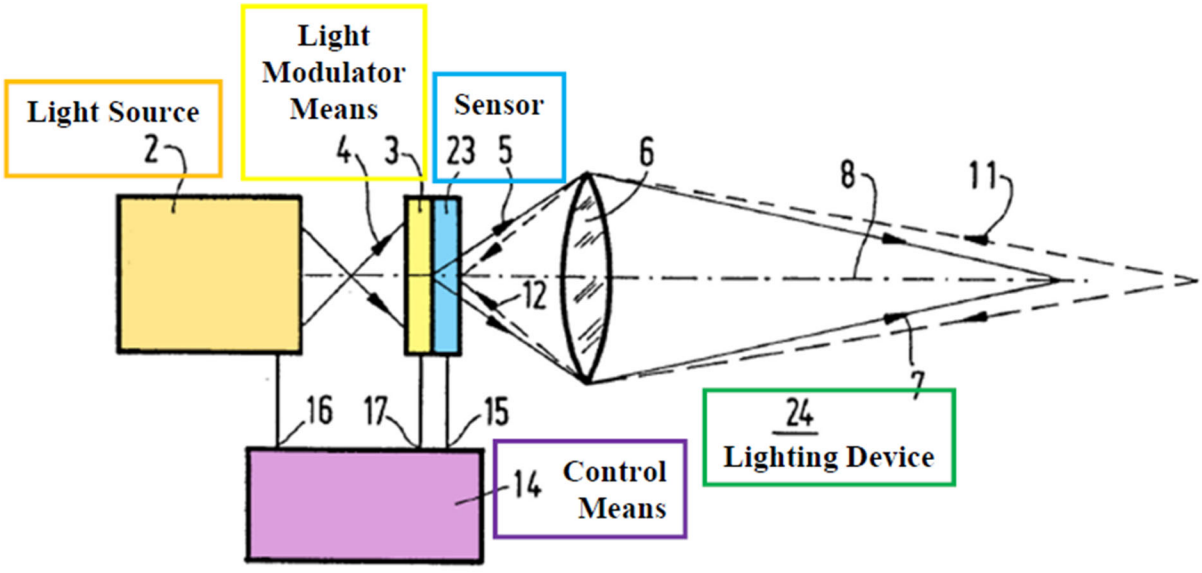



FIG. 1

EX1010, FIG. 1.




EX1010, FIG. 3 (annotated).

667. In view of the above, Karlsson discloses or renders obvious these elements.

**3. [2.3]: "one or more light modifying elements provided in the path of light emitted from at least one of the sources, further controlling the light-source characteristics;"**

**[42.3]: "one or more light modifying elements provided in a path of light emitted from at least one of the light sources, further controlling at least one light characteristic of the at least one of the light source;"**

668. In my opinion, there is no patentable difference between claim elements [42.3] and [2.3]. *See also* Appendix A. The same disclosures below address each feature.

669. Karlsson's "light source 2…*light modulator means 3*…can be arranged…in…housing 18" and "light 4 from the light source 2 incidences the *light modulator means 3*." EX1010, 8:31-9:1, 8:10-18, FIGS. 1, 16; EX1010, 8:27-31, 10:18-25. Karlsson discloses "a plurality of *controllable spotlight beams*" and "*spotlight beams 34* may also be made up of…*light modulators* which can be controlled to transmit light *to a specified degree*…for each *individual* spotlight beam 34 or for a *group* of spotlight beams." EX1010, 4:25-31, 14:5-15, FIGS. 3, 6; EX1010, 11:25-28 ("*given directions*"), 14:1-4 ("spotlight beams 34 can be…a *grid of separate light sources*"), 19:29-33 ("desired pattern and *direction of the beam*"), FIG. 14.

670. A POSA would have understood that Karlsson's light modulator means 3 is a "light modifying element[]" that further controls light from light source 2. EX1010, 8:10-18, 4:25-31, 14:1-15.

671. Additionally, Karlsson's lens 6 is a "light modifying element[]."

EX1010, 8:15-18, 8:31-35, 10:18-25, 11:2-15, FIGS. 1, 3.

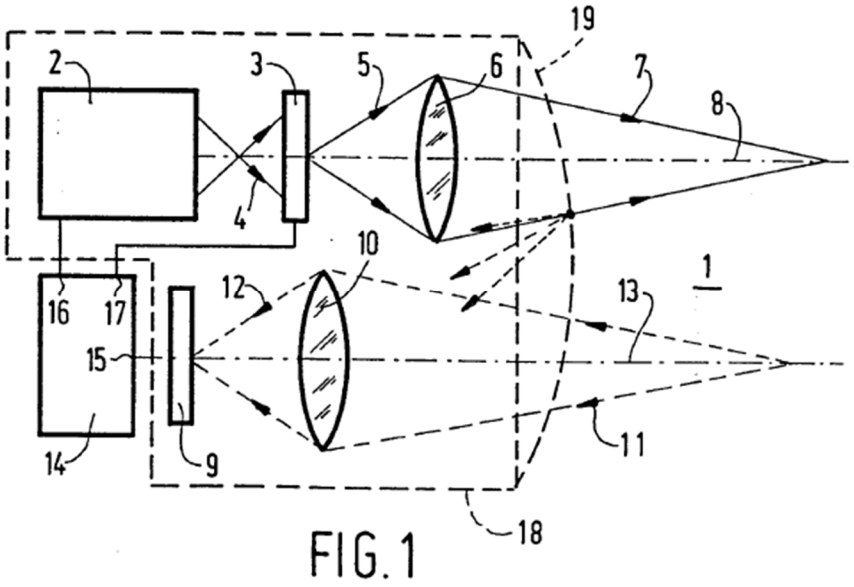
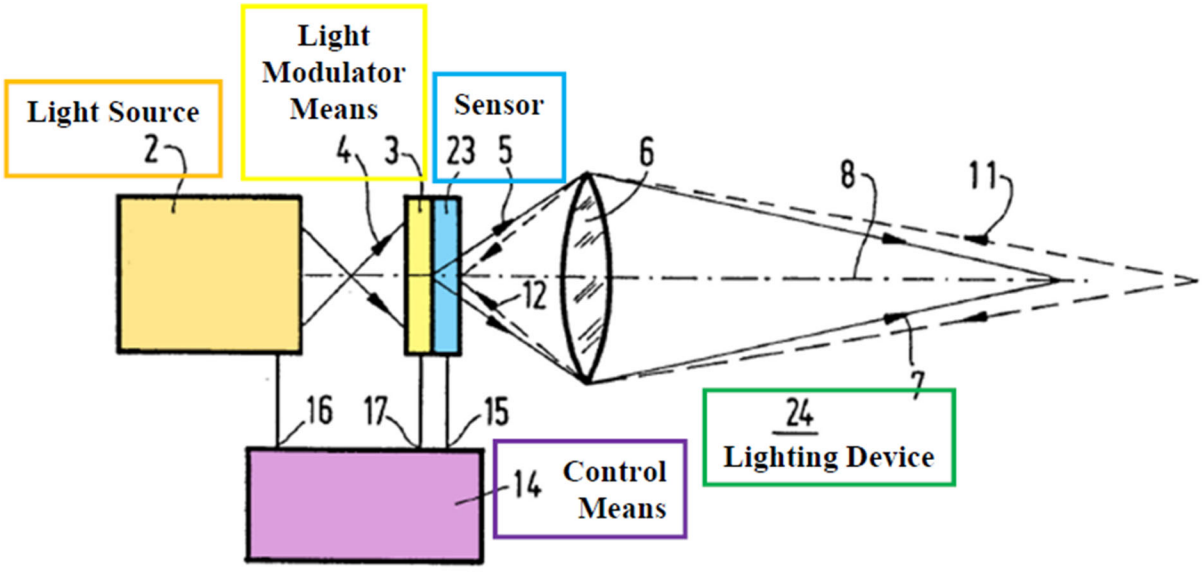



FIG. 1

EX1010, FIG. 1.




EX1010, FIG. 3 (annotated).

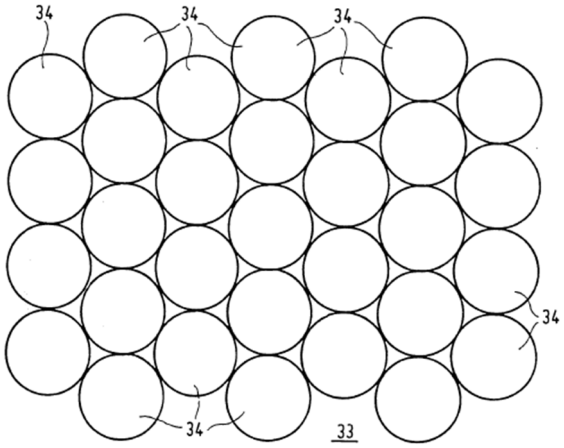



FIG. 6

EX1010, FIG. 6.

672. In view of the above, Karlsson discloses these elements.

**4. [2.4]: "wherein the structure combined with control of the light sources and light modifying elements results in an emitted light-cluster light characteristic including at least one of direction, intensity, beam spread, spatial light distribution or spectral light distribution."**

**[42.4]: "wherein control of the light sources and light modifying elements results in a specified emitted light-source light characteristic, where said emitted light-source light characteristic includes at least one of direction, intensity, beam spread, spatial light distribution or spectral light distribution."**

673. In my opinion, there is no patentable difference between claim elements [42.4] and [2.4]. *See also* Appendix A. The same disclosures below address each feature.

674. Karlsson's "light source 2…light modulator means 3…can be arranged…in…housing 18" and "control means 14…control[s] 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, 8:31-9:1, 9:9-17, FIGS. 1, 3, 6; EX1010, 8:27-31, 10:18-25. Karlsson discloses "a plurality of *controllable spotlight beams*" and "*spotlight beams 34* may also be made up of…*light modulators* which can be controlled to transmit light *to a specified degree*…for each *individual* spotlight beam 34 or for a *group* of spotlight beams." EX1010, 4:25-31, 14:5-15, FIGS. 3, 6; EX1010, 11:25-28, 14:1-4, 19:29-33, FIG. 14.

675. A POSA would have understood that Karlsson's system provides "an emitted light-cluster light characteristic," for example, "direction," "intensity," or "spatial light distribution." EX1010, 8:10-18, 4:25-31, 14:1-15, FIG. 14. As discussed, Karlsson, alone or in combination with Harbers, discloses "light clusters." *Supra* Section XVI.B.3.

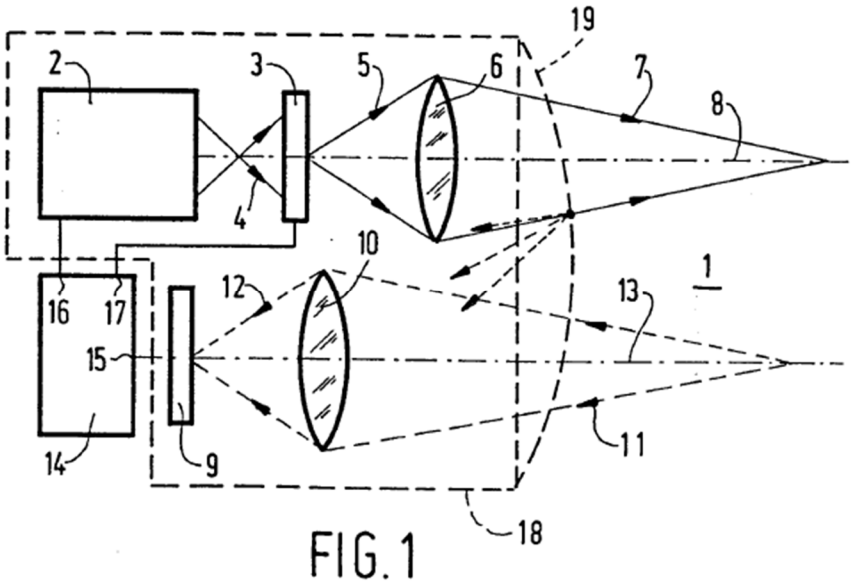
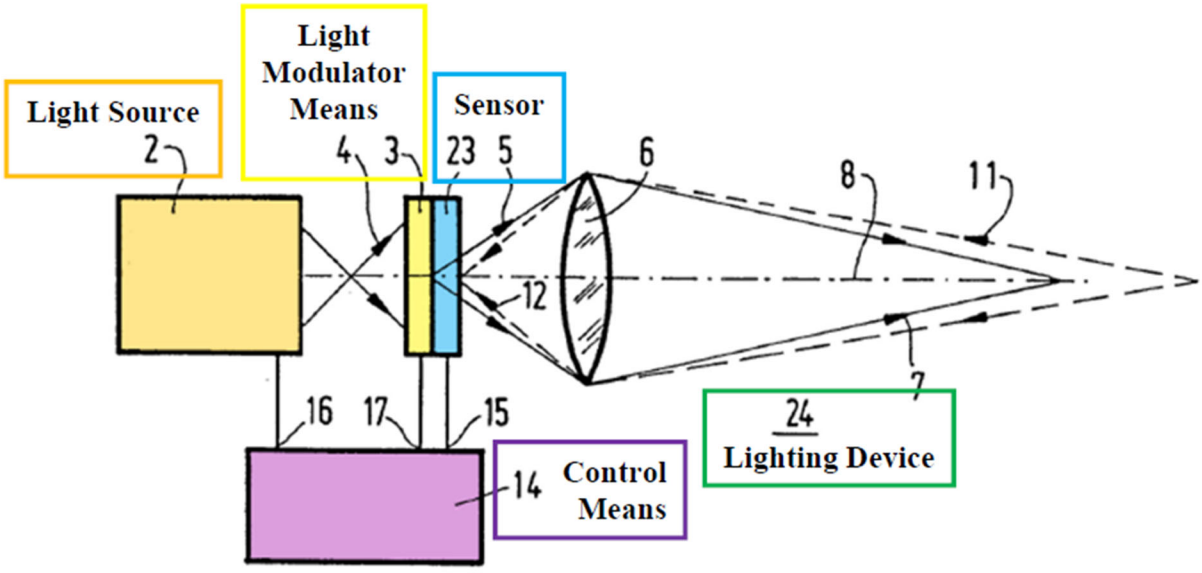



FIG. 1

EX1010, FIG. 1.




EX1010, FIG. 3 (annotated).

676. In view of the above, Karlsson, alone or in combination with Harbers, discloses or renders obvious these elements.

677. Thus, Karlsson, alone or in combination with Harbers, discloses or renders obvious these claims.

**E. Claim 3: "The headlight system of claim 2, wherein the one or more light modifying elements is at least one of a static light modifier or a variable light modifier, said light modifying element comprising at least one of reflectors or refractors, and wherein variable light modifier control circuitry is configured to control the light-cluster light characteristic by altering the light modifying elements in the path of the light emitted from the at least one of the light sources."**

**Claim 43: "The headlight system of claim 42, wherein the one or more light modifying elements comprises at least one of reflectors or refractors, and wherein at least one of the at least one processors is configured to instruct control of at least one light modifying**

**element resulting in a change to the light-source light characteristic."**

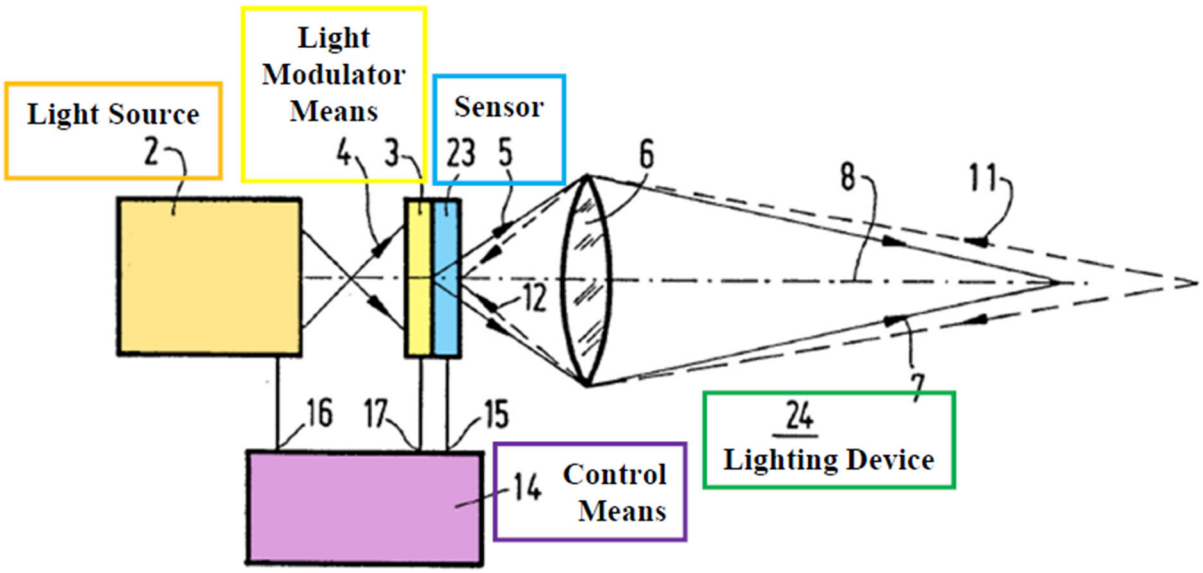
678. In my opinion, there is no patentable difference between the language of claim 43 and claim 3 as shown above. *See also* Appendix A. The same disclosures below address each feature.

679. Karlsson's "*lighting means 2, 3…[are] controlled by control means 14*…to *control*…*light beam 7* having a *desired pattern* and a *desired intensity*." EX1010, 9:9-17, FIGS. 3, 14-15; EX1010, 20:1-3 ("*control electronics 41*"), 2:7-9, 19:29-33, 20:12-32, 21:36-22:4. Karlsson discloses "*spotlight beams 34* may also be made up of…*light modulators* which can be controlled to transmit light *to a specified degree*…for each *individual* spotlight beam 34 or for a *group* of spotlight beams." EX1010, 4:26-5:15, 14:1-15, FIGS. 3, 6; EX1010, 5:7-15 ("*light modulator means*…a type which *reflects* light…for example…'Liquid Crystal Devices (LCDs)', '*Micro Mirrors*'…and the like"), 11:25-28 ("*given directions*"), 14:1-4 ("spotlight beams 34 can be…a *grid of separate light sources*"), 19:29-33 ("desired pattern and *direction of the beam*"), FIG. 14.

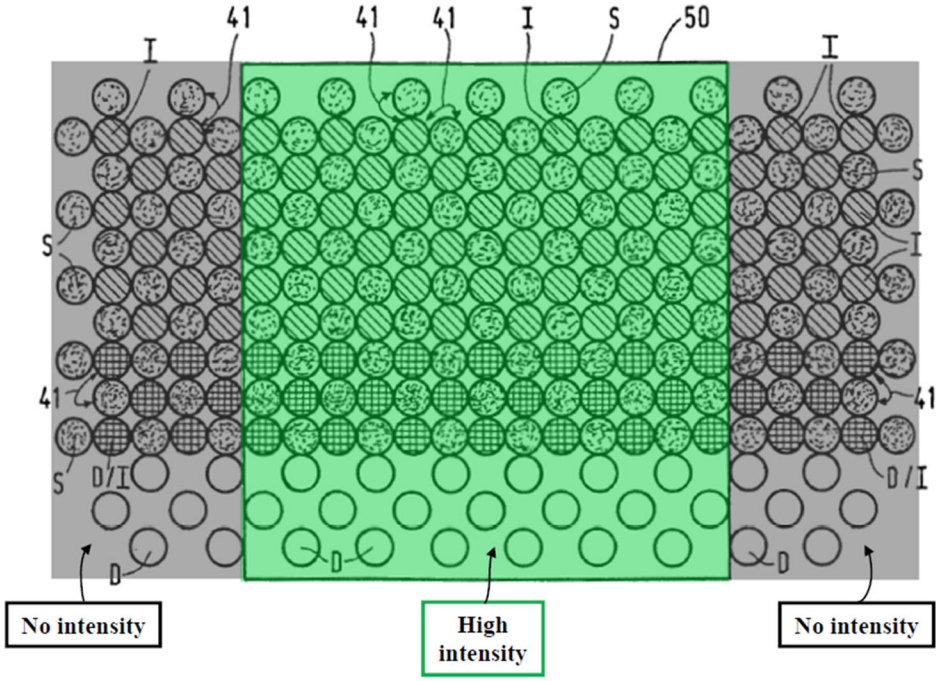
680. A POSA would have understood that Karlsson's light modulator 3 is "a variable light modifier" with "reflectors" that control the "light-cluster light characteristic," for example, "direction," "intensity," or "spatial light distribution." EX1010, 4:26-5:15, 14:1-15, FIGS. 3, 6.

681. A POSA would have understood Karlsson's light modulator 3 (micro mirrors) includes "variable light modifier control circuitry" to adjust the direction/intensity of each modulator (mirror) in the array. EX1010, 4:26-5:15, 8:25-31, 9:3-26, 14:1-15, FIGS. 3, 14-15.

682. Additionally, Karlsson's lens 6 is "a static light modifier" with "refractors." EX1010, 8:15-18, 8:31-35, 10:18-25, 11:2-15, FIGS. 1, 3.




EX1010, FIG. 3 (annotated).




EX1010, FIG. 14 (annotated).

683. In view of the above, Karlsson discloses these claims.

**F. Claim 4: "The headlight system of claim 2, wherein the light modifying element further comprises at least one of lenses, diffractors, optical devices, a light guide, filters, phosphors, optical coatings, prisms, controllable piezoelectric light guides, MEMS devices, light valves or optical switches."**

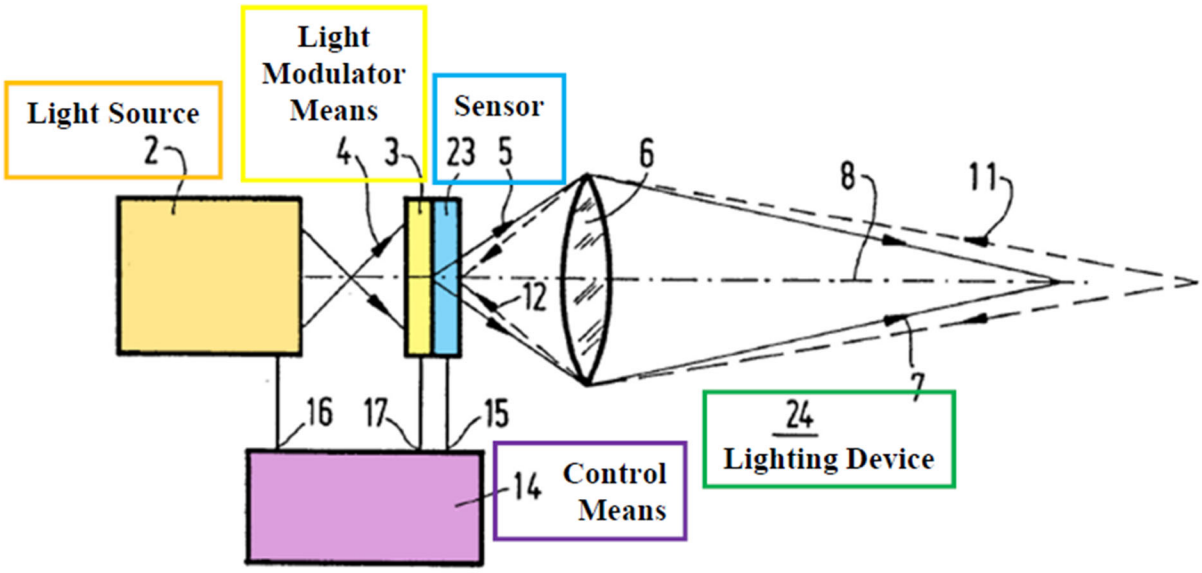
**Claim 44: "The headlight system of claim 42, wherein the light modifying element further comprises at least one of lenses, diffractors, optical devices, a light guide, filters, phosphors, optical coatings, prisms, controllable piezoelectric light guides, MEMS devices, light valves or optical switches."**

684. The language of claim 44 is identical to the language of claim 4 as shown above. *See also* Appendix A. The same disclosures below address each feature.

685. Karlsson discloses "*light modulator means*…[includes] '*Micro Mirrors*'…and the like." EX1010, 5:7-15, FIG. 3; EX1010, 4:26-5:15, 11:25-28, 14:1-15, 19:29-33, FIGS. 3, 6. Thus, Karlsson's light modulator 3 includes "optical devices." EX1010, 5:7-15.

686. Further, a POSA would have understood that "micro mirrors" include "MEMS devices." EX1010, 5:7-15.

687. Additionally, Karlsson's lenses 6, 10 include "lenses." EX1010, 8:15-18, 8:31-34, 10:18-25, 11:2-15, FIGS. 1, 3.




EX1010, FIG. 3 (annotated).

688. In view of the above, Karlsson discloses these claims.

**G. Claim 5: "The headlight system of claim 1, wherein at least one of the light-clusters includes: a plurality of light sources, wherein one or more of the plurality of light sources comprises at least one of multiple light-emitting-diodes (LEDs) or organic light-emitting-diodes, each light source having a spectral power distribution**

**characteristic and wherein the control circuitry is configured to alter the overall light-cluster spectral power distribution to illuminate at least one of the at least two subsections of the field-of-view with a different color of light from another of the at least two subsections."**

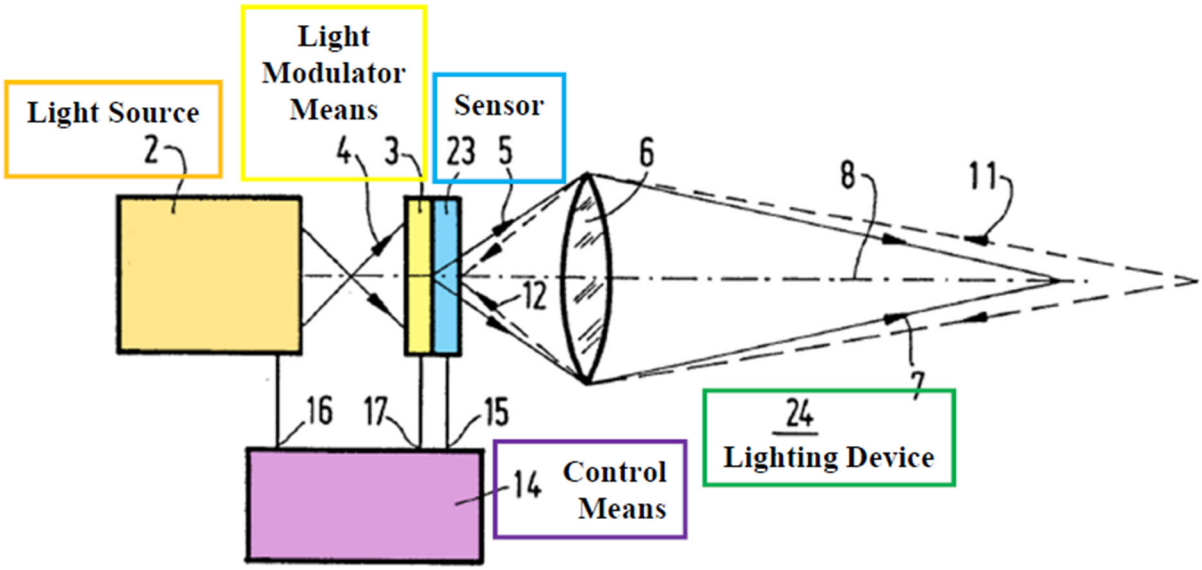
**Claim 45: "The headlight system of claim 37, wherein at least one of the light-clusters includes: a plurality of light sources, wherein one or more light sources of the plurality of light sources comprise at least one of light-emitting-diodes (LEDs) or organic light-emitting-diodes, each light source having a spectral power distribution characteristic alterable, at least responsive to instructions from at least one of the at least one processors, by modifying power to the one or more light sources of the plurality of light sources, resulting in a color change to projected light from the at least one light-cluster illuminating at least one sub-section of the field-of-view."**

689. In my opinion, there is no patentable difference between the language of claim 45 and claim 5 as shown above. *See also* Appendix A. The same disclosures below address each feature.

### 1. Karlsson's disclosure

690. Karlsson discloses "*spotlight beams 34* may also be made up of…*light modulators* which can be controlled to transmit light *to a specified degree*…for each *individual* spotlight beam 34 or for a *group* of spotlight beams." EX1010, 14:1-15, FIGS. 3, 6; EX1010, 4:26-5:15 ("spotlight beams can be made up of…a plurality of *light-emitting diodes*"), 11:25-28, 14:1-4, 19:29-33, FIG. 14. Additionally, Karlsson's "light source 2…is composed of a grid of separate light sources, such as *LEDs*…controlled either individually or in groups." EX1010, 14:1-15, 18:2-7, 20:16-32, FIGS. 1, 3, 6.

691. Karlsson's light sources may also include "a plurality of *light-emitting diodes*," that are controlled either individually or in groups. EX1010, 4:26-5:15, 11:25-28, 14:1-5, 19:29-33, FIG. 14, 18:2-7, 20:16-32, FIGS. 1, 3, 6.




EX1010, FIG. 3 (annotated).

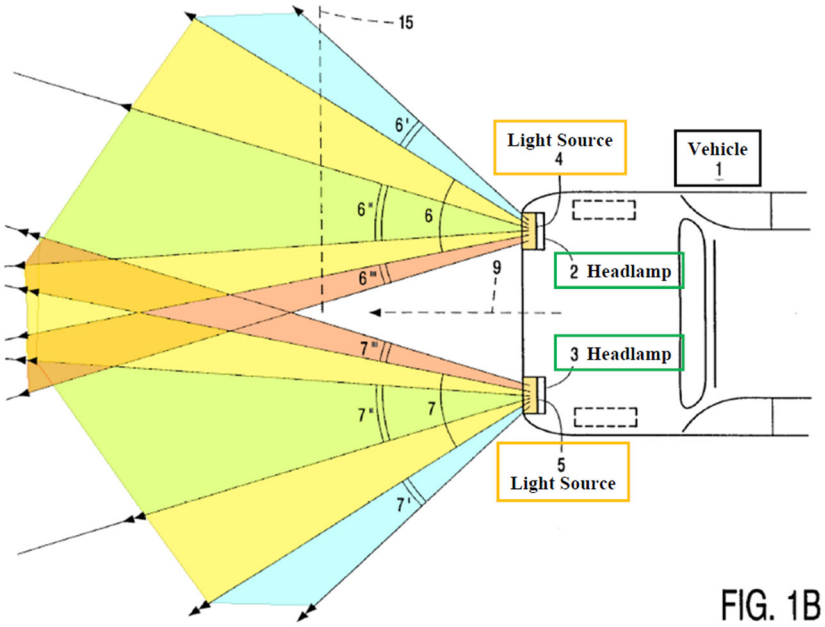
692. Karlsson does not disclose illuminating a subsection with a different color of light, but this feature was well-known in the prior art, e.g., as explicitly disclosed by Harbers.

**2. Harbers's disclosure**

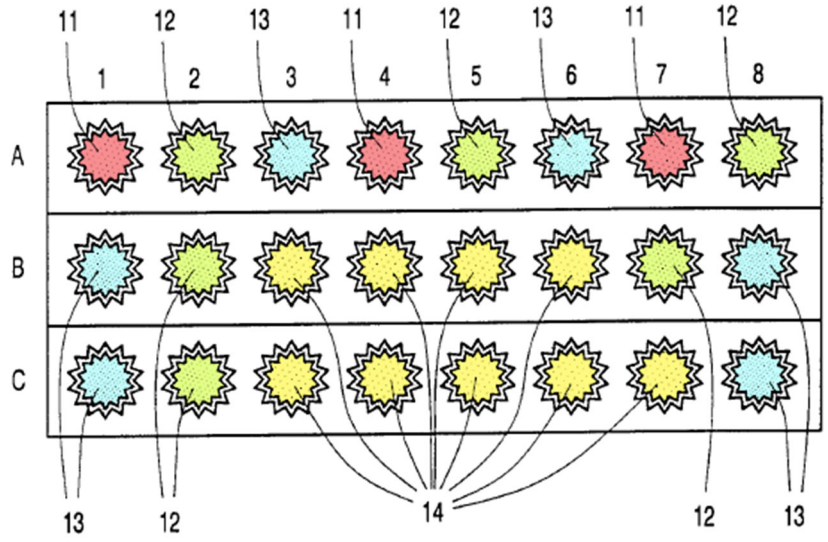
693. Harbers's opto-electronic elements 11-14 provide differently colored beam segments 6-6'-6"-6"', 7-7'-7"-7"' (clusters) for different distributions. EX1011, 5:14-26, 6:1-7, 6:27-7:19, FIGS. 1B-2, 4A; EX1011, 9:22-27 ("*yellow light*…to *improve*…*visibility*"), 10:6-14 ("*fog and snow*"), 7:27-32, 7:1-17, 9:28-10:5, 13:5-7. Further, Harbers discloses "*on-axis* part…is adapted to…*green-*

*yellow light*…*off-axis* parts…is adapted to…*blue-green light*." EX1011, 6:3-7, FIGS. 1B, 2; EX1011, 9:1-10:5 ("*6; 7*…*6", 6"'; 7", 7"'* with…*yellow-orange light*…*6'; 7'* with…*blue-green light*"), 9:28-10:5 ("*different spectral characteristic*"), 5:21-26 ("*visibility*…is *improved*").

694. A POSA would have understood Karlsson-Harbers's LEDs each have "a spectral power distribution characteristic" (color) and that Karlsson-Harbers's controller provides different colors to different subsections. EX1011, 9:28-10:5 ("*different spectral characteristic*"), 5:14-26, 6:1-7, 6:27-7:19, FIGS. 1B-2; EX1010, 4:26-5:15, 11:25-28, 14:1-5, FIGS. 1, 3, 6, 14. A spectral power distribution (SPD) is a pictorial representation of the radiant power emitted by a light source at each wavelength expressed in units of W/nm. Thus, different colors (e.g., red, green, blue) have different SPDs (as a function of wavelength) and a mixture of colors alters the overall SPD of the illumination.




EX1011, FIG. 1B (annotated).




EX1011, FIG. 2 (annotated).

695. As discussed, a POSA would have been motivated to combine Harbers with Karlsson with a reasonable expectation of success. *Supra* Section XVI.A.

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

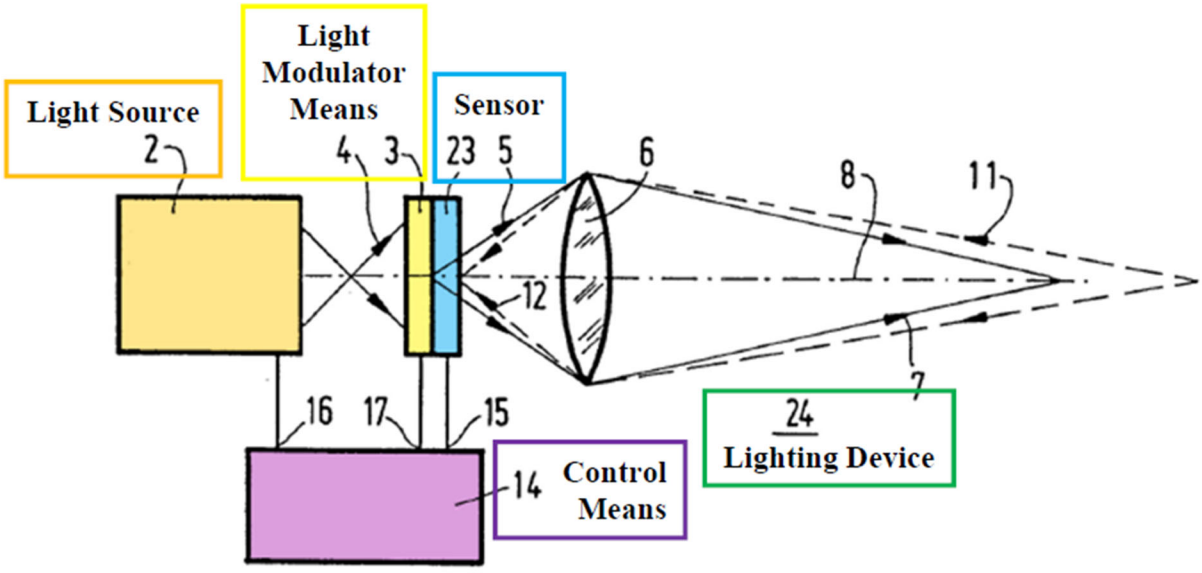
696. As discussed, Karlsson discloses "light clusters" with independently controlled angular positions for reducing glare towards other drivers. *Supra* Section XVI.A. Harbers provides further detail on implementing multiple colored "light clusters" for different functions. So naturally, it would have been obvious to a POSA designing an adaptive headlamp to implement Harbers's multiple colored beam segments for different functions in Karlsson's system.

697. Indeed, Harbers discloses such an implementation to provide different colored 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. EX1010, 1:10-13, 1:16-26, 4:17-21, 9:18-26.

698. Karlsson and Harbers are from the same field—controllable headlamps with dynamic illumination—and include the same building blocks (light sources, sensors, controllers). EX1010, Abstract, 2:30-35, 9:18-26, 13:24-14:4, 19:18-20:3, FIGS. 3, 6, 14-15; EX1011, Abstract, 2:27-3:10, 5:14-26, 6:27-7:19, 7:27-32, FIGS. 1B, 2. Further, improved visibility, thereby increasing safety is paramount in both. EX1010, 1:10-26, 4:17-21, 9:18-26; EX1011, 5:1-26, 7:1-14, 9:1-32.

699. A POSA would have sought to incorporate *known components* (hardware implementation) of Harbers's colored opto-electronic elements 11-14 on a "curved substrate" (with differently aimed opto-electronic elements 11-14, *see* EX1011, 5:14-26, 6:1-7, 6:27-7:32, FIGS. 1B-2) into Karlsson's system (with lighting means 2, 3). This would have, like Harbers, provided different colored spatial and spectral distributions for different driving situations (e.g., off-axis viewing, bends, narrow roads, motorways, etc.), improving visibility and thereby safety. This is a simple hardware implementation.

700. 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. Further, Karlsson's system "*selectively adjust[s]*…spotlight beam[s] 34, in response to a *control signal from sensor means 23*…to provide a *desired lighting pattern*" in "given *directions*." EX1010, 14:26-30, 11:25-28, FIGS. 3, 6, 14.




EX1010, FIG. 3 (annotated).

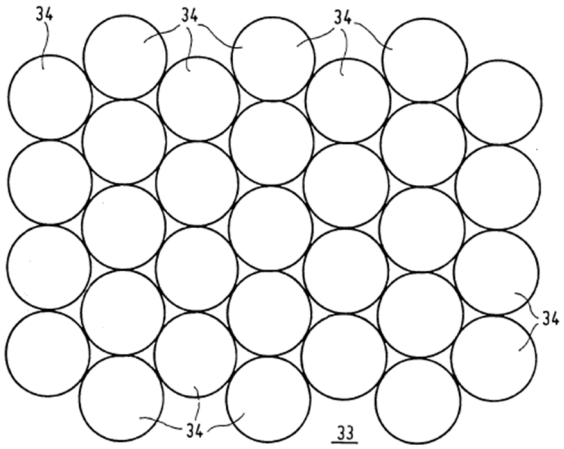


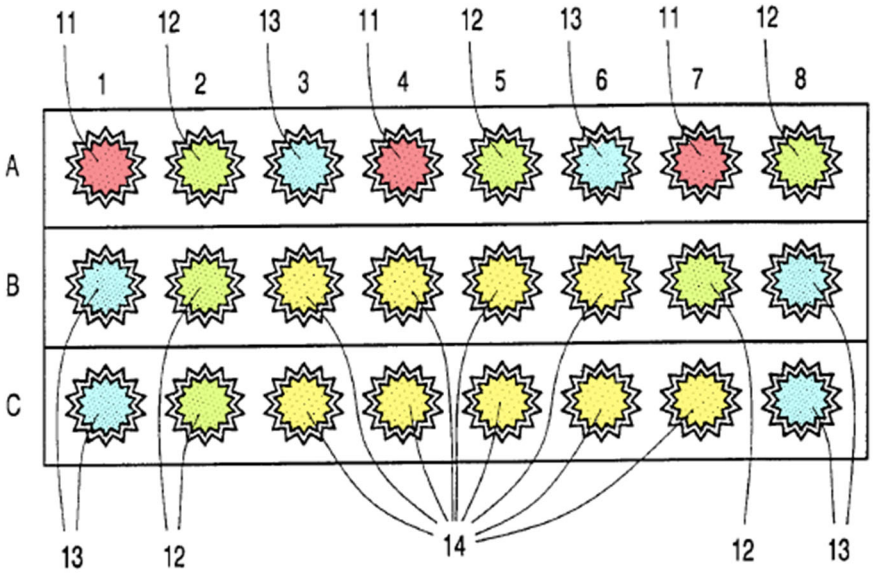

FIG. 6

EX1010, FIG. 6.

701. 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. Controllable headlamps "significantly increase the driving comfort and the road safety," and "glaring or 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. EX1010, 1:21-26, 1:10-13 ("comply with…regulations…preventing the *blinding* or *glare*").

702. And through its *system components* (hardware implementation), 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. Harbers's colored opto-electronic elements 11-14 arranged on a "curved substrate" provide colored beam segments 6-6'-6"-6"', 7-7'-7"-7"' (clusters) for different driving situations. EX1011, 5:14-26, 6:1-7, 6:27-7:19, FIGS. 1B-2; EX1011, 7:27-32 ("*curved* substrate"), 7:1-17, 9:28-10:5, 13:5-7.




EX1011, FIG. 2 (annotated).

703. This hardware combination—Karlsson's lighting means 2, 3 and Harbers's colored opto-electronic elements 11-14 on a curved substrate arranged in

beam segments 6-6'-6"-6"', 7-7'-7"-7"'—would have provided Karlsson's system with different colored spatial and spectral distributions for different driving situations, as in Harbers, thereby improving driver safety. This would have been merely combining prior-art elements or a simple substitution of one known element for another (e.g., Karlsson's array of lighting means 2, 3 and Harbers's colored 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). Overall, this is a simple hardware implementation.

704. A POSA would have had a reasonable expectation of success combining Harbers with Karlsson, for example, by simply modifying Karlsson's array of lighting means 2, 3 (e.g., LEDs) with Harbers's array of colored opto-electronic elements 11-14 (e.g., colored LEDs) to provide multiple colored light clusters (e.g., colored beam segments 6-6'-6"-6"', 7-7'-7"-7"') for different functions (hardware implementation).

705. Such modification 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. And in combining Karlsson with Harbers's array of colored opto-electronic elements 11-14 (e.g., modifying an illuminator), a POSA would have simply been combining known elements

according to known methods (disclosed in Harbers) to yield predictable results (light control for different functions, hardware implementation).

706. In view of the above, Karlsson in combination with Harbers renders obvious these claims.

**H. Claim 7: "The headlight system of claim 1, wherein at least one of the sensors is a camera-sensor configured to image at least lights indicative of oncoming vehicles having a driver whose vision could be disturbed by the headlight beam, and wherein the logical controller upon receiving data, indicating a position of the lights, from the camera-sensor, is configured to use one or more of the algorithms to determine a position of the oncoming vehicle, based on the position of the lights as indicated by the data, relative to the vehicle headlight system and responsively adapt the headlight beam to decrease at least one vision-disturbing characteristic to the oncoming vehicle driver."**

**Claim 8: "The headlight system of claim 1, wherein at least one of the sensors is a camera-sensor configured to image at least lights indicative of preceding vehicles having a driver whose vision could be disturbed by the headlight beam reflected in a mirror, and where the logical controller upon receiving data, indicating a position of the lights, from the camera-sensor, is configured to use one or more of the algorithms to determine a position of the preceding vehicle, based on the position of the lights as indicated by the data, relative to the vehicle headlight system and responsively adapt the headlight beam to decrease at least one**

**vision-disturbing characteristic to the driver of the preceding vehicle."**

**Claim 47: "The headlight system of claim 37, wherein at least one of the sensors is a camera-sensor configured to image at least lights indicative of an oncoming vehicle."**

**Claim 48: "The headlight system of claim 37, wherein at least one of the sensors is a camera-sensor configured to image at least lights indicative of a preceding vehicle."**

707. In my opinion, there is no patentable difference between the language of claim 8 and claim 7 as shown above. *See also* Appendix A and Appendix B. The same disclosures below address each feature.

708. In my opinion, there is no patentable difference between the language of claim 47 and claim 7 as shown above. *See also* Appendix A and Appendix B. The same disclosures below address each feature.

709. In my opinion, there is no patentable difference between the language of claim 48 and claim 8 as shown above. *See also* Appendix A and Appendix B. The same disclosures below address each feature.

710. Karlsson's controller is "a logical controller." *Supra* Section XVI.B.8.

711. Karlsson's "light-sensitive sensor" is a video camera, that "determin[es] the *direction* and the *intensity* of the detected light" and "*detects*…light in the *area ahead of a vehicle*," for example, "light from *oncoming traffic*." EX1010, 2:2-4, Abstract, 12:19-24, FIGS. 3, 14; EX1010, 3:19-20 ("*light of oncoming traffic*"), 5:16-32 ("*detecting*…*oncoming traffic* as a *parameter*"),

5:28-32 ("spotlight sensors…*determine* precisely the *direction*…[so] precise *adjustment of the pattern* of the light beam can be carried out"), 3:27-31.

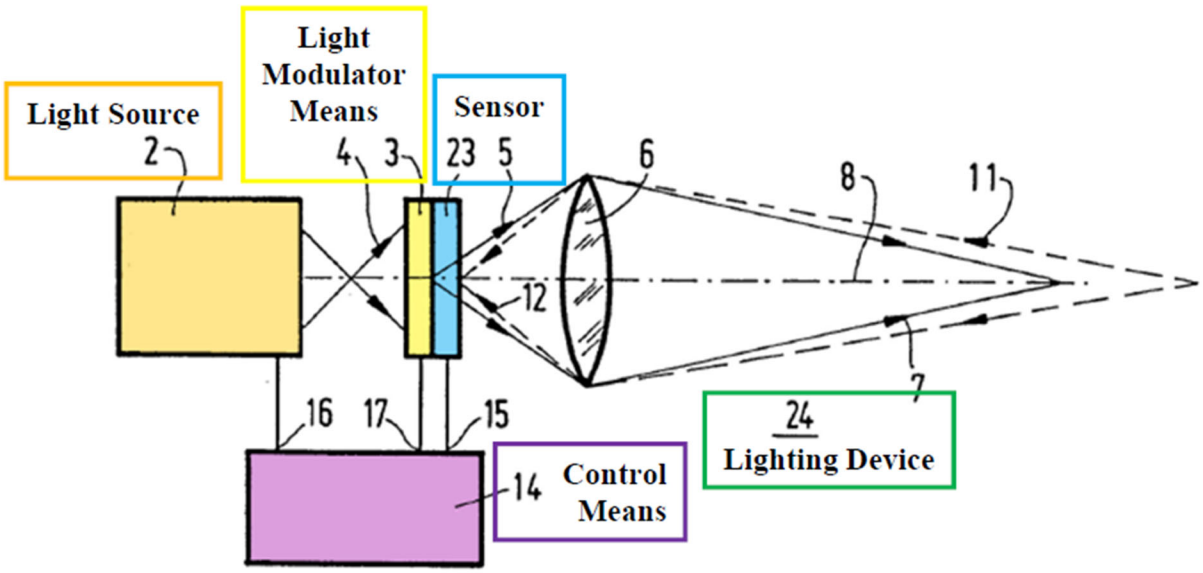
712. A POSA would have understood that Karlsson's system determines a vehicle position based on imaged incident light, which includes an oncoming vehicle or a preceding vehicle. EX1010, 2:2-4, Abstract, 8:19-24, 9:9-26, 11:18-28, 12:19-24, 15:17-22, 17:21-31, FIGS. 3, 14.

713. 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*" and "*memory 51*…may be used for *storing* and recording the *various adjustments*." EX1010, 9:9-17, 21:36-22:4, FIGS. 3, 14-15; EX1010, 21:36-22:1 ("*microprocessor*"), 20:12-32 ("*memory means 51*"), 20:1-3 ("*control electronics 41*"), 21:36-22:4.

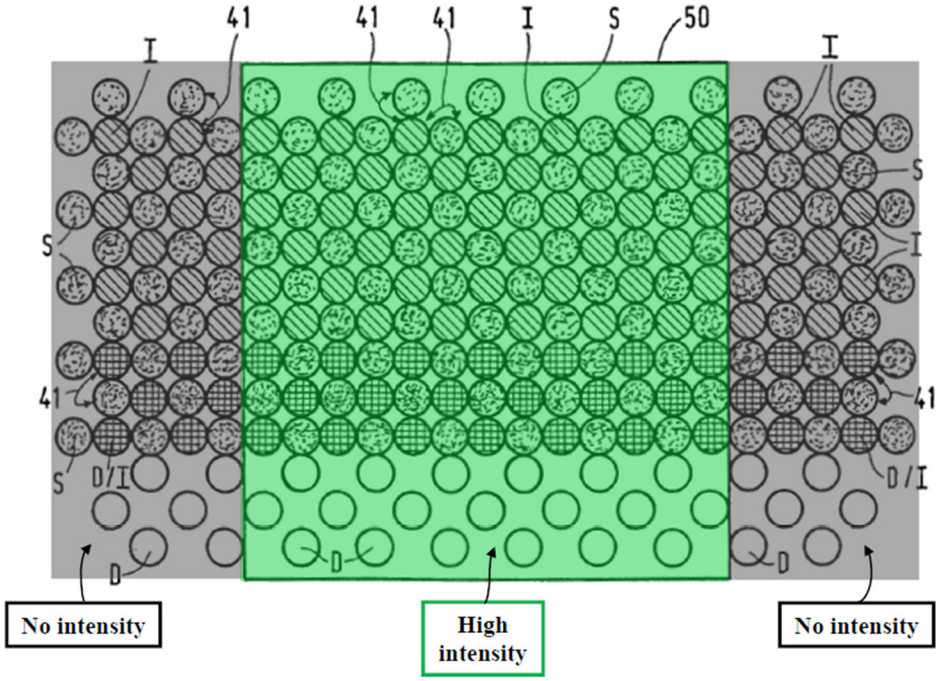
714. A POSA would have understood that Karlsson's memory 51 stores "one or more…algorithms" in communication with "processor-controlled control means 14" to determine a position of a vehicle (oncoming/preceding) based on the position of the incident light 11 and subsequently adapts light beam 7 accordingly. EX1010, 9:9-17, 12:19-24, 20:12-15, FIG. 15.

715. Thus, Karlsson's processor processes incident light 11, indicates a vehicle (oncoming/preceding), and uses algorithms to determine an area to be reduced within a first subsection of the field-of-view to "decrease at least one

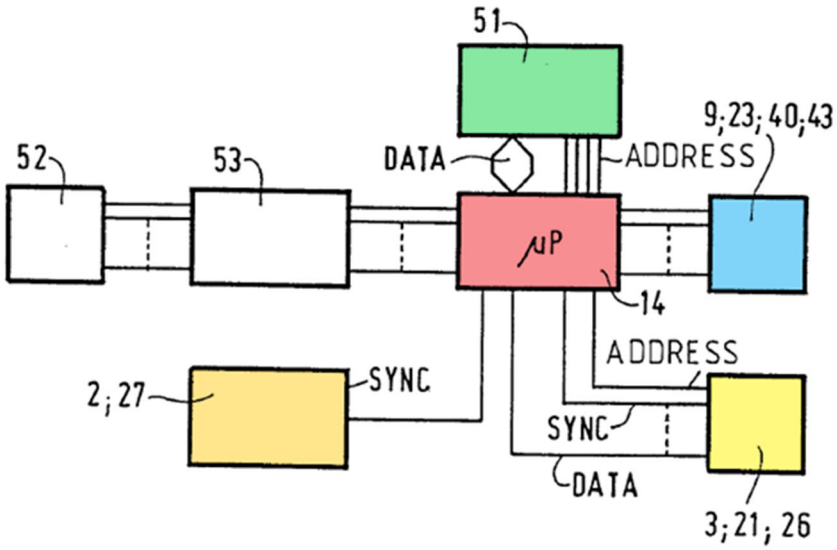
vision-disturbing characteristic," for example, glare or blinding. EX1010, 9:18-26 ("*glaring or blinding of oncoming traffic* is effectively *prevented*"), 2:7-9 ("*part of the light beam*…which might cause *inconvenience to oncoming traffic* is automatically *suppressed*"), 5:28-32 ("precise adjustment…so as *not to emit light* in the direction of the detected light"), 14:26-30, 9:9-17, 5:16-23, 20:12-32, 21:36-22:4, FIGS. 3, 14-15.




EX1010, FIG. 3 (annotated).




EX1010, FIG. 14 (annotated).

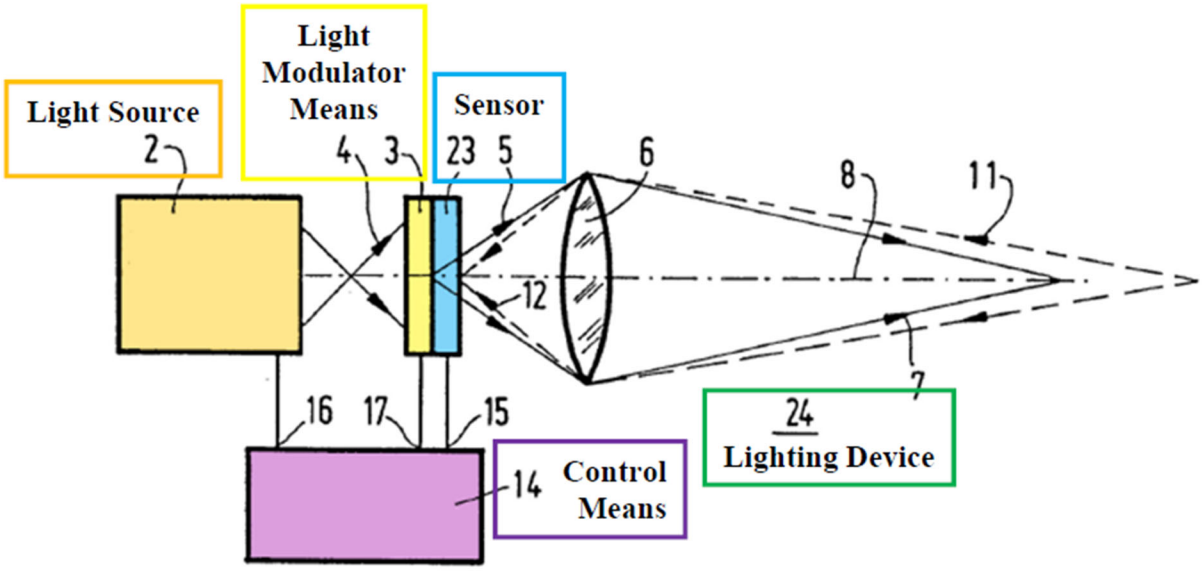



EX1010, FIG. 15 (annotated).

716. In view of the above, Karlsson discloses or renders obvious these claims.

**I. Claim 10: "The headlight system of claim 1, wherein at least one of the sensors is configured to detect at least one of oncoming headlights or preceding taillights."**

717. Karlsson's "light-sensitive sensor[]…determin[es] the *direction* and the *intensity* of the detected light 11" and "*detects*…light in the *area ahead of a vehicle*," for example, "light from *oncoming traffic*." EX1010, 2:2-4, Abstract, 12:19-24, FIGS. 3, 14; EX1010, 3:19-20 ("*light of oncoming traffic*"), 5:16-32 ("*detecting*…*oncoming traffic* as a *parameter*"), 5:28-32 ("spotlight sensors…*determine* precisely the *direction*…[so] precise *adjustment of the pattern* of the light beam can be carried out"), 3:27-31.




EX1010, FIG. 3 (annotated).

718. In view of the above, Karlsson discloses this claim.

**J. Claim 11: "The headlight system of claim 1, further including a computer vison processing unit configured to use the sensor data and one or more of the algorithms to identify entities including at**

**least one of beings, vehicles, roadway, or street signs and wherein the logical controller is further configured to modify the headlight beam to change illumination of the identified entity."**

**Claim 50: "The headlight system of claim 37, further including a computer vision processing unit configured to use the sensor data to identify entities including at least one of beings, vehicles, roadway, or street signs, and wherein the processor is further configured to determine modification of the headlight beam to change illumination of the identified entity."**

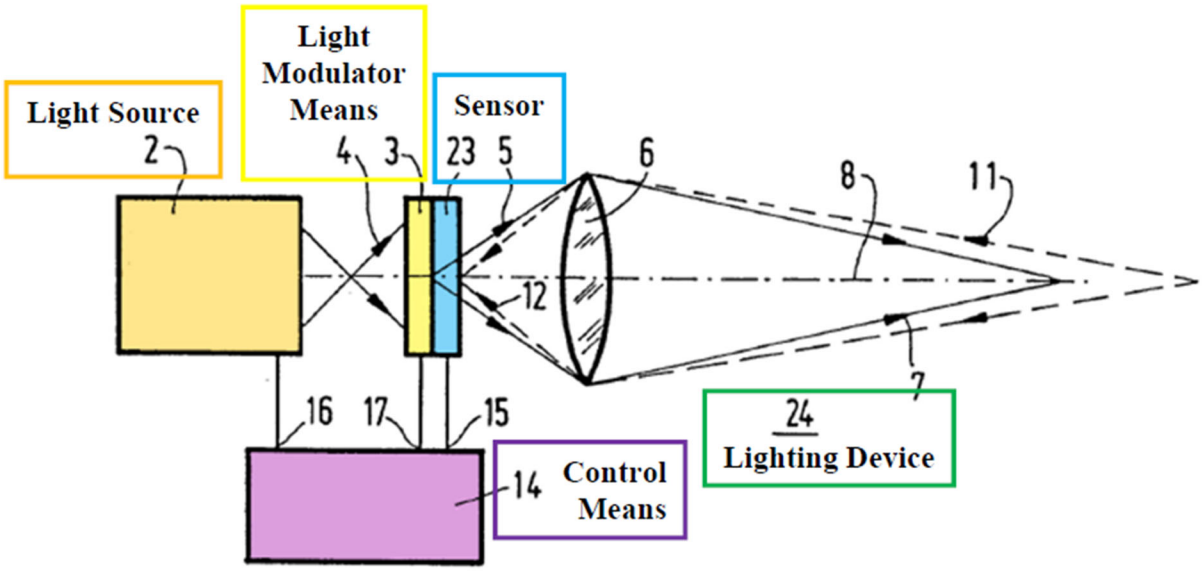
719. In my opinion, there is no patentable difference between the language of claim 50 and claim 11 as shown above. *See also* Appendix A. The same disclosures below address each feature.

720. Karlsson's controller is "a logical controller." *Supra* Section XVI.B.8.

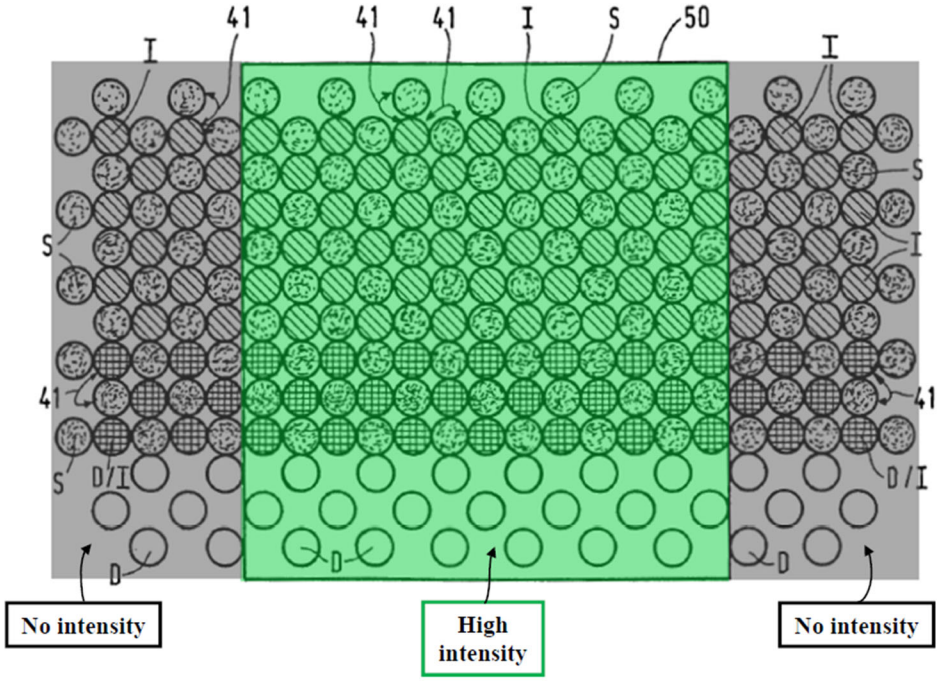
721. Karlsson identifies "oncoming traffic" as it "determin[es] the *direction* and the *intensity* of the detected light 11." EX1010, 2:2-4, Abstract, 12:19-24, FIGS. 3, 14; EX1010, 5:28-32 ("spotlight sensors…*determine* precisely the *direction*…[so] precise *adjustment of the pattern* of the light beam can be carried out"), 3:19-20, 5:16-32, 3:27-31.

722. Karlsson controls its light to emit "a *desired pattern* and a *desired intensity*" and "*memory 51*…may be used for *storing* and recording the *various adjustments*." EX1010, 9:9-17, 21:36-22:4, FIGS. 3, 14-15; EX1010, 21:36-22:1 ("*microprocessor*"), 20:12-32 ("*memory means 51*"), 20:1-3 ("*control electronics 41*"), 21:36-22:4.

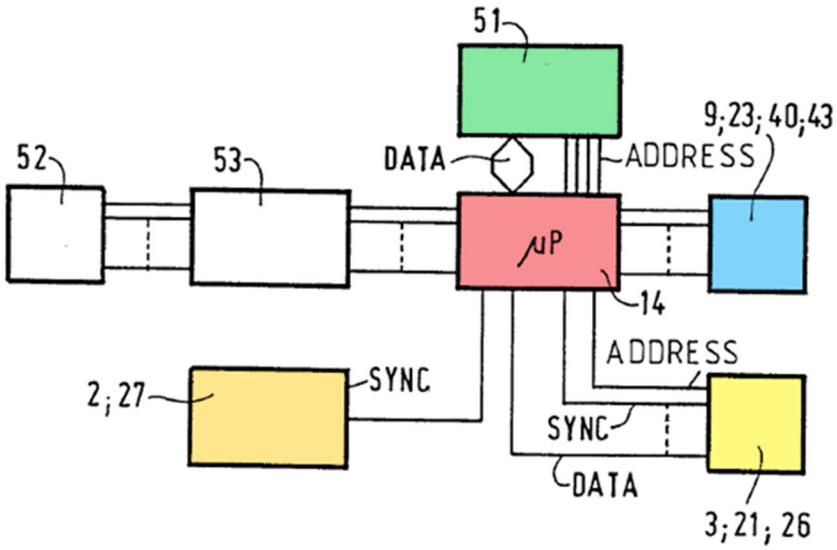
723. In my opinion, Karlsson's processor qualifies as/includes "a computer vis[i]on processing unit" because Karlsson's processor uses incident light data from sensor 9 and "one or more…algorithms" stored in memory 51 to identify vehicles (oncoming/preceding). EX1010, 2:4-9, 9:9-17, 12:19-24, 20:12-15, FIGS. 14-15.




EX1010, FIG. 3 (annotated).




EX1010, FIG. 14 (annotated).




EX1010, FIG. 15 (computer vision) (annotated).

724. Further, computer vision was well-known. EX1009, 22:17-23 ("[t]he *pattern recognition* application processes, using algorithms and *methods known in the art*, images of a scene…to *identify features and/or objects in the scene*"), 24:4-

7 ("*pattern recognition* application processes the *images*…and *identifies roadway signs 121 and 122*"), 26:31-27:1 ("'pattern recognize[s]' presence of *people*…and *spotlight[s] the people* to alert the driver"), FIGS. 5-6; EX1013, Nakamura, ¶¶34-46, FIGS. 10(2), 10(6); EX1014, Satonaka, ¶¶7-11, 16-17, 21-22, 25-38, FIGS. 4(2), 4(6), 6.

725. Indeed, the '503 patent admits that "computer vision methodologies…[were] *known in the art*." EX1001, 63:37-45; *see also* EX1009, 22:17-23, 24:4-7, 26:31-27:1, FIGS. 5-6; EX1013, Nakamura, ¶¶34-46, FIGS. 10(2), 10(6); EX1014, Satonaka, ¶¶7-11, 16-17, 21-22, 25-38, FIGS. 4(2), 4(6), 6. Thus, at a minimum, a computer vision processing unit would have been an obvious addition to Karlsson's controller/processor. And a POSA would have had a reasonable expectation of success, since a computer vision processing unit would have been just a simple substitution of one known prior art element for another.

726. In view of the above, Karlsson discloses or renders obvious these claims.

**K. Claim 12: "The headlight system of claim 1, where the determined illumination results in creation of a headlight beam providing a driver of the vehicle including said headlight system with higher visibility in at least a second of the at least two subsections relative to the first of the at least two subsections, while mitigating glaring illumination projected to reach the eyes of at least one of other drivers or pedestrians in the first of the at least two subsections,**

**based on detected other vehicles or pedestrians in the first of the at least two subsections as indicated by the sensor data."**

727. Karlsson's processor "determine[s] an illumination for at least two of the sub-sections." *Supra* Section XVI.B.9.

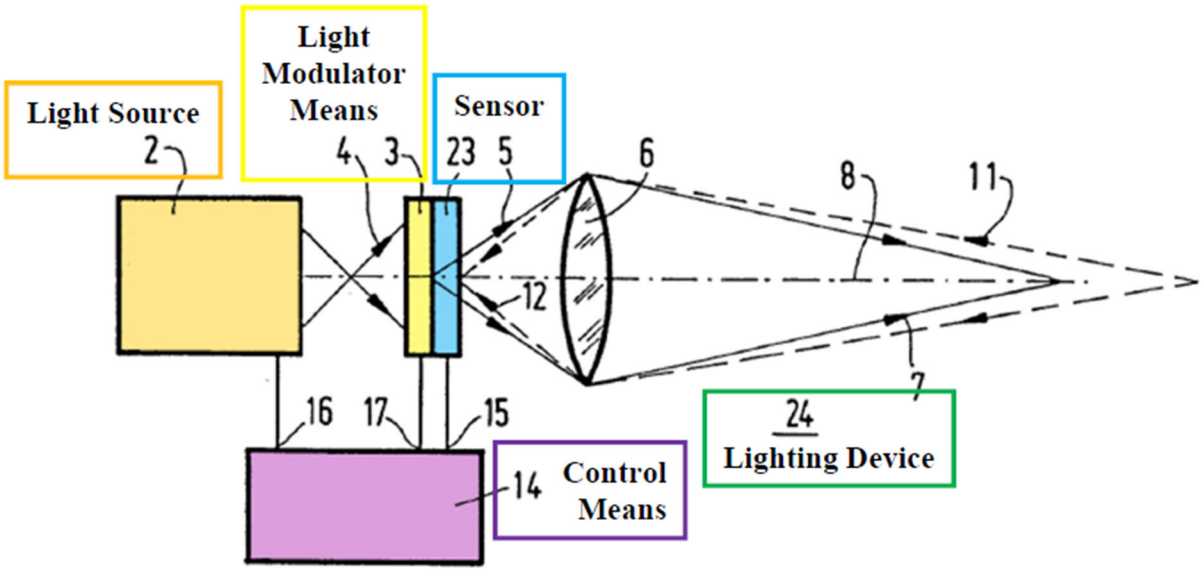
728. Karlsson discloses "light beam 7…*optimally adapted* to the road and to the ambient light" and "permit[s] a light intensity which is generally *higher than that of conventional dipped headlights*," where appropriate. EX1010, 9:18-26, Abstract, FIGS. 3, 14-15; EX1010, 19:26-27 ("*main-beam light function*"), 19:29-33 ("*emitted light beam 50*"), 2:7-9 ("*part of the light beam*…is automatically suppressed, whilst *retaining an optimum lighting* effect"), 14:26-30, 5:16-32, 9:9-17.

729. Karlsson also provides control such that "*no light at all* or *light having a low intensity* is emitted [where glare may occur]…[thus] *glaring or blinding of oncoming traffic* is effectively *prevented*." EX1010, 9:18-26, FIGS. 3, 14-15; EX1010, 19:24-25 ("*dipped light function*"), 2:7-9 ("*part of the light beam*…which might cause *inconvenience to oncoming traffic* is automatically *suppressed*"), 5:28-32 ("precise adjustment…so as *not to emit light* in the direction of the detected light"), 14:26-30, 9:9-17, 5:16-23, 20:12-32, 21:36-22:4.

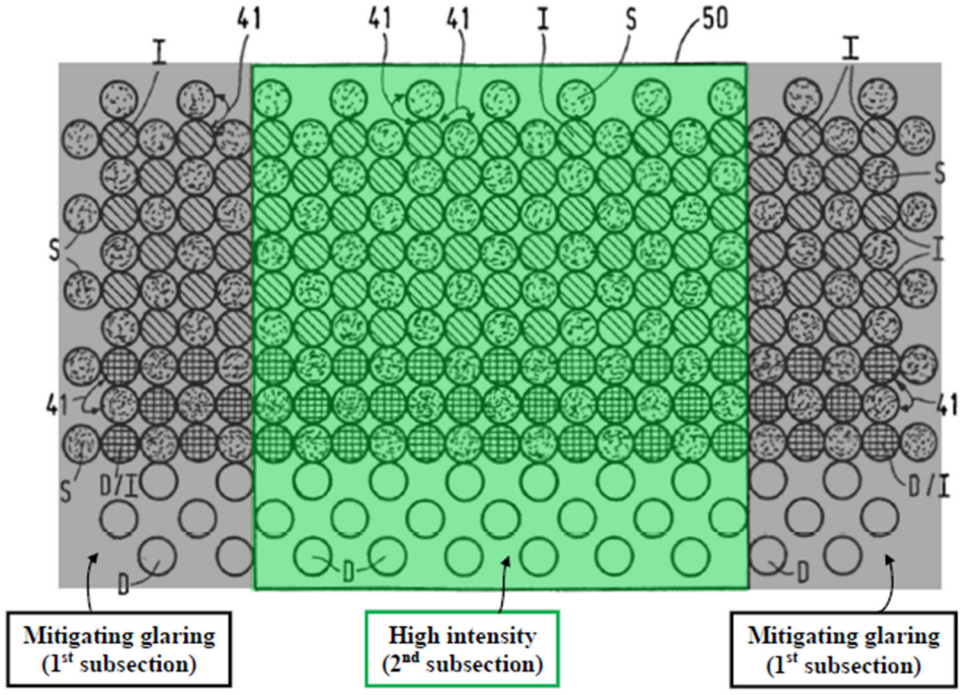
730. Simply, Karlsson's processor processes the light data, indicates a vehicle, and reduces illumination within a first subsection to "mitigat[e] glaring,"

and creates illumination in a second subsection to provide "higher visibility."

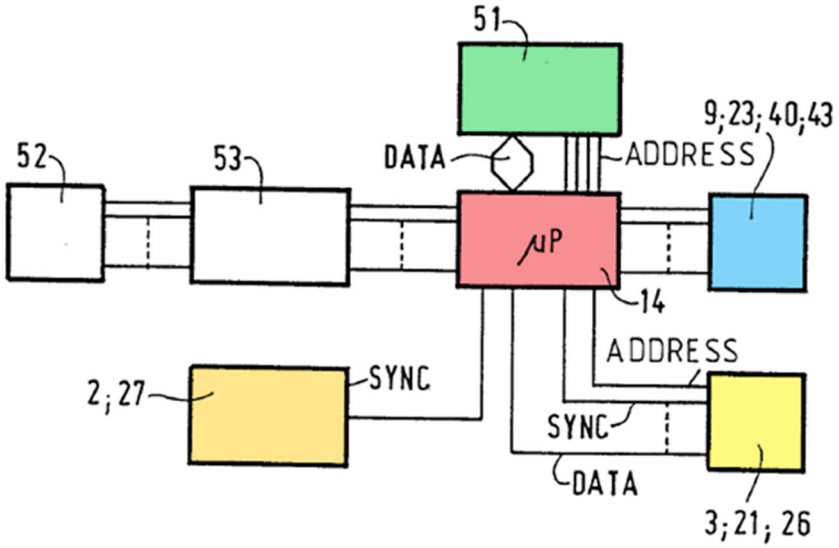
EX1010, 2:4-9, 9:9-17, 12:19-24, 20:12-15, FIGS. 14-15.




EX1010, FIG. 3 (annotated).




EX1010, FIG. 14 (annotated).

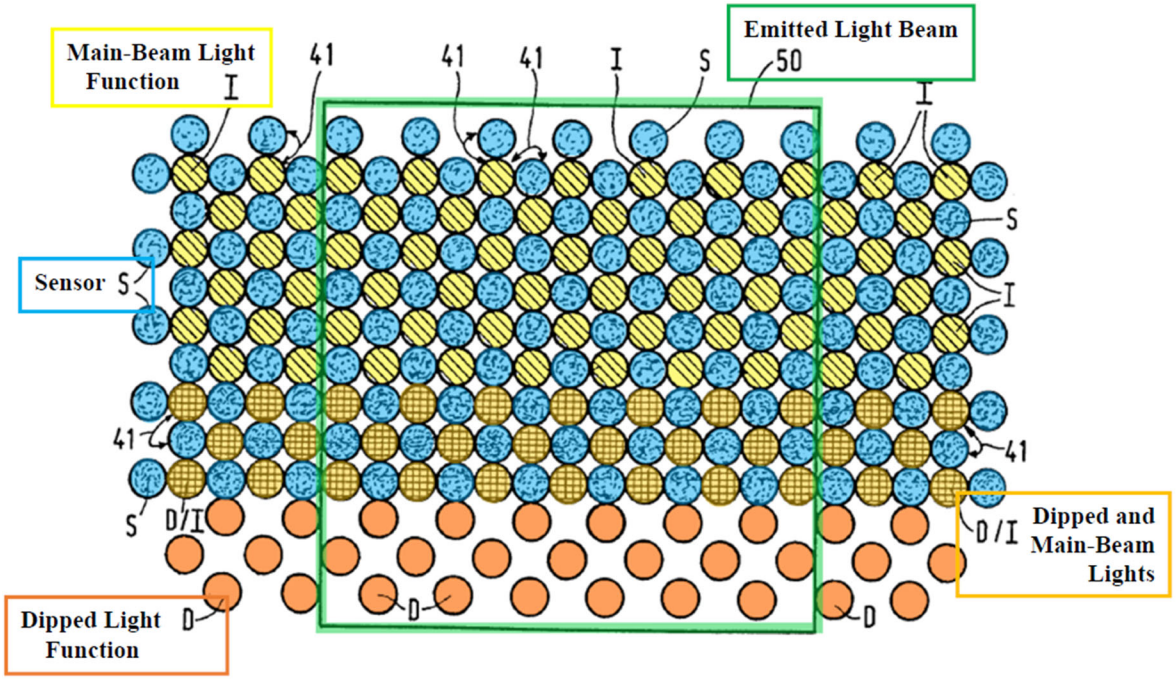



EX1010, FIG. 15 (annotated).

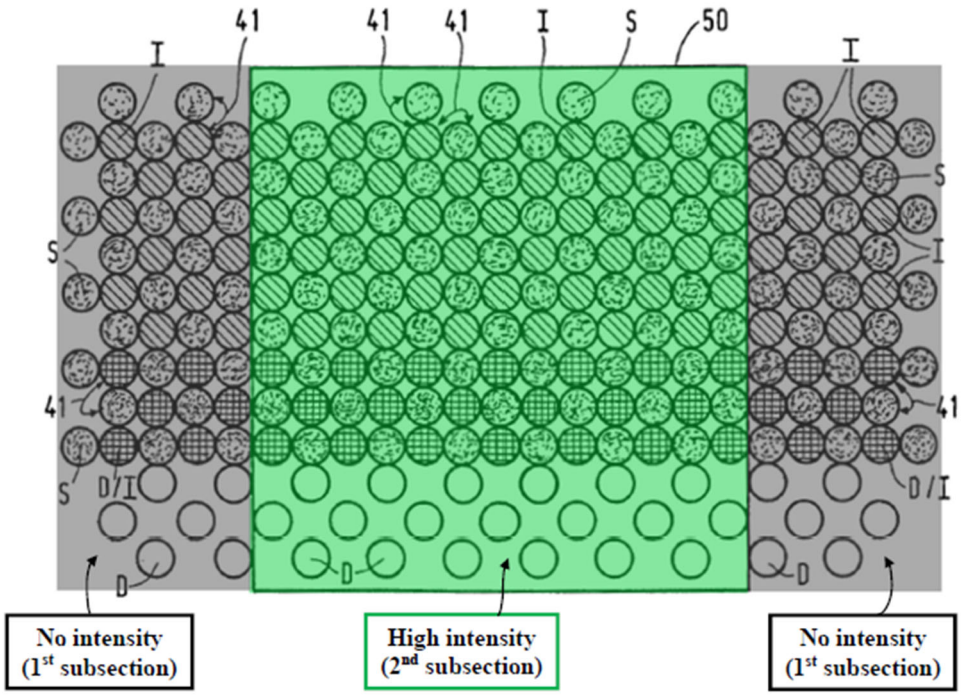
731. In view of the above, Karlsson discloses this claim.

**L. Claim 13: "The headlight system of claim 1, wherein the required illumination continues to provide high-beam illumination in at least a second of the subsections different from the first of the subsections, without diminishing a range of the high-beam illumination."**

732. Karlsson illumination in non-shaded areas is "*higher* than that of *conventional dipped headlights*," in the second subsection. EX1010, 9:18-26, Abstract, FIGS. 3, 14-15; EX1010, 2:7-9 ("*part of the light beam*…is automatically suppressed, whilst *retaining an optimum lighting* effect"), 19:26-27 ("*main-beam light function*"), 19:29-33 ("*emitted light beam 50*"), 1:27-30 ("*high beams* or *main-beams*"), 14:26-30, 5:16-32, 9:9-17. This "provide[s] high-beam illumination" in the second subsection "without diminishing a range of the high-beam illumination."




EX1010, FIG. 14 (annotated).




EX1010, FIG. 14 (annotated).

733. In view of the above, Karlsson discloses this claim.

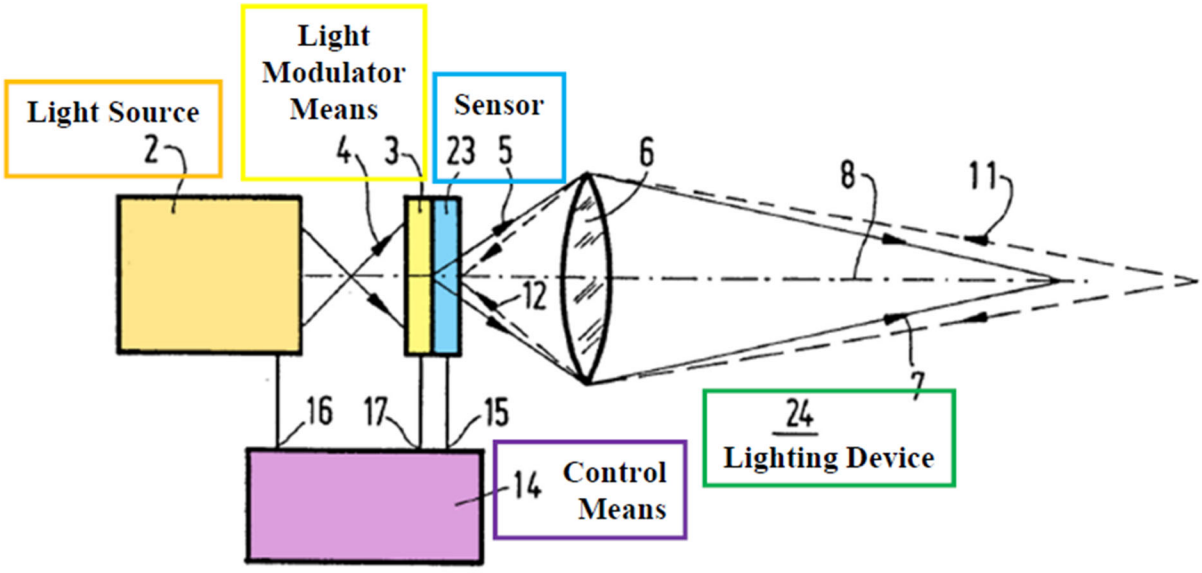
**M. Claim 14: "The headlight system of claim 1, wherein the one or more sensors further includes at least one of a camera, a microphone, an ultrasonic transducer and receiver, or an electromagnetic radiation source and detector including any of IR, UV, laser, or light."**

**Claim 53: "The headlight system of claim 37, wherein the one or more sensors further includes at least one of a camera, a microphone, an ultrasonic transducer and receiver, or an electromagnetic radiation source and detector including any of IR, UV, laser, or light."**

734. The language of claim 53 is identical to the langue of claim 14 as shown above. *See also* Appendix A. The same disclosures below address each feature.

735. Karlsson's *sensor 9, 23* can include a "video camera[]." EX1010, 12:19-24, FIGS. 3, 14; EX1010, 21:30-35, 19:18-20:5, 2:2-4, Abstract, 5:16-32.

736. Additionally, Karlsson's illuminator and sensor constitute "an electromagnetic radiation source and detector including…light." EX1010, 9:9-17, FIGS. 3, 6, 14-15; EX1010, 3:27-31, 4:26-29, 5:16-32, 2:7-9, 19:29-33, 9:19-22; 2:2-4, Abstract, 3:19-20, 12:19-24.




EX1010, FIG. 3 (annotated).

737. In view of the above, Karlsson discloses these claims.

**N. Claim 18: "The system of claim 1, wherein at least one light source provided to at least one headlamp includes a laser diode."**

**Claim 57: "The headlight system of claim 37, wherein at least one light source provided to at least one headlamp includes a laser diode."**

738. The language of claim 57 is identical to the language of claim 18 as shown above. *See also* Appendix A. The same disclosures below address each feature.

739. 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; EX1010, 5:4-15 ("*'Quantum Wells'* and the like"), 12:22 ("*photo diodes*"), 4:36-5:1 ("*pixel type light sources*").

740. Further, a "laser diode" was well-known, e.g., as expressly disclosed by Thominet. *See, e.g.*, EX1006, ¶28 ("*laser diodes*"). In addition, the '503 patent admits that a laser diode was a known light source. EX1001, 35:29-33 ("U.S. Pat. No. 5,537,433 by Watanabe, where a semiconductor light emitter, such as the light-emitting diode or the semiconductor laser"); EX1037, Abstract ("*semiconductor laser*"). Thus, at a minimum, a laser diode would have been an obvious light source for Karlsson's controllable light source of "limited physical dimensions." 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.

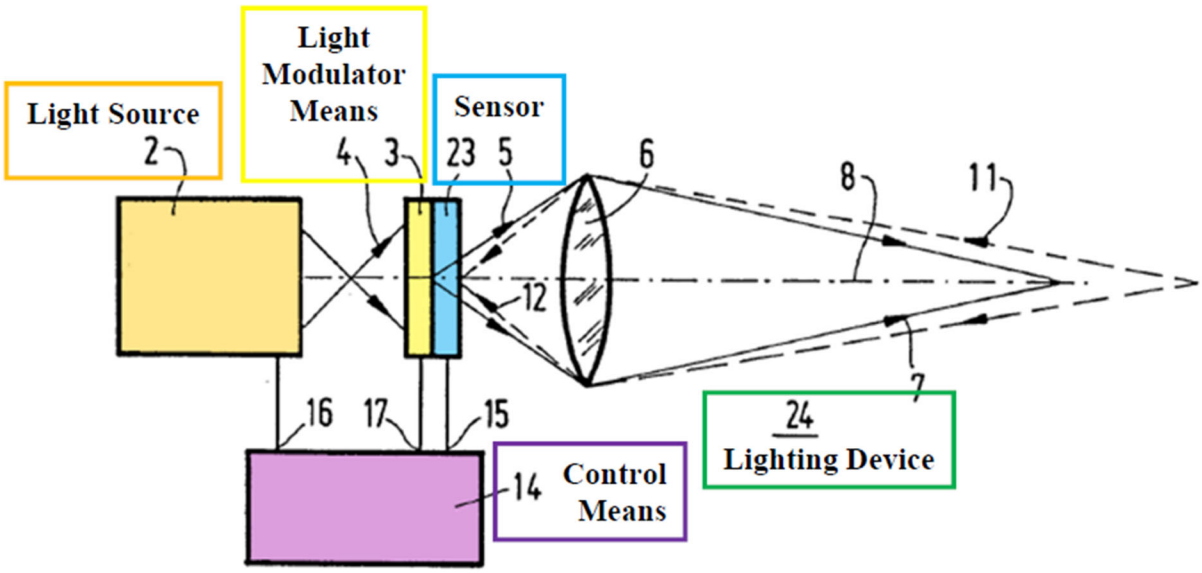
741. In view of the above, a POSA would have understood that Karlsson renders obvious these claims.

**O. Claim 19: "The system of claim 1, 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 clusters."**

**Claim 58: "The headlight system of claim 37, 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 clusters as part of the instructed operation."**

742. In my opinion, there is no patentable difference between the language of claim 58 and claim 19 as shown above. *See also* Appendix A. The same disclosures below address each feature.

743. Karlsson discloses "light modulator means…of a type which *reflects light…'Micro Mirrors'*. EX1010, 5:7-15, FIGS. 1, 3; EX1010, 8:15-17 ("a *lens 6*, which forms light 5 into a desired emitted light beam 7"), 8:29-35 ("*lenses 6, 10*"), Abstract, 5:11-15, 9:3-33, 10:32-11:1, 11:7-28.




EX1010, FIG. 3 (annotated).

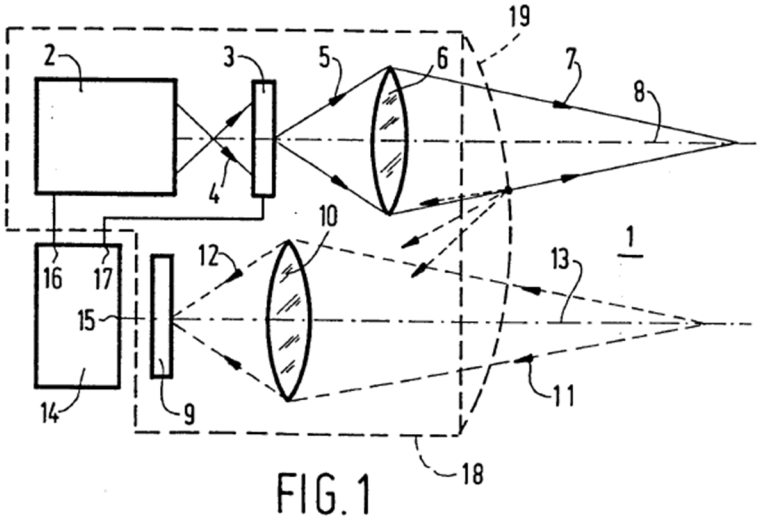



FIG. 1

EX1010, FIG. 1.

744. In view of the above, Karlsson discloses these claims.

**P. Claim 38: "The headlight system of claim 37, wherein at least one of the at least one processors is further configured to process the sensor data to determine illumination for at least one first subsection of the field-of-view, determined to include at least a portion of the second vehicle, based on the sensor data, and for at least one second subsection determined not to include the second vehicle, based on the sensor data."**

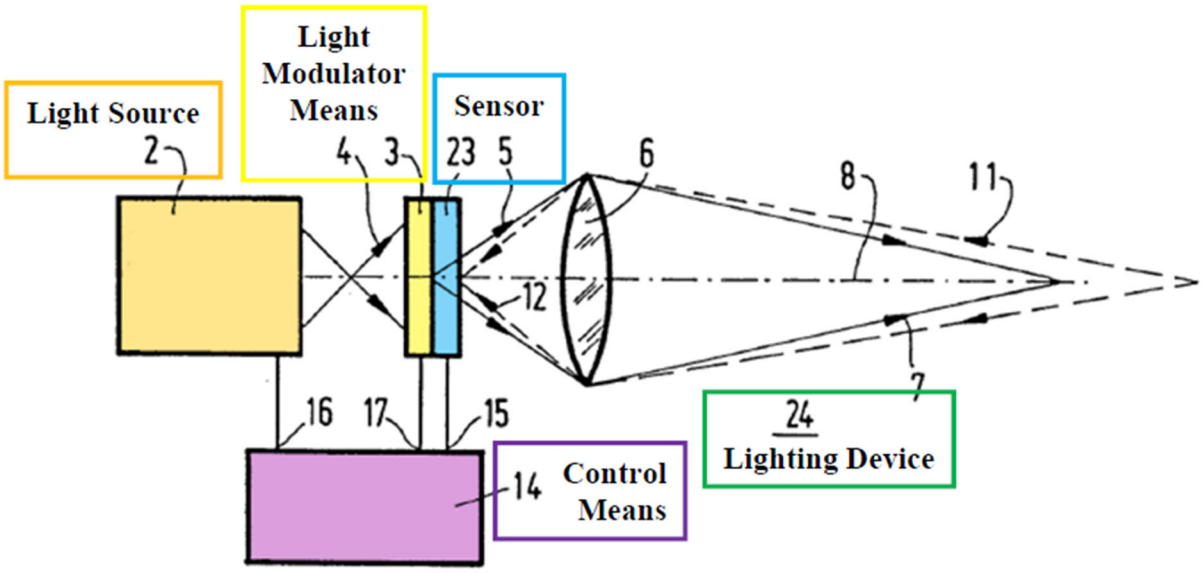
745. Karlsson discloses "*incident light 11* on the *light-sensitive sensor 9*…is *processed* into an *electric control signal* on input 15 of the *control means 14*" and "light beam 7 having a *desired pattern* and a *desired intensity* is emitted." EX1010, 9:9-17, FIGS. 3, 6, 14-15; EX1010, 3:27-31 ("*field of view*"), 4:26-29 ("*desired pattern*"), 5:16-23 ("*detecting*…*oncoming traffic* as a *parameter*"), 2:7-9 ("*part of the light beam*…is automatically suppressed"), 19:29-33 ("*vary* as regards its *shape* and *dimension*"), 9:19-22.

746. Karlsson also discloses "*part of the light beam* which might cause *inconvenience to oncoming traffic* is automatically *suppressed*, whilst *retaining an optimum lighting* effect" and "permitting a light intensity which is generally *higher than that of conventional dipped headlights*." EX1010, 2:4-9, 9:18-26, Abstract, FIGS. 3, 14-15; EX1010, 19:26-27 ("*main-beam light function*"), 19:29-33 ("*emitted light beam 50*"), 14:26-30, 5:16-32, 9:9-17.

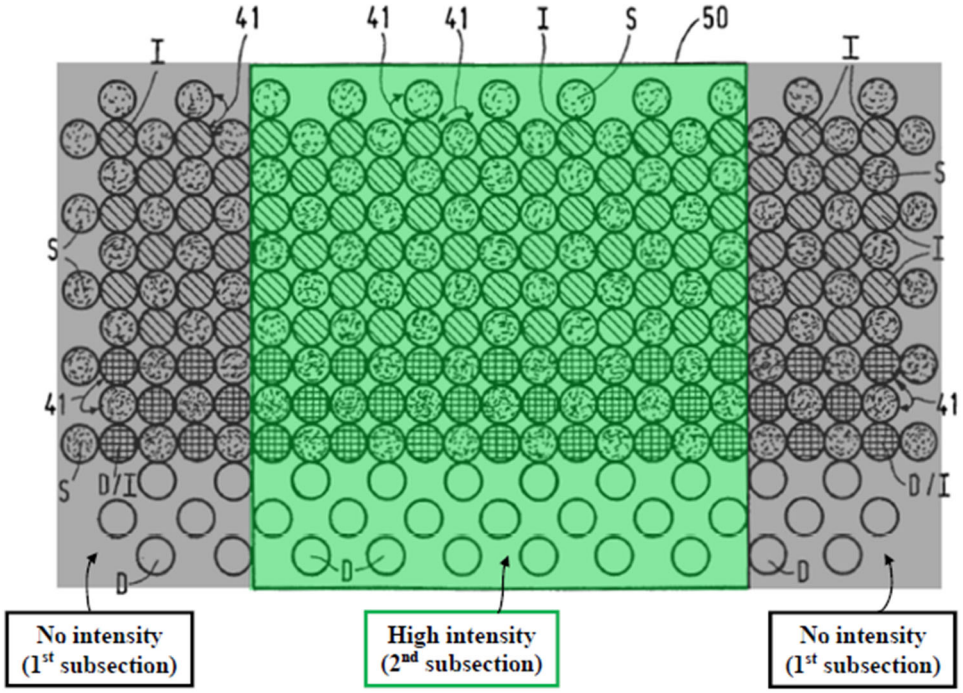
747. Thus, Karlsson's processor processes the light data and determines an area to be reduced within a first subsection (including a portion of the vehicle) and

an area to be illuminated within a second subsection (not including a portion of the vehicle). EX1010, 2:4-9, 9:9-17, 12:19-24, 20:12-15, FIGS. 14-15.

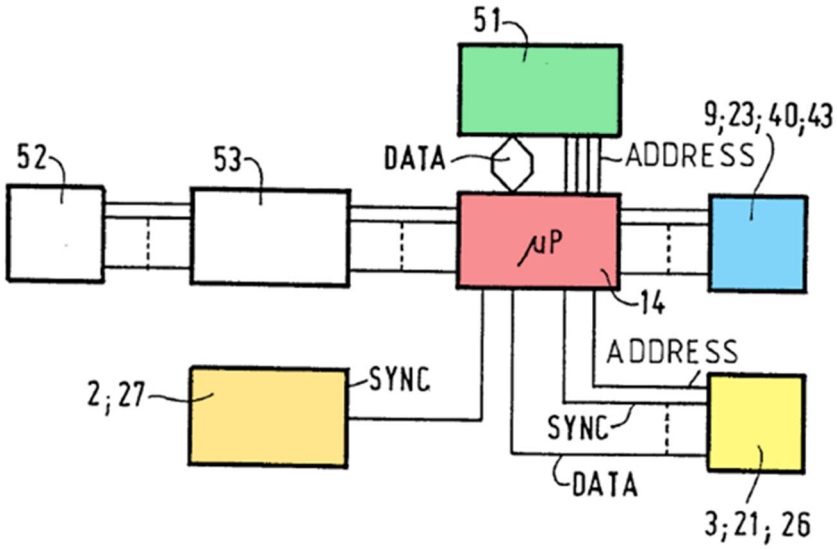
748. A POSA would have understood that Karlsson's first subsection can be adjusted such that the "second subsection…[does] not include the second vehicle" because Karlsson's system changes the "*shape* and *dimension*" of emitted light beam based on "the desired *pattern* and *direction* of the beam." EX1010, 19:29-23, FIG. 14.




EX1010, FIG. 3 (annotated).




EX1010, FIG. 14 (annotated).




EX1010, FIG. 15 (annotated).

749. In view of the above, Karlsson discloses this claim.

**Q. Claim 39: "The headlight system of claim 37, wherein the plurality of light clusters are further capable of illuminating at least two of the sub-sections with different illumination characteristics based**

**on the at least one processor determining specific, different illumination characteristics for each of the at least two sub-sections."**

750. Karlsson discloses illuminating "with different illumination characteristics." *Supra* Section XVI.B.4.

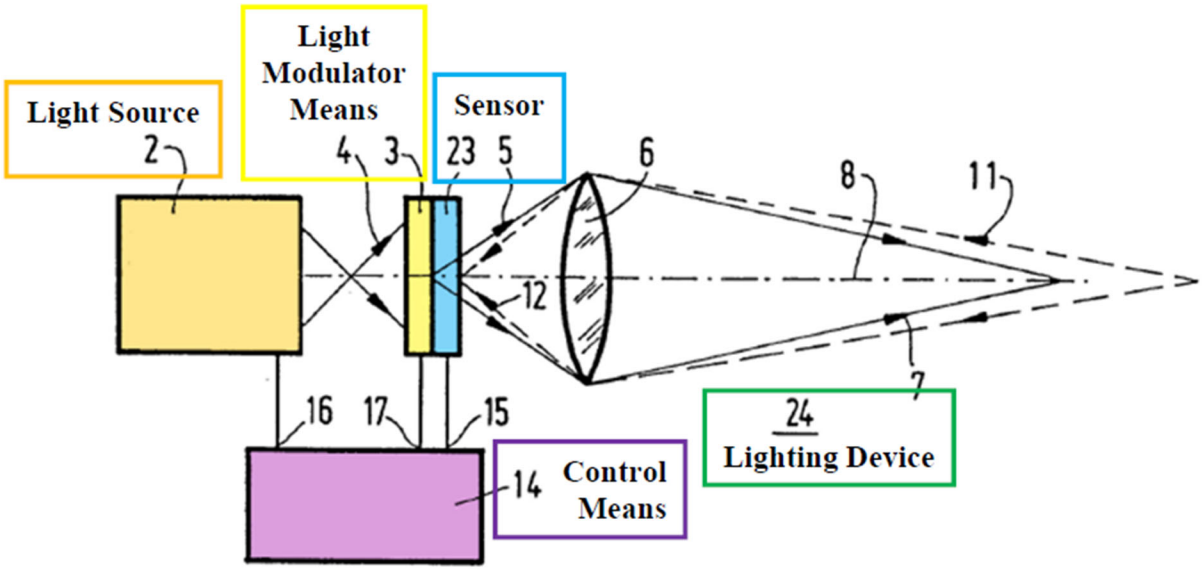
751. Karlsson's illumination in shaded areas (first subsection) is "*no light at all* or *light having a low intensity*" and "*part of the light beam*…which might cause *inconvenience to oncoming traffic* is automatically *suppressed*." EX1010, 9:18-26, 2:7-9, FIGS. 3, 14-15; EX1010, 19:24-25 ("*dipped light function*"), 5:28-32 ("precise adjustment…so as *not to emit light* in the direction of the detected light"), 14:26-30, 9:9-17, 5:16-23, 20:12-32, 21:36-22:4.

752. Karlsson's illumination in non-shaded areas (second subsection) is "*higher* than that of conventional *dipped* headlights" and "light beam 7…*optimally adapted* to the road and to the ambient light." EX1010, 9:18-26, Abstract, FIGS. 3, 14-15; EX1010, 19:26-27 ("*main-beam light function*"), 19:29-33 ("*emitted light beam 50*"), 2:7-9 ("*part of the light beam*…is automatically suppressed, whilst *retaining an optimum lighting* effect"), 14:26-30, 5:16-32, 9:9-17.

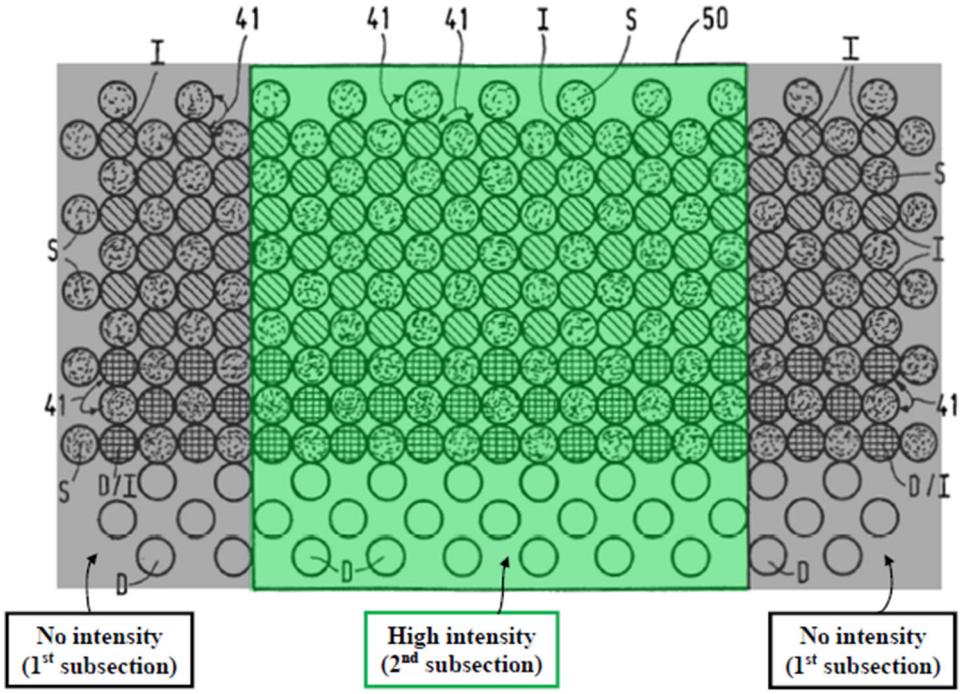
753. A POSA would have understood that "intensity" and "pattern" are "different illumination characteristics." *See also* EX1001, 16:43-50, 2:28-30.

754. Thus, Karlsson's processor controls illuminator to reduce a first subsection and illuminate a second subsection based on "different illumination

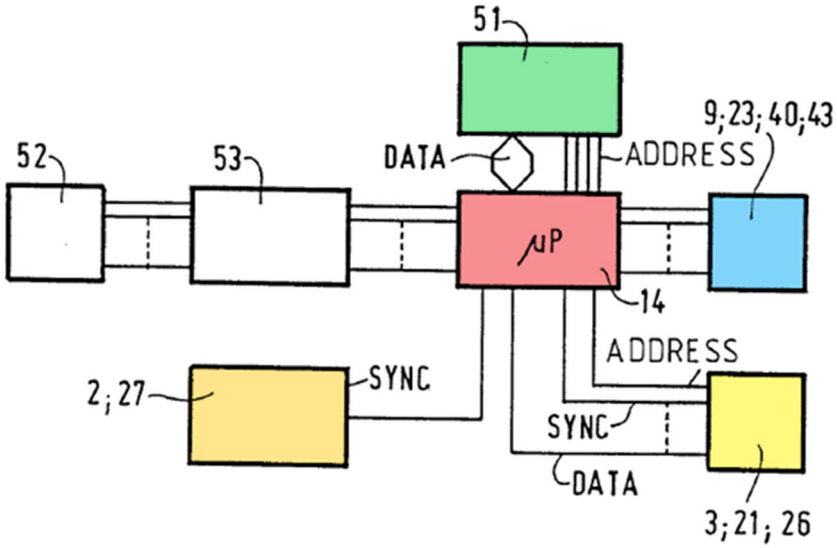
characteristics for each of the at least two sub-sections." EX1010, 2:4-9, 9:9-17, 12:19-24, 20:12-15, FIGS. 14-15. As discussed, Karlsson, alone or in combination with Harbers, discloses a "plurality of light clusters." *Supra* Section XVI.B.3.




EX1010, FIG. 3 (annotated).



EX1010, FIG. 14 (annotated).




EX1010, FIG. 15 (annotated).

755. In view of the above, Karlsson, alone or in combination with Harbers, discloses or renders obvious this claim.

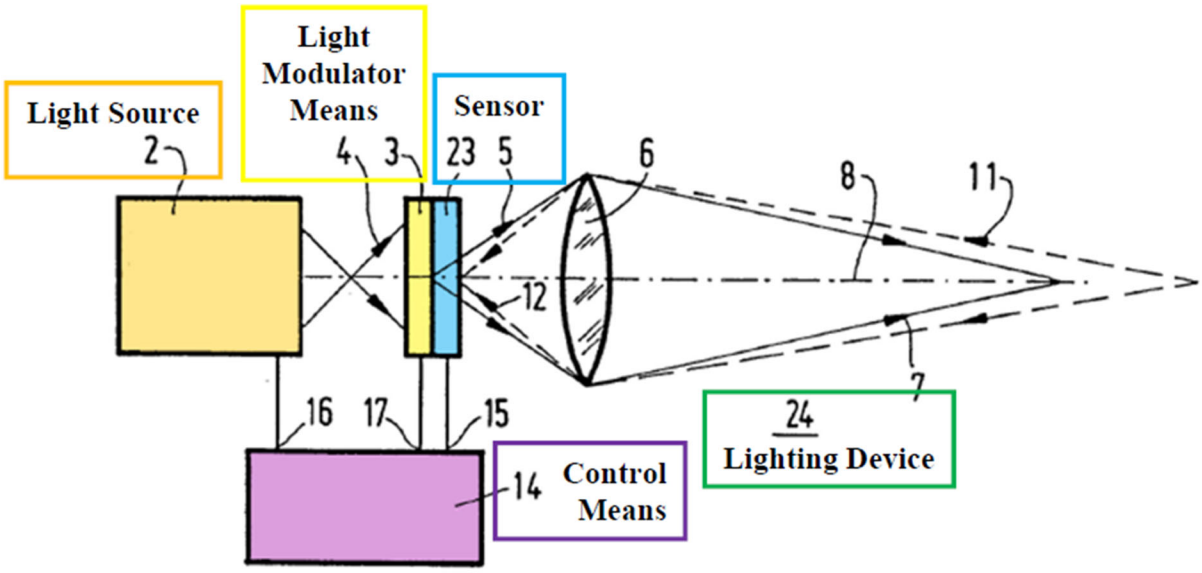
**R. Claim 40: "The headlight system of claim 37, wherein the light distribution pattern defines illumination for at least the first and the one or more second sub-sections of the field of view."**

756. Karlsson's processor "determine[s] a light distribution pattern." *Supra* Section XVI.B.9.

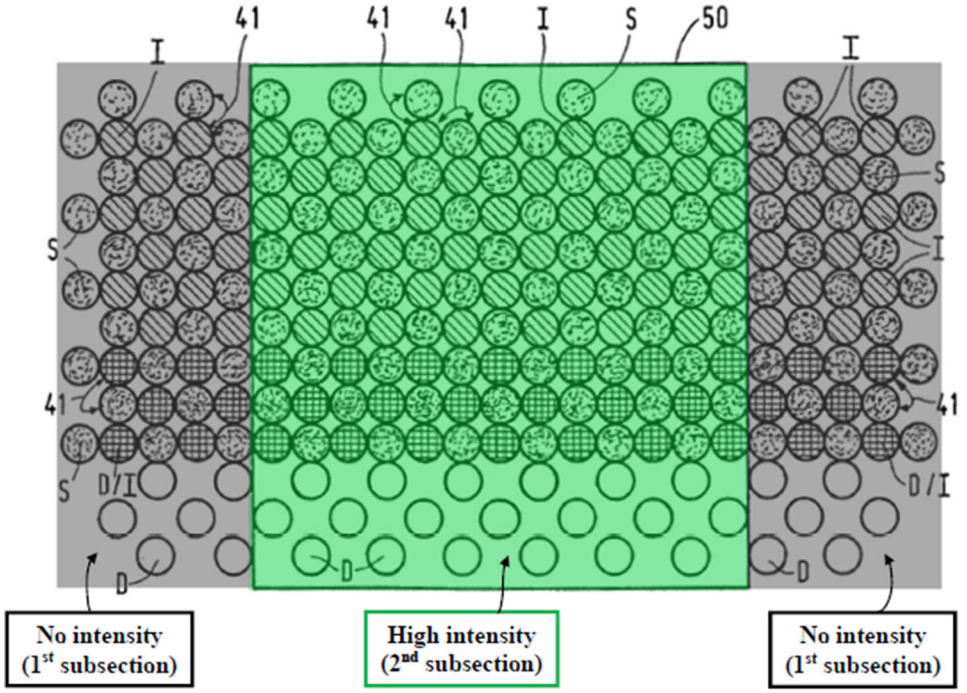
757. Karlsson's illumination in shaded areas (first subsection) is "*no light at all* or *light having a low intensity*" and "*part of the light beam*…which might cause *inconvenience to oncoming traffic* is automatically *suppressed*." EX1010, 9:18-26, 2:7-9, FIGS. 3, 14-15; EX1010, 19:24-25, 5:28-32, 14:26-30, 9:9-17, 5:16-23, 20:12-32, 21:36-22:4. Karlsson's illumination in non-shaded areas

(second subsection) is "*higher* than that of conventional *dipped* headlights" and "light beam 7…*optimally adapted* to the road and to the ambient light." EX1010, 9:18-26, Abstract, FIGS. 3, 14-15; EX1010, 19:26-27, 19:29-33, 2:7-9, 14:26-30, 5:16-32, 9:9-17.

758. Thus, Karlsson's light distribution pattern defines illumination in a first subsection of the field-of-view and illumination in a second subsection of the field-of-view. EX1010, 2:4-9, 9:9-17, 12:19-24, 20:12-15, FIGS. 14-15.




EX1010, FIG. 3 (annotated).




EX1010, FIG. 14 (annotated).

759. In view of the above, Karlsson discloses this claim.

**S. Claim 41: "The headlight system of claim 37, wherein the light distribution patterns defines illumination for the first subsection designed to result in an illuminance below the predefined threshold value, and defines illumination for the one or more second subsections designed to result in an illuminance above the predefined threshold value."**

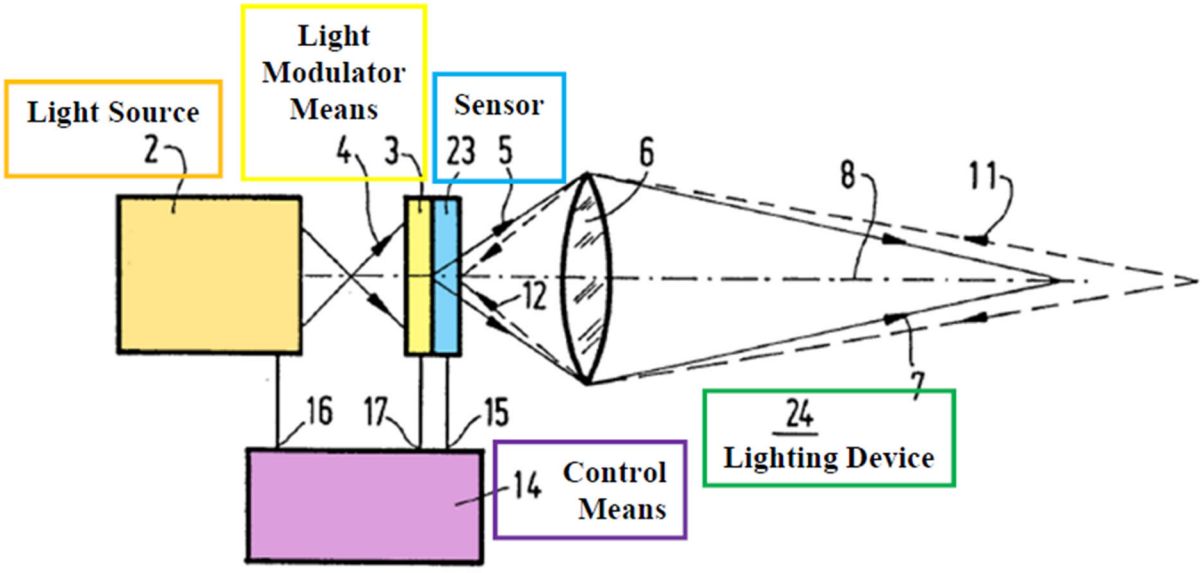
760. Karlsson's processor "determine[s] a light distribution pattern." *Supra* Section XVI.B.9.

761. Further, Karlsson discloses the first subsection (shaded area) is illuminated "below a predefined threshold" (below a predefined *dipped beam* threshold) and the second subsection (non-shaded area) is illuminated "above the

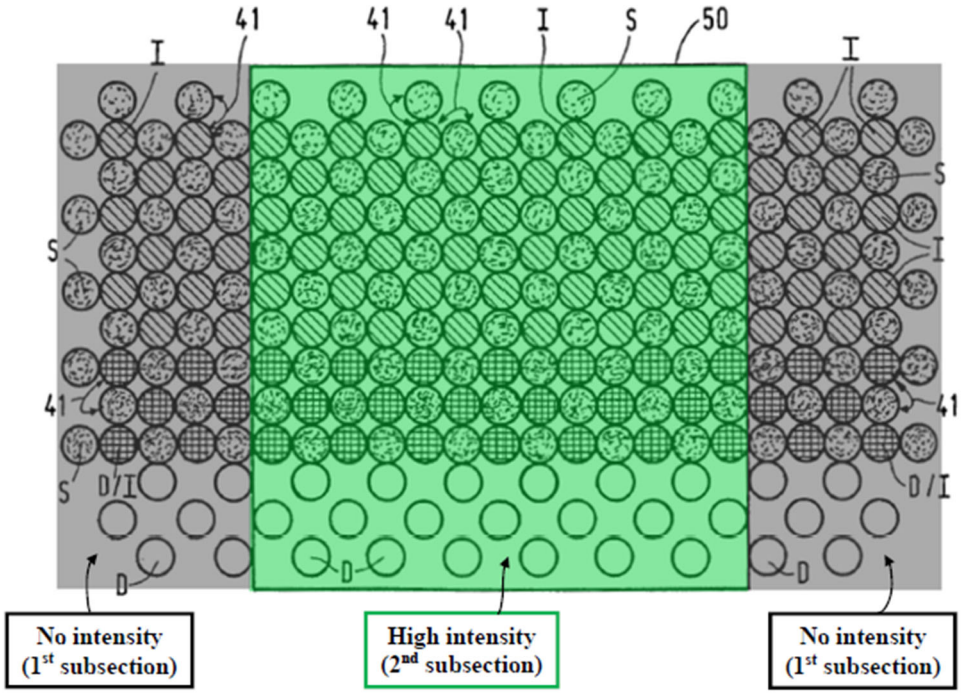
predefined threshold" (above a predefined *dipped beam* threshold). *Supra* Sections XVI.A/XVI.C.1/XVI.C.2.

762. Karlsson's illumination in shaded areas (first subsection) is "*no light at all* or *light having a low intensity*" and "*part of the light beam*…which might cause *inconvenience to oncoming traffic* is automatically *suppressed*." EX1010, 9:18-26, 2:7-9, FIGS. 3, 14-15; EX1010, 19:24-25, 5:28-32, 14:26-30, 9:9-17, 5:16-23, 20:12-32, 21:36-22:4. Karlsson's illumination in non-shaded areas (second subsection) is "*higher* than that of conventional *dipped* headlights" and "light beam 7…*optimally adapted* to the road and to the ambient light." EX1010, 9:18-26, Abstract, FIGS. 3, 14-15; EX1010, 19:26-27, 19:29-33, 2:7-9, 14:26-30, 5:16-32, 9:9-17.

763. Thus, Karlsson's light distribution pattern illuminates a first subsection "below the predefined threshold" and illuminates a second subsection "above the predefined threshold." EX1010, 2:4-9, 9:9-17, 12:19-24, 20:12-15, FIGS. 14-15.




EX1010, FIG. 3 (annotated).




EX1010, FIG. 14 (annotated).

764. In view of the above, Karlsson discloses or renders obvious this claim.

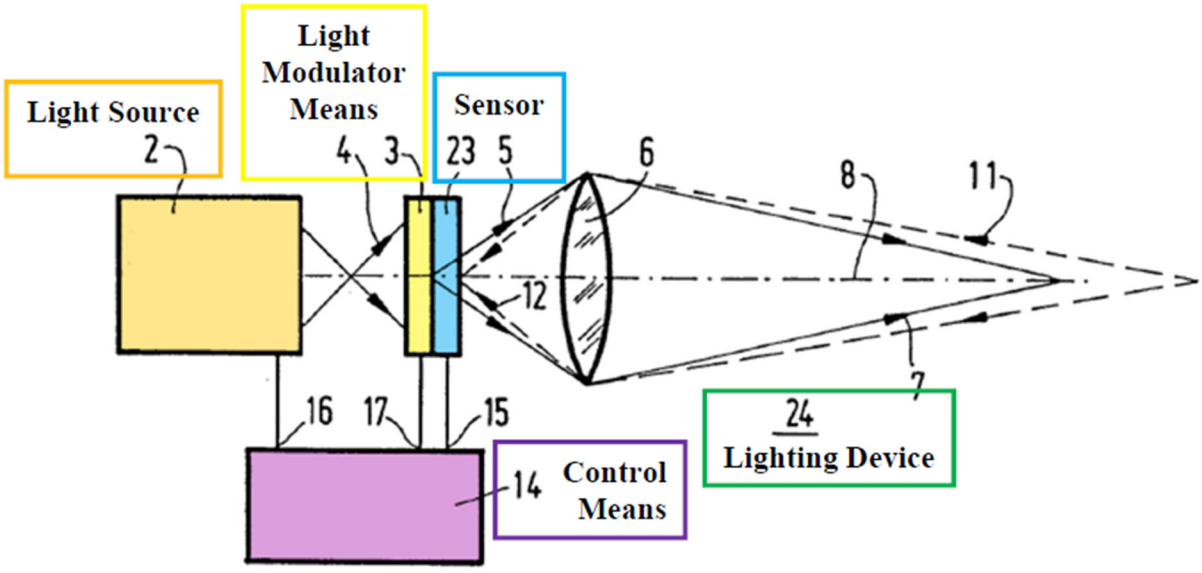
**T. Claim 51: "The headlight system of claim 37, where the illumination created by the headlight beam results in illumination**

**both providing a driver of the first vehicle with preserved illumination in the one or more second subsections and mitigating glare projected to reach the eyes of a driver of the second vehicle."**

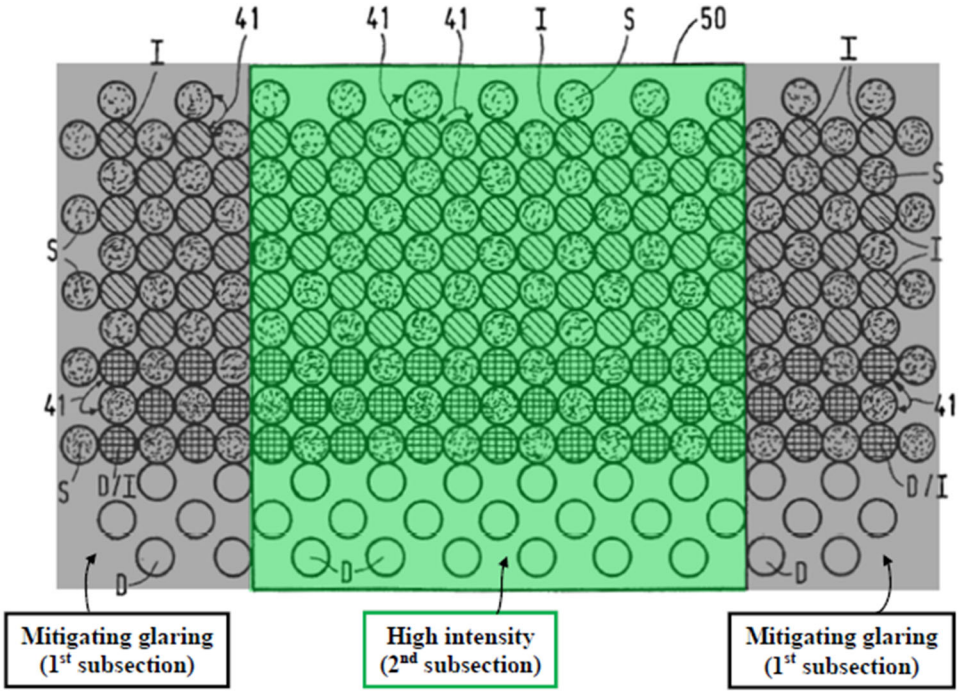
765. Karlsson discloses "light beam 7…*optimally adapted* to the road and to the ambient light" and "permitting a light intensity which is generally *higher than that of conventional dipped headlights*." EX1010, 9:18-26, Abstract, FIGS. 3, 14-15; EX1010, 19:26-27 ("*main-beam light function*"), 19:29-33 ("*emitted light beam 50*"), 2:7-9 ("*part of the light beam*…is automatically suppressed, whilst *retaining an optimum lighting* effect"), 14:26-30, 5:16-32, 9:9-17.

766. Karlsson also 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; EX1010, 19:24-25 ("*dipped light function*"), 2:7-9 ("*part of the light beam*…which might cause *inconvenience to oncoming traffic* is automatically *suppressed*"), 5:28-32 ("precise adjustment…so as *not to emit light* in the direction of the detected light"), 14:26-30, 9:9-17, 5:16-23, 20:12-32, 21:36-22:4.

767. Thus, Karlsson's light distribution pattern dims a first subsection to "mitigat[e] glare" and illuminates a second subsection to provide "preserved illumination." EX1010, 2:4-9, 9:9-17, 12:19-24, 20:12-15, FIGS. 3, 14-15.




EX1010, FIG. 3 (annotated).



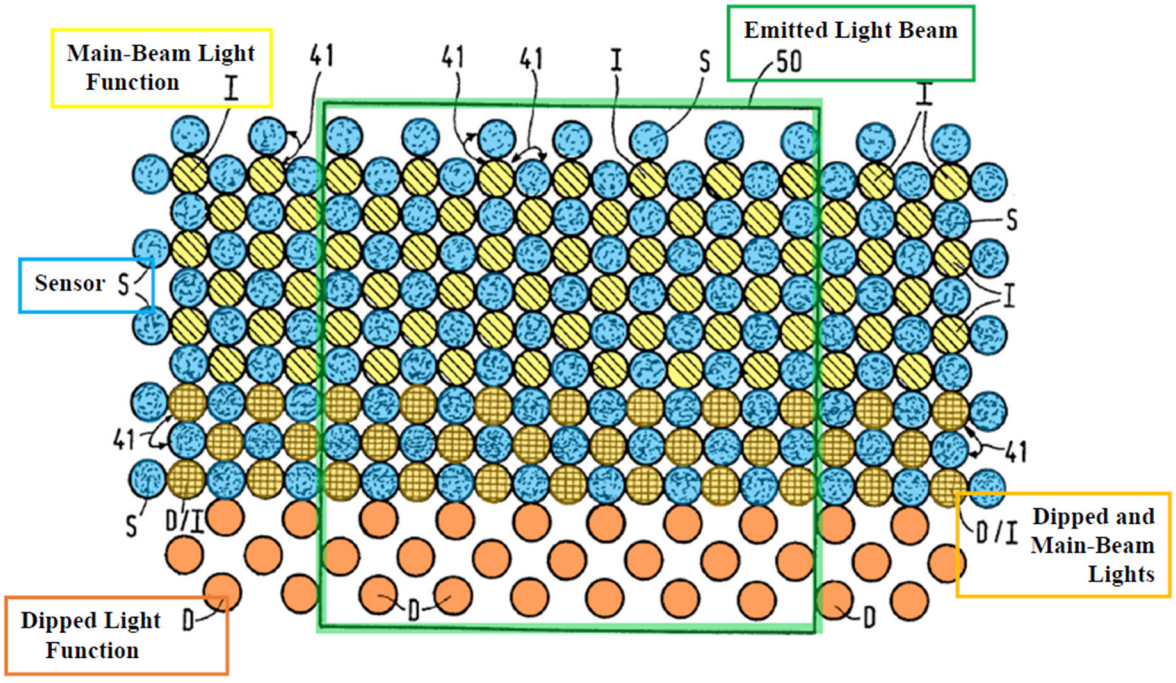

EX1010, FIG. 14 (annotated).

768. In view of the above, Karlsson discloses this claim.

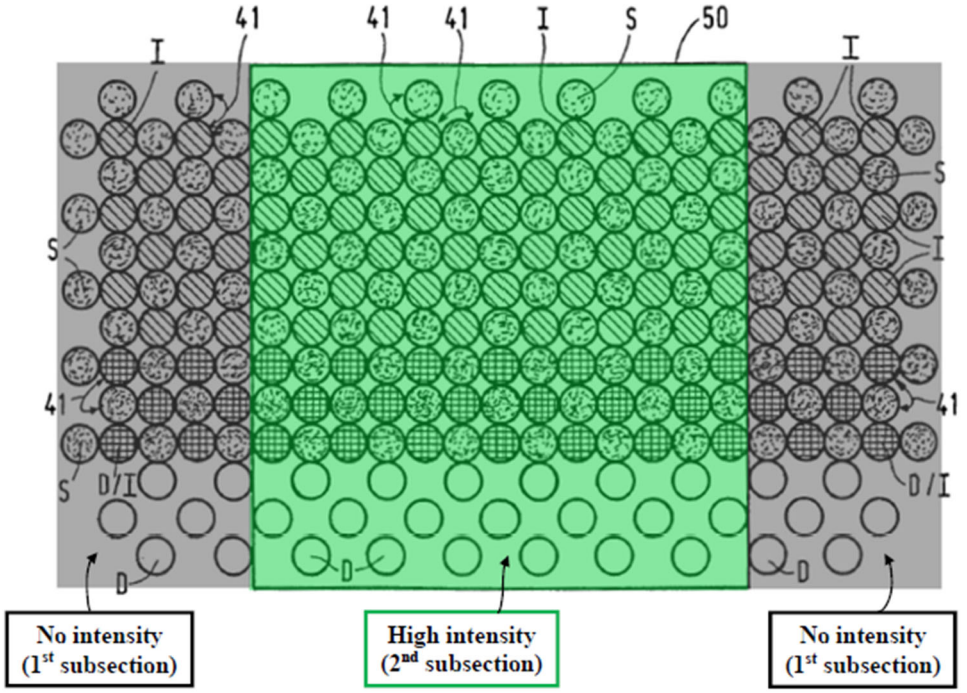
**U. Claim 52: "The headlight system of claim 37, wherein the adapted headlight beam continues to provide high-beam illumination in the**

**one or more second of the subsections without diminishing a range of the high-beam illumination."**

769. Karlsson's illumination in non-shaded areas is "*higher* than that of *conventional dipped headlights*" and "light beam 7…[is] *optimally adapted* to the road and to the ambient light." EX1010, 9:18-26, Abstract, FIGS. 3, 14-15; EX1010, 2:7-9 ("*part of the light beam*…is automatically suppressed, whilst *retaining an optimum lighting* effect"), 19:26-27 ("*main-beam light function*"), 19:29-33 ("*emitted light beam 50*"), 1:27-30 ("*high beams* or *main-beams*"), 14:26-30, 5:16-32, 9:9-17; *see supra* Section XVI.L. This "provide[s] high-beam illumination" in the second subsection "without diminishing a range of the high-beam illumination."




EX1010, FIG. 14 (annotated).




EX1010, FIG. 14 (annotated).

770. In view of the above, Karlsson discloses this claim.

771. Thus, Karlsson, alone or in combination with Harbers, discloses or renders obvious claims 1-5, 7-8, 10-14, 18-19, 37-45, 47-48, 50-53, and 57-58 of the '503 patent.

## XVII. GROUND 8: THE COMBINATION OF KARLSSON, HARBERS, AND GOTOU RENDERS OBVIOUS CLAIMS 9, 15-17, 49, AND 54-56.

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

772. As described in Section XVI.A, a POSA would have been motivated to combine Karlsson-Harbers. A POSA would have been further motivated to modify Karlsson-Harbers to adjust light based on sensed data, such as map data from a GPS sensor (including road curvature/planned upcoming turns), as in

Gotou, to further control Karlsson-Harbers's system to illuminate curves/turns, thereby improving driver safety—an express purpose of Karlsson. EX1010, 1:16-26, 4:17-21, 9:18-26.

773. Although live data could be used by vehicle sensors, it was well known that GPS navigation system gave additional advantages by providing more accurate information on driving regions. EX1026, 461-462 ("To obtain more accurate information on driving regions, it is advantageous to use data from a GPS navigation system.")

774. Further, conventional headlamps, with static high and low beams did not respond to changing driving conditions, and multiple beams were needed to provide "bending beams" for different types of road curvatures ("high speed," "middle speed," "low speed," "cross-roads"). EX1026, 451-452.

775. 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. EX1010, 1:21-26, 1:35-2:1, 9:18-26, 20:22-32; EX1012, 1:17-20, 2:19-26, 6:40-44.

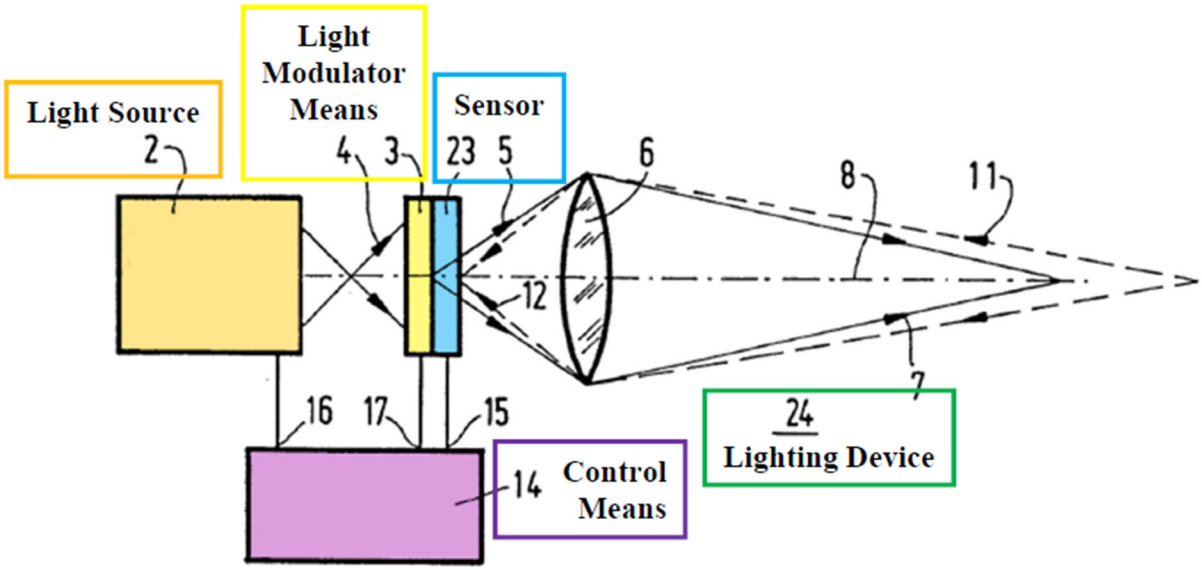
776. *First*, including an additional data source for Karlsson-Harbers's controller—Gotou's *known technique* of using GPS data—would have enhanced Karlsson-Harbers by increasing/adjusting illumination based on a road curvature/planned upcoming turn, improving driver safety by providing light to

where it is needed. *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. 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/planned upcoming turn, further improving and safety.

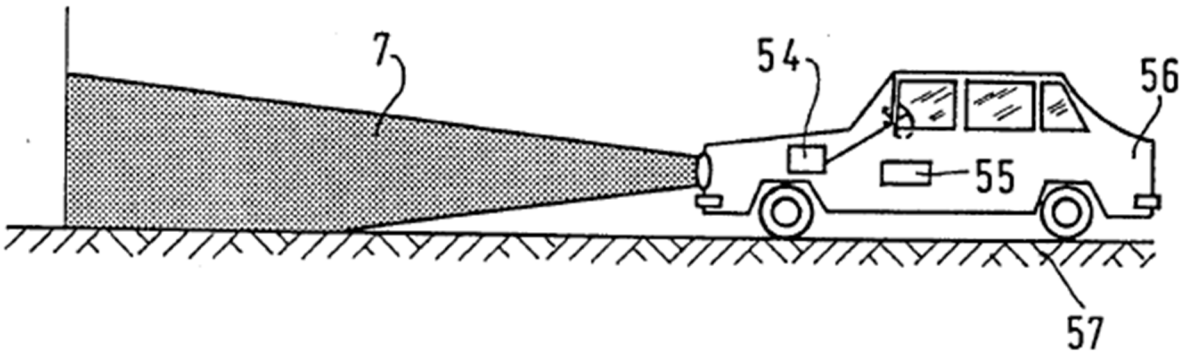
777. Indeed, Karlsson's technique and system of controlling individual spotlight beams emphasize safety of all drivers. EX1010, 1:16-26, 4:17-21, 9:18-26. Controllable headlamps "significantly increase the driving comfort and the road safety," and that "glaring or blinding of oncoming traffic is effectively 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. EX1010, 1:21-26.

778. Karlsson's system "*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. 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. EX1010, 1:35-2:1; 20:22-32, FIG. 16; EX1010, 6:26-33, 9:22-26.



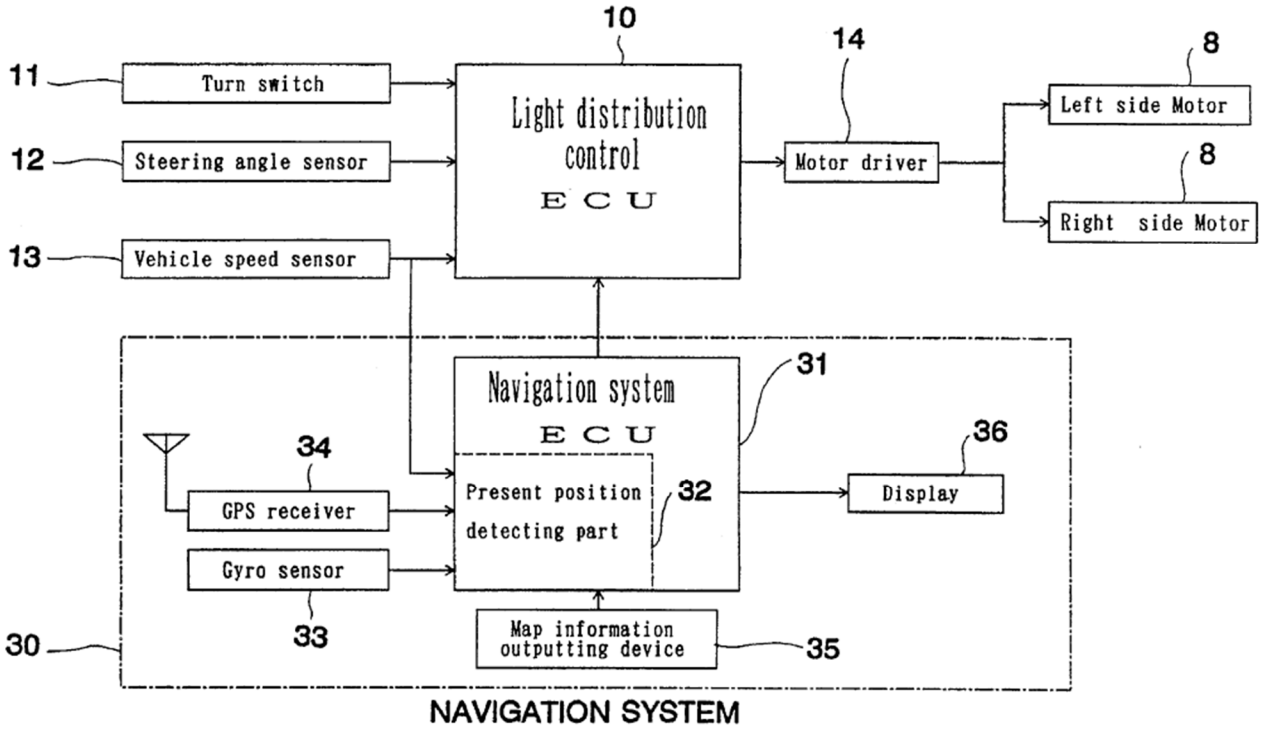

EX1010, FIG. 3 (annotated).




EX1010, FIG. 16.

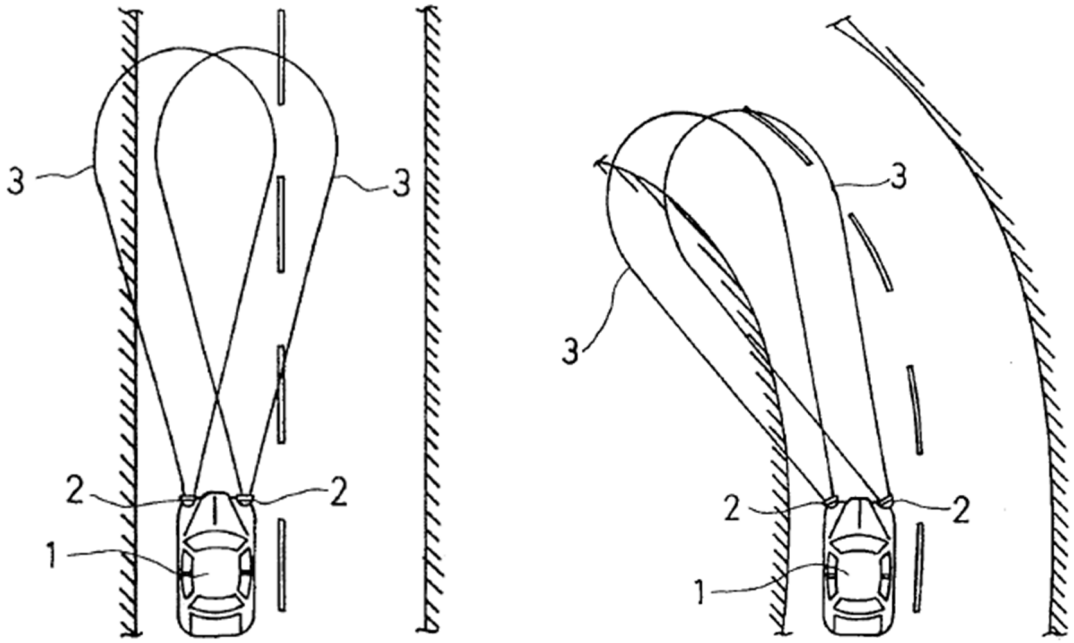
779. Gotou's active *techniques and system components*, like Karlsson-Harbers, seek to enhance driver safety—using GPS sensor data-based control to control light direction. EX1012, 1:17-20, 2:19-26, 6:40-44. Gotou's navigation

system 30 data is input to ECU 10, which alters the light direction from headlamp 2 in response to GPS data, 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. EX1012, 1:52-59, 2:19-26, 6:40-44, 8:28-35.




EX1012, FIG. 3.

780. Gotou's Figures 8 and 9 show that illumination control is planned and controlled for curves/turns. When there is a planned leftward curve, for example, the light distribution is adjusted leftward prior to reaching the curve. EX1012, 3:24-55, 7:32-43, 8:28-35, FIGS. 8-9.




EX1012, FIGS. 8-9.

781. A POSA would have understood that including an additional data source for Karlsson-Harbers's controller/processor—Gotou's GPS sensor data—would have enhanced Karlsson-Harbers by increasing/adjusting illumination of a road curvature/upcoming turn, thereby improving safety. This would have merely been applying Gotou's known technique (GPS input to direct/redirect light) to Karlsson-Harbers's similar, known device (dynamic headlamp system with controllable spotlight beams), in the same way. 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.

782. 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 GPS data) according to known methods (disclosed in Karlsson-Harbers and Gotou) to yield predictable results (illuminating a road curvature/upcoming turn, improving safety).

783. 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 GPS data (including road curvature/turns). 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).

784. Such modifications 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. In applying Gotou's technique to Karlsson-Harbers, a POSA would have simply been applying a known technique in a predictable way—controlling headlights in

part based on GPS data (including road curvature/planned upcoming turns)—as already disclosed in the art. And in combining Karlsson-Harbers with Gotou's navigation system 30 (e.g., revising control input/ouput on an ECU), a POSA would have simply been combining known elements according to known methods (disclosed by Gotou) to yield predictable results (additional light control).

785. I lay out below the specific disclosures of Karlsson-Harbers and Gotou, and expand on this combination and reasonable expectation of success analysis below.

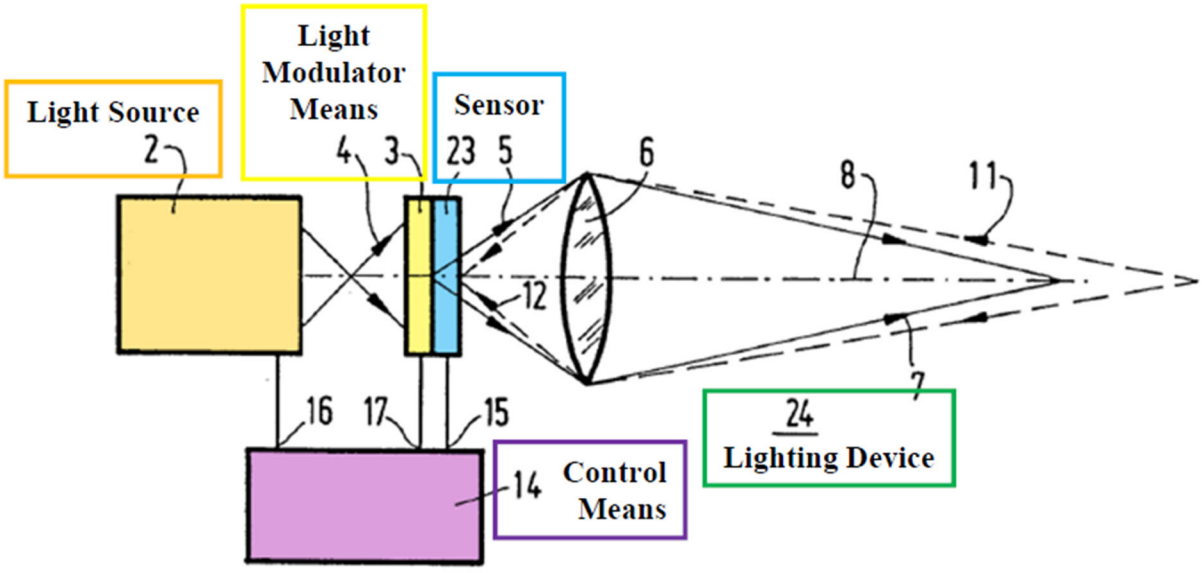
### B. Claim 9: "The headlight system of claim 1, wherein the one or more sensors includes a GPS sensor."

### Claim 49: "The headlight system of claim 37, wherein the one or more sensors further includes a GPS sensor."

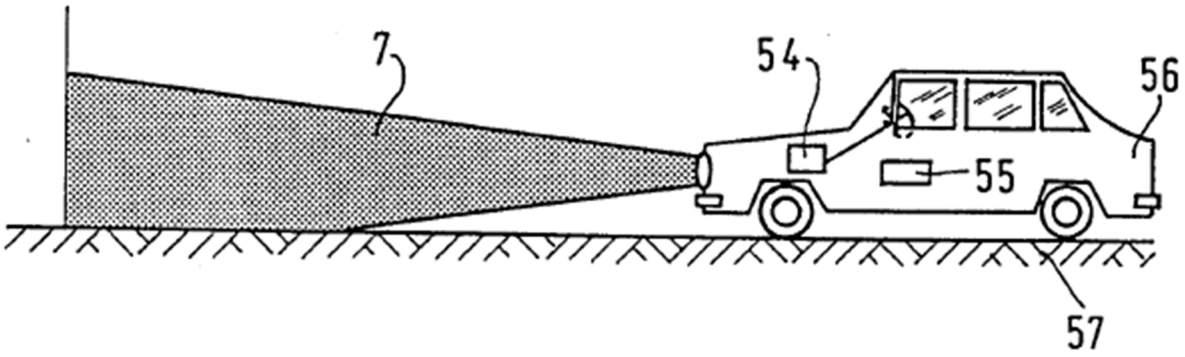
786. In my opinion, there is no patentable difference between the language of claim 49 and claim 9 as shown above. *See also* Appendix A. The same disclosures below address each feature.

#### 1. Karlsson-Harbers's disclosure

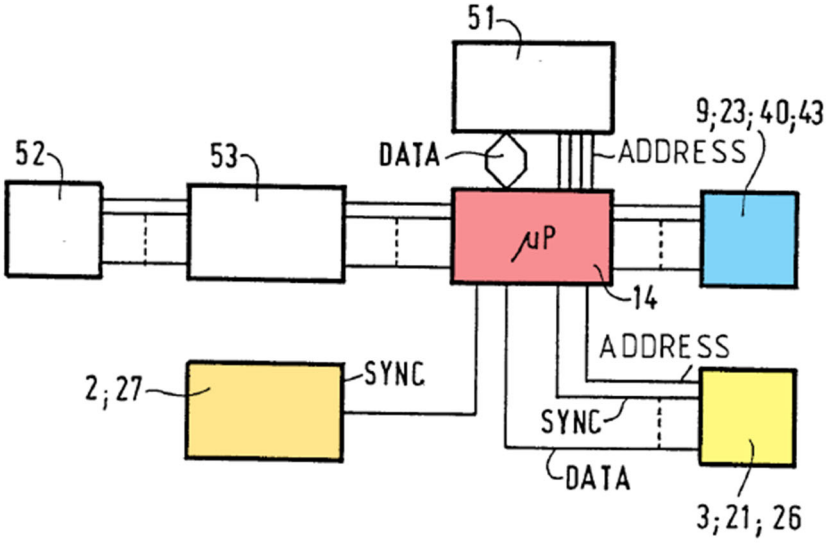
787. Karlsson's "light-sensitive sensor…detects…the area *ahead of a vehicle*" and "*direction sensor 54*…determin[es] when the car 56 is *taking a bend*, so that the light beam 7 can be *adapted*." EX1010, 2:2-4, 20:29-32, FIGS. 3, 14-16; EX1010, 6:26-33 ("headlights are incorrectly adjusted"), 9:9-17 ("incident light 11…is *processed* by the control means 14…to control…*light beam 7*"), 1:35-2:4.




EX1010, FIG. 3 (annotated).




EX1010, FIG. 16.

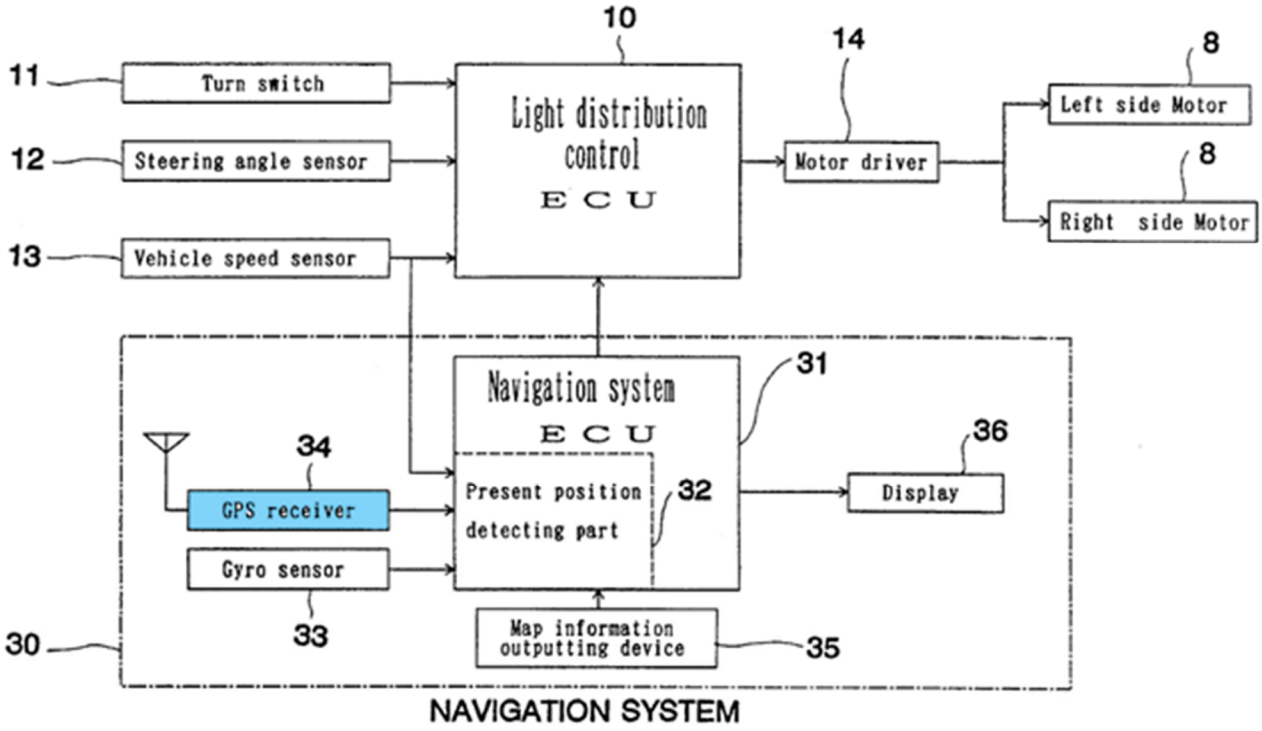



EX1010, FIG. 15 (annotated).

788. Karlsson-Harbers does not disclose a GPS sensor, but this feature was well known in the prior art, e.g., as explicitly disclosed by Gotou. *See also* EX1024, 815-816 ("digital *GPS information* on actual road curvature, information on distance of preceding or following vehicles etc"); EX1026, 461-462 ("[t]o obtain more accurate information on driving regions, it is advantageous to use data from a *GPS navigation system*").

**2. Gotou's disclosure**

789. Gotou's "*GPS receiver 34*" is connected to navigation system ECU 31 to detect an accurate position of the vehicle. EX1012, 4:1-11, FIGS. 3, 8-10; EX1012, 6:40-44 ("*improves the visibility*"), 3:52-64, 8:28-35.




EX1012, FIG. 3 (annotated).

790. As discussed, a POSA would have been motivated to combine Gotou with Karlsson-Harbers with a reasonable expectation of success. *Supra* Section XVII.A.

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

791. As described in Section XVI.A, a POSA would have been motivated to combine Karlsson-Harbers. A POSA would have been further motivated to modify Karlsson-Harbers to adjust light based on sensed data, such as map data from a GPS sensor (including road curvature/planned upcoming turns), as in Gotou, to further control Karlsson-Harbers's system to illuminate curves/turns,

thereby improving driver safety—an express purpose of Karlsson. EX1010, 1:16-26, 4:17-21, 9:18-26.

792. Although live data could be used by vehicle sensors, it was well known that GPS navigation system gave additional advantages by providing more accurate information on driving regions. EX1026, 461-462 ("To obtain more accurate information on driving regions, it is advantageous to use data from a GPS navigation system.")

793. Further, conventional headlamps, with static high and low beams did not respond to changing driving conditions, and multiple beams were needed to provide "bending beams" for different types of road curvatures ("high speed," "middle speed," "low speed," "cross-roads"). EX1026, 451-452.

794. 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. EX1010, 1:21-26, 1:35-2:1, 9:18-26, 20:22-32; EX1012, 1:17-20, 2:19-26, 6:40-44.

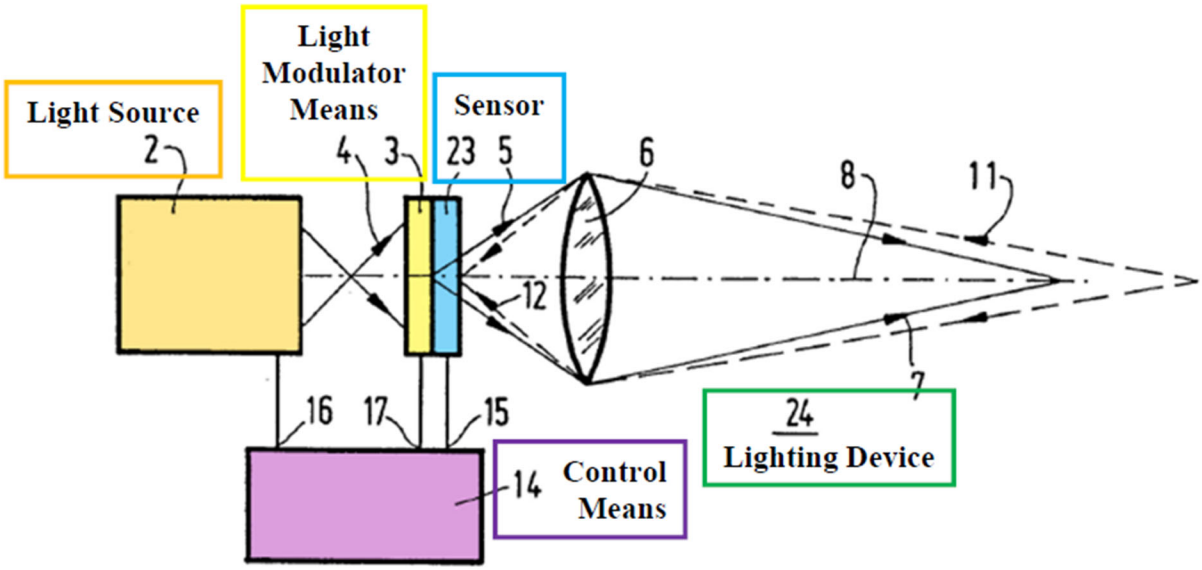
795. *First*, including an additional data source for Karlsson-Harbers's controller—Gotou's *known technique* of using GPS data—would have enhanced Karlsson-Harbers by increasing/adjusting illumination based on a road curvature/planned upcoming turn, improving driver safety by providing light to where it is needed. *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. 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/planned upcoming turn, further improving and safety.

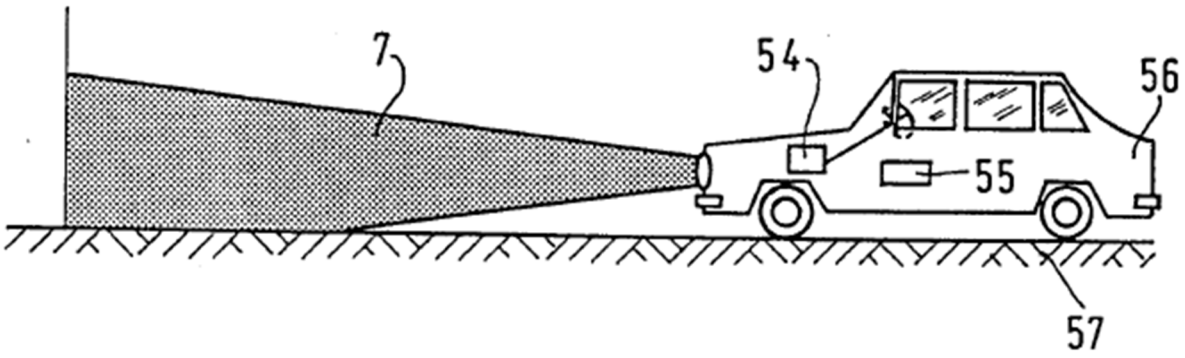
796. Indeed, Karlsson's technique and system of controlling individual spotlight beams emphasize safety of all drivers. EX1010, 1:16-26, 4:17-21, 9:18-26. Controllable headlamps "significantly increase the driving comfort and the road safety," and that "glaring or blinding of oncoming traffic is effectively 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. EX1010, 1:21-26.

797. Karlsson's system "*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. 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. EX1010, 1:35-2:1; 20:22-32, FIG. 16; EX1010, 6:26-33, 9:22-26.



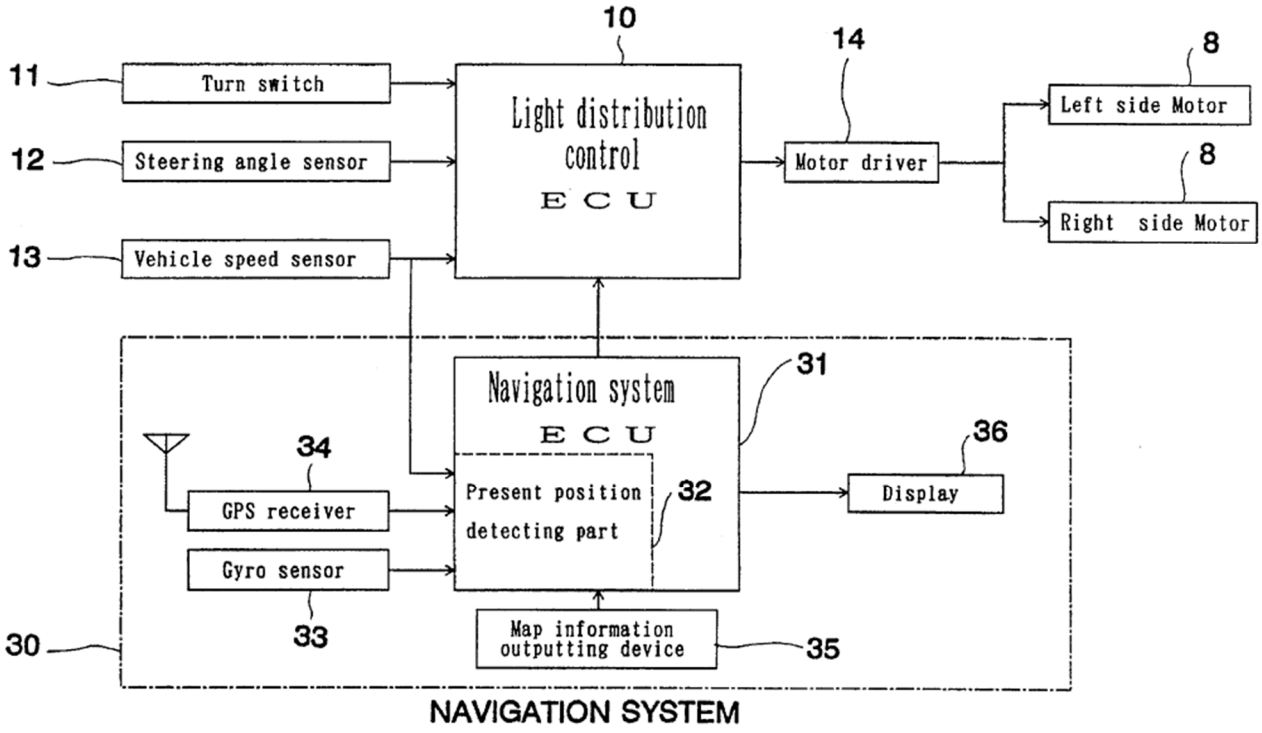

EX1010, FIG. 3 (annotated).




EX1010, FIG. 16.

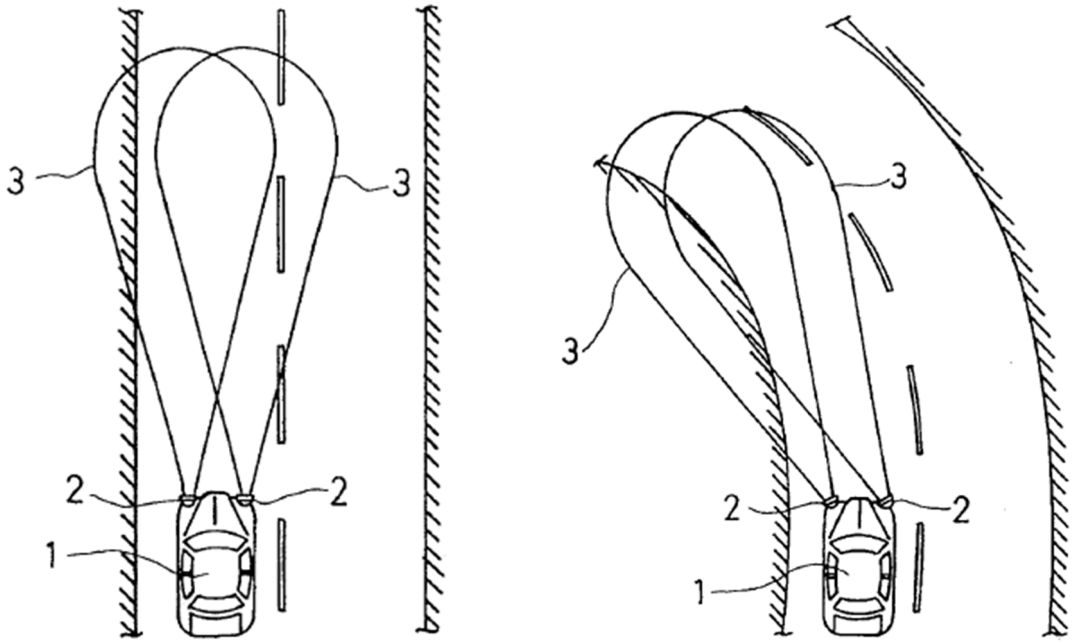
798. Gotou's active *techniques and system components*, like Karlsson-Harbers, seek to enhance driver safety—using GPS sensor data-based control to control light direction. EX1012, 1:17-20, 2:19-26, 6:40-44. Gotou's navigation

system 30 (including *GPS receiver 34*) data is input to ECU 10, which alters the light direction from headlamp 2 in response to GPS data, 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. EX1012, 1:52-59, 2:19-26, 6:40-44, 8:28-35.




EX1012, FIG. 3.

799. Gotou's Figures 8 and 9 show that illumination control is planned and controlled for curves/turns. When there is a planned leftward curve, for example, the light distribution is adjusted leftward prior to reaching the curve. EX1012, 3:24-55, 7:32-43, 8:28-35, FIGS. 8-9.




EX1012, FIGS. 8-9.

800. A POSA would have understood that including an additional data source for Karlsson-Harbers's controller/processor—Gotou's GPS sensor data—would have enhanced Karlsson-Harbers by increasing/adjusting illumination of a road curvature/upcoming turn, thereby improving safety. This would have merely been applying Gotou's known technique (GPS input to direct/redirect light) to Karlsson-Harbers's similar, known device (dynamic headlamp system with controllable spotlight beams), in the same way. 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.

801. 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 GPS data) according to known methods (disclosed in Karlsson-Harbers and Gotou) to yield predictable results (illuminating a road curvature/upcoming turn, improving safety).

802. 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 GPS data (including road curvature/turns). 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).

803. Such modifications 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. In applying Gotou's technique to Karlsson-Harbers, a POSA would have simply been applying a known technique in a predictable way—controlling headlights in

part based on GPS data (including road curvature/planned upcoming turns)—as already disclosed in the art. And in combining Karlsson-Harbers with Gotou's navigation system 30 (e.g., revising control input/ouput on an ECU), a POSA would have simply been combining known elements according to known methods (disclosed by Gotou) to yield predictable results (additional light control).

804. In view of the above, Karlsson (with Harbers) in combination with Gotou renders obvious these claims.

### C. Claim 15: "The system of claim 1, wherein the logical controller is further configured to determine at least a road curvature, indicated by the sensor data, ahead of the vehicle and wherein the required illumination includes increasing illumination in a direction of the road curvature."

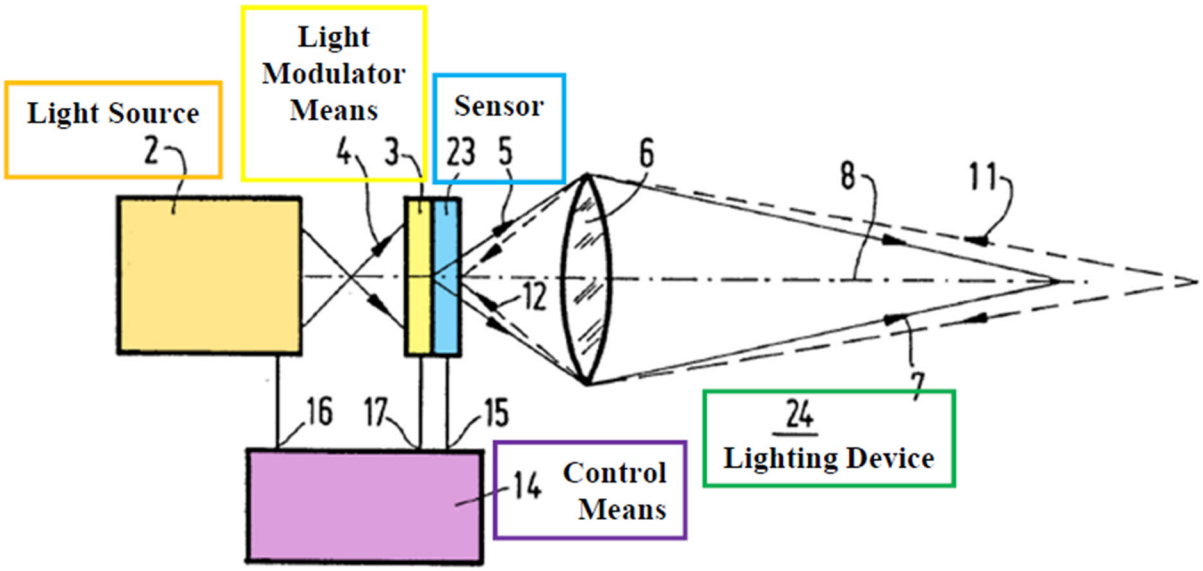
**Claim 54: "The headlight system of claim 37, wherein at least one of the at least one processors is further configured to determine at least a road curvature, indicated by the sensor data, ahead of the first vehicle and to determine a second illumination pattern defining increased illumination in a direction of the road curvature."**

805. In my opinion, there is no patentable difference between the language of claim 54 and claim 15 as shown above. *See also* Appendix A. The same disclosures below address each feature.

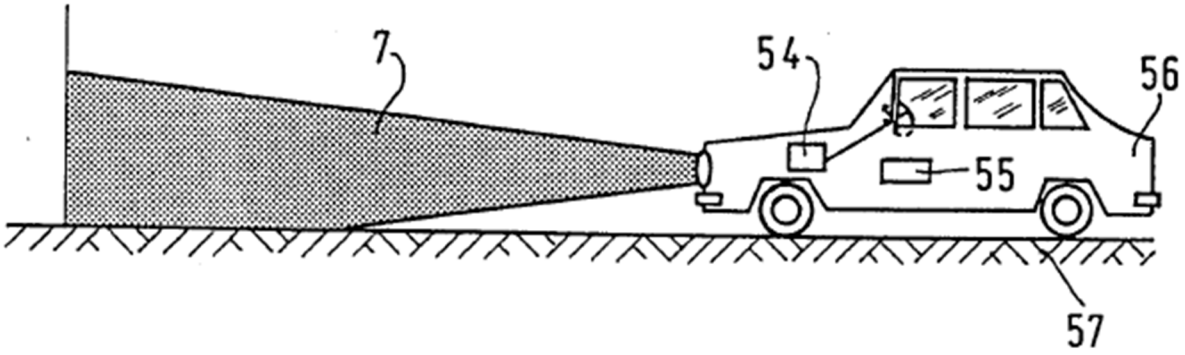
#### 1. Karlsson-Harbers's disclosure

806. Karlsson's "light-sensitive sensor…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; EX1010, 20:29-32 ("*direction sensor*

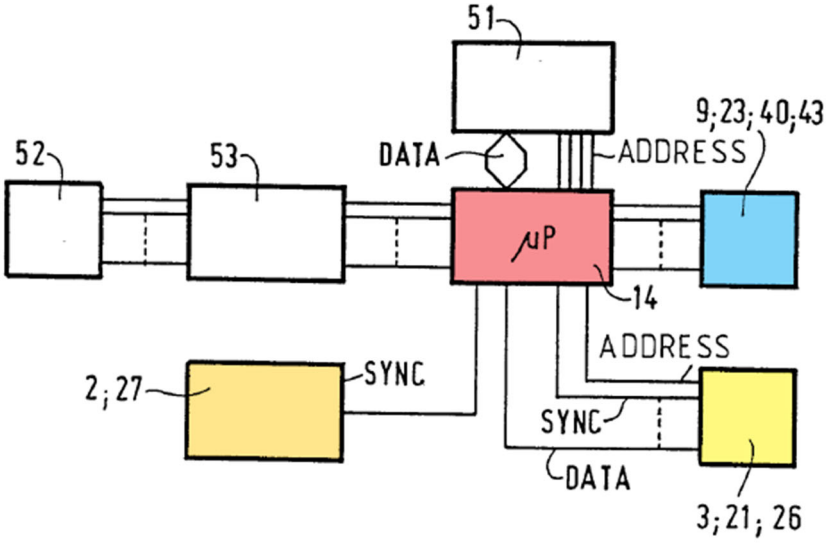
*54*…determin[es] when the car 56 is *taking a bend*, so that the light beam 7 can be adapted"), 9:9-17.




EX1010, FIG. 3 (annotated).

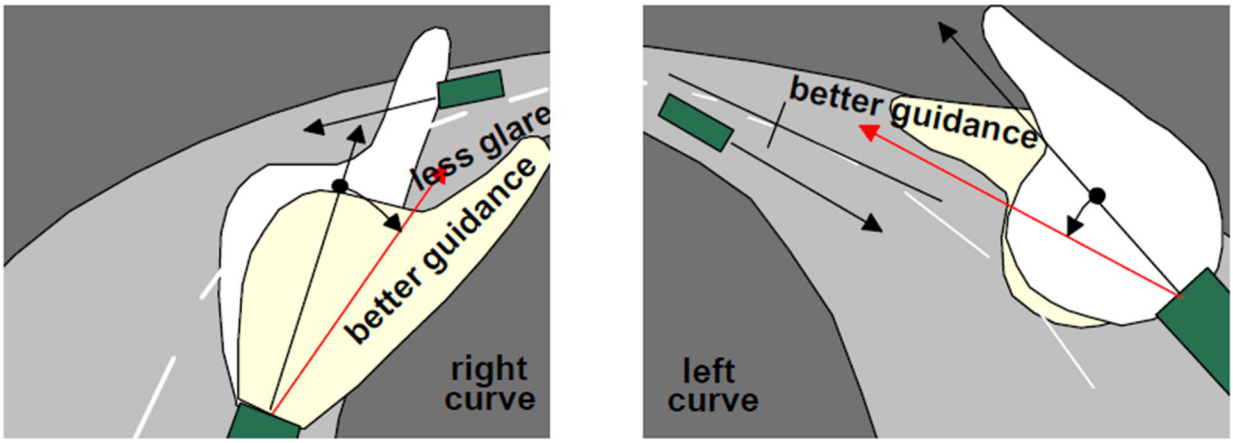



EX1010, FIG. 16.




EX1010, FIG. 15 (annotated).

807. Karlsson/Karlsson-Harbers does not disclose determining a road curvature and increasing illumination in a direction of the road curvature, but this feature was well known in the prior art, e.g., as explicitly disclosed by Gotou. *See also* EX1015, 18 ("glare reduction and visibility improvement in curves"), FIG. 2.8; EX1017, 5, 8 ("in a narrow bend a special curve illumination makes pedestrians or obstacles visible for the driver which normally will be hidden"), FIGS. 1, 3-5, 7; EX1020, 376 ("curve lighting"), 378 ("turns/crossings lighting"), FIGS. 10-11.




EX1015, FIG. 2.8.

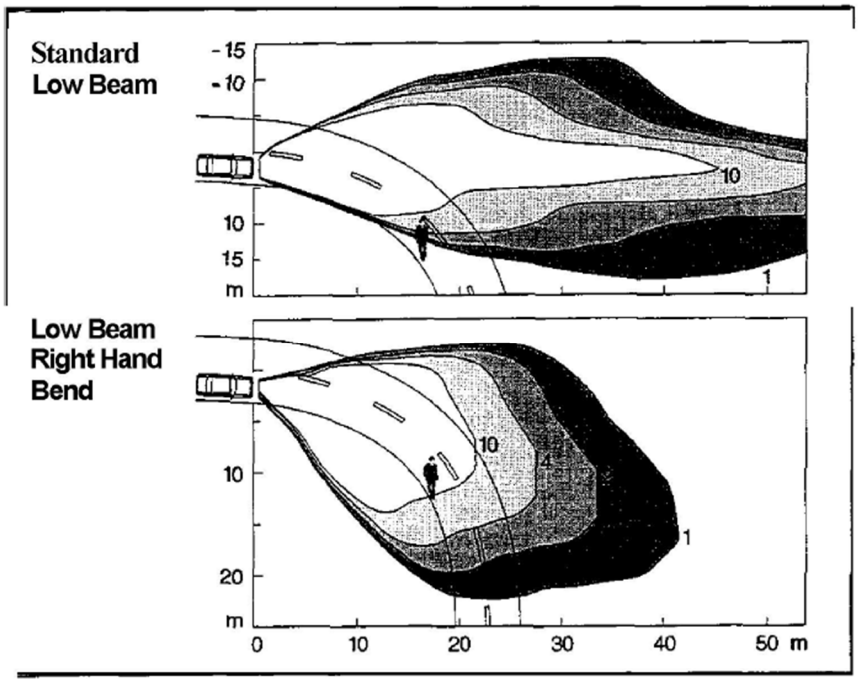



Fig. 7: comparison between basic low beam and right curve illumination, Isolux curves from bird eye's view

EX1017, FIG. 7.

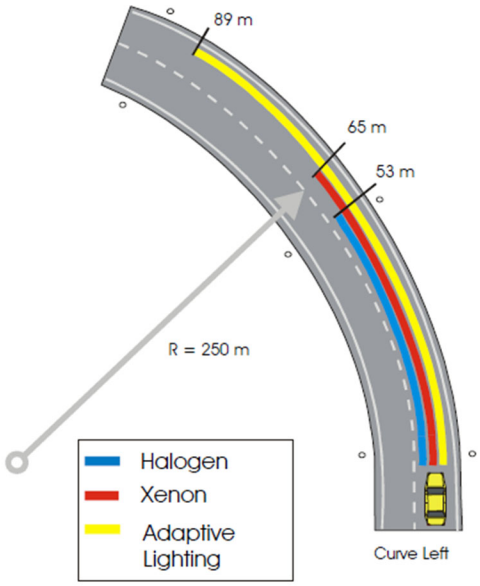


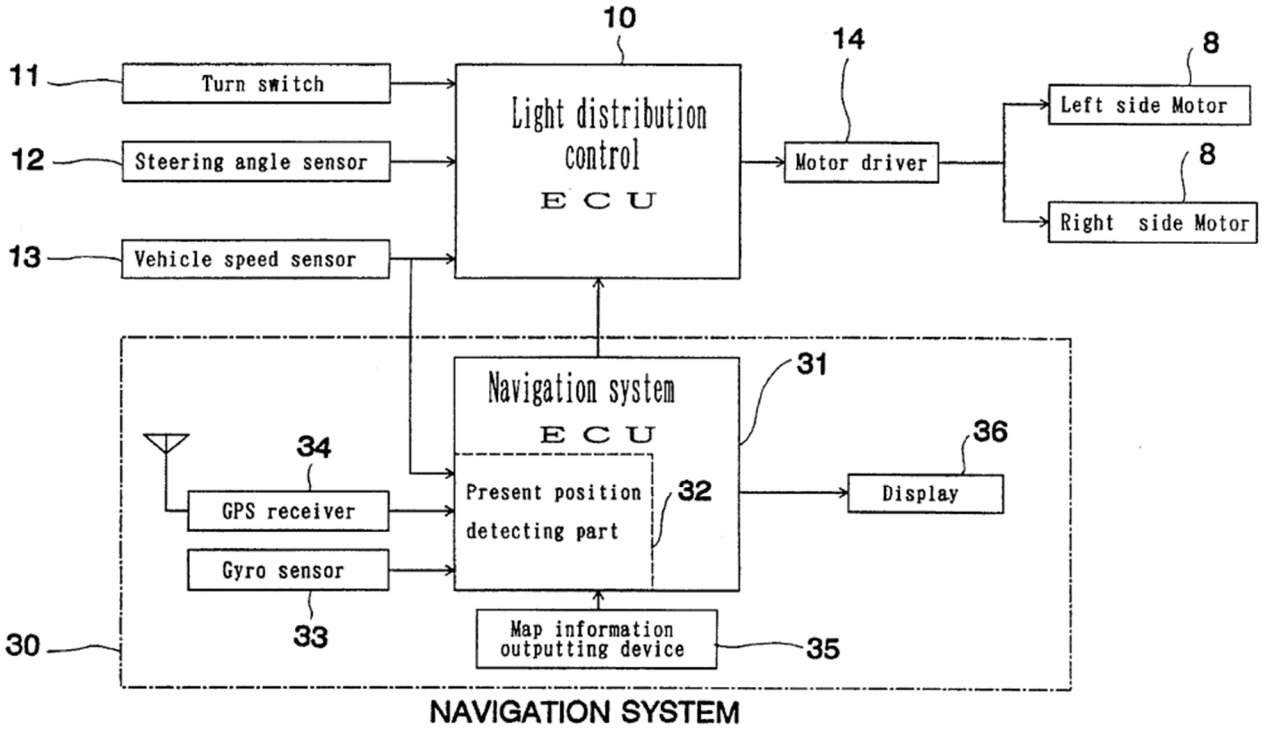

*Figure 10: Static test: Results of the investigations about visibility distances obtained with halogen-, HID- and adaptive headlamps.*

EX1020, FIG. 10.

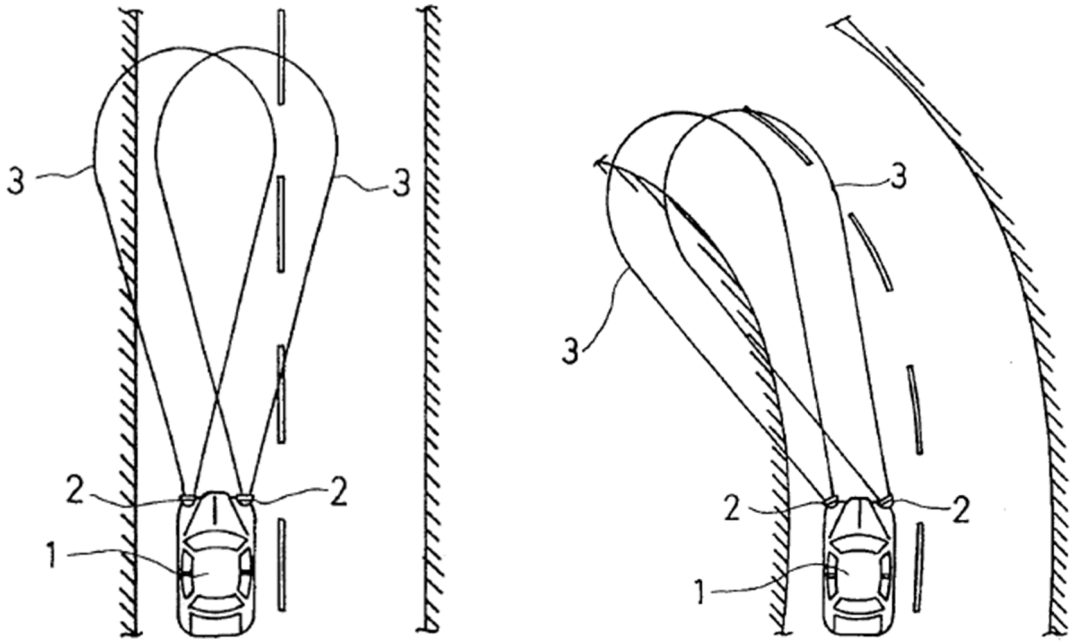
**2. Gotou's disclosure**

808. Gotou's "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," which includes "curves." EX1012, 3:52-64, 8:28-35, FIGS. 3, 8-9; EX1012, 4:30-49 ("*map information*…such as…*directions of the curves*"), 6:28-39 ("*analyz[ing]* whether the *forward curve* is…rightward or leftward").

809. A POSA would have understood that Gotou's system "determine[s] a second illumination pattern" recited in claim 54 because illumination is controlled along the "forward road shape" (e.g., left or right curve). EX1012, 3:52-64, 8:28-35, FIGS. 3, 8-10; EX1012, 4:30-49 ("*directions of the curves*"), 6:28-44 ("*analyz[ing]* whether the *forward curve* is…rightward or leftward").




EX1012, FIG. 3.




EX1012, FIGS. 8-9.

810. As discussed, a POSA would have been motivated to combine Gotou with Karlsson-Harbers with a reasonable expectation of success. *Supra* Section XVII.A.

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

811. As described in Section XVI.A, a POSA would have been motivated to combine Karlsson-Harbers. A POSA would have been further motivated to modify Karlsson-Harbers to adjust light based on sensed data, such as map data from a GPS sensor including road curvature, as in Gotou, to further control Karlsson-Harbers's system to illuminate roadway curves, thereby improving driver safety—an express purpose of Karlsson. EX1010, 1:16-26, 4:17-21, 9:18-26.

812. Although live data could be used by vehicle sensors, it was well known that GPS navigation system gave additional advantages by providing more accurate information on driving regions. EX1026, 461-462 ("To obtain more accurate information on driving regions, it is advantageous to use data from a GPS navigation system.")

813. Further, conventional headlamps, with static high and low beams did not respond to changing driving conditions, and multiple beams were needed to provide "bending beams" for different types of road curvatures ("high speed," "middle speed," "low speed," "cross-roads"). EX1026, 451-452.

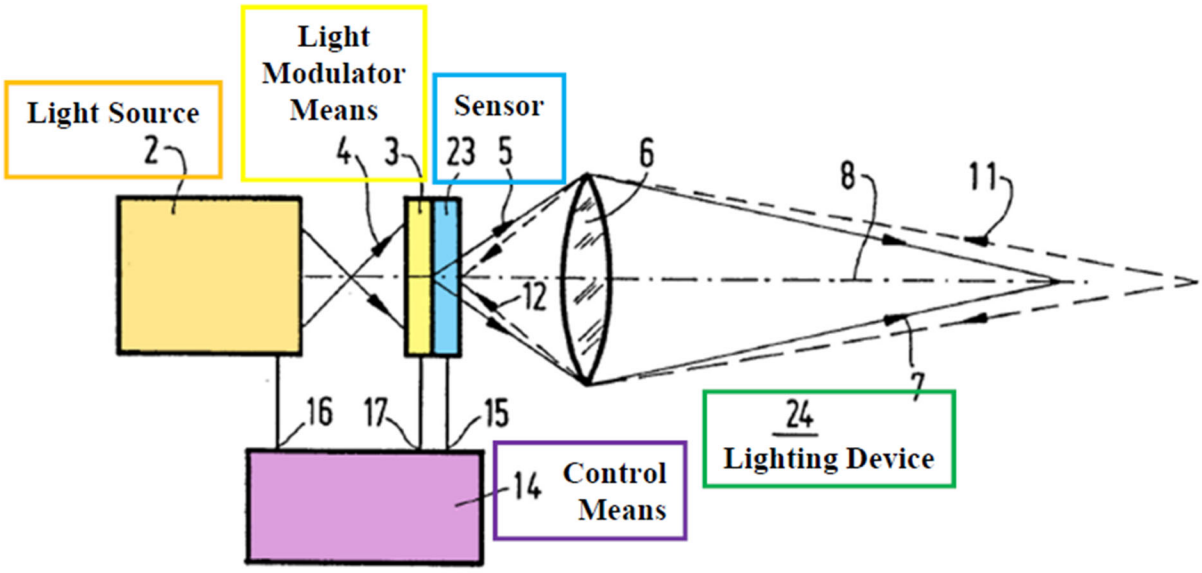
814. Karlsson-Harbers and Gotou are from the same field—controllable headlamps with dynamic illumination—and include the same building blocks (light sources, sensors, controllers). Further, driver safety is paramount. EX1010, 1:21-26, 1:35-2:1, 9:18-26, 20:22-32; EX1012, 1:17-20, 2:19-26, 6:40-44.

815. *First*, including an additional data source for Karlsson-Harbers's controller—Gotou's *known technique* of using GPS data—would have enhanced Karlsson-Harbers by increasing/adjusting illumination based on a road curvature, improving driver safety by providing light to where it is needed. *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. 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 and safety.

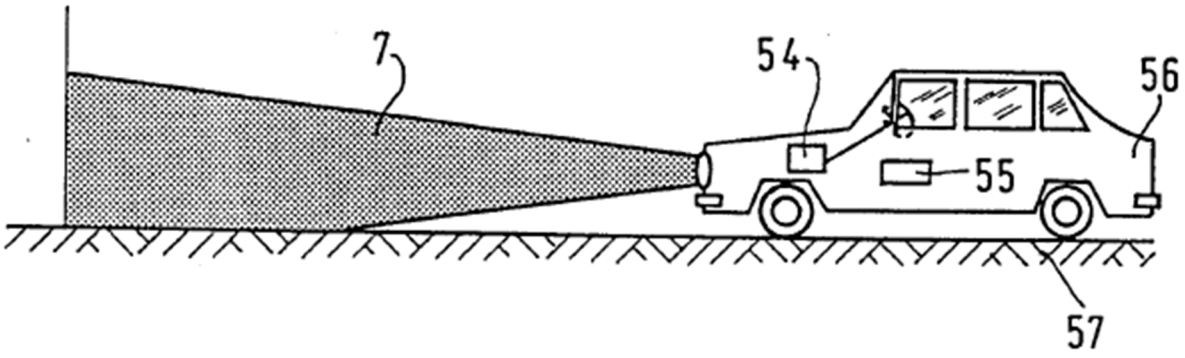
816. Indeed, Karlsson's technique and system of controlling individual spotlight beams emphasize safety of all drivers. EX1010, 1:16-26, 4:17-21, 9:18-26. Controllable headlamps "significantly increase the driving comfort and the road safety," and that "glaring or blinding of oncoming traffic is effectively 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. EX1010, 1:21-26.

817. Karlsson's system "*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. 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. EX1010, 1:35-2:1; 20:22-32, FIG. 16; EX1010, 6:26-33, 9:22-26.

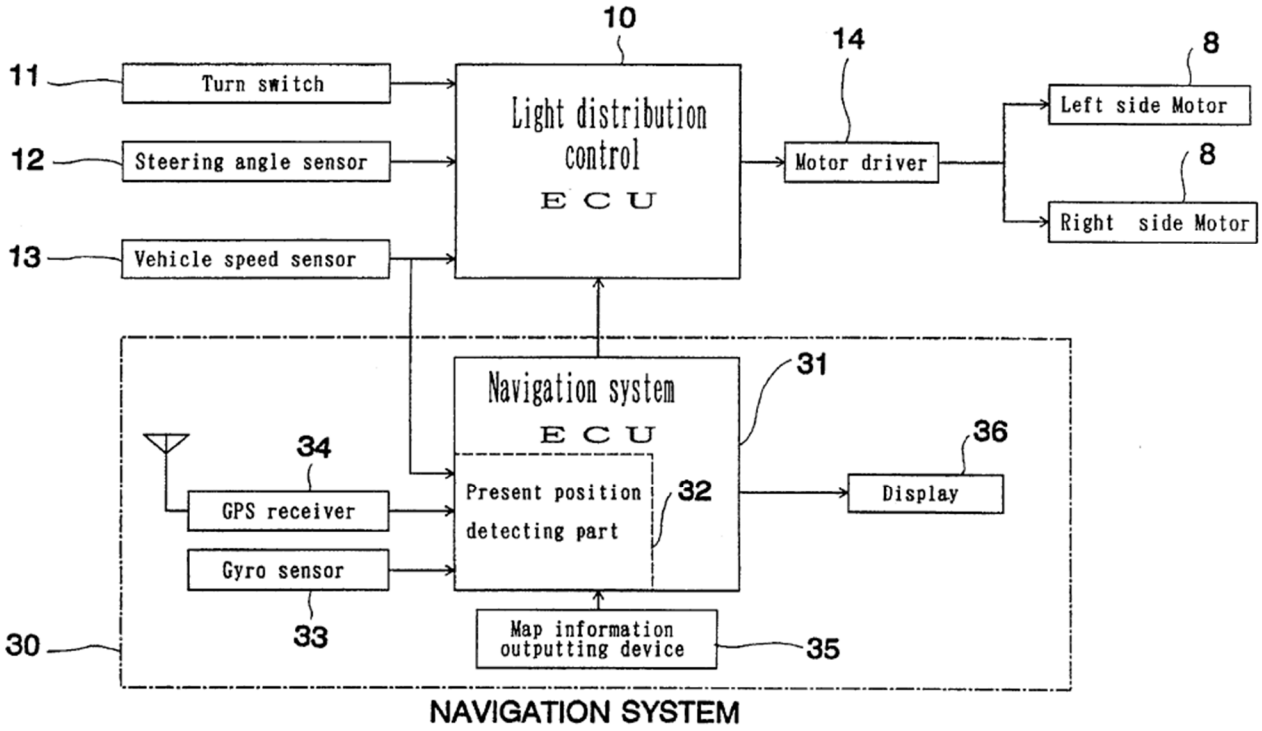



EX1010, FIG. 3 (annotated).



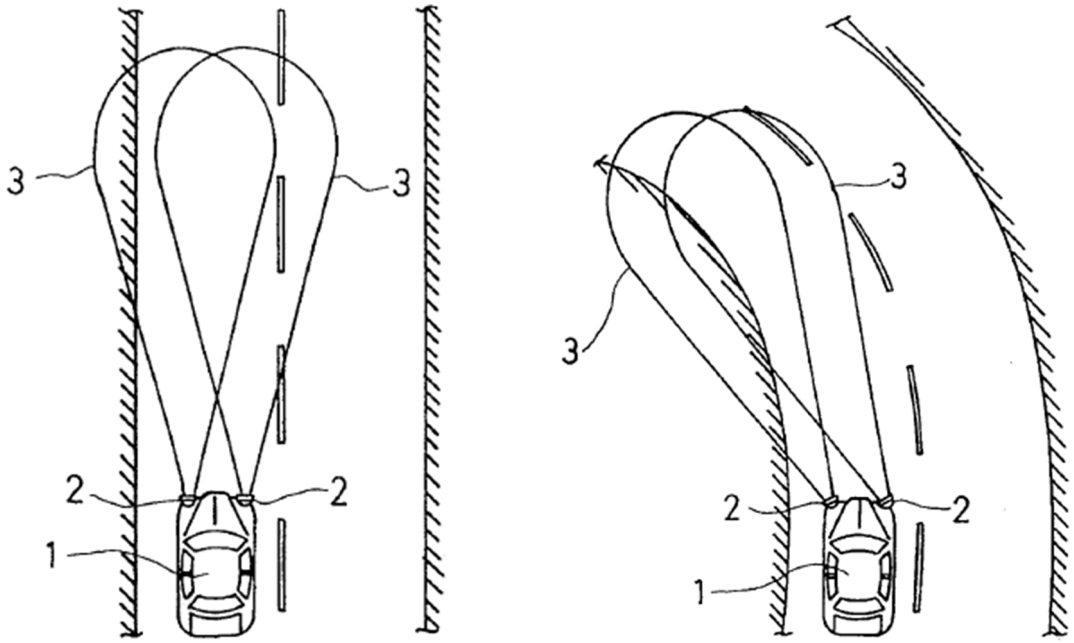

EX1010, FIG. 16.

818. Gotou's active *techniques and system components*, like Karlsson-Harbers, seek to enhance driver safety—using GPS sensor data-based control to control light direction. EX1012, 1:17-20, 2:19-26, 6:40-44. Gotou's navigation system 30 data is input to ECU 10, which alters the light direction from headlamp 2 in response to GPS 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. EX1012, 1:52-59, 2:19-26, 6:40-44, 8:28-35.




EX1012, FIG. 3.

819. Gotou's Figures 8 and 9 show that illumination control is planned and controlled for curves/turns. When there is a leftward curve, for example, the light distribution is adjusted leftward prior to reaching the curve. EX1012, 3:24-55, 7:32-43, 8:28-35, FIGS. 8-9.




EX1012, FIGS. 8-9.

820. A POSA would have understood that including an additional data source for Karlsson-Harbers's controller/processor—Gotou's GPS sensor data—would have enhanced Karlsson-Harbers by increasing/adjusting illumination of a road curvature, thereby improving safety. This would have merely been applying Gotou's known technique (GPS input to direct/redirect light) to Karlsson-Harbers's similar, known device (dynamic headlamp system with controllable spotlight beams), in the same way. 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.

821. 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 GPS data) according to known methods (disclosed in Karlsson-Harbers and Gotou) to yield predictable results (illuminating a road curvature, improving safety).

822. 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 GPS data (including road curvature). 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).

823. Such modifications 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. In applying Gotou's technique to Karlsson-Harbers, a POSA would have simply been applying a known technique in a predictable way—controlling headlights in part based on GPS data (including road curvature)—as already disclosed in the art. And in combining Karlsson-Harbers with Gotou's navigation system 30 (e.g., revising control input/ouput on an ECU), a POSA would have simply been

combining known elements according to known methods (disclosed by Gotou) to yield predictable results (additional light control).

824. In view of the above, Karlsson (with Harbers) in combination with Gotou renders obvious these claims.

**D. Claims 16: "The system of claim 15, wherein the logical controller is further configured to determine at least a planned upcoming turn, indicated by the sensor data, and wherein the required illumination includes increasing illumination illuminating the turn."**

**Claim 17: "The system of claim 1, wherein the logical controller is further configured to determine at least a planned upcoming turn, indicated by the sensor data, and wherein the required illumination includes increasing illumination illuminating the turn."**

**Claim 55: "The headlight system of claim 54, 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 a third illumination pattern defining increased illumination illuminating the turn."**

**Claim 56: "The headlight system of claim 37, 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 a third illumination pattern defining increased illumination illuminating the turn."**

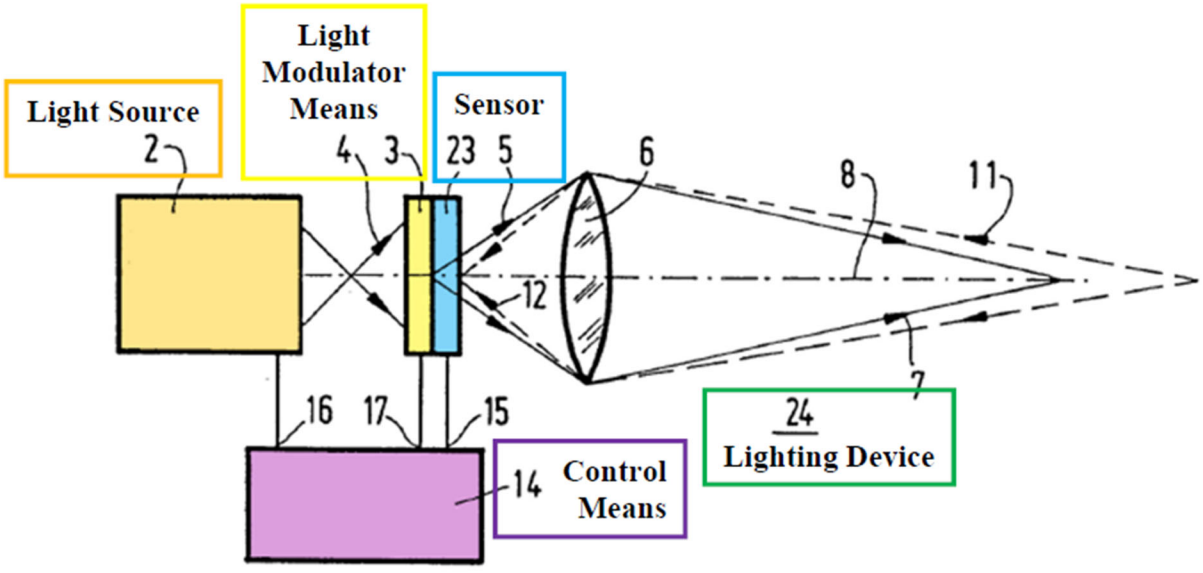
825. The language of claim 17 is identical to the language of claim 16 as shown above. *See also* Appendix A. The same disclosures below address each feature.

826. In my opinion, there is no patentable difference between the language of claim 55 and claim 16 as shown above. *See also* Appendix A. The same disclosures below address each feature.

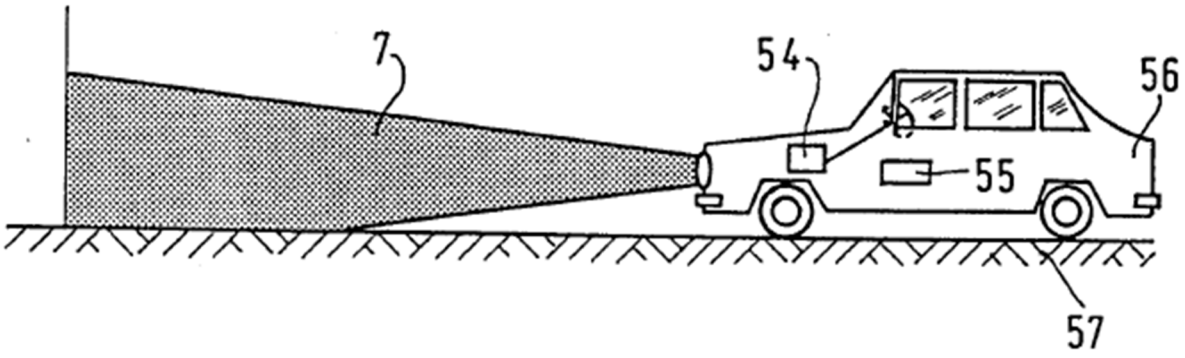
827. The language of claim 56 is identical to the language of claim 55 as shown above. *See also* Appendix A. The same disclosures below address each feature.

### 1. Karlsson-Harbers's disclosure

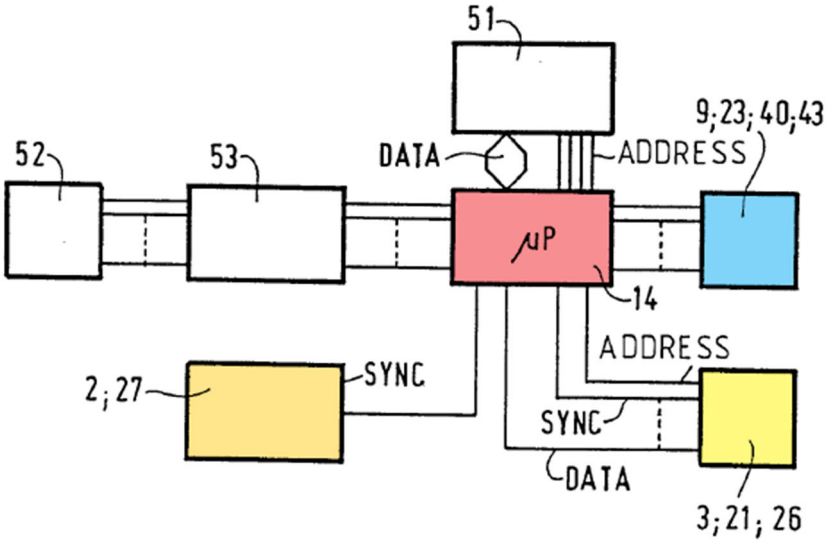
828. Karlsson's "light-sensitive sensor…detects…the area *ahead of a vehicle*" and "*direction sensors*, for detecting whether a vehicle is *taking a bend*." EX1010, 2:2-4, 6:26-33, FIGS. 3, 14-16; EX1010, 20:29-32 ("*direction sensor 54*…determin[es] when the car 56 is *taking a bend*, so that the light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




EX1010, FIG. 3 (annotated).

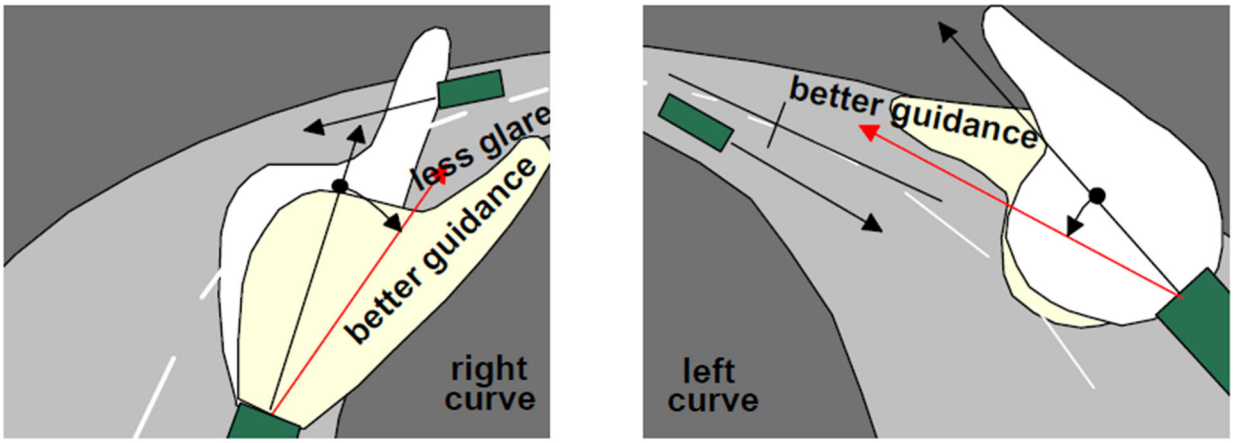



EX1010, FIG. 16.




EX1010, FIG. 15 (annotated).

829. Karlsson-Harbers does not disclose determining a planned upcoming turn and increasing illumination to illuminate the turn, but this feature was well known in the prior art, e.g., as explicitly disclosed by Gotou. *See also* EX1015, 18 ("glare reduction and visibility improvement in curves"), FIG. 2.8; EX1017, 5, 8 ("in a narrow bend a special curve illumination makes pedestrians or obstacles visible for the driver which normally will be hidden"), FIGS. 1, 3-5, 7; EX1020, 376 ("curve lighting"), 378 ("turns/crossings lighting"), FIGS. 10-11.




EX1015, FIG. 2.8.

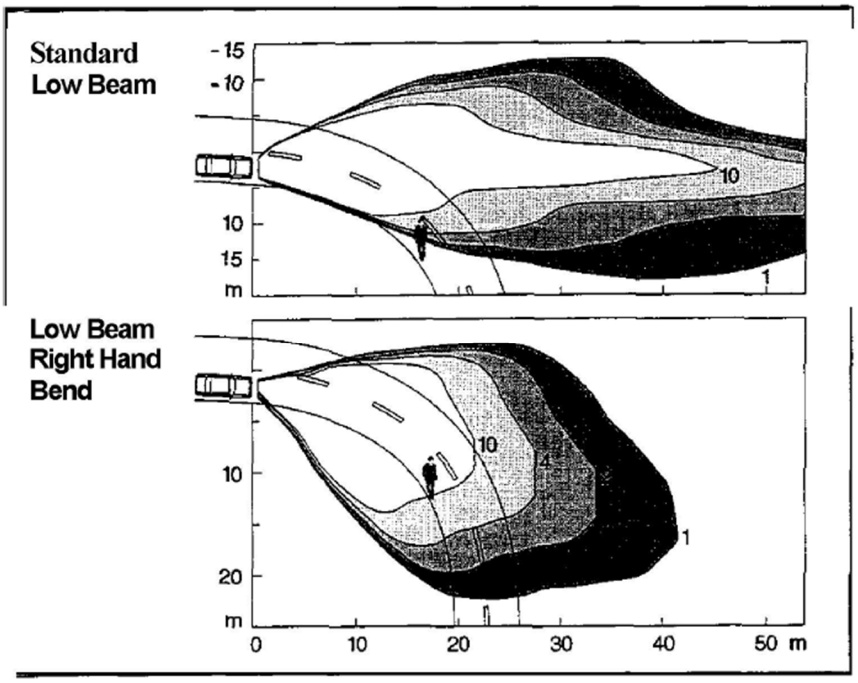



Fig. 7: comparison between basic low beam and right curve illumination, Isolux curves from bird eye's view

EX1017, FIG. 7.

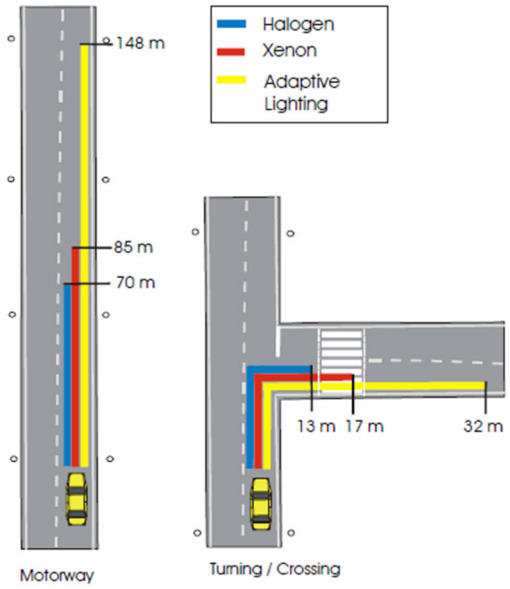



*Figure 11:*
*Static test: Results of the investigations about visibility distances obtained with halogen-, HID- and adaptive headlamps*

EX1020, FIG. 11.

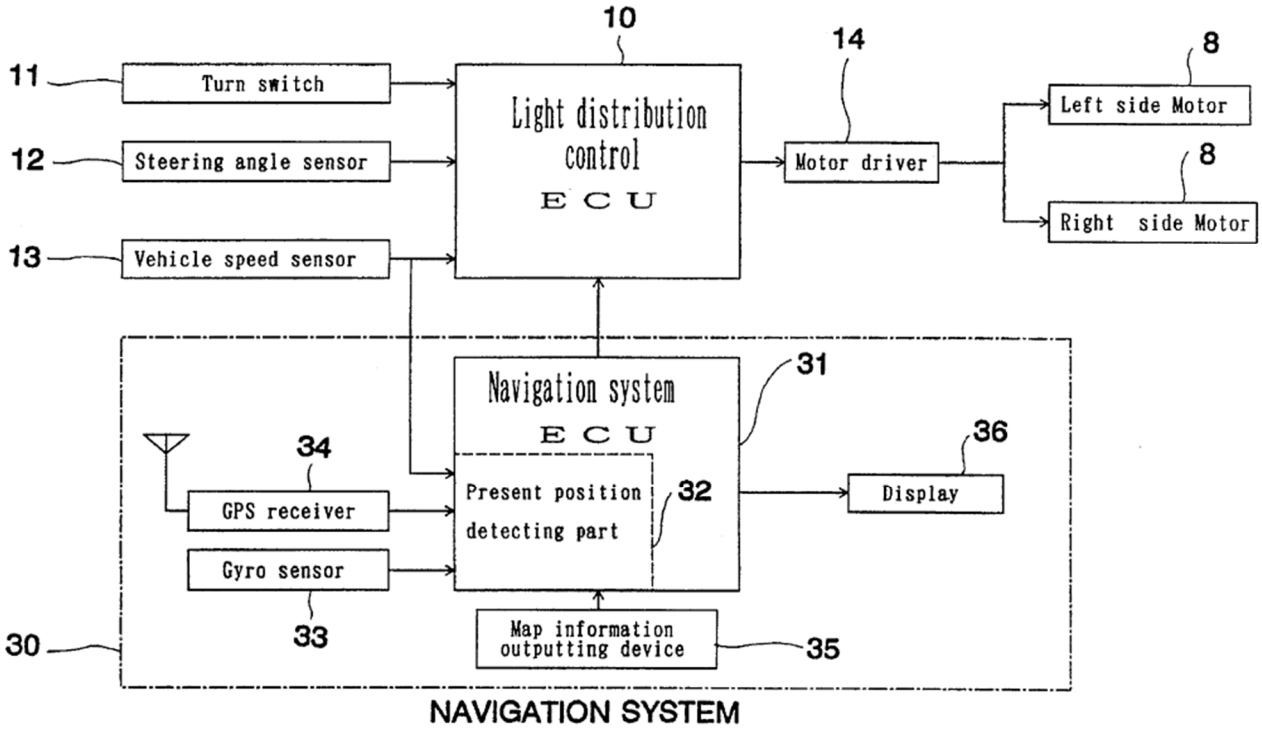
**2. Gotou's disclosure**

830. Gotou's "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, 3:52-64, 6:40-44, FIGS. 3, 8-10; EX1012, 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.

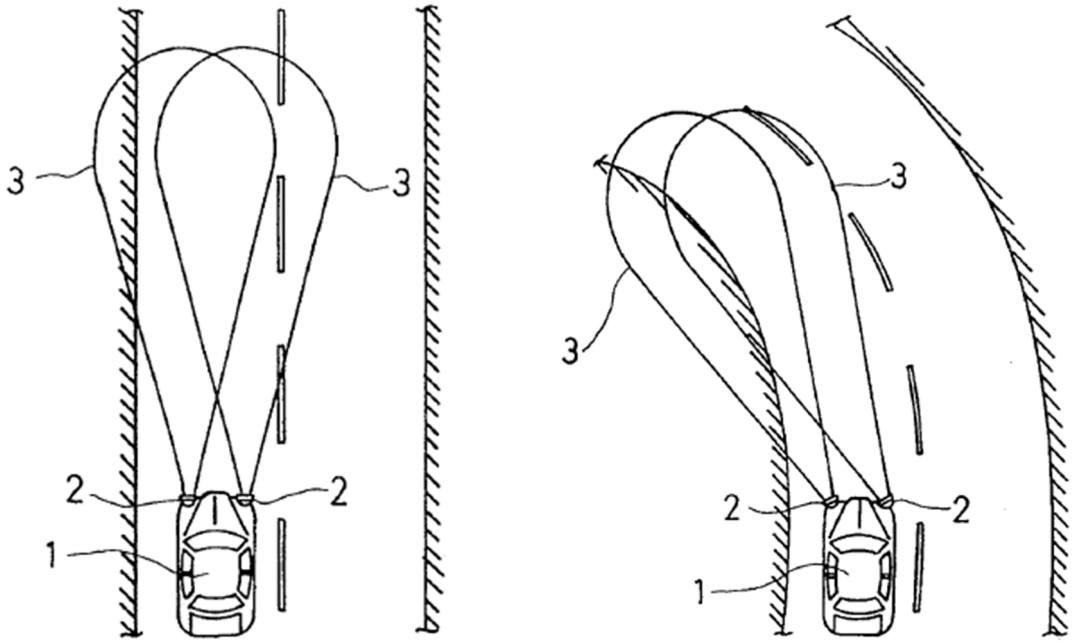
831. A POSA would have understood that Gotou discloses illumination for "a planned upcoming turn" recited in claims 16-17 and 55-56 because illumination is controlled along the "planned running direction" that includes an intended direction of a driver (e.g., left or right turn). *See* EX1012, 6:40-44 ("*improves the*

*visibility* by varying the optical axis toward the *planned running direction* at an early stage *before the steering wheel is actually turned*"), 6:8-17 ("the optical axis is swung…toward the *planned* running path"), FIGS. 8-10; EX1001, 54:1-15 ("[a] driver can't make a 90-degree turn traveling 90 km/h but from a stop, the turn may be around a corner…the more angled SLS 284, closer in for illuminating [a] sharp turn, than that of the less angled SLS 283 for a shallow curve"), 56:33-54.

832. Further, a POSA would have understood that Gotou's system "determine[s] a third illumination pattern" recited in claims 55-56 because illumination is controlled along the "planned running direction" (e.g., left or right turn) and applied to a specific "*optical axis angle θ*." *See* EX1012, 6:40-44 ("*improves the visibility* by varying the optical axis toward the *planned running direction* at an early stage *before the steering wheel is actually turned*"), 6:8-17 ("the optical axis is swung…toward the *planned* running path"), 3:52-64, 8:28-35, FIGS. 3, 8-10.




EX1012, FIG. 3.




EX1012, FIGS. 8-9.

833. As discussed, a POSA would have been motivated to combine Gotou with Karlsson-Harbers with a reasonable expectation of success. *Supra* Section XVII.A.

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

834. As described in Section XVI.A, a POSA would have been motivated to combine Karlsson-Harbers. A POSA would have been further motivated to modify Karlsson-Harbers to adjust light based on sensed data, such as map data from a GPS sensor (including planned upcoming turns), as in Gotou, to further control Karlsson-Harbers's system to illuminate turns, thereby improving driver safety—an express purpose of Karlsson. EX1010, 1:16-26, 4:17-21, 9:18-26.

835. Although live data could be used by vehicle sensors, it was well known that GPS navigation system gave additional advantages by providing more accurate information on driving regions. EX1026, 461-462 ("To obtain more accurate information on driving regions, it is advantageous to use data from a GPS navigation system.").

836. Further, conventional headlamps, with static high and low beams did not respond to changing driving conditions, and multiple beams were needed to provide "bending beams" for different types of road curvatures ("high speed," "middle speed," "low speed," "cross-roads"). EX1026, 451-453.

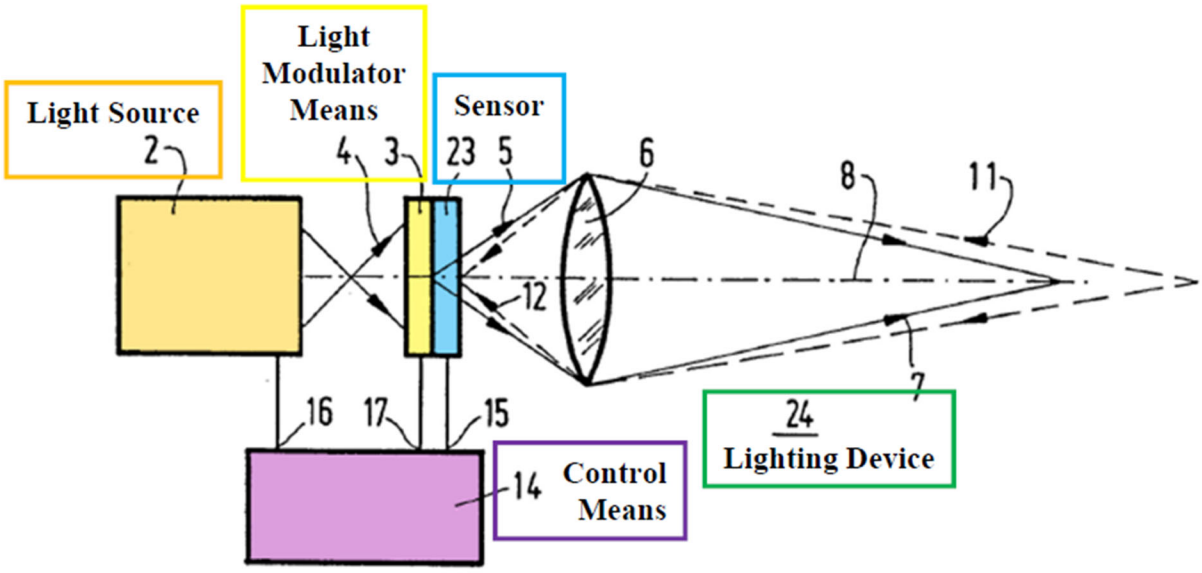
837. Karlsson-Harbers and Gotou are from the same field—controllable headlamps with dynamic illumination—and include the same building blocks (light sources, sensors, controllers). Further, driver safety is paramount. EX1010, 1:21-26, 1:35-2:1, 9:18-26, 20:22-32; EX1012, 1:17-20, 2:19-26, 6:40-44.

838. *First*, including an additional data source for Karlsson-Harbers's controller—Gotou's *known technique* of using GPS data—would have enhanced Karlsson-Harbers by increasing/adjusting illumination based on a planned upcoming turn, improving driver safety by providing light to where it is needed. *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. 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 planned upcoming turn, further improving and safety.

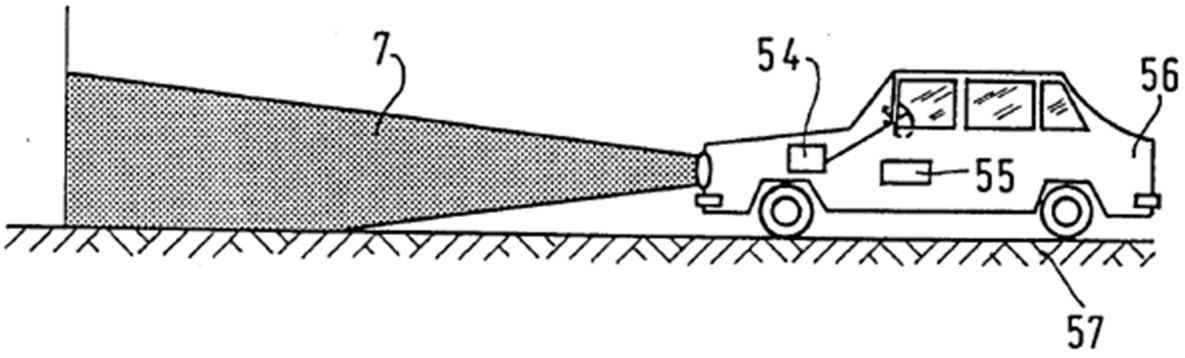
839. Indeed, Karlsson's technique and system of controlling individual spotlight beams emphasize safety of all drivers. EX1010, 1:16-26, 4:17-21, 9:18-26. Controllable headlamps "significantly increase the driving comfort and the road safety," and that "glaring or blinding of oncoming traffic is effectively 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. EX1010, 1:21-26.

840. Karlsson's system "*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. 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. EX1010, 1:35-2:1; 20:22-32, FIG. 16; EX1010, 6:26-33, 9:22-26.

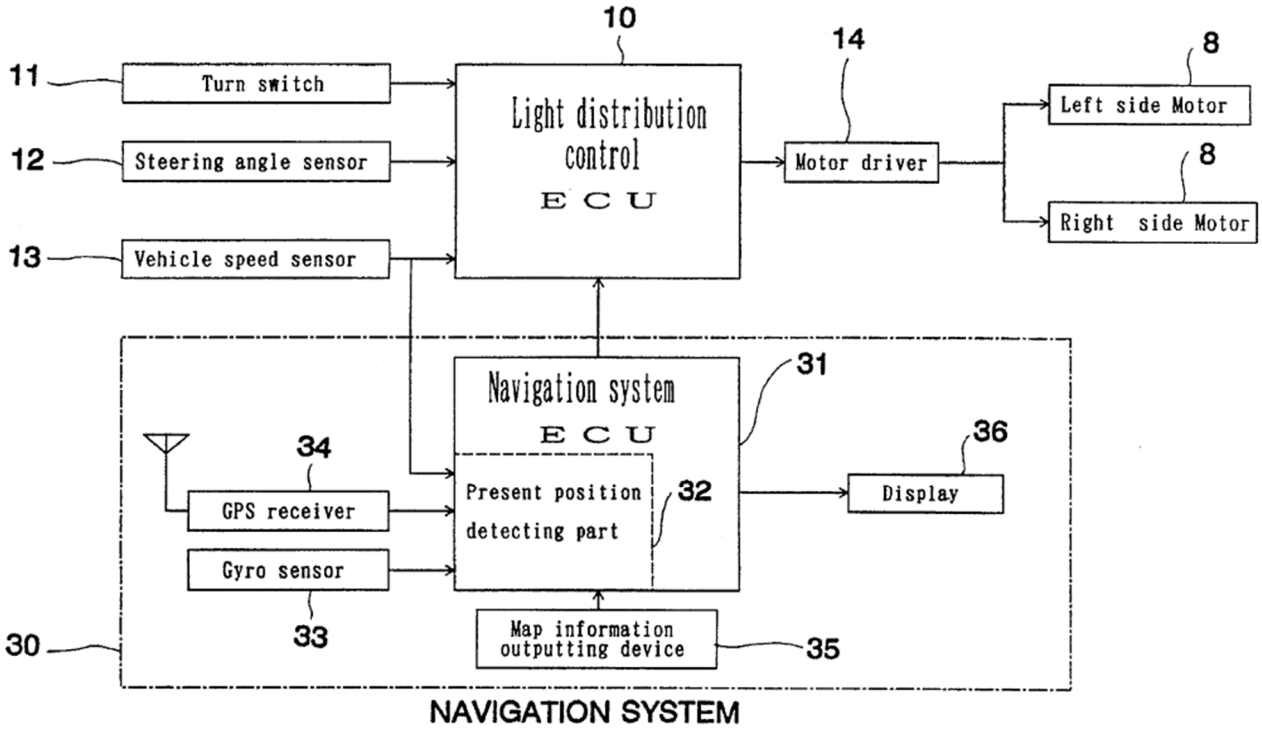



EX1010, FIG. 3 (annotated).



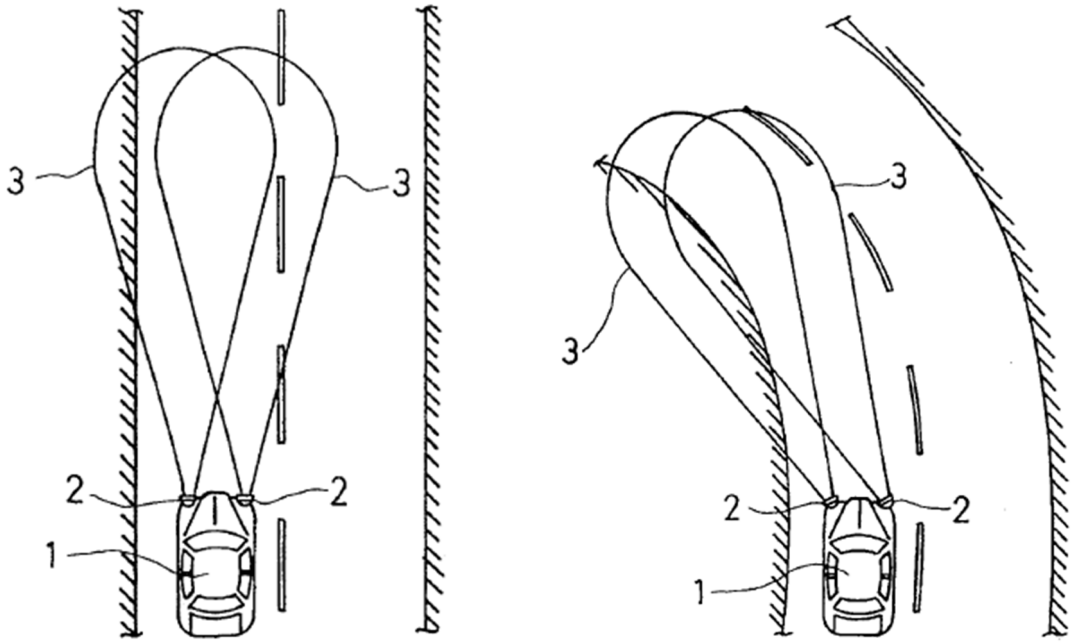

EX1010, FIG. 16.

841. Gotou's active *techniques and system components*, like Karlsson-Harbers, seek to enhance driver safety—using GPS sensor data-based control to control light direction. EX1012, 1:17-20, 2:19-26, 6:40-44. Gotou's navigation system 30 data is input to ECU 10, which alters the light direction from headlamp 2 in response to GPS data, 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. EX1012, 1:52-59, 2:19-26, 6:40-44, 8:28-35.




EX1012, FIG. 3.

842. Gotou's Figures 8 and 9 show that illumination control is planned and controlled for multiple turns. When there is a planned leftward turn, for example, the light distribution is adjusted leftward prior to reaching the turn. EX1012, 3:24-55, 7:32-43, 8:28-35, FIGS. 8-9.




EX1012, FIGS. 8-9.

843. A POSA would have understood that including an additional data source for Karlsson-Harbers's controller/processor—Gotou's GPS sensor data—would have enhanced Karlsson-Harbers by increasing/adjusting illumination of an upcoming turn, thereby improving safety. This would have merely been applying Gotou's known technique (GPS input to direct/redirect light) to Karlsson-Harbers's similar, known device (dynamic headlamp system with controllable spotlight beams), in the same way. 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.

844. 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 GPS data) according to known methods (disclosed in Karlsson-Harbers and Gotou) to yield predictable results (illuminating a road curvature/upcoming turn, improving safety).

845. 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 GPS data (including turns). 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).

846. Such modifications 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. In applying Gotou's technique to Karlsson-Harbers, a POSA would have simply been applying a known technique in a predictable way—controlling headlights in part based on GPS data (including planned upcoming turns)—as already disclosed in the art. And in combining Karlsson-Harbers with Gotou's navigation system 30 (e.g., revising control input/ouput on an ECU), a POSA would have simply been

combining known elements according to known methods (disclosed by Gotou) to yield predictable results (additional light control).

847. In view of the above, Karlsson (with Harbers) in combination with Gotou renders obvious these claims.

848. Thus, Karlsson (with Harbers) in combination with Gotou renders obvious claims 9, 15-17, 49, and 54-56 of the ’503 patent.

## XVIII. GROUND 9: THE COMBINATION OF KARLSSON, HARBERS, AND BRAUN RENDERS OBVIOUS CLAIMS 6 AND 46.

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

849. As described in Section XVI, a POSA would have been motivated to combine Karlsson-Harbers. A POSA would have been further motivated to modify Karlsson-Harbers to include infrared (IR)/ultraviolet (UV) wavelengths, as in Braun (EX1009, 3:4-8, 3:26-27, 8:4-5, 9:23-28, 14:21-30, 18:13-14, 19:9-21, 20:25-21:16, FIGS. 3-6), to further control Karlsson-Harbers’s adaptive headlamps to illuminate a roadway, thereby improving visibility and driver safety—an express purpose of Karlsson-Harbers. EX1010, 1:16-26, 4:17-21, 9:18-26; EX1011, 5:1-26, 7:1-14, 9:1-32.

850. Karlsson-Harbers and Braun are from the same field—controllable headlamps with dynamic illumination—and include the same building blocks (e.g., light sources, sensors, controllers). Improved visibility and driver safety is

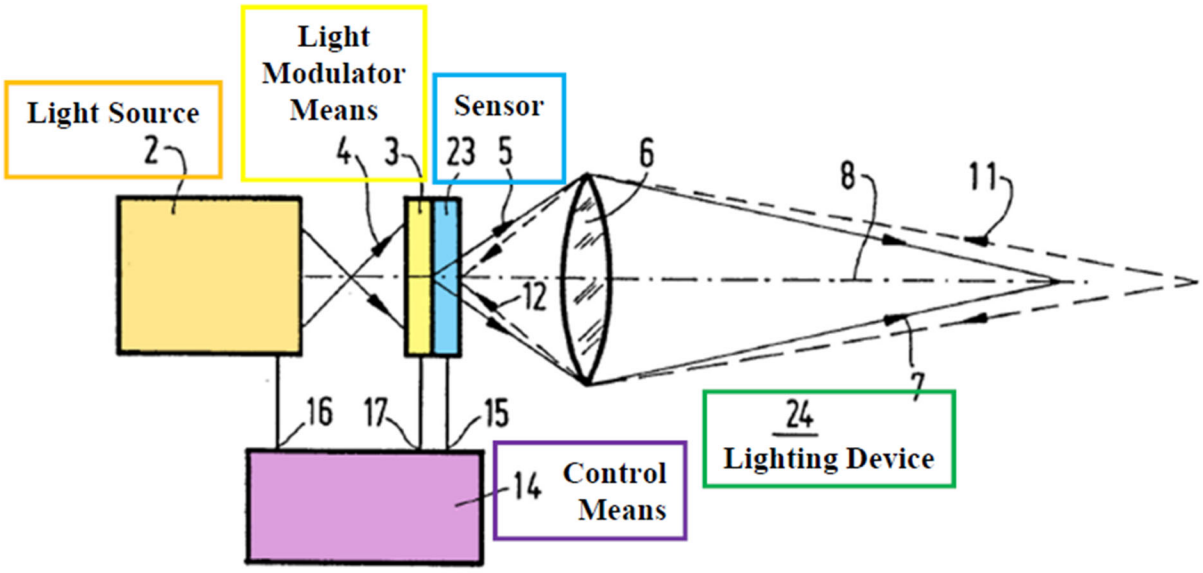
paramount. EX1010, 1:16-26, 4:17-21, 9:18-26; EX1011, 5:1-26, 7:1-14, 9:1-32; EX1009, 21:1-4 ("*IR light*…to provide *desired illumination* of scene"), 21:9-12 ("*IR light* for determining *distances* to a scene"), 22:19-23 ("*identify features and/or objects* in the scene"), 6:4-51 ("*prevent glare*"), 5:27-31 ("*improve…readability*"), 11:26-30 ("*maximize visibility*"), 26:29-27:4, 22:24-25, FIGS. 3-6.

851. A POSA would have sought to incorporate *known components* (hardware implementation) of Braun's colored luxels 26 (with IR/UV wavelengths, *see* EX1009, 3:4-8, 3:26-27, 8:4-5, 9:23-28, 14:21-30, 18:13-14, 19:9-21, 20:25-21:16, FIGS. 3-6) into Karlsson-Harbers's system (illuminator). This would have, like Braun, provided different colored spatial distributions for different situations, improving visibility and thereby safety.

852. Additionally, this would have provided increased illumination of certain surfaces (e.g., fluorescent surfaces), for example, road signs, road markers, etc. via UV luminescence. Luminescence occurs when light of a shorter wavelength (e.g., UV light) is absorbed by a material, and light of a longer wavelength (e.g., visible light) is reemitted from the material. UV light is absorbed by the luminescent objects/surfaces that reemit visible light, which increases drivers' visibility for the road signs, road markers, and other objects with the luminescent surfaces. It can improve road safety at night.

853. Further, IR sensing would have provided longer distance detection of objects (e.g., vehicles, road signs, road curvature, etc.). Indeed, as Braun details "illuminator 24…provides *IR light* for *determining distances* to a scene." EX1009, 21:9-12, 20:25-21:8, 23:28-24:27, FIGS. 5-6.

854. Karlsson's spotlight beams (LEDs) modified by Harbers provides differently colored beam segments 6-6'-6"-6'", 7-7'-7"-7'" forming different distributions. EX1011, 5:14-26, 6:1-7, 6:27-7:19, FIGS. 1B-2, 4A; EX1011, 9:22-27 ("*yellow light*…to *improve*…*visibility*"), 10:6-14 ("*fog and snow*"), 7:27-32, 7:1-17, 9:28-10:5, 13:5-7; EX1010, 14:26-30, 11:25-28, FIGS. 3, 6, 14; EX1010, 4:32-5:15 ("*spotlight* beams can be made up of separate, spatially distributed, pixel type light sources, for example a plurality of *light-emitting diodes*").




EX1010, FIG. 3 (annotated).

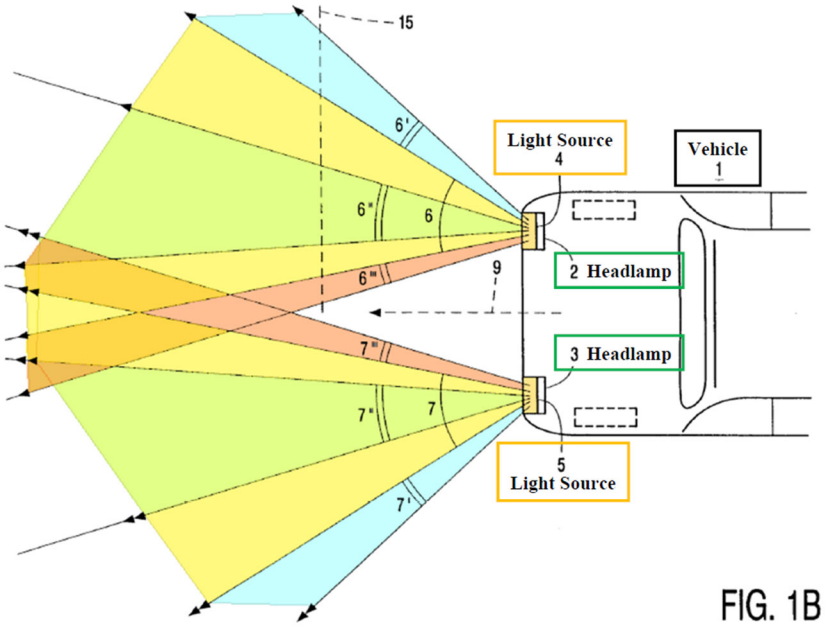
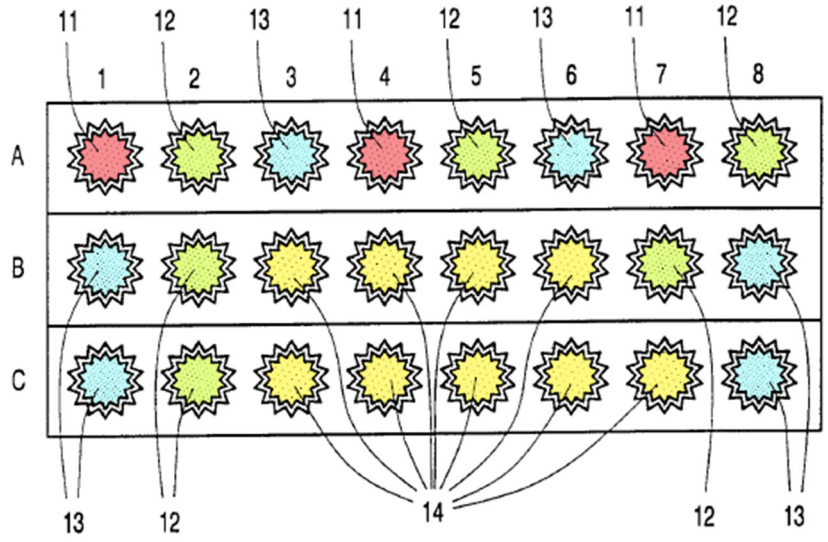



FIG. 1B

EX1011, FIG. 1B (annotated).




EX1011, FIG. 2 (annotated).

855. Indeed, Karlsson's technique and system of controlling individual spotlight beams emphasize safety of all drivers. EX1010, 1:16-26, 4:17-21, 9:18-26. Controllable headlamps "significantly increase the driving comfort and the road safety," and that "glaring or 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 other drivers from glare. EX1010, 1:21-26.

856. And through its *system components*, Braun, like Karlsson-Harbers, seeks to enhance driver visibility and thereby increase safety. EX1009, 3:4-8, 3:26-27, 8:4-5, 9:23-28, 14:21-30, 18:13-14, 19:9-21, 20:25-21:16, FIGS. 3-6. Braun's colored luxels 26 provide "adaptive illumination of a *roadway* and *neighboring regions*" (e.g., road signs 121, 122) and "luxels 26 [are] not limited to the visible spectrum but may, for example, comprise *infrared* or *ultraviolet* light." EX1009, 14:21-30, 5:22-25, FIGS. 2-3, 5-6; EX1009, 21:1-4 ("*IR light*…to provide *desired illumination* of scene"), 21:9-12 ("*IR light* for determining *distances* to a scene"), 18:13-14 ("illuminator 24 provides *IR light*"), 23:28-24:27. And like Karlsson, Braun's system "identifies *oncoming vehicles* and automatically adjusts illumination…to *prevent glare*…[and] *blinding* a driver of the oncoming vehicle," so Braun's colored luxels 26 (hardware implementation) would have been a natural extension and improvement on Karlsson's adaptive system and would have been obvious to a POSA.

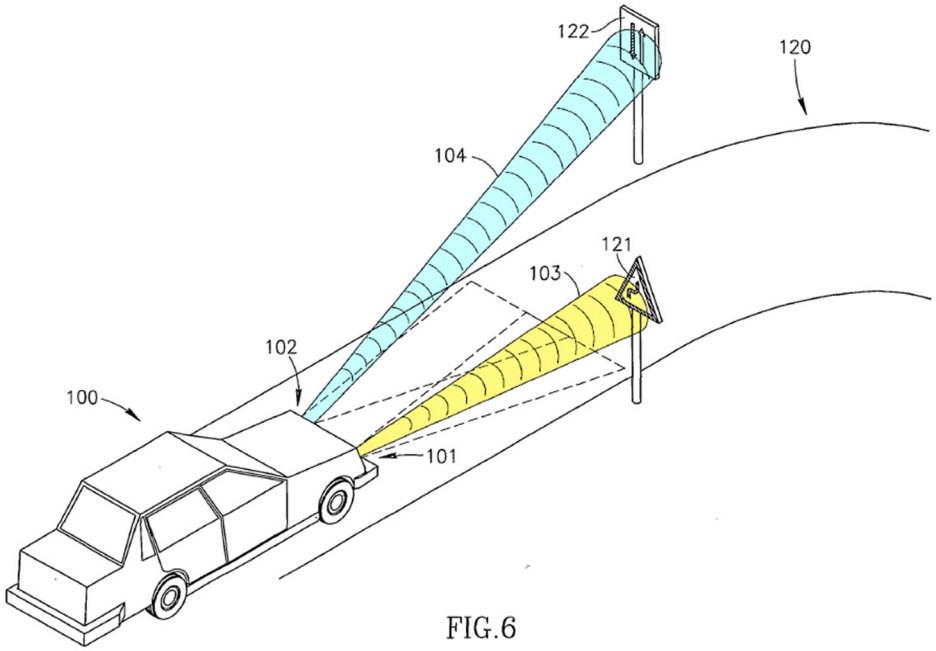



FIG.6

EX1009, FIG. 6 (annotated).

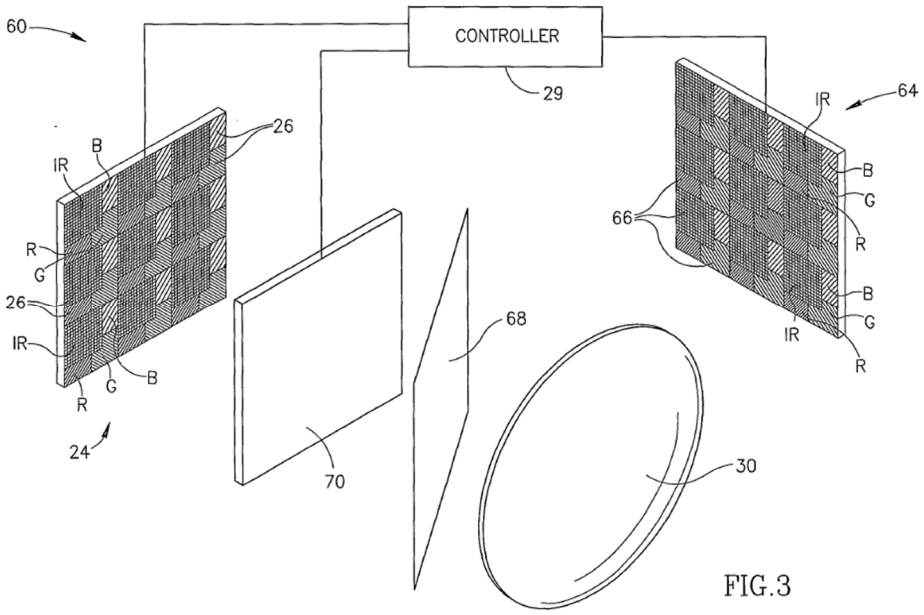



FIG.3

EX1009, FIG. 3.

857. This hardware combination—Karlsson's array of spotlight beams (LEDs) and Braun's differently colored luxels 26 including IR/UV wavelengths—

would have provided Karlsson-Harbers's system with different colored spatial distributions for different situations, as in Braun, thereby improving driver safety. This would have been merely combining prior-art elements or a simple substitution of one known element for another (Karlsson's array of spotlight beams and Braun's array of colored luxels 26) according to known methods (disclosed in Beam-Thominet and Braun) to yield predictable results (improved visibility and safety).

858. A POSA would have had a reasonable expectation of success combining Karlsson-Harbers and Braun, for example, by simply modifying Karlsson's array of spotlight beams (e.g., LEDs) with Braun's array of colored luxels 26 (e.g., colored LEDs) to provide colored light sources (e.g., colored luxels 26 with IR/UV wavelengths) for different functions. This would have been routine and well within a POSA's skill due to the similarities in Karlsson-Harbers's and Braun's adaptive systems—their common components were well-known and there would have been no limitations for a POSA to make such modifications.

859. I lay out below the specific disclosures of Karlsson-Harbers and Braun, and expand on this combination and reasonable expectation of success analysis below.

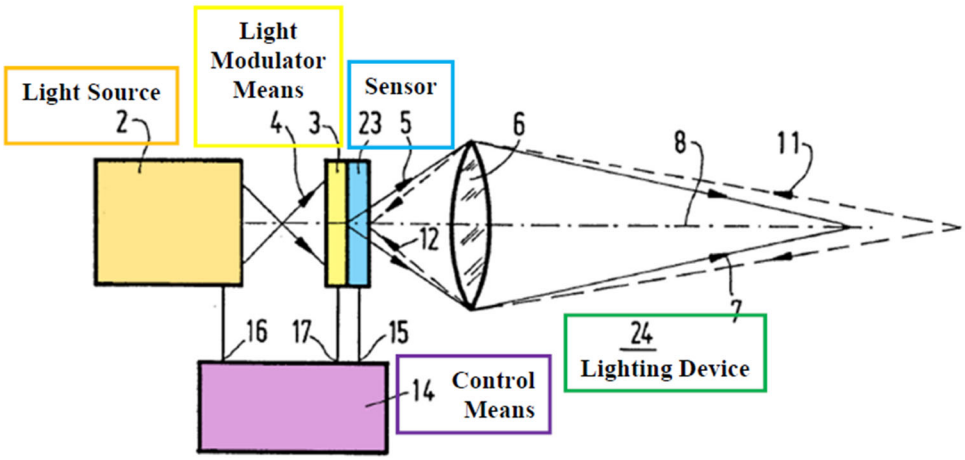
**B. Claim 6: "The headlight system of claim 1, wherein the headlight beam further comprises light in at least one of infra-red (IR) or ultra-violet (UV) wavelengths."**

**Claim 46: "The headlight system of claim 37, wherein the light output from at least one headlamp further comprises at least one of infrared or ultraviolet wavelengths."**

860. In my opinion, there is no patentable difference between the language of claim 46 and claim 6 as shown above. *See also* Appendix A. The same disclosures below address each feature.

**1. Karlsson-Harbers's disclosure**

861. Karlsson-Harbers's "spotlight beams 34 [are]…a *grid of separate light sources, such as LEDs…controlled* either *individually* or in *groups*" and Karlsson recognizes the problem of illuminating "when driving on *dark*, *unilluminated* roads" with just low beam illumination. EX1010, 1:16-24, 14:1-4, FIGS. 3, 6, 14; EX1010, 11:25-28 ("*given directions*"), 4:32-35, 4:26-5:15, 14:5-15; EX1011, 5:14-26, 6:1-7:32, FIGS. 1B-2, 10:6-14, 9:22-10:5, 13:5-7.




EX1010, FIG. 3 (annotated).

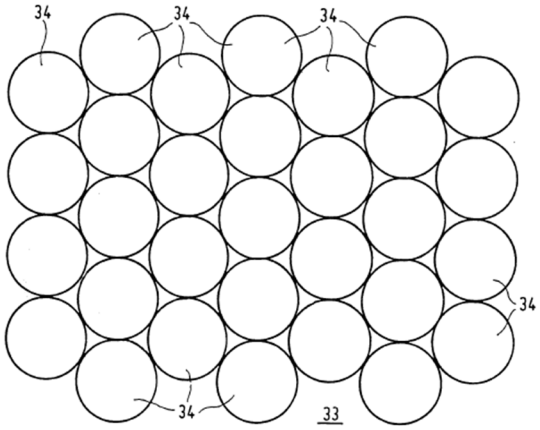
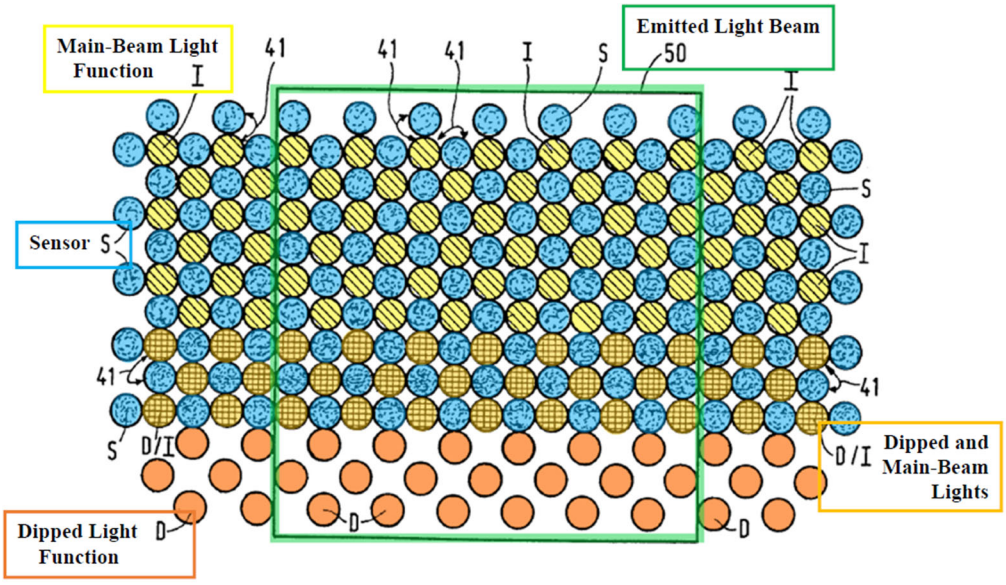



FIG. 6

EX1010, FIG. 6.




EX1010, FIG. 14 (annotated).

862. Karlsson-Harbers does not disclose IR or UV illumination, but this feature was well-known in the prior art, e.g., as explicitly disclosed by Braun.

**2. Braun's disclosure**

863. Braun's colored luxels 26 provide "adaptive illumination of a *roadway* and *neighboring regions*" and "light provided by luxels 26 is not limited

to the visible spectrum but may, for example, comprise *infrared* or *ultraviolet* light." EX1009, 14:21-30, 5:22-25, 14:21-25, FIGS. 2-3, 5-6; EX1009, 18:13-14 ("illuminator 24 provides *IR light*").

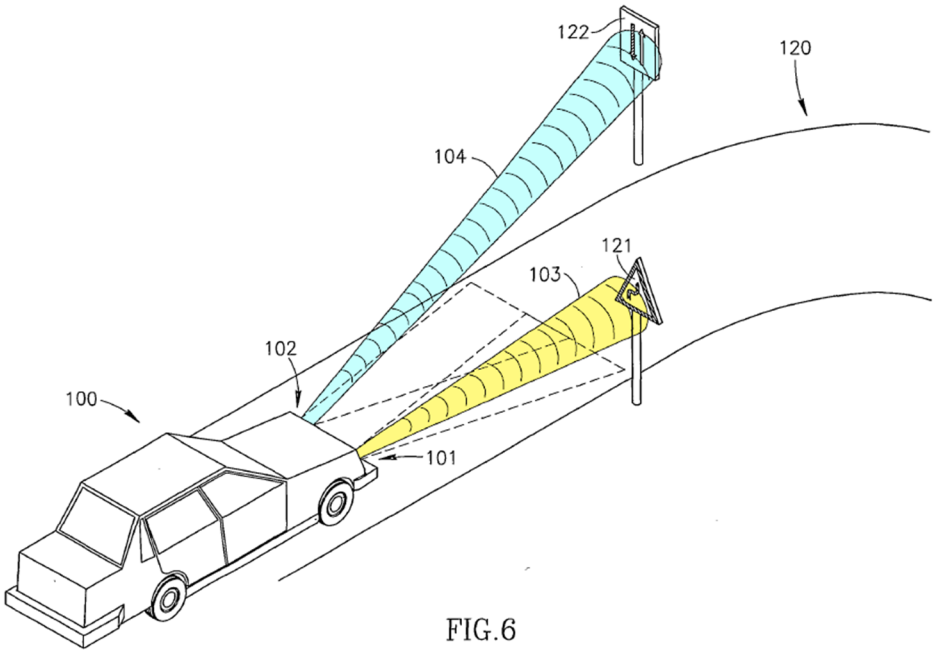



FIG.6

EX1009, FIG. 6 (annotated).

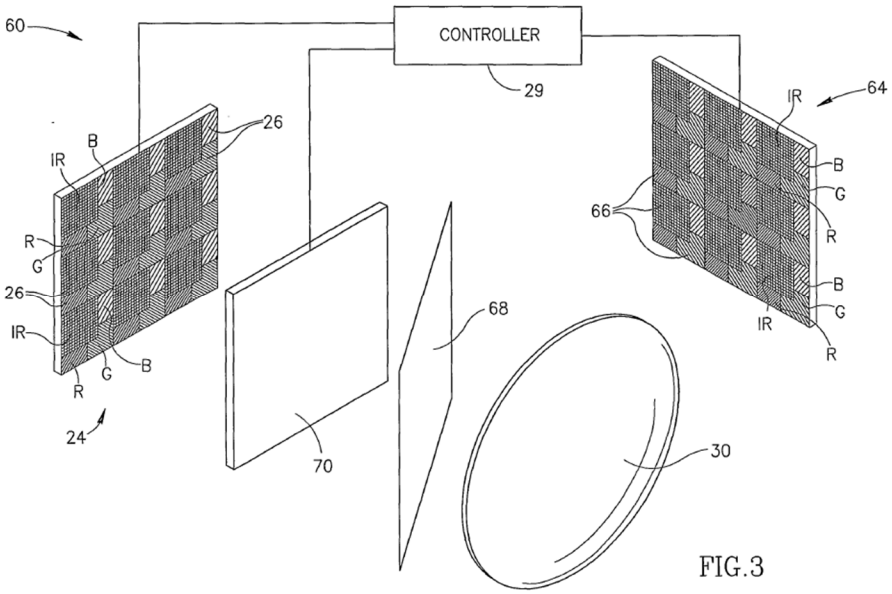



FIG.3

EX1009, FIG. 3.

864. As discussed, a POSA would have been motivated to combine Braun with Karlsson-Harbers with a reasonable expectation of success. *Supra* Section XVIII.A.

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

865. As described in Section XVI.A, a POSA would have been motivated to combine Karlsson-Harbers. A POSA would have been further motivated to modify Karlsson-Harbers to include infrared (IR)/ultraviolet (UV) wavelengths, as in Braun (EX1009, 3:4-8, 3:26-27, 8:4-5, 9:23-28, 14:21-30, 18:13-14, 19:9-21, 20:25-21:16, FIGS. 3-6), to further control Karlsson-Harbers's adaptive headlamps to illuminate a roadway, thereby improving visibility and driver safety—an express purpose of Karlsson-Harbers. EX1010, 1:16-26, 4:17-21, 9:18-26; EX1011, 5:1-26, 7:1-14, 9:1-32.

866. Karlsson-Harbers and Braun are from the same field—controllable headlamps with dynamic illumination—and include the same building blocks (e.g., light sources, sensors, controllers). Improved visibility and driver safety is paramount. EX1010, 1:16-26, 4:17-21, 9:18-26; EX1011, 5:1-26, 7:1-14, 9:1-32; EX1009, 21:1-4 ("*IR light*…to provide *desired illumination* of scene"), 21:9-12 ("*IR light* for determining *distances* to a scene"), 22:19-23 ("*identify features and/or objects* in the scene"), 6:4-51 ("*prevent glare*"), 5:27-31

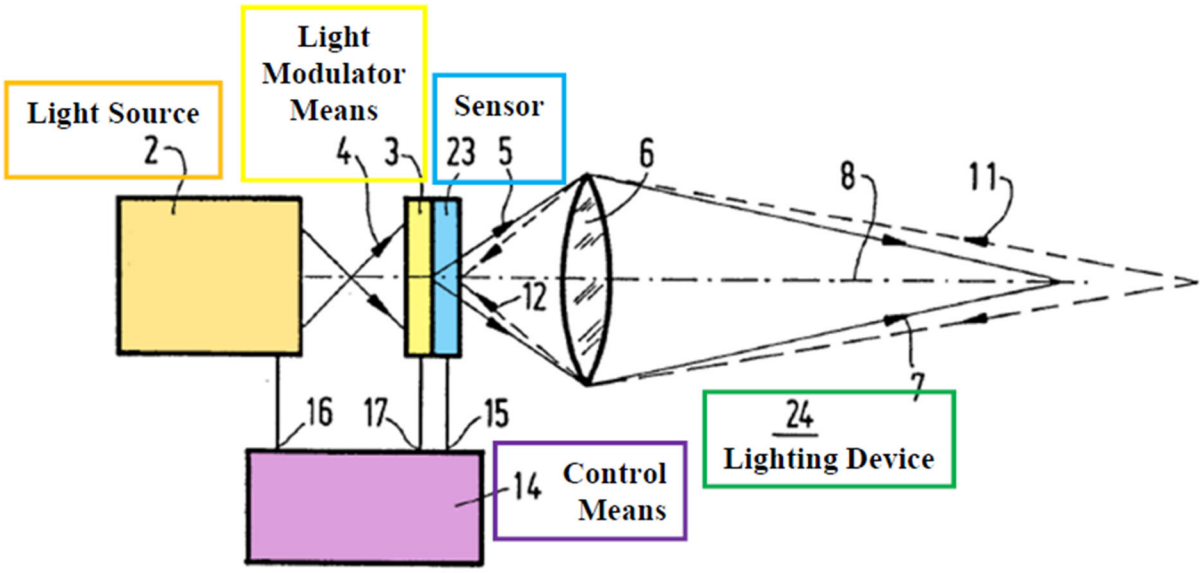
("*improve…readability*"), 11:26-30 ("*maximize visibility*"), 26:29-27:4, 22:24-25, FIGS. 3-6.

867. A POSA would have sought to incorporate *known components* (hardware implementation) of Braun's colored luxels 26 (with IR/UV wavelengths, *see* EX1009, 3:4-8, 3:26-27, 8:4-5, 9:23-28, 14:21-30, 18:13-14, 19:9-21, 20:25-21:16, FIGS. 3-6) into Karlsson-Harbers's system (illuminator). This would have, like Braun, provided different colored spatial distributions for different situations, improving visibility and thereby safety.

868. Additionally, this would have provided increased illumination of certain surfaces (e.g., fluorescent surfaces), for example, road signs, road markers, etc. via UV luminescence. Luminescence occurs when light of a shorter wavelength (e.g., UV light) is absorbed by a material, and light of a longer wavelength (e.g., visible light) is reemitted from the material. UV light is absorbed by the luminescent objects/surfaces that reemit visible light, which increases drivers' visibility for the road signs, road markers, and other objects with the luminescent surfaces. It can improve road safety at night.

869. Further, IR sensing would have provided longer distance detection of objects (e.g., vehicles, road signs, road curvature, etc.). Indeed, as Braun details "illuminator 24…provides *IR light* for *determining distances* to a scene." EX1009, 21:9-12, 20:25-21:8, 23:28-24:27, FIGS. 5-6.

870. Karlsson's spotlight beams (LEDs) modified by Harbers provides differently colored beam segments 6-6'-6"-6"', 7-7'-7"-7"' forming different distributions. EX1011, 5:14-26, 6:1-7, 6:27-7:19, FIGS. 1B-2, 4A; EX1011, 9:22-27 ("*yellow light*…to *improve*…*visibility*"), 10:6-14 ("*fog and snow*"), 7:27-32, 7:1-17, 9:28-10:5, 13:5-7; EX1010, 14:26-30, 11:25-28, FIGS. 3, 6, 14; EX1010, 4:32-5:15 ("*spotlight* beams can be made up of separate, spatially distributed, pixel type light sources, for example a plurality of *light-emitting diodes*").




EX1010, FIG. 3 (annotated).

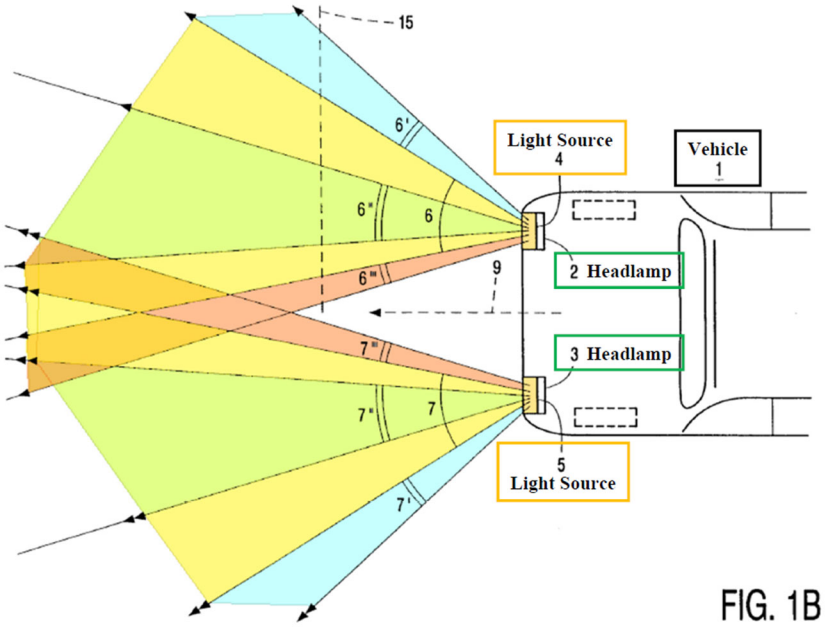
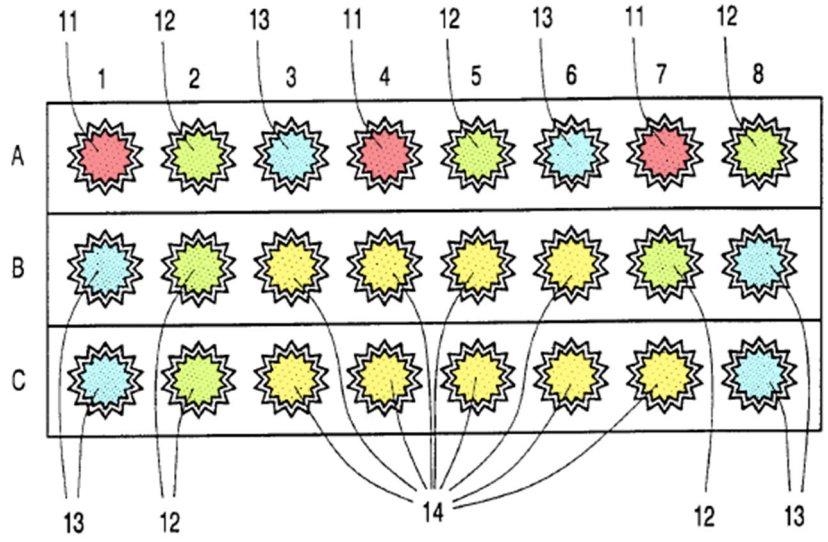



FIG. 1B

EX1011, FIG. 1B (annotated).




EX1011, FIG. 2 (annotated).

871. Indeed, Karlsson's technique and system of controlling individual spotlight beams emphasize safety of all drivers. EX1010, 1:16-26, 4:17-21, 9:18-26. Controllable headlamps "significantly increase the driving comfort and the road safety," and that "glaring or 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 other drivers from glare. EX1010, 1:21-26.

872. And through its *system components*, Braun, like Karlsson-Harbers, seeks to enhance driver visibility and thereby increase safety. EX1009, 3:4-8, 3:26-27, 8:4-5, 9:23-28, 14:21-30, 18:13-14, 19:9-21, 20:25-21:16, FIGS. 3-6. Braun's colored luxels 26 provide "adaptive illumination of a *roadway* and *neighboring regions*" (e.g., road signs 121, 122) and "luxels 26 [are] not limited to the visible spectrum but may, for example, comprise *infrared* or *ultraviolet* light." EX1009, 14:21-30, 5:22-25, FIGS. 2-3, 5-6; EX1009, 21:1-4 ("*IR light*…to provide *desired illumination* of scene"), 21:9-12 ("*IR light* for determining *distances* to a scene"), 18:13-14 ("illuminator 24 provides *IR light*"), 23:28-24:27. And like Karlsson, Braun's system "identifies *oncoming vehicles* and automatically adjusts illumination…to *prevent glare*…[and] *blinding* a driver of the oncoming vehicle," so Braun's colored luxels 26 (hardware implementation) would have been a natural extension and improvement on Karlsson's adaptive system and would have been obvious to a POSA.

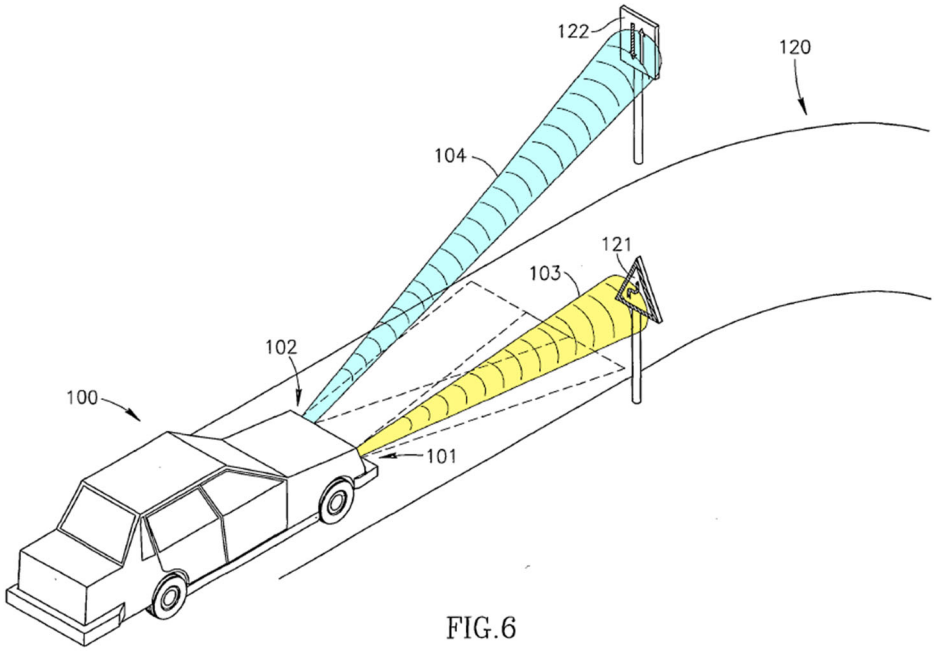



FIG.6

EX1009, FIG. 6 (annotated).

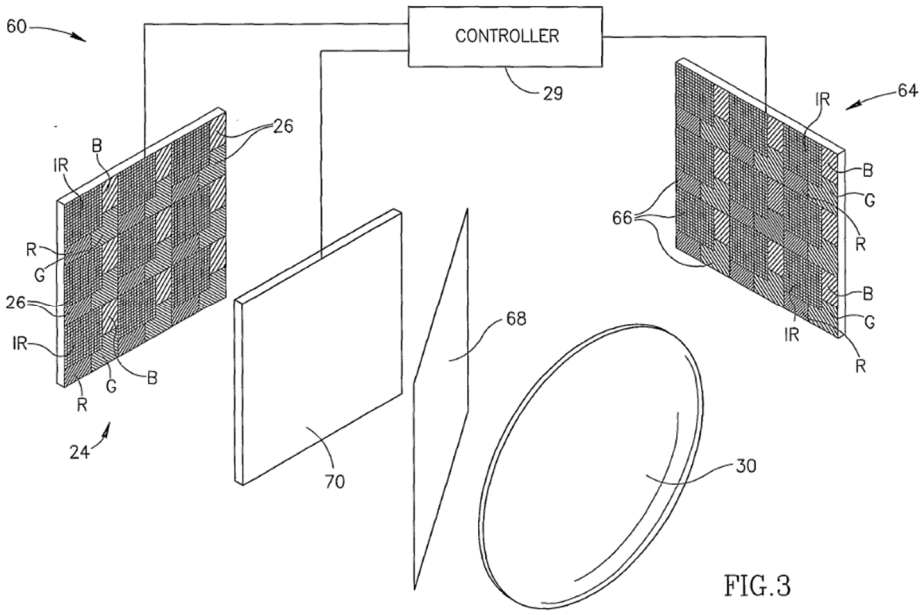



FIG.3

EX1009, FIG. 3.

873. This hardware combination—Karlsson's array of spotlight beams (LEDs) and Braun's differently colored luxels 26 including IR/UV wavelengths—

would have provided Karlsson-Harbers's system with different colored spatial distributions for different situations, as in Braun, thereby improving driver safety. This would have been merely combining prior-art elements or a simple substitution of one known element for another (Karlsson's array of spotlight beams and Braun's array of colored luxels 26) according to known methods (disclosed in Beam-Thominet and Braun) to yield predictable results (improved visibility and safety).

874. A POSA would have had a reasonable expectation of success combining Karlsson-Harbers and Braun, for example, by simply modifying Karlsson's array of spotlight beams (e.g., LEDs) with Braun's array of colored luxels 26 (e.g., colored LEDs) to provide colored light sources (e.g., colored luxels 26 with IR/UV wavelengths) for different functions. This would have been routine and well within a POSA's skill due to the similarities in Karlsson-Harbers's and Braun's adaptive systems—their common components were well-known and there would have been no limitations for a POSA to make such modifications.

875. In view of the above, Karlsson-Harbers in combination with Braun renders obvious these claims.

876. Thus, Karlsson-Harbers in combination with Braun renders obvious claims 6 and 46 of the '503 patent.

## XIX. OBJECTIVE INDICIA DO NOT SUPPORT PATENTABILITY

877. I understand that the obviousness analysis includes considering evidence of secondary indicia of nonobviousness (if available). I understand that any secondary indicia of nonobviousness must have a nexus, or a close connection, to the novel aspects of the claimed invention. I understand that secondary indicia of nonobviousness include the following: commercial success, long-felt but unmet need, failure of others, copying, praise in the industry, and unexpectedly superior results as compared with the closest prior art.

878. Considering the information I have reviewed, my general knowledge of the field of headlamp systems, including adaptive headlamp systems, and publications within that and related fields, I am not aware of any objective evidence that might support the patentability of the claims of the ’503 patent. Further, from my review of the file history (EX1002) of the ’503 patent, I did not see that the applicant raised any secondary indicia of nonobviousness during prosecution. I am not otherwise aware of any publicly available evidence of secondary indicia of nonobviousness. Should any alleged secondary indicia of nonobviousness be presented, I reserve the right to provide an opinion thereon.

879. Counsel has informed me that Patent Owner submitted alleged evidence of secondary considerations in a reexamination proceeding involving U.S. Patent No. 9,955,551, but I understand that the Central Reexamination Unit

did not address it. In any event, in my opinion, that evidence would not be applicable here at least because the ’503 patent involves different claims than in the ’551 reexamination. Again, should any alleged secondary indicia of nonobviousness be presented, I reserve the right to provide an opinion thereon.

## XX. CONCLUSION

In signing this Declaration, I recognize that this Declaration will be filed as evidence in an *inter partes* review before the Patent Trial and Appeal Board of the United States Patent and Trademark Office. I also recognize that I may be subject to cross-examination in the case and that cross-examination will take place within the United States. If cross-examination is required, I will appear for cross-examination within the United States during the time allotted.

I hereby declare that all statements made herein are made of my own knowledge and are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

Executed on this 8th day of August 2023, in Petaluma, California.



Scott Andrews

# Appendix A

| Comparison of Independent Claim 1 and Claim 37[13] | |
|---|---|
| [1.P] A vehicle headlight system comprising: | [37.P] identical to [1.P] |
| [1.1] one or more headlamps and a vehicle structure, arranged for affixing components of the system to the vehicle; | [37.1] one or more headlamps affixable to a first vehicle; |
| [1.2] a plurality of light clusters, arranged in each of the one or more of the one or more headlamps, | [37.2] a plurality of light clusters arranged in each of the one or more of the headlamps and |
| [1.3] the headlamps capable of projecting light so as to illuminate a plurality of sub-sections of a field-of-view with different illumination characteristics, | [37.3] capable of illuminating sub-sections of a field-of-view with different illumination characteristics, |
| [1.4] the subsections determined in response to sensor data, wherein the light clusters operate to create a headlight beam; | [37.4] wherein at least two of the light clusters operate to create a headlight beam; |
| [1.5] electronic control circuitry configured to independently operate the light clusters; | |
| [1.6] one or more sensors configured to obtain and provide the sensor data predefined as pertinent to illumination requirements for the field-of-view; and | [37.5] one or more sensors configured to obtain and provide sensor data,<br>[37.6] at least a portion of the sensor data indicating a second vehicle within the field-of-view; and |

[13] EX1001, 95:40-65, 100:3-28 (numbering and spacing added).

| | |
|---|---|
| [1.7] a logical controller including a processor, the processor in communication with a memory storing one or more algorithms, with the sensors, and with the control circuitry, | |
| [1.8] wherein the processor is configured to process the one or more algorithms and the sensor data to determine an illumination for at least two of the sub-sections, | [37.7] at least one processor configured to: receive the sensor data; process the sensor data to determine a light distribution pattern for an adaptive headlight beam, |
| [1.9] that reduces illumination to reduce glare in at least a first of the at least two subsections and | |
| | [37.8] such that a headlight beam adapted to the pattern substantially illuminates a first subsection of the field-of-view including at least a portion of the second vehicle with an illuminance below a predefined threshold value, |
| | [37.9] while the beam substantially illuminates at least the one or more second subsections of the field-of-view to either side of the first subsection with an illuminance above the predefined threshold value; and |
| [1.10] adapt the light emitted from one or more of the light-clusters so as to create the headlight beam that provides the determined illumination. | [37.10] instruct operation of at least two of the light clusters to create the adapted headlight beam. |

| Comparison of Claim 2 and Claim 42[14] | |
|---|---|
| [2.1] The headlight system of claim 1, wherein at least one of the light clusters comprises: a structure to position the light cluster, such that the projected light from the at least one cluster has an aiming direction in relation to a forward travel direction of the vehicle; | [42.1] The headlight system of claim 37, wherein at least one of the light clusters comprises: |
| [2.2] one or more light emitting sources, each having a variable light-source characteristic dependent on power, and wherein the control circuitry is arranged to alter said light-source characteristic via power control; and | [42.2] one or more light sources, each having a variable light-source light characteristic dependent on power and alterable, at least responsive to instructions from at least one of the at least one processors, via power control; and |
| [2.3] one or more light modifying elements provided in the path of light emitted from at least one of the sources, further controlling the light-source characteristics; | [42.3] one or more light modifying elements provided in a path of light emitted from at least one of the light sources, further controlling at least one light characteristic of the at least one of the light source; |
| [2.4] wherein the structure combined with control of the light sources and light modifying elements results in an emitted light-cluster light characteristic including at least one of direction, intensity, beam spread, spatial light distribution or spectral light distribution. | [42.4] wherein control of the light sources and light modifying elements results in a specified emitted light-source light characteristic, where said emitted light-source light characteristic includes at least one of direction, intensity, beam spread, spatial light distribution or spectral light distribution. |

[14] EX1001, 95:66-96:17, 100:51-67 (numbering and spacing added).

| **Comparison of Claim 3 and Claim 43[15]** | |
|---|---|
| 3. The headlight system of claim 2, wherein the one or more light modifying elements is at least one of a static light modifier or a variable light modifier, said light modifying element comprising at least one of reflectors or refractors, and wherein variable light modifier control circuitry is configured to control the light-cluster light characteristic by altering the light modifying elements in the path of the light emitted from the at least one of the light sources. | 43. The headlight system of claim 42, wherein the one or more light modifying elements comprises at least one of reflectors or refractors, and wherein at least one of the at least one processors is configured to instruct control of at least one light modifying element resulting in a change to the light-source light characteristic. |
| **Comparison of Claim 4 and Claim 44[16]** | |
| 4. The headlight system of claim 2, wherein the light modifying element further comprises at least one of lenses, diffractors, optical devices, a light guide, filters, phosphors, optical coatings, prisms, controllable piezoelectric light guides, MEMS devices, light valves or optical switches. | 44. The headlight system of claim 42, wherein the light modifying element further comprises at least one of lenses, diffractors, optical devices, a light guide, filters, phosphors, optical coatings, prisms, controllable piezoelectric light guides, MEMS devices, light valves or optical switches. |

[15] EX1001, 96:18-25, 101:1-6.

[16] EX1001, 96:26-30, 101:7-11.

| **Comparison of Claim 5 and Claim 45[17]** | |
|---|---|
| 5. The headlight system of claim 1, wherein at least one of the light-clusters includes: a plurality of light sources, wherein one or more of the plurality of light sources comprises at least one of multiple light-emitting-diodes (LEDs) or organic light-emitting-diodes, each light source having a spectral power distribution characteristic and wherein the control circuitry is configured to alter the overall light-cluster spectral power distribution to illuminate at least one of the at least two sub-sections of the field-of-view with a different color of light from another of the at least two sub-sections. | 45. The headlight system of claim 37, wherein at least one of the light-clusters includes: a plurality of light sources, wherein one or more light sources of the plurality of light sources comprise at least one of light-emitting-diodes (LEDs) or organic light-emitting-diodes, each light source having a spectral power distribution characteristic alterable, at least responsive to instructions from at least one of the at least one processors, by modifying power to the one or more light sources of the plurality of light sources, resulting in a color change to projected light from the at least one light-cluster illuminating at least one sub-section of the field-of-view. |
| **Comparison of Claim 6 and Claim 46[18]** | |
| 6. The headlight system of claim 1, wherein the headlight beam further comprises light in at least one of infra-red (IR) or ultra-violet (UV) wavelengths. | 46. The headlight system of claim 37, wherein the light output from at least one headlamp further comprises at least one of infrared or ultraviolet wavelengths. |

[17] EX1001, 96:31-42, 101:12-24.

[18] EX1001, 96:43-45, 101:25-27.

| Comparison of Claim 7 and Claim 8[19] | |
|---|---|
| 7. The headlight system of claim 1, wherein at least one of the sensors is a camera-sensor configured to image at least lights indicative of oncoming vehicles having a driver whose vision could be disturbed by the headlight beam, and wherein the logical controller upon receiving data, indicating a position of the lights, from the camera-sensor, is configured to use one or more of the algorithms to determine a position of the oncoming vehicle, based on the position of the lights as indicated by the data, relative to the vehicle headlight system and responsively adapt the headlight beam to decrease at least one vision-disturbing characteristic to the oncoming vehicle driver. | 8. The headlight system of claim 1, wherein at least one of the sensors is a camera-sensor configured to image at least lights indicative of preceding vehicles having a driver whose vision could be disturbed by the headlight beam reflected in a mirror, and where the logical controller upon receiving data, indicating a position of the lights, from the camera-sensor, is configured to use one or more of the algorithms to determine a position of the preceding vehicle, based on the position of the lights as indicated by the data, relative to the vehicle headlight system and responsively adapt the headlight beam to decrease at least one vision-disturbing characteristic to the driver of the preceding vehicle. |
| **Comparison of Claim 7 and Claim 47[20]** | |
| 7. The headlight system of claim 1, wherein at least one of the sensors is a camera-sensor configured to image at least lights indicative of oncoming vehicles having a driver whose vision could be disturbed by the headlight beam, and wherein the logical controller upon receiving data, indicating a position of the lights, from | 47. The headlight system of claim 37, wherein at least one of the sensors is a camera-sensor configured to image at least lights indicative of an oncoming vehicle. |

[19] EX1001, 96:46-57, 96:59-97:2.

[20] EX1001, 96:46-57, 101:28-30.

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| the camera-sensor, is configured to use one or more of the algorithms to determine a position of the oncoming vehicle, based on the position of the lights as indicated by the data, relative to the vehicle headlight system and responsively adapt the headlight beam to decrease at least one vision-disturbing characteristic to the oncoming vehicle driver. | |
| **Comparison of Claim 8 and Claim 48[21]** | |
| 8. The headlight system of claim 1, wherein at least one of the sensors is a camera-sensor configured to image at least lights indicative of preceding vehicles having a driver whose vision could be disturbed by the headlight beam reflected in a mirror, and where the logical controller upon receiving data, indicating a position of the lights, from the camera-sensor, is configured to use one or more of the algorithms to determine a position of the preceding vehicle, based on the position of the lights as indicated by the data, relative to the vehicle headlight system and responsively adapt the headlight beam to decrease at least one vision-disturbing characteristic to the driver of the preceding vehicle. | 48. The headlight system of claim 37, wherein at least one of the sensors is a camera-sensor configured to image at least lights indicative of a preceding vehicle. |

[21] EX1001, 96:59-97:2, 101:31-33.

| **Comparison of Claim 9 and Claim 49[22]** | |
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| 9. The headlight system of claim 1, wherein the one or more sensors includes a GPS sensor. | 49. The headlight system of claim 37, wherein the one or more sensors further includes a GPS sensor. |
| **Comparison of Claim 11 and Claim 50[23]** | |
| 11. The headlight system of claim 1, further including a computer vison processing unit configured to use the sensor data and one or more of the algorithms to identify entities including at least one of beings, vehicles, roadway, or street signs and wherein the logical controller is further configured to modify the headlight beam to change illumination of the identified entity. | 50. The headlight system of claim 37, further including a computer vision processing unit configured to use the sensor data to identify entities including at least one of beings, vehicles, roadway, or street signs, and wherein the processor is further configured to determine modification of the headlight beam to change illumination of the identified entity. |
| **Comparison of Claim 14 and Claim 53[24]** | |
| 14. The headlight system of claim 1, wherein the one or more sensors further includes at least one of a camera, a microphone, an ultrasonic transducer and receiver, or an electromagnetic radiation source and detector including any of IR, UV, laser, or light. | 53. The headlight system of claim 37, wherein the one or more sensors further includes at least one of a camera, a microphone, an ultrasonic transducer and receiver, or an electromagnetic radiation source and detector including any of IR, UV, laser, or light. |

[22] EX1001, 97:3-4, 101:34-35.

[23] EX1001, 97:8-14, 101:36-41.

[24] EX1001, 97:31-35, 101:52-56.

| **Comparison of Claim 15 and Claim 54[25]** | |
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| 15. The system of claim 1, wherein the logical controller is further configured to determine at least a road curvature, indicated by the sensor data, ahead of the vehicle and wherein the required illumination includes increasing illumination in a direction of the road curvature. | 54. The headlight system of claim 37, 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 a second illumination pattern defining increased illumination in a direction of the road curvature. |
| **Comparison of Claim 16 and Claim 17[26]** | |
| 16. The system of claim 15, wherein the logical controller is further configured to determine at least a planned upcoming turn, indicated by the sensor data, and wherein the required illumination includes increasing illumination illuminating the turn. | 17. The system of claim 1, wherein the logical controller is further configured to determine at least a planned upcoming turn, indicated by the sensor data, and wherein the required illumination includes increasing illumination illuminating the turn. |
| **Comparison of Claim 16 and Claim 55[27]** | |
| 16. The system of claim 15, wherein the logical controller is further configured to determine at least a planned upcoming turn, indicated by the sensor data, and wherein the required illumination includes | 55. The headlight system of claim 54, 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 a third illumination |

[25] EX1001, 97:36-40, 101:57-62.

[26] EX1001, 97:41-45, 97:46-50.

[27] EX1001, 97:41-45, 101:63-67.

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| increasing illumination illuminating the turn. | pattern defining increased illumination illuminating the turn. |
| **Comparison of Claim 55 and Claim 56[28]** | |
| 55. The headlight system of claim 54, 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 a third illumination pattern defining increased illumination illuminating the turn. | 56. The headlight system of claim 37, 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 a third illumination pattern defining increased illumination illuminating the turn. |
| **Comparison of Claim 18 and Claim 57[29]** | |
| 18. The system of claim 1, wherein at least one light source provided to at least one headlamp includes a laser diode. | 57. The headlight system of claim 37, wherein at least one light source provided to at least one headlamp includes a laser diode. |
| **Comparison of Claim 19 and Claim 58[30]** | |
| 19. The system of claim 1, 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 clusters. | 58. The headlight system of claim 37, 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 clusters as part of the instructed operation. |

[28] EX1001, 101:63-67, 102:1-5.

[29] EX1001, 97:51-53, 102:6-8.

[30] EX1001, 97:54-57, 102:9-13.

# Appendix B

Claim listing:

| Claim: | Element: | Claim Language: |
|---|---|---|
| Claim 1 | [1.P] | A vehicle headlight system comprising: |
| | [1.1] | one or more headlamps and a vehicle structure, arranged for affixing components of the system to the vehicle; |
| | [1.2] | a plurality of light clusters, arranged in each of the one or more of the one or more headlamps, |
| | [1.3] | the headlamps capable of projecting light so as to illuminate a plurality of sub-sections of a field-of-view with different illumination characteristics, |
| | [1.4] | the subsections determined in response to sensor data, wherein the light clusters operate to create a headlight beam; |
| | [1.5] | electronic control circuitry configured to independently operate the light clusters; |
| | [1.6] | one or more sensors configured to obtain and provide the sensor data predefined as pertinent to illumination requirements for the field-of-view; and |
| | [1.7] | a logical controller including a processor, the processor in communication with a memory storing one or more algorithms, with the sensors, and with the control circuitry, |
| | [1.8] | wherein the processor is configured to process the one or more algorithms and the sensor data to determine an illumination for at least two of the sub-sections, |
| | [1.9] | that reduces illumination to reduce glare in at least a first of the at least two subsections and |

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| | [1.10] | adapt the light emitted from one or more of the light-clusters so as to create the headlight beam that provides the determined illumination. |
| Claim 2 | [2.1] | The headlight system of claim 1, wherein at least one of the light clusters comprises: a structure to position the light cluster, such that the projected light from the at least one cluster has an aiming direction in relation to a forward travel direction of the vehicle; |
| | [2.2] | one or more light emitting sources, each having a variable light-source characteristic dependent on power, and wherein the control circuitry is arranged to alter said light-source characteristic via power control; and |
| | [2.3] | one or more light modifying elements provided in the path of light emitted from at least one of the sources, further controlling the light-source characteristics; |
| | [2.4] | wherein the structure combined with control of the light sources and light modifying elements results in an emitted light-cluster light characteristic including at least one of direction, intensity, beam spread, spatial light distribution or spectral light distribution. |
| Claim 3 | - | The headlight system of claim 2, wherein the one or more light modifying elements is at least one of a static light modifier or a variable light modifier, said light modifying element comprising at least one of reflectors or refractors, and wherein variable light modifier control circuitry is configured to control the light-cluster light characteristic by altering the light modifying elements in the path of the light emitted from the at least one of the light sources. |
| Claim 4 | - | The headlight system of claim 2, wherein the light modifying element further comprises at least one of |

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| | | lenses, diffractors, optical devices, a light guide, filters, phosphors, optical coatings, prisms, controllable piezoelectric light guides, MEMS devices, light valves or optical switches. |
| Claim 5 | - | The headlight system of claim 1, wherein at least one of the light-clusters includes: a plurality of light sources, wherein one or more of the plurality of light sources comprises at least one of multiple light-emitting-diodes (LEDs) or organic light-emitting-diodes, each light source having a spectral power distribution characteristic and wherein the control circuitry is configured to alter the overall light-cluster spectral power distribution to illuminate at least one of the at least two sub-sections of the field-of-view with a different color of light from another of the at least two sub-sections. |
| Claim 6 | - | The headlight system of claim 1, wherein the headlight beam further comprises light in at least one of infra-red (IR) or ultra-violet (UV) wavelengths. |
| Claim 7 | - | The headlight system of claim 1, wherein at least one of the sensors is a camera-sensor configured to image at least lights indicative of oncoming vehicles having a driver whose vision could be disturbed by the headlight beam, and wherein the logical controller upon receiving data, indicating a position of the lights, from the camera-sensor, is configured to use one or more of the algorithms to determine a position of the oncoming vehicle, based on the position of the lights as indicated by the data, relative to the vehicle headlight system and responsively adapt the headlight beam to decrease at least one vision-disturbing characteristic to the oncoming vehicle driver. |
| Claim 8 | - | The headlight system of claim 1, wherein at least one of the sensors is a camera-sensor configured to |

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| | | image at least lights indicative of preceding vehicles having a driver whose vision could be disturbed by the headlight beam reflected in a mirror, and where the logical controller upon receiving data, indicating a position of the lights, from the camera-sensor, is configured to use one or more of the algorithms to determine a position of the preceding vehicle, based on the position of the lights as indicated by the data, relative to the vehicle headlight system and responsively adapt the headlight beam to decrease at least one vision-disturbing characteristic to the driver of the preceding vehicle. |
| Claim 9 | - | The headlight system of claim 1, wherein the one or more sensors includes a GPS sensor. |
| Claim 10 | - | The headlight system of claim 1, wherein at least one of the sensors is configured to detect at least one of oncoming headlights or preceding taillights. |
| Claim 11 | - | The headlight system of claim 1, further including a computer vison processing unit configured to use the sensor data and one or more of the algorithms to identify entities including at least one of beings, vehicles, roadway, or street signs and wherein the logical controller is further configured to modify the headlight beam to change illumination of the identified entity. |
| Claim 12 | - | The headlight system of claim 1, where the determined illumination results in creation of a headlight beam providing a driver of the vehicle including said headlight system with higher visibility in at least a second of the at least two subsections relative to the first of the at least two subsections, while mitigating glaring illumination projected to reach the eyes of at least one of other drivers or pedestrians in the first of the at least two subsections, based on detected other vehicles or pedestrians in the first of the at least two subsections as indicated by the sensor data. |

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| Claim 13 | - | The headlight system of claim 1, wherein the required illumination continues to provide high-beam illumination in at least a second of the subsections different from the first of the subsections, without diminishing a range of the high-beam illumination. |
| Claim 14 | - | The headlight system of claim 1, wherein the one or more sensors further includes at least one of a camera, a microphone, an ultrasonic transducer and receiver, or an electromagnetic radiation source and detector including any of IR, UV, laser, or light. |
| Claim 15 | - | The system of claim 1, wherein the logical controller is further configured to determine at least a road curvature, indicated by the sensor data, ahead of the vehicle and wherein the required illumination includes increasing illumination in a direction of the road curvature. |
| Claim 16 | - | The system of claim 15, wherein the logical controller is further configured to determine at least a planned upcoming turn, indicated by the sensor data, and wherein the required illumination includes increasing illumination illuminating the turn. |
| Claim 17 | - | The system of claim 1, wherein the logical controller is further configured to determine at least a planned upcoming turn, indicated by the sensor data, and wherein the required illumination includes increasing illumination illuminating the turn. |
| Claim 18 | - | The system of claim 1, wherein at least one light source provided to at least one headlamp includes a laser diode. |
| Claim 19 | - | The system of claim 1, 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 clusters. |

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| Claim 37 | [37.P] | A vehicle headlight system comprising: |
| | [37.1] | one or more headlamps affixable to a first vehicle; |
| | [37.2] | a plurality of light clusters arranged in each of the one or more of the headlamps and |
| | [37.3] | capable of illuminating sub-sections of a field-of-view with different illumination characteristics, |
| | [37.4] | wherein at least two of the light clusters operate to create a headlight beam; |
| | [37.5] | one or more sensors configured to obtain and provide sensor data, |
| | [37.6] | at least a portion of the sensor data indicating a second vehicle within the field-of-view; and |
| | [37.7] | at least one processor configured to: receive the sensor data; process the sensor data to determine a light distribution pattern for an adaptive headlight beam, |
| | [37.8] | such that a headlight beam adapted to the pattern substantially illuminates a first subsection of the field-of-view including at least a portion of the second vehicle with an illuminance below a predefined threshold value, |
| | [37.9] | while the beam substantially illuminates at least the one or more second subsections of the field-of-view to either side of the first subsection with an illuminance above the predefined threshold value; and |
| | [37.10] | instruct operation of at least two of the light clusters to create the adapted headlight beam. |
| Claim 38 | - | The headlight system of claim 37, wherein at least one of the at least one processors is further configured to process the sensor data to determine |

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| | | illumination for at least one first subsection of the field-of-view, determined to include at least a portion of the second vehicle, based on the sensor data, and for at least one second subsection determined not to include the second vehicle, based on the sensor data. |
| Claim 39 | - | The headlight system of claim 37, wherein the plurality of light clusters are further capable of illuminating at least two of the sub-sections with different illumination characteristics based on the at least one processor determining specific, different illumination characteristics for each of the at least two sub-sections. |
| Claim 40 | - | The headlight system of claim 37, wherein the light distribution pattern defines illumination for at least the first and the one or more second sub-sections of the field of view. |
| Claim 41 | - | The headlight system of claim 37, wherein the light distribution patterns defines illumination for the first subsection designed to result in an illuminance below the predefined threshold value, and defines illumination for the one or more second subsections designed to result in an illuminance above the predefined threshold value. |
| Claim 42 | [42.1] | The headlight system of claim 37, wherein at least one of the light clusters comprises: |
| | [42.2] | one or more light sources, each having a variable light-source light characteristic dependent on power and alterable, at least responsive to instructions from at least one of the at least one processors, via power control; and |
| | [42.3] | one or more light modifying elements provided in a path of light emitted from at least one of the light sources, further controlling at least one light characteristic of the at least one of the light source; |

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| | [42.4] | wherein control of the light sources and light modifying elements results in a specified emitted light-source light characteristic, where said emitted light-source light characteristic includes at least one of direction, intensity, beam spread, spatial light distribution or spectral light distribution. |
| Claim 43 | - | The headlight system of claim 42, wherein the one or more light modifying elements comprises at least one of reflectors or refractors, and wherein at least one of the at least one processors is configured to instruct control of at least one light modifying element resulting in a change to the light-source light characteristic. |
| Claim 44 | - | The headlight system of claim 42, wherein the light modifying element further comprises at least one of lenses, diffractors, optical devices, a light guide, filters, phosphors, optical coatings, prisms, controllable piezoelectric light guides, MEMS devices, light valves or optical switches. |
| Claim 45 | - | The headlight system of claim 37, wherein at least one of the light-clusters includes: a plurality of light sources, wherein one or more light sources of the plurality of light sources comprise at least one of light-emitting-diodes (LEDs) or organic light-emitting-diodes, each light source having a spectral power distribution characteristic alterable, at least responsive to instructions from at least one of the at least one processors, by modifying power to the one or more light sources of the plurality of light sources, resulting in a color change to projected light from the at least one light-cluster illuminating at least one sub-section of the field-of-view. |
| Claim 46 | - | The headlight system of claim 37, wherein the light output from at least one headlamp further comprises at least one of infrared or ultraviolet wavelengths. |

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| Claim 47 | - | The headlight system of claim 37, wherein at least one of the sensors is a camera-sensor configured to image at least lights indicative of an oncoming vehicle. |
| Claim 48 | - | The headlight system of claim 37, wherein at least one of the sensors is a camera-sensor configured to image at least lights indicative of a preceding vehicle. |
| Claim 49 | - | The headlight system of claim 37, wherein the one or more sensors further includes a GPS sensor. |
| Claim 50 | - | The headlight system of claim 37, further including a computer vision processing unit configured to use the sensor data to identify entities including at least one of beings, vehicles, roadway, or street signs, and wherein the processor is further configured to determine modification of the headlight beam to change illumination of the identified entity. |
| Claim 51 | - | The headlight system of claim 37, where the illumination created by the headlight beam results in illumination both providing a driver of the first vehicle with preserved illumination in the one or more second subsections and mitigating glare projected to reach the eyes of a driver of the second vehicle. |
| Claim 52 | - | The headlight system of claim 37, wherein the adapted headlight beam continues to provide high-beam illumination in the one or more second of the subsections without diminishing a range of the high-beam illumination. |
| Claim 53 | - | The headlight system of claim 37, wherein the one or more sensors further includes at least one of a camera, a microphone, an ultrasonic transducer and receiver, or an electromagnetic radiation source and detector including any of IR, UV, laser, or light. |

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| Claim 54 | - | The headlight system of claim 37, 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 a second illumination pattern defining increased illumination in a direction of the road curvature. |
| Claim 55 | - | The headlight system of claim 54, 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 a third illumination pattern defining increased illumination illuminating the turn. |
| Claim 56 | - | The headlight system of claim 37, 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 a third illumination pattern defining increased illumination illuminating the turn. |
| Claim 57 | - | The headlight system of claim 37, wherein at least one light source provided to at least one headlamp includes a laser diode. |
| Claim 58 | - | The headlight system of claim 37, 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 clusters as part of the instructed operation. |